ARCTIC CHANGE 2014

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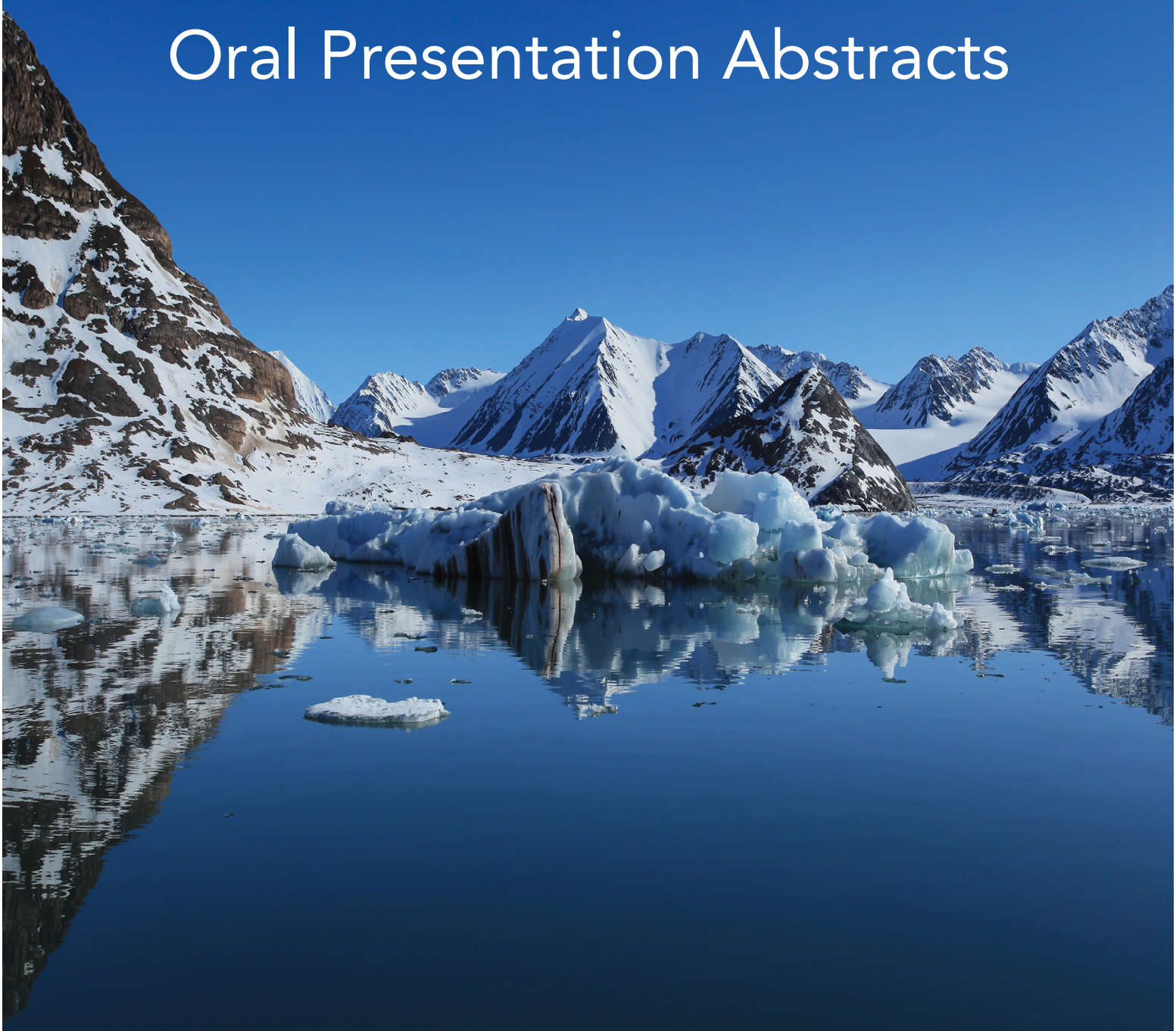
Oral Presentation Abstracts



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ORAL PRESENTATION ABSTRACTS

TEMPORAL TREND ASSESSMENT OF CIRCULATING MERCURY AND PCB 153 CONCENTRATIONS AMONG NUNAVIMMIUT PREGNANT WOMEN (1992-2013)

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Background: The consumption of traditional country food by Inuit people is nowadays recognized as beneficial from a nutritional, economical, and cultural viewpoint. Unfortunately, it also represents the main pathway of exposure to a wide range of environmental contaminants. These include several metals, such as mercury (Hg) and Persistent Organic Pollutants (POPs), such as polychlorinated biphenyls (PCBs). Previous studies revealed that prenatal methylmercury and PCBs exposure could potentially affect fetal growth and induce cognition impairments in children. Pregnant women are therefore considered as a vulnerable subgroup. Over the last 20 years, given the concern about the possible effects of these neurotoxicants on foetus and child development, measures and programs were implemented to reduce exposure of pregnant Inuit women to these compounds and to monitor maternal contaminant blood levels. Objectives: (1) to assess temporal trend of mercury and PCBs blood levels on the basis of samples collected among pregnant Inuit women in Nunavik, over 20 years from 1992 and 2013; (2) provide an update of the current levels of exposure. Method: The database was created by integrating data collected through 4 research projects conducted in Nunavik between 1992 and 2013. Close to 500 women were recruited in total. Sample sizes at each time points ranged from 11 to 112 women. Temporal trend analyses for Hg and PCB 153 (the main PCB congener) were performed by using regression models after log-transformation of data. Blood concentrations of Hg and PCB 153 were defined as the dependent variables and the year of sampling as the independent variable. All models were adjusted for age of participants and the region of residence (Hudson Bay or Ungava Bay). Since selenium and omega-3 fatty acids are frequently used as markers of traditional food consumption, trend analyses for these compounds were also conducted when possible. Results: Maternal levels of Hg and PCB 153 significantly decreased between 1992 and 2013. Overall, concentrations of Hg and PCB 153 among pregnant women decreased respectively by 57% and 77% over the last two decades. In 2013, concentrations of Hg and PCB 153 were respectively 5.2 µg/L and 40.36 µg/kg plasma lipids (geometric means). Discussion: Our results suggest a significant decrease of Hg and PCB 153 maternal levels from 1992 to 2013. Geometric mean concentrations of Hg and PCB 153 measured in 2013 were below Health Canada guidelines. The decline observed could be related to measures implemented at regional, national and international levels to reduce environmental pollution by mercury and PCB and/or a significant decrease of seafood consumption by pregnant women. These results have to be interpreted with caution. Indeed, Hg and PCB 153 concentrations measured in samples might not be representative of population levels. In addition, due to missing information, adjustments for season (hunting season or not), trimester of pregnancy, parity and breastfeeding were not applied.

TEST OF FIBER OPTICS LINEARLY DISTRIBUTED TEMPERATURE SENSING FOR PERMAFROST MONITORING IN SALLUIT, NUNAVIK

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Fiber optics distributed temperature sensing (DTS) is a new technology that opens the door on original approaches to study permafrost temperature regime in a variety of environmental settings and engineering situations. In DTS systems, as pulses of light emitted by a laser travel in a fiber optics cable, a small fraction of the signal is reflected along its course back to the source with a slight frequency shift that is temperature dependant, thus allowing to measure temperature along the cable by measuring two-way travel time. A cable can be laid in an infinite number of configurations over many kilometers and across variable environmental settings. Readings are made from a single control unit. An occasion to try the new technology arose in 2012 as it was decided to rebuild the Salluit road to the community airport that had been seriously

impacted by permafrost degradation. The permafrost beneath the road consists of very ice-rich post-glacial marine silt that puts the road at high risk of deterioration by permafrost thawing following any input of heat that may occur anywhere along its length, the most feared heat sources being snow insulation on shoulders in winter and water seepage underneath the structure in summer. About 900 m long of embankment were rebuilt: specially designed heat drains were buried under one side of the road to cool the embankment under snow in winter. On the other side of the road, the geometry of ditches and culvert was redesigned so as to reduce heat advection by water infiltration in summer. In addition to thermistors strings at selected control and sampling sites, a total length of 3.4 km of DTS cable were buried under the embankments slopes on both sides of the road. On one side, the cable is buried at two depths (0.3 and 0.8 m) to detect heat carrying water seepage in the ground whereas on the other side it is buried under the heat drain to assess its efficiency in cooling back the permafrost under the road. A section of the cable also measures ground temperature 0.25 deep in the natural terrain several meters off the roadside as a reference. The cable also runs in loops across the road under four culverts. The linear resolution of the system is 0.25 m and the temperature measurement precision is 0.1 °C. The datalogging system was programmed to take readings every 3 hours over a year. Results show the different timing of freeze back of the embankment under the roadside in relation with wet and dry sections of terrain on which the road is built. Differential insulation provided by unequal snow cover on the sides can be observed. At spring time, heat intake in the ground by water flowing through the culverts and the impact of some seepage under the road at a few points could be detected. The linearly measured temperature data allows detection of sensible spots anywhere along its length and to accurately measure temperatures variations both in time and space.

NORTHERN MARINE TRANSPORTATION CORRIDORS

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Due to melting sea ice, the Arctic is opening up and lending way to increased prosperity attracting economic and touristic activities in the region. However, the north is vast and operationally-demanding. Given its geography, and limited infrastructure, marine transportation is a critical mode of transportation. Consequently, the presence of chokepoints and challenging weather can impede navigation and potentially increase navigational risks and constrain economic development. While the current marine transportation system meets current demand, trends are suggesting that this situation is likely to change in the decades to come. Canada's southern waters have been enjoying a relatively safe and efficient marine transportation system commensurate with risks. The system was built over the past many decades at high costs and at a time where technological solutions were limited. However, the Arctic is vast and still pales in terms of marine traffic when compared to Canada's southern waters. Despite relative low traffic compared to the South, the level of traffic is significant for the region and requires attention given the harsh nature of the marine environment and minimal infrastructure available. Developing and investing in Canada's northern marine transportation is critical to ensure safe, secure, and accessible marine corridors that will foster and encourage economic development and prosperity in the Arctic. Replicating a transportation system similar to that found in southern Canadian waterways is not feasible or desirable; as such, a strategic approach is required to focus marine transportation activities along defined Corridors in the Arctic to ensure marine services support economic development opportunities in the north, assert Canadian sovereignty, and have a predictable preparedness and response framework should emergencies arise. Canada requires a solid marine navigational support system (i.e. charts buoys, icebreakers, etc.) and appropriate emergency response capabilities (eg SAR, ER) that are based on a solid risk analysis in the North. The concept of Northern marine transportation corridors is a strategic long term approach to guide future federal investments in the Arctic.

THE NUNAVUT COMMUNITY AQUATIC MONITORING PROGRAM – TRAINING AND KNOWLEDGE SHARING FOR COMMUNITY-BASED FISHERY DEVELOPMENT

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Communities across Nunavut continue to face challenges in regards to developing important economic opportunities and to being active participants in monitoring their environment. The development of Nunavut's commercial fishery resources has consistently been identified as one of the priority areas of economic development. However, the lack of local and regional resources and capacity has impeded the collection of the necessary information to facilitate this development. In response to these needs, the Fisheries and Sealing Division of the Government of Nunavut's Department of Environment

developed the Nunavut Community Aquatic Monitoring Program (N-CAMP). The N-CAMP is an on-the-land, community-based, and practical training program to increase community capacity to participate in aquatic data collection and monitoring activities that would both enhance community fisheries economic development and provide solid, consistent and useful data to resource managers. The N-CAMP has been developed in partnership with communities, Fisheries and Oceans Canada, researchers and environmental consultants to provide standardized training in fisheries and aquatic health monitoring techniques and directly link managers and communities to share results and Inuit Qaujimajatuqangit about fisheries. The N-CAMP was piloted in 2014 in Igloolik, Coral Harbour and Kugluktuk to support exploratory fisheries and fish health research and habitat enhancement projects. A total of 28 Nunavummiut were trained and other Nunavut communities are now lining up for their own N-CAMPs. This presentation will describe the fun, the successes and the challenges experienced during the N-CAMP pilot camps in 2014; as well as how the N-CAMP can continue to be a resource for communities and fisheries managers throughout Nunavut.

QUANTIFYING SOURCES OF ARCTIC TROPOSPHERIC OZONE AND ITS CLIMATE & ECOSYSTEM IMPACTS

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Model calculations suggest that changes in short-lived climate-relevant pollutants such as ozone and aerosol may have contributed significantly to recent Arctic warming. Ozone is a secondary pollutant that is harmful to human health, vegetation and acts as a greenhouse gas. Arctic tropospheric ozone is influenced by both local sources and by long-range transport of ozone and its precursor gases from Europe, Asia and N. America, and from boreal wildfires in summer. Our understanding of how different sources contribute to Arctic ozone is limited, and is reliant on sparse observations and models of tropospheric chemistry and atmospheric transport. In this talk, we will present recent results on the ability of global atmospheric chemistry models to simulate observed tropospheric ozone and precursors in the Arctic. We show substantial variability in the ability of models to simulate abundances of key ozone precursor species throughout the depth of the Arctic troposphere. Using an offline radiative transfer model and land surface model with output from an atmospheric chemistry model, we compare the relative efficiencies of different mid-latitude anthropogenic sources and boreal fire emissions in contributing to high latitude ozone, resultant radiative forcing and ecosystem damage. We demonstrate a large efficiency for fire emissions to form high latitude ozone and impact the local radiation balance, despite a small overall contribution compared with anthropogenic sources. Finally, we will summarise some important chemical uncertainties in simulating Arctic tropospheric ozone response to mid-latitude emissions and subsequent climate impacts, including interactions between stratospheric ozone import and in-situ ozone production.

TURNING TRADITIONAL KNOWLEDGE ON CUMULATIVE IMPACTS INTO LONG OVER-DUE ACTION FOR STEWARDSHIP IN THE GREATER HUDSON BAY MARINE REGION

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Many initiatives have been taken to compile traditional knowledge of Inuit and Cree communities in Hudson Bay, including the Hudson Bay Programme (1991-1995), Voices from the Bay (1997), The Nunavut Hudson Bay Inter-Agency Working Group / NTK (2004-2009), and International Polar Year Programs led by the Arctic Eider Society (2009-2011). Despite well identified priorities and data gaps, little progress has been made on these issues due in part to the inter-jurisdictional challenges of working in Hudson Bay and a lack of cross-regional funding. Recently, the Arctic Eider Society, NTK and the Hudson Bay Inland Sea Initiative have partnered towards forming a Consortium to address these issues in Hudson Bay, and along with other partners have formed a Hudson Bay Network to address these issues from the ground up by building capacity for community-driven research and networking. This presentation outlines results of over 20 years of bringing together traditional and scientific knowledge to address cumulative impacts in Hudson Bay and summarizes identified priorities and data gaps, with a goal of turning this knowledge into action for communities in Hudson Bay by contributing to the Hudson Bay IRIS, forming additional partnerships for the Hudson Bay Network and contributing to formation of a consortium that would provide much needed environmental stewardship for Hudson Bay.

WORKING WITH NORTHERN RESIDENTS TO LINK LOCAL PROBLEM WEATHER INTO THE LARGE-SCALE

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Local-scale weather dominants all aspects of life in the North. This encompasses all those who live or work there, including communities, industry groups, and operational/response units. Long-term changes to climate patterns at the large-scale are translated to the individual via the local weather. Most activities must be conducted with the weather borne in mind, and generally, most residents, through long experience, have historically been adept at handling the challenges this entails. Recent climate change has been rapid, however, such that residents of communities have been commenting that their capacity to know the weather is not as effective as it once was, and that the knowledge of the elders is not serving as reliably as in the past. In particular, comments from the Canadian Beaufort region and Western Alaska indicate that the weather is more variable in general. Where once the passage of a storm meant three or four good days, now there can be one nice day followed by another storm. This is getting people into trouble, as they get caught out on the land or on ice floes. Ultimately, traditional ways of knowing are being compromised, which is putting those who spend time on the land at increased risk. One response to this problem is to bring in other sources of information. Although internet access can be a challenge in the North, its reliability and bandwidth have been improving, such that it is becoming more reasonable to utilize "western" information, such as data and charts produced by Environment Canada or NOAA's National Weather Service. These groups have very large and complex forecasting regions to cover, meaning it can be difficult to provide tailored forecasts down to the local scale in the communities. Thus, key to a strategy to improve the utility of western weather information is to link local-scale problematic weather to the larger-scale weather patterns. This is done in two ways: by working with Northern residents, and by installation of equipment to measure parameters of interest to residents, which are not already being measured. This approach, coupled with training to use the EC or NWS charts, should begin to provide Northern residents with additional sources of information for decision making. Several projects engaging in this work are underway in Canada and Alaska. Various methodological aspects of this work will be overviewed, including preparation of appropriate interviews, extracting useful data, and follow-up visits for verification work. Examples will be drawn from work with coastal communities, industrial operators, and operational groups. Examples of how local comments can guide synoptic-scale weather analysis will be presented.

DISCRIMINATING WATER SOURCES FROM SPACE: A CASE STUDY FOR THE SOUTHERN BEAUFORT SEA, CANADIAN ARCTIC

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The discrimination of water sources in the Arctic Ocean is key to better understanding physical and biogeochemical processes but is restricted both geographically and temporally in field observations. Here we propose a simple algorithm for discriminating water sources using satellite remote sensing data alone. Salinity and the light absorption coefficient of colored dissolved organic matter at 443 nm [aCDOM(443), m-1] derived from SMOS/MIRAS and Aqua/MODIS satellite sensors, respectively, are used in this study. Assuming aCDOM(443) and salinity values for the three end-members observed in the Arctic Ocean (i.e., seawater, ice melt water, and river water), this algorithm, based on mass balance equations, provides fractions of the three end-members for a given location using satellite-derived aCDOM(443) and salinity. Application of this algorithm may lead to the discrimination of water sources in the surface layer in nearly real time in various environments.

HOW DIFFERENT IS DISSOLVED ORGANIC MATTER IN A DISCONTINUOUS PERMAFROST AREA AROUND YELLOWKNIFE, NWT?

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As northern climates become warmer and permafrost degrades, large stores of previously-frozen carbon can become mobilized into the hydrosphere as dissolved organic matter (DOM) and make its way into surrounding surface waters. Dissolved organic matter plays many important roles within the environment, ranging from absorbing harmful ultraviolet radiation in lakes and rivers, to providing an important energy source for microbes. In addition, DOM can impact drinking water quality as it can bind and mobilize heavy metals, as well

as potentially form carcinogenic disinfection by-products during chlorination of drinking water. Reactivity of DOM within the environment is a function of overall quality, which varies with source, amount of degradation, and season. However, it is uncertain whether degrading permafrost will contribute DOM that can alter the overall DOM quality in surrounding surface waters. Our research used geochemical and isotopic techniques to determine the range in DOM composition and quality among rivers, creeks, ponds, and groundwater within a discontinuous permafrost environment. Furthermore, we test whether spatial differences in DOM composition matters for overall quality, using 30-day incubations to test the susceptibility of ground and surface water DOM to microbial and photolytic degradation.

COMMUNITY-BASED PARTICIPATORY RESEARCH IN NUNAVIK: EXAMPLES OF COLLABORATIVE EXCHANGE BETWEEN INUIT AND NATURAL AND SOCIAL SCIENTISTS

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The North—its natural environment and its people—has inspired generations of scientists from around the world. Yet, while decades of comprehensive research in both the natural and social sciences has generated a vast body of knowledge, this knowledge has been for the most part generated using Western scientific methodologies, and results have been the property of Southern academic and government institutions; Northerners have historically been excluded from the research process. In recent years however, Northerners have become increasingly engaged in all types of research. One of the pioneers in this movement is Makivik Corporation's Nunavik Research Centre, established in 1978. Makivik was one of the first to recognize the importance of ensuring that research addresses the priorities of Northerners and to this end it created a Research Department and a Research Centre that have fostered the "meshing" of conventional science and Traditional Knowledge for over 30 years. These different, but complementary, approaches to research are in keeping with a paradigm shift that is becoming increasingly generalized; a shift that has seen Northern communities, individuals and organisations take charge and formulate research agendas themselves. Emerging from this shift in paradigm is a new era of collaborative research where Northern organizations (such as Wildlife Co-Management Boards, Hunting Associations and Research Centres) not only conduct research themselves, but also partner with Southern organizations in order to address issues that are of direct relevance to Northerners. As well, the use of such processes as community consultations, community-based monitoring strategies and Traditional and Local Knowledge has significantly improved the depth and breadth of research results, and made science not only more accessible, but also more acceptable to communities. This presentation will explore two examples of participatory research that have been used successfully in a Northern context to address food security issues. The first is a multi-faceted community-based monitoring strategy run by the Nunavik Research Centre that involves Inuit hunters and community members in the collection of data from country food (i.e.: marine mammals, fish and berries). Results from these data sets not only help ensure food safety (notably with respect to parasites and contaminants), but also directly influence public health policy. As well, these results help local authorities to better understand the population dynamics of country food species' which in turn helps decision makers to plan for the future. The second example stems from a collaborative research initiative that saw the development of a community greenhouse project in the village of Kuujjuaq. Multiple partners (Université Laval, the Kativik Regional Government, the Municipality and local volunteers) came together to address the need for increased access to fresh fruit and vegetables. Over the years, this participatory research project also led to the creation of a series of complementary capacity building initiatives in the village. These two examples prove that when Northerners play a leading role in the development and application of Northern-based science and research—and when communities are actively engaged—project design and integrity are strengthened, and final results are infinitely more valuable to all.

INFLUENCES OF DIFFERENT FRESHWATER SOURCES ON CARBONATE SATURATION STATES IN DAVIS STRAIT

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Davis Strait connects the North Atlantic, specifically the Labrador Sea, with the Arctic Ocean through the Canadian Arctic Archipelago (CAA) and Baffin Bay. It is an ideal gateway to observe the interaction between the Arctic and the North Atlantic: propagation of changes from the Arctic into the

Labrador Sea and the intrusion of the warm and saline Atlantic water into Baffin Bay. The rapidly changing polar environment including melting sea ice in the Arctic, surface warming and more transport of warm water from the south and the Greenland ice sheet melt can influence not only circulation and mixing, but also air-sea CO2 uptake, nutrient cycles and ocean acidification.

Calcium carbonate saturation states (Ω) and pH together with freshwater composition using multiple chemical tracers were studied along Davis Strait annually from 2004 to 2011 and also in 2013. The distribution of dissolved inorganic carbon (DIC) and total alkalinity (TA) were strongly influenced by water mass structure. Low Ω was associated with the Arctic outflow in the upper 300 m of the water column on the western side of the Strait, and extending to >50 km offshore. The Arctic outflow through the Canadian Arctic Archipelago has a high content of Pacific Water, which has a lower saturation state than the receiving Atlantic Water, and Ω is further lowered due to modification by ice-melt and fluvial input during its transit.

In all water masses, aragonite saturation state (Ωarg) decreased during the study period at a rate from 0.04 to 0.09 units a year. Although Ωarg in Greenland Shelf Water is highest of all the water masses along Davis Strait, the rate of decrease was also highest. The water on Greenland Shelf is strongly influenced by glacial meltwater from the Greenland Ice Sheet, with very little influence from sea ice meltwater during this study. The influence of glacial meltwater on Ω and pH was studied in Disko Bay, a deep ocean fjord with a large outlet glacier. At the glacial front, Ω and pH(total) were comparatively low with a lower TA/DIC ratio than offshore, and increased as the salinity increased away from the glacial front. This implies observed changes in West Greenland Shelf Water are due to the increased glacial meltwater contribution on the shelf.

SEASONAL EVOLUTION OF SEA ICE MOTION IN THE BEAUFORT SEA AND THE ICE PACKS RESPONSE TO ATMOSPHERIC FORCING.

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Through Spring the ice pack of the Beaufort Sea transitions from an extensive, consolidated ice state in late winter to a less extensive, weaker, marginal ice zone in summer. Using an array of autonomous instruments deployed in early April 2012 along the periphery of the multiyear ice pack of the Beaufort Sea we highlight the seasonal evolution of ice drift characteristics that occurred as the ice pack broke up and individual ice floes entered a state of free drift. Coincident hourly observations of ice drift, surface winds, and ice mass balance were collected from early April to the end of July 2012 when the autonomous equipment failed. During this period ice drift speeds tripled, meander coefficients increased, ice drift became less correlated across increasingly small length scales, inertial oscillations developed along the ice floe trajectories and ice floes became increasingly responsive to surface winds, as indicated by increasing scaling factors and turning angles. Given that monthly mean wind speeds remained around 4 m/s throughout the study, we ascribe the seasonal change in ice drift characteristics to the seasonal mechanical weakening of the ice pack. Using a combination of in situ and remotely sensed observations we highlight the seasonal decline of local and regional ice concentrations, declining ice floe flexural strengths, substantial surface melt and bottom ablation and a seasonal tendency towards smaller floe sizes. Collectively these observations represent the mechanical weakening of the ice pack that reduced internal stresses and fostered an increasing responsiveness of the ice pack to atmospheric forcing.

AN ICE FREE BEAUFORT SEA DURING SEPTEMBER 2012

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During the record sea ice minimum of September 2012 the Beaufort Sea became ice free for the first time in 34 years. Using a combination of in situ and remotely sensed observations we analyze the anomalous absorption of solar energy by areas of open water that fostered an accelerated ice albedo feedback loop which in turn led to anomalously high bottom melt rates. In situ thermodynamic observations from a 5m thick multiyear ice floe show how the floe warmed from a cold late winter state in early April to an isothermal state by mid-June, at which point bottom ablation proceeded rapidly. In situ observations ended at the end of July when the autonomous system failed, but we provide evidence that the entire floe melted out prior to September 1st. The dramatic retreat of the Beaufort ice pack was fostered by a 102% anomaly in solar absorption that began during May and persisted through summer. Anomalies in solar absorption developed during May when areas of open water became present in the Beaufort Sea earlier than they had historically and exposed greater areas of open water during the solar maximum. Premature breakup of the Beaufort ice pack and negative anomalies in SIC are ascribed to preconditioning towards

younger and thinner ice types which have made the Beaufort ice pack more susceptible to melt. We compare the observations of 2012 to the previous 34 years and set the climatological context of the dramatic retreat that left the Beaufort Sea ice free during September 2012.

THE EFFECTS OF PROJECTED OCEAN ACIDIFICATION ON THE EARLY DEVELOPMENT OF A KEY ARCTIC COPEPOD, CALANUS GLACIALIS

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The world's oceans have absorbed about a third of anthropogenically produced carbon dioxide in the last 200 years, resulting in a reduction of seawater pH by ~ 0.1 units via a process called ocean acidification. Of all global seas, the Arctic seas are expected to experience the greatest decrease in pH in the near future, with changing sea ice regimes and naturally cold and brackish water accelerating ocean acidification processes. Despite the historically unprecedented rate of change awaiting the Arctic seas, there is relatively little known about the effect of ocean acidification on Arctic organisms. Copepods are abundant and widespread in the world's oceans, where they are central to both ecosystem functioning as well as the global carbon budget. This makes them an important focus for studies on the effects of ocean acidification. Ocean acidification has been found to have species-specific effects on copepods, with some species apparently unaffected and some experiencing reductions in reproductive output, metabolism, and developmental rate. In this study we examined the effect of projected future ocean acidification levels on the naupliar development of a key Arctic zooplankton species, the copepod Calanus glacialis. The few previous studies on ocean acidification effects on this species have focused on short-term exposures of eggs or on single, older stages. In this long-term exposure experiment, we raised the offspring of wild-caught C. glacialis females from Svalbard, Norway (80°N) through 8 life stages, from eggs to copepodite stage 1 in 2°C seawater of 4 different pHs (8.05, 7.9, 7.7, and 7.5) for 2 months. Stage composition, body size, dry weight and CHN content were measured every other day throughout the exposure to detect effects of seawater pH on developmental rate and growth. Respiration was measured at naupliar stages N3, N6 and copepodite stage C1. As young stages of invertebrates are expected to be disproportionately affected by ocean acidification, this unique and detailed dataset on the development of young stages of an Arctic copepod will add to the understanding of the effects of ocean acidification on Arctic marine ecosystems.

PUBLIC HOUSING ACCOUNTABILITY IN NUNAVUT: A PROPOSED FRAMEWORK FOR INVESTIGATION

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Public housing in Nunavut is a critical service that has been plagued by overcrowding, health and safety issues, and in recent years, significant cost overruns and issues of accountability. A 2009-2010 survey revealed that 35% of occupied dwellings were crowded, 23% required major repairs and 63% of public housing dwellings were below housing standards. That is, 63% of public housing units were either over crowded, in need of major repairs, or both. The Auditor General noted in a 2008 report that "because the (Nunavut Housing) Corporation has not monitored community partners' operations as it is required to do, it was not aware of the extent of the problems we identified and therefore was unable to correct them." A key component to delivering and monitoring public housing is the system of accountability that has been put in place and the degree to which it supports the achievement of public housing objectives. Public housing in Nunavut is largely administered in the communities by local community organizations, "…who provide most of the day-to-day services associated with program delivery to individuals and families". Local housing organizations are independent organizations overseen by a locally elected board of directors and work with the Nunavut Housing Corporation, an organization that provides funding, administrative support, and monitors these local organizations. For its part, the Nunavut Housing Corporation reports to the Minister Responsible for the Nunavut Housing Corporation as well as other stakeholders (an example being the Canada Mortgage and Housing Corporation). Binding these various organizations together is a complex of accountability relationships. This presentation introduces an investigative framework for examining accountability for the delivery of public housing in Nunavut. This framework of accountability is designed to provoke a critical examination of the mechanisms that constitute public housing accountability. In doing so, shortcomings in the existing system can be identified and overall accountability for public funds and the provision of public housing can be improved.

ASSESSING THE PERFORMANCE OF COLD CLIMATE NATURAL WETLANDS IN THE TREATMENT OF DOMESTIC WASTEWATER EFFLUENTS IN NORTHERN CANADA

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The ability of 13 natural wetlands to treat wastewater effluents generated by northern communities within Nunavut and Northwest Territories was assessed over the course of five years. The study demonstrated that natural wetlands can effectively reduce the concentration of major wastewater parameters. The study followed the performance of six wetlands (Arviat, Baker Lake, Chesterfield Inlet, Coral Harbour, Repulse Bay, Whale Cove) through one arctic summer by monitoring effluent parameters entering and leaving the wetland. This extended study period enabled the assessment of seasonal influences such as the spring freshet and operational influences related to lagoon decanting / exfiltration management practices. Mean cBOD5 and COD removal were observed to vary between 47-94% and 57-96%, respectively amongst the wetlands. The percent removal of COD and cBOD5 and TSS were generally lower in the wetlands that received wastewater that was first pre-treated in either a facultative lake (e.g., Whale Cove) or an engineered lagoon (e.g., Coral Harbour). The reason for the lower treatment rates in these wetlands likely relates to the fact that much of the oxidative treatment and settling of TSS was occurring within the pre-treatment phase meaning less reduction was taking place in the wetlands. Overall TSS reduction was variable (39-98%) and a poor indicator of treatment performance since some wetlands generated fixed suspended solids. The volatile suspended solids parameter was found to be a more reliable indicator of performance. Mean removal rates for TP and TAN, amongst the wetlands, varied between 80-99% and 85-100% respectively. Pathogen concentrations were generally reduced significantly (2-4 log reduction), although results were variable and likely influenced by natural sources such as snow geese. In all wetlands the effluent was below 25 mg/L for cBOD5 and TSS, which are the effluent standards for municipal wastewater for cBOD5 and TSS in southern Canada. At the time of study, treatment facilities with a minimal holding capacity during the winter months (e.g., Chesterfield Inlet) discharged greater nutrient loadings to their respective wetlands during late winter / early spring meaning that treatment within these wetlands during spring freshet was poorer as the wastewater which had accumulated as ice during winter months began to melt. A slow exfiltration release of effluent from lagoons to the wetlands was found to be more effective rather than late summer decants. The remaining seven wetlands (Paulatuk, Pond Inlet, Edzo, Fort Providence, Gjoa Haven, Uluhaktok, Taloyoak) were more intensely assessed within 2-3 days by establishing a minimum of 40 sampling locations along transects within the wetland. Using this approach treatment performance was monitored as the effluent traversed the wetland. Overall treatment performance for these seven wetlands was similar to the six described above. During this study the SubWet 2.0 computer model was calibrated to all 11 study wetlands. Simulated treatment levels for BOD, TAN and TP were within 10% of measured values after calibration to site conditions. Study results demonstrate the added treatment value of natural wetlands and provides insight into how these lands can be co-managed in a lagoon + wetland hybridized treatment strategy for northern communities.

ICE-DRIVEN OVERWINTERING OF BREEDING ATLANTIC WALRUS IN HUDSON STRAIT

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Atlantic walrus (Odobenus rosmarus rosmarus) distribution in Canadian Arctic extends from the Canadian Archipelago down to southern Labrador. Shallow divers, in summer walruses are generally found resting on haul-out sites on coast or ice in between foraging dives on benthic preys. In autumn they move south following the thickening and extension of the ice sheet. Except for known polynias, overwintering grounds, where breeding occurs, are poorly known. In this study, we exploit passive acoustic monitoring methods (PAM) to contribute to fill this knowledge gap and to evidence that the Hudson Strait is one such intensively-used overwintering and breeding area for Western Atlantic walrus. From October 2011 to June 2012, PAM systems have been deployed at three locations along the Hudson Strait to record the annual cycle of marine mammal use of this habitat of eastern Canadian Subarctic by tracking their specific calls. During courtship, male walruses emit stereotyped sequences of underwater sounds consisting of taps, knocks and bell-like sounds. Dedicated signal processing algorithms have been developed to detect and identify these specific calls. Resulting detection time-series and manual inspections of the recordings indicate month-long presence of Atlantic walruses in the Hudson Strait during the

winter months. The frequentation time-series along the 500-km long strait is analyzed in relation with the spatial extension and recession of the seasonal ice cover in this region of the marginal ice zone. Because of the strong relation of walrus with the ice, the effects of global warming on Arctic and Subarctic sea ice may affect this overwintering and breeding of Western Atlantic walrus in Hudson Strait.

OPPORTUNITIES FOR PUBLIC-PRIVATE PARTNERSHIPS IN NORTHERN SEARCH & RESCUE (SAR): ENHANCEMENT TO CIVILIAN HELICOPTER SAR CAPABILITY

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As the North becomes more active due to economic development, an increase in population base is also occurring. Maritime shipping is well on the rise with recent accessible seaways, increased mining activity and development, increased tourism industry in many parts of the Arctic as well as the future exploration and development of Oil and Gas. Additionally, Canada's north is now experiencing a significant increase in polar overflights with obvious signs of future routing implementations in the planning stages. The challenges facing northern helicopter SAR response going forward are evident, with significant growth in the north, so too must there be additional response capability and coverage in this massive area of responsibility. The total area of Canadian SAR coverage is estimated at 18,000,000 square kilometers, a great deal of this number lies in the northern regions above latitude 55. Search and Rescue (SAR) is about saving lives in a timely, professional and effective fashion. It can easily be ascertained that an overwhelming area of coverage may be exposed to lengthy SAR helicopter transit times to arrive on-scene when tasked to respond to distress calls in the North, given that the majority of professional helicopter SAR support is currently located in the southernmost regions of Canada. Response time is vital to any SAR mission and having the proper assets assigned to northern geographical locations to effectively manage emergency services - critical. On the global stage, many countries have now opted for outsourced Government Helicopter SAR Services due to the modern robust aircraft systems, SAR program developments and overall SAR capability enhancements of civil operators, while some others have chosen the Public / Private partnership initiative for the same reason. This presentation explores the much needed and viable solution by way of such a partnership in Canada and discusses the civil SAR enhancements garnished by the operators in the past few years, that could provide dual role civil helicopter SAR assets based in strategic northern locations, assuming both professional SAR and Air Ambulance services simultaneously for the effective response and assistance to those in need.

TECHNOGENIC IMPACT ON THE PECHORA AND KARA SEA COASTAL DYNAMICS UNDER CLIMATE CHANGE CONDITIONS: MECHANISMS AND RISKS

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Examples of the negative impact of the oil and gas development on the resistance of the coasts to erosion are analyzed for the coasts of the Pechora and Kara seas. Local technogenic disturbances in the cryolithozone put the activating mechanism of thermal abrasion into action. Under the conditions of global warming and ice cover decrease, this effect is enhanced due to the increase of the length of the ice free period and the length of the wave fetch. As a result, anthropogenic impact and climate change create a synergetic effect, due to which rates of coastal retreat may double or even triple. Such negative experience has been observed on the coasts of Varandey island, Pechora Sea, and hasn't been taken into consideration during the latest works on oil and gas infrastructure construction on the coasts of the Kara Sea, which also lead to dramatic abrasion rates increase in the region. The task of the present study was to assess the technogenic impact and separate it from the natural consequences of the climate change in coastal areas of the Kara sea. For several key areas on the western coast of Yamal Peninsula, rates of retreat were assessed using multiannual repeated stationary observations data. The time period of observations includes initial natural undisturbed conditions, the years of construction of the underwater pipeline crossing of the Baidaratskaya Bay and other oil and gas facilities in Western Yamal, as well as the most recent period when these facilities started to function. Additionally, multitemporal satellite imagery analysis for Western and Eastern Yamal allowed to enlarge the period of analysis, as well as to compare the rates and mechanisms of coastal dynamics change for Eastern and Western Yamal. In order to separate the technogenic impact on the coastal destruction from the retreat rates' growth due to air temperature rise and ice-free period increase, the amounts of wind-wave energy were calculated for each site. After their comparison with the observed retreat rates, it became evident that the increase of abrasion rates within Western Yamal in 2009-2012 was mainly caused by the construction of the pipeline crossing, and namely by excavation of sediments from the beach and low terrace as well as intense traffic of heavy vehicles. However, the latest trend shows that

these changes have not been irrecoverable; and in case of reasonable maintenance, the rates of retreat will not experience dramatic acceleration comparable to the one of 2009-2012. However, in case of coincidence of future construction works with years with high wind-wave energy values, coastal retreat can be considerable and might damage the buildings and infrastructure.

ASSESSING THE SHORT TO LONG-TERM IMPACTS OF AN EXPERIENTIAL ARCTIC FIELD PROGRAM FOR HIGH SCHOOL STUDENT AND TEACHER PARTICIPANTS

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'Schools on Board' is a national outreach program of ArcticNet, based out of the University of Manitoba. This program was developed in 2003 as part of the Canadian Arctic Shelf Exchange Study (CASES), the first major scientific expedition of the CCGS Amundsen. The aim of the program is to bridge Arctic climate change research with environmental and science education in high schools across Canada, by providing opportunities to connect students and teachers with researchers through a variety of one-day events, and an annual field program on board the research icebreaker CCGS Amundsen. The multidisciplinary nature of ArcticNet research exposes participants to different aspects of Arctic system sciences and the interconnections between science teams using this platform to examine and understand the Earth's processes affected by climate change in the Arctic. The focus of this talk is the assessement of the Arctic field program, an experiential approach to teaching science 'IN' the Arctic and 'IN' a research environment and also introduces participants to life aboard a working research vessel, life as a scientist, and life in the Arctic. The success of the field program has resulted in 10 years of support from the ArcticNet science community and funding agencies. In an attempt to measure the impacts of this program, Schools on Board has partnered with Health in Common, to conduct an extensive assessment of the field program. Health in Common is a non-profit organization with a mandate to strengthen communities and organizations through planning and evaluation support and facilitating communication and collaboration within and across sectors. The goal of the Schools on Board assessment was to examine the impacts (short to long-term) of a 'Schools on Board' experience, on the personal and working lives of participating students and teachers. This comprehensive study utilized telephone interviews, an online survey, an onboard focus group, and participant questionnaires to answer the following questions: • What are the impacts of the program on the personal and working lives of participating students? • What are the impacts of the program on the personal and working lives of participating teachers? • How can the program improve? This presentation will reveal assessment results and will stimulate a discussion regarding the challenges of measuring and communicating the outcomes of such programs to stakeholders and funding agencies.

OVERWINTERING OF BARGES IN THE BEAUFORT SEA

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The BREA program contained a research priority related to worst-case environmental design limits for ice. The project described here fell under this priority, and examined the potential ice loads that a vessel overwintering in ice could experience. This is of relevance for worst-case design limits as, although the practice of overwintering vessels in ice in this region is by no means a new practice, there is little guidance regarding best practices and even less with respect to governing federal regulations. While the risk of damage to an overwintering barge and an associated spill can be of relatively low likelihood, the consequences of such an event would be very high. This priority area was also identified as a long-standing concern Inuvialuit and local governments. While focused on the Beaufort Sea and Mackenzie delta regions of Canada, this community-driven research priority has pan-Arctic considerations for the practice of overwintering vessels in ice.

CENTRE D'ÉTUDES NORDIQUES (CEN): BRIDGING SCIENTIFIC RESEARCH TO EDUCATION AND OUTREACH AT WHAPMAGOOSTUI-KUUJJUARAPIK

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Since its inauguration in 2012, the CEN Community Science Centre has been bustling with activities involving Cree and Inuit youth, elders and scientists. This was built as a new, energy-efficient addition to the CEN field station at Whapmagoostui-Kuujjuarapik, the largest of nine CEN field stations throughout the eastern Canadian subarctic and Arctic. It is located in a bicultural community on the eastern shore of Hudson Bay, at the terrestrial boundary between taiga and tundra. The Community Science Centre hosts outreach and knowledge exchange activities to raise awareness on the research conducted by the scientific community and to stimulate public interest in science in general. Through these activities, we also help to identify northern research needs that are relevant to the communities. The circumpolar scientific community also uses the Centre to host workshops, field schools, and to coordinate field operations in the area and throughout Nunavik. Over the past 2 years, a diverse range of activities have kept both the youth and the elders engaged and interested in science. Examples include: 1) a science field trip for Inuit high school students related to forest ecology; 2) a cross-generational and cross-cultural plant gathering expedition on the land to share mutual knowledge and to come together around the themes of northern plants, climate change and environmental sciences, which was captured in a documentary film, 'Eeyu Cheschaaydamowin/The Plant Gathering Project'; 3) an international, ArcticNet-sponsored winter field school with graduate students who engaged the youth in their activities; 4) active in-class participation of the youth on a wide variety of science activities; 5) three teenagers (1 Cree, 2 Inuit) completed paid internships at the station and helped plan and animate science education workshops for children at 2 day camps; 6) greenhouse projects, which kept the youth busy during the summer; 7) a plant restoration project around the station which raised awareness on erosion and restoration practices tailored to the northern environment; and 8) field trips and participation by school students in activities of the researchers. The success of this education and outreach program can be attributed to the presence of a coordinator who lives at the field station and who actively engages youth through science activities at the local schools and at the Centre on a daily basis. This position was created by CEN in partnership with Youth Fusion (an independent charity organization which aims to reduce school dropout and to empower youth; www.youthfusion.org), with the objective of engaging youth in hands-on, locally-relevant applications of science concepts. The full-time presence of the coordinator ensures a strong, active link between the community, including teachers and students, and all of the research going on at the field station.

WARMING THE TUNDRA: RECIPROCAL RESPONSES OF INVERTEBRATE HERBIVORES AND PLANTS

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Rapid warming in northern ecosystems is simultaneously influencing plants, herbivores and the interactions among them. Recent studies suggest that vertebrate herbivory could buffer plant responses to environmental change. Invertebrate herbivory plays an important, yet generally overlooked, role in the structure and dynamics of tundra plant communities. Invertebrate herbivores are also likely to respond more rapidly to warming because their behaviour and life cycles strongly depend on temperature. We investigated the effects of current season warming on Arctic moth caterpillars, their herbivory rates, and the subsequent responses of two common tundra plants, Salix arctica and Dryas octopetala. We manipulated herbivore presence and temperature in a full-factorial field experiment at two elevations, using enclosures and passive warming chambers. Warming directly affected caterpillars and their interactions with plants. Caterpillars performed worse (higher respiration rates and lower growth rates) in warmer plots and shifted their diets towards more nutritious foods, such that the relative intensity of herbivory changed for the two focal plants, with S. arctica being preferred over D. octopetala under warmed conditions. Within-season responses of the focal plants were weak and occurred through different traits for each species, but suggest that the presence of invertebrate herbivores affected the immediate responses of plants to warming. Our results highlight the potential for invertebrate herbivores to modulate the responses of tundra plants to environmental drivers.

INUIT KNOWLEDGE AND CONSERVATION OF THE TORNGAT MOUNTAINS CARIBOU HERD

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The Torngat Mountains Caribou Herd (TMCH), inhabiting the northern tip of the Québec-Labrador Peninsula, is not well documented in regard to scientific or Inuit Knowledge. Limited information on this herd suggests a recent population

decrease. Given the importance of caribou for Inuit, precipitous declines in the neighbouring George River Herd, and the upcoming Committee on the Status of Endangered Wildlife in Canada assessment, increasing our understanding of these animals is critical. Many management decisions and monitoring techniques are developed purely using Scientific Knowledge (SK). Typically SK has been given preference over Traditional Ecological Knowledge (TEK) or Inuit Knowledge (IK) when managers are making conservation-related decisions. However, very little SK is currently available regarding any aspect of the TMCH. This provides a unique opportunity, indeed a necessity, for IK to be a highly utilized source of information for the monitoring and management of this herd in collaboration with SK. This study brought together Inuit from Nunatsiavut and Nunavik and government agencies, from regional to federal levels and across provincial borders to document Inuit Knowledge and values regarding the TMCH. Thirty-three semi-directed interviews were conducted, including participant mapping, with hunters and Elders in Nunavik and Nunatsiavut, representing over seven decades of IK on the species. Thematic content analysis was performed on interview narratives, highlighting IK on this species including new information about topics such as the changing role of predators and herd behaviour. Digitized spatial data visualized the long-standing Inuit-caribou relationship in the area, while augmenting the limited existing geographic information. Considerable depth and breadth of IK in Nunatsiavut and Nunavik regarding caribou and their ecology was evident, representing contributions to the overall understanding of TMCH ecology, particularly as it pertains to assessment and future Species At Risk Act designation for this herd. In addition, this study uncovered several potential areas where SK and IK could work in collaboration to achieve mutually beneficial goals. For example, an ongoing mapping program that allowed Inuit hunters to share their knowledge on a regular basis, when the information is most recent, could provide highly important ecological information for wildlife stewardship. It could also be useful for informing and providing direction to future scientific surveys and monitoring, and be used to increase the efficiency of aerial surveys. The success of participant mapping sessions in documenting and representing an expansive body of geographical Indigenous Knowledge, as well as the desire for both Inuit stewardship and external monitoring indicated during the semi-directed interviews further confirms the importance of this herd to the Inuit that share the land with it, and the high priority they place upon conservation. This, along with the relatively small body of SK on the herd makes it an ideal population for novel initiatives in Inuit wildlife stewardship and a potential model for successful co-management practices.

NUNAVIK INUIT KNOWLEDGE OF POLAR BEARS

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Inuit Knowledge (IK) is a valuable, albeit underused, knowledge system with regards to the conservation and management of arctic species, including polar bears. In matters of wildlife management, decision-makers have typically relied more heavily on Scientific Knowledge (SK). Inuit Knowledge holders can provide important ecological details and useful, practical conservation knowledge and techniques that are unavailable or more difficult to glean using scientific methods. While IK on polar bears has been documented in many arctic regions, documentation of Nunavik Inuit Knowledge (NIK) has been more limited. Upcoming decisions on total-allowable-takes (TAT) for the three polar bear sub-populations in Nunavik (South-Hudson Bay, Fox Basin, and Davis Strait) have expedited the need for an increased body of knowledge on the species, including NIK. This project has been undertaken by the Nunavik Marine Region Wildlife Board (NMRWB) and Trent University to support access to the best available information for use in decision-making regarding Nunavik polar bear management. The main objective is to document NIK of polar bear ecology, biology and traditional management practices, so that it can be formally considered during the NMRWB's decision-making processes. Individual and small group interviews have been held in the three Nunavik communities (Inukjuak, Kuujjuaraapik, Umiujaq) within the SHB sub-population range to date. A preliminary report has been presented back to the NMRWB, with presentations to the communities for verification and validation occurring in November. Preliminary results from interviews with communities within SHB polar bear range indicate an extensive level of knowledge regarding the ecology and biology of the species, its role and importance to Nunavimmiut, and the traditional Inuit approaches to stewardship of polar bear. Respondents provided information on distribution, migration, feeding behavior and preferences, mating and denning, habitat, and abundance. Interviews indicated that Inuit have several concerns with the future management of these animals including issues with a quota system, interest in a flexible multi year management plan, equity and Inuit involvement in the decision making process, and thoughts on managing polar bears as separate sub-populations. Concerns arose that undesirable human-bear interactions could increase if hunting is restricted, as all three communities have witnessed an increase in polar bear sightings since the 1960s. Respondents indicated that

traditional management practices include seasonal hunting closures, and general avoidance of harvesting cubs. These practices are governed by need and appropriate use of polar bears. Results also indicate the high level of importance of polar bears for Nunavimmiut as an economic and cultural resource, and the important role they play in the ecosystem. Nunavik Inuit wish to be heavily involved in the management decisions regarding polar bears in the region, and the rich level of NIK available supports this desire. Interviews will be conducted in communities within the range of the other two sub-populations in Nunavik this fall and winter with final results from the study being returned to communities next year and included in the public hearings for establishment of TATs.

ICE-WEDGE THERMOKARST LEADS TO GREATER HETEROGENEITY OF ARCTIC ECOSYSTEMS

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The Canadian High Arctic is home to a polar desert biome that is set to experience some of the greatest mean annual air temperature increases on the planet. It is thus imperative to describe the dynamic relationship between the geomorphic changes of melting ice-rich permafrost (thermokarst) and the resident vegetation in light of a warming climate. For this study we have selected a site having undergone thermokarst on the Fosheim Peninsula, Ellesmere Island, Nunavut (80°N, 85°W) to examine the effects of ice-wedge thermokarst on ecosystem processes. Results show that subsidence caused by the degradation of ice-wedge troughs catalyzes a suite of environmental and biotic changes: a new hydrological balance has altered community composition and abundance of vascular vegetation, creating distinct soil chemistries and a detectable ground penetrating radar (GPR) signal of disturbance. Biotically, plot-level species richness declines with the increase of thermokarst while the overall species pool richness does not change. While thermokarst plots favour a set of species distinct from the polar desert, these show no significant phylogenetic clustering or over-dispersal despite significant abiotic environmental stressors. Additionally, thermokarst areas shows greater species turnover (?-diversity) between plots and exacerbated abiotic differences between top/trough microtopography. This suggests that with projected thermokarst increase in the region, ice-wedges will be catalysts in creating a more heterogeneous high arctic landscape.

INCREASING USE OF TRADITIONAL KNOWLEDGE ACROSS THE ARCTIC

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As the Arctic changes around us, there is an increasing need to understand what collaborative adaptation actions are possible. Such a process requires the use of both Traditional Knowledge and science. When we think about the use of information from Traditional Knowledge along with western science, there are many questions to be addressed, such as what is the best way to store this information; what is the best way to share this information and to manage its overall use and accessibility, while ensuring that the knowledge holder maintains ownership of it. In addressing these questions it is important to recognize that these are two different sources of knowledge with two different methodologies and different questions being asked. However, they can complement and often do complement each other. The challenge we face is in educating people on the importance of this information, that Traditional knowledge is a systematic way of knowing and is a living process. This way of knowing is taught from birth and cannot be translated into another source of knowledge. This presentation will discuss ICC's efforts to advance the understanding and us of Traditional Knowledge within the Arctic Council and within work conducted through the ICC-AK office.

HOW TO ASSESS FOOD SECURITY FROM AN INUIT PERSPECTIVE: BUILDING A CONCEPTUAL FRAMEWORK ON HOW TO ASSESS FOOD SECURITY IN THE ALASKAN ARCTIC

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Inuit possess a unique understanding of food security within the Arctic; viewing food security to encompasses both cultural and environmental systems; systems which interlink and support each other. While many changes are taking effect within Arctic ecosystems, primarily resulting from climate change and industrialization, food security is becoming a central topic of conversation. Research shows that food security definitions and assessment methods do not necessarily match the Arctic ecosystem or cultures within. In response to the need to address food (in)/security of traditional food resources within a changing Arctic, the Inuit Circumpolar-Council Alaska (ICCAK), has commenced building a conceptual framework on how to assess food security from an Alaska Inuit perspective through a multi-

year project. The project builds upon the support of the ICC-AK board's decision to place food security as its first priority. Three objectives will be met within this project: 1) provide an understanding of Arctic food in/security, from an Alaska Inuit perspective; 2) identification of drivers of food in/security; 3) create a conceptual framework on how to assess food in/security across both cultural and environmental systems. Additionally, we hope to begin to identify what will need to be monitored in order to create action plans. In part the development of this project aims to bring a greater level of Inuit involvement and Traditional Knowledge to future and ongoing assessment projects; providing greater insight into the Arctic ecosystem. Food security is not simply one of academic interest; it is a cornerstone of Inuit culture. Understanding Arctic food security and derived cultural and environmental system interconnections will provide policy makers and leaders with a holistic view of the Arctic. This proposed presentation will describe the reasoning behind this Inuit led project; the methodology being used; and a few preliminary findings.

CIRCUMPOLAR ARCTIC COASTAL COMMUNITIES OBSERVATORY NETWORK (CACCON): HOW WE SEE IT WORKING IN NUNATSIAVUT

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CACCON is an emerging pan-Arctic network of community-engaged, multifaceted and integrative coastal community observatories and knowledge hubs. These address the current status and present or anticipated trends in natural and social conditions affecting human settlements and activities along the circumpolar Arctic coast. Following best practices in co-design, the network works with governments, industries, communities, and researchers to collaborate in the identification of key research questions relevant to specific global, regional and community situations. It aims to attract funding to enable research to answer those questions, carry out or facilitate community-engaged research, and work with stakeholders to identify ways to implement those findings. The project aims not only to generate and compile appropriate data sets and indices of change, but crucially to understand how scientific and indigenous knowledge can and might better contribute to informing decisions on critical issues of climate, resources, and well-being in the north. The network provides training opportunities to build local capacity across a range of disciplines and to facilitate the involvement of early-career researchers and northern residents in community-engaged research. The network and affiliated observatories archive, manage, and disseminate the data, reports and other products of this research for use by future researchers and stakeholders, including traditional knowledge where appropriate. There is no precedent for a network of coastal community observatories and knowledge centres that collect, distil, and share both physical/ecological and social science data to enable evidence-based decision-making in the Arctic. We use the term "community" in its broadest sense; it may refer to communities of residents (from hamlets to cities), industries, NGOs, or governments. As a consequence of climate change, changing demographics, resource shifts and extraction, and globalization, northern coastal zones are rapidly changing environments. There is an urgent need to inform adaptation processes in a way that addresses the local priorities of coastal communities in the Arctic. Moreover, once established, it is critical that these adaptation processes and decision-making supports are sustained within the region. A network of integrated Arctic coastal community observatories and knowledge hubs will fill this important gap. Our presentation elaborates on and illustrates with examples how the CACCON network is operating within the regional knowledge hub of Nunatsiavut today. It briefly describes the co-designed Digital Information for Sustainable Communities (DISC) initiative and the Sea Ice Monitoring and Real Time Information for Coastal Environments (SmartICE) project. Most importantly, it demonstrates how co-produced information sharing within and between knowledge hubs can address local priority issues.

COUPLING OF CLIMATE, BIOGEOCHEMISTRY AND ECOSYSTEMS UNDER ARCTIC OCEAN ACIDIFICATION

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Changes to Arctic Ocean biogeochemistry will result from a complex array of climate and chemical perturbations over the next decades. Changes to freshwater and nutrient supply through ice melt and continental runoff; warming of the ocean and an increasing ocean acidification through partial equilibrium with a rising anthropogenic CO2 load will change

the nature of Arctic Ocean ecological and biogeochemical coupling. This is no more apparent on the shelf regions where there is strong influence from land sources of freshwater and total alkalinity. This presentation will document our combined approach of studying Arctic biogeochemical change through coupled observational, experimental and modelling campaigns. We have identified large changes in recent anthropogenic carbon transport to the Arctic and have characterised the associated regional and water mass ocean acidification. We have determined, through targeted Arctic pelagic ecosystem perturbations experiments, changes to ecosystem structure, succession and biogeochemical cycling under high CO2. Observations have been incorporated into regional, coupled physical-ecosystem-carbon biogeochemical models (informed at the boundaries by downscaled global earth system models) to develop scenarios of change in biogeochemical pathways. We have identified large regional variability in ocean acidification that is shown to impact on shelf biogeochemistry, ecosystems and climate feedbacks in the Arctic Ocean. This new information was delivered to the AMAP OA report. A brief overview of the 2014 OA report will be given along with an introduction of the strategy for the 2017 AMAP OA2 report.

COUPLED WIND AND SEA-ICE TRENDS IN THE HUDSON BAY REGION: MODEL-BASED CLIMATE PROJECTIONS

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An evaluation of North American Regional Reanalysis (NARR) data has shown increases in wind speed of up to 60% over the past three decades in the northern regions of Ontario, with the main increase taking place over southern Hudson and James Bays and the adjacent Lowlands. There are multiple impacts of increasing wind speed in this area, ranging from the threat to the local fishery and coastal erosion to possible damage to infrastructure. Future projections should be capable of assessing future wind speeds with high spatial resolution in order to assess specific infrastructural risks such as the exposure of the Five Nations Energy transmission line linking the coastal communities of James Bay with the Provincial power grid. Given the poor measurement coverage in these remote regions of the Hudson and James Bay coast, the analysis is restricted to model data. The trend of increasing wind speeds is also present in a wind projection from 1960 to 2095 using the Regional Climate Model (RCM) PRECIS, resulting in a rate of increase of more than 0.1 m s-1 decade-1 for coastal regions. These trends are subject to strong seasonality with maximum wind speeds during the winter months. A comparison of monthly PRECIS modeled output with NARR data for the decade of 1980 to 1990 for a 10 x 1 degree strip in the Hudson Bay Lowlands has yielded limited agreement with an overall R2 of 0.38. This originates from the overestimation of winter wind speeds in PRECIS, suggesting that the future seasonal projections have to be interpreted with caution. The general seasonal pattern as well as the decreasing gradient with distance from the coast found in the PRECIS data was fairly reproduced in NARR but extended further inland. Causes of these wind speed increases appears to be related to changes in atmospheric stability arising from an enhanced heat loss through diminishing sea ice which augments the downward transfer of horizontal momentum from aloft. This coupling has been already demonstrated for Lake Superior and is confirmed with the NARR data for the southern Hudson and James Bays for the 31 year period of 1980 to 2010, revealing a statistically significant negative relationship between seasonal wind speeds and ice cover estimated through inter-annual changes in monthly surface albedo. We will use the North American Regional Climate Change Assessment Program (NARCCAP) data and investigate additional parameters accounting for changes in atmospheric stability and in sea-ice cover to further investigate the sensitivity of the underlying processes responsible for increasing wind speeds in the northern maritime environments. Since Arctic sea-ice decrease is a circumpolar phenomenon, the accompanying increases in wind speed are likely to have broad implications in the near future.

ARE WE READY: PERSPECTIVES ON EMERGENCY RESPONSE IN THE CANADIAN ARCTIC

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"Perspectives on Emergency Response in the Arctic" reveals the findings of a hypothetical case study of the sinking of a foreign cruise ship in Cumberland Sound, Nunavut, near the community of Pangnirtung. The paper explores relevant questions of jurisdiction and authority as well as the interoperability of response protocols belonging to the community, territory and Federal government.The challenges to an effective rescue imposed by the isolation of the scene, disparity in capacity and training and diversity of institutional cultures involved and exacerbated by the fractured responsibility for response services in the far North are highlighted through this simulation exercise, revealing a system of well-intentioned, but potentially conflicting policies and practices. The findings raise questions regarding the readiness of responders in both the far North and south to react in a timely and appropriate fashion to a major incident in Canada's Arctic and identifies

potential fault lines in operational capacity and the jurisdictional structures that currently govern Northern search and rescue.

EXPLORING KEY DRIVERS OF FOOD INSECURITY: CHANGES IN LAND USE, SKILLS, AND KNOWLEDGE

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According to the FAO definition, populations are considered food-insecure when there is limited availability of, or ability to acquire, culturally acceptable, nutritionally adequate and safe foods on a sustained basis. The issue was explored by a Council of Canadian Academies Panel, Aboriginal Food Security in Northern Canada (2014) (www.scienceadvice.ca) The Panel addressed the question, What is the state of knowledge of the factors influencing food security in the Canadian North and the health implications of food insecurity for Northern Aboriginal populations? The Panel's report found that Indigenous households in Canada experienced food insecurity at a rate of about three times higher than non-indigenous households, and women and children were particularly vulnerable. The apparent drivers of food insecurity were poverty, isolation of northern communities and high cost of store food. Underlying drivers of food insecurity were related to the difficulty of access to traditional foods. There seems to be two key factors related to the difficulty of accessing traditional foods: less time spent on the land, and erosion of skills and traditional ecological knowledge (TEK). The first of these can be partially documented from various parts of the Canadian North; the second is more difficult to document. In a project with Norway House Cree Nation in Northern Manitoba, we are focusing on the fishery and exploring solutions by considering three interrelated areas. The first is the ecological aspect and resource capacity. The second is the cultural aspect, including traditional knowledge, skills, and values. The third (which is the PhD work of Durdana Islam) is the economic aspect (commercial vs. subsistence fishery, entrepreneurial skills development, and social enterprises). Our integrated approach helps explore interdependencies of these three domains. For example, strengthening the cultural domain through better transmission of land-based skills (TEK) and cultural revitalization will help make better use of the biological resource base. Focus on community economic development through the use of social enterprises brings in new skills and financial incentives. Food insecurity problems no doubt differ from region to region, and involve multiple factors. Food insecurity is further impacted by pollution of northern food webs; large-scale development projects, and climate change which interferes with the ability to access resources. However, solutions are likely to involve re-vitalization of culture, TEK and skills. Along with policies for use of nutritious non-traditional foods, building social enterprises that address multiple objectives is potentially one of the keys. In northern Canada and elsewhere, the solutions are not about merely providing cheaper store food, but rebuilding the resilience of food systems to provide multiple food sources and land-based options. Essential in this process is food sovereignty, or the ability of Indigenous peoples to control their own means of food production.

THE ROLE OF THE REGIONAL SCALE IN PLANNING FOR FUTURE MARITIME TRAFFIC IN THE CANADIAN ARCTIC: A STUDY IN THE INUVIALUIT SETTLEMENT REGION

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The Arctic is a world in transition. Expectations are that sea ice will decline through the Northwest Passage, expanding the areas available for potential transit and triggering conversations surrounding developments in marine-based industries such as cruise tourism, fishing, and bulk shipping. In order to take advantage of these opportunities, the potential benefits and risks need to be understood from the perspective of both the natural and human dimensions. By reviewing the literature and interviewing Inuvialuit, federal and territorial government representatives on the topics of the risks and opportunities associated with maritime traffic in the Beaufort Sea Region, the need for integrated and collaborative work becomes clear. This research also highlights what national, territorial, and indigenous stakeholders can offer to discussions in developing a management plan for maritime activities.

HUMAN–ENVIRONMENT RELATIONSHIP SINCE THE LITTLE ICE AGE (1500 – 1870) IN NUNAVIK AND NUNATSIAVUT (CANADA)

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To document the relationships between climatic changes and human activity during and following the Little Ice Age

(LIA; 1500–1870) in northern Canada, several archeological sites located in Nunavik and Nunatsiavut were studied using an interdisciplinary approach (geomorphology, archaeological surveys and excavations, palaeoecology, geoarchaeology, traditional ecological knowledge (TEK)). We present here tow syntheses of projects: the first one concern studies that were conducted at sites located on Hudson Bay and Strait Bay coast to document the choice of Thule/Inuit dwelling style in the eastern Arctic in a context of climate changes. The sites selected for habitation were well-drained sandy marine terraces in a valley sheltered from prevailing winds. Sod houses were in turn made possible by the abundance of driftwood on the island and the presence of nearby peatland. Thule/Inuit people used those warm semi-permanent houses rather than igloos at many sites during the dry, cold conditions toward the end of the Little Ice Age. The second synthesis presents projects which conducted on Nain region to document how Thule/Inuit people used terrestrial resources (peat and wood) during and after the LIA. It was revealed that peat accumulation increased after ca. 580 cal. yr B.P. likely due to the elevation of the frost table during the LIA. Natural resources such as trees and peat were therefore readily available and then extensively used by the Inuit for house construction and heating in Nain region. Moreover, through a focus on TEK and patterns of forest resource exploitation, we documented recent changes (decrease of spruce population and increase of Larix stands) that have occurred in the forest landscape of the Nain archipelago since the end of the 18th century. Preliminary results of this study show that the forest has played a central role in local resource use by Labrador Inuit and had a significant impact on the regional forest landscape.

ARCTIC CHANGE: FROM THE SURFACE TO THE BOTTOM DURING THE RECORD SUMMER SEA-ICE MINIMUM IN 2012

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The Arctic Ocean is rapidly changing due to increasing temperatures and the loss of sea ice. The decrease in sea-ice cover and increased temperatures affect physical properties of the Arctic Ocean, and will influence geochemical and biological processes across different marine environments. One of the central questions about the consequences of the shrinking sea-ice cover is to what extent primary production and subsequent export of matter to the seafloor will be affected, and how this will influence the structure and functioning of the entire ecosystem. In September 2012 Arctic sea-ice extent declined to a record minimum. The observed rapid sea-ice melt resulted in the sinking and widespread deposition of fresh ice algal aggregates of the diatom Melosira arctica to the deep seafloor at 3500-4400 m water depth (Boetius et al. 2013, Science 339: 1430). Algae patches covered up to 10% of the seafloor and attracted opportunistic deep-sea fauna, such as the holothurians Kolga hyalina and Elpidia heckeri. In addition, elevated oxygen uptake rates were measured in sediments with algal deposits, indicating remineralization by bacteria and evidencing a response of the entire ecosystem down to the deep sea to the increased carbon flux. Microbial communities play an essential role in carbon and nutrient cycling not only at the seafloor, but also in the sea ice and in the water column, contributing significantly to Arctic ecosystem functioning. Hence, we specifically investigated bacterial communities in a wide range of Arctic environments from the surface to the deep sea, including sea ice, melt ponds, surface seawater, and deep-sea sediment, which were sampled during Polarstern expedition ARK-XXVII/3 to the Central Arctic in summer 2012. Bacterial communities were investigated using molecular fingerprinting and next-generation sequencing techniques, in order to test for differences in community structure and to identify the most abundant bacterial groups in each habitat. Although some bacterial classes (Flavobacteria, Gammaproteobacteria, Alphaproteobacteria) were common to all of the investigated environments, overall community composition and structure exhibited specific habitat signatures, with distinct differences between surface and deep-sea environments. But also more similar environments displayed differences in the presence of certain bacterial types, e.g. Verrucomicrobia were detected in multi-year ice, but were absent in first-year ice. This may suggest a decrease in the abundance of certain bacterial groups with the ongoing decline of multi-year ice in the Arctic. Furthermore, the detection and relatively high contribution of the genus Polaribacter in algal aggregates from melt ponds and from the seafloor, indicated a transport of surface-derived bacterial cells to the deep sea with the rapidly deposited aggregates. Export events, such as the one observed in 2012, may continue to occur in the next years and may cause shifts in Arctic bacterial community diversity and functioning in the future. This work contributes to the ERC Advanced Investigator Grant ABYSS (no. 294757).

THREE-YEAR LANDSCAPE-GRADIENT ASSESSMENT OF THERMOKARST LAKE HYDROLOGY IN NUNAVIK (QUEBEC, CANADA) USING WATER ISOTOPE TRACERS

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A three-year landscape-gradient assessment of thermokarst lake hydrology provides baseline information on changes in hydrological processes associated with recent climate changes. Progressive and rapid degradation of permafrost since the mid-20th century, followed by the development of thermokarst lakes and terrestrialization of peat-plateaus, are all climate-driven changes with major consequences on regional landscape hydrology. Our study aims at assessing the influence of temperature, precipitation, catchment vegetation and permafrost degradation on thermokarst lake hydrology. Our four main study areas are distributed across a latitudinal, vegetational, climatic and permafrost gradient between Whapmagoostui-Kuujjuarapik and Umiujaq, stretching from spruce-lichen woodland with sporadic permafrost in the south to shrub-tundra overlying discontinuous permafrost in the north. Lakes were sampled during mid-summer 2012-2014 and analyzed for water isotope composition (?18O, ?2H) to provide a snapshot of lake hydrological conditions. An isotope-mass balance model was used to 1) infer lake-specific input water isotope compositions (?I) that differentiate the relative roles of primary source waters (e.g., rainfall and snowmelt), and 2) calculate lake-specific evaporation-to-inflow (E/I) ratios to evaluate the influence of vapor loss. The lake water isotope data series defines two groups of lakes: 1) snowmelt-dominated lakes (?I < ?p ; ?p is amount-weighted isotope composition of annual precipitation), and 2) rainfall-dominated lakes (?I > ?p). Snowmelt-dominated lakes are located in catchments with dense forest vegetation, whereas rainfall-dominated lakes tend to be more prevalent at sites with sparse vegetation overlying discontinuous permafrost. Lakes situated in the sporadic permafrost terrain to the south are more isotopically enriched, and thus experience greater evaporation than those from discontinuous permafrost terrain to the north. Lakes overlying mineral-rich soils with scarce vegetation are also more isotopically enriched due to evaporation than lakes overlying organic-rich soils surrounded by forested vegetation. These results suggest that there is greater snow accumulation and meltwater input to lakes in the forested study areas. Lakes in close proximity to rivers are isotopically depleted likely due to river flooding. We speculate that thawing permafrost in discontinuous permafrost terrain offsets the effect of evaporation, whereas lakes in sporadic permafrost terrain are most vulnerable to becoming evaporation-dominated because permafrost thaw no longer provides a source of water.

IDENTIFYING INDIGENOUS DETERMINANTS OF HEALTH: INSIGHTS FROM ANALYSIS OF INUIT SELF-RATED HEALTH IN NUNAVIK

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Rationale: It is argued that current and future health research with Indigenous populations should expand beyond a predominantly biomedical perspective as it limits our understanding of the complexity of Indigenous health and does not adequately capture the social, cultural and environmental determinants that have been critically linked to the health of Indigenous peoples today. Purpose: The primary research question in this study is, what are the key factors influencing Indigenous health? Through research into Inuit self-rated health in Nunavik this project aims to increase our understanding of Indigenous-defined determinants of health. Methods: This research uses an exploratory sequential mixed-methods design. It draws upon two bodies of literature to understand health – that resulting from an epidemiological approach informed by self-rated health literature and the other resulting from a population health approach to understand social determinants of Indigenous health. The initial qualitative phase of the project employs key-informant interviews with Inuit health experts in Nunavik. Determinants of Inuit health identified by key-informants will then be used to inform quantitative analysis of the existing Qanuippitaa? Nunavik regional Inuit health survey dataset to explore associations and insights into Inuit self-rated health. Results: Preliminary results from the qualitative analysis will be presented. This will include insights from the regional health experts on some of the key factors that influence Inuit health in Nunavik. Early analysis suggests the importance of factors such as the nature of family-home relationships, maintaining a link to the land, sense of identity and pride in oneself, and cultural continuity. Conclusions: This project has the potential to identify and show evidence for more appropriate and accurate factors influencing Inuit self-rated health. With this information it will be possible to recommend consideration

for important and previously overlooked determinants of Inuit health in future health surveys and community health evaluations in the region and perhaps elsewhere.

SEASONAL CHANGES IN PREVALENCE OF ACUTE GASTROINTESTINAL ILLNESS IN RIGOLET, NUNATSIAVUT, CANADA

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BACKGROUND: Acute gastrointestinal illness (AGI), including vomiting and diarrhea, can be caused by parasitic, viral, or bacterial pathogens whose transmission can include food, water and contact with various environments. Thus, the prevalence of AGI is often variable by season and affected by changes in weather patterns. As such, climate-related variability of AGI poses particular relevance for many Canadian Inuit because a close relationship with the land is central to well-being. Thus, variability in the climate and changes in season are particularly relevant to exposure and transmission of AGI. METHODS: Utilizing data from six previously conducted census surveys in Rigolet, Nunatsiavut from fall 2011 to spring 2013, incidence and prevalence of self-reported AGI was estimated. A multi-level mixed effects logistic regression model was used to examine the association between seasonality and AGI when accounting for repeated measures. RESULTS: During the 2-week recall periods, incidence rates ranged from 2.94 episodes/person-year in spring to 6.96 in winter. Prevalence estimates based on 4-week recall ranged from 3.24-4.19 episodes/person-year. Winter was the only season with significantly different rates of AGI than other periods of the year ($p<0.001$). Respiratory symptoms, season, and gender variables were significantly associated with the incidence of AGI in Rigolet. An adjusted annualized incidence rate of AGI was estimated at 2.71 episodes/person-year. CONCLUSIONS: Prevalence estimates vary widely by season and are particularly high in winter. Winters are long and sometimes harsh in the Canadian Arctic, and may be impacting the significant relationship with other seasons. Respiratory conditions, such as influenza, potentially account for the seasonal increase of AGI in Rigolet. Additional work is needed to identify factors driving AGI in other seasons.

THE NEW GTN-P DATABASE - HINTS FROM METADATA STATISTICS FOR FUTURE RESEARCH

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The Page21 EU projects data management group operates towards providing a web-based resource for the Global Terrestrial Network for Permafrost (GTN-P), aiming to enable the assessment of the relation between ground temperature, gas fluxes and the Earth's climate system. The dynamic and comprehensive GTN-P database contains time series for borehole temperatures and grids of active layer thickness (TSP, CALM) as well as air and surface temperature and moisture (DUE Permafrost, MODIS) from terrestrial Panarctic, Antarctic and Mountainous realms. The permafrost monitoring parameters are accompanied by detailed metadata following international standards for geospatial metadata ISO 19115/2 and TC/221. As an open-source spatio-temporal database it is implemented with PostGIS, the spatial version of PostgreSQL, following the object-oriented logic. Carefully designed user interfaces, tutorials, templates, and the nomination of National Correspondents (NCs) provide the tools to facilitate the smooth input and extraction of data. The output is provided in popular formats including csv, xml, NetCDF, kml, and shapefiles for GIS. We assessed the quality of the database content and performed statistics on the GTN-P metadata set to detect inhomogenous sample distribution in the Panarctic realm using a Voronoi Tessellation Analysis. To identify the main geographical gaps we compared the results with relevant environmental parameters, such as the spatial distribution of organic carbon contents and the expected temperature differences at the end of the 21st century according to climate models.

PHENOLOGICAL AND EVOLUTIONARY RESPONSES TO NATURAL AND EXPERIMENTAL WARMING AT ALEXANDRA FIORD, ELLESMERE ISLAND, CANADA

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Climatic changes due to anthropogenic activity are predicted to have a profound effect on the world's biodiversity and ecosystem functioning over the coming decades. The response of natural communities to rapid climate change will depend in part on the ability of species to respond in situ to changing temperatures and precipitation trends through phenotypic plasticity or evolutionary adaptation. Two decades of passive warming experiments at Alexandra Fiord, Ellesmere Island provide an ideal system in which to assess phenotypic and evolutionary responses to warming. In order to understand how Arctic plant species respond to warmer temperatures, we monitored flowering and seed maturation phenology in response to both experimental and ambient (non-experimental) warming over 21 years for four widespread species in two habitat types at Alexandra Fiord, Ellesmere Island. We then asked whether adaptation to experimental warming has occurred by conducting reciprocal transplant experiments between the above-mentioned experimental warming and control treatments in both habitat types. As expected, long-term experimental warming led to earlier flowering time in all four species, and earlier seed maturation in all but one species. In contrast, flowering did not advance significantly in the control plots over the 21 years of the study, despite more than 1°C of ambient warming, and was significantly delayed for at least one species. Reciprocally transplanted individuals maintained advanced phenologies in two of the four experiments, suggesting that at least some of the differences between warmed and control populations may be due to evolutionary adaptation over the two decades of the experiment. The results of this study enhance our understanding of the ability of Arctic species to respond to warming, both through plasticity and adaptation, and highlight the importance of considering a suite of environmental and biological factors that will influence the persistence of these species in the future.

ENGAGING SCALE AND MEANING IN FORMULATING POLICY LEARNING FOR DISASTER GOVERNANCE: AN INTEGRATED RISK MATRIX MODEL

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The ways in which disasters are understood, mitigated, and responded to are largely constructed through social processes. It is human perceptions and decisions that define the physical and social boundaries of disaster events, control the flow of resources during relief efforts, and manage rebound processes. Power struggles fueled by debates about knowledge, risk management, and the equity of outcomes are an inherent part of disaster definition and management. In general, only risks that are recognized legally and scientifically are mitigated and compensated for, therefore it is vital that local needs for economic, social and cultural security shape policy decisions. In order to manage disasters fairly and efficiently, these social realities must figure centrally in the governance of hazards and risks. We conceptualize disaster risks and governance by analyzing ways in which actionable local and global response strategies and social learning may evolve depending on spatial (local/global) and temporal (short/long-term) attributes of hazards and the speed of hazard event onset (slow/rapid). We establish this framework based on a set of local to global case studies whose effects and onset move along different time scales. The local cases compare formal and informal pre and post-disaster governance in Alaska linked to the 1964 Great Alaska Earthquake and Tsunami and the 1989 Exxon Valdez Oil Spill, to the global cases of climate change governance, water and economic security. Our results are mapped within a matrix to explain the construction of disasters as a social process and to translate this importance to policy learning at different scales of governance. Because to almost any risk, people are not equally vulnerable, our "disaster governance matrix" indicates as an adaptation action the extended engagement, through different pertinent participatory models, between local and institutionalized responses to hazards. Furthermore, the cumulative impacts from the interaction of multiple risk sources, and uncertainties from complex hazards such as climate change demand innovative solutions as the adaptive capacity of local communities is closely linked with regional and global processes.

EXPERIMENTS IN CULTURALLY-APPROPRIATE DWELLINGS FOR NUNAVIK: ARCHITECTURE STUDIOS EXPLORE THE IDEA OF A CONTEMPORARY INUIT HOME AND ITS RELATIONSHIP TO THE TERRITORY.

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In architecture, and particularly in educating future architects, the ideas of "home" and "dwelling" are crucial and prevail over any other considerations of a more technical nature (as, for instance, the supply of houses). The home, as Gaston Bachelard underlines in La poétique de l'espace (1957), is a "corner of the world", a "happy/pleasing" place, a region of memory and imagination: it is a place for "dwelling". Several authors, architects and philosophers (Berque, A. (1996) Être humains sur la terre; Paquot, T. (2005) Demeure terrestre. Enquête vagabonde sur l'habiter; Roux, M. (2002) Inventer un nouvel art d'habiter. Le ré-enchantement de l'espace), stress the fact that the "home" possesses a poetic territory that gathers and involves imagination, significant human experiences, and representations of the world: in short, which "enchants/delights". Architecture thus produces the physical forms which allow "to dwell", in the sense of all that contributes, for every human being, "to be", to take "place", to have a "place". It is in such spirit that we initiated a reflection and a creation-research (in architecture design studios) on the Arctic home, for the Inuit communities of Nunavik. In the context of an interuniversity research project titled Définition d'un habitat à haute efficacité énergétique répondant aux besoins des populations du Grand Nord et aux enjeux climatiques et logistiques (2013-2015)*, professors and students in the Schools of architecture at Université Laval in Québec and Institut national des sciences appliquées in Strasbourg undertook, in light of the challenges and difficulties that characterize the actual arctic houses, to explore more sustainable alternatives, culturally and territorially better adapted. During its first year (2013-2014), the project rallied the talents and the creativity of about twenty architecture students, in Québec and in Strasbourg, on the question of dwelling in Nunavik, from the requalification of Nordic villages and the design of new homes, up to the construction details. Several students had the opportunity to make a fieldtrip to Umiujaq in order to meet with members of the community, to present their preliminary projects, and to discuss the relevance and the potentials of these projects in their cultural and territorial dimensions. Our talk will relates this rich cultural experience by presenting the itineraries that the idea of the "home" (from its imagination to the anticipated human experiences it might provide, via its revisited construction and considerations about climate and energy) allowed to discover, through the design of innovative homes for Nunavik. Although still at an exploratory stage, those projects allow all the same to see the research possibilities and dimensions for future developments for the culturally-appropriate Arctic home. * Definition of a high-efficiency dwelling environment that meets the needs of populations of the Far North, and the climatic and logistic stakes (2013-2015). École d'architecture de l'Université Laval à Québec et Institut national des sciences appliquées de Strasbourg. In association with the Laboratoire d'habitation nordique de la Société d'habitation du Québec, and with the support of the Fonds franco-québécois pour la coopération décentralisée, Québec International, and Pôle Alsace énergivie.

MINE, EMPLOI ET DÉVELOPPEMENT ÉCONOMIQUE; UNE ÉQUATION À REVISITER

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Les discours dominants valorisent souvent l'industrialisation minière comme un moyen de développer les régions isolées de l'Arctique Canadien, principalement via la création d'emploi, des offres de formation et l'apport de nouvelles infrastructures. L'objectif de la présentation est de questionner l'évidence de cette équation « emploi à la mine = vecteur de développement ». Pour ce faire, une étude comparative a été réalisée au printemps 2014 au Nunavut à Qamanit'uaq (mine d'or) et au Nunavik.à Kangiqsujuaq (mine de nickel). Elle a consisté à comparer les impacts socio?économiques des 2 mines, explorer les scénarios du futur et les raisons du faible taux d'emploi inuit. Nous avons utilisé une approche de recherche participative en ateliers au sein de la mine et au village. Bien que ces thématiques soient contrastées, l'ensemble des résultats nous amène à reconsidérer la signification de cette équation ainsi que ses termes « emploi » et « développement ». A Kangiqsujuaq, l'enquête menée dans les mines Raglan et Expo (nickel), a permis de revoir et repenser le terme générique « emploi » qui masque une réalité complexe. Les salariés donnent une signification « extra?ordinaire » à leur travail, en comparaison d'un « travail ordinaire » dans les communautés d'origines. A Qamanit'uaq, le travail en atelier révèle que la notion de « bien?être » n'est pas dépendante uniquement des emplois créés par la mine, mais dépend de toute une série de facteurs complexes: comme l'entraide communautaire, le transfert de savoirs intergénérationnels et les services sociaux. Les impacts socioéconomiques de la mine d'or sont bien plus importants que prévus initialement. L'ouverture potentielle de la mine d'uranium (Areva) vient confirmer ce sentiment de vulnérabilité. Les scénarios confirment la menace potentielle sur la santé des hommes et des caribous. Sur les deux sites d'étude, l'argent généré par l'emploi minier se traduit difficilement en « développement local ». Le lien entre « emploi à la mine » et « développement » est donc beaucoup moins évident que ce qui est annoncé dans les discours courants.

REFLECTIONS ON THE NORTHERN HOME

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On May 2, 3 and 4, 2012, a charrette was held in Kuujjuaq to redefine the Nunavik habitat. Through the intensive process, stakeholders representing different Inuit community groups in Nunavik came together to discuss their needs and develop a common vision of the ideal home. The event in Kuujjuaq aimed to gather practical ideas and points of view leading into the process to design new northern housing and foster the collaboration and contributions of the participants who are directly involved. The charrette takes root in a reflection process launched in 2010 by the Makivik Corporation, which is tasked with improving the living conditions of the Nunavimmiut. The aim to redefine the needs of the Inuit population—and the design of northern homes—is also part of the research undertaken by the Société d'habitation du Québec (SHQ), which is working to develop a new type of housing that suits the northern lifestyle. The workshop provided a better understanding of Nunavik's contemporary needs as well as the opportunity to assess the preliminary models that were constructed ahead of the next design phase to build several hundred new housing units in the coming years. Based on the information provided by community members during the Kuujjuaq charrette, research and studies carried out by public bodies, technological innovations in the building sciences and a search for precedent, we have developed a draft design for further reflection on the contemporary northern home in Nunavik. Village development planning must account for the drive to bring people together to create a community spirit for service, equipment, storage space and workplace sharing. Building a small number of homes around a common area that showcases the natural landscape and provides a safe haven for children will foster neighbourly relations. The expansion of the villages requires new streets that will reduce the presence of the natural landscape in residential areas, paradoxically creating urban sprawl on an immense, sparsely populated territory. A street layout that intrudes as little as possible on the natural ground and perpendicular development in which the homes project into the landscape will bridge the village and the tundra, providing visual and physical contact between the two settings that constitute the contemporary reality of the Inuit peoples. The housing plan accounts for the site's geological and topographic characteristics, the orientation of the sun and the direction of the prevailing winds. These bioclimatic aspects impact the volumes, interior design, location and dimension of the openings to capitalize on solar gains for passive heating and natural ventilation in living areas. Northern populations naturally tend to build aerodynamic forms. The dynamic indoor spaces created by the prismatic shapes of the homes will be enhanced with precast panels for the outside walls and roofs, making the attics liveable. This search for a typology that is adapted to the northern conditions and which will involve the communities in the design and building processes constitutes a factor that will ensure the adoption of the new northern home—a living space that could come to define contemporary Inuit culture.

THE PREVALENCE OF PARASITIC DISEASES AMONG THE INHABITANTS OF THE ARCTIC ZONE OF THE RUSSIAN FEDERATION

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The material presented here contains an important collection of information on the use of the practice population surveys in remote regions of the Arctic zone of the Russian Federation on the example of the Nenets Autonomous Okrug (NAO). The report demonstrated the causes and conditions leading to an increase in the prevalence of parasitic diseases among the population of the district, especially the indigenous population, as well as the reasons for the emergence of new types of parasites for the district in all age groups of the NAO. Materials and methods. Material for the study were as follows: serum, emulsion feces. Methods of analysis: macro and microscopic analysis, enzyme-linked immunosorbent assay (ELISA) methods of descriptive statistics (mean values, the percentage error of the mean, the construction of the trend line) made in Excel 2010. Criteria for sampling were taken: nationality, occupation, place of residence, age categories. The criteria for inclusion in the sample was the presence of a written informed consent to participate in the study, specifically designed for this purpose. The criteria for inclusion was not a refusal to participate in the study; disability. Type of study: cohort, longitudinal, retrospective. Results. In most villages NAO no centralized water supply, sewerage, water treatment systems. Discharge of sewage into the river insufficiently treated mainly causes entering the basin of a large number of infectious and parasitic agents that cause infection of fish. This ultimately causes an increase in the incidence of parasitosis population. In the district there are new types of parasites - giardiasis, opistorhoz ($y = 0.181 + 0,087h$ at $R^2 = 0,076$), toxocariasis ($y = 0,573h - 1,727$ at $R^2 = 0,356$) and echinococcosis ($y = 0,573h - 1,727$ at $R^2 = 0,356$) . Observed excess incidence of ascariasis population 2.3 times compared with the incidence rate in the Russian Federation, lyabliozom - 47.7 times ($y = 100,8-366,0$ at $R^2 = 0,529$), diphyllobothriasis - 2, 65 times ($y = -7,713 x + 130.4$ at $R^2 = 0,059$). We have observed that the incidence

of parasitic infections among Aboriginal people is significantly higher than in those of other nationalities, because of their closer contact with the environment, and that the incidence of parasitic diseases of children ranged from 5.29% for up to 56 difillobotrioze , 18% for ascariasis. Discussion. Revealed that there is a sharp increase in morbidity NAO parasitosis and no tendency to reduce it, because of the poor sanitary conditions of life in the townships County decreased availability of providing qualified specialized medical assistance to indigenous residents of the District, in the absence of most of the settlements of the centralized water supply and sewerage that will promote the spread of parasitic diseases and the underestimation of the impact of parasites on the health of the population, especially children. The dynamics of the population ascariasis suggests that ascariasis may be in the NAO is not an imported infection, but is a consequence of climate change, which resulted in the winter roundworm eggs safely overwinter in cold conditions.

SENSITIVITY OF PERMAFROST MODELS TO PROJECTED CHANGES IN CONTINENTALITY, YUKON, CANADA

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The distribution of permafrost in the mountain ranges of the Yukon differs from that in mid-latitude mountains because the links between air temperature and elevation are non-linear and spatially variable. Permafrost may be present below treeline because of the high frequency of inversions in Surface Lapse Rate (SLR), especially in winter. Inversion frequency and strength relate to the degree of continentally of an area, defined as the difference in the mean temperatures between the warmest and coldest months. As a result SLR can be calculated based on this magnitude and projected spatially. Incorporation of the magnitude and sign of SLRs into empirical statistical permafrost modelling allows spatial trends in mountain permafrost distribution to be predicted for the present day and into the future. The nature and degree of SLR inversion controls how the permafrost distribution is expected to change as climate warms and equilibrium is re-established. Previous modelling has been based on uniform changes in mean annual air temperature (MAAT) (e.g. +1-+5°C) (Bonnaventure and Lewkowicz, 2013). However, GCM predictions for the region indicate that there will be spatial variability in warming and that warming will be greatest in winter. Our premise is that this change in the annual temperature range (i.e. continentality) will be associated with alterations to the pattern and magnitude of SLRs. This study examines the importance of this alteration through a sensitivity analysis of the impact on permafrost for a series of non-uniform warming scenarios with and without changing the degree of continentality. Three sets of models were developed: (1) uniform spatial change in MAAT based on the average level of projected warming for IPCC scenarios A1B, A2 and B1 for the end of the century; (2) a spatially variable change in MAAT based on downscaling of the same scenarios used in set 1; and (3) a spatially variable change in MAAT as in set 2 but with a change in SLRs due to seasonally asymmetric warming. In model set 1, the results are similar to those predicted using whole number fixed inputs. Areas in the northernmost continental locations where SLR inversions are most frequent show the highest probabilities of permafrost on mountaintops and valley bottoms, with lower values displaced up the mountain above treeline and down mountain below treeline when the warming is applied. In less continental locations, lower probabilities always displace up mountain when a warming is applied, but do so according to the magnitude of change controlled by the strength of the SLR. In model set 2, areas, which are more maritime such as those in the southwest, receive less warming than those in more continental locations resulting in a lesser degree of change. The third model set reveals a higher degree of spatial change for permafrost in valley bottoms in continental areas where warming will be greater than on adjacent mountain tops. These models suggest that the degree of climate warming will be amplified in valley bottoms in the central and northern Yukon and this can be expected to exacerbate local loss of permafrost with concomitant effects on buildings and linear infrastructure.

UNHEARD VOICES: A PARTICIPATORY APPROACH TO THE INCLUSION OF INDIGENOUS VOICE IN DEFINING HOME IN NORTHERN MANITOBA

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Homelessness issues affect a significant group of Indigenous peoples across northern Canada. In response, governments and service providers continue to develop strategies to address this problem. Dominant approaches to date have tended to be designed and implemented by experts and authorities. In taking such an approach, they often exclude the voices of the homeless people themselves when designing solutions. We argue that attempts to develop meaningful and long-term initiatives without including the voices of homeless people run the risk of failing, unless Indigenous homeless people

are included in any design. For example, by actively involving those without homes in our ongoing study in Thompson, Manitoba, it became clear that a "one size fits all" or a linear approach does not adequately respond to the multiple stages of homelessness nor does it meet the varied needs of those who find themselves in such conditions. We also found that the definition of 'home' can vary according to one's personal pathway to homelessness. To gain this multiplicity of understanding, we ask participants how their knowledge gained by living as homeless people can be incorporated into the co-construction of the concept of home. We document our process using Freire's 'praxis' approach of learning, action and reflection through a community-based research experience that uses photo-voice (M. Bonnycastle, 2013; Wang & Burris, 1997) when possible to promote dialogue, collect data and influence changes that will reflect the experience and needs of the homeless population. The research data was generated from weekly conversation among Indigenous homeless people and those at risk of becoming homeless at different locations in the community. In this presentation, we highlight the stories, narratives, concerns, and concepts co-constructed through photographs used and taken by both Indigenous homeless people and staff. Findings include the reasons for homelessness in a northern context, knowledge from the homeless themselves about their concept of home, and their contribution to the Thompson homelessness strategy to improve the quality of life for Indigenous homeless people in Thompson and the surrounding communities. This is a collaborative project between the University of Manitoba, the University College of the North and the City of Thompson.

IMPACTS OF PERMAFROST DEGRADATION PROCESSES ON AQUATIC SYSTEM BIOGEOCHEMISTRY, BYLOT ISLAND, NUNAVUT

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Located in the heart of the Eastern Canadian Arctic, Bylot Island (Nunavut) comprises numerous glacial and periglacial aquatic landscapes. Several glacial valleys of the island represent highly dynamic biogeosystems rich in permafrost ground ice, peat, and aquatic environments. We aimed at characterizing the influence of geomorphology and permafrost degradation processes on aquatic system biogeochemistry. We sampled gas, water, permafrost and lacustrine sediment in different types of aquatic systems: polygonal ponds, collapsed ice-wedge trough ponds, and larger lakes overlying unfrozen soil ('talik'). Preliminary results and field observations indicate a relationship between pond/lake morphology, processes of permafrost degradation, and the age of carbon processed – ultimately released as GHG – in these aquatic systems. Small and shallow ponds produced modern or young (< 500 yr BP) CO2 and CH4, whereas larger and deeper lakes released older (< 2000 yr BP) gases. We also observed a substantial difference in gas fluxes between similar ponds of comparable size and depth. When pond margins were actively eroding (eroded and collapsed peat blocks), fluxes were several orders of magnitude higher than when their margins were stabilized. Such findings underscore the strong impact of local geomorphology and permafrost degradation processes on aquatic system biogeochemistry. Upscaling of GHG emissions at the watershed scale requires a better understanding of the emissions from different types of ecosystems, especially small and shallow ponds that can act as effective carbon processors but are usually not included in large-scale surface classifications.

FISHERIES GOVERNANCE IN NUNAVUT: UNDERSTANDING CHALLENGES AND SEIZING OPPORTUNITIES WITHIN AN EXISTING LEGISLATIVE CO-MANAGEMENT FRAMEWORK

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The decision-making processes governing the harvesting and allocation of fisheries resources in Canada takes place within the Federal Department of Fisheries and Oceans (DFO). Using western science-based knowledge systems and operating under three key pieces of legislation, the Oceans, Fisheries, and Species at Risk Acts, the shape, or perception, of how these decisions are put into practice varies across the different management regions in Canada. We examined the structure of fisheries governance in Canada while focusing on Nunavut and the co-management framework, created through the Nunavut Land Claims Agreement (NLCA). Given the diversity of resources and fishing practices within the Nunavut Settlement Area (NSA), and adjacent waters, our research explores the different major fisheries in Nunavut, the regulating bodies, guiding policies and frameworks for decision-making influencing the fisheries in Nunavut. Specifically, we explore how the NLCA directs the co-management framework within the NSA (12 miles limit of Canada's Territorial Sea boundary), and how fisheries management and decision making takes place outside of that boundary. The challenges arising from this form of governance structure for fisheries in Nunavut are highlighted as well as opportunities leading to more effective decision-making, taking

into account the use of both Inuit and western knowledge systems in the management of the Territory's fisheries resources.

ARCTIC ECOSYSTEM FUNCTIONING: BENTHIC REMINERALISATION FUNCTION.

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The functioning of benthic ecosystems is strongly influenced by resource availability, disturbance regimes, and diversity but also increasingly by global change. It is widely recognized that the Arctic region is very sensitive to climate change and wide areas of the Arctic are changing from Arctic to subarctic conditions. The first signs of perturbation are already evident with a rapid increase of temperature and drastic reduction of sea ice cover. These two factors will likely induce severe ecosystem changes. A large number of studies on terrestrial and marine ecosystems have demonstrated the importance of biodiversity on ecosystem functioning and services. In the past decades, benthic remineralisation and the pelagic-benthic coupling have largely been studied in Arctic Seas and at regional scales. This study presents a pan-Arctic overview of the benthic remineralisation. Sediment oxygen demand values, measured throughout the Arctic region, are gathered from 26 publications and 12 databases. In total, the 683 compiled values are spread over three decades (from 1980 to 2013). In parallel, we carried out a data collection of chlorophyll-a concentration in Arctic sediments (n=475 values) in order to estimate the influence of resource availability on benthic oxygen fluxes. Sediment oxygen demand (SOD) exhibited a large scatter of values, which oscillated from 0 to 47.8 mmol O2 m-2 d-1. The continental shelves which account for approximately the half of the Arctic Ocean's total area were characterised by high values of SOD (7.79±5.83 mmol O2 m-2 d-1) in comparison to the slope/rise (2.53±2.49 mmol O2 m-2 d-1) and the abyssal plain (1.20±1.28 mmol O2 m-2 d-1). This first pan-Arctic compilation of benthic remineralisation highlighted a maximum of remineralisation in the Chukchi Sea and that benthic oxygen fluxes strongly depended on depth as well as the availability of labile organic supply.

TRANSPORT PATHWAYS OF POLLUTION PLUMES INTO THE CANADIAN ARCTIC DURING RACEPAC AND NETCARE 2014

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We present trace gas measurements in the Arctic during RACEPAC and NETCARE 2014. The measurements were performed in May and July 2014 out of Inuvik and Resolute Bay with the POLAR 6 DC-3 aircraft of Alfred Wegener Institute (AWI) and focused on cloud processes in the Canadian Arctic as well as transport processes of pollution. CO and CO2 measurements indicate that long range transport from various sources affected the arctic lower troposphere during spring / summer 2014. Whereas the high latitudes were relatively unaffected by pollution plumes from lower latitudes, the more southern parts of the arctic regions were strongly perturbed by pollution from various sources. These events are likely connected to biomass burning. We also performed measurements of local emissions from shipping, to investigate their potential to penetrate the arctic boundary layer and affect the arctic free troposphere thereby becoming part of the large scale flow.

CHANGES IN TROPHIC POSITION AFFECT TEMPORAL TRENDS OF CONTAMINANTS AT A SEABIRD COLONY IN HUDSON BAY

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Some Arctic food web structures are being affected by climate change with potential consequences for long-term trends

of environmental contaminants. We examined how a shift in diet affected the trophic position of an Arctic-breeding seabird and how that change affected temporal trends of mercury and six major organochlorines, including p,p'-DDE and total PCBs, in eggs. The diet and environmental contaminants of thick-billed murres breeding at Coats Island in northern Hudson Bay, Canada, have been monitored since 1993. A change of diet in the mid-1990s led to a lowering of d15N values, signifying that the birds were feeding at a lower trophic position after the change, which lowered their exposure to environmental contaminants. After adjusting mercury concentrations for trophic position in the murre eggs, the temporal trend of mercury changed from non-significant to a significantly increasing trend, and the rates of decline in concentrations of all six organochlorines were reduced. Interactions of changes in contaminant emissions with climate change and food web processes are complex, and may have serious consequences for our understanding of contaminant temporal trends. Valid trends can be deduced only when these factors have been taken into account.

THE INTEGRATED ECOSYSTEM MODEL FOR ALASKA AND NORTHWEST CANADA: AN INTERDISCIPLINARY DECISION SUPPORT TOOL TO INFORM ADAPTATION TO ARCTIC ENVIRONMENTAL CHANGE

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The physical and biotic components of arctic and boreal terrestrial ecosystems in Alaska and Northwest Canada (permafrost, hydrology, vegetation, biogeochemistry, and disturbance) are tightly linked and sensitive to climate change. Individual models of these components have been developed to assess the response of each component to climate change, but it is also important to represent interactions among the components to comprehensively assess how this northern landscape may respond to environmental change. Such an integrated model has the potential to provide stakeholders and decision makers the ability to better visualize potential future landscapes resulting from the interaction of biological and physical processes. In this study, an integrated framework is under development to dynamically couple (1) a model of disturbance dynamics and species establishment (the Alaska Frame-Based Ecosystem Code, ALFRESCO), (2) a model of soil dynamics, hydrology, vegetation succession, and ecosystem biogeochemistry (the dynamic organic soil-dynamic vegetation model version of the Terrestrial Ecosystem Model, TEM), and (3) a model of permafrost dynamics (the Geophysical Institute Permafrost Lab model, GIPL). Together, these three models comprise the Integrated Ecosystem Model (IEM) for Alaska and Northwest Canada. We will present our progress to date, anticipated model projections of landscape structure and function that will inform adaptation to Arctic environmental change, and results from our work to improve the tundra fire and vegetation dynamics component of the IEM. Major contributors to the IEM include: Stephen Gray (USGS Alaska Climate Science Center, Anchorage, Alaska, USA); Tom Kurkowski, Alec Bennett, Kristin Timm and Michael Lindgren (Scenarios Network of Alaska and Arctic Planning, International Arctic Research Center, University of Alaska, Fairbanks, Alaska, USA); Bob Bolton (International Arctic Research Center, University of Alaska, Fairbanks, Alaska, USA); Helene Genet, Tobey Carman, Yujin Zhang, and Mark Lara (Institute of Arctic Biology, University of Alaska, Fairbanks, AK, USA); Paul Duffy (Neptune and Company, Boulder, Colorado USA); Stephanie McAfee (Department of Geography, University of Nevada, Reno, Nevada, USA), Reginald Muskett (Geophysical Institute Permafrost Lab, University of Alaska, Fairbanks, AK, USA)

PROGRESS ON THE NORTHERN ALASKA PROTOTYPE OF THE ARCTIC VEGETATION ARCHIVE

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The Arctic Vegetation Archive (AVA) working group of the Conservation of Arctic Flora and Fauna (CAFF), the

biodiversity arm of the Arctic Council, is gathering a baseline record of vegetation plot-data within the Arctic, an area of about 7.1 million km2. The goal of the AVA is to unite and harmonize vegetation data from the Arctic tundra biome for use in developing a pan-Arctic vegetation classification and to facilitate research on vegetation and biodiversity change and ecosystem models. The AVA was launched in 2013-14 with two meetings in Krakow, Poland, and Boulder, Colorado, USA. The AVA working group has started work on two prototype databases for Greenland and northern Alaska. Here we report progress on the Alaska prototype. The Alaska Geobotany Center (AGC) is building the AAVA, which will be made accessible to scientists and the public via the Arctic Alaska Geoecological Atlas (AAGA), an on-line resource being developed by the Geographic Information Network of Alaska (GINA). The AAVA utilizes the Turboveg for Windows database program and follows protocols developed for the European Vegetation Archive (EVA) and the Global Index of Vegetation Databases (GIVD). Vegetation-plot data will also be deposited in the US vegetation archive, VegBank. A PanArctic Species List (PASL, beta 1.0) provides a standard list of accepted vascular plant, bryophyte, and lichen species names for the Arctic biome. A variety of photos, maps, reports, and other ancillary data are linked to each plot's geographic location. High quality plot data and non-digital legacy datasets that are in danger of being lost have the highest priority for entry into the plot archive. Approximately 5600 vegetation plots in northern Alaska are being evaluated for inclusion in the Alaska AVA (AAVA) and nearly 500 plots have been imported thus far. The AAVA received a strong boost with funding from the US National Aeronautics and Space Administration (NASA) in preparation for its Arctic-Boreal Vulnerability Experiment (ABoVE) (http://above.nasa.gov/index.html), which is scheduled to begin in 2015. Abundant ground-based information, such as that contained in the AAVA will be needed to inform the ABoVE remote-sensing and modeling studies. Major contributors to the AAVA include: Keith Boggs & Tina Boucher (Alaska Natural Heritage Program, Anchorage, AK, USA), Helga Bültmann & Fred Daniëls (Münster University, Münster, Germany) David Cooper (Colorado State University, Fort Collins, CO, USA), Marcel Buchhorn , Anja Kade & Will Fisher (University of Alaska Fairbanks, AK, USA), Jim Ebersole (Colorado College, Colorado Springs, CO, USA), Borja Jiménez-Alfaro (The European Vegetation Archive, Masaryk University, Czech Republic), Torre Jorgenson (Alaska Ecoscience, Fairbanks, AK, USA), Michael Lee & Robert Peet (University of North Carolina, Chapel Hill, NC, USA), William MacKenzie (British Columbia Forests and Natural Resources, Smithers, BC, Canada), Udo Schickhoff (University of Hamburg, Hamburg, Germany), Stephen Talbot (U.S. Fish and Wildlife Service, Anchorage, AK, USA), Craig Tweedie & Sandra Villareal (University of Texas El Paso, El Paso, TX, USA), and Patrick Webber (Michigan State University, USA (retired), Rancho de Taos, NM, USA).

HOW WILL FIRE SHAPE TREELINE DYNAMICS UNDER CLIMATE CHANGE?

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There is a widespread expectation that treelines will advance in response to warming climate trends in arctic and alpine regions, consistent with past patterns of Holocene tree migration. However, changes in climate are also bringing changes in disturbance regimes, with the potential for strong effects on treeline dynamics. Fire is a climate-sensitive disturbance that disrupts the feedbacks that constrain community change, creating opportunities for rapid shifts in composition. At the same time, fire directly affects key demographic processes that determine treeline dynamics (e.g. seed dispersal, recruitment, survival). Thus, fire can act as a catalyst of treeline change as well as a direct driver that interacts with climate to shape demographic outcomes. Here we report on case studies of natural fires near treelines in NW North America to examine how fire effects on seed availability, seedling recruitment, and tree survival shape patterns of treeline change. We used a set of seeding and transplant experiments at paired burned and unburned sites in Alaska (n = 7) and Yukon Territory (n = 8) to test the relative importance of demographic bottlenecks related to seed availability, seedbed quality, and early survivorship in determining how fire may shape treeline dynamics. Seed applications caused the greatest increase in observed germination at sites in the North Yukon where there was a short interval (15 years) between successive fire events, but not in adjacent burned sites with a long fire return interval (>80 years). Concurrent measurements of seed rain indicate that repeat fire events deplete local seed stores, causing acute seed limitation for the serotinous treeline species, Picea mariana and, unexpectedly, resulting in treeline retraction. In Alaska (n = 7), seed applications stimulated recruitment only where severe fires had removed patches of the surface organic layer. At these sites, tree density increased more than 2-fold compared to the pre-fire community, and species composition altered from being 100% conifers to dominance (>50%) by deciduous trees. In both regions, adjacent unburned stands showed no successful seedling recruitment, demonstrating the role of fire in creating windows of opportunity for seedling recruitment. Rates of seedling recruitment from sowing trials were positively correlated with survivorship and growth of transplanted seedlings,

emphasizing the recruitment phase as a key bottleneck in post-fire regeneration at treeline. These studies illustrate that fire events can lead to divergent outcomes of retraction or expansion at treeline, depending on fire effects on seed availability and seedbed quality.

OBSERVED AND PROJECTED CHANGE IN TERRESTRIAL SNOW COVER OVER THE ARCTIC REGION FOR SWIPA AND AACA

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The main objective of the SWIPA (Snow, Water, Ice and Permafrost in the Arctic) follow-up and AACA (Adaptation Actions for a Changing Arctic) initiatives is to provide a synthesis of current and projected change in the Arctic for informed, timely and responsive policy and decision-making. SWIPA has a pan-Arctic focus while AACA is focussed over three pilot regions: the Barents region, the Baffin Bay/Davis Strait Region and the Bering/Beaufort/Chukchi Region. All three regions cover marine and terrestrial areas. This talk will present an overview of Arctic terrestrial snow cover change material being developed for the SWIPA and AACA activities. Snow cover is present for 7-10 months of the year in the Arctic and is a key component of Arctic climate, hydrology, and ecology, with important implications for human activities such as winter transport and hunting. In situ and satellite observations show widespread evidence of significantly earlier spring melt of Arctic snow cover over the past 40 years in response to warming. There is also evidence from northern Eurasia of increases in winter accumulation and changes in snowpack properties from a changing precipitation regime. Changing Arctic vegetation (e.g. increased "shrubiness" in the tundra region) also has consequences for snow trapping and spring snow melt. The presentation will include a discussion of the main drivers of snow cover change, the characteristics of current trends in Arctic snow cover from in situ and satellite data, and Arctic snow cover simulations and projections from the recent CMIP5 model ensemble.

AN ASSESSMENT OF THE CO2 DYNAMICS OF TUNDRA PONDS IN THE LOW-ARCTIC , NORTHWEST TERRITORIES, CANADA

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Extensive research has gone into measuring changes to the carbon storage capacity of Arctic terrestrial environments as well as large water bodies in order to determine a carbon budget for many areas across the Arctic. Inland Arctic waters such as small lakes and ponds are often excluded from these carbon budgets, however a handful of studies have demonstrated that they can often be significant sources of carbon to the atmosphere. This study investigated the CO2 cycling of tundra ponds in the Daring Lake area, Northwest Territories, Canada (64052'N, 1110 35'W), in order to determine the role ponds have in the local carbon cycle. Observations from past research in this area indicate that the terrestrial tundra landscape sequesters approximately 46 g CO2-C m2 y-1. Lakes and ponds make up approximately one third of the landscape in this area; however, nothing was known about the carbon cycling of these aquatic systems. Floating chambers, NDIR sensors and headspace samples were used to measure carbon fluxes from selected local ponds. Multiple environmental, chemical and meteorological parameters were also monitored for the duration of the study, which took place during the snow free season of 2013. Average CO2 emissions ranged from approximately -0.0035 g CO2-C m-2 d-1 to 0.12 g CO2-C m-2 d-1. The total carbon loss from water bodies in the Daring Lake area equal 1 to 3% of the landscapes net CO2 uptake; this much lower than what was found in previous studies where CO2 emissions from lakes and ponds accounted for as much as 50% of the landscapes net CO2 uptake. Results from this study indicated that the production of CO2 in tundra ponds is positively influenced by both increases in temperature, and the delivery of carbon from their catchments. The relationship found between temperature and carbon emissions suggests that warming Arctic temperatures have the potential to increase carbon emissions from ponds in the future. These findings emphasize the need for more research on inland waters in order to improve our understanding of the total impact these waters may have on the Arctic's atmospheric CO2 concentrations now and in the future.

DISCOVERING THE SUBTIDAL BENTHOS IN CAMBRIDGE BAY: SCUBA SURVEYS AND SAMPLING OPERATIONS AT THE OCEAN NETWORKS CANADA OBSERVATORY.

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Near-shore benthic communities are less studied than those in other marine habitats in the Arctic, yet are more likely to be impacted by human disturbance, particularly in the vicinity of coastal communities. Ocean Networks Canada has maintained an underwater observatory at 6 metres depth in Cambridge Bay since September 2012, near the local wharf. Data generated by observatory sensors and a pan/tilt/zoom video camera support year-round studies of benthic faunal responses to environmental change. Camera observations are confined to a small area of seafloor around the instrument platform, providing only a partial view of an unknown, broader distribution of benthic species, many of which are mobile. This limits interpretation of the relationship between species presence/absence and diversity, and environmental variables. To mitigate this problem and support a separate study of benthic faunal distribution in the subtidal zone, Ocean Networks Canada undertook a systematic seafloor survey along the 6-metre isobath in Cambridge Bay, in September 2014. This presentation will describe the survey methodology, and provide a preliminary overview of the subtidal fauna. The survey extended westward from the wharf toward an area subject to less physical disturbance from vessel traffic. Downward-looking video imagery was acquired along a seafloor transect, with a diver-held camera frame, from a constant height above bottom. Divers also photographed epibenthic organisms in situ and collected specimens for identification. Grab samples of sediment infauna were collected at 5-metre intervals along the same transect. Precise GPS positioning during video transects and sample collections will enable high-resolution study of species distribution patterns (infaunal and epifaunal) and their relation to seafloor features. Divers also deployed an array of sediment traps every 40 m along transect, to quantify organic matter input to the benthos and inform the study of pelagic-benthic coupling in this near-shore environment. The relationship of total sediment collected in each trap versus distance from the wharf may also provide insight into sediment re-deposition caused by vessel traffic.

INUIT WOMEN AND CLIMATE CHANGE: PERSPECTIVES AND EXPERIENCES REGARDING CLIMATE CHANGE AND ADAPTATION IN IQALUIT, NUNAVUT.

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In order to adequately support adaptation policy and projects in Canada's North, data on how both men and women are adapting and interacting with climate change must first exist. Currently very little research exists globally on the issue of gender and climate change, and far less in an Inuit or Arctic context. Research that does focus on marginalized sub-groups, such as women, children and the elderly, lacks specific case studies and is often critiqued as resting on generalizations. Due to the additional societal and economic barriers these sub-groups face the cultivation of adaptation strategies and adaptive capacity is more difficult. In the case of Inuit women, there are additional barriers due to the remote location of their communities and histories of colonization. Despite the barriers they may face, women have a great deal to offer climate change adaptation and vulnerability research, policy, and practice. Due to their distinctive roles in society, women have unique skills and knowledge that should be accounted for when determining adaptation priorities. Research that has taken a gendered lens to climate change experiences of Inuit communities tends to focus on traditionally male dominated traditional activities, such as hunting; however, literature focusing on the female experience of climate change is still very limited. This research aims to fill that gap using a conceptual framework rooted in gender, adaptation and vulnerability literature. Research conducted in Iqaluit, Nunavut in June 2014 explored the climate change experience of Inuit women within the context of greater socio-economic change and discussed coping mechanisms and adaptation strategies being developed to adapt to change. Data was collected through 42 interviews, 2 focus groups and a small photovoice project. This presentation will discuss preliminary findings of this research and provide insight into how health, gender roles, food security, social change and environmental change intersect to impact Inuit women's experience with climate change. Adaptation priorities identified by research participants themselves will be discussed. Gaining a stronger understanding of these intersections will clarify researchers' understanding of women's climate change experience in Iqaluit, Nunavut and aid in future adaptation policy and project development.

AIRBORNE OBSERVATIONS OF THE ARCTIC SUMMERTIME AEROSOL NEAR RESOLUTE BAY

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Airborne measurements of the atmospheric aerosol were conducted from Resolute Bay, Nunavut (Canada) during July 3-23, 2014 as part of the Network on Climate and Aerosols: Addressing Key Uncertainties in Remote Canadian Environments (NETCARE). The measurements were taken from the Alfred Wegener Institute (Germany) POLAR 6 DC-3 aircraft on 11 research flights and 8 ferry flights (Toronto to Resolute Bay return). The aircraft was deployed with several aerosol instruments, gas monitors and basic meteorological instruments. Particle size distributions were characterized using a BMI SMS, a DMT UHSAS and a GRIMM OPC. Total particle number concentrations were measured using a TSI CPC 3787 and cloud condensation nuclei concentrations were measured with a DMT CCN Counter. Aerosol chemical components were measured with a DMT SP2, an Aerodyne SP-AMS and the Mainz single particle mass spectrometer, ALABAMA. Low level flights were conducted over ice, water and melt ponds etc.), and vertical profile data were regularly collected up to 3 km over areas of Lancaster Sound and the Wellington Channel. We focus on frequently observed high concentrations of small particles (<20nm) which are likely an indication for new particle formation (NPF). During such NPF events concentrations of small particles increased from a few tens up to a few thousand per cubic centimeter. The majority of these events were observed approximately 60 m above the water or ice surface with a few observed at higher altitudes between 2 km and 3km. Most of the NPF events were characterized by low pre-existing particle surface areas or low condensation sinks. In general, the cases of NPF were associated with very few particles >100nm, and most of the particles were smaller than 20nm. In at least two cases, the concentrations of particles between 20 nm and 50 nm were observed to increase, indicating some growth of the newly formed particles. The NPF events will be associated with meteorological influences as well as the underlying surface: solid ice, open water, melt ponds. The CCN measurements, made at a supersaturation of 0.8%, will provide information on hygroscopicity of particles that have grown to between 30 nm and 50 nm. In a final step, the data will be linked to particle and gas composition measurements, including MSA (methane sulfonic acid) and DMS (dimethylsulfide).

ARCTIC STRAITS: THE RUSSIAN-CANADIAN ALLIANCE

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Russia and Canada both take the position that the straits along their northern coastlines constitute 'internal waters' where foreign ships always require permission and the full force of domestic law applies. The United States take the position that both the Northern Sea Route and the Northwest Passage are 'international straits' through which foreign vessels may pass without permission or much in the way of regulatory restraint. As more international shipping is drawn to the Arctic region, additional opposition to one internal waters claim could only serve to weaken the other. For this reason, Russia and Canada would be wise to pursue a joint position on the legal status of the Northern Sea Route and Northwest Passage. Such issue-specific diplomatic cooperation would strengthen the leverage of both countries as they seek, singly or jointly, to negotiate some kind of long-term compromise with the United States.

SUSTAINABLE HARVEST OF ARCTIC CHAR, SALVELINUS ALPINUS, IN THE CANADIAN ARCTIC

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The prevention of overfishing has long been recognized as a fundamental goal of fisheries management. Nonetheless, overexploitation of fishery resources remains one of the most serious threats to the conservation of aquatic ecosystems worldwide, and has caused a number of prominent fishery collapses over the past century. Arctic Char Salvelinus alpinus, is widely distributed throughout the Canadian Arctic, where it supports both culturally important and economically valuable fisheries in Nunavut Arctic Char are typically slow growing, long-lived, and mature late in life; these demographic traits suggest Arctic Char is highly vulnerable to overexploitation.

Important commercial Arctic Char fisheries presently occur throughout the Kitikmeot (Cambridge Bay, Victoria Island), Qikiqtaaluk (Pangnirtung, Baffin Island), and the Kivalliq (Rankin Inlet, Western Hudson Bay) regions, and there is substantial pressure in all three regions to both increase existing commercial quotas and rapidly develop entirely new commercial fisheries. A critical question presently facing Nunavut's developing Arctic Char fisheries is "what level of fishing effort should be allowed or even encouraged as an initial development target?" This question is of paramount importance considering economic overcapitalization in the early stages of fishery development greatly increases the odds of subsequent fishery collapse (Hilborn and Walters 1992; Walters and Martell 2004). However, little information on biologically sustainable harvest levels or exploitation rates is available, due largely to the challenges of working in remote, northern systems. Accordingly, harvest quotas in Nunavut have been set mainly based on biologist opinion, and are intended to represent a precautionary approach to fisheries management (e.g., DFO 2006). However, the data-poor nature of Arctic Char stocks throughout the Canadian Arctic makes it virtually impossible for Fisheries and Oceans Canada to 1) defend the scientific basis for current Arctic Char harvest quotas, 2) assess the sustainability of current harvested Arctic Char fisheries and the efficacy of current fisheries management practices, and 3) provide realistic, biologically founded recommendations for these developing fisheries. The data-poor nature of Arctic Char stocks essentially vitiates the effective management of this species, and may ultimately have profound consequences for the northerners relying on this resource. We are currently undertaking a landscape-level adaptive management experiment involving Arctic Char harvest in collaboration with DFO, local fishers, and communities. Our research project is explicitly designed to determine the sustainable harvest limits for commercial Arctic Char fisheries in the Kitikmeot, Qikiqtaaluk, and Kivalliq regions by strategically harvesting select charr stocks in each of these regions, and by then determining how basic population demographic rates (i.e., size-at-age, age-at-maturity, growth, natural mortality) respond to these perturbations. The information gained these through experimental fisheries will then be used to set scientifically defensible harvest quotas, and evaluate the sustainability of current Char fisheries and fisheries management practices across this region. Moreover, this information can then be used to provide landscape-level, biologically-based guidance for Nunavut's developing Char fisheries.

VULNERABILITY OF THE NORTH ALASKA HIGHWAY TO CLIMATE CHANGE, YUKON, CANADA

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The Alaska Highway is the single overland route by which to distribute food, supplies and medical necessities to several Yukon and Alaskan communities. It is also the only all-season highway that provides access to Alaska's interior. The northern 200 km of the Alaska Highway, from Destruction Bay to the Yukon/Alaska border, is underlain by extensive discontinuous, warm (> -2°C), and potentially ice-rich permafrost. An increase in heat flow from the ground surface can produce rapid permafrost thawing, resulting in damage to highway infrastructure. Increased ground temperature can result from climate warming, construction activities, or changes in surficial conditions. Preliminary research suggests a combination of these factors has already initiated thawing of permafrost underlying this section of highway. In the future, climate changes may accelerating permafrost thaw, further destabilizing the foundations of the highway. Highways and Public Works (H&PW) has partnered with the Northern Climate ExChange (NCE), Yukon Research Centre, Yukon College, to develop a climate change adaptation strategy for this section of the Alaska Highway. The project examines the potential sensitivity of the permafrost along the highway to present and future climate variability. The objectives are: 1) to identify and characterize sensitive permafrost areas underlying the highway; 2) to establish potential future climate scenarios for the study region; and 3) to estimate the potential impacts of the identified climate scenarios for areas of the highway underlain by thaw sensitive permafrost. A multi-disciplinary approach is being used, including permafrost coring, geocryological analyses, ground temperature and climate monitoring, ERT (Electrical Resistivity Tomography), and remote sensing techniques. We are presenting some results of the survey for specific areas displaying a wide range of permafrost distribution and characteristics. The regional glacial history had a significant impact; and sites underlain by permafrost, located within a few square kilometers of each other, exhibit a wide range of ages, ground temperatures, thicknesses, and ground ice content and nature. This variability complicates the understanding of the potential impacts of climate change on the foundation of the North Alaska Highway; a difficulty that can only be overcome through improving the knowledge of the Quaternary history of the study area. The assessment of the nature of future permafrost changes will facilitate the development of appropriate maintenance and remediation strategies, ensuring the highway's continued viability.

HOW PERMAFROST-RELATED LANDSCAPE CHANGES MAY IMPACT FOOD SECURITY OF JEAN MARIE RIVER FIRST NATION, NWT

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The Jean Marie River First Nation (JMRFN) and its project partners combined and shared traditional, local and scientific knowledge to produce climate change vulnerability maps of traditional use areas near Jean Marie River. The landscape of the JMRFN lands is changing. Changes have been observed by the community members and documented by the researchers during the geological field work. It is undeniable that these changes are significant. The impact assessment on food security tells that changes have and will have considerable impacts on country food. For example, an average of 33.4% of sites, indicating the presence of animals used for food, overlap with areas vulnerable to permafrost. The JMR people's diet is composed of 75% country food so this gives them great concerns in terms of food security. The geological survey and mapping results suggests that: 1- Approximately 50% of the study area encompasses grounds having a medium to high vulnerability to permafrost thaw. 2- The permafrost present on our land is warm and close to degradation. Several areas already are experiencing severe degradation processes. 3- The resulting landscape changes affect the wildlife habitat and wildlife behavior. 4- The permafrost degradation process is quite advanced in some areas, and with the ground temperature being close to the 0°C threshold, it is possible that the degradation process will be completed in only a few decades. This information gives an approximate yet short, time frame to develop our adaptation strategies. The vulnerability hazard map resulting from this project is tailored to the needs of the JMRFN community, is culturally oriented and, when overlain with spatial traditional land use information, brings a new, integrated perspective regarding climate change impacts on the JMRFN. In light of the results of this study, there are several issues that require attention: 1- The immediate issues are the access to country food and the quality of the food that is decreasing. 2- In the future the quantity of country food will be added to the list of issues. The quantity of animals and plants that we currently use for food are likely to be reduced as the degradation of permafrost continues to change their habitat. This project represents a prototype for future surveys and mapping aimed at identifying and quantifying the impacts of permafrost degradation from a broader and more holistic viewpoint that combines western science and traditional and local knowledge.

TRANSLATING CLIMATE CHANGE: ADAPTATION, RESILIENCE, AND CLIMATE POLITICS IN NUNAVUT, CANADA

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This presentation examines the translation of key terms about climate change from English into Inuktitut, considering not only their literal translation but also the broader epistemological, ontological, cultural, historical, and political context within which words make sense. We argue that notions of resilience, adaptation, and climate change itself mean something fundamentally different in Inuktitut than they do in English, and that this has implications for climate policy and politics. To the extent that climate change is translated into Inuktitut as a wholly environmental phenomenon over which humans have no control, both "adaptation" and "resilience" come to be seen as appropriate and distinctly Inuit modes of relating to shifting climatic conditions, calling upon practices of patience, observation, creativity, forbearance, and discretion. If translated as a matter of unethical harm of sila, however, Inuit frameworks of justice, relationality, and healing would be activated. In the context of a broader global shift away from mitigation and toward enhancing the adaptive capacities and resilience of particular populations, current modes of translating climate change, we argue, are deeply political.

REMOTELY-SENSED EVIDENCE OF SPATIOTEMPORAL VARIATION IN THE PRODUCTIVITY OF CARIBOU CALVING GROUNDS: THE MIXED INFLUENCES OF CLIMATIC CHANGE AND CARIBOU FORAGING PRESSURE

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The migratory Rivière-George (RG) caribou herd of the Québec-Labrador Peninsula has demonstrated large changes in the size and location of its calving grounds since the monitoring of satellite-collared animals began in 1987. These changes appear to reflect RG herd demographic trends, with an apparent shrinking and eastward drift of the calving grounds since the herd started to decline in the early 1990s. It is suspected that caribou-induced changes in habitat quality (i.e. vegetation degradation through browsing and trampling) have partly driven the observed changes in calving ground use, but evidence of

habitat deterioration has not yet been conclusively detected at the range-scale. In this study, we use Landsat-derived summer mosaic images and 10-day AVHRR composites to assess the relationship between forage abundance on the RG calving grounds and the RG demographic trend for the 1987-2012 period. This period encompasses the most recent peak in RG population size (~823,000 animals in 1993) and the subsequent decline phase (~385,000 animals in 2001; ~27,600 animals in 2012), thus permitting an investigation of vegetation responses to varying levels of caribou browsing/trampling pressure. For each mosaic, mean NDVI (normalized difference vegetation index) and total barren ground area are computed as proxies for forage abundance and trampling-induced erosion impacts, respectively. These values are reported for both the global (cumulative area) calving grounds and annual calving grounds, allowing for comparisons between used and unused areas, and thus enabling an assessment of the NDVI/barrenness influence on broad-scale calving ground selection. A modelling approach is used to control for the climate signal and isolate the influence of caribou browsing/trampling pressure on vegetation productivity; the residuals calculated from a fitted NDVI-climate model are plotted against estimates of caribou density. Density-dependent interactions between caribou and vegetation are examined in the context of RG herd population fluctuations and projected climatic changes. The utility of remote sensing approaches in caribou habitat monitoring is discussed.

DATA ACCESS THROUGH PUBLICATION - AN IPY INNOVATION

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The International Polar Year 2007-2008 stimulated a new journal 'Earth System Science Data' (published by Copernicus) intended to promote, facilitate and recognise open access data exchange. Working in collaboration with more than 20 data centres worldwide ESSD has now published, and thereby brought into open and prominent access, more than 100 datasets. Initially intended to focus on polar data, ESSD has expanded to serve a very wide community in oceanographic, atmospheric and terrestrial research. The ESSD experience (since copied by two additional data journals) provides unique insights into key issues in open data access: formats (what actually constitutes a non-proprietary data format?); attribution policies (which can differ widely among data centres); living data (through regular or periodic updates); persistent identifiers (which may or may not work in all cases); and indexing (for the data set, the data description, or both together). The accumulated wealth of open access data, even focusing only on data published by ESSD, opens some very interesting possibilities for earth system reanalysis and modelling.

ECOSYSTEM DRIVERS OF MERCURY BIOACCUMULATION AND BIOMAGNIFICATION IN PAN-ARCTIC MARINE ZOOPLANKTON

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Mercury (Hg) is a potent neurotoxin that readily bioaccumulates and biomagnifies up the foodweb, and presents problems for apex predators, such as Inuit. Long-term collections of marine zooplankton (1998-2013) from across the Canadian Arctic, Chukchi Sea and Laptev Sea show distinct geographical hotspots across all measured species, with the highest concentrations observed in the Chukchi and Beaufort Seas. Along with Hg analyses, we have stable isotope data of carbon and nitrogen, which examine source of food (?13C) and trophic level (?15N). Our data show that riverine/terrestrial influence likely plays a significant role in Hg bioaccumulation and biomagnification, as the highest concentrations are observed near regions of major rivers (Mackenzie River in the Beaufort, influence of the Yukon River in the Chukchi). This coincides with lower (i.e., terrigenous) ?13C. Both the Mackenzie and Yukon Rivers are known to originate from headwaters flowing over base metal containing mineral deposits, which are important sources of iron (Fe) and other biologically important metals (e.g., copper, zinc). These metals may be driving the higher productivity and uptake of Hg in marine biota. A new look at the geological-biological interactions of the Arctic and how they affect Hg uptake are thus warranted.

RESILIENCE, DIVERSITY AND THE CAPACITY TO ADAPT TO RAPID CHANGE

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While communities in the Arctic must increasingly adapt to changing conditions, the capacity to respond effectively is more than a function of the scale and type of changes being experienced; it is also a function of the resilience of those communities. This is especially the case where complex interactions such as combined drivers, feedbacks, and the

non-linear nature of many types of change make prediction difficult. A resilience approach speaks directly to this system complexity and to the capacities required to adapt – to the basic qualities of coupled social-ecological systems that enable effective responses to change. Here, resilience analysis offers a system-based understanding of the nature of the changes underway. It also focuses on the linkages between people and the ecosystems of which they are a part and upon which they depend for critical resources such as food and water, and for well-being and development. A resilience approach therefore speaks to not only the capacity to respond to change, but also to the system properties that people must monitor, evaluate and engage with to prepare for the unexpected. This presentation examines diversity as a key element of adaptive capacity. Characteristics such as economic well-being, strong knowledge traditions, culture and social cohesion significantly influence the capacity of a community to effectively navigate sometimes rapid change. In many Arctic communities, these characteristics are intimately linked to the ecosystems in which communities are embedded. We suggest that the diversity found in mixed economic systems (including market and non-market), mixed knowledge systems (traditional and conventional knowledge), and rules and regulations that support flexible responses to changing conditions foster resilience, and thereby the capacity to more effectively adapt to change. For example, while the market economy provides many of the elements of material well-being, important components of well-being (some types of food, for example) draw directly on ecosystem services and and lie largely outside the cash economy. The presentation draws on case studies to examine how the diversity embedded in these mixed systems contributes to adaptive capacity.

IMPACTS OF HIGH ARCTIC RETROGRESSIVE THAW SLUMPS ON ECOSYSTEM FLUXES

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Land surface disturbances, including active layer detachment slides and retrogressive thaw slumps, are an indicator of thawing permafrost and climate change in the Arctic. These disturbances are widespread across the Fosheim Peninsula (79° 57'N, 84° 26'W), Ellesmere Island. This research examines the dynamics of these disturbances and the initial impacts of disturbance on tundra ecosystem fluxes as part of a project that has studied disturbances across the Fosheim Peninsula over the past three years. Over the 2014 growing season, one large active retrogressive thaw slump was monitored using the eddy covariance technique. Two flux towers were established adjacent to this retrogressive thaw slump and ran continuously, providing a comprehensive record of carbon fluxes throughout the growing season. Using multiple footprint modelling techniques, fluxes were partitioned based on source location allowing us to pinpoint the precise location of measurement and to isolate fluxes from disturbed and undisturbed terrain. Results indicate significant differences in NEE based on source location, as the active retrogressive thaw slump released carbon to the atmosphere, whereas undisturbed tundra acted as a small net sink. Further separation of fluxes was determined using ensemble averaging throughout the season based on plant development and climatic conditions. Fluxes emitted from disturbed and undisturbed tundra are most similar during the early season, with both areas acting as a source. Differences in fluxes are most apparent during mid July, as control tundra switches to a carbon sink, while the retrogressive thaw slump continues to emit carbon throughout the season. Fluxes collected using a static chamber method were consistent with those measured using eddy covariance, highlighting the potential of eddy covariance as a method of quantifying the impacts of disturbance on tundra ecosystem fluxes over heterogeneous terrain.

POTENTIAL POSITIVE FEEDBACK BETWEEN BAFFIN BAY CIRCULATION AND WEST GREENLAND GLACIER MELT

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Increasing atmospheric and ocean temperatures have accelerated the melt of Greenland glaciers with the highest melting rate observed in the southeast and northwest where warmer shelf waters accelerate basal melting of marine-terminating glaciers. Over the past 50 years, a cumulative meltwater discharge of 14,190 km^3 from western Greenland entered Baffin Bay/Labrador Sea, with rapid increases measured in the last decade. The impact of increased glacial discharge on Baffin Bay salinity and circulation has been study previously, but its impact on shelf heat content has not. Recent observations in Disko Bay show that the warming of the shelf water is associated with changing circulation in Baffin Bay. We show that this is linked to the western-glaciers discharge. To study the relation we set-up eight sensitivity experiments based on the ocean-sea ice model NEMO by manipulating Greenland glacier runoff into Baffin Bay. We find that enhanced runoff from Greenland increases the sea surface height which reduces the inflow of colder Arctic waters, and strengthens the halocline and the West Greenland Current. While these processes contribute to further

freshening of Baffin Bay. It also leads to a Baffin Bay-wide warming and lifting of the warm West Greenland Intermediate Water (WGIW). With higher heat content and shallower depth the WGIW can more easily enter the fjords and enhanced the basal melting of glaciers. Thus, we suggest that an increase in Greenland's meltwater production can positively feedback in conjunction with changes in Baffin Bay circulation.

EFFECTS OF CONTAMINANTS ON ARCTIC WILDLIFE: A FRENCH-NORWEGIAN COOPERATION

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Added to climate change, the Arctic is also subjected to high levels of environmental contaminant such as mercury (Hg) and persistent organic pollutants (POPs). This may represent a supplementary challenge for top predators such as seabirds which accumulate high levels of these contaminants. Although toxic effects of Hg and POPs have been described under controlled laboratory conditions, their consequences on long-term fitness have been virtually neglected in free-living vertebrates because of the dearth of long-term data sets that would be required to address this topic. Further, to date very few data are available on the physiological mechanisms (ex: endocrine disruption) involved in the adverse consequences of contaminant exposure in free-living animals. Thanks to a long-term French-Norwegian cooperative project on Svalbard seabirds we investigated the consequences of Hg, legacy POPs (PCBs and organochlorine pesticides) exposure on reproductive performances and hormonal mechanisms. Using long-term ringing surveys and a non-destructive sampling, we show that adult mortality and reproductive failure were exacerbated in most POPs- and Hg –contaminated individuals. Further, high POPs burden were associated with other fitness-related traits such as a faded coloration during the mating season. Regarding endocrine disruption, most PCB-contaminated birds showed an increased stress hormones levels and high Hg contamination was associated with impaired secretion of several hormones involved in reproductive behaviors. Finally we provide the first evidences for wildlife of negative impacts of some emerging POPs such as long-chained (C12, C13 and C14) perfluorocarboxylic acids (PFCAs) on endocrine mechanisms and fitness. Thus, endocrine disruption by Hg and POPs can have long-term demographic consequences for artic seabirds since most contaminated individuals would be less able to cope with stressors such as ongoing environmental changes.

DEVELOPING A INTEGRATIVE SURVEILLANCE SYSTEM FOR MUSKOX HEALTH AND RESULTING PUBLIC HEALTH, FOOD SECURITY AND MUSKOX CONSERVATION, IN THE WESTERN KITIKMEOT REGION

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Muskoxen have cultural value for northern people and have been important sources of country food and employment income through sport hunting and commercial harvest. Sustainable muskox populations are needed to support these activities in the future. Current reports of declining muskox populations on Victoria Island highlight the ongoing need for action. A unique and comprehensive surveillance program for muskox health, initiated in Ikaluktutiak and Kugluktuk in 2009, is designed to aid in the management of sustainable muskox populations as well as to protect muskox and human health. We are exploring components required for this system to be successful in northern communities. Successes and challenges of this system will be discussed. Engagement of community members, in priority setting, planning, implementation, interpretation and reporting, is essential. The system must be based on priorities of all key stakeholders who will use the information. Samples must be representative of the muskox population by sex, age and location requiring multiple sources of samples. Sample collection is possible with local hunters and other partners at community hunts, sport hunts and commercial harvest to increase the geographical range of samples. Collection of blood and tissue samples along with relevant animal information (e.g. body size and condition, location, age, sex, herd composition) for laboratory and statistical analysis is needed to assess health and disease exposure; however, this must take into consideration ease of sampling and transportation of samples in the arctic climate. The system must target diseases of high concern (e.g. muskox lungworm) but also parameters

of health that indicate overall health, stress and resiliency of the population (e.g. cortisol). Testing also focused on zoonotic diseases that can transmit from muskox to people. A sustainable surveillance system must collect and integrate traditional and local knowledge (TK) with the quantitative test results. This knowledge includes observations about muskox health, activity on the land and related environmental influences requiring a community-based system. Another key component is outbreak investigation, the critical response arm, for muskox die-offs and sick animals. Methods must be in place to collect information about dead or abnormal animals and mobilize trained people for field investigation and sampling. This information is often unique and not found through routine sampling of healthy hunted animals (e.g. Erysipelothrix rhusiopathiae found in muskox die-offs). Sample and data archiving are also critical for future testing of emerging pathogens and new hypotheses. Finally, communication of information to co-management partner and decision makers is essential and requires many partners including government, regional and local wildlife stakeholders, Nunavut Tunngavik Inc., Nunavut Wildlife Management Board and the public. Education about public health concerns must involve public health officials. Information on emerging disease and health status of the population is critical, so decision makers and wildlife managers can take steps required to maintain sustainable populations. A cutting-edge integrative surveillance system of this type requires a paradigm shift to broader health surveillance incorporating different types of information from different sources, including TK, to provide the most robust assessment of the population, to be used for health action. 498/2991

"POLAR LOAD LINES" FOR ARCTIC SHIPPING: A MISSING LINK IN MARITIME SAFETY REGULATION?

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This paper discusses load lines for safe loading arrangements of vessels for international navigation in polar waters within the framework of a global system designed for safe carriage of goods and passengers. Recent science suggests that there is more fresh water in the Canadian Arctic than previously thought. The International Convention on Load Lines (LLC), 1966 as amended, establishes a regulatory framework for the limits of loading of ships on international voyages. The LLC is an important technical instrument that safeguards life and property at sea. In recent years the International Maritime Organization (IMO) has had a flurry of polar shipping regulatory activities, most especially the Polar Code, expected to be adopted with amendments to SOLAS and MARPOL in 2015. Currently, load lines for ships in polar navigation are not addressed by the LLC or Polar Code. This paper discusses the importance of load lines in polar navigation, considers the possible significance of increased freshwater in navigable areas and questions whether the current regulation of navigation in the Arctic should introduce polar-specific load lines requirements. The difficult navigation conditions in the Arctic require a higher standard of seaworthiness than usual, better termed "polarworthiness", and load lines should play a significant role. Seaworthiness is essential to guide risk distribution in maritime contracts and can be expected to play an important commercial role in maritime trade in and through the Arctic. The paper draws on current work of the International Working Group on Polar Shipping of the Comité Maritime International.

ARCTIC TERRESTRIAL BIODIVERSITY MONITORING PLAN

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This presentation will provide an overview of the Arctic Terrestrial Biodiversity Monitoring plan developed through the Circumpolar Biodiversity Monitoring Program. The plan lays out a framework for coordinated terrestrial biodiversity monitoring that aims to enhance the collective ability of Arctic stakeholders to track, assess and report on biodiversity change to inform decision-making. The nested, multi-scaled approach to monitoring aims to link locally observed information with remotely sensed data to assess and report on changes at landscape, regional and pan-Arctic scales. Implementation projects will be undertaken by bird, mammal, vegetation and invertebrate expert networks with integration around cross-cutting themes. The presentation will highlight priority activities and products identified in the three year work plan of the CBMP Terrestrial Steering Group. Opportunities for researchers, community members, governments and other stakeholders to participate in this collaborative initiative will be described.

IS EVERYTHING EVERYWHERE? INVESTIGATING THE IMPORTANCE OF SCALE IN SPATIAL VARIABILITY OF PERMAFROST MICROBIAL COMMUNITY COMPOSITION AND BIOGEOCHEMISTRY

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Arctic and boreal soils are estimated to contain twice as much carbon as currently found in the atmosphere. This large carbon pool is predominantly stored as soil organic matter in near-surface (<3 m) permafrost which is projected to undergo substantial thaw by the end of this century. Microbial decomposition of organic matter in recently thawed permafrost will undoubtedly lead to enhanced trace gas emissions and soil nutrient mobilisation, thereby, significantly altering tundra carbon and nutrient cycling, not just at the ecosystem scale but across landscape and regional scales – with far-reaching feedbacks to global climate change. Nevertheless, our current knowledge of the biogeochemical pools and microbial communities in permafrost is very limited, especially with regard to patterns in spatial variability at scales ranging from a few meters to thousands of kilometers apart. Do active layer and permafrost microbial communities differ more with depth or horizontal spatial extent across the Arctic in ways that might affect biogeochemical processes during thaw – and can we relate community composition to differences in soil properties such as carbon or nutrient availability? One of the key initiatives in our ADAPT – Arctic Development and Adaptation to Permafrost in Transition – programme is to characterize permafrost from multiple Canadian low and high arctic sites, including regions underlain by continuous and discontinuous permafrost, to investigate whether spatial variation in near-surface permafrost biogeochemical properties contains predictable spatial structures at short (<10 m), medium (100s of meters to few kilometers), and long (1000s of kilometers) distances. Here, we present biogeochemical data from 13 soil cores obtained from Cape Bounty (Nunavut), Daring Lake (Northwest Territories), and Umuijuaq, (Quebec) that ranged in length from 1.5 to 3 meters, including active layer and near-surface permafrost soil horizons. We determined total and dissolved pools of organic carbon, essential plant nutrients (such as inorganic and organic forms of nitrogen and phosphorous), microbial biomass pools of carbon, nitrogen and phosphorous, as well as soil water content and pH. Furthermore, we characterized bacterial, archaeal, and fungal community composition using denaturing gradient gel electrophoresis and pyrosequencing of genomic soil DNA to relate microbial community composition with biogeochemical soil properties, aboveground vegetation cover, and geographical location. Preliminary data show large variation in soil organic matter and ice lens content with depth and across sites – both close and far apart. To our surprise, organic matter content and microbial biomass increased with depth in some cores, where the permafrost horizon contained greater total and dissolved organic carbon and nitrogen pools than the seasonally thawed active layer above. By contrast, microbial community composition was consistently more diverse closer to the soil surface than deeper in the active layer or permafrost. The implications of these results will be discussed in terms of our capacity to predict the biogeochemical impact of permafrost thaw in a changing climate.

DEVELOPING CAPACITY FOR SOURCE WATER PROTECTION PLANNING IN CANADA'S FAR NORTH

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Delivery of safe, potable water to remote northern communities is challenging, with limited resources for infrastructure and training, and technological challenges caused by climate extremes. Protection of drinking water sources is a cost efficient mechanism to reduce the requirements for costly treatment options. However there is limited capacity within remote northern communities to develop and implement

Source Water Protection (SWP) plans. Through support to The Institute for Watershed Science (IWS) at Trent University from a 5 year RBC Blue Water Project Leadership Grant in 2009 the IWS, in collaboration with the Indigenous Environmental Studies Programme, developed training materials for SWP in remote communities in the Northwest Territories and the Yukon. This training emphasizes community based SWP planning as a tool for providing safe drinking water. Collaboration with many project partners has resulted in the development of training programs combining northern IK with western science to create culturally relevant SWP training for northern Indigenous communities. Development of guidance and training opportunities for SWP planning has been successful in the Northwest Territories and Yukon Territory. This presentation outlines our approach to providing SWP training for remote communities.

THE DOMINANT WEATHER REGIMES FOR LAKE MIXING IN THE WESTERN ARCTIC

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The biological productivity of Arctic lakes that are deep enough to stratify during the ice-free summer season is dependent on the distribution of dissolved gases and nutrients by vertical mixing. Stratification occurs as the lake surface is heated over the summer, while mixing is initiated by individual weather events -- primarily cold fronts that drive strong wind stresses and heat fluxes. Summertime Arctic warming will impose a positive trend in lake stability over the ice-free season, but the trend in mixing events is dependent on trends in weather regimes and is more difficult to infer. Further complications arise from the strong interannual variability of synoptic activity in the Arctic summer. Toolik Lake is a Long Term Ecological Research site located on the northern slope of the Brooks Range in Alaska with a record long enough to observe interannual climate variability. It has high resolution multi-depth lake and surface meteorology data dating back to 1998. The goal of this work is to characterize the weather systems that are conducive to mixing at Toolik Lake as a means to elucidate the climatic drivers of productivity in the western Arctic. We expand upon previous studies that explored the relationship between this lake and the atmosphere from a local perspective by characterizing the propagation, development and climatological context of mixing-relevant weather regimes. Data from the research site were used to identify mixing while atmospheric reanalysis data (Modern Era-Retrospective Analysis for Research and Applications - MERRA) were used to describe the weather systems. An automated algorithm was developed to detect weather-driven mixing events. The daily-averaged 500 hPa geopotential height field from MERRA (1979-2013) in the western Arctic and corresponding subpolar region centred on Toolik (120°E to 60°W, 35°N to 90°N) was first filtered to remove high frequency variations, then clustered using the K-Means method. Three distinct weather regimes were found to be primarily associated with mixing: two with a strong cold front, as was expected from previous analyses, and the other characterized by warm, windy weather at Toolik without a strong front. The relationship between these regimes and the projected changes to the Arctic midtropospheric flow and surface storm tracks can be explored in order to gain a more complete understanding of the future of lake mixing frequency at Toolik Lake and over the western Arctic.

THE NITROGEN BALANCE OF SEA ICE : IMPLICATIONS FOR BIOLOGICAL PRODUCTIVITY IN THE CANADIAN ARCTIC ARCHIPELAGO

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Nitrogen (N) supply exerts a major control on primary production in seasonally ice-covered waters of the Arctic Ocean. The biogeochemical N cycle is complex and involves diverse steps mediated by a variety of organisms ranging from microbes (bacteria, archea and microalgae) to microzooplankton and larger animals. Some of these steps lead to a net loss or gain of available N from the ecosystem while others recirculate N under different forms. These different N sources fuel either “new” (based on allochthonous N) or “regenerated” (based on recycled N) primary production, a fundamental distinction affecting the biogeochemical impact of biological productivity in the ocean. Overall, most of the current knowledge on N cycling comes from water column studies. Yet sea ice provides a unique habitat for a host of microbes and small grazers. The contribution of sea ice to total annual production is highly variable, but can be substantial in some regions. The rapid environmental changes now occurring in the Arctic result in a clear decline of sea ice extent and thickness; a delay in the freezing period; and a shift from multi-year to first-year sea ice. Under these conditions, there is renewed interest in understanding how sea ice affects biogeochemistry and the cycling of key elements driving the ocean productivity. While

previous studies typically focused on one or two N cycling processes, this study aims to provide a more detailed picture of N balance in bottom sea ice by quantifying the rates of and relationships between crucial N cycling steps. We collected bottom ice cores at 22 stations near Cornwallis Island during spring 2013, under the BIOTA (Biological Impacts of Trends in the Arctic) program. The ice samples were melted in filtered sea water and incubated with a suite of stable isotopic tracers to estimate N assimilation, regeneration, nitrification and fixation. Results suggest a very dynamic situation with variable but high inorganic N concentrations, distinct contributions of prokaryotes and eukaryotes to N assimilation and potentially significant N fixation and nitrification. Based on these results, we present new perspectives on N cycling in sea ice and discuss their implications on the biological productivity of a rapidly changing Arctic Ocean.

WINTER VERTICAL MIGRATION ACROSS THE ARCTIC: SEEKING THE PAN-ARCTIC VIEW

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The study of vertical migration in the arctic has to date been restricted to observations from rather limited sites. The techniques of measurement and analysis vary from study to study and so our view of this key biological process is at best piece-meal. Nevertheless, by using moored acoustic instruments we are beginning to discern the key aspects of migration behaviour and developing a deeper understanding of the external controls over seasonal timescales. What is lacking is a sense of whether our current understanding of vertical migration from highly localised sites is common across the arctic. In essence, what are the pan-arctic, first order migratory behaviours of zooplankton. This is a key step in being able to construct reliable models that represent active carbon flux. The most prevalent instrument used to detect and quantify vertical migration is the Acoustic Doppler Current Profiler (ADCP). Whilst this instrument is not designed specifically for biological measurements it has proved exceptionally powerful at revealing seasonal scale changes in migratory behaviour. In this presentation we will use our understanding of winter migration derived from moored acoustic instruments in Svalbard to an archive of data from ADCPs deployed from across the Arctic. The archive contains data from deep ocean, shelf slope and shelf sites which are variously ice-covered during the year. We will show the utility of the archive to extend the detailed information given by local process studies to a pan-arctic understanding of a key biological process.

PARAMETERIZING A COASTAL EROSION MODEL FOR TUKTOYAKTUK, N.W.T.

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Coastal erosion in the Arctic can be up to three times greater than what is seen in more temperate regions. Erosion is affected by wind, waves, sea ice and the composition of the coastal materials. A number of these environmental factors are likely to be affected by a warming climate, so there is interest in monitoring current rates of coastal erosion and in determining how those rates may change in the future. The hamlet of Tuktoyaktuk, N.W.T. has experienced significant shoreline retreat in the past with a mean erosion rate of almost 2 metres per year. This rate is likely to increase over the next several decades and poses a threat to coastal and nearshore infrastructure. Modelling future erosion will assist stakeholders in coastal management planning and development. We use a morphodynamic model adapted for permafrost coasts to investigate coastal profile evolution and coastal erosion at Tuktoyaktuk. Past conditions are examined to verify the model results. Future erosion will be predicted using projected changes in input parameters. Here, we present the initial model parameterization. Shoreline retreat occurs as water depths change, resulting in a shoreward translation of the coastal equilibrium profile. Changes in nearshore water depth are a function of short-term cross-shore sediment transport (i.e., at the scale of individual storm events), long-term (i.e., decadal scale) transport in both cross- and along shore directions, and variations in relative sea level. Current wave climate is established from the Meteorological Service of Canada's Beaufort wind and wave re-analysis (MSCB) which accounts for sea ice and covers the period 1970-2008. Deep water waves are transformed to account for shoaling, refraction and incident wave angle, and nearshore wave conditions are obtained, including mean and significant wave heights and wave periods. Wind speeds, duration and storm events are also hindcast from the MSCB data. The amount of sediment available for transport in this setting depends on cliff height and the volume of ground ice in the cliffs. Cliff heights are extracted from digital elevation models and topographic maps, while ground ice is quantified using a morphological model that accounts for ground ice types and the stratigraphic relationships between them. The

active cross-shore zone depends not only on wave conditions, but on beach and nearshore slope as well. These parameters are established from topographic and bathymetric surveys carried out by the Geological Survey of Canada. A hydrodynamic model (Delft 3D) is used to simulate currents and wave-driven sediment transport in both the across- and along-shore directions. Variations in relative sea level are obtained from the Canadian Hydrographic Service tide gauge at Tuktoyaktuk.

UNCOVERING THE SUBMERGED SEA-LEVEL HISTORY OF CUMBERLAND PENINSULA, BAFFIN ISLAND, NUNAVUT

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Eastern Baffin Island, Nunavut, has a complex history of glacio-isostatic adjustment and relative sea level since the Last Glacial Maximum. From the eastward-dipping raised shorelines on Cumberland Peninsula, eastern Baffin Island, Dyke (1979, Arctic & Alpine Research 11: 179-202) inferred the continuation of postglacial shorelines below present sea level to the east, with a continuous history of submergence for the easternmost coast. Miller (1975, PhD dissertation: University of Colorado) provided the founding evidence for this hypothesis from single-beam sounding profiles across submerged delta terraces at 32-38 m depth within Boas Fiord (northeastern peninsula). Until now, however, this hypothesis has not been tested due to the lack of full-coverage bathymetric mapping in the region. Using multibeam sounding technology, this project has uncovered the submerged postglacial sea-level lowstand of northeastern Cumberland Peninsula and its spatial distribution. Eight submerged proglacial delta terraces and two other types of submerged shorelines (boulder barricade and sill platform) were mapped during multibeam surveys from 2012 to 2014 aboard the Nunavut research vessel MV Nuliajuk in coastal waters of Cumberland Peninsula. From subbottom soundings over the delta terraces, the transgressive surface (contact between foreset and topset beds) was used to mark the depth of the lowstand during deposition. When these depths are plotted longitudinally, the shorelines present a linear trend of increasing depth eastwards similar to that of the raised shorelines farther west on the peninsula, though less pronounced. Contradicting the hypothesis that the lowstand was time-transgressive is the distinct linear trend that is strongly suggestive of synchronous deposition across the northeastern peninsula. The age of deposition of the deltas must be determined to add these palaeo-sea-level positions to the regional sea-level curve. Coring efforts are planned to enable sedimentary facies analysis and radiocarbon dating for the depositional age of the submerged deltas. Without chronostratigraphic data, this study has confined the age of deposition based on the ice limits of the last major glacial recession (Dyke, et al., 2003: GSC Open File 1574). Though the age of the postglacial lowstand is speculated to have been late Wisconsinan, the recession of ice up-fiord constrains the deposition of the submerged proglacial deltas to <10 ka BP (radiocarbon time scale). The Cockburn readvance ca. 9.6 ka BP likely provided the pulse in glacial meltwater and sediment, through the downcutting of valley-floor moraine deposits, necessary for the deposition and progradation of deltas at the lowstand. A submerged delta in the southeast of the peninsula with a water depth anomalous to the regional trend is explained by earlier deglaciation in this part of the outer peninsula. Sediment cores are therefore a high priority to provide ages on the deposition of these deltas and to constrain the temporal distribution of the lowstand. With the addition of absolute ages, these results will provide important index points to better constrain the sea-level history of eastern Cumberland Peninsula.

FIRST 'IN-SITU' DETERMINATION OF GAS DIFFUSIVITY IN SEA ICE: GAS DIFFUSION THROUGH THE POROUS MICROSTRUCTURE OF SEA ICE IS A PATHWAY FOR OCEAN–ATMOSPHERE EXCHANGE

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For a long time, sea ice has been assumed to be an obstacle to exchanges of matter between the atmosphere and the ocean. However, the permeability of sea ice rapidly increases when the brine volume fraction exceeds 5% and recent studies have shown that, under these conditions, exchange can occur between the atmosphere, ocean and sea ice. Data from a survey of sub-Arctic,

landfast sea ice in Kapisillit Kangerluaq fjord (Greenland) show that argon can be used to distinguish the physical processes affecting the gas composition in regard to biogeochemical processes within the sea ice. The correlation (R2>0.8) between Ar with both O2 and N2, as well the Ar:O2 and Ar:N2 ratios, pinpointed that during the Kapisillit survey physical transport processes mainly regulated the gas composition within the sea ice, while biological processes only had a minor effect. Most past studies suggest that convective transport is the main driver of gas displacement and neglect diffusion processes. According to our data, brines were stratified within the ice, so that no convective transport took place in the brine network during the study. Therefore, diffusive transport was the main driver of gas motion. By analysing the temporal evolution of an internal gas peak within the ice, we deduced the bulk gas diffusion coefficients, for oxygen (DO2), argon (DAr) and nitrogen (DN2). We report the gas diffusivity coefficients and the values fit to the few previous estimates from experimental work, and are close to diffusivity values in water. Moreover, these results underline that when there is no convective transport within the sea ice the transport of gas by diffusion through the brines, either in the liquid or gaseous phases, could be an important pathway for ocean–atmosphere exchange. Lastly, our results suggest that the brine volume permeability threshold for the gas displacement by diffusion may be similar to the theoretical permeability threshold of 5% for the fluid transport.

THE LONG AND SLOW DEMISE OF PETERMANN ICE ISLAND-B: THE FACTORS AND FORCES AT PLAY OVER 4 YEARS OF DETERIORATION.

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Ice islands (large tabular icebergs) adrift in the Canadian Arctic are potential hazards to shipping and offshore natural resource extraction operations. In-situ data is necessary for deterioration analyses and operational model validation. This data is historically sparse; however, Petermann Ice Island (PII)-B is a unique case as it was both remotely monitored and visited by two field expeditions over a 4-year period. The analysis of these complimentary datasets has allowed for the investigation of environmental factors and physical forces influential to an ice island's deterioration and resulting hazard production. PII-B's areal dimensions were monitored with image digitization of RADARSAT-2 (ScanSAR: 160 m resolution; Fine-Quad: 8 m resolution) acquisitions. PII-B was 69.8 ±1.8 km2 on 7 September 2011 and experienced an average areal deterioration rate of 0.09 km2 d-1 over the following 22 months. Of the assessed environmental variables, sea ice concentration was most highly correlated to the areal decrease rate (r2 = -0.53). PII-B's average thickness (70 ±10 m) was determined by modeling total thickness from LiDAR freeboard scans. The estimation of mass decrease and quantification of ice hazard production was calculated with the areal and thickness dimensions. It was determined that 4.2 gigatonnes of independent ice hazards were adrift in Arctic waters due to PII-B's deterioration over the FQ monitoring period. Physical-oceanographic forces which impact areal deterioration were investigated during field expeditions conducted in 2011 and 2012 when PII-B was grounded on a shoal of approximately 90 m depth. Analysis of conductivity-temperature-depth (CTD) profiles and corresponding wind data determined that PII-B's grounding caused wind-induced upwelling and downwelling of the water column on opposing sides of the ice island. This led to preferential deterioration along PII-B's south face. Upwelling-enhanced deterioration is likely to produce smaller ice hazards in comparison to larger fractures caused by buoyancy stresses, the latter of which was also observed during 2012 field work. Both large and small ice fragments are potentially hazardous to offshore operations, either due to their large mass or the difficulty associated with detecting and tracking numerous small pieces, respectively. The investigation of various environmental and physical factors which contribute to varying magnitudes of deterioration was possible due to the multifaceted, long-term study of PII-B. It is recommended that assessment of ice island deterioration continues to be assessed with both field data and remote sensing analyses. This will lead to a greater understanding of ice island deterioration mechanisms and improved prediction of ice hazard quantities, thus mitigating the chance of a collision between an ice hazard and offshore operations in the Canadian Arctic.

THERE IS LIGHT IN THE DARK: BIOLUMINESCENCE IN THE HIGH ARCTIC POLAR NIGHT

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Bioluminescence is an understudied phenomenon in Arctic waters generally, and particularly so during the high Arctic winter. Here we synthesize data from two (2012 and 2014) winter field campaigns during which a bathyphotometer was used to profile the water column for bioluminescence in several Svalbard fjords (Isfjord, Kongsfjord, and Rijpfjord) and north of Svalbard in the southern Arctic Ocean. We assembled a library of flash kinetic signatures for luminescent plankton including ctenophores, copepods, krill, and dinoflagellates and used it to identify the luminescent taxa in these profiles. Bioluminescence was prevalent in all areas and shows a diel pattern consistent with zooplankton vertical migration observed previously during the polar night. These data suggest that the photic ecology of the high Arctic winter parallels that of the deep sea where bioluminescence is an ecologically relevant light source apart from atmosphere-derived light.

ILIKKUSET-ILINGANNET/CULTURE-CONNECT: PROMOTING CULTURAL-BASED YOUTH MENTORSHIP PROGRAMS TO SUPPORT MENTAL HEALTH, RESILIENCE, AND CULTURAL SUSTAINABILITY IN NUNATSIAVUT, LABRADOR

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Inuit populations are at the frontlines of climate change and, due to continued reliance on the land for sustenance and wellbeing, already-present health disparities, and difficulty accessing health-sustaining resources, are often susceptible to resulting impacts to physical and mental health and wellbeing. When combined with other stressors from changes in governance structures, economies, and social structures, as well as the intergenerational impacts of colonialism, there are further potential impacts on cultural continuity, knowledge exchange, and individual and community resilience. Understanding these needs, communities across the North are proactively finding ways to maintain cultural values, foster livelihoods, and promote resilience to change. For example, responding to these stressors and community needs and building from previous research conducted in the region that found that youth and middle-aged adults are particularly susceptible to the mental health impacts of climate change, the Inuit Community Governments of Rigolet, Makkovik, and Postville, Nunatsiavut, Labrador designed and piloted the IlikKuset-Ilingannet!/Culture-Connect! Program. This program ran from October 2013 to March 2014 and united 5 youth with 5 adult mentors in each community to learn cultural skills—hunting, trapping, food preparation, snowshoe-making, music, carving, art, and sewing—in order to assist both youth and adults in connecting together in a positive and health-promoting environment dedicated to knowledge transmission and cultural skills development and preservation. Evaluation research conducted with 40 youth, mentors, and key stakeholders in the region found that participating in the IlikKuset-Ilingannet! program increased confidence and self-worth among the youth and mentors; created new and/or enhanced relationships between and among the youth and mentors; revitalized cultural pride among youth and mentors; supported skills training and development; and showed promise as a strategy for supporting youth and mentor resilience, mental health, and adaptive capacities in the short and long term. This presentation will provide an overview of the likKuset-Ilingannet!/Culture-Connect! program, and will describe how this cultural mentorship program linking youth and adults together may have the potential to enhance and expand mental health, build adaptive capacities and youth resilience, and increase knowledge transfer among generations to promote sustainability in health and culture within the context of rapid change.

ATMOSPHERIC DIMETHYLSULPHIDE AND SEA ICE COVERAGE IN THE ARCTIC

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Changes in sea ice coverage in the Arctic may lead to increases in biological productivity in the surface ocean and will certainly lead to an increase in the surface area available for gas flux to the atmosphere. Dimethylsulphide (DMS) may be the archetypal marine gas, produced as it is in abundance in surface ocean waters - constituting what has been called "the smell of the sea." Since Glenn Shaw first suggested 30 years ago that DMS may be a significant aerosol precursor in clean Arctic air, the question has remained unresolved. Others have since found increases in non sea-salt-sulfate of 10% per year in recent years, with concomitant increases in atmospheric MSA - an oxidation product of DMS. There have been very few long-term measurements of atmospheric DMS in the Arctic (or anywhere

on Earth), probably because of the difficulty in making the measurement. We have developed an unattended system for calibrating and measuring DMS on approximately 15 minute intervals. In a preliminary deployment at the NOAA GMD lab at Barrow, we measured strong variations in DMS from <10 pptv to more than 500 pptv. We need such measurements across the seasons and through the years to understand how the Arctic atmosphere will be influenced by changes in sea ice coverage.

SIGNIFICANT IMPACT OF GLACIAL MELTWATER ON THE PELAGIC CARBON CYCLE IN A HIGH ARCTIC GREENLAND FJORD

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Global warming has accelerated the melting of the Greenland Ice Cap (GIC) resulting in increased loading of coastal waters with meltwater and associated inorganic particles and organic matter, a development that is projected to be enhanced in the future. In Young Sound, North Eastern Greenland, Carbon cycling in the water column was greatly influenced by meltwater from the GIC in summer 2011. Young Sound is a high arctic fjord (ca. 74° N) ca. 80 km long and 1 – 7 km wide ice free conditions from mid July to mid October. Meltwater was mainly delivered to the inner parts of the fjord creating a gradient in salinity and turbidity along the length of the fjord. The mixed surface layer (ca. 5 m thick) varied in salinity from ca. 10 in the innermost part to 28 at the opening to the Greenland Sea. The depth of the photic zone was highly influenced by the turbidity leading to an increase from 4 m in the innermost part to 48 m in the opening of the fjord and into the Greenland Sea. Nitrate concentrations were 3–12 µM at 80 m depth but decreased to below detection at the surface. Except for the innermost turbid part, the photic zone and the nitrate containing zone overlapped by 3-39 m. Integrated chlorophyll a concentrations, mainly concentrated in a pronounced deep chlorophyll maximum (DCM), reflected the overlap between the nitracline and the photic zone, with 5-10 fold higher values in the outer part of the fjord and in the Greenland Sea, as compared to the inner fjord. The depth of the DCM increased from 5–40 m out through the fjord. The planktonic community in the innermost part was dominated by hetero- and mixotrophs, whereas it in the outer part and the Greenland Sea was dominated by large diatoms. The central part of the fjord was a mix of the two extremes. The described horizontal gradients in the fjord significantly affected pelagic carbon turnover: Primary production was low, 20-45 mg C m-2 d-1, in the more turbid inner half of the fjord increasing ten-fold to around 350 mg C m-2 d-1 in the Greenland Sea. Community respiration was measured at fewer stations but showed a clear effect of the freshwater input with respiration rates 2–3 fold higher in the turbid inner fjord than in the outer less turbid waters. At high turbidity close to a river outlet, gross primary production (O2 mass balance in bottles) was below detection whereas these both were around 2 µM O2 d-1 in the outer part of the fjord and in the Greenland Sea. The positive net production in most of the fjord resulted in waters with pCO2 values of 60 to 80 ppm below atmospheric saturation. Predicted future increases in glacial meltwater run-off may increase the extent of the turbid low-saline surface layer and reduce the total productivity of the Young Sound fjord system with implications for the CO2 uptake from the atmosphere.

RESPONSES OF FOREST-TUNDRA ECOTONES TO CLIMATE VARIABILITY IN SUBARCTIC NORTH AMERICA

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The transition from forest to tundra in arctic and alpine regions – referred to as the 'forest-tundra' and punctuated by the upper limit of tree growth, known as 'treeline' – is expected to exhibit some of the most extensive changes of any component of the global vegetation system as a result of continued climate change. Still, despite the warming trend of the last century, the pace and mode of response has been extremely varied and ecotone advance has not been ubiquitous. In some regions an infilling of the ecotone has been typical. In other areas, a change in the growth of individual trees has been predominant, but without a change in vegetation type or cover. An increase in the abundance of shrub communities has been an equally significant response to climate change in some regions. We provide a broad overview of these different types of responses, with emphasis on subarctic North America. We examine the mechanisms that

appear to influence the different types of change that have been observed and typify them based on their predominant scale of influence. We conclude that while it is useful at coarse scales, relying exclusively on the relationship between temperature and plant physiology is insufficient for predicting change – particularly at moderate spatial scales (i.e. landscapes) and time frames (i.e. decades), which are the most relevant for human adaptation.

SELECTED PHYSICAL, BIOLOGICAL AND BIOGEOCHEMICAL IMPLICATIONS OF A RAPIDLY CHANGING ARCTIC MARGINAL ICE ZONE

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The Marginal Ice Zone (MIZ) of the Arctic Ocean is changing rapidly due to a warming Arctic climate with commensurate reductions in sea ice extent and thickness. This Pan-Arctic review summarizes the main changes in the Arctic ocean-sea ice-atmosphere (OSA) interface, with implications for primary-and secondary producers in the ice and the underlying water column. Changes in the Arctic Marginal Ice Zone (MIZ) were interpreted for the period 1979-2010, based on best-fit regressions for each month. Trends of increasingly open water were significant for each month, with quadratic fit for August-November, illustrating particularly strong seasonal feedbacks in sea ice formation and decay. Geographic interpretations of physical and biological changes were based comparison of regions with significant changes in sea ice: 1) The Pacific Sector of the Arctic Ocean including the Canada Basin and the Beaufort, Chukchi and East Siberian Seas; 2) The Canadian Arctic Archipelago; 3) Baffin Bay and Hudson Bay; and 4) the Barents and Kara Seas. Changes in ice conditions in the BSKS region appear to be primarily forced by ocean heat fluxes during winter, whereas changes in the other sectors appear to be more summer-autumn related and primarily atmospherically forced. Effects of seasonal and regional changes in OSA-system with regard to increased open water were summarized for photosynthetically available radiation, nutrient delivery to euphotic zone, primary production of ice algae and phytoplankton, ice-associated fauna and zooplankton, and gas exchange of CO2. Changes in the physical factors varied largely among regions, and showed direct effects on organisms linked to sea ice. Zooplankton species appear to be more flexible and likely able to adapt to variability in the onset of primary production.

ENHANCING THE CANADIAN METAREAS OPERATIONAL COUPLED OCEAN-ICE-ATMOSPHERE ANALYSIS AND FORECASTING SYSTEM FOR FINE-SCALE APPLICATIONS IN THE BEAUFORT SEA

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We present results from the Beaufort Regional Environmental Assessment Program (BREA) project entitled "Enhancing the Canadian METAREAS operational coupled ocean-ice-atmosphere analysis and forecasting system for fine-scale applications in the Beaufort Sea". Our objective is to improve ice and ocean models used within the Environment Canada METAREA program with particular emphasis on improving ocean and ice forecast information for the Beaufort Sea. The project is structured under the Government of Canada CONCEPTS (Canadian Operational Network of Coupled Environmental PredicTion Systems) MOU in collaboration with MERCATOR-Ocean. We present results on ice and ocean model improvement. A high resolution historical ocean model reconstruction of Beaufort Sea ice and Ocean Circulation from 2003 to 2009 is presented. We focus on prediction ability in the Beaufort from 2-10 days into the future and we present verification of predictions against observed satellite data of ice concentration. The operational prediction verfication system has as objective to provide forecast end users with an estimate of model prediction error.

OUT OF HARMS WAY? A PROFILE OF CHILD AND ADOLESCENT INJURY IN NORTHERN CANADA

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Objectives: To profile individual and home community characteristics and injury occurrences among youth from the northern territories and to examine risk and protective factors related to injury among northern youth. Methods: Cross sectional, self- reported data from the 2009/2010 Health Behaviour in School-aged Children survey was collected from children in grades 6-8 from the Canadian northern territories (Nunavut, Yukon, and the Northwest Territories)(n=3942) and the rest of Canada (n=25991). This data was linked to community- level data (2006 census, geographical information systems/ Google maps data and community alcohol policies) and used to create a profile of individual and home community characteristics. Injury occurrence was profiled by select measures and compared between the northern and southern regions. A multivariable binomial logistic regression model was built to examine the association between individual and community characteristics and injury in northern youth. Results: Individual characteristics of northern children vary from those of southern Canadian children most notably by Aboriginal ethnicity and increased personal motorized vehicle use. A higher percentage of northern children lived in communities that were small, indigenously diverse, without road access, and with more dwellings in need of repair. No difference was found in the occurrence of overall injury between southern and northern populations; however, northern youth experienced a significantly greater percentage of neighborhood (P<0.001) and fighting (P=0.02) injuries. Southern youth had a greater proportion of sport injuries (P=0.01). Among northern youth, female gender (RR=0.88, 95% CI 0.81- 0.94), average (RR=0.88, 95% CI 0.80- 0.97) or above average affluence(RR=0.84, 95% CI 0.77- 0.91), not being drunk (RR=0.77, 95% CI 0.69- 0.85) not riding a motorized vehicle in the past 12 months (RR=0.81, 95% CI 0.68- 0.98) and not having permanent road access (RR=0.88, 95% CI 0.79- 0.97) were determined as factors protective against injury. Conclusions: The community context for life in the Canadian northern territories differs from that of the rest of Canada, indicating that potential exposures for injury also vary. Overall injury rates are the same between the two populations, but the distribution of injuries by location and activity is different. There are many protective factors that reduce the risk for injury among northern youth. When implementing injury prevention initiatives, policy makers must consider the community context and the types of injury a community is susceptible to.

COMMUNITY-LEVEL ALCOHOL REGULATION IN CANADA'S NORTH: PATTERNS AND POTENTIAL IMPACTS ON THE SUBSTANCE USE BEHAVIOURS OF ARCTIC YOUTH.

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Objectives: The objectives of this study were to document community-level alcohol regulations in Canada's northern territories between 1970 and 2008 and then to examine the association between different kinds of regulations and substance use behaviours among northern youth. Methods: Alcohol regulations for 78 Arctic communities were identified through each territory's most recent revised statutes and revised regulations. These regulations were updated through Territorial Gazettes Indices, and traced backward using each territory's annual bound volumes of the Gazette. The liquor regulations for each community were categorized under open, restriction, or prohibition for every year between 1970 and 2008 and were then mapped using ArcView 9.0 Geographic Information Software. Substance use outcome data was collected from the Health Behaviour in School-aged Children (HBSC) survey (2009, n=3942). Associations were determined using multi-level log binomial regression (SAS version 9.3) adjusted for relevant potential covariates and for the school-clustered nature of the HBSC data. Results: There was a gradual decline in the number of open (wet) communities and increase in the number of other types of regulations. Prohibition (dry) was originally the most popular form of regulation, this changed to restriction (damp) in 1996. In the Yukon, all communities remained open until 1991 when the settlement of Old Crow enacted prohibition. Later other communities enacted public place prohibitions, however most communities remain open. In the Northwest Territories, prohibition has been the most common form of regulation. The number of prohibited communities has not increased since 1992, while restricted communities have gradually increased. Most communities in NT still remain open. Nunavut Territory currently has more regulated than open communities. While initially prohibition was more common the number of prohibited communities has not changed in Nunavut since 1980

and as of 1985, restricted communities were most common. As compared to open communities, prohibited communities were protective for youth having drunk any alcohol in the past 12 months (RR 0.56 95%CI 0.33-0.94); been drunk in the past 12 months (RR 0.51 95%CI 0.34-0.76) using illicit or other drugs (RR 0.30 95%CI 0.13-0.72) and going to school or bed hungry (0.50 95%CI 0.25-0.99). Communities with restrictions and not complete prohibition appeared marginally protective, although illicit drug use in these communities was greater (RR1.8 95%CI 1.17-2.77) than in communities with no specific regulations. Conclusions/Significance of the Research: It is clear that Arctic communities have taken a population based approach using a public policy strategy to improve health. Over time, the popularity of the specific policy choice has favoured "restricted" over "prohibited" communities although prohibition appears to offer more protection against substance use in young people in the north. It is recognized however, that there are many other factors to consider in addition to youth substance use, in these complex community-level and community-led policies.

ARCTIC MARINE USE AND TRANSPORTATION (AMUT): EXAMINE THE ROLE OF SEA ICE CHANGE AS A DRIVER OF HISTORIC SHIPPING TRENDS IN ARCTIC CANADA (1990-2013)

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Total vessel traffic in Arctic Canada has grown by more than 75% over the past decade with strong increases since 2007. Climate change is thought to play a critical role in influencing shipping volume and trends, not only through increases in accessibility due to diminishing sea ice, but also through a lengthening of the shipping season. Despite speculation of the relationship between climate change and shipping trends there is limited empirical analysis or understanding of the extent to which climate change influences shipping patterns especially in comparison to other drivers of change (e.g. commodity prices, demographic change). To better understand the controls on shipping trends in Arctic Canada, an inventory of temporal and spatial variations in shipping patterns was performed using data from the Vessel Traffic Reporting Arctic Canada Traffic Zone (NORDREG) between 1990 and 2013. A correlation analysis was undertaken to examine the statistical relationship between historic shipping patterns and sea ice change using the Canadian Ice Service Digital Archive (CISDA), and a series of semi-structured key-informant interviews were conducted with ship operators and government experts to identify the strength of factors influencing shipping patterns. Results indicate significant increases in total ship volumes during the summer and shoulder seasons with the most dramatic growth from pleasure craft (i.e. private yachts) and research vessels (rate = 8 ships per decade increase). Overall relationships between sea ice reductions and shipping trends in the dataset was weak, but the correlation becomes stronger in recent years. This suggests that climate change is beginning to play a larger role in influencing shipping patterns and trends. However, ship operators and other experts are currently reluctant to identify climate change as an important driver of shipping change, rather suggesting that key drivers include economic demand and technology development. Despite this dissonance it is clear that climate change is playing a role in increasing entry to areas throughout Arctic Canada that were previously not accessible and is thus enabling important economic opportunities.

STUDENTS ON ICE: ASSESSING IMPACT OF 15 YEARS OF POLAR EDUCATION PROGRAMS

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For Students on Ice (SOI), 2015 marks 15 years offering unique educational expeditions to the Antarctic and the Arctic. SOI's approach to education weaves together elements of experiential, expeditionary, inquiry-based, and place-based learning. In starting with a very 'hands-on' approach, active participation and critical thinking are important elements in the SOI learning process. SOI expeditions become personal learning journeys and include general knowledge building, the development of a relational understanding of the issues, opportunities and challenges facing the polar regions of today and in the future, as well as personal reflection on how each student might transfer this unique learning experience into his/her daily life post-expedition. To ensure impacts are being made, its programs remain current and relevant, and to evaluate and meet the evolving needs of students, SOI has created a series of methods to assess its polar education program. 1.0. Expedition Evaluations are conducted at the end of every expedition while students are still deep in their learning experience. This allows SOI to capture 'in the moment' feedback directly speaking to specific elements of the expedition and its polar education program. This understanding helps SOI focus program development in the areas most valuable and impactful to students and to include aspects that may be lacking. 2.0. Alumni Impact Surveys are conducted to reach out to SOI Alumni each year to track their paths and choices as they relate

to research, training, careers, and opportunities. This provides SOI with a means to qualitatively measure where the initial expedition experience propels its Alumni. 3.0. Major Initiatives serving as assessment opportunities: 3.1. ExpeditionArctic.ca An educational website where the journeys, impacts, and research of 7 SOI participants (students, staff, leaders) were compiled. This medium provides insight into how program impacts and values are built depending on the nature of the participant. 3.2. 15th Anniversary Book: The Greatest Classrooms on Earth SOI is compiling an extensive collection of Alumni profiles, founding stories, and inspiring outcomes to cover some of the most significant impacts of SOI's 15 years of operation. A central part of collecting information for this project was a core team of Alumni interviewing student and staff Alumni on the impacts, experiences, and opportunities that have been a part of their lives resulting from their SOI expedition. 3.3. Research & Thesis (Alumni and external) Several alumni and external organizations have conducted research on SOI as an organization, its expeditions, and the transformative changes as a result of its polar education program. Two such examples include: 3.3.1. Lilith Wyatt, Dalhousie University, Master's Thesis 2007: "Stories of Arctic Wonder: Exploring Transformative Environmental Education." 3.3.2. Louise Lyman, Carleton University, Honours Thesis, 2011: "Learning Through Place: Exploring the legacy of Students on Ice Arctic expeditions through southern students' perspectives." From these methods of assessment, SOI's strives to ensures that its polar education program continues to be accessible, palpable, and critically relevant to its students and make improvements wherever possible.

COLD-WATER CORALS AND SPONGE OBSERVATIONS IN HOME BAY AND SCOTT INLET, BAFFIN BAY

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Cold-water corals and sponges are important structure-forming benthic fauna in Canada's three oceans, yet knowledge of their distribution in the Canadian Arctic is limited to fisheries bycatch data and a few scientific surveys. Fisheries and Oceans Canada (DFO) aims to identify hotspots of cold-water coral and sponge biodiversity in steep, deep, unfished habitats in the Eastern Canadian Arctic. To this end, we used the remotely operated vehicle (ROV) aboard CCGS Amundsen to survey corals and sponges in two locations in western Baffin Bay: Home Bay and Scott Inlet in July 2014. These sites were chosen based upon their bottom geology: the Home Bay site is on the upper parts of a trough-mouth fan, while the Scott Inlet site is a bedrock massif inside a shelf-crossing trough. Dive transects were planned using previously collected multibeam bathymetry and sub-bottom profiles. The Home Bay survey followed a video-transect ~2.2 km long, at depths ranging 700-750 m, and the Scott Inlet survey followed a transect ~2.7 km long, at depths ranging 475-600 m. Water temperature for both locations at 700 and 600 m, respectively, was ~1.2 °C. At Home Bay the bottom was fine-grained with abundant boulders and cobbles, on slopes up to 30 degrees. In Scott Inlet, the near-vertical walls were composed of exposed bedrock, while the top of the massif was covered in a veneer of fine-grained sediment with boulders and cobbles. The only corals observed in both dive locations were soft corals (family Nephtheidae) and the sea pen Umbellula cf. encrinus, both of which had previously been recorded in fisheries bycatch from the region. On the other hand, both locations held abundant erect sponges, including carnivorous species in the family Cladorhizidae. At least five different types of sponges were observed, including Chondrocladia sp., Cladorhiza sp., Polymastia sp., Stylocordila sp., and other unidentified sponges. No Geodia spp. sponges were observed. Among the carnivorous sponges, Chondrocladia sp. was found in both sites, while Cladorhiza sp. was only seen in Scott Inlet. Cladorhiza sp. can be easily mistaken for a coral due to its tree-like shape. Cladorhiza on the cliff face were quite small individuals, with maximum height 33 cm, but were much larger on the large boulders above the cliff, with some individuals nearly 1 m high. Other epifauna were abundant in these areas, including basket stars Gorgonocephalus sp. in Home Bay, and diverse sea anemones in Scott Inlet. At both sites, hard substrates were common, especially in Scott Inlet, but no gorgonian or antipatharian corals were seen attached to them, suggesting that factors other than substrate availability affect the distribution of corals in western Baffin Bay. Bottom water temperature, high glaciomarine sedimentation rates, food availability, water chemistry, and coral larval dispersal are all possible limiting factors to coral distribution in the studied areas. Overall, these preliminary observations suggest that both locations have a diverse and abundant sponge-rich epifauna, which might also be found in similar regions in the Eastern Arctic.

RECIPROCITY IN COMMUNITY-SUPPORTED RESEARCH- PUBLISHING THE KUGLUKTUK BERRY BOOK

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The link between language and cultural identity plays an essential role in the welfare of not only an individual but also community. Pursuing language revitalization of the Inuit language through community-based initiatives is fundamental for the wellbeing of the Inuit culture and for the future of Nunavut. Kugluktukmiut share concerns about the loss of the Inuinnaqtun language especially regarding language describing the land. As a way to give back to the community for their contributions to my Master of Science graduate project, I am producing in collaboration with Elders, students, teachers and community members a bilingual book about berries and plants. Information was gathered through oral history training workshops that took place at the high school in conjunction with a weeklong environmental studies program.

MODELLING SEA-ICE GROWTH AND MELT USING OCEAN NETWORKS CANADA'S CAMBRIDGE BAY OBSERVATORY DATA

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The Arctic Ocean is anticipated to under-go significant changes in response to climate change, and predicting the presence and thickness of sea-ice is of critical importance. In September 2012, Ocean Networks Canada installed a near-shore ocean observatory in Cambridge Bay to begin real-time monitoring of the near-shore marine environment. The observatory includes a meteorological station and sub-sea instruments for measuring water properties (e.g. temperature and salinity), ice thickness, a hydrophone, and a benthic camera for imagery. In this study, we present results on modelling the growth and melt of near-shore first-year sea-ice forced by the in situ observations. In addition to the top-down forcing associated with radiative and atmospheric warming and cooling, the direct measurement of seawater properties and ice thickness provide both critical input and validation of the predicted rate of freezing and melting. Critical to freezing is the accurate determination of the conductive heat flux, given the air temperature above and the water temperature below. Additionally, the direct measurement of seawater salinity and pressure under the ice provides the two parameters necessary to determine the freezing point of sea water at the base of the ice. Observations and simulations from October 2012 through September 2014 will be presented, and the various model components and formulations will be assessed in terms of their contribution to predicting sea ice growth and melt.

THE EFFECTS OF DECREASING SEA ICE AND INCREASING SEA SURFACE TEMPERATURE ON AN ARCTIC SEABIRD DEPENDENT ON ARCTIC COD

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Recent major reductions in arctic sea ice extent could be expected to be affecting the distributions and life histories of arctic marine biota adapted to living adjacent to sea ice. Of major concern are the effects of ice reductions, and resulting increasing sea surface temperature (SST), on the most abundant forage fish in the Arctic, Arctic Cod (Boreogadus saida), the primary prey for the region's upper trophic level marine predators. The Black Guillemot (Cepphus grylle mandtii) is an ice-obligate diving seabird specializing in feeding on Arctic Cod and has been studied annually since 1975 at Cooper Island in the western Beaufort Sea. The data set is one of the few allowing assessment of the response of an upper trophic marine predator to recent decadal changes in the region's cryosphere. Analysis of annual oceanographic conditions north of the colony from 1975 to 2012 for the annual period when parents provision young (mid-July to early September), found no major regime shifts in ice or SST until the late 1990s with both sea surface temperature and distance to ?30% sea ice undergoing major increases in the 21st Century. Comparison of a historical (1975-1984) and recent (2003-2012) period found dramatic oceanographic changes occurred in the waters adjacent to the guillemot colony with SST averaging >0.5°C in the historical period and increasing to 2.9 °C in the recent. The recent period regularly had SST <4°C. The rate of retreat of sea ice from the colony (ice ?30% surface concentration) was 1.7 km/day in the historical period but increased to 9.6 km/day in the recent. The distance to ice ?30% concentration on 1 September, the end of the nestling period, averaged <100 km in the historical period and > 500 km in the recent. While arctic cod was the primary

prey provided to nestlings in the historical period, the recent period had 80% of the years have a prey shift with nearshore demersals, primarily sculpin (Cottidae) comprising the majority of the nestling diet. The shift from Arctic Cod to demersals was associated both seasonally and annually with decreases in nestling growth, mass and survival and a near five-fold increase in the percentage of chicks starving in nests, increasing from 5% to 24%. Annual survival of Black Guillemot adults breeding on Cooper Island did not differ between the two periods indicating that availability of Arctic Cod, or alternative prey, has not changed in the Chukchi and Bering sea ice margins occupied by the guillemots during the September-May nonbreeding period. Our findings of a substantial decrease in Arctic Cod availability in late summer in response to decreased ice extent and increasing SST have implications for the entire Arctic given the importance of Arctic Cod to the region's upper trophic level predators and the ongoing and predicted basin-wide reductions in arctic sea ice. Black Guillemot, Arctic, breeding success, trophics, sea ice

CHARACTERISING DIFFERENCES IN THE TROPHIC ECOLOGY OF NORTH AMERICAN ATLANTIC SALMON (SALMO SALAR L.) ALONG THE WEST GREENLAND COAST USING STABLE ISOTOPES

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Atlantic salmon, Salmo salar L., are widely studied in the freshwater environment. However, given the difficulties of sampling in the ocean, the ecology of the marine life-history stage is poorly understood. Many non-maturing adult salmon of North American origin undertake a feeding migration up the west coast of Greenland in late summer. Initial feeding studies (1960s) based on gut content analyses indicated heavy reliance on capelin (Mallotus villosus), sand lance (Ammodytes spp.) and amphipods, with latitudinal differences in diet evident. These studies have not been repeated since and in the face of the widely documented Northwest Atlantic oceanic regime changes, a contemporary feeding study using modern stable isotope analysis (SIA) methods was undertaken. Atlantic salmon were caught at three locations at differing latitudes off the West Greenland coast (Qaqortoq, Nuuk and Sisimiut) over a three year period (2009-2011). The hypotheses tested were that there were significant differences in the SI values of Atlantic salmon among communities (and hence latitudinal differences as evidenced in the historical diet data), as well as significant differences among years. Stable isotope data from prey items from the West Greenland coast and the Atlantic salmon overwintering area in the Labrador Sea were used to assist interpretation of the data. Current Atlantic salmon diet was found to still be heavily reliant on capelin and amphipods, but with increased importance of boreoatlantic armhook squid (Gonatus fabricii). Significant differences were found among the years and communities when a two-way ANOVA was run for both ?13C and ?15N, with a significant interaction between the two variables ($p < 0.001$ for both ?13C and ?15N). The significant interaction indicates that differences among years depend on the community being analysed, and varying differences between year and community were also evident in the results of SI centroid testing and ellipse overlap. Although there was no consistent pattern across years as to the niche metrics, Atlantic salmon at Nuuk consistently had the lowest ?13C values. When Atlantic salmon stable isotope data were represented in a bi-plot space, they varied less on the ?15N axis (?1 trophic level) than on the ?13C axis (> 4 trophic levels). A lack of consistent patterns among years and communities shown in the SIA data is understandable, given the complex interplay between ocean temperature, changes in ocean currents and water bodies and associated variation in the distribution, abundance and use of prey species.

POLYNYA VENTILATES HIGH-ARCTIC FJORD IN NORTHEAST GREENLAND

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A storm event late December 2013 with northerly winds up to 25 m/s forced the collapse of the land-fast ice over the Young Sound (YS) fjord outlet in northeast Greenland. This storm created a coastal polynya that was further maintained by several consecutive wind events until early March 2014. During the polynya period, three land-fast ice-tethered oceanographic moorings recorded an enhanced surface layer (~0-40 m) transport towards the mouth of YS and a layer below (~40-140 m) flowing into the fjord and supplying the interior with cool and saline water from the polynya. The CTD transects in

May 2014 reveal that this lower layer was filled with polynya originated cool, saline and oxygen enriched water with oxygen concentration significantly exceeding summer values. Salt balance bulk estimates show that the polynya is able to generate a sufficient amount of brine to ventilate the fjord interior.

"THESE TREES HAVE STORIES TO TELL": LINKING INDIGENOUS KNOWLEDGE AND SCIENCE IN THE MONITORING OF BARREN-GROUND CARIBOU MOVEMENT IN THE NORTHWEST TERRITORIES, CANADA.

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Caribou are inextricably linked to the health, well-being and cultural strength of northern indigenous communities. The Denesoline (Chipewyan) are recognized to be the most widely travelled and populous of the Northern Athapaskan groups with historical evidence of land-use and occupancy that parallels variation in range and movement patterns of barren-ground caribou (Rangifer tarandus groenlandicus) verified by the oral histories of the Tlicho, Denesoline and Inuit as well as documentation from early explorers. The deep spiritual and material connection between caribou and the Denesoline has allowed the development of a rich body of knowledge about the historical and contemporary patterns of caribou movement and population health. Using ethnography and dendrochronology (tree-ring analysis) we worked with Denesoline elders, caribou harvesters, youth and graduate students/faculty from the University of Alberta to track the effects of diamond mining activity on barren-ground caribou movements over a three-year period. Outcomes include a conceptual framework for using western methods within an indigenous methodology and a set of best practices for conducting scientific research in an indigenous context.

IMPACT OF VEGETATION GROWTH ON SNOW PHYSICAL PROPERTIES AND ON PERMAFROST THERMAL REGIME

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Shrubs and small trees growing on the tundra favor snow accumulation. Furthermore, the dense twig networks of shrubs such as dwarf birch and Richardson's willow prevent snow compaction and densification, and favor the formation of depth hoar crystals. These form snow layers with a low thermal conductivity which efficiently limits winter ground cooling. To quantitatively explore these effects, we have measured the density and thermal conductivity of snow on tundra with various vegetation covers. Studies were performed on herb tundra and low shrub tundra at Bylot Island (73°N), and on low and high shrub tundra and forest tundra at Umiujaq (56°N). Results show more complex relationships between snow properties and vegetation cover than expected. In particular, very dense and conductive snow was found in small black spruce stands growing on shrub tundra. Numerical simulations attempting to reproduce the processes at play were carried out using the detailed snowpack model Crocus coupled to the multi-layer ground model ISBA, in order to quantify the effect of vegetation-induced changes in snow properties on ground temperature and permafrost stability.

A LARGE-SCALE COLLABORATIVE EFFORT TO ESTIMATE ABUNDANCE OF NARWHALS AND BOWHEAD WHALES: RESULTS OF THE 2013 HIGH ARCTIC CETACEAN SURVEY

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Inuit communities across the Canadian Arctic hunt narwhals and bowhead whales for subsistence, economic and cultural reasons. Sustainable management of these important harvesting activities relies on up-to-date estimates of population abundance. Because of the vast geographic areas to cover and the seasonal movements of whales, obtaining credible estimates requires the participation of all co-management partners. A large-scale aerial survey was conducted by the Department of Fisheries and Oceans in the eastern Canadian Arctic in August 2013 to obtain new abundance estimates of the Baffin Bay narwhal population and the Eastern Canada-West Greenland bowhead whale population, for which the last estimates were dated and incomplete. This was achieved by using three aircraft simultaneously, which flew for a combined total of 241 hours and covered the entire summering range

of the target populations. Nunavut co-management partners helped fund the project and were involved at every step of the process: consultations and traditional knowledge were used in conjunction with telemetry studies to design the flight plans and determine the best timing, and Inuit observers were an integral part of each survey team. In addition to visual observations, 180,000 geo-referenced photographic images were collected using digital cameras taking pictures through the aircrafts' belly windows. By counting all of the Canadian Baffin Bay narwhal stocks in one summer, the survey addresses previous concerns raised by stakeholders and yields the first estimates for the narwhal stocks found around Ellesmere Island, which are crucial for High Arctic communities such as Grise Fiord. These improved abundance estimates will allow co-management partners to determine how many whales can be hunted sustainably while decreasing the risk of local depletion of resources in each community, and will help document how whale distribution is changing in response to environmental changes in the Arctic.

HIGH RESOLUTION OF TEMPORAL VARIATION OF THE BENTHIC COMMUNITY IN CAMBRIDGE BAY, NU (ARCTIC), FROM A COMMUNITY-BASED OBSERVATORY

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Arctic benthic communities are potentially good climatic change indicators because of their longevity. However, very few high resolution and long term studies have been undertaken to assess their temporal variability. The objective of this study was to quantify season variations in benthic organism abundance, diversity and activity, at a high temporal resolution, using cabled seafloor observatory technology deployed by Ocean Networks Canada in 2012, in Cambridge Bay, Nunavut. This observatory included a 6-meter deep underwater platform with an HD video camera that acquired five-minute video clips of the seabed every two hours. In addition, the platform was equipped with a suite of water property sensors (temperature, conductivity, dissolved oxygen, salinity, fluorescence and turbidity). We analyzed a total of 30 videos, randomly sampled from the archive for the period December 2012-July 2013. Seawater properties data for this same period were included in the analysis of community variation. Results show an increase in the abundance of benthic organisms during summer (between June 1st and July 15th). However, there were no significant differences in benthic organism diversity between seasons. Seawater temperature coupled with dissolved oxygen concentration explained most of the variation in benthic faunal abundance. Faunal activity rates were significantly different between seasons. Surprisingly, winter months (December 15th to March 1st) had a higher activity rate than the other seasons. Limited food availability in winter could force organisms to be more active in order to acquire enough nutrition. Observatory studies of this type provide insight into larger scale benthic community processes in coastal Arctic waters.

THE COMPLEMENTARITY OF INUIT AND SCIENTIFIC KNOWLEDGE OF POLAR BEAR POPULATION TRENDS

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In Inuit Nunangat (the Canadian Inuit homeland), Inuit knowledge (IK) is becoming more integrated into wildlife management, but in many cases there is a bias to using scientific knowledge. We present evidence that Inuit knowledge can be a powerful source of information on population trends in wildlife. We conclude that IK and scientific knowledge should be used synergistically to improve wildlife management. In this presentation we explore the subpopulation growth rates and probability of decline for the 13 Canadian subpopulations of polar bears (Ursus maritimus) from both a scientific and Inuit knowledge perspective in order to highlight agreements and disagreements. The two forms of knowledge agreed on 7 stable/increasing populations and 1 declining populations. The two forms of knowledge disagreed on the remaining 5 subpopulations. Disagreements were non-random. Four of the disagreements were for populations where the scientific data came from incomplete mark-recapture samples which may have biased survival rate estimates and subpopulation size estimates. Scientific determination of the status of final subpopulation, the Baffin Bay subpopulation, appears to have been compromised by over-reporting of harvest in Greenland (where several hunters take one bear, but may report individually that they have each harvested a bear). We suggest that IK can be used as a reliable correspondence test to evaluate scientific results independent of the assumptions of the scientific analysis models. This supports the further integration of IK into wildlife management systems.

EFFECTS OF FUTURE CLIMATE CHANGE ON THE MARINE ECOSYSTEMS OF THE ARCTIC AND SUBARCTIC SEAS WITH EMPHASIS ON FISH AND FISHERIES

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The Arctic and high latitude northern regions are expected to experience the greatest changes globally under anthropogenic climate forcing, including rising air and sea temperatures, reductions in sea ice, and changes in ocean circulation. The present warming and sea-ice trends are already producing major ecosystems responses and further modifications are expected under continuing future global change. With a geographic emphasis on the Northeast Atlantic and its adjacent Arctic sector, recent climate-induced changes in abundance, production and distribution of phytoplankton, zooplankton and fish, as well as species interactions through predator-prey and competition linkages, will be discussed. Using these examples and other earlier historical records, the mechanisms through which climate affects the various ecosystem components will be highlighted. These will be used to present potential ecosystem scenarios under future climate change. Given the fish population scenarios, their implication on fisheries will also be briefly discussed. The role of natural climate variability in combination with anthropogenic-induced climate change will be presented and caution given in regards to subscribing observed changes and responses to anthropogenic climate change. Consideration of multi-stressors, such as ocean acidification, fishing intensity, etc. in addition to climate change will also be stressed. Knowledge gaps that need to filled in order to improve our future ecosystem projections will be given along with some recommendations for future research.

WHAT IS THE BEST WAY TO ASSESS ATTENTIONAL FUNCTIONS IN CHILDREN EXPOSED TO ENVIRONMENTAL CONTAMINANTS?

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People living in the Canadian Arctic are highly exposed to environmental contaminants due to transport of these chemicals via the atmosphere and ocean currents, and their bioaccumulation in fish and sea mammals. The Inuit frequently and preferentially consume traditional native foods, particularly, seal and beluga whale. Therefore, in addition to postnatal exposure, a substantial proportion of Inuit children have been exposed in utero to contaminant levels well above the limits recommended by Health Canada. Scientific interest has been largely spent on children development because of their higher vulnerability to contaminant exposure. Among the harmful effects observed on cognitive or intellectual functions, attention is one of the most studied, as it is crucial in everyday life to accomplish most of the tasks. The present study aims to critically review the literature on the impact of chronic exposure to the major legacy contaminants (i.e., mercury, lead and persistent organic pollutants or POPs) on attentional functions. Attention capacities have been assessed with questionnaires or behavioral coding but the most powerful way is the use of computerized tasks. Studies in the literature using computerized tasks have almost exclusively been conducted with the Continuous Performance Task (CPT). This task is specifically designed to assess impulsivity and sustained attention, which have been shown to be associated with contaminant exposures. As a matter of fact, the current research is thus restricted to these specific attentional dimensions without systematic data on the other processes of attention such as visuospatial attention, which are yet essential for cognition and learning. Attention as a whole encompasses many networks that either work in unison or separately depending on the task. Since the current literature only investigates sustained attention, other attentional functions could also be impacted but we don't know. It is therefore important to look on a bigger scale when it comes to study the effects of contaminant exposure on attention. Consequently, we suggest to develop a test that can assess many dimensions of attention or, alternatively, to have a battery of different attentional tests. An additional challenge for the researchers in the field is that each contaminant may have its specific effect on attention, i.e., may alter only some attentional dimensions and spare others. Therefore, it is important for future research to take into consideration the complexity of attention as well as the particularities of each contaminant. This will in turn improve substantially our understanding of the effects of contaminants on attentional capacities, which is a particular concern in Arctic populations. keywords: environmental contaminants, attention, literature review, mercury, manganese, lead, polychlorinated biphenyls, arctic population

RAPIDLY DEPOSITED LAYERS FROM WESTERN HUDSON BAY (CANADA): A POSSIBLE RECORD OF FLOODS FROM THE NELSON AND CHURCHILL RIVERS IN THE LAST 700 YEARS

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Hudson Bay is a large shallow inland sea that receives about 30% of the total Canadian river runoff and experiences a complete annual sea-ice cover. With their mouths located in western Hudson Bay, the Nelson and Churchill Rivers drain watersheds across several Canadian provinces, making their hydrology and sediment discharge highly sensitive to climatic oscillations such as the Pacific Decadal Oscillation (PDO) and environmental changes in central Canada. Moreover, these rivers were dammed in the 1970s, and a major part of the natural Churchill River flow has been diverted to the Nelson River channel. Here, by analysing radiocarbon- and 210Pb-dated sediment cores recovered at their mouths on board the CCGS Pierre-Radisson as part of the ArcticNet project, we reconstruct variations in river dynamics in relation to climatic and anthropogenic changes during the last centuries. In order to achieve this goal, two gravity cores were collected near the Nelson River mouth (778 and 780), one at the Churchill River mouth (776), and a fourth one 200 km offshore from these rivers (772) that will serve as a witness core without the major influence of a river. In the laboratory, all the cores were imaged by digital X-Rays, their physical and chemical properties were measured using a Multi Sensor Core Logger (MSCL), and some magnetic properties were measured by a 2G cryogenic magnetometer. Discrete samples were also taken to determine the grain size. According to 210Pb and 14C data, core 772 spans the last 1700 years and most of the physical sediment properties do not show significant variability. On the other hand, most of cores 778 and 780 consist of fine silt to fine sand layers characterized by a coarsening-upward unit followed by a fining-upward unit. These features, called hyperpycnites, are typical of hyperpycnal currents caused by river floods, and may have resulted from floods of the Nelson River since the last few centuries, probably during spring melting. By assuming that hyperpycnites were deposited instantaneously, the 210Pb data were used to estimate that cores 778 and 780 cover about the last 620 and 660 years, respectively. The frequency of hyperpycnal deposits was compared to the PDO index, which influences greatly the climate in Central Canada, and revealed that most of the hyperpycnal flows occurred during negative PDO phases. Finally, differences between the different cores and the two rivers will also be discussed.

BUILDING A FRESHWATER DATA MANAGEMENT SYSTEM FOR THE MACKENZIE RIVER BASIN

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The Mackenzie River Basin is a vast, beautiful and critical natural feature of Canada. Flowing North, it extends through three provinces and three territories connecting distant corners of the West before spilling its waters into the Arctic Ocean. This Basin, which has been shown to have significant hydroclimatic effects on both a North American and global scale, is critical to the lives and livelihoods of local people and beyond. The Mackenzie River Basin is largely pristine—in many places, its waters are considered the cleanest in the world—but the region is undergoing an unprecedented period of change due to climate change and natural resource and infrastructure developments. It's been said that you can't manage what you don't measure. In the Mackenzie River Basin, the business of "measuring" can be a real challenge. But freshwater data is being collected by a number of initiatives throughout the Basin. Notably, critical datasets are being generated through growing network of community-based monitoring programs, a large number of which are being facilitated by the Government of the Northwest Territories. This degree of focus on community-based monitoring at the government level—which is unique in Canada and rare internationally—is a fundamental aspect of the Northwest Territories Water Stewardship Strategy and the foundation upon which a new public-private collaboration has emerged. Beginning in the Fall of 2014, The Gordon Foundation together with the Government of the Northwest Territories and a third-party developer, is building a data management system (DMS) to make community-collected data more widely available to decision makers at all levels of the water management landscape. This presentation will describe how this unique partnership evolved and explore the shared visions for this project moving forward.

MONITORING SUBARCTIC SHRUB CHARACTERISTICS USING MULTIFREQUENCY AND MULTIPOLARIZATION RADAR REMOTE SENSING

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The expansion of shrub vegetation in polar and alpine regions has received some attention in the past decades. The presence of shrubs can trigger a feedback loop where shrubs capture windblown snow, keeping ground temperatures relatively warm during the winter and accelerating the onset of growth in the spring. While optical satellite imagery and aerial photography have been successfully used to monitor the spatial distribution of shrubs in the past, the only way to assess their vertical structure is mostly through in-situ measurements. Synthetic Aperture Radar (SAR) remote sensing has the ability to penetrate the canopy and provide information on the vertical structure of shrubs and could become a very useful tool to complement current observations. While a few studies have investigated the sensitivity of SAR backscattering to shrub vegetation parameters, none have specifically turned their attention to subarctic environments. This study aims to assess the sensitivity of SAR remote sensing data to subarctic shrub vegetation characteristics, in particular height and ground coverage, and to perform image classifications in order to map the various types of shrub coverage. The study area is a 60 km² region situated around the Umiujaq community (56.55° N, 76.55° W) in northern Quebec, Canada. The area can be divided into two distinct environments: the coastal region to the east and the Lac Guillaume-Delisle graben to the west. The vegetation in the coastal region is very sporadic and dominated by tundra vegetation, while the graben vegetation is mainly shrublands with patches of conifers. Field measurement campaigns where performed during the summer of 2009 and the winter of 2012 to collect data on the vegetation and snow characteristics respectively. In-situ observations have shown that the height of the shrub vegetation influences the depth of the snow cover. A series of polarimetric RADARSAT-2 C-band images (HH, VV, HV, VH polarizations) and dual-polarized TerraSAR-X X-band images (HH, HV polarizations) have been acquired over the area between October 2011 and April 2012 during the fall and winter seasons. Sensitivity analysis where performed comparing SAR backscattering coefficients with shrub coverage and height and supervised Support Vector Machine classifications where performed on the images. Results show that the backscattering coefficients increase with shrub density, but only up to 20% of shrub ground coverage, after which point the SAR signal tends to saturate. When comparing backscattering coefficients with the average heigt of the shrubs within a plot, a significant positive correlation can be observed, in particular at HV/VH polarizations. The RADARSAT-2 datasets display better correlations and higher sensitivity to shrub height than TerraSAR-X. The classification yielded 5 vegetation classes: trees, high shrubs, low shrubs, lichen dominated and grass dominated. The best classification accuracy was obtained by combining two images from two different dates in October and March. The overal classification accuracy obtained with this method was 87%. While RADARSAT-2 provides interesting results for the monitoring of subarctic shrub vegetation, TerraSAR-X tends to exhibit less sensitivity to shrubs but a higher sensitivity to snow cover.

EXPLORING RELATIONSHIPS BETWEEN INDIVIDUAL SOCIO-ECONOMIC STATUS, SUBCLINICAL ATHEROSCLEROSIS, CARDIOMETABOLIC DISEASES AND PREVALENT CARDIOVASCULAR DISEASES AMONG NUNAVIMMIUT

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Cardiovascular diseases (CVD) are the leading cause of morbidity and mortality among high-income countries. Over the last decades, in developed countries Indigenous populations are disproportionately affected by chronic diseases, including CVD, compared to non-Indigenous populations. However little is known about specific risk factors for CVD, including socioeconomic conditions. Associations between health and socioeconomic status (SES) have been widely demonstrated in different populations with an inverse social gradient, i.e. the less advantaged having a greater burden of diseases compared to more well-off individuals. SES can influence behaviors and lifestyle (smoking, physical activity, food, alcohol consumption), access to health services, psychosocial factors, which in turn can influence indirectly or directly cardiometabolic diseases (CMD) and the incidence of CVD. This study aims to examine the association between SES and subclinical atherosclerosis, CMD or prevalent CVD among Inuit people from Nunavik, adjusting for behavioral factors. Data from Qanuippitaa? How are we? Nunavik Inuit Health Survey, a cross-sectional study conducted in 2004 in the 14 communities in Nunavik

(Quebec, Canada) were analysed. SES was measured using self-reported information on education level, income, employment. Participants reported whether they had been diagnosed by a physician with a CMD (at least one among high blood pressure, diabetes, high cholesterol) and CVD (at least one diagnostic of CVD within myocardial infarction, stroke and other heart disease). Assessment of subclinical atherosclerosis was performed using measurements of carotid intima-media thickness (CIMT). Multivariate linear regression and logistic regression were applied depending on the nature of the issue. All analysis were adjusted on age, gender, marital status, physical activity, smoking status, and Body Mass Index (BMI). A total of 268 Inuit ?40 years old were included in our analysis. In fully adjusted models, people unemployed or economically inactive reported higher odds of CMD (among individuals without CVD; (OR=3.52 [1.24-9.96], p=0.018), and of CVD (OR=4.22 [1.53-11.63], p=0.005); CIMT did not vary by employment status. Associations between education or income and the health outcomes investigated were not statistically significant. Results suggest that employment status may be an important social determinant of CMD and CVD prevalence, above and beyond behavioral risk factors and obesity, as well as a marker of social inequality among Nunavimmiut. Because of the cross-sectional design, causality cannot be ascribed to these observations; longitudinal studies are needed to examine the role of employment status on the development of CVD over the life course.

PROCESS OF ORGANIC TRANSPORT IN LAKES OF THE YAMAL REGION (POLYAR)

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Climatic and environmental fluctuations in the permafrost zone lead to activation of various cryogenic processes. This activation results in a strong impact on redistribution of substances and changes in biochemical composition of the water bodies. Lakes in the Arctic are good indicators of changing natural conditions. These indicators are expressed in both areal changes of thermokarst lakes, and changes in biochemical composition of water. Thus, we analyze the interconnection between water bodies and their catchments on Yamal peninsula in temporal and spatial extent. Main objective of this research is to study which processes affect the quality and quantity of dissolved organic matter in the water bodies across the Yamal peninsula (central, eastern and coastal parts) in the continuous permafrost zone. The studies are based on batymetric in-situ measurements and water sampling, optical and SAR remote sensing, and topographic data analysis. From 2011 to 2014 samples for colored dissolved organic matter (cDOM) have been taken at different parts of Yamal. Also in field season permafrost landscapes were observed and described to get more knowledge on lake catchment ecosystems. The Yamal Peninsula is in the area of widely distributed tabular ground ice of up to 20-30 m thick. Degradation of this ground ice leds to thermokarst in depressions and thermal denudation on slopes. Thermokarst features are formed within the ice-wedge polygons as well, which degrade under the observed climate warming. Tabular ground ice degradation resulted in the formation of the deep (15 and more meters deep) thaw lake basins. High coastal cliffs around the thaw lakes potentially provide terrestrial organic matter. It was established that biochemical composition of lake water is affected by sediment transport from the coastal lake cliffs due to coastal erosion and thermal denudation. The research result of this study: connection of the cDOM concentration of the different water bodies, which have different optical properties to coastal retreat activities and catchment properties (vegetation, topography, snow storage). These data supports the model of the contributions of a number of factors (like slope processes, vegetation and snow cover in the lake catchments) in the dissolved organic matter concentration in lakes at variable climatic conditions (summer temperature, winter temperature, precipitation).

MAPPING INUIT MENTAL HEALTH AND WELLNESS ON THE ATLAS OF COMMUNITY-BASED MONITORING (CBM) AND TRADITIONAL KNOWLEDGE IN A CHANGING ARCTIC.

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The Inuit Circumpolar Council (ICC) represents Inuit in four countries: Alaska, Canada, Greenland, and in Chukotka (Russia). Inuit health and wellbeing is a policy priority for ICC action. A part of this work is to document the different health

and wellness experiences of Inuit and to advocate for solutions within international forums. Based on the need for better integration of Inuit health related information, ICC-Canada with its partners from Brown University and ELOKA, developed an online map of Inuit mental health and wellness programs: www.arcticcbm.org/wellness based on the 2012 ICC report on Circumpolar Inuit Health Priorities: Best Health Practices and Research. By using the CBM Atlas framework, it allows users to search by keyword and to quickly identify programs that are relevant to specific regions or communities. The purpose of this map is to share more about the programs and initiatives with other communities, program managers, and researchers, and to learn how Inuit are addressing the challenges and finding solutions with mental health and wellness.

IKAARVIK: MOVING FROM BARRIERS TO BRIDGES WITH ARCTIC YOUTH

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Ikaarvik: Barriers to Bridges was born from three ideas: 1) Northern communities are often not involved in all aspects of the science occurring around them, have little say in the questions asked, and results are rarely presented in a way that is accessible or relevant to them; 2) Southern Canadians understand very little about the Arctic, its people, social/cultural/ecological issues, wildlife and the relations between these; and 3) Northern youth desire, and can benefit from, Northern-led programs that empower them to be agents of positive change in their communities and provide the self-confidence and communication skills that allow them to grow into leaders. The Ikaarvik partnership combines these ideas by working with young emerging leaders—youth with the interest, drive and motivation to become leaders in their communities—to create stronger connections between their communities and western science and with institutions that help shape southern Canadians' understanding of the north (zoos and aquariums). It also connects these youth to young emerging Arctic scientists with an interest in working with northern communities. Ikaarvik is a Laureate of the 2013 Arctic Inspiration Prize. Now in its first year, Ikaarvik includes the partner communities of Cambridge Bay, Gjoa Haven, Kugluktuk, and Pangnirtung, and youth mentors from Pond Inlet who participated in the pilot program in 2011. In this first year, youth participants were from the communities of Cambridge Bay and Gjoa Haven. Southern Institutions include the Vancouver Aquarium, Assiniboine Park Zoo, Ecomuseum Zoo, Toronto Zoo, Telus World of Science in Edmonton and the Canadian Science and Technology Museum. Also a partner, the Canadian Rangers Ocean Watch (CROW) program engages the youth in a real science project while developing a stronger partnership with participating communities. In a series of "modules" created and presented by the mentors, the youth were introduced to the basic concepts of science, explored how traditional knowledge and science could work more effectively together and began to engage with their communities' elders and other leaders. Youth in Gjoa Haven received training on conducting sampling for the CROW science program. In October, the youth traveled south to meet with scientists and policy makers and to work with staff and volunteers at one of the participating southern institutions that communicate to millions of Canadians annually about the Arctic. This trip was a two-way dialogue in which they were empowered to express their opinions, concerns and perspectives. At the zoos, the youth critiqued exhibits and participated in Ways of Knowing workshops among other activities with staff and volunteers. Ikaarvik provides a voice for young, emerging Inuit leaders to communicate their perspectives and directly impact institutions that help to shape science, and southern Canadians' understanding of the Arctic. It helps to build a new generation of leaders with a greater appreciation for the roles of science and traditional knowledge, and grows their communication skills and self-confidence. This presentation will discuss lessons learned during Ikaarvik's first year and will include youth involved in the program and program leaders.

FUTURE PLAN FOR ARCTIC RESEARCH OF JAPAN – JCAR CONTRIBUTION TO ICARPIII –

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Japan Consortium for Arctic Environmental Research (JCAR) has compiled a report for Arctic research strategy of Japan. In this report, we have described four major objectives concerning a time frame of 10 to 20 years in future and identifying the gaps in the current understanding, and then, necessary research directions and systems. The first one is on "Understanding of the abrupt-complex phenomenon and elucidation of the mechanisms and impacts associated with global warming enhanced in the Arctic, along with improvement of their future prediction". In this objective, seven themes have been selected such as amplification of warming in the Arctic. The second one, the research to elucidate "Biodiversity in land

and ocean, and also the effects of anthropogenic environmental change on ecosystem, not limited to global warming" is divided into the terrestrial and marine themes. The third one covers "Broad and important research on the Arctic environment and its fundamental information" which includes three themes such as the geospace environment surrounding the earth. The forth objective covers three categories of methods as the themes, "Monitoring, modeling and data assimilation to bridge them, enabling breakthroughs in environmental research". Most of the environmental changes considered for those objectives contain complicated interactions among the atmosphere, ocean, cryosphere, land surface, geochemical cycle and ecosystem. Hence, the research on them activates collaborations of the existing disciplines. In turn, such activities help understanding of each discipline in depth and lead to exploration of non-elucidated phenomena. The forth objective starts breakthrough research from the development of innovative methods of observation and modeling, not confined within the improvement of techniques.

RECENT TEMPORAL DYNAMICS OF ARCTIC TUNDRA VEGETATION WITHIN THE CONTEXT OF SPATIAL BIOMASS-TEMPERATURE RELATIONSHIPS

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Large-scale spatial gradients are particularly useful for developing relationships between ecosystem properties and environmental variables. Assuming these variables and system properties are dynamic over time, the spatial relationships may be used as a first approximation for how ecosystems respond to environmental changes, i.e. space-for-time substitutions. We used data from two spatial gradients within the arctic tundra to examine how the observed temporal dynamics of tundra vegetation compared to space-for-time projections based on spatial biomass-temperature relationships. Over the past several decades, data were collected on vegetation, soil, climate, and other ecosystem properties, across two long latitudinal gradients in the arctic tundra, spanning all of the major tundra subzones on two continents (North American Arctic Transect and Eurasian Arctic Transect). Field-harvested, aboveground vegetation biomass data were related to satellite-derived temperature data, in this case the Summer Warmth Index (SWI - sum of mean monthly temperatures > 0 °C); total aboveground vegetation biomass increases exponentially as a function of SWI. Field-harvested biomass has also been related to the satellite-derived Normalized Difference Vegetation Index (NDVI), with total aboveground vegetation biomass also increasing exponentially with NDVI. We used a 32-year record (1982-2013) of satellite-derived Land Surface Temperatures and NDVI from Advance Very High Resolution Radiometer (AVHRR) sensors onboard NOAA satellites (GIMMS 3g dataset) to evaluate projected and observed changes in total aboveground vegetation biomass over this time period; SWI was determined from the Land Surface Temperature data. We calculated the annual values of projected vegetation biomass as a function of SWI (space-for-time substitution), and we calculated the annual values of observed vegetation biomass as a function of NDVI. Finally, we evaluated the 32-year trends in projected and observed biomass for three regions: the arctic tundra as a whole, as well as for North American tundra and Eurasian tundra. We hypothesized that 1) NDVI-derived (observed) biomass would have less interannual variability than SWI-derived (projected) biomass, as actual vegetation changes from year-to-year are constrained by biological and abiotic factors other than temperature, and 2) the rate of change in NDVI-derived biomass over the entire record would be less than the projected rate of change (SWI-derived), again likely due to ecosystem constraints. As we expected, interannual standard deviations for SWI-derived biomass were 2.0 – 2.5 times greater than those for NDVI-derived biomass (for all three regions of interest), and the trendlines for NDVI-derived biomass were much "tighter" with greater r^2 values than those for SWI-derived biomass. Surprisingly however, the observed rates of change (NDVI-based) in total aboveground vegetation biomass (range of 2.5 to 2.6 g m-2 y-1) were greater than the projected rates of change based on temperature (SWI) dynamics (range of -0.2 to 2.2 g m-2 y-1) , for all three regions. These results suggest that 1) in addition to changing temperatures, there are other factors (including direct/indirect effects of temperature changes) that are yielding high vegetation biomass responses, and 2) there is the potential for at least the temporary formation of novel tundra ecosystems with respect to the zonal climate (e.g. tall shrublands).

IN SITU CONTRIBUTION OF OLD CO2 AND CH4 RELEASED FROM SOILS IN BURNT AND COLLAPSED PERMAFROST IN CANADA

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Permafrost degradation is associated with an aggradation of the active layer thus exposing previously frozen soil carbon (C) to microbial activity. This may increase the generation of greenhouse gases and potentially increase rates of climate change. However, the rate of C release remains highly uncertain, not least because few in situ studies have measured the rate at which previously frozen C is released from the soil surface, post thaw. We quantified the contribution of this "old" C being released as CO2 and CH4 from permafrost degraded soils in sporadic and discontinuous permafrost in Yukon and Northwest Territories, Canada. Firstly, we studied the effect of fire on black spruce forests as the removal of vegetation, especially mosses, may play a key role on thaw depth. Secondly, we investigated the collapse of peatland plateau after permafrost thaw which resulted in the formation of wetlands. We combined radiocarbon measurements of respired CO2 and CH4 with a novel collar-design that either included or excluded respiration from deeper soil horizons. Our results show that, while excluding deeper layers did reduce the average age of the C being released from the soil surface, more than 90% of the CO2 and CH4 came from contemporary sources, even after burn and permafrost plateau collapse. Furthermore, soil cores dated using 210Pb show that the rapid accumulation of sedge peat after plateau collapse may more than compensate for any C losses from depth. Additional incubation experiments quantified the effect of temperature on respiration rates and assessed the vulnerability of permafrost soil C. Our results from the Canadian boreal contrast strongly with findings from other geographical areas emphasising the complexities of predicting the impact of permafrost thaw on the carbon balance of northern ecosystems.

MERCURY AND PERSISTENT ORGANIC POLLUTANT TRENDS IN PREDATORY FISH IN THE MACKENZIE RIVER BASIN, NORTHERN CANADA: A GREAT SLAVE LAKE FOCUS

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Great Slave Lake, the headwaters of the Mackenzie River, is a key biomonitoring site under Canada's Northern Contaminant Program with mercury (Hg) and persistent organic pollutants (POPs) measured in lake trout and burbot in two different ecological regions of the lake since the early 1990s. Fish length, weight, age, condition factor, lipid content, and carbon and nitrogen ratios also are being measured to assess life history and feeding characteristics including possible temporal change. The West Basin (WB) of the lake receives substantial inputs of the turbid waters of the Slave River which has its origin in the more developed regions of Alberta to the south; WB waters are relatively warm and turbid in summer and the basin is productive supporting a commercial fishery since the 1940s. The East Arm (EA) has low-conductivity, clear waters and is relatively unproductive. Over the study period, average concentrations of POPs such as PCB, DDT, chlordane were higher in lake trout collected from the EA than the WB (20.2 ± 8.3 vs 12.6 ± 12.4 ng/g PCB; 4.9 ± 4.7 vs 3.0 ± 2.9 ng/g DDT; 9.4 ± 7.6 vs 5.2 ±7.6 ng/g chlordane respectively) despite the fact that the former location is influenced by development from the south where these compounds were used. Higher POPs concentrations in EA trout may be related to a combination of their slower growth rates than in the WB, fewer particulates in the water column on which atmospherically-derived POPs can be adsorbed, and lower sedimentation rates than in the WB. Burbot were substantially younger and more littoral in their feeding in the EA than WB and also tended to have higher POPs concentrations. Many POPs are declining in concentration in both species with their curtailed use in the global environment including ?-HCH (10-12%/yr), ?-HCH (8-11%/yr), chlordane (5-7%/yr, WB only), DDT (5-8%/yr), and dieldrin (6-8%/yr, WB only); there is weaker evidence of declines in PCBs with only WB burbot showing a significant trend of decrease (5%/yr). In contrast, Hg concentrations are showing a general trend of increase (1.4-2.9% for WB burbot and lake trout and 3.3-4.8%/yr for EA fish); such increases do not appear to be related to warming trends as has been proposed elsewhere. Hg concentrations also are being investigated in periodic assessments of various species in smaller lakes in the vicinity of Great Slave Lake and in lake trout and cisco from Great Bear Lake to the north. Hg concentrations in fish in the smaller lakes are higher than in Great Slave Lake with some evidence of temporal increase; consumption advisories have been issued for predatory fish in a number of these lakes. With increasing Hg concentrations in smaller lakes along the Mackenzie River, the demand for Great Slave Lake and Great Bear fish may increase. To date, there is little evidence that developments in the Peace and Athabasca River watersheds have had profound impacts on the concentrations of contaminants investigated in this study on Great Slave Lake burbot and lake trout.

SEASONAL DEMOGRAPHY OF A CYCLIC LEMMING POPULATION IN THE CANADIAN ARCTIC

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Lemmings (Avinngaq) have long fascinated both the layman and the scientific community because of the elusive factors that are responsible for their high-amplitude cyclic fluctuations of abundance. Several hypotheses have been suggested to explain the multi-annual population cycles of lemmings, such as the exhaustion of food and high mortality caused by predation. Both of these hypotheses can explain the periodic declines of lemming populations but a consensus about the main driving factor of their population change is lacking. We documented the seasonal timing of the decline phases and demographic parameters (survival and reproduction) associated with seasonal population changes in lemmings, which allowed us to evaluate specific predictions of each of these two hypotheses. We analysed the seasonal demography of brown lemmings (Lemmus trimucronatus), a species showing 3-4 year population cycles, on Bylot Island, Nunavut, using a unique dataset spanning a 10-year period (2004-2013) that combined capture-mark-recapture live-trapping data during the summer with the monitoring of nests during the winter. We also examined the effects of some weather variables (i.e. snow depth in spring and rainfall) on summer survival. We found that population declines after a peak occurred between the late summer and winter period and not at the end of the winter. During the summer, population growth was driven by change in survival, but not in fecundity or recruitment, whereas in winter population growth was driven by changes in late summer and winter reproduction. We did not find any evidence for direct density effects on summer demographic parameters. Weather effects on survival was detected only in early summer when lemming survival was positively related to snow depth at the onset of melt but negatively related to rainfall. Our results suggest that high predator-induced mortality causes population declines during the summer and fall, a period when predator density should be highest, and is likely sufficient to cause population crashes of lemmings. Our results are not consistent with food exhaustion hypothesis, as this should lead to population crashes in late winter, when food should be most limiting. During winter, high fecundity is the primary factor leading to population irruptions. The positive effect of snow depth on survival may be due to the protective cover from predators offered by snow. Our results support a multi-factorial hypothesis to explain lemming population dynamic where changes in survival and reproduction may be caused by both biotic (i.e. predation) and abiotic (i.e. snow cover and rainfall) factors. The general decline of the snow cover in the Arctic may represent a bad omen for lemmings because it may extend their period of vulnerability to predators during the snow-free period while reducing their potential for population growth under the snow.

LONG TERM PATTERNS OF SUSPENDED SEDIMENT TRANSPORT IN A HIGH ARCTIC RIVER

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Projected climate change is expected to have substantial impacts for Arctic ecosystems, especially altering the stability of the landscape and hydrological regime. Changes to the established patterns suspended sediment transport can impact downstream aquatic and coastal marine ecosystems, given that sediment acts as a substrate for both nutrients and contaminants alike. Furthermore, changes to sediment storage and release patterns in this region can signal climatically-induced alterations to the fluvial system. This study seeks to characterize the sediment transport dynamics and seasonal and decadal time scales in the West River (unofficial name) at the Cape Bounty Arctic Watershed Observatory (CBAWO) on Melville Island, Nunavut (74.91° N, 109.44° W). This river has over a decade of hydrological and sediment transport research that is unique in the Canadian Arctic. Specifically, this study investigates the linkages between channel snowpack, morphology and major sediment sources outside of the channel on erosion and the downstream transport of suspended sediment. During the nival melt period of the 2012 season, a bed-contact survey was undertaken along the West River to map areas of the bed that had made contact with the flow. Results highlight the importance of channel snowpack in isolating channel sediment from erosion and the need for downstream hydrological connectivity for efficient sediment transport. Following the nival melt, suspended sediment datasets were collected from a primary outlet station and six upstream locations to generate an inferred sediment budget to identify the sources and sinks of sediment in the reaches of the West River. The sediment budget was used to identify storage and release dynamics through an analysis of the spatially and temporally variable source and sink areas of the river, along with daily and event-scale hysteresis analysis. Results indicate that a sediment slug resulting from 2007 permafrost disturbance has impacted the West River through enhanced bed storage and slow downstream release.

Analysis of diurnal hysteresis relationships for the years 2004-2012 signal a shift in daily sediment-discharge hysteresis from primarily clockwise to counter-clockwise following an episode of permafrost disturbance and enhanced catchment erosion in 2007, suggesting sediment sourced from the upper catchment is increasingly important in the river. These results indicate that the river is responding to disturbance by increasingly storing suspended sediment as a slow-moving slug that has dampened the release of sediment but will prolong the impact. This study provides insights into the fluvial and geomorphological responses to perturbations affecting the Arctic rivers, as results from this study are broadly applicable to other High Arctic rivers. In particular, this study contributes to understanding the processes of sediment transport in response to warming Arctic temperatures, which is expected to increase as the century progresses, but has had limited study due to the emphasis on snow melt processes and hydrological fluxes in this region.

SHARK PREDATION: IS THIS HOW SEAL DISTRIBUTION WILL CHANGE WITH WARMING?

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We look at worldwide pinnipeds and use Arctic seals as an example in an effort to understand how species will re-distribute with changing climate. We compare world-wide shark and pinniped distribution to test for possible competition and predation by examining global species diversity patterns as a function of latitude. We used 294 shark species and collected data on trophic position, body size, and geographic distribution and contrasted similar data with 34 species of pinnipeds. Ecological relationships between the species groups were diverse with some larger sharks actively consuming pinnipeds. Most sharks (81%) overlap with pinnipeds for trophic position (3.3-4.3), with some (18%) sharks having a higher trophic position. Latitudinal variation of sharks and pinnipeds indicated that species richness of pinnipeds was bimodally higher at temperate latitudes and lowest at equatorial latitudes between +40 and -40, the geographic region where shark species richness was greatest. Results suggest that sharks may exclude pinnipeds from much of the warmer oceanic waters through direct predation. Looking at Arctic seals living with sea ice loss as an example, we find little support for bottom-up food limitation as a mechanism of distributional changes. However, evidence suggests that seal predators in the Arctic, such as Greenland sharks, may be more numerous and widespread than originally thought and may be increasing at the northern limits of their distribution. Further, the distributions of temperate shark species, such as the blue sharks, are expanding north. Therefore, top-down predation may be the mechanism of how Arctic and Subarctic pinnipeds will be forced to adjust their distribution as high latitude regions become inhabited by greater shark diversity initiating trophic cascades.

GAPS IN KNOWLEDGE TO INFORM ADAPTATION: FINDINGS FROM THE CANADIAN POLAR COMMISSION'S REPORT ON THE 'STATE OF NORTHERN KNOWLEDGE IN CANADA'

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Canada's North is undergoing significant change driven by a number of complex factors, with overlapping consequences for Northerners, their communities and cultures, their natural and built environments, northern economies and Canada as a nation. Earlier this year, the Canadian Polar Commission published a report on the 'State of Northern Knowledge in Canada' which presents significant research gains made since the beginning of International Polar Year in 2007 and identifies key knowledge gaps most critical to Northerners and the Canadian North in order to prepare for large-scale resource development; increase community sustainability; strengthen resilience; and understand environmental change. The report is built on semi-structured interviews with 114 northern researchers and practitioners, two-thirds of them resident in Canada's North. Interview input was corroborated through an extensive survey of peer-reviewed and grey literature and reinforced by further expert consultation. The full report including references is available on the Canadian Polar Commission's website: http://www.polarcom.gc.ca/sites/default/files/snk_report_english.pdf.

DOCUMENTING FOOD SECURITY INTERVENTIONS IN THE INUVIALUIT SETTLEMENT REGION: PARTICIPATORY EVALUATION OF COMMUNITY FREEZER INITIATIVES

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Recent studies indicate alarming rates of household food insecurity in the Canadian Arctic, which, in conjunction with the current nutrition transition, impact the health and well-being of the Inuit population. Since food security is multifaceted, there is a need to develop a holistic understanding of its determinants. This enables the development of effective and culturally appropriate strategies to guarantee the continuous availability of, access to, quality of and use of both traditional and market food. As part of our participatory research on food security and food safety, we held a 2-day workshop in Inuvik (NT) in May 2014 with key health and wildlife stakeholders from the Inuvialuit Settlement Region (ISR). Among a range of food security interventions discussed, participants highlighted community freezers as a focal area for further consideration as they can increase community member access to country food all year long. Since communities from the ISR have had different experiences with community freezers, participants encouraged the documentation and evaluation of elements of success and non-success to inform the development of future initiatives. We are developing a framework to document and evaluate past and current local-scale food security interventions in the six ISR communities using community freezers as a case study. A participatory evaluation methodology is being followed, with active engagement of regional and local stakeholders, including the Inuvialuit Regional Corporation, Community Corporations, Hunters and Trappers Committees and community members. In a first phase (Fall 2014), we are working with key informants to identify culturally relevant evaluation questions and outcome indicators. In a second phase (Winter 2015), we will collect the data to complete the evaluation. This participatory evaluation process will provide a mixed qualitative and quantitative understanding of community freezer initiatives in the ISR, identifying elements of success and non-success. Outcomes will improve decision-making and design of future food security interventions. The authors acknowledge funding from ArcticNet.

CONTEXT MATTERS: DEVELOPING AN APPROACH FOR FOOD SYSTEMS RESEARCH IN RIGOLET, NUNATSIAVUT

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Food research in the Canadian North is mainly focused on the challenges that communities face in accessing traditional and market foods. These challenges are attributed to a complex combination of factors including climate change, social and economic shifts, colonial legacies, and the remote geography of Northern communities. Despite these challenges, communities across the Circumpolar North are resilient in maintaining food as a core element of their culture and economies. It is therefore essential to search deeper, beyond the generalized experiences, to gain a contextual understanding of individual communities and the intricacies of their local food systems. This presentation will discuss the importance of careful consideration of local contexts in food systems research by examining the process of a Masters research project in Rigolet, Nunatsiavut conducted in partnership with the Rigolet Inuit Community Government. The project examines community members' perceptions, preferences and experiences with both wild and market foods in an effort to contribute to a holistic understanding of the food system. The selection of methods and their adaptation to the study context will be examined with particular focus on the use of photo cards and food inventories. Examples will be given from the research of how local connections to the land and culture have been central aspects of the research design. The importance of the contributions from community-based researchers to all elements of the project, including study design and data collection, will also be discussed. The presentation will speak to the benefits of considering context throughout all phases of this research, as well as how these considerations led to stronger participation and engagement from participants and the community.

CITIZEN SCIENCE PROGRAMS IN CHURCHILL, MB: COMBINING SCIENCE OUTREACH WITH LONG-TERM RESEARCH GOALS AT THE ARCTIC'S EDGE

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The "Climate Change at Arctic's Edge" research program, funded in part by the EarthWatch Institute, has been an important opportunity for citizen scientists from around the

globe to be engaged in subarctic climate change research in Churchill, Manitoba, and the Mackenzie Mountains, NWT. Citizen science (CS) is receiving increased attention in recent years as new opportunities emerge for the engagement of citizens on both local and global scales to collect data, share, and interact within an active research program. A major goal of CS is to benefit research activities, while simultaneously providing a positive experience to participants. In line with this goal, data gathered through the "Climate Change at Arctic's Edge" program provide useful input for snowpack, permafrost, treeline, and wetland ecology research while also engaging these citizens in on-going discussions about the nature of science, environmental awareness, and global environmental and sustainability issues surrounding climate change. With increased diversification of CS programs, there is a need to better understand how CS programs affect participants. This includes the development of methods to assess the impact of the experience on CS participants. As such, this presentation will discuss the aforementioned CS program, highlighting program design over the last 15 years and how it has influenced participants' awareness of environmental issues.

ARCTIC CHARR DISCOVERIES AND ADVENTURES ON THE SIXTH LARGEST LAKE IN CANADA: NETTLING LAKE, NUNAVUT

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In 2013 Expedition Q – a group crossing Baffin Island using traditional sea kayaks – discovered a previously unknown arctic char migration on the Amadjuak River which flows from Amadjuak Lake into Nettilling Lake to the North. Nettilling Lake is the biggest lake in the Eastern arctic and is the sixth largest lake in Canada. It is has both sea-run and resident char within its waters. The subpopulation of sea run char is estimated to be the largest in Nunavut; no estimates of the resident char population have ever been made. Nettilling Lake also has the largest commercial quota in Nunavut, none of which is being harvested due to a lack of economic viability. The discovery that substantial numbers of char migrate south enriches our knowledge of this ecosystem, and raises the possibility that a viable winter fishery could be established that would supply the currently underserved Iqaluit market. In August 2014 a scientific expedition was mounted as a collaboration between the Ocean Tracking Network, the Government of Nunavut's Fisheries and Sealing division, the Federal Department of Fisheries and Oceans, Expedition Q, and Project Nunavut – an Iqaluit based social enterprise. The goal of the expedition was to make the first recorded descent of the Amadjuak River in order to tag char as they were migrating south and to set acoustic telemetry gates that demarcated plausible end points of the char's southward migration. The telemetry data from the project will provide insight into the timing and extent of the migration in the Amadjuak River. In addition fin clippings were taken from tagged char in order to provide isotope and DNA analysis that will determine, among other things, whether the char are sea-run or resident to the lake system. This project is a model for the benefits of recognizing the overlapping interest between local and national research priorities and of sharing expertise and resources to achieve positive outcomes that would otherwise be impossible.

CABLED OBSERVATORY OPERATIONS FOR COASTAL COMMUNITIES: OCEAN NETWORKS CANADA'S CAMBRIDGE BAY OBSERVATORY AND "SMART OCEANS" PROJECTS

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The rapidly changing physical, economic, and social environments in the Arctic have created a strong need for improved data collection to serve the local and scientific communities as well as government and industry stakeholders. However, the extreme environmental conditions, logistics, sheer geographical size, and length of coastline are only some of the challenges associated with collecting high-quality real time relevant data in the Arctic. The Cambridge Bay community-based cabled observatory is now displaying and archiving its third year of continuous real-time data such as water properties, ice draft, underwater imagery, local weather, and commercial ship traffic. Due to the size and design of the instrument platforms, the Cambridge Bay underwater platforms can be serviced and maintained for a much lower cost relative to other cabled observatories. In addition, annual maintenance visits to the site have provided an opportunity to develop partnerships within the local community and school, with Canadian industry looking to test new technology, and with Canadian universities and researchers. The Cambridge Bay observatory has served as the proof-of-concept for Ocean Networks Canada's "Smart Oceans" projects which aim to use a wide distribution of multi-

parameter observatory sites to improve marine safety, drive new economic benefit to Canada, and support First Nations priorities. This approach of dispersing coastal-community observatories throughout the Canadian Arctic, which emulates Ocean Networks Canada's "Smart Oceans BC "project, would provide the real-time data access and low maintenance-cost benefits inherent to cabled observatories while also covering a much greater geographical area than a single-cable observatory network of the same cost. It is the goal of "Smart Oceans North" to combine different types of data from a network of monitoring sites to capture the diverse environments and create a baseline to track a rapidly changing region.

CULTURAL RESILIENCE OF SOCIAL-ECOLOGICAL SYSTEMS IN THE NENETS AND YAMAL-NENETS AUTONOMOUS OKRUGS, RUSSIA: A FOCUS ON REINDEER NOMADS OF THE TUNDRA

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Empirical data on resilience in social-ecological systems (SESs) are reviewed from local and regional scale case studies among full-time nomads in the neighboring Nenets and Yamal-Nenets Autonomous Okrugs, Russia. The focus is on critical cultural factors contributing to SES resilience. In particular, this work presents an integrated view of people situated in specific tundra landscapes that face significantly different prospects for adaptation depending on existing or planned infrastructure associated with oil and gas development. Factors contributing to general resilience are compared to those that are adapted to certain spatial and temporal contexts. Environmental factors include ample space and an abundance of resources, such as fish and game (e.g., geese), to augment the diet of not only the migratory herders, but also residents from coastal settlements. In contrast to other regions, such as the Nenets Okrug, Yamal Nenets households consist of intact nuclear families with high retention among youth in the nomadic tundra population. Accepting attitudes toward exogenous drivers such as climate change and industrial development appear to play a significant role in how people react to both extreme weather events and piecemeal confiscation or degradation of territory. Consciousness of their role as responsible stewards of the territories they occupy has likely been a factor in maintaining viable wildlife populations over centuries. Institutions administering reindeer herding have remained flexible, especially on Yamal, and so accommodate decision-making that is sensitive to herders' needs and timetables. This affects factors such as herd demography, mobility and energetics. Resilience is further facilitated within the existing governance regimes by herders' own agency, most recently in the post-Soviet shift to smaller, privately managed herds that can better utilize available pastures in a highly dynamic environment experiencing rapid socio-economic, climate and land use change.

CIRCUMPOLAR ARCTIC COASTAL COMMUNITIES OBSERVATORY NETWORK (CACCON)

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CACCON ("Catch-On") initiates a pan-Arctic network of community-engaged, multi-faceted and integrative coastal observatories and knowledge hubs. This ICARP-III initiative builds on the results of an initial scoping workshop in April 2014, with support from LOICZ (Land-Ocean Interactions in the Coastal Zone) and IASC (International Arctic Science Committee), involving four IASC Working Groups, and addresses a gap identified in the 2011 State of the Arctic Coast report. The CACCON observatories will facilitate co-design of research agendas and co-production of knowledge with local and regional stakeholders, building capacity through sharing insights between stakeholder peers across the circumpolar world to identify information needs and transdisciplinary insights. Following best practices in co-design, the network will work with governments, industries, communities, and researchers, including early-career and indigenous scientists, to collaborate in the identification of key research questions relevant to pan-Arctic, regional and specific community situations. The starting point for the network will be existing coastal observational datasets or monitoring programs, in the biophysical and social sciences, as well as existing community-based monitoring programs and compilations of local and traditional knowledge. Through a collaborative process involving end users, information available from these existing sources will be assessed to extract a set of indicators that will be relevant for local, regional, and larger-scale decision-making. These indicators will then define

a core set of future community-based observations, providing a basis for policy development and planning, to be supplemented by efforts supporting locally-identified priority issues. The information emanating from CACCON knowledge hubs will be used to inform and support local and regional evidence-based decision-making and adaptation planning in the rapidly changing Arctic coastal environment, and will feed back into the network to prioritize research agendas. Several localities in five Arctic nations have been identified and consulted as potential hubs in an initial network trial. These are Lorino and other nearby communities in Chukotka (Russian Federation), the city of Murmansk and smaller communities in the Murmansk District (Russian Federation), Shishmaref and vicinity in northwest Alaska (USA), the Inuvialuit Settlement Region (ISR) in the Yukon and Northwest Territories (Canada), Clyde River in the Baffin region of Nunavut (Canada), Nunatsiavut in Labrador (Canada), the municipality of Kujalleq (South Greenland) and the municipality of Unjárgga/Nesseby in Finnmark (Norway). As a consequence of climate change, changing demographics, resource shifts and extraction, and globalization, northern coastal zones are rapidly changing social-ecological systems. There is an urgent need to support formal and informal adaptation processes in ways that address the local priorities of coastal communities in the Arctic, while simultaneously addressing larger-scale issues of social-ecological change. Moreover, once established, it is critical that these adaptation processes and decision-making models be sustainable within the region. The network of integrated Arctic coastal community observatories and knowledge hubs will address this important gap

RIDING THE FLOOD WAVE: PARTICIPATORY TRACKING OF SPRING BREAKUP IN THE MACKENZIE DELTA AND BEAUFORT SEA

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Since 2006, a daily newsletter has been produced and distributed by e-mail during the spring breakup season in the Mackenzie Delta and southeastern Beaufort Sea. Initially led by our late colleague, Steven Solomon, this was originally intended primarily as a research tool. Over time, the value of near real-time tracking of water levels, breakup, and flood extent derived from a variety of sources, combined in a readily accessible format, became apparent as the mailing list grew to more than 300. Experience accumulated from 9 years of breakup tracking supports interpretation provided in the newsletter. The regional coverage includes the Inuvialuit Settlement Region (Aklavik, Inuvik, Tuktoyaktuk, Paulatuk, Sachs Harbour, Ulukhaktok) and the Gwich'in communities of Tsiigehtchic and Fort McPherson. The readership includes community leaders, hunters and trappers, other residents, land managers, emergency planners, policy advisors, the research community, industrial players, and more. The data supporting regular updates on flood and breakup conditions include on-line, real-time, weather data and water levels (Environment Canada), daily MODIS satellite imagery (NASA), and multiple scenes of Radarsat-2 synthetic aperture radar imagery. These provide information on water levels, timing of the freshet, and events such as flood crest, ice jams, and first flow or ice overflow in delta-front channels. The satellite imagery provides visual representation of the progress of snowmelt, river- and sea-ice decay, over-ice and overbank flooding, and the expansion of the sediment plume seaward of the delta. In the early years of the newsletter, field observations of breakup and flooding were conducted by personnel from Natural Resources Canada, Environment Canada, Fisheries and Oceans Canada, Chevron Canada Resources, Simon Fraser University, University of Alberta, and others, providing ground-truth validation of remote earth observation data. With a decline in the level of scientific field activity, the newsletter has relied for several years on reports and photographs contributed by observers living and working in the region and, in most cases, personally affected by breakup events. The richness of this locally sourced information and the ability to reflect it back to the region has transformed the newsletter. To some extent, it has become a community resource and two-way communication tool. Reports and photographs from camps in the delta and from many of the communities have been shared through daily reporting, providing on-the-ground intelligence on current conditions. As we prepare for the tenth season of the newsletter in its current form, the annual series of past newsletters is being published for reference purposes. We are seeking to begin a conversation on new approaches to share near real-time information, capture it appropriately for later analysis, and disseminate it widely to stakeholders both inside and outside the region. This is likely to be most meaningful and sustainable if led from within the region, identified in the work plan of one or more individuals, supported by relevant government agencies, included in the wider framework of community-based monitoring activities, and partnered with similar efforts elsewhere in the north through initiatives such as the Circumpolar Arctic Coastal Communities Observatory Network (CACCON).

MONITORING PATHOGEN BIODIVERSITY IN THE ARCTIC: IDENTIFICATION OF A RECENTLY EMERGED BACTERIUM ASSOCIATED WITH LARGE-SCALE MORTALITY IN MUSKOXEN

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Infectious diseases are an important driver of wildlife health; pathogen surveillance and management consequently represent a necessary element for ensuring sustainable wildlife populations and food security for the people who depend upon them. The muskox is a keystone species and an important source of food and income for northern communities. Since 2010, summer mortality events involving up to hundreds of muskoxen have occurred in the Canadian Arctic archipelago, raising concerns about the health of these populations. Erysipelothrix rhusiopathiae, a zoonotic bacterium never previously reported in muskoxen or in the Arctic, was consistently isolated from multiple tissues of sampled carcasses. As part of the outbreak investigation, we performed whole-genome sequencing of E. rhusiopathiae isolated from muskox carcasses (n=11) from three outbreaks on Banks and Victoria Islands (2010-2012), from the bone marrow of a carcass found in Aulavik National Park on northern Banks Island in 2013, and from the tonsil of a healthy, hunter-killed muskox from Victoria Island. These sequences were compared to a wide range of isolates from swine, poultry, marine mammals and wild birds (n=64) on a global scale to provide context within which to evaluate the genetic diversity. Very little variability was found among the E. rhusiopathiae isolates from muskoxen, suggesting that these currently circulating strains originated from a recent common ancestor. To estimate how long E. rhusiopathiae has been circulating in muskoxen, we used two approaches: first, Bayesian phylogenetic methods were used to estimate the date of the most recent common ancestor of the muskox isolates, and second, archived serum samples collected over a 20-year period were tested using an adapted serology test for antibody detection. We show that E. rhusiopathiae has been present in muskox populations since at least the early 1990's. Investigating the genetic diversity was essential for distinguishing this bacterium as a recently emerged strain that has spread across several hundred kilometers within two decades. Further research into the epidemiology of E. rhusiopathiae in the Arctic will be essential, including investigating how it is spread and maintained in this environment.

PHYSICAL FORCINGS AND INTENSE SHELF-SLOPE FLUXES OF PARTICULATE MATTER IN THE MID-WATER COLUMN OF THE CANADIAN BEAUFORT SEA DURING WINTER

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Resolving the physical mechanisms that support the transfer of particulate matter across the shelf-slope interface is a key issue for the sustainable development of marine resources along continental margins. A better comprehension of shelf-slope exchange processes is particularly needed in the Arctic Ocean given the intensification of human activities and rapid environmental changes that prevail along the Arctic shelf. Here, we use three years of physical and biogeochemical data collected with mooring arrays deployed as part of the ArcticNet/Industry partnership and Beaufort Regional Environmental Assessment (BREA) from September 2009 to August 2012 over the slope of the Mackenzie Shelf to identify the processes that drive the lateral transport of particulate matter off the shelf. The main dataset consists of particle flux time-series collected with automated sediments traps deployed on tautline moorings at ~80 and ~180 m depth over the mid-slope. We detected a strong vertical discrepancy in the magnitude of particulate matter fluxes that were 20-600% higher at ~180 m than at ~80 m (in terms of absolute mass), and up to ~1500% greater during the winter season alone. The high fluxes at ~180 m depth were linked to several sedimentation events occurring from November to May

each year and that were not captured by the upper trap. The large differences between the two trap collections corroborate previous studies that documented active transport of suspended and/or resuspended material near the bottom across the shelf-break and in the mid-water column over the upper slope. Consideration of particle fluxes along with synchronous current and density time-series and regional meteorological data revealed that storm winds and thermohaline convection driven by sea ice growth may act synergistically as the main mechanisms for sediment resuspension on the shelf and upper slope through the generation of moderate- to high-velocity currents (~20-80 cm s-1) during fall and winter. Their combination drives mesoscale eddy formation and downwelling to transport particles in the mid-water column across and down the slope. Turbidity near the shelf-break and particle fluxes over the slope were particularly enhanced (fluxes of up to ~2000 mg DW m-2 d-1) when strong coastal downwelling occurred from January to April 2011. Overall, our mooring-based analysis revealed a complex pattern of net residual currents favorable to instabilities, shear and eddying motion that control particulate matter transport across the shelf-slope interface in the Beaufort Sea. Additional work is needed on erosion mechanisms in the bottom boundary layer and their relationship to regional and mesoscale circulation and eddy activity over the upper slope.

SPATIAL ECOTOXICOLOGY: HOW DO NON-BREEDING DISTRIBUTION OF MIGRATORY ARCTIC SEABIRDS AFFECT THEIR HG SEASONAL CONTAMINATION?

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The Arctic wildlife is exposed to increasing levels of pollutants in their environment, among which mercury (Hg) has raised important environmental concerns. Hence, defining concentrations, trends and ecotoxicological effects of Hg on Arctic organisms is essential for the conservation of vulnerable species and sensitive ecosystems, and has been the objective of various studies. However, many top-predators such as seabirds are highly mobile, often migrate over large distances and spend a large part of their cycle far from the Arctic, in areas where their exposure to contaminants remains largely unknown. By combining biotelemetry to pollutant analyses, we investigated the seasonal Hg contamination of little auks (Alle alle) in relation to their breeding distribution and migratory patterns, and showed how migratory long-lived top-predators such as seabirds, tracked with electronic devices, can be used to monitor pollution of marine ecosystems at large spatial scale. More specifically, we used geolocators to investigate the non-breeding distribution of three Arctic little auk populations from Greenland and Spitsbergen. We showed that birds from all sites were more contaminated when not breeding, with an important influence of migratory strategies on bird exposure to Hg. Furthermore, we found that bird exposure during their non-Arctic non-breeding period affect the following reproduction in the Arctic. We therefore believe that such seasonal processes should be considered to improve efforts in Arctic biodiversity conservation. Finally, we highlighted a non-breeding area located in the northwest Atlantic associated with a higher Hg contamination and merits further attention.

THE LATE PLEISTOCENE VISCOUNT MELVILLE SOUND ICESHELF: A VIEW FROM THE SEA FLOOR

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Recent work in the western Canadian Arctic Archipelago has seen a dramatic re-evaluation of the timing and extent of Late Wisconsinan glaciation by a primarily cold-based Laurentide Ice sheet. This has included the passage of ice across purportedly ice-free terrain as well as the extension of grounded ice throughout the central channels of the Northwest Passage, westwards onto the polar continental shelf. Although the pattern of ice extent and initial retreat is now better constrained in the terrestrial environment, significant questions remain regarding the ice retreat southeastwards from the marine channels onto mainland Canada in response to ameliorating climate and sea-level change. Earlier research along the coasts of Victoria, Banks, and Melville islands facing Viscount Melville Sound have demonstrated the retreat of grounded glacial ice from this >105,000 km2 basin by ~13.5 cal ka BP.

This was followed by the re-establishment of a floating iceshelf impinging on the coasts of Viscount Melville Sound ~10.9 cal ka BP. Molluscan chronologies suggest the establishment of the iceshelf was extremely rapid, persisting for some 800 years, and subsequently undergoing an equally rapid collapse. These terrestrial observations are now complemented by a series of Geological Survey of Canada / ArcticNet piston cores from the central part of Viscount Melville Sound, to test for the evidence of the short-lived ice shelf, especially to elaborate on the potential mechanisms and dynamics of iceshelf formation and collapse. Analyses of ice-rafted debris (IRD), coupled with micropalaeontological and chronostratigraphic data suggest a rapid ice advance into Viscount Melville Sound consistent with terrestrial interpretations. The presence of stratified, low shear strength diamictons (interpreted as "rain-out till") as well as IRD indicative of a Victoria Island / M'Clintock Channel provenance is considered a result of deposition from a debris-rich tongue of floating glacial ice associated with streaming ice exiting M'Clintock Channel, permitting the on-shore rafting of ice and emplacement of coastal till sequences and iceshelf moraines. The rapid transition from sub-iceshelf sediments to ice-proximal and distal deposits is also consistent with terrestrial evidence for the rapid retreat of the Viscount Melville Sound Iceshelf. AMS 14C-dated benthic foraminifera from above the iceshelf-marine transition provide a minimum age on iceshelf collapse of ~10.6 cal ka BP. Age-depth model projections indicate an approximate iceshelf collapse date far earlier than previously-published raised marine and terrestrial sequences indicate. This suggests an even more dramatic and short-lived large scale event than previously hypothesised; an iceshelf establishing itself in Viscount Melville Sound and then collapsing in <400 cal yrs. This detailed study contributes towards an improved understanding of the glaciological constraints placed on the streaming of ice from M'Clintock Channel into the sound and the resulting draw-down and destabilization of the NW sector of the Laurentide Ice Sheet. Furthermore, emerging foraminiferal, diatom, and biogeochemical data provide valuable insights into the deglacial and postglacial history of the western sector of the Northwest Passage.

POSTGLACIAL CLIMATE HISTORY OF THE CANADIAN ARCTIC AND GREENLAND FROM TERRESTRIAL AND FRESHWATER RECORDS

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A synthesis of 39 lake sediment records spanning from Banks Island, across to Ellesmere and Baffin Islands in the Canadian Arctic Archipelago (CAA) and around Greenland shows that the Holocene can be divided into three regimes, with transitions at 7.9 and 5.2ka. These results are coherent with previously published reconstructions from boreal Canada and Alaska, enabling the quantification of Holocene climates across all of Northern North America and Greenland. Maximum temperatures, up to 2oC warmer than the 20th century, occurred in the early Holocene in the western and central CAA, in the mid-Holocene in eastern Canada and much of Greenland, and in the late Holocene in areas surrounding the Labrador Sea and also in western Alaska. Most sites show cooling in the past 3.2ka. In some cases, multi-proxy records are available from sites, permitting an estimation of potential errors and variability and also illustrating the impact of climate variability on terrestrial and freshwater ecosystems. Higher frequency climate variability of decadal to century-scale variability superimposed on the Holocene climate changes.

INFLUENCE OF HIGH LIGHT EXPOSURE ON DMSP PRODUCTION BY UNDER-ICE ALGAL BLOOMS IN SPRING

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In polar regions, spring/summer under-ice algal blooms may be suddenly exposed to high irradiance in leads, polynyas or at the ice edge. During the Arctic-ICE project (Arctic marine Ice-associated ecosystem in a Changing Environment) in Resolute Passage (Nunavut), we experimentally determined during two successive years how such rapid increase in light affects the production of dimethylsulfoniopropionate (DMSP), an antioxidant compound, by under-ice algae in spring. Microalgae collected underneath the sea ice were incubated for 8 to 24 h under the ice and on the ice at irradiances mimicking the conditions they would encounter in the surface mixed layer of ice-free waters. In 2010, the increase in irradiance generated the same response during all four experiments, i.e., a rapid (6 to 8 h) decrease in chlorophyll a (bleaching) and a quasi-total release of their intracellular DMSP content (DMSPp) into the dissolved phase (DMSPd). In 2011, only the first experiment resulted in a bleaching of the cells and a rapid exudation of DMSP. All other experiments showed no effect of light on

chlorophyll a and DMSP. The inter-annual variations in the sensitivity of the under-ice algae to light may be attributed to a change in the species dominance of the under-ice bloom: centric diatoms in 2010 were more prone to bleaching and releasing their DMSP content when exposed to a sudden increase in light than sympagic pennate diatoms in 2011. In addition, under-ice irradiance was higher in 2011 that in 2010 during the under-ice blooms, suggesting that the light history of the algal cells could have also shape their response to the sharp increase in light they experience when exiting the protective ice pack.

GETTING READY TO RESPOND: UNDERSTANDING AND ADDRESSING DIVERSE SEARCH AND RESCUE NEEDS IN THE CANADIAN ARCTIC

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Relationships form the foundation of addressing the complex challenges in Canada's North. For search and rescue, when time is of the essence, the strength of relationships is acutely felt. Trust is critical for response coordination, efficacy, and success. For the past two years, the Munk-Gordon Arctic Security Program has explored Canada's complex search and rescue landscape. It was revealed that the depth of this complexity impacts those tasked with preventing and responding to search and rescue needs in the region. Through a series of research projects and stakeholder consultations, several recommendations emerged, including: • Increased focus on northern residents, opposed to an exclusive focus on visitors to the region; • Skill development for search and rescue volunteers, including for those whose first language is not English; • Sharing traditional knowledge and technical SAR training using a "two-way knowledge exchange;" • Prepositioning of federal air assets north of the 60th parallel; and • Increase in publicly available GPS location devices, and an examination of the feasibility of two-way devices. The process of arriving at these recommendations revealed how a strictly technical approach to Arctic SAR training cannot adequately address the region's diversity. The best preparation is a combination of technical training with continuous knowledge sharing and relationship building with those on the ground and in communities. It can sometimes be as simple as bringing people together in a room. This presentation will explore the different perspectives and processes that led to these final recommendations, and how nuance will continue to be an important element of search and rescue coordination in Canada's Arctic region. Ultimately, a comprehensive approach to Arctic search and rescue would create a system that is "more than the sum of its parts." However, this will require deeper analysis of the relationship between diverse local, indigenous (and to some extent, territorial) practises and their federal/international SAR counterparts.

MONITORING OF TERRESTRIAL WILDLIFE ON BYLOT ISLAND IN A GLOBAL WARMING CONTEXT: WHAT DID WE LEARN AFTER 20 YEARS?

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Arctic wildlife is often presented as being highly at risk in the face of current climate warming. However, studies documenting clear impacts of warming on wildlife species are still scarce. Detecting temporal trends in animal populations (or their attributes, e.g. phenology) requires long-term datasets with sufficient sample size, which are rare in the Arctic. We will use data from the long-term (up to 20+ years) monitoring program available on Bylot Island in the Canadian Arctic to examine temporal trends in population attributes of several terrestrial vertebrates and in primary production. This program is unique because it embraces all the key elements of an entire arctic terrestrial ecosystem, including species interactions, The food web on Bylot Island is dominated by small and medium-size herbivores (snow goose and lemmings), insectivores (shorebirds and passerines) and their predators (arctic fox, stoat and birds of prey; red fox is also present at low density). Our weather station revealed that, over the past 24 years, a warming trend was detected in all summer months and was strongest in spring (May) and late summer (August; ~1 C of warming per decade). As a result, the cumulative thawing degree-days increased by 37% over that period and snow melt advanced by 4 to 7 days. Despite these climatic trends, we did not find evidence for change in the nesting phenology, abundance or productivity of geese, passerines or birds of prey during that time. Lemmings have maintained their 3-4 year cyclic dynamic throughout a 22-year period although we found temporal variation in the amplitude of their oscillations. Production of arctic foxes did not show any trend despite annual variations, and the relative proportion of arctic and red foxes did not change in the area during the study period. Only primary production showed a response to warming as annual aboveground biomass of wetland graminoids increased by 123% during this period. We nonetheless found evidence for potential mismatches between herbivores and their food plants in response to warming as

snow geese adjusted their laying date by only 3.8 d on average for a change in snow-melt of 10 d, half of the corresponding adjustment shown by the timing of plant growth (7.1 d). We discuss several reasons (duration of time series, large annual variability, amplitude of observed climate change, non-linear dynamic or constraints imposed by various rates of warming with latitude in migrants) to explain the general lack of response by herbivores and predators to climate warming at our study site. It is unclear if the observed lack of response is good news (the ecosystem is resilient to the rapid climate change) or bad news (the ecosystem fails to adapt to the rapid climate change).

VERTICAL SEGREGATION OF ARCTIC COD (BOREOGADUS SAIDA) EARLY STAGES AND ADULTS OVER THE ANNUAL CYCLE IN THE CANADIAN BEAUFORT SEA

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Hydroacoustic surveys were conducted in the Canadian Beaufort Sea from 2006 to 2012 with a multi-frequency echosounder and a fisheries sonar to document the vertical distribution and migrations of Arctic cod (Boreogadus saida) over an annual cycle. New regressions between Target Strength-Standard Length and weight-Standard Length were calculated to estimate fish size and biomass. Arctic cod was by far the dominant species and represented 95% of the pelagic fish community. No surface schools were detected and the length of Arctic cod increased with depth. Age-1+ Arctic cod remained at depth >100 m in winter and densely aggregated over the continental slope from December to April. Age-1+ had a scattered distribution at depths >200 m the rest of the year and formed a mesopelagic layer of fish in the Atlantic waters. Fish biomass within this mesopelagic layer diminished in July, most likely as Arctic cod larger than 10 cm migrated towards the seafloor to avoid visual predators. Fish >10 cm started returning in the mesopelagic zone in August. Early stages remained in the upper 100 m after hatching, forming an epipelagic layer of fish from June to November. In autumn, YOY Arctic cod started descending towards the mesopelagic fish layer upon reaching a standard length between 3 and 5.5 cm and late hatchers possibly recruited to the ice-cover. YOY performed diel vertical migrations from spring to fall and age-1+ from the end of August until mid-May. This study demonstrates that, in the Beaufort Sea, most adult Arctic cod remain in the deeper water layers throughout the year and that their ecosystem would be vulnerable in the event of deep oil spills over the slope.

AUV-BASED ACOUSTIC OBSERVATIONS OF THE SUMMER DISTRIBUTION AND PATCHINESS OF ZOOPLANKTON IN SPITSBERGEN

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An Autonomous Underwater Vehicle (AUV) was deployed in three fjords and one offshore location in Spitsbergen, Norway, in July 2010. An upward- and downward-looking 600 kHz RDI Acoustic Doppler Current Profiler (ADCP) mounted on the AUV allowed testing the hypothesis that AUV-mounted ADCPs can be used for biological studies. The backscatter signal was extracted and analysed to document the vertical distribution and migrations of zooplankton in the different areas. The acoustic backscatter and physical data were coupled to study the effects of the different water masses on the abundance and distribution of zooplankton and the occurrence of Diel Vertical Migrations (DVM) in summer. In particular, we verified if the presence or absence of Atlantic waters had an impact on the biomass of zooplankton. No DVM were detected at that time of the year and results indicate that the summer vertical distribution of zooplankton was related to depth rather than water masses. In the fjords, most of the biomass was distributed above the pycnocline, in the top 50 m. On the contrary, at the offshore location the biomass increased at depth >100 m. In addition, a patchiness index was calculated and suggested a patchy distribution of the zooplankton. This study demonstrates that backscatter data from AUV-mounted ADCPs can be used for biological studies in the Arctic. These instruments can provide high spatial resolution and large-scale measurements of zooplankton biomass and distribution compared to net deployments or moored ADCPs.

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Geoffroy, Maxime(1) (maxime.geoffroy.1@ulaval.ca), A. Majewski (2), M. LeBlanc (1), S. Gauthier (3), W. Walkusz (2), J. D. Reist (2) and L. Fortier (1)

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Hydroacoustic surveys were conducted in the Canadian Beaufort Sea from 2006 to 2012 with a multi-frequency echosounder and a fisheries sonar to document the vertical distribution and migrations of Arctic cod (Boreogadus saida) over an annual cycle. New regressions between Target Strength-Standard Length and weight-Standard Length were calculated to estimate fish size and biomass. Arctic cod was by far the dominant species and represented 95% of the pelagic fish community. No surface schools were detected and the length of Arctic cod increased with depth. Age-1+ Arctic cod remained at depth >100 m in winter and densely aggregated over the continental slope from December to April. Age-1+ had a scattered distribution at depths >200 m the rest of the year and formed a mesopelagic layer of fish in the Atlantic waters. Fish biomass within this mesopelagic layer diminished in July, most likely as Arctic cod larger than 10 cm migrated towards the seafloor to avoid visual predators. Fish >10 cm started returning in the mesopelagic zone in August. Early stages remained in the upper 100 m after hatching, forming an epipelagic layer of fish from June to November. In autumn, YOY Arctic cod started descending towards the mesopelagic fish layer upon reaching a standard length between 3 and 5.5 cm and late hatchers possibly recruited to the ice-cover. YOY performed diel vertical migrations from spring to fall and age-1+ from the end of August until mid-May. This study demonstrates that, in the Beaufort Sea, most adult Arctic cod remain in the deeper water layers throughout the year and that their ecosystem would be vulnerable in the event of deep oil spills over the slope.

POLICIES AND TOOLS TO SUPPORT RENEWABLE ENERGY DEVELOPMENT: TAKEAWAYS FOR THE ARCTIC FROM THE REST OF THE WORLD

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Renewable sources seem to be a straightforward way to provide "sustainable energy for all" in the Arctic. The Arctic has vast reserves of renewable energy – hydro-, bio-, wind and geothermal. Renewable energy technologies have been successfully tested and put in operation in the Arctic. Large-scale hydro-power accounts for up to 75% of electricity in Greenland and a significant share of electricity supply in northern Norway, Russia, Iceland and some other parts of the Arctic. Small-scale renewable energy technologies and off-grid solutions for remote communities have also been successfully applied in the Arctic. There are striking similarities and synergies in terms of renewable energy solutions for small remote communities in the Arctic and in small island and archipelago states, in some of which (for instance, the Philippines or Cape Verde) renewable energy accounts for 25-30 per cent of electricity generation, with successful off-grid installations. Yet, despite this evidence in favour of renewable energy development in the Arctic, the take-off of renewable energy in the region is slow. The work that the International Institute for Sustainable Development (IISD) has undertaken on successful policies for deployment of renewables around the world suggests several lessons learned that may be highly relevant for the Arctic: - Clear long-term policies supporting renewables are essential to ensure investors' decisions; - In particular, phase-out of subsidies to fossil fuels such as the highly-subsidized diesel in the Arctic, is essential to promote renewable energy. Subsidies to fossil fuels distort the playing field for renewable energy that can be cost-competitive in remote communities if there are no such distortions; - Fossil-fuel subsidy reform should be well-communicated and include transition and mitigation measures for the groups that heavily depend on subsidized diesel, for instance, local transport, fisherman, small businesses; - Dedicated funds to support renewable energy development can be accumulated in a number of ways, including through environmental taxes (carbon tax, taxes on pollution, etc.) The non-affectation principle requires that tax revenues not be ring-fenced, but political economy benefits may override this principle.

EXTRACTIVES IN THE ARCTIC: AT WHAT COST? CASE STUDIES OF GOVERNMENT SUPPORT TO EXTRACTIVE PROJECTS IN RUSSIA AND CANADA

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What are the costs of Arctic oil, gas and gold, and who is paying them? Several studies have attempted to give a range of breakeven prices for extractives in the Arctic, but the extent of government support to exploration and development in the Arctic has been hard to define and compare between countries. The International Institute for Sustainable Development (IISD) has prepared first-of-a-kind studies quantifying federal and some regional subsidies to oil and gas in Canada and Russia. The estimates have provoked a lot of debate in both countries, which the research team have addressed through broader research approaches and modelling in its new case studies on individual Arctic projects: the Yamal LNG and Prirazlomnoye hydrocarbon developments in Russia and the Meadowbank gold mine in Canada. The case studies inform a discussion of social costs and benefits of the projects receiving government support in the Arctic, including at the community level. This work has created the basis for IISD's frameworks for increasing transparency of such extractive projects, and ways forward towards more sustainable natural resource policies in the Arctic. Link to the Russian case studies report: http://www.iisd.org/publications/government-support-upstream-oil-gas-russia-how-subsidies-influence The case study of the Meadowbank mine in Nunvut is work in progress, presentable as of December 2014.

THE CHALLENGE OF MEASURING "SUCCESS" IN TRANSDISCIPLINARY EVIDENCE-BASED STAKEHOLDER DIALOGUE PROCESSES IN THE ARCTIC REALM: POTENTIALS AND PITFALLS OF QUANTITATIVE AND QUALITATIVE METRICS

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Various societal systems around the globe have endorsed a scientific-evidence based technocratic approach to decision-making. Thus the question is not if we should invest in science, but rather to what extent and in which way. What do stakeholders expect in return? And in which way they would like to be involved or like to have the scientific output being presented? These questions are central to understand the reasons for policies, the ways in which policies are formulated, processes of policy implementation, and the effects policies have on people and society. Such issues surface especially in coastal and marine ecosystems of the Arctic in the context of climate change, where a whole bundle of different utilizations, mind-sets (western and indigenous), cultural values, as well as different geo-biophysical units clash together. This calls for interdisciplinary and transdisciplinary research efforts that effectively bridge the gap between different spheres of knowledge. Although each discipline defines scales in a subtly different way, both ecological and social processes roughly correspond to certain spatial scales. However, while natural scientists operate with relatively well-defined hierarchical systems of analysis, social scientists employ a far greater variety of scales with a less precise scale definition. This given, metrics of "success" that effectively measure and demonstrate the impact of science for society on an evidence-based manner are difficult to develop. This is rooted in several different aspects, one of which pertains to the role of evidence within knowledge generation, knowledge sharing, combining knowledge and knowledge-based decision-making. Possible potentials and pitfalls of quantitative and qualitative metrics are discussed and future challenges outlined. A blueprint for a globally focused but regionally evidence-based criteria framework for stakeholder dialogue processes remains to be worked out.

PALEOHYDROGRAPHY OF BAFFIN BAY DURING THE LAST CLIMATIC CYCLE FROM MICROFOSSIL RECORDS

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Baffin Bay is a semi-enclosed arctic basin through which about 50% of Arctic freshwater is exported towards the North Atlantic Ocean. Changes in past Arctic freshwater (solid and liquid) outflow through Baffin Bay probably played an important role in Labrador Sea Water formation and thus North Atlantic overturning circulation. The paleoceanography of Baffin Bay, however, remains imperfectly known because of low biogenic production, high terrigenous inputs, and poor carbonate preservation making it difficult to set a chronology and reconstruct past ocean conditions. Paleomagnetic measurements in a deep Baffin Bay core (HU2008-029-016) coupled with paleoceanographic records of surrounding cores have provided a chronostratigraphic framework spanning the last ~116 ka. The oxygen isotopic composition (?18O) of benthic and planktic (Npl) foraminifera were analysed, and organic-walled dinoflagellate cyst (dinocyst) assemblages were examined to reconstruct the bottom, subsurface, and surface water conditions from the core sediments. Very low microfossil abundance characterizes Marine Isotope Stage (MIS) 4 and 2 likely due to a harsh, ice covered environment. Episodes marked by high ?18O values (>+4‰ vs VPDB) in both the subsurface and bottom waters were identified during MIS 5d, 3 and the MIS 2/1 transition, likely in response to the advection of saline Atlantic water. The absence of dinocysts during these intervals points toward extremely low productivity probably due to a perennial sea ice cover. Episodes with slightly lighter ?18O-Npl values, some concurrent with dinocysts, were

recorded during MIS 5c, 5a, 3 and the 2/1 transition. These intervals were also marked by an incursion of Atlantic water into the Bay, as well as occasional summer opening of the perennial sea ice cover. Therefore, they correspond to slightly milder conditions. Dinocyst assemblages from postglacial sediments change from a heterotrophic species assemblage which tolerates cold, near permanent ice-covered conditions, to assemblages characterized by a higher diversity and the occurrence of phototrophic taxa associated with North Atlantic waters. Sea surface reconstructions using the modern analogue technique display a shift from harsh, quasi-perennial ice cover to warmer summer sea surface temperatures and a seasonal sea ice. Due to carbonate dissolution, the timing of this shift in central Baffin Bay remains poorly constrained. However, the same regime shift occurred south of the Davis Strait sill at ca. 11.9 cal ka BP under the influence of North Atlantic waters, while eastern Baffin Bay remained densely sea ice covered until about 7.4 cal ka BP, when these warmer waters penetrated in to the Bay. This mixing was facilitated by the retreat of the Greenland Ice Sheet margins and breakup of the Laurentide Ice Sheet. Almost synchronously to the main shift in Baffin Bay at ~7.6 cal ka BP, a weakening of the upper water stratification is recorded in the Labrador Sea due to the reduction in freshwater meltwater supplies, finally allowing winter convection and the inception of Labrador Sea Water formation. Late Holocene records demonstrate large fluctuations in sea surface conditions tightly controlled by the relative strengths and shifts of the warmer West Greenland Current and colder Baffin Island Current.

PUTTING IT ALL TO THE TEST: LESSONS LEARNED DURING OUR RECENT RESCUE IN THE CANADIAN ARCTIC

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Late in the summer of 2014, a graduate student working in the Arctic as part of an Environment Canada seabird research team was very seriously injured when a bolder suddenly dislodged from a cliff face striking him. This random occurrence triggered a series of events in which field staff on site, local Search and Rescue personnel from the nearby community of Ivujivik, and SARTECH teams of the Canadian Air Force (dispatched from southern Canada), all worked together to accomplish his rescue. We will review the events as they occurred and the roles and effective integration of these rescue teams who worked together over many hours to stabilize, rescue, and transport a gravely injured person from the accident location on a remote cliff ledge, to emergency medical care waiting for him in Winnipeg, Manitoba. The entire incident has since been externally reviewed and this presentation is meant to disseminate 'lessons learned' for the benefit of all those working and living in the north. We will highlight those factors that contributed to a positive outcome of the incident including the degree of prior training of field staff, team selection, equipment available on site, communication technologies, and Post Critical Incident Counselling provided to those affected. We will also highlight shortcomings that were identified and what we intend to do to address them. Finally, we will review the medical evacuation and disability insurance policies that we now recommend for field workers in general, and graduate students in particular; issues that are very necessary for recovery and positive long-term outcomes, but that often over-looked by those working in remote and dangerous northern locations.

OCEAN CIRCULATION AND MARINE TERMINATING GLACIERS OF THE GREENLAND ICE SHEET

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It has been shown that warm Irminger Water has played a role in accelerating marine terminating glaciers around Greenland. As well melting and freshwater discharge from the Greenland Ice Sheet has been increasing with time. Two questions we explore are classifying the relatively warmer waters that reach the fjords of the Greenland Ice Sheet and where the low salinity melt water will go and thus how and where it will be taken up in the Atlantic Ocean. We will examine these questions using the output from a series of ocean general circulation models ranging in resolution from 1/4 degree to 1/12 degree. Pathways will be tracked using the Ariane Lagrangian flow package to look at probabilities of freshwater from given glaciers reaching given parts of the Atlantic Ocean as well as reverse trajectory analysis of the warm Irminger water source.

SCIENCE FOR THE PEOPLE: DEVELOPING FISH AND MARINE MAMMAL RESEARCH PRIORITIES BASED ON INUVIALUIT TRADITIONAL KNOWLEDGE AND COMMUNITY NEEDS

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The Fisheries Joint Management Committee (FJMC) was established in 1986 to provide advice to both the Inuvialuit and Fisheries and Oceans Canada (DFO) on issues related to fish and marine mammal management within the Inuvialuit Settlement Region (ISR). One of the primary tasks of the FJMC is to ensure that fish and marine mammal research and monitoring efforts within the ISR accurately address the priorities and management objectives of Inuvialuit hunters and fishers. This task is accomplished through an annual communication and decision-making process that focuses on: 1) discussing fish and marine mammal stocks and management concerns with the ISR Hunters and Trappers Committees; 2) reviewing, outlining and communicating ISR-wide and community-specific priorities to DFO; 3) allocating available research funding based on Inuvialuit priorities. This is an adaptive process that has evolved to ensure that the FJMC continually support the needs of the Inuvialuit for the management of their resources. Over the past 28 years, this process has successfully facilitated a continuous dialogue between the Inuvialuit and researchers working in the ISR, and has helped to unite these groups towards the achievement of common goals.

TROPHIC PATTERNS OF ARCTIC FISHES IN THE CANADIAN BEAUFORT SEA: A FATTY ACID AND STABLE ISOTOPES APPROACH

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Fatty acid (FA) and stable isotopes (SIA) analyses were used to study the trophic ecology of 16 species (n = 292) of the most abundant demersal fishes in offshore waters of the Canadian Beaufort Sea. Both approaches revealed among- and within-species variability in the foraging habitats and diet compositions of these fishes. Correspondence analysis of FA signatures identified resource partitioning among agonids (Ulcina olrikii, Leptagonus decagonus) and cottids (Gymnocanthus tricuspis, Triglops pingelii), and dietary overlap among zoarcids (Lycodes frigidus, Lycodes seminudus). Calanus FA markers (?20:1 + ?22:1) comprised up to 20% FA in Greenland Halibut (Reinhardtius hippoglossoides) and Arctic Cod (Boreogadus saida) suggesting a strong contribution of pelagic FA to benthic fish communities. Mean SIA values also differed among species indicating a large range of trophic positions (max ?15Nrange of 6 for Greenland Halibut) and carbon dietary sources are exploited by fishes (max ?13Crange of 3 for Triglops pingelii). Linear discriminant analysis on FA distinguished the majority of the species from each other reflecting that among-species variability was greater than intraspecific variability thus validating the use of prey FA signatures in the dietary studies of top predators.

BIOACCESSIBILITY OF MERCURY IN THE FOODS INUIT AND CAUCASIAN POPULATIONS: CULINARY PRACTICES, DIET AND THE GUT MICROBIOME

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In humans, the ingestion of contaminated food is an important source of exposure to metals such as mercury (Hg). This is particularly important in the Canadian Arctic, where Hg is an important health concern. However, current pharmacokinetic models aiming to predict the effects of Hg on humans are unable to adequately describe non-Caucasian ethnic groups, most notably Inuit populations. Therefore, it appears that genetic, cultural or environmental factors may play a role in absorbing Hg. The objective of this project is to determine what factors can alter Hg absorption in foods of the Inuit of Resolute Bay (Nunavut) and of Caucasians of Montreal (Quebec). As a proxy for Hg absorption, we use bioaccessibility, a measure of the fraction of a contaminant that is solubilized in the digestive fluids. Here we examine the impact of cultural practices and diet on bioaccessibility, and we explore the potential role of the gut microbiome in altering the gastrointestinal fate of Hg. Interviews were conducted in both study groups to assess differences in diet and culinary practices. The observed differences were then tested with a simulator of the human digestive system, to assess the impact of various food preparation techniques on Hg bioaccessibility in fish. Various cooking techniques lowered Hg bioaccessibility by 51-55%, while co-ingestion of foods such as tea or coffee reduced bioaccessibility by 28-40%. The impact of co-ingested foods appears to be due to their phyto-rich content, as experiments conducted with isolated phytoelements replicated their effect. Cooking treatments and co-ingested foods had a combined effect greater than their individual impacts. Thus, dietary practices, which vary across both populations, can heavily alter the solubilisation of Hg in the gut, thus limiting its absorption by the body. Participants from both populations also donated a stool sample, allowing us to describe the gut microbiome, the bacterial community of the intestine. Deep sequencing of the bacterial 16S rRNA gene showed that both groups differed significantly

in terms of bacterial community composition: Montreal samples had a relatively higher Firmicutes:Bacteroidetes ratio, while Resolute samples were enriched in Proteobacteria. Microbial taxonomic richness was greater in Montreal than in Resolute, potentially due to a more diversified diet. The traditional Inuit diet had a large and significant effect in explaining variation in the microbiome across samples (Analysis of variance of UniFrac distances, $R2 = 0.26$, $P < 0.005$). Thus, the microbiomes of individuals living in Resolute and Montreal differ significantly in terms of composition and diversity, and appear to be heavily influenced by the traditional Inuit diet. Towards the eventual goal of understanding the function of the microbiome in Hg metabolism, we are currently investigating the distribution of bacterial genes involved in Hg cycling (hgcA and the mer operon) in both populations. We conclude that diet, culinary practices and the microbiome may all have the potential to alter the bioaccessibility of Hg. These results further our understanding of the fate of food-borne Hg in the human body, and may contribute to improve pharmacokinetic models that inadequately describe Northern populations.

CAN ANIMAL MIGRATION EXPLAIN THE DOMINANCE OF TOP-DOWN FORCES IN MANY ARCTIC FOOD WEBS? INSIGHTS FROM A THEORETICAL MODEL

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Animal migration can generate the spatial coupling of ecosystems characterized by sharp differences in primary productivity. For instance, the millions of tundra-nesting birds that migrate annually from more productive systems such as agricultural lands to less productive ones such as the arctic tundra can generate a massive flow of additional food for local predators. Yet, we have little understanding of how inputs of allochthonous energy can influence the functioning of tundra ecosystems. Here, we developed a theoretical model that aims at predicting the strength of top-down forces (i.e. predation) relative to bottom-up forces (i.e. resource limitation) in food webs when increasing the level of consumption of food subsidies such as migrating birds by arctic predators. We used differential equations to model the dynamics of nutrients, plants, herbivores, and predators at increasing levels of allochthonous food subsidies consumed by predators. Allochthonous food subsidies were modeled as alternative prey whose abundance is not influenced by predator consumption, similarly to migratory bird populations such as geese that have exploded after taking advantage of the rich crop fields of temperate regions. According to our model, the strength of top-down forces relative to bottom-up forces increases with the abundance of food subsidies consumed by predators, due to the increasing abundance of predators sustained by allochthonous food subsidies. This prediction is congruent with an increasing body of empirical work showing that top-down forces drive the functioning of many tundra food webs distributed across a circumpolar scale. Our model can contribute to quantify and predict the role of animal migration in the functioning of tundra ecosystems in a changing Arctic.

MERCURY AND METHYLMERCURY DISTRIBUTION IN DATED SEDIMENT CORES COLLECTED ACROSS THE NORTH AMERICAN ARCTIC MARGIN

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Mercury (Hg), and specifically the organic species methylmercury (MeHg), which is the form presenting the greatest toxic risk, is accumulating in Arctic marine food webs to levels that pose risks to top aquatic predators and northern peoples who depend on these organisms for food. The MeHg concentrations are often presumed to reflect global emissions of anthropogenic Hg and/or enhanced atmospheric deposition within the Arctic. However, a growing body of evidence suggests that processes within Arctic margin areas, which enhance the conversion of Hg(II) to MeHg, may in fact control the accumulation and distribution of Hg in higher trophic levels. Recently, sediment cores collected along a transect extending from the Bering Sea to the western Beaufort Sea through the Canadian Archipelago and into Baffin Bay were analyzed for Hg and MeHg and for a number of other key reactive elements (organic C, Mn, Fe, S, acid volatile sulfide) and radioisotopes (Pb-210, Ra-226 and Cs-137). The intent of this talk is to provide pictures of the large-scale distributions of Hg and MeHg across Canada's Arctic margin sediments and to discuss processes and factors influencing observed distribution patterns.

SOURCES AND FATE OF ORGANIC MATTER IN MARINE SEDIMENTS FROM THE NORTH AMERICAN ARCTIC MARGIN

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Sediment samples from cores collected at different locations along the North American Arctic margin (North Bering Sea, Chukchi Sea, Beaufort Sea, Canadian Archipelago, Baffin Bay and Davis Strait) as part of the Canadian IPY Program were analyzed to determine the distribution, composition and ultimate burial fluxes of organic and inorganic carbon. Previous studies have investigated the distribution of organic matter in core-top sediments, along with the down-core distributions of 210Pb, 137Cs and the accumulations trace element at these sites. In this paper, we present down-core profiles of organic carbon, nitrogen and inorganic carbon contents and relate these distributions to trends in sediment accumulation, oxygen exposure, mineral surface area and reactive iron concentrations. Furthermore, we use elemental carbon/nitrogen rations, stable carbon isotopic compositions and a suite of organic biomarkers (e.g., lignin phenols, cutin acids, amino acid products) to investigate spatial and temporal contrasts in the compositions and sources of organic matter present in sediments from different regions of the North American Arctic margin. We integrate these various data sets to evaluate overall controls on carbon sequestration in Arctic coastal sediments, investigate historical changes in contributions from marine and terrestrial sources and quantify carbon burial rates in the different depositional environments with contrasting productivity, allochthonous sediment input and variable water column chemistry.

GLOBAL CRYOSPHERE WATCH (GCW): A CONTRIBUTION TO ARCTIC OBSERVATION, RESEARCH AND SERVICES

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There is an unprecedented demand for authoritative information on the past, present and future state of the world's snow and ice resources. The cryosphere is one of the most useful indicators of environmental change, yet is one of the most under-sampled domains in the climate system, particularly in remote regions as the Arctic. The World Meteorological Organization (WMO) recognized there was an urgent need for a sustained, robust, end-to-end global cryosphere observing and monitoring system and, with its partners, is now developing and implementing an operational Global Cryosphere Watch (GCW). GCW will ensure a comprehensive, coordinated and sustainable system of observations and information to allow for a more complete understanding of the changing cryosphere and to contribute to improved observation, research and services which are essential to fully assess, predict, and adapt to the variability and change now witnessed in the Arctic. GCW is initiating a core surface-based cryosphere observing network called "CryoNet" which will, by building on existing efforts, establish best practices and guidelines for cryospheric measurement, data formats, and metadata providing compatible observations from all GCW constituent observing and monitoring systems. CryoNet "Reference" and "Integrated" sites will provide long-term data for calibration and validation of satellite products, for the assessment of long-term changes of the cryosphere, and for verification of cryospheric processes in models. Eight of the first 14 global CryoNet sites (including Eureka), are in the Arctic and will provide data and information for all cryosphere components that occur at each site. All of the initial sites are part of WMO's Integrated Global Observing System, the Global Atmosphere Watch (GAW) or the International Arctic Systems for Observing the Atmosphere (IASOA) network. They will be particularly important for the study of feedbacks and complex interactions between the atmosphere, cryosphere, biosphere and ocean. It is hoped that community monitoring could become an integral part of this network. Providing authoritative information is important for GCW activities. GCW Snow Watch has identified critical issues affecting the ability to provide authoritative information on the current state of snow cover, and has initiated projects to address priority areas. These include improving the real time flow and access to in-situ snow measurements; initiating a satellite snow products evaluation and intercomparison activity; developing hemispheric "snow anomaly trackers"; rationalizing terminology; and developing an inventory of existing snow datasets. GCW is establishing interoperability between major data centers and

data management systems. The GCW Data Portal (gcw.met.no) will provide the ability to exchange data and information among a distributed network of providers. The "Watch", provided through the GCW website (globalcryospherewatch.org), will provide authoritative, clear, and useable data, information and analyses on past, current and future state of the cryosphere to meet the needs of WMO Members and partners. GCW is a WMO contribution to the International Polar Initiative,offering a valuable contribution to improved observations, research and services in the North that are required to meet current and future information needs.This presentation aims to stimulate discussion on collaboration and priorities for Arctic research and observations.

THE IMPACT OF CLIMATIC CHANGES ON LAKE TROUT HABITATS IN LAKES OF NORTHERN QUÉBEC

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Anticipated climate changes will have a major impact on the physical properties of lakes, and especially northern lakes (located at 50° N and above) in Québec. These changes will alter the dynamics of freshwater ecosystems, although it is still unclear to what degree. Water temperature and the dissolved oxygen concentration are considered to be two variables that will affect, and in some cases limit, the growth and survival of fishes in these lakes, especially species in the salmon family. Future water temperatures and ice covers are estimated for the period 2040-2070 for the lakes of Northern Québec. The impacts of these changes on lake trout thermal habitat are discussed.

ENERGY, INSECURITY, AND INUIT IN ARCTIC CANADA

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Energy is at the heart of some of the most challenging policy questions concerning the transforming Arctic region. As climate change enables access to energy resources in the circumpolar region, many environmentalists and indigenous peoples are increasingly concerned over the potential local and global ecological consequences of expanded hydrocarbon extraction. This paper examines this debate in terms of competing accounts of energy security versus human and environmental security in the Canadian Arctic. It examines how energy and security are defined and understood in the discourses employed by the Canadian state and by Inuit in northern Canada. The findings suggest that Inuit primarily articulate a conception of environmental security in the Arctic that stands in strong opposition to the understanding of energy security employed by the Canadian state. Whereas Canada sees hydrocarbon resources as contributing to energy security for the Canadian and global economies, Inuit tend to see them as further endangering the fragile Arctic ecosystem, and the indigenous ways of life that rely upon it. This raises important questions of how and by whom security is defined in the Arctic region, and the future role of hydrocarbon extraction in understandings of who is to be made secure and through what means. This paper implicates the production of insecurity in the Arctic with broader global processes of energy extraction and consumption that helps to situate the Arctic as a fundamental part of the interconnected global system.

THE DISTRIBUTED BIOLOGICAL OBSERVATORY: TRACKING ECOSYSTEM RESPONSE TO CHANGING ENVIRONMENTAL CONDITIONS IN THE PACIFIC ARCTIC

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Seasonal sea ice conditions and seawater temperatures strongly influence biological processes and marine ecosystems at high latitudes. In the Pacific Arctic, localized and persistent areas with high benthic macroinfaunal biomass, termed "benthic hot

spots", have been documented over four decades. These regions are now being more actively sampled to relate recent changes in seasonal sea ice retreat and physical forcing to ecosystem response through an Arctic Distributed Biological Observatory (DBO). DBO sampling is conducted in cooperation with the Canada's Three Oceans (C30) program, with support by multiple US agencies, Canadian and other international partners through the Pacific Arctic Group. The DBO is also endorsed within the 2014 US federal government's National Strategy for the Arctic Region. These hotspots are important foraging areas for upper trophic level benthic feeders, such as marine mammals and seabirds. South of St. Lawrence Island (SLI) in the northern Bering Sea, benthic feeding spectacled eiders, bearded seals and walruses are important winter consumers of infauna, such as bivalves and polychaetes. Gray whales have historically been a major summer consumer of benthic amphipods in the Chirikov Basin to the north of SLI, and may facilitate availability of benthic prey to a variety of seabird species, although summertime sightings of gray whales declined in the Chirikov from the 1980s up until at least 2002. The SE Chukchi Sea hotspot, similar to the other DBO sites, is maintained by high chlorophyll a that is produced locally as well as advected by water masses transiting northward from Bering Strait. Both walruses and gray whales are known to forage in this hotspot seasonally on the high biomass levels of benthic prey. In the NE Chukchi, the benthic hotspot is dominated by clams, polychaetes and sipunculids that are important prey for walrus. Finally, the upper Barrow Canyon hotspot is dominated by a high diversity of mussels, polychaetes, and soft corals, with canyon dynamics being an important forcing function for maintaining this site. Notably the center of the highest benthic biomass regions has shifted northward in the three southern DBO hotspots in recent years. This has coincided with changing sediment grain size, an indicator of current speed, and these are also likely responses to changes in primary production in the region. These broad biological responses are being linked to changing physical drivers through development of the DBO cooperative effort by US, Canadian, and other international scientists. The DBO incorporates a series of coordinated, multi-trophic level observations that integrate physical, biogeochemical and biological measurements along transect lines that intersect all of the benthic hotspots. This presentation will highlight results from the C30 and DBO time-series sites in relation to retrospective and ongoing process-oriented studies in the Pacific Arctic region.

DISENTANGLING THE INCIDENCE OF OCEANOGRAPHIC CONDITIONS ON THE FORAGING STRATEGIES OF LITTLE AUKS ACROSS THE NORTH ATLANTIC – WILL SEABIRDS SURVIVE A SEA-ICE FREE ARCTIC?

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The Arctic is warming at an alarming rate and it is essential to understand the impact of climate change on arctic marine ecosystems, within which seabirds are ecologically preponderant. Using a multidisciplinary analysis conducted at multiple spatial and temporal scales across the North Atlantic, we studied the incidence of changing atmospheric conditions, rising ocean temperatures, sea-ice and coastal glacier dynamics, bathymetry as well as primary and secondary productivity on the foraging performance and fitness of breeding little auks. Little auks are the most numerous seabirds of the Arctic, with a total population estimated between 40-80 million individuals. They are planktivorous, participate in a short trophic chain, and feature powerful ecological indicators of arctic environmental change. Here we present a review of the current knowledge related to little auk foraging dynamics, based upon our own work and further recent studies conducted between Greenland and the Russian Arctic. Through this overview at the interface between ecology and physical oceanography we demonstrate how little auks develop foraging plasticity to buffer environmental change, suggesting that they are capable of surviving a sea-ice free arctic. Further, we outline how novel, physical/ecological indicators of environmental health can be developed for the study of a changing maritime Arctic, to help design current and forthcoming monitoring and management schemes.

CULTURAL SENSITIZATION AIMED TO NON-INUIT WORKERS IN THE MEDICAL SECTOR

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The Nunavik Regional Board of Health and Social Services located in Kuujjuaq is now providing some cultural sensitization to their non-Inuit workers in the social services field. The Board plan to offer this kind of training to other fields especially in the medical sector. This obviously implies a reflection as cultural elements are often taken for granted and not necessarily adequately identified. From where do we intend to start? What should outside workers in the medical sector need to know to have rewarding, fruitful communication with us Inuit in the Health Centres or in other related settings? The presentation will be followed by a discussion on the way in which Inuit culture and language should be presented to the southern healthcare workers. What would be the ideal way to sensitize them to the fundamental Inuit cultural values and specific perceptions of health, well-being and wellness? The ethical challenges brought by the contact between cultures will conclude the presentation.

ECOLOGY OF ARROW WORMS IN THE ARCTIC – ARE THEY REALLY "TIGERS OF THE ZOOPLANKTON"??

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Organisms residing in seasonal environments schedule their activities to annual cycles in prey availability and predation risk. These cycles may be particularly pronounced in pelagic ecosystems of the high-Arctic, where the seasonality in irradiance and thus primary production is strong. Whilst the annual activities of several herbivorous zooplankters have been relatively well-documented, much less is known about the strategies of omnivores and carnivores, including chaetognaths. Also known as arrow worms, these gelatinous animals are numerous in high-latitude seas, and may be important prey for the early life stages of some fish. Some have considered chaetognaths as strict predators, based on a few laboratory studies observing ferocious feeding on copepods, and aspects of their anatomy such as hooks and teeth. Others report that the guts of net-caught specimens in fact only rarely contain prey, and sometimes contain algae or detritus, introducing questions on the true feeding behaviours and ecological role of these animals. Here we document the life histories and annual routines of three Arctic chaetognaths: Parasagitta elegans, Eukrohnia hamata and Pseudosagitta maxima, based on studies in both Norway and Canada. We focus on diet, distribution, and on the timing of key life cycle events (e.g. reproduction, growth and energy storage). P. elegans and E. hamata are common chaetognaths above 1000m and reach maximum body lengths ~55mm in the Arctic. P. maxima individuals residing at bathypelagic depths may grow much larger. Whilst P. elegans appears to produce a single yearly cohort in spring and/or summer, multiple cohorts may be produced by E. hamata, also in winter. We discuss the potential role of a centrally positioned oil vacuole, exclusively observed in E. hamata individuals. Finally, in contrast to the accepted paradigm of chaetognaths as exclusive carnivores, we present evidence for detritivory and omnivory as additional feeding modes.

PHOSPHORUS: IS IT JUST AS IMPORTANT AS NITROGEN IN LIMITING BIRCH SHRUB PLANT GROWTH ACROSS THE LOW ARCTIC?

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Nitrogen is widely cited as the principal growth limiting nutrient for plants in moist, mesic and dry arctic tundra ecosystems. As such, the widespread increases in deciduous shrubs that have been observed across the Arctic as the climate has warmed over the past 30 years, are generally attributed to enhanced nitrogen supply due to temperature-induced increases in soil organic matter decomposition. A recent factorial nitrogen-phosphorus (N x P) chronic addition experiment in the Canadian low Arctic demonstrated that birch shrub growth was as limited by the availability of P as by N. How widespread is this N P colimitation of birch growth, and might variation in the extent of N relative to P limitation be a primary determinant of niche space and therefore species coexistence in birch hummock tundra plant communities? In this talk I will address the following specific questions: a) Can birch leaf N:P be used as a reliable indicator of the relative importance of N and P as growth limiting nutrients? b) What is the pattern of birch leaf N:P ratios across the Arctic? c) Do species that grow alongside birch differ in leaf N:P in ways that suggest differing relative limitation? With the assistance of many colleagues, I collected 150 birch leaf and underlying soil samples from 50 different locations across the North American and European Arctic. I used the factorial experiment described above to test the suitability of leaf N:P ratio as an indicator of relative nutrient limitation for all species in birch hummock tundra communities, and then interpreted the patterns of birch leaf N:P across the Arctic to characterise the

spatial extent of NP co-limitation. The results strongly suggest that birch shrub growth is co-limited by N and P availability across the Arctic. This conclusion is important because the controls on P availability in soils are as much abiotic (e.g. pH) as biotic (e.g. decomposition), implying that the impacts of climate warming on P supply to plants may be quite different to those of N supply. These results will be discussed in terms of plant community responses to greenhouse warming, as well as ongoing change in unmanipulated tundra vegetation, all with a view to better predicting the likely outcomes of climate warming on plant growth and community structure in the low Arctic.

THICKNESS OF SEA ICE AND EXTREME ICE FEATURES IN THE BEAUFORT SEA

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Sea ice in the Beaufort Sea has retreated strongly in recent summers, raising interest in its role for the Arctic climate and eco system, and in allowing access for shipping and offshore resources extraction both in Canada and in Alaskan waters further downstream. However, little is known about the thickness of its remaining first- and multiyear ice regimes, and the occurrence of hazardous ice features, which continue to limit the accessibility of the region for shipping and natural resource extraction. Here we present results from spring-time airborne electromagnetic ice thickness surveys performed in the Canadian Beaufort Sea as part of the Beaufort Regional Environmental Assessment (BREA) since 2009. Hundreds of kilometers of various first- and multiyear ice regimes were thus profiled. Surveys are complemented by satellite radar imagery allowing regional extrapolation of results, and the operation of air-dropped drifting buoys. Results show large regional thickness variability with bands of first-year ice in the south and east, of heavily deformed old multiyear ice further north, and of younger multiyear ice in the Canada Basin further to the Northwest. This regional variability is hard to capture with moored ice thickness echo sounders. While the thickness of multiyear ice has generally decreased during the observation period, first-year ice thickness has changed little. Results also show the widespread occurrence of extreme ice features, defined as sections of sea ice at least 100 m long and 6 m thick. These occur both in the first-year ice regime, e.g. in near-shore shear zones, and in the band of the thickest multiyear ice originating from the coast of the Queen Elizabeth Islands. Few ice islands were also surveyed, revealing thicknesses of 20 to 30 m related to initial thickness upon calving, and length of drift period. These results are important for the design of policies and regulations for save and environmentally sustainable future offshore activities.

MAPPING THIN LANDFAST ICE IN THE CANADIAN ARCTIC

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Ice thickness climatologies obtained at few near-shore observatories in the high Canadian Arctic show that first-year fast ice in the Canadian Arctic Archipelago grows approximately 2 m thick in the end of the winter, depending on snow thickness, and that it has changed little over the past few decades. However, concurrently there are also recurring polynyas in nearby sounds and straits, indicating that thermodynamic first-year ice growth on the Canadian polar shelf may actually be quite variable depending on oceanic conditions and ice age. Here we present results from thousands of kilometers of snowmobile ice thickness surveys performed during hunting and recreational over-ice travel and Canadian Rangers traverses. Measurements were carried out with a novel, short, 2 m long electromagnetic ice thickness sensor mounted on a sledge. We show that this sensor provides accurate ice thickness measurements with low noise and little drift throughout the winter season, and is thus ideally suited for large-scale, seasonal mapping of the thickness of level fast ice as part of a future distributed, community-based observation network. Results show the occurrence of widespread regions of thin, less than 1 m thick ice in various fjords and straits surrounding Jones Sound and Baffin Island. Coincident water temperature and salinity measurements show that these regions are related to regions of increased ocean heat flux supported by local bathymetry and tidal mixing, while differences of snow thickness play a minor role. These results provide new insights into ice-ocean interaction on the Canadian polar shelf and the occurrence of these "invisible polynyas", characterized by oceanic conditions intermediate between "visible" polynyas and near-shore shallow water regimes. Under warmer climate conditions, these regions may become open polynyas with likely strong consequences for local and regional climatic and ecological conditions.

GOING OFF, GROWING STRONG: ADVANCING THE EVALUATION OF MENTAL HEALTH INTERVENTIONS FOR INDIGENOUS YOUTH

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Outcome measurement in mental health is universally fraught with difficulties across cultures, particularly so in Northern contexts where psychometric tools tend to be culturally disconnected and irrelevant. In response to community health challenges in Northern Canada, a number of initiatives such as youth mentorship programs have shown some value in enhancing physical and emotional wellbeing. In this presentation, we reflect upon the implementation and evaluation of the first year of the Aullak, Sangilivallianginnatuk (Going off, growing strong) program in Nain, Nunatsiavut. This program was designed to build the resilience of a group of Inuit youth facing widespread social, environmental, and cultural change. The overarching goals of this program are to: 1) enhance the mental, physical and spiritual health of a group of 'at-risk' youth; 2) build social connections between the youth and other community members; and 3) transmit environmental knowledge, skills and values from experienced harvesters to youth. We consider the challenges and benefits to program evaluation in this context, with a focus on how to measure and capture mental health indicators and change over time in this setting. We will highlight the common issues faced in defining, measuring and interpreting programs aimed at improving mental health and wellbeing in the applied context of Nain, Nunatsiavut. Conceptual and methodological issues including data collection, whether quantitative or qualitative, and the translation of knowledge, will be explored. We reflect upon the evaluation process and offer ways to move forward in empirically capturing mental health and wellbeing in Northern Indigenous populations. Specifically, we discuss the process of designing a mixed-method evaluation, and the barriers to finding and selecting appropriate psychometric tools and methods for collecting qualitative data.

PREDICTIONS REPLACED BY FACTS: A KEYSTONE SPECIES' RESPONSES TO A CHANGING ARCTIC

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The arctic is currently warming faster than any other region on the planet. Sea-ice extent has declined drastically in recent decades and future declines are expected. Many predictions have been made about the consequences of this decline for arctic marine mammals, but at present little hard evidence of impacts exist. Ringed seals (Pusa hispida) are an endemic, circumpolar keystone species in the arctic ecosystem because of their importance in the food web, both as a predator and a prey. They are the primary prey species for polar bears (Ursus maritimus) and they are an important food source for coastal Inuit communities. Ringed seals are intimately associated with sea ice for almost every aspect of their existence: pupping, nursing, moulting, resting and some of the foraging all take place associated with sea ice. In this study, 22 ringed seals were equipped with Satellite-Relay Data Loggers (SRDLs) in 2002-2003 in Svalbard, Norway when sea-ice conditions were historically "normal." In 2006, the sea-ice situation in Svalbard changed dramatically and the new reduced-ice situation has prevailed in the years since. Following the shift, summer sea-ice extent changed from a position over the continental shelf to a new northward retracted position over the deep Arctic Ocean Basin and the amount of land-fast ice forming in the fjords in western Spitsbergen decreased sharply. In 2010-2012, 38 additional ringed seals were equipped with SRDLs in order to study the effects of this sea-ice decline. Ringed seals in the two time periods exhibited similar habitat preferences with regard to environmental factors such as ice concentration and distance to glacier fronts. However, we document a sharp increase in foraging costs for ringed seals in Svalbard in 2010-2012 compared to 2002-2003. Dive durations have increased and surface intervals between dives have decreased for all observed months (July-April). Seals in the latter period also swam greater distances per day, rested less on the sea ice and performed more searching and less area-restricted search (which they do when foraging intensely in an area) when on offshore trips in the late-summer. If these increased foraging costs are not compensated for by increased energetic returns, growth, age at sexual maturity, reproduction and survival will be affected. Ringed seals are a central component of the arctic food web and changes in their abundance will reverberate through the arctic ecosystem.

HARP SEAL, POLAR BEAR AND CLIMATE CHANGE: TROPHIC CASCADES APPLYING PRESSURE AT BOTH ENDS

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Animals are not distributed uniformly throughout their range. Instead, they actively select habitats in response to resource availability, life-history strategies, and threats from predation. Seals rely on marine foraging with the requirement for a solid platform to rest, reproduce, and moult. Many pinnipeds use land, but in temperate and polar regions, ice provides a seasonally available platform for these functions. The harp seal (Pagophilus groenlandicus) is an ice-dependent, sub-Arctic species found across the North Atlantic. Northwest Atlantic harp seals have their young on annually forming pack-ice. In spite of the existence of a large quantity of pack-ice throughout the Northwest Atlantic and Davis Strait, pupping occurs at the southern limit of the annual pack-ice, off the southeast Labrador coast (the 'Front') and in the Gulf of St Lawrence (GSL). Changes in ice conditions, due to climate change within the breeding area of Northwest Atlantic harp seals have been observed over the last decade and in some years neonatal mortality has been high. If recent trends continue, the southern limit of the seasonal pack ice will shift northwards, and it has been expected that the southern limit of the harp seal breeding habitat might also shift northwards. However, such changes fail to consider trophic cascade effects resulting from climate change. Predators affect prey populations most obviously by killing individuals. Recent empirical research has shown that predators may also influence their prey through the threat of predation and the development of prey avoidance strategies. The 'risk' effects of intimidation involve changes in prey traits that reduce predation mortality through changes in distribution or development of defensive mechanisms. The Polar bear (Ursus maritimus) is a key predator associated with Arctic and sub-Arctic ice. Their main prey is the ringed seal (Pusa hispida) and threats of bear predation have likely had a major impact on the development of prey traits specific to this small seal (eg dispersed distribution pattern, use of a subnivean lair). A reduction in suitable fast-ice for ringed seals is will negatively impact bears unless alternative food resources can be developed. We suggest that one potential prey would be the harp seal. However, harp seals are poorly adapted to polar bear predation and this might be one reason for the location of their current pupping grounds at the southern limit of the seasonal pack-ice. In Davis Strait, harp seals are an important polar bear prey and this abundant prey is considered to be a major factor for the marked increase in bear abundance over the last 5 decades, particularly in the southern part of Davis Strait. Both Davis Strait polar bears and Northwest Atlantic harp seals are showing signs that are consistant with density dependent changes, habitat changes or interaction between these two factors. We suggest that the ability of harp seals to adapt to changes in ice habitat by moving north will be limited by predation pressure from polar bears as they search for alternative food resources in response to declines in abundance of other preferred prey.

'WINNERS AND LOSERS' IN A CHANGING BEAUFORT SEA ECOSYSTEM: DIVERGING TRENDS IN THE BODY CONDITION OF FIVE MARINE VERTEBRATE SPECIES

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Studies of the body condition of five marine vertebrates in the Beaufort Sea and Amundsen Gulf, conducted independently during the past 2-4 decades, suggest each has been affected by large-scale biophysical changes in the marine ecosystem. There has been a temporal trend of increasing body condition in two species (subadult bowhead whales, Arctic Char), in both cases influenced by the extent and persistence of annual sea ice. Three other species (ringed seal, beluga, black guillemot chicks), primarily consumers of Arctic cod, experienced declines in body condition, growth and/or production during the same time period. The proximate causes of these observed changes remain unknown, but appear to reflect an upward trend in secondary productivity, and a concurrent downward trend in availability of forage fishes, possibly Arctic cod. To further our understanding of these apparent ecosystem shifts, we urge the use of multiple marine vertebrate species in the design of future biophysical sampling studies to identify causes of these changes. Continued Long-term, standardized monitoring of vertebrate

body condition should be continued and paired with concurrent direct (stomach contents) or indirect (isotopes, fatty acids) monitoring of diet, detailed study of movements and seasonal ranges to establish and refine baselines, and identify critical habitats of the marine vertebrates being monitored. This would be coordinated with biophysical and oceanographic sampling, at spatial and temporal scales, and geographic locations, that are relevant to the home range, critical habitats and prey of the vertebrate indicator species showing changes in condition and related parameters.

THE IMPACT OF CHANGING SEA ICE ON MICROBIAL ECOSYSTEMS IN THE LINCOLN SEA

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Arctic sea ice is a vast environment that houses abundant and productive microbial ecosystems that play important roles in Arctic marine biogeochemistry, nutrient and food web dynamics, and ecology. Due to climate change, Arctic sea ice is undergoing a shift from predominantly perennial, thick multi-year ice (MYI) to seasonal, thinner first year ice (FYI). This shift has profound implications for the biogeochemical and physical environment in the ice. We hypothesize that these changes have important implications for microbial community composition (MCC) in the ice, which in turn has important and unforeseen implications for the Arctic marine environment and feedback to the climate system. We will present our data from the Lincoln Sea indicating that distinct microbial communities reside in different annual layers and layers of different origins within MYI. However, the biogeochemical and physical differences between those layers do not play as strong a role as ice origin in structuring the MCC. We will also present our data indicating that MYI and FYI house different microbial communities and will discuss some potential implications of the shift from MYI to FYI on Arctic sea ice ecosystem processes and dynamics.

LOCAL LIVELIHOODS AND GLOBAL FORCES: CLIMATE CHANGE IN NORTHERN GREENLAND

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The recent research on the human dimension of climate change focuses on politics that revolves around the human–environment relationship of locality. The impact of climate change not only reflects the environmental conditions of the places in question but also reflects local and global politics that plays out in the community to affect local human-environmental relationship. Based on my 2009 fieldwork and the follow-up research in northern Greenland , I analyze how changing climatic conditions have affected local residents' livelihoods and how they have coped with the ecological impact of climate change. Northern Greenland is home to Inuit-descended Greenlanders. Severe climate conditions, a low population density, and its remoteness from the capital, deterred economic development for a long time. Hunting and fishing still form the primary economic base of local residents. The research shows that local hunters have been well aware of changing climate conditions for the past two decades and have been coping with them with physical and psychological flexibility - namely by shifting place and time to hunt, changing transportation routes for dog sleds, and hunting different species according to the sea ice condition. The breadth of their environmental knowledge (also know as traditional ecological knowledge in Canada, TEK) certainly helps them cope with and adapt to change. Locally-established customs and by-laws concerning hunting have helped regulate local wildlife populations that they depend on for their livelihood. Inuit hunters are capable of coping with environmental change; however, this does not mean that they can cope with the political and economic implications of climate change. What is more problematic than experiencing increasing unpredictable inter-annual variability of weather conditions are national and global political forces that are outside of their control. Anti-fur campaigns which began in Europe in the 1980s are detrimental to the sale of furs that is almost the only source of income for hunters. International wildlife conservation initiatives triggered a number of scientific research programs in the area without any consultation with local hunters, which restricted their subsistence activities. The Greenlandic government also has intervened in local wildlife management that ignores local hunters' efforts to keep animal populations healthy. This research shows that in order to build a viable community, economically and culturally, it is important to create a system that incorporates a local point of view in living resource (wildlife) management. Eventually, this kind of system in which all levels of people can work together for a clear goal will promote sustainable development of community.

BUILDING CAPACITY FOR COMMUNITY STEWARDSHIP OF KNOWLEDGE

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The Geomatics and Cartographic Research Centre (GCRC) at Carleton University has carried out numerous projects involving indigenous communities and in particular, Arctic communities. We have worked directly for community organizations, for researchers under classic tri-council funded academic projects, for government, and for other private & public institutions. In our experience, these arrangements all have very different models for community engagement and, in fact, different understandings of the term. Our work has always focused on multiple representations of knowledge, and we are sensitive to the idea that the designers of the research, the process by which it moves ahead, and the way in which results are achieved, communicated, and preserved will affect the impact on communities. There are several areas that the GCRC and its partners are researching to help inform and change practice and build community capacity with the ultimate goal of empowering communities. We are working to evaluate the current practices for collecting data and are working with partners to develop the idea of a standard community knowledge license that would see communities own and license data to researchers rather than individuals having to understand and sign a new and different researcher-drafted legal document every time. We assisted Arctic College with courses to build knowledge of data management and research process within arctic communities and are actively working to encourage education about research through the college and our atlas projects where methodologies are explained alongside the data. The processes and technologies used can also affect the community's ability to access, control, and possess the data collected. We have been developing a data management platform with the ability to ingest and store qualitative and/or quantitative data locally, render it in useful ways to the community, and replicating or be accessed by external systems for analytic use, preservation, or for sharing among communities. We've also been actively promoting open standards and open source in our work to ensure that communities will have the interoperability, access to tools, and resiliency necessary to be stewards to their knowledge for the long haul. I will present examples of our work, discuss the hopes and dreams we have for community directed research, and the challenges we see with trying to turn things on their heads.

PILIRIQATIGIINNIQ 'WORKING IN A COLLABORATIVE WAY FOR THE COMMON GOOD': A PERSPECTIVE ON WHERE HEALTH RESEARCH METHODS AND INUIT WAYS OF KNOWING COME TOGETHER.

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This presentation will outline a model for health research that is based on Inuit perspectives on health-related research epistemologies and methodologies. Increasing attention on the Arctic has led to an increase in health research in this region. A growing segment of the research community is focused on explaining and understanding Indigenous knowledge and ways of knowing. Researchers have become increasingly aware that Inuit knowledge and perspectives must be perceived, collected, interpreted, and shared in ways that are unique to, and shaped by, the communities and individuals from which this knowledge is gathered. The Inuit concepts of Inuuqatigiittiarniq ("being respectful of all people"), Unikkaaqatigiinniq (story-telling), Pittiarniq ("being kind and good"), and Iqqaumaqatigiinniq ("all things coming into one") and Piliriqatigiinniq ("working together for the common good") are woven into a responsive community health research model grounded in Inuit ways of knowing. The model was developed over the course of 7 years, with the intent that it may inform health researchers with an interest in Arctic health.

NETWORKING COMMUNITY-DRIVEN RESEARCH PROGRAMS, USE OF INTERACTIVE KNOWLEDGE MAPPING TOOLS, AND DEVELOPING CAPACITY FOR STEWARDSHIP IN THE GREATER HUDSON BAY MARINE ECOSYSTEM.

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The Arctic Eider Society has been developing a collaborative network of Community-Driven Research (CDR) programs that are committed to addressing the environmental, economic and sociocultural issues affecting communities across Hudson Bay. The most critical concerns raised by Inuit and Cree communities involve significant chances to sea ice ecosystems due to cumulative impacts of climate change and development projects. The Hudson Bay Program, Voices from the Bay, and community-driven programs developed during International

Polar Year on the Belcher Islands have set a precedent for networking among communities, integrating Traditional and Scientific knowledge, and have provided local hunters with training, experience, and oceanographic equipment to document the changes they have been observing. Beginning in winter 2015, The Arctic Eider Society will be expanding programs to include Sanikiluaq, Inukjuak, Umiujaq, Kuujjuaraapik and Chisasibi across overlapping land claims of Nunavut, Nunavik and the Eeyou Marine Region. These programs will develop the capacity for communities to conduct their own environmental research, facilitate the collaborative networking needed to overcome inter-jurisdictional challenges and address long standing concerns about cumulative impacts, and build sustainable solutions for stewardship in Hudson Bay. To facilitate active outreach and networking among communities and stakeholders, the project will produce a cutting-edge Interactive Knowledge Mapping Platform (IK-MAP) in collaboration with interactive media specialists and the Google Earth team. IK-MAP will make Traditional Knowledge and near real-time results from ongoing CDR programs accessible to non-technical users by integrating multi-media, social networking, training and educational resources into an easy-to-use online interface. The IK-MAP infrastructure will set new precedents for data sharing and accessibility while providing a novel way for communities to quantify the environmental impacts they are observing and to partner with stakeholders including scientific researchers, policymakers and other communities to interpret results and more fully assess and mitigate the cumulative impacts of environmental change in the region. An educational interface of the IK-MAP will further provide culturally-relevant math, science and social studies curriculum linked to multi-media resources and community collected data, as a means to engage Inuit and Cree youth in CDR programs following graduation. The capacity for networked research and communications developed on the ground in east Hudson Bay is being further used to develop stewardship across the greater Hudson Bay marine ecosystem. The Arctic Eider Society, the Nunavut Hudson Bay Inter-agency Working Group and the Hudson Bay Inland Sea Initiative have partnered to begin planning for a Hudson Bay Consortium that would provide a governance structure allowing communities to collaboratively address inter-jurisdictional challenges, assess cumulative impacts of development projects, and address environmental justice issues in Canada's largest drainage basin. This would provide substantial benefits for communities and stakeholders and catalyze a long term legacy of environmental stewardship and governance in Hudson Bay.

DEFINING SUCCESS IN EDUCATIONAL OUTREACH INITIATIVES IN NORTHERN COMMUNITIES : THOUGHTS FROM A DECOLONIZATION PERSPECTIVE

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More and more researchers studying northern environments are building, complementary to their research, education or outreach projects in local communities. As most of these projects are carried and developed by non-Aboriginal researchers with different levels of community involvement, project goals and expectations might not be consistent with local priorities. How can we define and then assess the success of these initiatives? Reviewing research ethic documents developed by Indigenous nations across Canada and the world, we will take a look at what is expected from researchers by the communities. Inverting perspectives will shed light on what is decolonizing methodologies: working with communities, with a humanist approach, coproducing results and question the target of knowledge (Lévesque, C. 2014). We will also discuss the challenges facing environmental scientists when implementing education or outreach initiatives and when trying to assess them. To do so, we will share our own experience and challenges trying to follow a decolonizing approach in assessing the student perception of Avativut project in its implementation phase. Avativut is a young Nunavik high school program that seeks to foster greater interest in environmental sciences, as well as in school education more broadly. Qualitative research was led, using participant observation, focus group, personal interviews and researcher's journal. One month was spent in Kuujjuarapik-Whapmagoostui to participate in the implementation of a new learning and evaluation situation focused on ice in three high school classes. So far, from our preliminary results, the success of the project lies in the cultural elements and the outdoor activities incorporated in the science and technology curriculum. The challenges identified to decolonizing science education and science were mostly associated to the lack of knowledge of decolonization approaches themselves both in education and research. There was also a lack of a concerted approach among the different actors. The elements presented will try to address the question: What kind of researchers do we want to be?

THE OCCURRENCE OF NEW SPECIES AND DEVELOPMENT OF FISHERIES IN SVALBARD WATERS

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Atlantic mackerel (Scomber scombrus) were recorded in Isfjorden, Svalbard (78°15'N, 15°11'E), September 2013, for the first time on record. This represents a potential northwards expansion of its distributional range of approximately 5° latitude. Juvenile herring has been observed regularly in the same fjord since 2012. Together with an increase in landings of commercially important sub-Arctic fish species, such as Northeast Arctic cod, haddock and ling, from Svalbard waters, this is likely to represent a recent general trend of species extending their distributional ranges northwards into the high Arctic. The occurrence of new species, life stages, and the increase in biomass of existing sub-Arctic fish species are compared to the increasing population sizes of the same species. Both the Northeast Arctic cod and Atlantic mackerel stocks have increased and their distributional ranges have expanded during the last years. We further discuss the occurrence of mackerel, new establishment of herring, and the increase in landings of other established sub-Arctic fish species as a result of the ongoing increase of water temperatures in the Arctic. The current introduction of new species and increase in biomass of sub-Arctic fish species seen in Svalbard fjords and waters may indicate that a further expansion northwards and into other Arctic regions are imminent if water temperatures continue to increase.

SEASONAL FINGERPRINTS OF DINOFLAGELLATE CYST PRODUCTION IN SEDIMENT CORES FROM THE HUDSON BAY SYSTEM

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Natural archives, i.e., proxy data, provide a key instrument for assessing the resilience of current rapidly changing sea-ice ecosystems to perturbations and defining their pre-anthropogenic variability. While sea ice is clearly a marine element, many high-resolution proxy reconstructions of decadal- to millennial-scale sea-ice history are based on the analysis of terrestrial archives, such as lake sediments, ice cores, tree rings, coastal driftwood and beach deposits, and then reconstructing sea-ice conditions through sea-surface temperatures or oceanic circulation patterns inferred from these proxies. Recently, new and enhanced developments of marine sea-ice proxies, predominantly based on sedimentary remains of ice-dwelling or ice-affiliated biota, have emerged. These include sea-ice diatom biomarker IP25, sea-ice dwelling ostracod Acetabulastoma arcticum remains, and transfer function approaches based on foraminifer, diatom, and dinoflagellate cyst (resting cell) assemblages. The latter are one of the most widely applied proxy for late Quaternary sea-ice reconstruction in the Northern Hemisphere, and the reconstructions provide much needed quantitative estimates for comparison with modern and predicted sea-ice trends, and for climate model evaluation. Nevertheless, sea-ice reconstructions based on dinoflagellate cysts do not always corroborate with commonly observed large-scale temperature trends inferred from other proxies. This stimulates questions related to the limited knowledge of the ecologies and life-cycle transitions of arctic dinoflagellate species, i.e., the seasonal patterns in cyst production, species-environment relations in various scales of time and space, and the relationships of sedimentary cysts to their planktonic counterparts. This presentation introduces a viewpoint to sediment-core assemblages that is based on continuous year-round series of cyst production. The prime objective is to define seasonal and environmental fingerprints of dinoflagellate cyst production within the Hudson Bay system, and then probe the fingerprints through time. A compilation of species-specific cyst flux data from seasonal (trap) and spatial (surface-sediment) components is used to interpret the patterns of temporal changes evidenced in dated box-cores. The results demonstrate that contrary to the hypothesis of sea-ice governed light regime being the overarching control of cyst production of heterotrophic vs. autotrophic species, in the Hudson Bay system the trophic composition and its seasonal patterns are not related to sea-ice, even though species-specific seasonal fingerprints are. In an attempt to elucidate the trends and variability evident in dinoflagellate-cyst based climate and sea-ice reconstructions, it is important that future research attempts to probe dinoflagellate life-cycle patterns over several annuals cycles and across different sea-ice covered systems.

ARCTIC VEGETATION SENSITIVITY TO CLIMATE VARIATIONS

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We projected Arctic biomes across a region including Alaska and Eastern Russia using the BIOME4 biogeochemical and biogeography vegetation model. BIOME4, which produces an equilibrium vegetation distribution under a given climate condition, was forced by CMIP5/PMIP3 climate data considered in IPCC AR5. We are exploring vegetation and permafrost distributions during the last 21,000 years and future projections (2100 C.E.) to gain an understanding of the effects of climate shifts on this complex subsystem. When forced with the baseline climatology, compiled from the University of Delaware temperature and precipitation climatology and ERA-40 sunshine data, our biome simulations were generally consistent with current vegetation observations in the study region. The biomes in this region are mostly evergreen and deciduous taiga capped by shrub and graminoid tundras to the north. The more noticeable differences were the tree line simulated north of the Brooks Range in Alaska and evergreen taiga in southwest Alaska where we know these biomes do not exist today. We conducted sensitivity tests on BIOME4 to gain insight into how Arctic vegetation reacts to changes in temperature and precipitation. The present day mean monthly temperature and precipitation values were changed by ±10°C and ±30%, in increments of 2°C and 10%, respectively. We sought to have an inclusive list of sensitivities for values that were present 21,000 years ago as well as projected values associated with climate change. Many of the biomes simulated in the sensitivity tests were also found in the modern biome reconstructions; however, based on our results, temperature appears to be the strongest driver for changes in Arctic vegetation. Within the prescribed temperature range, the vegetation in our study area changed from graminoid tundra and forb, moss, and lichen tundra with little shrub tundra or taiga at -10°C all the way to desert, temperate grassland, and areas of temperate deciduous forest and warm mixed forest at +10°C. Changing precipitation alone did not produce as significant of differences in biomes compared to changes in temperatures. Major differences include more graminoid tundra in place of shrub tundra and a larger expanse of deciduous taiga in place of evergreen taiga simulated in both wetter and, paradoxically, drier conditions.

A SYNTHESIS OF EXISTING, PLANNED, AND PROPOSED INFRASTRUCTURE AND OPERATIONS SUPPORTING OIL AND GAS ACTIVITIES AND COMMERCIAL TRANSPORTATION IN ARCTIC ALASKA

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This paper synthesizes quantitative and qualitative information about existing, planned, and proposed infrastructure and operations that support oil and gas production and commercial transportation over the whole of Arctic Alaska, compiling a region-wide vision of these industrial activities that has not previously existed. It presents an overview of the history, current conditions, and plausible future extent of industrial infrastructure in Arctic Alaska. It is intended for use as a factual and unbiased reference for the wide range of stakeholders interested in integrated Arctic planning. In addition to tables and text, the paper contains ten original maps of infrastructure and industrial transportation. It is illustrated by numerous photographs of oil and gas infrastructure in the region. The paper can be downloaded for free at: http://www.iarc.uaf.edu/en/NX2020/current-projects/oil The findings indicate that if proposed infrastructure projects develop in the manner described in state and federal analyses, the extent of Arctic Alaska's industrial infrastructure would increase significantly. The number of structures would almost double, from 460 to 816. The number of wells would increase by around one third, from 6,215 to 8,673. Miles of road would more than double, from 1,138 to 2,503. Miles of pipeline would more than quadruple, from 901 to 4,667. Lastly, the infrastructure footprint would increase by about half, with over 27,000 acres of Arctic Alaska being directly covered or excavated for industrial development. The area and resources affected by that infrastructure footprint—what the National Research Council refers to as "zones of influence"—would be considerably greater.

ADAPTATION ACTIONS FOR A CHANGING ARCTIC – BERING CHUKCHI BEAUFORT REGION

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"Adaptation Actions for a Changing Arctic" (AACA, part C) is an Arctic Monitoring and Assessment Programme (AMAP)

led assessment of climate and integrated social/environmental frameworks/models that can inform adaptation actions in the face of Arctic change. AACA-C is a major contribution to an international synthesis effort that will break new ground through its focus on adaptation to multiple stressors. We will conduct an assessment of the adaptations residents of the Bering /Chukchi /Beaufort Sea (BCB) region have implemented (or need to develop) to deal with the rapid changes in climate, landscape, ecosystems and social systems that have occurred in recent decades. We also hope to characterize deficiencies in their abilities to adapt so we may better understand where assistance is needed or where alternatives to adaptation must be developed. This report will include an examination of the relevant sectors to this region and a summary of what has been learned and what challenges remain. We anticipate 60 – 80 authors from across Canada, the US and Russia will be involved in completion of this assessment. The specific goal of AACA-C is to consider Arctic-focused climate and integrated environmental frameworks or models that can improve predictions of climate change and other relevant drivers of Arctic change and identify adaptations that may be implemented or identify deficiencies where additional understanding is required to promote adaptive capacity. AACA-C will guide Arctic adaptation efforts inform future Arctic research and serve as an Arctic linkage to the USGCRP's sustained assessment plan. The information required for this assessment will be completed through a review of published literature, a distillation of scenario information, and direct interviews with a wide variety of members from sectors important in this region. We have received IRB approval for these interviews and anticipate completing approximately 100 by September 2014. These will provide the primary foundation of the assessment with respect to adaptations.

USE OF AN ECOSYSTEM MODEL TO ASSESS FOOD WEB STRUCTURE, KEY PLAYERS, ECOSYSTEM STRESSORS, AND FUTURE IMPACTS OF CLIMATE CHANGE IN THE BEAUFORT SEA.

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The Beaufort Sea marine ecosystem is under increasing pressure from changes in climate, oil and gas development, and shipping. It is also the location of the Arctic's first marine protected area, (MPA) the Tarium Niryutait MPA. In order to better understand the structure of the Beaufort Sea Shelf marine ecosystem and the impact of multiple stressors, an Ecopath with Ecosim food web model was created. Construction of the food web model was achieved by linking predators and prey through trophic interactions to identify key players or unique species within the ecosystem. The Ecopath (static) portion of the model contains 34 functional groups ranging from primary producers to whales. In addition to synthesizing existing data, gaps in ecosystem knowledge were identified and ranked based on the availability of data for each species or species group. The model provides previously unknown estimates of fish biomass based on predators dietary needs and ecosystem productivity, and identifies the harvest mortality for all harvested fish and mammals within the model. Keystone indices have been calculated and identify species such as echinoderms, arthropods, bearded seals, cods, and macro-zooplankton as having a high impact to biomass ratios. These unique species are some of the most understudied components of the food web. Through the use of a dynamic temporal simulation (Ecosim), past ecosystem trends (1970-2012) were simulated by fitting the model to past abundance and harvest data, while including environmental changes in sea ice, temperature, and primary production. Changes in species composition, ecosystem biomass, and ecosystem trophic level indicate a relatively stable past ecosystem. Future simulations incorporating the impacts of increasing temperature and decreasing sea ice are used to assess the vulnerability of the ecosystem and individual species within it to potential future changes. Future climate drivers were extracted from the ESM2M global climate model using the rcp 2.6 and 8.5 projections to represent low and high future climate scenarios. Output from past and future simulations aim to identify vulnerable species as well as the overarching impacts from climate change to this ecosystem, to assist with management decisions. This information, coupled with the identification of unique and/or poorly studied species is important to drive future research activities in the region to improve our overall understanding of the ecosystem.

SEABED MAPPING IN THE ARCTIC

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More than two thirds of the earth is covered by ocean and in the artic part of the ocean is also covered by ice. Much of the ocean seafloor is very sparsely explored. Seafloor mapping using multibeam echo sounder and sub bottom profilers are important in many aspects, seafloor mapping for safe navigation, habitat mapping, change monitoring and defining the continental shelf as described in the United Nations Convention on the Law of the Sea. As well as using the water column data for seep detection and other acoustically detectable phenomena in the water column. This presentation will cover surveying with standard multibeam echo sounder and sub bottom profilers and the extra challenges installation on icebreakers introduce. A standard echo sounder does not have the necessary strength to be installed in the hull of a ship working in artic

ice conditions. Extra ice windows or reinforced transducers are necessary to protect the echo sounder from the ice. The working environments are challenging with a noisy ships and requirements of flush installation in the hull. The icebreaking itself generates air bubbles and ice raft in near vicinity to the transducers giving non optimum conditions for the multibeam echo sounder. Examples of installation on icebreakers will be shown. The multibeam echo sounders presented has also some specialized operation modes made special for operation in the ice. Those are results of cooperation with researchers doing surveying on icebreakers. Results from multibeam and sub bottom profiler mapping with icebreakers will also be presented. The multibeam echo sounder produces multiple data output. A combination of depth values, seafloor reflectivity(backscatter) and water column data. Backscatter data is important for seafloor characterisation and the water column data can be used for seep detection and mapping of the total water column. The sub bottom profiler will characterize the sediments and have also the possibility to log water column data.

SEA ICE AREA FLUX FROM THE SVERDRUP BASIN TO THE NORTHWEST PASSAGE: 1997-2013

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The deep-water route of the Northwest Passage crosses the Canadian Arctic Archipelago near 75°N to connect Baffin Bay to the Arctic Ocean. The major challenge to safe navigation of this route is the presence of multi-year sea ice (MYI). Some of the MYI in the Northwest Passage forms in situ but some also flows southward from the higher latitude in the Sverdrup Basin via Byam-Martin Channel and Penny Strait. While the latter drift is widely known to occur, it has never been quantified. We provide the first estimates sea ice area flux from the Sverdrup Basin into the Northwest Passage using RADARSAT imagery from 1997-2013 for the months of July to November. Over the period, Byam-Martin Channel had a mean flux of 6±3x10^3 km^2 and ranged from -200 km^2 (northward flow) in 1999 to 10x10^3 km^2 in 2005. Penny Strait had a mean flux of 1±3x10^3 km^2 and ranged from -68 km^2 (northward flow) in 2010 to 3x10^3 km^2 in 2004. For both passageways, the ice flux is almost always southward from the Sverdrup Basin and is equivalent to ~83% of Arctic Ocean-Sverdrup Basin ice inflow. The majority of ice flows through Byam-Martin Channel in August and through Penny Strait in October. The ice flux remained relatively consistent over the 17-year record suggesting recent reductions of ice in the Northwest Passage are not associated with less inflow from the Sverdrup Basin. We also compared RADARSAT ice velocity estimates to ice velocity measured by Doppler sonar and sea-ice drifters deployed in Byam-Martin Channel and Penny Strait. The comparison revealed that the variability in ice velocity is high, both along and across Byam-Martin Channel and Penny Strait and can range from -20 km/day (northward flow) to 61 km/day (southward flow). Finally, we explored the connection between recent changes in sea ice and marine transportation within the Northwest Passage. Only weak correlations were identified, although a step increase in marine transportation activity was apparent following the former summer sea ice extent minimum in 2007.

VALIDATION OF THE ARCTIC AND CANADIAN ARCTIC ARCHIPELAGO ICE THICKNESS IN HIGH-RESOLUTION NEMO SIMULATIONS

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Sea ice is a key component in the climate system, especially in the high-latitude region. It affects the exchanges of momentum, heat, and freshwater (mass) fluxes between the atmosphere and ocean locally as well as the large scale climate change through albedo-feedback. Understanding the physical processes of the dramatical Arctic sea ice changes observed in the past has been a hot research topic for many years. Compared to ice concentration, which is available back to the late 1970s from the satellite, ice thickness observations are limited. On the other hand, numerical simulation provides a helpful approach, however, validation is still in progress due to the limited observations. Using the ice thickness data collected by various projects in recent years, we validate the simulated ice thickness over the period of 2003-2010. All the simulations are based on the Nucleus for European Modelling of the Ocean (NEMO) numerical framework. Two regional configurations covering the Arctic Ocean and Northern Hemisphere Atlantic, with a horizontal resolution of 1/4 degree (ANHA4) and 1/12 degree (ANHA12) respectively, are setup as the twin experiments to show the impact of model resolution. Both of the two simulations are ran with LIM2-EVP driven by high frequency (hourly) atmospheric forcing from Canadian Meteorological Center (CMC) global deterministic prediction system (GDPS). Besides the direct comparison with the observations (thickness

and distribution), we also decompose the simulated ice thickness change into the thermodynamic and dynamic parts at select locations to study the dominant factor of local ice growth. The impact of initial condition will also be presented.

IS PHOSPHATE A LIMITING NUTRIENT FOR BIOLOGICAL ACTIVITY IN SEA ICE?

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During sea ice formation, a portion of seawater is trapped in the ice matrix, resulting in concentrated brine. The nutrients in sea ice brine are expected to behave conservatively as a function of brine salinity. However, it is often found that the salinity-normalized nutrients in sea ice brine are depleted compared to those in the surface seawater, which is normally attributed to biological activity. Here we ask the question, are there other factors that can affect phosphate concentration in sea ice? A recent laboratory-based study (Hu et al., 2014, JGR-Oceans, accepted) reveals that phosphate can be strongly co-precipitated with ikaite under conditions representative for natural sea ice. Depending on the experimental conditions, around 50% to nearly 100% of phosphate can be removed from the solutions due to ikaite precipitation. The removal of phosphate by ikaite precipitation is influenced by pH and initial phosphate concentration. The change in salinity (up to 105) as well as temperature has little impact. These findings suggest phosphate might be a limiting nutrient for biological activity in sea ice. However, field work on this aspect so far is not available. Therefore, it should be of great interest to investigate the role of ikaite precipitation in phosphate removal in natural sea ice.

INVESTIGATIONS INTO THE COMMERCIAL POTENTIAL OF A SUB-ARCTIC POPULATION OF PORCUPINE CRAB(NEOLITHODES GRIMALDII): ESTABLISHING INFORMATION ON LIFE HISTORY CHARACTERISTICS KEY TO EFFECTIVE MANAGEMENT.

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Porcupine Crab (Neolithodes grimaldii) is a deep-water (>1000m) member of the king crab family (Lithodidae) which have been documented in Arctic waters along the continental shelf and slope on both sides of the North Atlantic. In Atlantic Canada, Porcupine crab are predominately captured as bycatch in Greenland halibut (Reinhardtius hippoglossoides) gillnet fisheries. The commercial potential of Porcupine Crab has long been recognized by the fishing industry of Atlantic Canada, yet due to the deep water residence of this species very little of its biology is known. For a New Emerging Fishery, it is paramount to establish biological information to contribute to its effective management. The focus of this study is to determine biological parameters and life history characteristics in order to provide the best advice to fisheries managers, industry and science. These parameters include: the size at maturity of males and females, fecundity, and reproductive cycles. Working closely with industry to ensure timely sharing of information and issues for stakeholders, all field data was collected at sea over a three-week period aboard a commercial gillnet fishing vessel targeting Greenland halibut in NAFO Division 0B. My presentation will discuss data on size at maturity and molt cycles in male and female Porcupine Crab that we collected during in June-July, 2014.

SMALL-SCALE VIGOROUS DEFORMATION OF AN ARCTIC SEA ICE FLOE DETECTED BY GPS AND SATELLITE IMAGERY

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In 2012 summer, multiple GPS drifting buoys were deployed on an sea ice floe in the north of the East Siberian Sea. The buoys include sea ice mass balance buoys with standard-quality GPS receiver as well as a geodetic-quality GPS system that can measure GPS position within cm accuracy. These buoys captured small-scale (~100 to 200 m) deformations which have not been reported in literature. The deformation events were intermittent, each lasted less than a day, and highly compressive; the area occupied the buoy array decreased by 39 to 61% during these deformation events. The strain rate during the deformation, of the order of 10^-5 s^-1, which is much higher than a model estimate for brittle fracturing for the cracks of 100 m in length. The results shows the effects of large-scale wind

stress (ice motion) on the small-scale deformation. However it also reveal that the impact of large-scale wind stress is also dependent on both the state of sea ice (thickness, strength, the degree of consolidation etc.) and the spatial and temporal evolution of deformation. Discussions include the effects of local and basin-scale freeze-up and ice motion on small-scale deformations, and some results of perturbation analysis under dynamic wind forcing.

SAVING THE PAST TO SAVE THE FUTURE - ARCTIC CHANGE MONITORING, IDENTIFYING REFUGIA AND DIVERSITY MAPPING FOR WILDLIFE GENETIC RESILIENCE

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Migratory species experience the combined set of stressors and challenges faced during their annual cycles at wintering sites, stop-overs, and breeding grounds. For Arctic breeders, rapid, multi-scale environmental change and the resulting cascading effects is unprecedented within and beyond circumpolar regions. While Pleistocene climate change had profound historic effects for biodiversity and ecosystems, modern changes also include altered climate, landscapes, and ecological shifts, but in addition, now include increasing contaminant levels, exposure to non-native species, and large-scale anthropogenic disturbance potentially at all locations and stages of the annual cycle. What will environmental change mean for species and what traits will become advantageous in responding to change? Do current management units and protected areas include historic population sources, refugia, and hotspots of diversity? Do these units contain sufficient genetic diversity to include a diverse repertoire of possible solutions in changing environments? While untangling the effects from stressors at multiple sites is challenging, migratory species can serve as indicators of change and as an early warning system of system disturbance. Recommendations for expanded and more comprehensive monitoring include the deployment of devices such as geolocators and other data loggers to track species movements and time budgets in particular sites, augmenting automated site-based data-capture networks, creating archives of photographs of sample sites and individuals, and including non-destructive sampling for current or future genetic, microscopic, isotopic and contaminant analysis (including prey and predators, for example), for establishing baselines and for archiving, and for detecting ecological changes.

BUILDING HOMES: DOMESTIC VIOLENCE AND HOUSING POTENTIALS IN NUNAVUT

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The warming climate has led to the increase in resource development in Northern Canada because as the ice melts it is easier to access non-renewable resources. As industry moves into the Northern territory it is imperative that the way of life of the people who currently inhabit the territory are taken into account and that this economic development benefits the Inuit people of Canada. Nunavut has a young and growing population which is eager to participate in the resource development, they are also concerned with how the increase in economic activity will be felt within the communities. One of the manners in which energy companies can work with and directly benefit communities is to invest in better housing. The current housing stock in Nunavut is insufficient and inadequate and is cited as the root cause of many social issues including: low education rates, high suicide rates, an increasing requirement for government support, and the highest rates of domestic violence in the country. Inuit women in Canada experience a rate of victimization 2.5 times greater than non-aboriginal women. A suitable housing design which is appropriate for the specific environmental and cultural context of the Canadian North has not yet been developed because of the logistical complications of building in the North. The research investigates the relationship between the current housing conditions and the elevated rate of domestic violence in order to propose ways that resource development firms can improve the social conditions of the areas they are developing. Appropriate and sufficient housing is not the only area that requires development in the North but it is central to all other issues and advancements in this sector have the potential to improve many other social issues. Providing evidence for the connection between housing and domestic violence to organizations and individuals within Nunavut equips them with the tools to demand and advocate for improved housing models from companies who wish to develop resources in the North. If companies want to develop resources in the Arctic it is their ethical obligation to ensure that communities directly benefit socially and economically from these activities.

WATER MASS COMPLEXITY AND VARIABILITY OVER THE SLOPE IN THE CANADIAN BEAUFORT SEA: ANALYSIS AND INTERPRETATION USING INDUSTRY/ARCTICNET AND BREA OBSERVATIONS

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Four years of oceanographic data collected from 2009 to 2013 during Industry/ArcticNet and Beaufort Regional Environmental Assessment (BREA) programs are used to investigate the complexity and variability in water masses that occupy the upper water column (from about 50-300 m) in the Canadian Beaufort Sea. Our focus is on the lower part of the Halocline containing Pacific Winter Water (PWW, salinity 33.1) and/or seawater with equivalent properties, in relation to the upper part of the Atlantic Water (AW, salinity 35) layer beneath it. Using temperature, salinity, and current velocity/direction from instruments deployed on taut-line moorings, and CTD and chemistry data (e.g. nutrients, dissolved oxygen, stable isotopes) from ship-based measurements, we will contrast the markedly distinct dynamics and characteristics of these two water masses. Progressive vector diagrams from multiple year-long time series of current velocity/direction at typical PWW and upper AW depth indicate that substantial changes, including flow reversals, current surges, rotatory currents, and likely shifts in vertical positioning, occur in both water layers on daily-to-weekly, seasonal, and inter-annual time scales. The circulation patterns in the Halocline and AW layers (e.g. shelf-break jet and/or Beaufort undercurrent in the Halocline, Boundary Current in AW) are not coupled and appear more dynamic than previously thought. For example, currents in the Halocline and AW layers often flow in different directions and show multiple instances of velocity being 3 to 5 times greater in the mid-to-lower part of the Halocline compared to the upper part of the AW. In a lateral sense, variability and complexity in water column structure and current velocity/direction decrease as the distance beyond the shelf edge increases, and generally, are lower at locations on the lower slope than on the outer shelf and upper slope. In addition, changes in current velocity/direction can occur over relatively short distances, suggesting that topography plays a major role in driving the magnitude and directional variability of circulation along the slope. This affects transport of suspended matter, distribution of biogeochemical compounds, and pattern and timing of shelf-basin exchange. The possible sources and causes of variability and complexity in the Halocline and AW layers, including sub-surface mesoscale eddies, upwelling and downwelling cycles, position or behavior of the Beaufort Gyre, and winter water convection on the shelf, will be discussed in terms of frequency, prevalence, and implications for physical-biological coupling and ecosystem services in the Canadian Beaufort Sea.

ON THE WATERS UPSTREAM OF NARES STRAIT, ARCTIC OCEAN FROM 1991 TO 2012

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The Lincoln Sea is a bifurcation point, where waters from the Canadian and Eurasian Basins flow to Nares or Fram Strait. Mechanisms that control which waters are found in the Lincoln Sea, and on its continental shelves, are unknown. Using CTD, nutrient, and mooring data together with the DRAKKAR global 3-D coupled ocean/sea-ice model, the Lincoln Sea was examined from 1991 to 2012. Although both Pacific and Atlantic waters were observed on the North Ellesmere and North Greenland shelves, Atlantic water was shallower on the North Greenland shelf. Thus, deeper than 125 m, water on the North Greenland shelf was likely from the Eurasian Basin. Three different water types were identified on the North Ellesmere shelf – waters from the Canadian Basin were observed 1992, 1993, 1996, 2005, and 2012, waters from both the Canadian and Eurasian Basins were observed in 2003, 2004, and 2008, and waters with no temperature minima or maxima below the surface mixed layer were observed in 1991, 2006, 2009, and 2010. Mixing with vertical advection speeds of 1x10^-4 m s^-1 were observed on the continental slope and this mixing could cause the disappearance of the temperature maxima. Model results suggest that currents on the North Ellesmere shelf were weak (less than 10 cm s^-1), baroclinic, and directed away from Nares Strait while currents on the North Greenland shelf were stronger (less than 15 cm s^-1), and primarily directed towards Nares Strait. CTD, mooring, and model results suggest that the water advected to Nares Strait is primarily from the North Greenland shelf while water on the North Ellesmere shelf is advected westward.

INUIT WOMEN'S PERSPECTIVES ON A HEALTHY LIFE

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Climate change has been identified as the biggest human health threat of the 21st century and Inuit are believed to be one one of the most at-risk populations. Northern communities and health systems will have to adapt. Inuit are active players in adaptation and Inuit perceptions of health need to be central to research if we are to focus on health risks relevant and important to people and capture the complex and culturally specific interactions of climate and non-climate factors influencing vulnerability. To date, however, Inuit conceptualizations of and approaches to health are underrepresented in current northern healthcare services and given little consideration in the context of adapting to climate change. As documented in previous research, the health effects of climate change are differentiated by gender. To date, most research has focused on the exposure of Inuit male hunters to dangers of engaging in land-ice-based activities under changing conditions. Less is known about health effects of climate change for Inuit women. This research responded to this knowledge gap and examined Inuit women's conceptualizations of and approaches to health in adaptation to climate change through a case study of Ulukhaktok, NWT, Canada. Data were collected over a three-month period, between May and August 2014. Semi-structured interviews using free listing, open-ended questions and visualization methods were conducted with 30 Inuit women capturing a cross-section of the community, representative of age. Interviews data are complimented by participant observation, including Nutrition North cooking classes, community celebrations and camping with Inuit families. Preliminary analysis of the data shows that Inuit women's conceptualizations of and approaches to health differ in several ways from the dominant paradigm of western healthcare. Respondents describe personal health as focusing beyond the individual, where one's health is associated with that of the familial unit. Spending time with and caring for one's family and maintaining happy relationships are identified as healthy pursuits. In this vain substance abuse emerges as a predominant health concern among Inuit women as these habits consume the funds required to provide for a family and strain relationships. "The land" is also identified as central to good health and is regarded as having ancestral and cultural significance, contributing to mental and emotional wellbeing and a healthy family dynamic. The land is also the source of country foods, which are ubiquitously believed to be the base of a nutritionally and culturally rich diet. Women identify environmental and economic stresses that restrict access to the land, country food and the associated health benefits. Participants express that they are experiencing health effects of this withdrawal such as stress and poor nutrition. The project is part of ArcticNet Project 1.1 Community Adaptation and supported by the CIHR project IK-ADAPT (Inuit Traditional Knowledge for Adaptation to the Health Effects of Climate Change) and Nasivvik Centre for Inuit Health and Changing Environments.

NON-CONVENTIONAL WASTEWATER TREATMENT METHODS FOR GREENLANDIC COMMUNITIES

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Wastewater treatment in Greenland is non-existing: Wastewater effluents are discharged directly at the coastline to local water recipients. In larger towns (> 500PE) sewering has been installed and most dwellings are connected, while in smaller settlements, honey bag toilets are collected from the dwellings and discharged to sea, ice or land by the municipality. Apart from a) releasing an organic and nutrient load which may damage the ecosystem in the local recipients - depending on the hydraulic conditions; the effluents may also: b) contain pathogenic microorganisms, parasites and antibiotic resistant bacteria, which pose a health threat for the local population; c) contain visible floating items which pose aesthetic disturbance and may affect e.g. tourism; and d) contain heavy metals and anthropogenic toxins that may further affect the local ecosystem. Conventional treatment, is neither environmentally nor economically sustainable to implement in Greenlandic communities, due to the cold climate, and scattered population. In addition, advanced removal of nutrients may in many cases be overstated due to the low population density and large receiving water bodies. Prior to establishment of new means of handling waste water the objective must thus be evaluated in each individual case, as the main challenges may not be identical at all locations. In this work we investigated possible treatment methods to target organic load, nutrients, pathogens and heavy metals. We have investigated the effect of sanitation of the waste water by chemical-mechanical treatment followed by hygienisation by UV-radiation or acetic acid treatment with encouraging results. We have also investigated the feasibility of treating the sludge of the chemical-mechanical treatment by anaerobic digestions in mixture with industrial waste from the local fishing industry; or by composting, which is a more simple process and might be done in mixture with organic household waste.

THE ATLAS OF COMMUNITY-BASED MONITORING IN A CHANGING ARCTIC

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Community-based monitoring engages community members in directing, collecting, analyzing, and utilizing observational data. It has the potential to contribute to long-term observing networks and systems at a pan-Arctic scale, as well as to local and regional networks for natural resource management. While interest in community-based monitoring is growing, these initiatives are dispersed and not well networked; as a result, there is little understanding of how to support this approach to monitoring and how to ensure that communities remain central to its goals and practices. This presentation describes a collaboration to develop a web atlas of community-based monitoring and traditional knowledge projects across the circumpolar region (www.arcticcbm.org). Atlas users can view monitoring networks by region and focus area, access in-depth information about each monitoring initiative, and conduct keyword searches. The atlas provides a baseline for a comprehensive review of the state of community-based monitoring from a circumpolar perspective, which is currently being compiled.

DISTRIBUTIONS OF NUTRIENTS, DISSOLVED ORGANIC MATTER IN THE CHUKCHI AND BEAUFORT SEAS

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Seawater samples were collected over the Chukchi and Beaufort Seas during the ARA04B (25 August–1 September 2013) and ARA04C (7 September–28 September 2013) cruises aboard Korean icebreaker R/V Araon, and analyzed for nutrients, dissolved organic carbon (DOC) and dissolved organic nitrogen (DON). Nutrients (nitrate, phosphate, silicate) were depleted at the surface. The nutrients concentrations increased with increasing depth, with maxima centered at ~150 m depth within the halocline layer, then decreased with increasing depth below the maxima, indicating that the modified Pacific Waters dominate the upper halocline layer. The ratio of nitrate to phosphate in the Chukchi and Beaufort Seas showed that water of Pacific origin is depleted in nitrate with respect to phosphate. In addition, N* values, which reflect only the net impact of N2 fixation, denitrification, and any other process that adds or remove nitrate with a N:P stoichiometry different than 16:1, showed negative values in upper halocline layer, whereas the N* values in lower halocline layer was close to zero. These results suggest that the North Atlantic Ocean acts as a net source of fixed nitrogen while the North Pacific Ocean acts as a net sink, and that the Arctic Ocean plays a key role in balancing the global nitrogen cycle. Concentrations of DOC and DON ranged from 45–125 μM and 3–17 μM, respectively. The highest DOC and DON concentrations were observed in polar surface layer, suggesting that the large contribution of terrigenous dissolved organic matter (DOM) from Arctic rivers is responsible for the elevated concentrations of DOC and DON in this layer. While DOC showed a significant inverse relationship with salinity, a negative correlation between DON and salinity was weak, probably due to biological influence on DON.

SEASONALITY OF SHELL DISSOCIATION OF MARINE CALCIFERS IN THE ARCTIC OCEAN

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The dissolution of atmospheric CO2 with seawater reduces pH and carbonate ions. In the western Arctic Ocean, the parts of surface water are already corrosive to aragonite and aragonite saturation (?ara) is less than 1 (undersaturation). It is urgently required to understand the affection of ocean acidification for marine calcifying organisms for conservation of marine ecosystems. Especially, pteropods having aragonite shell is one of most sensitive to ocean acidification and are key species in the food web in polar region. Unfortunately, there is no common quantification method to evaluate the response of micro or nano size marine organisms on the acidification.

Previous study has evaluated by measurement of the weight of carbonate shell of organisms, however, measurement of weight is not suitable method for micro or nano size organisms. Thus, we have developed more sophisticated quantification method for micro size plankton by Micro-focus X-ray Computing Tomography (MXCT) technique. MXCT can produce virtual cross-section images of an object. The 16-bit image achieved by MXCT includes the information of X-ray attenuation of an object as grey scale gradations and it has linear relationship with density of an object. We digitized CT numbers of calcite from box-cell values using the calibration software Molcer Plus and defined calcite/aragonite CT number to know relative carbonate shell density. This calcite/aragonite CT number is a linear transformation of the original linear attenuation coefficient measurement into one in which the radio density of air is defined as zero, while the radio density of carbonate crystal is defined as 1000. MXCT can evaluate the shell density and its inner structure of objects precisely. Using MXCT, we estimated shell dissociation of pteropods collected from the time-series sediment trap observations settled at the Northwind abyssal plain in western Arctic Ocean (Stn. NAP, 75°N, 162°W) where ocean acidification has seriously progressed. Pteropods shell density changed seasonally and decreased in the early winter (November). Our results might indicate that living marine calcifers have affected by acidification in the Arctic Ocean while their biologic responses to ocean acidification are not simple and the mechanism occurring the seasonal change in the shell density is still unknown.

NILLIAJUT: INUIT PERSPECTIVES ON SECURITY, PATRIOTISM AND SOVEREIGNTY

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Issues of Arctic sovereignty, security and militarization have attracted surging interest in the Arctic, creating increasing demands for the best available information. In order to broaden the current discourse on sovereignty and security in the Arctic, often dominated by issues associated with the military, there is a need to understand and include the diverse and unique perspectives of Inuit, as citizens of Canada and stewards of the Arctic. Inuit Qaujisarvingat: Inuit Knowledge Centre, the research centre at Inuit Tapiriit Kanatami, collaborated with the Walter Duncan Gordon Foundation and the Canada Centre for Global Security Studies to undertake a research project to gather Canadian Inuit perspectives on security, patriotism and sovereignty. The project was titled Nilliajut (to speak up, speak out). Nilliajut was specifically designed to explore the multifaceted views of security, patriotism and sovereignty in the Arctic by providing a forum for Inuit to speak openly about issues affecting their daily lives and to share their unique perspectives, understandings and reflections. Nilliajut demonstrates a thought-provoking juxtaposition between Inuit and Western ways of thinking. It brings forward different facets of security, patriotism and sovereignty, as seen through an Inuit lens – one that is varied, complex and nuanced. This presentation will detail the innovative approach taken in gathering this insight and highlight the unique perspectives and personal views expressed throughout Nilliajut with the goal of bringing Inuit perspectives on Arctic security, patriotism, and sovereignty to the forefront.

EXPLORING IDEAS FOR A UNIVERSITY IN THE CANADIAN ARCTIC

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Canada is the only circumpolar nation without a university in the Arctic. In recent years, there has been renewed interest in establishing such an institution. In the spring of 2014, Agnico-Eagle Mines announced it would provide funds for a university in Nunavut – a strong symbol of the influence that industry can have beyond its traditional boundaries. With this announcement came speculation about what a university in Nunavut might look like. Building on our work tracing the historical evolution of post-secondary education and the idea of a university in Northern Canada prior to 1999, in this paper we review the various ways that Northerners have envisioned a university in more recent years, aiming to draw out some of the main themes and debates. We offer a preliminary review of some of the challenges of the past and present and assess university models found in other circumpolar countries. Based on our research, we conclude with thoughts about how the dream of a university in the Canadian Arctic might become a reality.

OVERCOMING LEGACIES: TAKU RIVER TLINGIT EXPERIENCES WORKING TOWARDS DEVELOPMENT ON THEIR TERMS

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Given ongoing mineral exploration and development across Canada's largely Indigenous north, it is essential that

opportunities are captured, impacts are minimized, and Aboriginal rights are exercised in mineral development planning and permitting. To this end, some communities have increased their use of governance mechanisms such as Environmental Assessment, Impact and Benefit Agreements, and government-to-government agreements at the broad and project-specific level to ensure that concerns are addressed and aspirations achieved. While these processes hold the potential to overcome historical legacies of disempowerment, they are considered complex and difficult to navigate by both Indigenous and western actors. In this presentation, the first-hand experiences of the Taku River Tlingit will showcase how these complexities have been navigated to work towards realizing community goals in the face of multiple proposed developments within their traditional territory.

PARTICIPATORY FOOD COSTING AS A STRATEGY TO UNDERSTAND THE INUIT FOOD SYSTEM AND THE CHANGING INUIT DIET

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Residents of Canada's north often cite the high price of nutritious market foods as an obstacle to healthy eating and food security. This presentation reports on an ongoing participatory food costing study in the six communities of the Inuvialuit Settlement Region. The Inuvialuit Settlement Region (ISR), home to the Inuvialuit people, includes one road-accessible community and five plane-accessible communities. The Inuit Health Survey 2007-2008 found that 33% of households in the ISR were moderately food insecure, with 13% experiencing severe food insecurity. Despite access in 5 of 6 communities to a federally administered food subsidy program, there is concern within the region that food is unjustly expensive. While it is mandatory for food retailers to publish quarterly food price reports in remote communities, residents have expressed concern that these reports lack transparency and that the "voice" of communities is neither being heard, nor heeded, on the issue of food prices. Participatory food costing is an established methodology for gathering food prices; yields independent, internally generated food price data at the community level; and empowers community members to contribute directly to the resolution of an important local food system issue. This project has been developed in a participatory manner following a 2-day food security workshop in Inuvik in May 2014, which involved representation from all ISR communities and from the health, education and wildlife sectors. This project builds on local expertise and strengthens capacity in ISR communities through the hiring and training of community members in food-costing methodologies. To capture seasonal price fluctuations, we are collecting data at two time points, fall 2014 and early spring 2015. The list of food items included in the costing was established in consultation with the ISR Food Security Working Group to capture the realities of healthy eating in ISR communities, and to reflect the dietary habits of Inuit reported in the 2007-2008 Inuit Health Survey. Researchers are coordinating with other food costing initiatives, including those operated by Food Secure Canada (e.g., Paying for Nutrition in Northern Canada). This will advance the development of a culturally appropriate, northern food costing methodology, and facilitate the inter-regional comparability of food price results. A strategy for knowledge translation and results dissemination is being developed in collaboration with local stakeholders to render results from the study accessible and meaningful to community members. The authors acknowledge the funding support of ArcticNet.

ENERGY RESILIENCE IN NORTHERN COMMUNITIES: CRITICAL SUCCESS FACTORS FOR SUSTAINABLE NORTHERN ENERGY

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Energy resilience describes the ability of a population to adapt and thrive when undergoing unexpected transformation, disruption or crisis related to its energy provision. It is a critical issue when applied to vulnerable northern communities largely dependent upon fossil fuel energy. The factors that contribute to energy resilience in the north are not well understood. This research project addresses this gap by examining social, economic and environmental factors that have influenced the initial stages of a northern Indigenous community's transition from fossil fuels to a more locally-sourced, clean and autonomous energy future. The case study focuses on the remote northern Gwich'in village of Fort McPherson, NWT, and their pilot biomass boiler project which is offsetting oil and providing clean heat to community buildings. The biomass

boiler, and the local willow harvesting and chipping industry that has developed to supply fuel for the boiler, is providing local employment, building community pride and social capacity, enhancing autonomy, and keeping money spent on energy in the community. This case study examines both the community perspective of success, and the jurisdictional support provided by governmental, NGO and industry partners from the territorial capital of Yellowknife, NWT. The research identifies success factors that might aid policy makers and northern communities in the transition from fossil fuels toward sustainable energy practices. Among these factors for success are the project's relevance to local environmental issues, resonance of the technology with traditional values, local employment and capacity building, community engagement and buy-in, presence of a committed champion and spokesperson, industry involvement, and strong governmental collaboration, policy and support.

OVERVIEW OF BIODIVERSITY RESEARCH BASED ON LOCAL FLORA APPROACH IN RUSSIAN ARCTIC AND APPLICATION TO THE CIRCUMPOLAR ARCTIC

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Concept (and method) of "concrete" flora (later called "local") was introduced by A.Tolmatchev in the 1930s and was widely used by Russian botanists especially when studying extensive and hardly accessible northern territories. It is more efficient and gave more reliable date than travelling through the areas and is less time and labor consuming than method of regular squares. Local flora is a flora of relatively little territory (100-300 km2) studied by radial routes where all sorts of habitats were visited repeatedly and species lists were compiled. Researches of the Far North Vegetation Laboratory at Komarov institute have applied concept of local flora for study of vegetation cover of Russian Arctic for more than 50 years. Study of the big amount of such localities across the Russian Arctic revealed that their floras are characterized by certain species richness and geographical structure. For example, in bioclimatic subzone D local floras in Central Yamal number 130-160 species, in Gydan 150-170, in East European tundra 190-200, in Taymyr 200-250. Knowledge of these values helps to estimate how complete flora of certain locality is revealed, some often overseen species could be specifically searched for and in many cases found. Species richness of local flora depends on the characteristic for the area set of habitats and historical factors. Study of local floras provides information about species populations as both frequency and abundance of each species is recorded. The "Arctic Flora of the USSR" was written mainly on the base of material obtained by studies of local floras. Our database is created in IBIS and contains now species lists and short characteristics of 250 local floras from Arctic and Subarctic (totally about 2000 vascular plant species). Different tables (with both quantitative and qualitative values) can be constructed in IBIS and exported if necessary. We made sketch maps in CorelDraw showing studied localities and on them different floristic parameters can be drawn and their spatial changes can be followed. We are planning to transfer these data to GIS. We use the database for analysis of changes in geographic and taxonomic structure both across latitudinal and longitudinal gradients and for purpose of regionalization but it can have direct implementation for biodiversity conservation issues – indicating areas with any species of interest (rare, endemics,non-endemics), areas with increased species richness etc.

ANALYSIS OF OFF-ROAD VEHICLE-TRACK DYNAMICS ON YAMAL PENINSULA, RUSSIA

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Results of the study of vegetation cover and active layer depth dynamics under technogenic impact in permafrost zone, particularly in the typical tundra subzone, are presented. Study of both vegetation cover and active layer disturbance after off-road vehicle traffic at Central Yamal had started in 1991 in connection with active gas field development and investigations for railway construction in this area. As a result of 2012 field survey and measurements, vehicle tracks were subdivided into 3 groups according to the degree of disturbance: with low, medium and high technogenic impact. The current state of abandoned vehicle tracks which were previously investigated was analyzed. Noticeable recovery of old vehicle tracks is observed on all sites and recovered communities are similar to the original ones, or are replaced by more hydrophilic species. The least visible is recovery of dwarf shrubs and lichens. It contradicts the results obtained in the more southern subzone in Alaska. Old tracks in shrub tundra of Alaska are marked by dwarf birch while in Central Yamal recovery not only takes more time, but old tracks are marked by willow shrubs. Dwarf birch in old fully recovered tracks has less coverage compared to background. Recent tracks are re-vegetating mainly by grass-sedge pioneer groups. Active layer depth as a rule increase in the vehicle tracks.

The degree of deepening results from more or less active traffic, and replacement of initial shrubby communities with high species diversity by mainly sedge communities. The highest increase of active layer depth on old tracks is resulting from thermokarst development. When thermokarst does not develop and surface remains stable, active layer depth moves towards the background values. Next step included mapping of the system of vehicle tracks using aerial images of 1990 and satellite image GeoEye-1 of August 15, 2009. Two time slices were compared. Total length of vehicle tracks was 126 km in 1990 and 235 km in 2009 within 20 square km area. Total area affected by vehicle tracks was at least 0.51 square km (2.5 per cent) in 1990 and 0.95 square km (4.6 per cent) in 2009. Over 19 years total length of vehicle tracks has increased by 86 per cent. However, most of vehicle tracks appeared not to be actively used, they look like not used for a long time. Only 24.5 km (10.4 per cent) of 2009 tracks could be interpreted as actively used.

THE SHALLOW GEOLOGIC FRAMEWORK OF THE BANKS ISLAND SHELF, EASTERN BEAUFORT SEA: EVIDENCE FOR GLACIATION OF THE ENTIRE SHELF AND MULTIPLE SHELF EDGE GEOHAZARDS

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Laurentide ice sheet configuration in the southwest Canadian Arctic Archipelago remains uncertain despite being key in understanding the late evolution of Canada's polar margins. Recent terrestrial studies have inferred that the last glaciation reached the continental shelf west of Banks Island. Further, these studies have placed important constraints on the thickness and dynamics of this ice sheet. Up to now almost no geological or geophysical data from the Banks Island Shelf was available to address the unknown glacial stratigraphy, architecture and sedimentary processes. In August 2014, an ArcticNet expedition aboard CCGS Amundsen collected new high resolution sub-bottom profiler (3.5 kHz) and multibeam bathymetry (EM-300) data (~800 km) and multiple sediment cores towards understanding the type and distribution of glaciogenic sediments on the Banks Island Shelf. The data provide clear stratigraphic and morphologic evidence for glaciation and the cores have age-dating potential. Also identified are ubiquitous sediment instability elements at and beyond the shelf break. Till sheets with marginal wedge-shaped aprons (till tongues) occur on the outermost central and southernmost shelf and interfinger with a stratified glacimarine blanket at their seaward zero edge. They define a >100 km ice margin along the shelf break near 400 m water depth. Multi-stack tills at the NW mouth of the Amundsen Gulf trough may record a correlative ice stream margin. Sediment cores recovering the base of overlying glacimarine muds will provide a robust chronology for the former ice margins. Local angular unconformities in overridden glacimarine sediment are attributed to subglacial erosion. Glacial flutes several hundred metres across, with up to13 m relief (no berms) delineate a north- northwesterly flowing ice transitioning to a floating margin in 450 m water depth. The limit of iceberg scour is consistently 380 to 400 m present water depth. Sediments in depths shallower than this have been fully iceberg turbated. Generalized regional bathymetry across the central and southern Banks Island Shelf resolves a mid- to inner-shelf terrace (30 to 65 km offshore) dipping slightly westward (< 0.05°) with a steep west-facing scarp of 20-40 m relief. Sub-bottom profiler data indicate crude yet consistent progradational strata, dipping westward on the central shelf and southward near the Amundsen Gulf trough. A short but thick (60 m) isolated ridge in the southwest is interpreted as a moraine representing still-stand and minor re-advance. A core from this mid-shelf glacial moraine was recovered from its distal side. This, together with the shelf-edge tills, record two regional glacial margins, each with high age-dating potential. Surficial slope-situated failure scarps are almost ubiquitous, with tens of metres relief and related debrites. These have removed and locally overridden the glacimarine blanket. A thick debrite at 670 m water depth induced diapiric action at its downslope edge. Structurally disturbed sediments (mainly diapiric, so-called pingo-like features) line the entire southern bank, flanking Amundsen trough. Simple canyon systems occur most with narrow collection tributary geometries, one dominant thalweg and little or no fill, many with heads cut into shelf-break till. Isolated sandwave fields indicate shelf-break currents. These findings contribute geographically and conceptually to a framework for geohazards.

THE EFFECT OF OCEAN HEAT FLUX ON SEASONAL ICE GROWTH IN YOUNG SOUND FJORD (NORTH-EAST GREENLAND)

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The seasonal ice cover plays an important role in the climate system by limiting the exchange of heat and momentum across the air-water interface. Among other factors, sea ice

is very sensitive to the oceanic latent heat flux. In this study we use in situ oceanographic, sea ice and meteorological data collected during winter 2013/2014 in Young Sound (YS) fjord in Northeast Greenland to estimate the oceanic heat flux to the land fast ice cover. During the preceding ice-free summer, incident solar radiation caused sea surface temperatures of up to 5-6°C. Subsequently this heat is transferred downwards to the intermediate depths, but returns to the surface and retards ice growth throughout winter. Two different approaches were used to estimate the oceanic heat fluxes in YS based on (i) in situ ice thickness measurements and the conductive heat flux derived from a 1D thermodynamic ice growth model and (ii) the bulk parameterization using the friction velocities and the available heat content of water beneath the ice cover. Both methods yield similar results, but the second approach tends to underestimate the heat flux at the beginning of ice formation. The average heat flux in the inner part of YS varied from 13 W/m2 in October-December to less than 2 W/m2 in January-May. An average heat flux of 9 W/m2 was calculated for the outer part of YS, though it varied from 0 to 140 W/m2. Moreover, we show that the upward heat flux in outer fjord is strongly modulated by surface outflow currents which produce two maximums (up to 18-24 W/m2) during the periods between 26 December – 27 January and 11 February – 14 March. By May 2014, the upward oceanic heat flux reduced the land-fast ice thickness by 18% and 24% in the inner and outer parts of YS respectively.

TUKTU AND CLIMATE CHANGE: INUIT HARVESTING ON SOUTHERN BAFFIN ISLAND

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Up to this point there has been relatively little research that has examined human-caribou interactions in the context of multiple stresses. Previously the focus of management studies has been on the co-management structures and their function. By addressing community interactions with caribou on Southern Baffin Island in the context of changing access, climate-driven caribou population changes, and a number of management frameworks and institutions, this study aims to develop a baseline understanding of the sustainability of caribou harvesting in the Iqaluit region. Drawing attention to caribou as a major source of country food, and one of the Arctic species that will potentially be profoundly impacted by climate change, the study will be a resource for land-use planners and policy-makers on the importance of preserving biodiversity and sustainable northern ecosystems from ecological, cultural and food security perspectives. This study will help to refocus attention on sustainable harvesting and co-management as a key adaptation and resiliency strategy in the face of a rapidly changing Arctic. The presentation will discuss the preliminary findings of this ongoing study of the caribou-human relationship based around Iqaluit, Nunavut. Working closely with community members, and building upon over 6-years of previous research in Iqaluit, this research examines how hunters are adapting their behaviors to changing access to harvest areas and variations in caribou populations. This will be considered against the backdrop of adaptive changes within the territorial institutions and organizations that are engaged in wildlife management.

ADAPTIVE MANAGEMENT OF CUMULATIVE EFFECTS : THEORY VS REALITY

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Rapid change in Arctic social-ecological systems has generated considerable discussion among academics of resource management about the potential benefits adaptive management (AM). Defined as a structured, iterative process of decision making in the face of uncertainty, AM aims to link monitoring, analysis, critical reflection, and decision making with the intent of facilitating social learning while improving resource management. In face of recent trends of directional rapid change, the concepts of adaptive co-management and adaptive governance have been introduced and developed by advocated of sustainability science and resilience theory. The development and use of decision-support systems and "structured decision making" processes, double- and triple-loop learning cycles, cross-scale linkages in adaptive governance, inclusion of local knowledge in AM, and the view of policies as experiments have all been suggested. The successful application of these ideas, however, has come with considerable challenges and in many cases failure. In the context of the Alaska North Slope oil and gas development, the implementation of AM has been the espoused goal of specific agencies (e.g., AK Department of Natural Resources) as well as collaborative efforts (e.g., North Slope Science Initiative (NSSI) and the Arctic Land Conservation Cooperative (LCC)). The NSSI has undertaken this effort by building metadata sets, developing emerging issue papers, and most recently initiating scenarios analyses (Streever et al 2011). At the agency level the results of these efforts have been mixed. For example, a study of Alaska Department of Natural Resources/ Northern Regional Office found a number of organizational and informational

constraints in the implementation of AM and CE assessment, including the problem of limited staff size, high turnover of agency personnel, limitations in handling the high number of applications received, a lack of standardized policies and guidelines for addressing applications, limited engagement with a greater community such as university researchers community and regional assessment teams, and inadequate GIS capacity. In other cases problems have followed from the legal constraints in undertaking environmental impact assessments, which do not provide opportunities for simulation modeling and structured decision support tools. Interestingly, our first review of AM shows that industry may have the most experience and success with AM applications. In this paper we present core elements of AM of cumulative effects in theory, and explore the short comings in practice. We go on to describe our current research that is exploring the gap between theory and practice, drawing on evidence from industry, government, and Alaska Native community experiences. We undertake the research with the goal of bridging the gap and helping meet the challenges of a changing North.

DOES ICE COVER REGIME INFLUENCE SEDIMENTARY MERCURY ACCUMULATION IN HIGH ARCTIC LAKES?

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Recent observations of rising mercury concentrations in some Arctic lake sediment cores appear inconsistent with anthropogenic emission patterns. Instead, it has been postulated that dramatic changes occurring in the Arctic as a result of recent climate warming (e.g. decreased ice cover, increased primary production) may be increasing mercury flux to aquatic ecosystems. Assessing the effects of climate warming on mercury sequestration in Arctic lake sediments is confounded by the temporal overlap between warming temperatures and increased long-range transport of atmospheric mercury following the industrial revolution. In order to test the hypothesis that environmental changes occurring as a result of recent climate warming are causing mercury increases in aquatic ecosystems, we obtained sediment cores from a strategically selected set of lakes in the Canadian High Arctic that have different climate and ice-cover regimes: 1) "warm" sites, which responded early to climate warming and have a relatively long ice-free season; 2) "cool" sites, which tend to lose their ice cover much later in the summer and are less sensitive to warming compared to warm sites; 3) "cold" sites, which are rarely ice-free and have only been minimally impacted by recent warming; 4) "Arctic oasis" sites, which likely had a long ice-free season prior to anthropogenically-induced climate warming. We analyzed algal diatoms and primary production as markers of recent warming to compare with sedimentary mercury deposition profiles. Similar to previous investigations of mercury in sediment cores from High Arctic lakes, we observed post-industrial increases in mercury concentrations consistent with increased atmospheric transport, but little evidence of decreases in mercury concentrations following international reductions in mercury emissions. Temporal trends in sedimentary mercury accumulation were variable both within and between lakes of different ice-cover regimes, and no clear patterns emerged that would indicate lakes impacted by climate warming and loss of ice cover are more vulnerable to mercury deposition relative to lakes minimally impacted by climate warming. In fact, the largest post-industrial increase in mercury was observed in a lake that still maintains its ice cover throughout the summer, and has not experienced any recent increases in organic carbon and chlorophyll a. Only a few sites showed significant correlations between trends in sedimentary mercury accumulation and organic carbon flux / inferred primary production, and overall we provide only weak support for the algal scavenging hypothesis. Instead, our results show that the accumulation of mercury over time in High Arctic lake sediments is a complex process influenced by a range of factors, including catchment size, sedimentation rate, lake area, ice-cover, and organic carbon flux. By applying a multi-proxy paleolimnological study design using a strategically selected set of lakes along a climatic gradient, we provide critical insights into the effects of climate warming on the delivery of mercury to Arctic lakes.

MANAGEMENT ADAPTATIONS TO INDIGENOUS PERSPECTIVES: EXAMPLES FROM NUNAVUT WILDLIFE MANAGEMENT

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With the signing of the Nunavut Land Claims Agreement twenty one years ago, Inuit and Government have been implementing and adapting to various management regimes that were created. A wildlife management system was created that aims to promote Inuit participation in all aspects of wildlife management. This goal has presented challenges on how Inuit participation and perspectives can be part of the system, but there has been some progress over the years. This presentation will first provide information on the Nunavut wildlife management system objectives, such as the conservation

principles and Inuit interests, participation and confidence. After that context has been created, examples of how Inuit perspectives are incorporated into wildlife management in Nunavut, particularly research, will be provided. These examples will focus on adaptations in polar bear research and in methods that actively involve Inuit in wildlife research. As well, methods of documenting and communicating Inuit perspectives will be described and contrasted, with examples on Inuit societal values, traditional ecological knowledge and scientific research. Key Words: Communication, Conservation Principles, Decision-Making, Indigenous Perspectives, Inuit societal values, Inuit Confidence, Inuit Interests, Inuit Participation, Management Adaptation, Wildlife Management, Research Methods, Social Science, Traditional Ecological Knowledge

ADAPTATION ACTIONS FOR A CHANGING ARCTIC – THE BARENTS CASE

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IPCC's fifth assessment report shows that changes in the Arctic happens very quickly, both in terms of ice extent, temperature and weather patterns, ocean acidification and other factors that may have a considerable effect on the environment, society and the conditions for future development. As the ice cover in the Arctic is reduced, economic activity may increase. Transarctic shipping may increase significantly as retreating summer sea ice extent makes shorter shipping routes between Europe and Asia more economically profitable. If new sea routes are opened, natural resources may become more accessible for extraction and harvesting, both from land, sea and seabed. The economic and societal potential is large. At the same time a number of questions arise, about the impacts these activities will have on society, the environment and ecosystem services, and the challenges we face in terms of adaptation. A better understanding of the developments underway in the Arctic is vital to ensure a sustainable future for the region and its peoples. To address such issues, the Arctic Council initiated the project Adaptation Actions for a Changing Arctic (AACA). The project is one of the Arctic Council priorities until 2017, and is implemented in three pilot areas. This presentation relates primarily to the ongoing work in the Barents region. In the Barents region, climate change is a reality and has already led to impacts on the environment and on economic activities. Despite these changes, the region is still relatively clean, with large intact natu¬ral areas and unique indigenous culture in Europe. Barents consists of developed states with strong government structures and localized economic activity, and is in many ways becoming a strategic region. Its natural resources and new transportation routes may change both the European and the global map on resource use and transportation. A continued warming will affect ecosystems, cultures, lifestyles and economies across the region -- future development depends on the ability to manage the challenges and opportunities from an opening Arctic. The future challenges and risks will vary across the region, by sectors and communities. The national story may differ from the story within an individual settlement or local community, and the story of northern communities may differ from southern communities. The main goal in the pilot study in the Barents region is to strengthen the knowledge base to address the challenges from societal, environmental and climate changes; to produce more reliable projections and reduce uncertainty; increase understanding of how the global climate, environmental and socio-economic drivers interplay; and how local people and nature are affected and can adapt. Further understanding of the resilience of Arctic ecosystems is also part of the project. Adaptation it has to do with viability, development and sustainability of social, economic and environmental systems. By using an integrated approach, the AACA and Barents study will produce information to assist local decision makers and stakeholders in developing adaptation tools and strategies to better deal with climate change and other pertinent environmental stressors.

MANUFACTURED NANOPARTICLES AND THEIR IMPACT ON SEASONAL CHANGE IN THE ARCTIC

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Currently millions of tonnes of nanoparticles (NPs) are manufactured on a yearly basis and there is every indication that such production will continue to increase in the future. Although some NPs are known to have anti-bacterial properties, their impact on the environment in general and on ecosystems at high latitudes in particular, is limited. Our initial experiments were designed to examine the potential toxicity of silver, copper and silica dioxide NPs on a high arctic soil and clearly showed that silver NPs were the most toxic to the consortium. Of special concern was that Rhizobiales bacteria, known to be beneficial to plants, proved to be very susceptible to silver NP treatment. Thus, we repeated these experiments to more fully explore the effect of silver NPs, this time on soil from

a low arctic site. The soils were tested in microcosms that were exposed to temperatures mimicking a winter to summer transition. Physiological and biochemical studies including respiration monitoring, fatty acid methyl ester identification, PCR-DGGE and metagenomic analysis together showed that notwithstanding the effect of silver microparticles, nanosilver had an obvious, additional impact on the microbial community. This underscores the importance of particle size in toxicity. Prominent after Ag NP-treatment were Hypocreales fungi, which increased to 70%, from only 1% of fungal sequences under control conditions. Genera within this Order known for their antioxidant properties (Cordyceps/ Isaria), dominated the fungal assemblage after NP addition. In contrast, sequences attributed to the nitrogen-fixing Rhizobiales bacteria again showed that they were vulnerable to Ag NP-mediated toxicity. This combination of physiological, biochemical and molecular studies clearly demonstrate that Ag NPs can severely disrupt the natural seasonal progression of tundra assemblages. These further studies have confirmed our initial observations on the dramatic impact NPs have on arctic soils. We thus urge caution before embracing technologies for energy exploration and remediation in arctic sites that utilize NPs.

DETECTION AND ANALYSIS OF RECENT LANDCOVER CHANGES IN CENTRAL YAMAL PENINSULA RUSSIA. A CASE STUDY FROM BOVANENKOVO GAS FIELD

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Petroleum production activity causes rapid land use and land cover changes in the Russian Arctic. In central Yamal peninsula in West Siberia both natural and anthropogenic changes have occurred during the past 40 years. Mega size Bovanenkovo gas field (BGF) was discovered in 1972. Giant gas resources of the field makes BGF one of the world's three largest with estimated reserves of 4.9 tcm. The large scale building of infrastructure started in mid 1980's but in early 1990's as the Soviet Union collapsed and economical crisis spread over Russia the gas field went into hibernation mode. In 2006 Gazprom launched a new plan for production and in October 2012 gas production began. Within a few years a new railroad, and pipelines were built to reach BGF. We have studied gas field development and natural changes like increases in shrub growth, cryogenic landslides, thawing lakes in the region. The traditional landuse in the Yamal is reindeer herding practiced by nomadic Nenets herders. The hydrocarbon industry is presently the source of most ecological changes in the Yamal peninsula and socio-economic impacts experienced by migratory Nenets herders who move annually between winter pastures at treeline and the coastal summer pastures by the Kara Sea Employing a variety of high- to very high-resolution aerial photographs and satellite-based sensors (Corona, KH-9, Landsat, SPOT, ASTER Terra VNIR, Quickbird-2, Worldview-2, Terra XS DEM, MODIS and TerraXS), we have followed the establishment and spread of Bovanenkovo, the biggest and first field to be developed in Yamal. Extensive onsite field observations and measurements of land use and land cover changes since 1985 have been combined with intensive participant observation in all seasons among indigenous Nenets reindeer herders and long-term gas field workers during 2004–2007 and 2010–2014. Nenets managing collective and privately owned herds of reindeer have proven adept in responding to a broad range of intensifying industrial impacts at the same time as they have been dealing with symptoms of a warming climate. Here we detail both the spatial extent of gas field growth and the dynamic relationship between Nenets nomads and their rapidly evolving social-ecological system.

INFORMING ADAPTATION ACTIONS IN A CHANGING ARCTIC (AACA)

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While existing assessments have evaluated individual drivers of change, it is recognized that climate, environmental, and socio-economic drivers will interact, amplifying the difficulty in making decisions in an unpredictable and rapidly changing Arctic. Cumulative changes may increase existing pressures in the Arctic, while others may bring new opportunities. This is the context of a new project designed to inform Adaptation Actions in a Changing Arctic (AACA), which is being implemented by the Arctic Council through its Arctic Monitoring and Assessment Program (AMAP). The goal of AACA is to provide the scientific foundation for making adaptation decisions about the future of the Arctic in the face of ongoing and future climate, environmental, and socio-economic change. The purpose of this presentation will be to acquaint the audience with AACA and to provide context for following presentations. It is hoped that persons interested in AACA will attend the session and participate in the follow-on discussion.

MIGRATIONS, SHIFTING BARRIERS AND CORRIDORS, AND HOST-PATHOGEN TRANSMISSION DYNAMICS: HOW WILL CARIBOU AND THEIR PARASITES RESPOND CLIMATE CHANGES?

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Widespread climate change is having profound impacts on physical and ecological processes across the Arctic. Our studies on Ostertagia gruehneri, the common and pathogenic abomasal nematode of caribou, demonstrate complex interactions between parasite life history strategies, host migratory behavior, and climate warming. Using complementary field studies, laboratory experiments, and modeling frameworks incorporating the Metabolic Theory of Ecology, we have described the life history of O. gruehneri in caribou and investigated the impacts of climate change on host-parasite interactions in three disparate caribou populations. We found that (i) the transmission dynamics for O. gruehneri are highly seasonal where host winter migration spatially and temporally separates caribou from their parasites, and parasites 'counteract' this by focusing their reproductive output during the summer; (ii) tundra surface temperatures now and in the future frequently exceed the upper tolerances of free-living stages of O. gruehneri and are likely to shift transmission from a unimodal to bimodal pattern with significant consequences on parasite transmission and disease syndromes; and (iii) changing physical barriers (sea ice and glaciers) that alter caribou movements will alter transmission dynamics and parasite diversity. Our results highlight the critical importance of examining the complex interactions between the physical environment, host behavioural ecology, and parasite life history strategies, plasticity, and tolerances, in order to anticipate caribou resilience to change. This work has far reaching consequences for understanding the role of migration in host-parasite interactions globally.

THE PIVOTAL ROLE OF HEALTHY WILDLIFE IN COMBATTING FOOD INSECURITY IN THE ARCTIC

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Wildlife are integral to the identity and physical, social and cultural health of many northern residents. For centuries arctic peoples have relied on a range of wildlife species for food, shelter, and clothing, and more recently, also as a focus for maintenance of cultural identity and part of a sustainable renewable resource economy. Today, wildlife populations remain important for food security in the North, providing an accessible, healthy source of food, and employment income through guiding of sport hunts and tourism. Rapid and unprecedented climatic and economic changes across the Arctic are, however, having significant impacts on wildlife health and population dynamics. In the last 10 years around the circumarctic, increasing reports of emerging pathogens and major disease events in important subsistence and commercial species such as waterfowl (eiders), marine mammals (seals, beluga), and terrestrial mammals (muskoxen, caribou, reindeer), have raised significant concerns among user communities, wildlife managers, scientists, public health professionals, and industry. Importantly, mere reports of disease have had negative impacts on the country-food system in that inappropriate press and risk communication have lead to fear and rejection of traditional foods, even when there is no human health risk. In this talk we discuss how emerging diseases in circumarctic wildlife have affected food security and real and perceived food safety. We elaborate on a case study of recently invading parasites and widespread unusual mortality events in muskoxen in the Canadian Arctic Archipelago. Population surveys and local knowledge in this area indicate muskox population declines and reduced access to muskoxen for subsistence hunting; the role of disease in these declines is being evaluated. In response to reduced muskox availability, the Victoria Island and Banks Island commercial muskox harvests have been suspended; further declines may reduce the local economic benefits of guided hunting industry. Together, the occurrence of zoonotic disease in muskoxen, loss of confidence in country food safety,

limited access/increased expenses associated with hunting, and loss of jobs associated with commercial harvest all contribute to accelerating food insecurity. It follows that reliable wildlife health surveillance systems combined with ongoing and appropriate risk communication are essential components of any program aiming to improve food security across the North.

THE PERMAFROST YOUNG RESEARCHERS NETWORK (PYRN): INVOLVING THE YOUNG GENERATION OF POLAR SCIENTISTS TO CROSS-DISCIPLINARY KNOWLEDGE EXCHANGES, POLICY AND STRATEGY DISCUSSIONS

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Getting started in a research career is challenging for many young scientists. There are many new skills to learn, managing their own research projects and planning their laboratory budgets, teaching responsibilities and at the same time developing network skills, building up the collaborations and seeking for new research opportunities as well as finding employment. PYRN is a network bringing together young and enthusiastic permafrost scientist from all around the world and is an ideal platform to exchange ideas and knowledge. PYRN was created in 2005 as the result of the 2nd International Conference on Arctic Research Planning (ICARP II) and boosted its activities and visibility since the 4th International Polar Year (IPY 2007-2008). We work in close collaboration with APECS and our overarching organization, the International Permafrost Association (IPA), together raising awareness of the necessity for permafrost early career scientists to be included in future polar activities. PYRN seeks building interdisciplinary knowledge on how the Arctic and Antarctic permafrost regions play a key role in the Earth System and to give each participant an embracing view on the regions beyond disciplinary research questions. Now comprising over 1100 members from more than 20 countries, PYRN represents an international organization for undergraduate and graduate students, postdoctoral researchers and early faculty members, and others with interest in the studying of permafrost. PYRN is guided by an Executive Committee but run through its members that organize themselves in an international Council, national communities, thematic groups and several groups of interest. During last years among PYRN main contributions were organizing the workshops during the regional and international permafrost conferences to maintain an active, dynamic and growing early career scientific network on permafrost. It was increasing its presence on large conferences like the European and American Geophysical Union (EGU, AGU) as a part of sessions and social network events. The value of knowledge accumulated by young researchers should not be underestimated. One of the goals of PYRN is to increase the communication between young and senior researchers, and to engage early career scientists in cross-disciplinary knowledge exchanges, policy and strategy discussions. As part of this strategy, PYRN led the Permafrost Young Researchers Workshop 2014 together with APECS, PAGE21 and ADAPT in conjunction with the 4th European Conference on Permafrost 2014 in Évora, Portugal. This workshop included approximately 100 early career permafrost scientists and engineers and aimed to give each participant an overarching view of permafrost related topics beyond disciplinary research questions. To achieve this, the participants shared their knowledge in thematic breakout sessions and elaborated on the future avenues of permafrost research. They were also inspired and guided by mentors who play a key role in permafrost research either in large scale international projects or science policy. Besides various activities along the way PYRN already gets prepared for its next major task: The PYRN workshop at the 11th International Conference on Permafrost 2016 in Potsdam, Germany.

EFFECT OF CLIMATE CHANGE ON ROAD INFRASTRUCTURE IN NORWAY

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Infrastructures are traditionally designed to face with various stresses along their life, including extreme weather events as historically and currently experienced (Nemry& Demirel, 2012). In Scandinavia, roads in regions that previously enjoyed stable winter conditions are now subject to several freeze-thaw cycles each winter. This will accelerate road deterioration and consequently increase maintenance costs. In general, cold climate countries have to cope with pavement deterioration effects, and in countries such as Norway represent ~30% of the maintenance budget (PIANC, 2010). The Norwegian Green Paper on Climate Change Adaptation, prepared for

the government by a committee of experts (Ministry of the Environment, 2010), offers detailed projections of future climate change in Norway, based on three scenarios. It shows annual mean temperatures will increase by 2.3°C to 4.6°C by 2100, with the greatest increase during winter and the least during summer, and major regional differences – northern regions will warm the most, and western Norway the least. Annual precipitation could increase by 5% to 30%, with major seasonal and regional variations, and more frequent torrential rains and massive snow falls. Some of the bigger concerns identified in the paper relate to how warming will affect the natural environment in the Arctic and in the High North, as well as in higher altitudes; these are areas with "marginal" natural conditions, and they are also where the most warming is expected. Species and ecosystems will become more vulnerable, and adaptation may not be enough to prevent biodiversity loss. Transport infrastructure is also of some concern, especially given existing inadequacies in maintenance and repairs. And the committee notes that because new infrastructure may have many decades' lifespan, climate considerations should be taken into account in planning for infrastructure and facilities. Higher precipitation, higher groundwater levels and more frequent freeze-thaw cycles affect the bearing capacity of roads (Adaptation to climate change, 2012). Frozen layers in the sub-base of roads with poor drainage properties or made of frost susceptible materials prevent melt water or precipitation from draining away from the road structure when thaw sets in. This temporarily reduces the bearing capacity of the road. A higher content of fines due to sub-base wear will increase moisture in the structure and the risk of subsequent frost heave. Due to climate change, frost heave problems may become more frequent in areas that previously had stable winter conditions. In particular, surface layer problems during winter are more common because the period without freezing conditions has increased. The main purpose of our research is specifying the materials and conditional factors that cause frost heave in the road structure, and giving suggestions for making modifications in existing requirements for road construction in Norway.

EARLY DIAGENESIS AND TRACE ELEMENT ACCUMULATION IN NORTH AMERICAN ARCTIC MARGIN SEDIMENTS

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Continental margin sediments are now recognized as disproportionately important in many global biogeochemical cycles. They account for as much as 90% of the oceanic burial of organic carbon and are the principal sites of pyrite sulphur burial formed during microbial oxidation of labile organic matter by sulphate reduction. Organic matter and sulphide burial in continental margin sediments, in turn, represent the major sink terms in the oceanic budgets of a number of redox-sensitive trace elements, including Mo, U, and Cd. Concentrations of redox-sensitive elements (S, Mn, Mo, U, Cd, Re) were analyzed in a set of 27 sediment cores collected along a section extending from the North Bering Sea to Davis Strait via the Canadian Archipelago. Sedimentary distributions and accumulation rates of the elements were used to document the early diagenetic properties of the sediments and to estimate the importance of this margin as a sink for key elements in the Arctic and global ocean. Most sediments along the North American Arctic margin had relatively thick (>1 cm) surface oxic layers, which are underlain by sediments with weakly reducing conditions and limited sulphate reduction. Strongly reducing conditions sufficient for significant sulphate reduction and strong sedimentary pyrite burial occurred only in certain subregions, including the Bering-Chukchi Shelves, shallow portions of Barrow Canyon, and, to a lesser extent, Lancaster Sound. Accumulation rates of trace elements displayed marked spatial variability that was related to the sedimentary redox conditions. Furthermore, strong relationships between the accumulation rates and vertical carbon flux, estimated from regional primary production values and water depth at the coring sites, indicate that the primary driver in the regional patterns is variation in labile carbon forcing. Very high primary production combined with shallow water columns drive high rates of authigenic trace element accumulation in sediments from the Bering-Chukchi Shelves, high to moderate production combined with deep conditions drive moderate rates of authigenic trace element accumulation in sediments from Lancaster Sound, and low to very low production combined with moderately deep conditions drive low rates of authigenic trace element accumulation in sediments in the Beaufort Shelf, Davis Strait and Canadian Archipelago. Using the average observed accumulation rates in sediments from the various regions, we estimate that the shelves along the North American Arctic Ocean margin are important sinks in global marine biogeochemical budgets. In the Chukchi Shelf, in particular, we estimate that the total authigenic S, Mo, Cd and U accumulation may account for as much as 10% of the pyrite S, 14% of the Mo, 6%-24% of the Cd, and 10% of the U that is captured in margin sediments of the world's ocean. Our results thus imply a disproportionately strong role for especially the broad, shallow, productive shelves along the Arctic Ocean margin in global marine biogeochemical cycles.

ARCTIC SECURITY AND SAFETY: INTERNATIONAL AND WHOLE OF GOVERNMENT APPROACHES

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Over the past decade, resource development and receding sea-ice have transformed the Arctic from a political afterthought to an area of immediate and expanding security concerns. These emerging security issues will, however, not entail conventional military threats, a fact made abundantly clear in recent years by the Arctic states, which have deliberately dispelled the myth of a "race" between circumpolar nations. Rather, Northern security will be defined by complex and unconventional challenges, such as natural or human disasters, environmental degradation, increased search and rescue requirements, espionage, organized crime, and pandemics. These situations will require a system-wide, multifaceted response that integrates a wide range of military and civilian resources, necessitating a multidisciplinary, trans-sectoral approach to identify research priorities and produce relevant and feasible policy options.

Although seldom discussed in academic literature, the Whole of Government (WoG) framework has emerged as a centerpiece of federal policy because it offers a way to address these security threats while rationalizing services and leveraging capabilities across government(s) and avoiding costly redundancies. This integrated, comprehensive approach is designed to compensate for the death of infrastructure and assets in the region, while ensuring a more focused response to threats that fall within the purview of multiple departments and agencies. This paper will reflect on the challenges and opportunities associated with a WoG framework to manage security and safety issues at an operational level, including civil-military cooperation and inter-governmental resource sharing, consultation, and integration with local communities, non-government organizations, and the private sector.

CARBON DIOXIDE FLUXES OF ESKER TOP TUNDRA VEGETATION COMMUNITIES

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In the Arctic, elevated terrain types (hills and ridge tops) present challenging environments for tundra plant communities because of their high exposure, resulting in sparse vegetation cover and seemingly low productivity. In this study we measured summer ecosystem-atmosphere carbon dioxide exchange at four different tundra communities located on the crest of an esker in the central Canadian low-Arctic. This extreme environment is characterized by harsh windy, cold conditions with little snow cover in the winter and hot, dry conditions in the summer. The study objectives were to quantify CO2 fluxes from these communities, examine the responses of these fluxes to environmental variables and compare these results to those from similar communities growing in less harsh (valley) tundra environments. There were some differences in net ecosystem exchange (NEE) and gross ecosystem production (GEP) among the communities, with the highest fluxes being observed at A. alpina dominated plots and the smallest at E. nigrum dominated plots. The two communities with erect deciduous shrubs, B. glandulosa and V. uliginosum, had similar fluxes. Ecosystem respiration (ER) was similar for all communities, except those dominated by B. glandulosa, which had larger fluxes. Overall, the mean fluxes measured at these esker communities were similar to those reported for lowland tundra communities. ER was related to soil temperature in all of the communities, whereas GEP and ER responded to a persistent decrease in soil moisture observed during the study, but only in the B. glandulosa plots. It is concluded that while CO2 fluxes are high at these esker top sites, harsh winter conditions reduce vegetation expansion and the accumulation of carbon in the soil.

SCALING DISTURBANCE IMPACTS ON DISSOLVED LOADS IN STREAMS: LESSONS FROM LONG-TERM MULTI-SCALE STUDIES AT THE CAPE BOUNTY ARCTIC WATERSHED OBSERVATORY (CBAWO), HIGH ARCTIC, CANADA

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Projected climate change is expected to substantially alter the distribution and quality of surface water in the Canadian Arctic. Changes in type and seasonality of precipitation will impact the characteristics of seasonal discharge, and changes in the thaw depth (thermal perturbation) and geomorphological characteristics of the active layer (i.e. physical disturbances such as active layer detachment slides ALDs) stand to significantly alter water quality, in terms of both dissolved and particulate loads. These changes in the quality and flow of water in rivers will in turn impact aquatic ecosystems, including fisheries, the

availability of potable water for northerners, as well as related resource and development concerns. Despite the importance of water resources and the direct link between water and climate, there are few comprehensive studies of permafrost change impacts on arctic river water quality. As a result there is limited understanding of the spatial or temporal scales over which impacts are observed. Since 2006 we have undertaken a comprehensive integrated hydrological research program at the CBAWO with the goal understanding of hydrological and biogeochemical processes that drive water quality in surface waters, and their responses to changing climate and permafrost conditions. This research includes studies of paired second order watersheds (~10 km2) and a series of tributary watersheds (~0.15-0.30 km2) that were subject to varying degrees of slope disturbance in the form of ALDs that were caused by exceptionally warm conditions in July 2007. Results from both the larger watershed scale and the tributary catchment scale, support that deep active layer thaw during warm years, even in absence of disturbance, yields elevated dissolved solute loads. The impact of this deep thaw is also evident in subsequent years despite significantly cooler conditions. The direct impact of physical disturbance (ALDs) on solute loads is difficult to discern at the larger catchment scale even in the season immediately following disturbance. The tributary catchment studies highlight that the impact of disturbance on solute loads is limited by the hydrological connectivity, and to a lesser extent the size of the disturbed areas. This finding supports that the disturbance impact at the larger watershed scale was not evident because the disturbed areas were small and not well hydrological connected. A comparison of pre-disturbance and post-disturbance N dynamics in disturbed and undisturbed tributary catchments demonstrated that disturbance significantly enhanced the export of microbially-derived nitrate (NO3-). This enhanced NO3- export was observed five years post-disturbance, and is likely the result of diminished NO3- retention and enhanced nitrification in the mineral soils exposed in the scar zones of ALDs. Finally, investigations at both scales also support that late summer precipitation events can create disproportionately large yields of solutes, and this is especially true for nitrate (NO3-). Our research program therefore demonstrates that hydrological connectivity, and the seasonality and magnitude of projected increases in precipitation need to be considered along with active layer perturbations (both physical and thermal) to predict the fluvial biogeochemical response of arctic watersheds to regional climate change.

CAF LESSONS LEARNED FROM ARCTIC OPERATIONS, 1970-2014

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Over the past decade, the Canadian Armed Forces (CAF) has devoted significant time and resources to developing new Arctic capabilities. In effect, the CAF has been trying to learn how to operate, survive, communicate, and even fight in the North. While exercises over the past decade have boosted the military's northern capabilities, many of the 'lessons learned' are actually being re-learned after having been lost during periods of inactivity. The most significant of these lessons concerns the Forces' strategic direction and purpose. As was the case in the 1970s and 1980s, the military must ask itself: in the absence of a conventional military threat to the region, what is the CAF really seeking to accomplish? How can a military "defend" sovereignty? Is this an effective, or even realistic, objective? This paper analyses current defence policy and activity and compares it to previous eras of intense Arctic activity. It concludes that, while most of the operational and tactical lessons from the CAF's Arctic past are being laboriously reacquired, the military has absorbed the broader strategic lessons. As such, the CAF is approaching the question of sovereignty, and its tasks in the North, in a different and entirely more productive manner.

AGE AND ORIGIN OF MULTIPLE ICE-RAFTED DEBRIS HORIZONS IN THE BEAUFORT SEA: IMPLICATIONS FOR PAST ICE SHEET DYNAMICS, PALEOCLIMATE, AND ARCTIC OCEAN STRATIGRAPHY

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Uncertainties regarding the age and origin of shelf and slope sediments in the Beaufort Sea constitute a major barrier to understanding the geological evolution of the Beaufort Sea margin. Multiple sediment cores collected from the upper slope of the Beaufort Sea and from adjacent Amundsen Gulf provide evidence for rapid, intermittent deposition of discrete

ice-rafted debris (IRD) horizons during the last deglaciation (i.e. 16–11 cal ka BP). The mineralogy of the IRD is defined by new quantitative x-ray diffraction (qXRD) analyses, which confirm a source area in the Canadian Arctic Archipelago. In addition, multiple radiocarbon ages of planktonic and benthic foraminifera constrain the ages of the IRD horizons. Three discrete IRD horizons are identified in the shelf and slope sediments based on their age, stratigraphic position, and composition. Two, paired, closely spaced IRD horizons (each 10 to 20 cm thick) occur in the upper 230 cm of the sediment cores from Amundsen Gulf and the upper slope. Multiple radiocarbon ages imply that these two, upper IRD horizons were deposited during the Younger Dryas chronozone. A third IRD horizon (up to 30 cm thick) occurs at greater depth in two of the sediment cores from the upper slope. A radiocarbon age indicates that this lower IRD horizon was deposited during the late Bølling-Allerød chronozone. The occurrence and age of these new IRD horizons bears on the timing and nature of ice sheet retreat from the Canadian Arctic Archipelago during the last deglaciation. Specifically, the IRD is inferred to represent sporadic deposition by icebergs produced during phases of rapid or catastrophic withdrawal of a former ice stream in Amundsen Gulf. Importantly, the age of the two, upper IRD horizons accords with previous inferences of rapid ice stream withdrawal in Amundsen Gulf during regional deglaciation, based on detailed mapping and dating of the glacial geomorphology of southern Banks Island. These new constraints on past ice stream dynamics provide insight into the variables that occasioned deglaciation of the marine channels of the archipelago, and constitute an important analogue for extant ice sheets. Further, recognition of discrete periods of high iceberg fluxes to the Arctic Ocean (during intervals of ice stream retreat) aids in understanding deglacial paleoclimatic archives. Finally, knowledge of IRD in the Beaufort Sea has implications for understanding the age and origin of IRD in the deep Arctic Ocean basin.

EXAMINING PERCEPTIONS OF LEARNING SUCCESS AMONG INUIT AND SOUTHERN EDUCATORS

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The research examined perceptions of learning success among Inuit and southern educators in a case study of Ulukhaktok, Northwest Territories, Canada. Despite efforts to include Inuit culture in schooling, formal education in the Arctic continues to be in conflict with Inuit worldviews and traditional modes of learning. The Nunavut Social Development Council wrote that schooling in Nunavut leaves young people "aimlessly stranded between the English and Inuit cultures" (NSDC 2000: 82). Many young Inuit have not acquired the knowledge and skills necessary to live on the land, to develop a career, or to complete a program of higher education. A source of conflict between the Euro-North American school system and Inuit culture is what constitutes success. The Euro-North American school system is heavily focused on standardized individual testing to measure success. It was hypothesized that part of the reason why many Inuit score poorly on educational assessments, is that there are discrepancies between what southern educators and Inuit consider to be success. To this end, data on perceptions of learning success were collected using semi-structured interviews and pile sorts with southern educators (n= 7), Inuit educators (n=3), Inuit community members (n=8) and Inuit students (grades 9-12) (n= 19) at Helen Kalvak Elihakvik (school) in Ulukhaktok. The data shows that southern educators perceive learning success differently than Inuit. Southern educators perceived learning success as individual means of accomplishment, their responses included examples such as learning literacy skills, working towards a personal objective or building a career. Inuit on the other hand perceived learning success as collective, or contributing to the common good (e.g. family and/or community). Inuit for example, considered success to be a tilguyuk meaning a great person, helping the community prosper, hunting and trapping, and encouraging others to pursue happiness. The research confirms discrepancies between southern educators' and Inuit traditional perceptions of learning success. The data suggests that current methods for evaluating Inuit student success, individual standardized testing, are in conflict with Inuit perceptions of learning success. The research is part of ArcticNet Project 1.1 Community Adaptation and IK-ADAPT (Inuit Traditional Knowledge for Adaptation to the Health Effects of Climate Change) supported by CIHR.

UNDERSTANDING THE LEGAL DISPUTES OVER THE NORTHWEST PASSAGE AND NORTHERN SEA ROUTE

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Both Canada and Russia claim to exercise full and exclusive sovereignty over the waters of the Northwest Passage and Northern Sea Route respectively. Both States are also a party to the 1982 United Nations Law of the Sea Convention and have publicly pledged to abide by the "extensive international legal framework" which applies to the Arctic [Ilulissat Declaration, 2008]. The Canadian and Russian legal claims will

therefore be critically examined as against the existing law of the sea regime and in light of strong opposition from the United States.

HOW LONG DOES THE IMPACT ON HIGH ARCTIC RIVERS LAST AFTER AN EPISODE OF PERMAFROST DISTURBANCE?

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Landscape degradation and disturbance caused by warmer melt seasons and resultant permafrost change has been observed widely across the Arctic. Disturbances, such as retrogressive thaw slumps, active layer detachments (ALD) and related thermo-erosional disturbances have important impacts on the fluxes of sediment and solutes in downstream rivers, and can have important impacts in aquatic ecosystems. Permafrost degradation and disturbance occurs most commonly as episodes of intense change, lasting one or more years, followed by years of stability. Hence, while the immediate impact of these perturbations is often apparent, the longer term consequences have rarely been investigated and remain poorly understood. To address this knowledge gap, we investigated the erosion rates and sediment fluxes from recent ALD in five small catchments to determine what geomorphic and hydrological factors affect downstream water quality. These catchments represent different disturbance size, slope position and hydrological pathways including an undisturbed control catchment. We collected seasonal discharge, suspended sediment and water quality data from the catchments from 2007-14. All disturbances generated high initial downstream sediment delivery in catchments where flow was channelized through disturbances. Sediment yields and concentrations decreased in subsequent years, and showed divergent responses. One catchment continued to evolve geomorphically through prominent channel incision in a disturbed area, resulting in increased sediment transport for several years, while other catchments developed stable internal channel systems that resulted in decreased sediment yields and concentrations. By contrast, disturbances that did not have developed downstream channel systems showed minimal response to upslope disturbance. The divergent geomorphic conditions that emerged in the seven years following disturbance suggest that landscape recovery will likely result in different equilibrium sediment loads. Hence, while the recovery appears to be well underway, the long term impact of this episode of disturbance remains evident on the landscape, and increasingly appears to have made permanent changes to drainage and erosion rates. These results provide a useful analog for the impact and recovery from natural and human-induced disturbance in this region, and will contribute to our ongoing modelling efforts and also aid in investigating aquatic biogeochemical changes.

EVALUATING ARCTIC THREATS AND FORMULATING SOLUTIONS: AN ANALYSIS OF PRINTING MEDIA IN CANADA FROM 2000 TO 2010

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The objective of this presentation is to shed light on how the Arctic security debate has taken form in Canada from 2000 to 2010. This period is particularly critical since it marks the beginning of a reflection on the impacts of global warming on the Arctic environment and Canada's Arctic sovereignty claims. This presentation will analyse both quantitatively and qualitatively how this debate played out in the Canadian printing media, focusing more specifically on the editorial section of 12 newspapers, both Francophone and Anglophone. These editorials are analytically rich since contributors are coming from different settings: academics, Inuit activists, politicians, ex-bureaucrats, journalists, etc. These editorials were trying to reduce uncertainty by describing threats and prescribing solutions. The type of threats perceived and solutions prescribed in that period of great Arctic activism could teach us about how to deal more maturely and wisely with complex issues that may arise in the future of this region. It also highlights that attempts at securitizing the Arctic could be counter-productive and can support or influence policy-making in less than optimal avenues by overplaying fear and anxiety.

PERMAFROST RESEARCH PRIORITIES: A ROADMAP FOR THE FUTURE OF PERMAFROST RESEARCH

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At present, no consensus document ("white paper" or "strategy") exists at the international level to identify forward-looking priorities in permafrost research. CliC has partnered with the International Permafrost Association (IPA) to seize the opportunity offered by the upcoming International Conference on Arctic Research Planning III (ICARP III) and the SCAR Horizon Scan to frame a consultative process that will result in the formulation of such permafrost priorities. Entitled "Permafrost Research Priorities: A Roadmap for the Future", it focuses on all permafrost regions, from the Arctic to the Antarctic and mountain permafrost around the globe in order to accurately represent the level of overlap in scientific challenges in all three domains. The product stemming from the effort will consist of a high level, but short publication (ca. 2-3 pages) in a high-profile journal listing and putting into context permafrost research priorities. The document aims to become the benchmark against which permafrost research should be gauged starting in 2015. Here we present the first results stemming from this effort and focus on questions relevant to Arctic permafrost. We also draw lessons relevant to the overal ICARPIII process in terms of consultation, community engagement and evaluation

WEREWOLVES IN THE DARK - MOONLIGHT STRUCTURES ARCTIC ZOOPLANKTON COMMUNITIES IN SPACE AND TIME DURING THE POLAR NIGHT

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Diel vertical migration (DVM) of aquatic organisms is one of the biggest (by biomass) daily migrations on the planet. It occurs in most water masses and is particularly prevalent in Polar seas where primary productivity, as an abundant food source for zooplankton, is high. DVM is characterized by defined vertical migrations down to depth during the day and to the surface at night to feed, hypothesised to avoid visually mediated surface predation. Since sunlight is considered to be the proximate driver of DVM, there is interest in understanding changes in migration patterns, and hence Arctic food web structure and carbon sequestration, as a consequence of changes in sea ice cover and light penetration. Highly synchronised "classical" DVM occurs during the autumn and spring when the difference between day and night is overt. However there are very few studies that have addressed migratory patterns during the Polar Night, those that have show DVM to be weak or undetectable. Classically zooplankton activity at this time is considered biologically quiescent. Here we present data that reveals that zooplankton migrations during the Polar Night are extant. They are primarily explained by astronomical and meteorological processes, specifically the interaction between the effect of sunlight, moonlight and clouds. Using long term moored Acoustic Doppler Current Profilers (ADCPs) at 79o North in Svalbard we show that, contrary to expectations, DVM continues long after the sun has sunk below the horizon and reveal that, during December and January, periods of full moon suppress surface communities and result in animals accumulating at depth. This migratory response is enhanced or suppressed with reduced or increased cloud cover respectively. The lunar cycle of migration to depth will only occur when the moon is at its highest and brightest, usually for a few days each lunar month. In addition the lunar cue may suppress, or "mask", migrations during the spring and autumn when solar DVM is still overt. Conversely the new moon may enable solar DVM to occur as early as the start of January, especially with reduced cloud cover. Together these data present a challenge to the concept that zooplankton migrations are limited during the Polar night or that they are solely driven by solar cycles and can even, on occasion, be driven by the lunar-day (24.8 hour) cycles, a behavioural response never documented before.

ARCTIC SHIPPING: OPPORTUNITIES FOR US-CANADA COOPERATION

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The United States and Canada maintain fundamentally different positions regarding the legal status of Arctic straits, including the Northwest Passage. The traditional US view coincides with the primacy of US navigational interests in the Arctic, placing flag state freedoms before other concerns, while the Canadian view emphasizes Canada's role as an Arctic coastal state with environmental protection and national security considerations at the fore. But the United States is also an Arctic coastal state and Canada may see benefits from increased Arctic navigation. When the rigid flag state/coastal state dichotomy is loosened, areas of cooperation emerge that do not undermine the basic legal positions of these Arctic neighbors.

REMOTE AND LOCAL SOURCES OF ARCTIC AIR POLLUTION

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Long-range of air pollution (ozone, aerosols) from mid-latitude emission regions in Asia, North America and Europe has a significant impact on Arctic chemical composition and climate. More recently, it has become apparent that near-Arctic sources of pollution such as emissions from oil/gas flaring or metal smelting in Russia or Siberian/North American boreal forest fires also make an important contribution to observed pollution in the Arctic. In addition, new activities are emerging in the Arctic as a result of rapid climate change, such as shipping, which are likely to lead to increased levels of local pollution with potential impacts on human health and ecosystems. As part of the French project, Climate Impacts of Short-Lived Pollutants and Methane in the Arctic (CLIMSLIP-ANR), new insights have been gained into factors governing the distributions and origins of Arctic pollution. For example, analysis of CALIPSO aerosol data shows that, as well as the habitual build of aerosols each late winter/early spring, there is also a secondary maximum in certain years, due to transport of Asian anthropogenic and Siberian fire pollution into the Arctic free troposphere during spring. Analysis of aircraft data collected as part of POLARCAT-IPY has been used to examine aerosol processing and radiative impacts in air masses transported from Europe during spring. Quantification of photochemical production of ozone in air masses transported from North America to Greenland during summer showed anthropogenic emissions making a larger contribution to Arctic ozone compared to Canadian boreal fires. Collection of new data such as aerosol/trace gas aircraft data over Siberia as part of YAK or black carbon/aerosol-cloud data on Svalbard is also providing new insights into Arctic pollution sources and processes. With regard to local pollution sources, analysis of aircraft data collected in the northern Norwegian Sea as part of the EU Arctic Climate Change Economy and Society (ACCESS) project is being used to validate local emissions from, for example, oil/gas extraction and to assess impacts on local and regional air quality. Regional model simulations are also being used to examine the transport of aerosols from Siberian boreal fires into the Arctic.

CHANGES IN FALL MIGRATION PATTERNS OF MIGRATORY CARIBOU HERDS FROM NORTHERN QUEBEC AND LABRADOR: EFFECTS OF CLIMATE AND POPULATION SIZE

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To follow seasonal changes in resources abundance and reduce predation risk, migratory caribou perform long migrations, leaving the taïga in spring to reach highly productive calving grounds in the tundra, and returning to their winter range in autumn. Major effects of climate changes are expected in northern environments and caribou are already facing changes in their habitat. Modifications in snow cover, reduction in the icing period of lakes and rivers or changes in resources availability could affect patterns of migration. In northern Quebec and Labrador, migratory caribou from the Rivière-George herd (RGH) and the Rivière-aux-Feuilles herd (RFH) range over one million squared kilometres. From over one million individuals in the 1990's, the two herds are currently declining, particularly the RGH. Patterns of fall migrations showed high variation during the last decades. Two main patterns of fall migration can be observed for the RFH, depending on the winter range used, and caribou from the RGH can migrate to four different winter ranges. We assessed how climate changes and variations in population size affected the patterns of the fall migration. We used random forest analysis to assess the effect of climate data derived from the Canadian Regional Climate Model (CRCM4) and demographic data on caribou migrations. The analysis was performed on 285 and 290 fall migrations, observed between 1991 and 2012, respectively for the RGH and RFH. Preliminary results suggest that the fall migration patterns of the RFH mostly depend on the RGH population size: RFH's migration toward the south-western winter range, used by the two herds, seems highly limited when RGH's population size is high, suggesting a potential competition for the use of this winter range. For the RGH, high precipitations in November and December seem to favor short migrations toward the closest winter range in Labrador. Abundant snow could increase the cost of movements during migration and then could limit the ability of individuals to

migrate toward the furthest winter ranges. Understanding the mechanisms underlying migration is essential in the conservation of long-distance migrant species, particularly in the actual context of global decline observed in most caribou herds. Our study will help assessing how climate and variations in population size affect fall migration patterns of the migratory caribou in northern Quebec and Labrador.

MODELLING AND MAPPING PERMAFROST AT HIGH SPATIAL RESOLUTION USING LANDSAT AND RADARSAT IMAGES

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Permafrost is an important feature that has significant biophysical and socioeconomic impacts on the northern landscape .In order to better understand the distribution and dynamics of permafrost, there is a need to map permafrost at high spatial resolution. This study is part of a research project that aims to develop a method to model and map permafrost using remote sensing images and the Northern Ecosystem Soil Temperature (NEST) model over the Victor Diamond Mine area located in the central part of the Hudson Bay Lowland, Ontario, Canada. The study area is near the southern margin of permafrost region where permafrost exists only in isolated patches. In this study, we ran the NEST model from 1932 to 2012 using a climate dataset compiled from station observations and grid data sources. The model outputs were then compared to field observations acquired during 2009 - 2012 at seven peat monitoring stations and two flux towers, which represent three major types of peatland in the study area (bog, fen, and palsa). The simulated soil temperatures at various depths show good agreement with the observations, and the simulated latent and sensible heat fluxes and net radiation are similar to the observations at the two flux towers. The model shows the existence of permafrost only at palsa sites, which is in agreement with field observations. Based on the general range of climate and ground conditions in this area, sensitivity tests indicate that the modelled permafrost conditions are sensitive to air temperature, precipitation and leaf area index. The validation and tests show that the model should be able of quantifying the distribution and dynamics of permafrost in this area. Further, the calibrated model was applied to the whole area. For this, NEST vegetation-related and soil-related variables were extracted from land cover and surficial deposit maps that were derived from RADARSAT-2 dual-polarized, LANDSAT-TM and DEM data. This study was funded by a grant from the Canadian Space Agency Class Grant and Contribution Program. The Canadian Space Agency provided the RADARSAT-2 data to the project via the Canadian Forest Service. The Canadian Forest Service and Ontario Ministry of Natural Resources provided field observations. Support to the field work has been provided by Ontario Ministry of Natural Resources and De Beers Canada.

NET PRIMARY PRODUCTIVITY ALGORITHM ROUND ROBIN (PPARR) – OCEAN COLOR-BASED MODELS FOR THE ARCTIC OCEAN

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Autochthonous primary production is the major source of energy for the Arctic Ocean (AO) ecosystem, as in most ecosystems. Reproducing current patterns of AO net primary production (NPP) is essential to understand the physical and biogeochemical controls in the present and the future. The Primary Productivity Algorithm Round Robin activity (PPARR) provides a framework such that the skill and sensitivities of NPP estimated by ocean color-based models, coupled global/regional climate models, and earth system models can be assessed in the AO. We present here the first phase results from 30 ocean color-based models that estimate depth-integrated marine NPP with respect to a unique pan-Arctic data set (1998-2011) that includes in situ NPP, chlorophyll a concentration, mixed layer depth (MLD), euphotic zone depth (Zeu), and sea surface temperature (SST) as well as physical parameters derived from satellite observations, climatology and/or re-analysis (MLD, SST, photosynthetically available radiation – PAR, and bio-optical variables). Twenty four cases with different sources of input variables were provided to all participating models; results will be presented for the two cases that used satellite-derived and in situ chlorophyll a data. Average model skill, determined by variability and mean difference between model estimates and observations, using root-mean square difference (RMSD), was very consistent for all models. Due to the inherent variability of the in situ data, chlorophyll a was the

primary influence on ocean color-based model performance and its data source (satellite vs. in situ) had the strongest effect. In general, model estimates better represented the mean NPP and its statistical distribution when in situ chlorophyll a data, rather than satellite chlorophyll a data, were used. Seven models showed a distribution of model results similar to the in situ data distribution, but not for the entire range of NPP data. Satellite algorithm improvement for these complex Arctic waters will likely increase the skill of ocean color models. Continual feedback, modification and improvement of the participating models and the resulting increase in model skill are the primary goal of the PPARR-5 AO exercise.

COUPLED TERRESTRIAL-AQUATIC CLIMATE IMPACTS ON THE WATERSHED OF THE HIGH ARCTIC'S GREAT LAKE (LAKE HAZEN, NUNAVUT)

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The Arctic is undergoing rapid climate change as demonstrated by increasing air temperatures, changes in precipitation patterns, permafrost degradation, and decreased sea ice extent and thickness. However, the impacts of this changing climate on Arctic lakes, especially larger lakes, are not well understood. Lake Hazen is the largest lake (by volume) north of the Arctic Circle and integrates a large watershed that is extensively glaciated. Because of its large size, Lake Hazen may be less sensitive, or slower to respond, to climate change compared to smaller lakes. We will present data on various physical, chemical and biological parameters, spanning ~15 years for observational data and ~100+ years for paleolimnological data, to determine how, and to what extent, climate change is impacting Lake Hazen and its watershed. We will show that the lake and its catchment are experiencing concerted changes that link that the various components of the watershed. Recent warming and temperature increases have been observed in air, glacier ice-surface, soil active layer and lake surface water. This warming has resulted in the mass-balance of glaciers within the watershed to switch from net accumulation to net loss, which in turn has dramatically altered lake hydrology and the delivery of sediments to the lake. For example lake water levels are significantly higher post-2007 compared with the previous decade, and discharge at the lake outflow has increased by a factor of four, on average, over the same time period. Sedimentation rates have increased by an order in magnitude in parallel to these changes, accompanied by a shift in sediment geochemistry. Lake ice cover is also decreasing, and the occurrence of ice-free conditions is becoming more frequent. The lake sediment record shows that the longer-term trend of decreasing ice cover, and increasing growing season length, has profoundly altered algal communities within the lake. These changes have important implications for in-lake processes that pertain to ecosystem productivity, and the cycling of carbon, nutrient and contaminants. Finally, these results demonstrate that even more resilient ecosystems such as very large lakes are exhibiting regime shifts and entering new ecological states.

DEEP CRATER IN CENTRAL YAMAL, WEST SIBERIA, RUSSIA AS A NEW PERMAFROST FEATURE IN RESPONSE TO LOCAL CLIMATE FLUCTUATIONS

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The paper is based on field data obtained during 2 short visits to Yamal Peninsula in summer 2014 to a newly formed permafrost feature: a relatively narrow, deep crater. As new features like this have been reported recently in a number of mass-media publications, the processes leading to their formation may already be underway elsewhere in the region, making the study of their origin and predicting such an activity an urgent task. Our field study included size measurements and photo- video-documentation of the feature and the surrounding environment. The main objective of the reconnaissance was to outline the range of possible hypotheses of the crater's formation, to exclude impossible and improbable versions of

its development, and to lay a basis for predicting such processes in the future. No landform like the crater in Central Yamal discussed in this paper has been reported previously. Yet similar forms: seabed pockmarks, have been known and discussed since the 1970's. It is established that permafrost prevents the migration of methane from deep-seated hydrocarbon collectors into the upper permafrost and to the surface. Concentration of methane in frozen Quaternary deposits in the Arctic depends on the age, origin and lithology of the permafrost. The gas and gas-hydrate accumulations are localized in the organic-rich horizons. The authors' main hypothesis for the crater's formation involves the release of gas inclusions out of initially frozen deposits and tabular ground ice. This assumption is based on the known cryolithology and geochemistry of permafrost in the region, with most of the studies produced in the Bovanenkovo gas field investigations. The Bovanenkovo studies revealed substantial gas concentrations, which are blocked by the permafrost. The possibility of the release of the gas from the collectors near the surface is shown by methane and hydrogen sulfide effusion under the Barents and Kara seas from 70 to 130 m beneath the sea floor. Boreholes at Bovanenkovo gas field revealed gas manifestations in the depth interval 20 to 130 m, most of which were contained in ice-bearing clays. These clays also enclose tabular ground ice and some voids filled with low-density ice. Active release of the gas from permafrost may be caused by change in ground temperature and resulting increase in unfrozen water content. Thus the origin of the Yamal crater hypothesized in this paper is based on the analysis of (a) existing features resulting from gas-release processes in the sea floor as analogues of the observed on-shore landform, (b) climate fluctuations that could have caused changes in thermal state of permafrost, and (c) comparison to other landforms connected to specific cryolithology and geochemistry of deposits. Excluding impossible and improbable versions of the crater's development, the authors conclude that it originated from warmer ground temperatures and an increase in unfrozen water content, leading to an increase in pressure from gas emissions from permafrost and ground ice. This conclusion is also supported by known processes in the palaeo-geography of Yamal lakes and recent studies of gas-hydrate behavior and subsea processes in gas-bearing provinces.

SELENIUM STATUS IN NUNAVIMMIUT: TOWARDS A BETTER UNDERSTANDING OF RISKS AND BENEFITS FROM COUNTRY FOOD CONSUMPTION IN NUNAVIK

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Background: Selenium (Se) is an essential element highly present in traditional marine foods consumed by Inuit, who exhibit one of the highest Se intake in the world. In fish and marine mammal eating populations, there is increasing evidence suggesting that the high Se intake may play a role in offsetting some deleterious effects of methylmercury (MeHg) exposure. However, in other populations, elevated plasma Se concentrations have been recently associated to type 2 diabetes, hypercholesterolemia and/or hypertension. In addition to plasma Se levels, the most common biomarker of Se status, several other biomarkers (e.g. selenoproteins and small Se molecules such as selenoneine) have been identified and these may help to better characterise Se status in Inuit. Methods: Archived plasma samples obtained from Inuit adults who participated to the Qanuippitaa health survey in 2004 were analysed for selenoproteins by affinity chromatography-inductively coupled plasma-mass spectrometry with quantification by post-column isotope dilution. Mercury (Hg) concentrations associated with selenoproteins were also quantified during the same analytical run. Results: Concentrations of glutathione peroxidase, selenoprotein P and selenoalbumin (expressed in µg Se/L) represented on average respectively 25%, 52% and 23% of the total plasma Se concentration (N = 854). In addition, small concentrations of Hg co-eluted with each Se-containing protein. Plasma Se concentrations [median = 139 µg Se/L; interquartile range (IQR) = 166 µg Se] were markedly lower and less variable than corresponding blood Se levels (median = 261 µg Se/L, IQR = 166 µg Se/L]. We observed a non-linear relation between plasma and blood Se levels in Inuit, in contrast to the linear associations noted in other populations displaying elevated Se status from plant-based food consumption in Brazil and China. Conclusions: Our results to date suggest that a selenocompound (possibly selenoneine) accumulate in the blood cellular fraction of several Inuit adults. We are currently focusing our effort on measuring this compound in red blood cells of participants and in Se-rich marine foods consumed by the Inuit. These data will improve our capacity to assess the risks and benefits of Se intake and the traditional marine diet in this population.

FROM FORT GEORGE TO THE JAMES BAY AND INUIT HEALTH: SELECTED FINDINGS FROM THE 2012 ABORIGINAL PEOPLES SURVEY, 2012

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The presentation is a summary of the the article "Inuit health: Selected findings from the 2012 Aboriginal Peoples Survey" which reports on the self-reported health status and chronic conditions of Inuit aged 15 years and older. Also covered are health behaviors such as smoking and drinking, and selected determinants of health such as food insecurity, access to health care, housing and culture. The results are for all Inuit in Canada, presented by the total population, inside and outside Inuit Nunangat and the four Inuit regions.

NEW CHEMICALS IN WILDLIFE AND FISH AND FUTURE RESEARCH ON PERSISTANT ORGANIC POLLUTANTS IN A CHANGING ARCTIC

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Although the Stockholm Convention on persistent organic pollutants (POPs) has resulted in global phase outs of about 23 organic chemicals, new chlorinated, brominated and fluorinated, and even non-halogenated chemicals with similar long- range transport potential are being reported in the Canadian Arctic, including in mammals and birds at the top of food chains. This complex cocktail of emerging, potential, POPs include an array of flame retardants (FRs) in addition to the phased-out and regulated polybrominated diphenyl ethers (PBDEs). Also, regulated POPs such as PBDEs require "renewed" attention, e.g. decabromodiphenyl ether (PBDE-209) may be on the rise in wildlife and is a known source of lower brominated PBDE degradation products. Also, other targeted emerging POPs include current-use pesticides (CUPs) and perfluoroalkyl acids (PFAAs) and the growing array of PFAA precursors. In this presentation, we will focus on new POPs, precursors and degradation products in top trophic level wildlife species and specifically polar bear (Ursus maritimus), ringed seal (Pusa hispida) and Arctic seabirds. The breadth of targeted new chemicals being screened for and in many cases being detected in (Canadian) Arctic wildlife include organophosphate FRs, Dechlorane (DP)-like norbornene derivatives, shorter-chain perfluorobutane carboxylic acid and sulfonate and their sulfonamide percursors, hexachlorobutadiene, chlorinated paraffins (SCCPs), and CUPs such as α-endosulfan, α-endosulfan, endosulfan sulfate, chlorothalinil and dacthal. The detection of these new chemicals underlines the need for temporal trend data, and for tissue archives for species such as ringed seal and polar bears to be put to greater use to assess retrospective trends of these newly found (or "re-discovered") POPs.

As climate change and industrial development impact the Arctic, the sources of POPs are also changing. Increasingly chemicals enter the Arctic via their use in consumer products and then end up in municipal waste. These local Arctic sources can also play a role is contaminating local marine food webs and/or directly in wildlife via the consumption of municipal waste and possibly via microplastics that are consumed directly, e.g. by seabirds such as glaucous gull. The changing Arctic climate may affect temporal trends of legacy and new POPs both in terms of changing sources (eg increased frequency of pollutants from forest fires) and changing food webs (shifts in migratory species). We will also briefly discuss how climate change and POPs are interacting to change and potentially increase the risk of biological effects in wildlife including seals and polar bear. There are new contaminant threats to Arctic wildlife such as nanomaterials and microplastics, and other anthropogenic pollutants, which can possibly make their way to the Arctic via long-range transport in the atmosphere or oceans, and thus increase the pollutant/chemical stress complexity of exposure in Arctic biota and wildlife.

NORTHERN QUEBEC AGREEMENT: A BRIEF HISTORY OF INUIT EDUCATION IN NUNAVIK, 1939-1975

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The development of Inuit education in Nunavik before the establishment of the Kativik School Board in 1976 has not been a coherent and straightforward endeavor. Whereas until the 1970s most Indigenous peoples from the Canadian Arctic and Subarctic were educated in residential schools operated by religious congregations, such was not the case of Nunavik Inuit

who had no residential schools on their territory. In fact, before the 1939 Supreme Court of Canada ruling re: Eskimo, Nunavik Inuit were not offered any western-type education at all. Only a small number of them received any kind of education in the few mission schools operated on an ad hoc basis by Anglican and Catholic missionaries. After 1939, the Canadian government scrambled to set up a system that would allow Inuit children to acquire some kind of education. Yet, it was not before 1949 that the first Federal day schools were established in Nunavik, followed by three hostels in the early 1960s in Inukjuak, Kuujjuarapik and Kangirsuk. During that period, a small number of Inuit attended the Anglican and Catholic residential schools in Cree territory in Fort George, Quebec. In the 1960s, a network of day schools was established by the province to compete with Federal schools for Inuit pupils. From 1964 to 1974, the province also operated a professional school with a hostel in Kuujjuarapik. Therefore, from 1939 to 1975, Nunavik Inuit experienced a wide variety of education services provided by different actors who each had their own objectives. The goal of this communication is to provide an overview of this complex history.

TIDES STIR UP DEEP ARCTIC HEAT

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The Arctic is warming at twice the rate of the rest of the planet. One of the largest sources of heat to the Arctic Ocean is the warm salty Atlantic water (AW) which enters through the Fram Strait and circulates at intermediate depth round the Arctic basin. The heat contained in the AW is sufficient to entirely melt the Arctic sea ice but is insulated from the surface by a layer of colder fresher water. Across much of the Arctic Ocean there is insufficient turbulence to drive vertical mixing, and so heat fluxes are a result of double diffusion (DD) and are consequently weak (< 0.1 Wm-2). Here we present a new pan-Arctic series of direct measurements of TKE dissipation rate. The new measurements show enhanced turbulent mixing, and hence heat fluxes, over much of the continental slope around the Arctic boundary. The rate of TKE dissipation is found to increase with the bathymetric slope and vary longitudinally with the largest values to the north of Svalbard resulting in enhanced diapycnal heat fluxes over this region (20 Wm-2). The observed 2-order of magnitude longitudinal variation in TKE dissipation rate correlates with the rate of dissipation of tidal energy, estimated from the local difference between the work done by the tide generating force and the tidal energy flux divergence from TPXO8 altimetry data. This correlation leads to the conclusion that the enhanced mixing observed over the continental shelf break north of Svalbard is a result of tidal processes

ON THE PROCESSES LEADING TO AIR-SEA GAS EXCHANGE IN THE SEA ICE ZONE

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The polar sea ice zones are regions of high primary productivity and interior water mass formation. Consequently, the seasonal sea ice cycle appears important to both the solubility and biological carbon pumps. To estimate net CO2 transfer in the sea ice zone, we require accurate estimates of the air-sea gas transfer velocity. In the open ocean, the gas transfer velocity is driven by wind, waves and bubbles - all of which are strongly altered by the presence of sea ice, making it difficult to translate open ocean estimates of gas transfer to the ice zone. In the presence of sea ice, the ice itself blocks air-sea flux, but additional sources of turbulence exist as a result of current shear from ice kinematics and convection and ice formation. We present results that demonstrate how convection and sea ice kinetics in the ice-ocean boundary layer lead to gas exchange.

DISTANT DRIVERS OR LOCAL SIGNALS: WHERE DO MERCURY TRENDS IN WESTERN ARCTIC BELUGAS ORIGINATE?

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Temporal trends of contaminants are monitored in Arctic higher trophic level species to inform us on the fate, transport and risk of contaminants as well as advise on global emissions. However, monitoring mercury (Hg) trends in species such as belugas challenge us, as their tissue concentrations reflect complex interactions among deposition, Hg methylation, physiology, dietary exposure and foraging patterns. The Beaufort Sea beluga population showed significant increases in Hg in the 1990's; since that time an additional 10 years of data have

been collected. During this long interval of data collection, changes in the Arctic have affected many of the processes that underlie the Hg cycle. Here, we examine Hg in beluga tissues and investigate possible factors that could contribute to the observed beluga trends. We account for confounding factors of beluga age and size on Hg concentrations using physiological and dietary factors. Finally, we examine commonly used indicators of climate variability (Arctic Oscillation (AO), the Pacific Decadal Oscillation (PDO) and sea-ice minimum (SIM) concentration) to evaluate their potential to explain Hg trends in beluga. Results reveal a decline in Hg concentrations from 2002 to 2012 in the liver of older whales and the muscle of large whales. The temporal increases in Hg in the 1990's followed by the recent declines are not easily explained by diet markers highlighting the complexity of feeding, food web dynamics and original sources. Regional scale variables SIM, AO and PDO revealed relationships with beluga Hg at varying lag times. Given that changes in climate may cause cascading ecosystem impacts, including alterations to beluga feeding opportunities, it is plausible that these climate-related variables are important in explaining beluga Hg trends. Such relationships require further investigation including continued analyses of the multiple connections between climate forcing and beluga Hg.

OCEANIC CONNECTIONS AND MARINE MICROBIAL EUKARYOTES, CAN WE MONITOR CHANGE?

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The vast majority of biological diversity of the planet consists of single celled organisms that are visible only using microscopy. In particular, there are thousands of species of open water marine microbial eukaryotes, consisting of phytoplankton and heterotrophic protists, that have been reported from microscopy studies and more recently using molecular techniques. This diversity suggests that marine eukaryotes are particularly sensitive to their immediate environment. Over the past 10 years we have participated in over 20 missions in the Arctic, the majority in conjuction with ArcticNet. During these missions, we sampled microbial DNA and RNA, which we use in high-throughput amplicon multiplex tag sequencing to identify microbial eukaryotes. This data is yielding a pan-arctic view of diversity over time and space. The goal is to establish the biogeography and temporal distributions of indicator taxa, which will provide the needed context to detect local and basin wide changes in biodiversity in the Arctic Ocean. Here we provide the first pan-arctic view of heterotrophic flagellates that are usually considered a single functional group, despite belonging to different phyla. Overall, the different groups were indicative of specific conditions and several species complexes may be candidates for indicator taxa, which could be incorporated into national biodiversity monitoring programs.

EVIDENCE FOR OCEAN CONTROL OF GLACIER ABLATION RATES IN SVALBARD TIDEWATER GLACIERS

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Loss of mass at the termini of tidewater glaciers, or frontal ablation, occurs by a combination of calving and submarine melting. The latter is important because, in addition to its direct contribution, submarine melting can amplify calving by undercutting and destabilizing the glacier front. Several recent studies have concluded that submarine melting can dominate mass loss at tidewater termini, particularly where glaciers are impacted by incursions of warm water sourced beyond the continental shelf. However, there remains a distinct lack of direct measurements of either calving or subaqueous melt rates; almost all estimates of frontal ablation are based on calculations of the frontal heat budget using oceanographic data, and are subject to large uncertainties. Lack of data on frontal ablation rates and their relationship to submarine melting places severe limits on our ability to predict the response of tidewater glaciers to oceanographic forcing. Here we present glacier ablation rates for a number of glaciers in Svalbard and relate it to seasonal changes in the upper ocean temperature. Ablation rates are derived from time-series of TerraSAR-X SAR data during a full seasonal cycle in 2013. Ocean temperatures are derived from long term observatories placed in fjordic locations in Svalbard. The calculated ablation rates are compared between fast-flowing glaciers, surge-type glaciers in active and quiescent phases, and glaciers discharging into different fjord systems. We note that changes in ablation rate are precisely in sync with variation in ocean temperature, even in mid-winter. Svalbard calving may

not be a good model for large Greenland outlet glaciers, but may be widely representative of calving mechanisms elsewhere.

OUR COLLECTIVE RESPONSIBILITY: ADDRESSING CLIMATE CHANGE IN THE ARCTIC AND BEYOND. LESSONS LEARNED FROM THE POTSDAM SUMMER SCHOOL, 2014 – A CASE STUDY IN COLLABORATION AND IMPLEMENTATION.

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The Arctic provides one of the strongest signatures of climate change impacts, with natural, social, economic, and political implications for the planet and international community. In recognition of the inter-, multi-, and trans-disciplinary discussions and tools necessary to address one of the most challenging issues of the 21st century, the Potsdam summer school (PSS), "Arctic in the Anthropocene" was held in Potsdam, Germany in summer, 2014. Coordinated by the Institute for Advanced Sustainability Studies (IASS), amongst other educational and research institutions in conjunction with the City of Potsdam, the summer school was developed with the intent of eliminating disciplinary language barriers and fostering communication amongst individuals trained in law and international relations, public health, and science. The goal of the program was to extend an integrated knowledge to society for the benefit of humanity, the planet that we inhabit, and for which we share a collective responsibility. Central to this goal is the idea of transferring knowledge and bridging the gap between science and policy making in Arctic development. In this presentation we develop one narrative conveyed at the summer school of a shared responsibility to recognize the Arctic and its inhabitants as being integral to the development of a comprehensive scientific, social, and legal framework at the international, national, and local level of organization and implementation. Highlighted also is the need for a permanent institutional framework dedicated to inter- and trans-disciplinary interactions comparable to IASS. Building on the educational framework provided by the Potsdam Summer School, we describe lessons learned at, and tools and techniques provided by, the PSS. Presented also are the processes involved in implementation of these tools by PSS participants in a case study designed to instigate the continuity essential to an organizational framework dedicated to the language and goal of climate change mitigation, adaptation, and most importantly, innovation. Potsdam Summer School Organizers: Kathrin Keil and Angela Borowski, IASS, Institute for Advanced Sustainability Studies, e.V. D-14467 Potsdam, Germany

GETTIN' F.O.X.Y.: EXPLORING THE DEVELOPMENT OF SELF-EFFICACY AMONG YOUNG WOMEN IN THE NORTHWEST TERRITORIES USING AN ARTS-BASED SEXUAL HEALTH INTERVENTION

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The sexual health of Northwest Territories (NWT) youth is a serious public health concern; thus, a social arts-based intervention that uses body mapping and drama techniques, named FOXY (Fostering Open eXpression among Youth) was developed to address the sexual health needs of young women in the NWT. This doctoral research is grounded in the theoretical perspectives of social cognitive theory and social ecological theory and uses a community-based participatory research approach, developmental evaluation methodology, and the grounded theory method to develop a theory of how FOXY influences sexual behavior expectations among young women in the NWT, considering determinants that contextualize sexual health outcomes. The first aim of this study explores the intrapersonal and interpersonal contexts that influence the efficacy expectations and outcome expectations of female youth in the NWT. The second aim determines if and how a social arts-based intervention influences individual efficacy expectations regarding sexual behaviors among female youth in the NWT. Finally, the third aim determines if and how a social arts-based intervention influences individual outcome expectations regarding sexual behaviors among female youth

in the NWT. In Phase I, pilot testing occurred with 6 female youth to improve design of the semi-structured interview guide. Phase II entailed semi-structured interviews with 41 female youth aged 13-18 years selected via purposive sampling (those who have completed the FOXY workshop within the previous three days). Data collection occurred until saturation of new themes was reached at 6 study locations across the NWT. Interview recordings are being transcribed verbatim and a multi-stage thematic analysis using memoing and coding using the grounded theory method will occur. Results are currently in process and will be presented at this conference. Front-line workers and researchers can use the results of this dissertation to inform arts-based intervention programs and research among other rural Arctic populations.

THE ROLE OF SCIENCE AND RESEARCH IN DESIGN AND POLICY A CASE STUDY CCME: CANADA-WIDE STRATEGY FOR THE MANAGEMENT OF MUNICIPAL WASTEWATER EFFLUENT

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There exists a broad range of research being undertaken in the North and as results become available it is imperative that this research be effectively disseminated in order to be best utilized by the decision makers and the residents of the region where this research is focused. It is a dual responsibility, taken on by both the researchers and the regions' decision and policy-makers, to ensure the information generated through research informs and improves upon decisions, designs, and policies in the North. Science and research are critical to the development of appropriate and applicable wastewater standards in the North. Under the Session Topic "Planning, Design, and Assessment of Water Resource Systems in Northern Communities", the GN's response to the CCME Canada-wide Strategy for the Management of Municipal Wastewater Effluent will be presented as a case study of how research and science are being utilized in making informed policy decisions. In 2009, the Canadian Council of Ministers of the Environment (CCME) endorsed the Canada-wide Strategy for the Management of Municipal Wastewater Effluent. Of the 13 provinces and territories, all but Newfoundland and Labrador, Québec and Nunavut were signatory jurisdictions. This Strategy identified that careful consideration was required in the North and thus granted a research window to investigate factors that affect performance of wastewater facilities in a northern context. In addition to the collaborative efforts and gains made through the Northern Working Group of the CCME Municipal Wastewater Effluent Coordinating Committee, the Government of Nunavut independently entered into a research contract with Dalhousie University. The intent of this partnership is to gain a better understanding of wastewater treatment under a northern context including compiling baseline data, evaluating the risk that effluent poses to the receiving northern environment, and evaluating appropriate treatment systems.

PALEOLIMNOLOGICAL ASSESSMENT OF TEMPORAL CHANGES IN METAL CONTAMINATION OF THE SLAVE RIVER DELTA IN RESPONSE TO RESOURCE DEVELOPMENT IN NORTHERN CANADA

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As resource development has increased in northern Canada, so too have concerns of communities about potential effects of associated pollution (e.g., PACs, metals, nutrients, etc.) on environmental and human health. Often, monitoring programs that aim to assess environmental consequences are initiated many years to decades after industrial activities began. Consequently, knowledge of baseline conditions and the range of natural variability, against which post-industrial conditions can be compared, remain unknown. One such ecosystem facing these issues is the Slave River Delta (SRD), Northwest Territories. Resource development, including the Alberta oil sands, gold mines and other potential far-field industrial sources of pollution, have resulted in community concerns of increased pollution via the Slave River and air. In the SRD, interpretation of data from monitoring programs is further complicated by supply of contaminants from natural deposits along the Slave and other upstream rivers. Here, we assess the influence of natural and industrial sources of metals of concern carried by the Slave River and via atmospheric transport by examining the sediment record from a flood-prone lake in the SRD. This study aimed to quantify baseline concentrations of metals that existed before various resource developments began (e.g., Alberta oil sands), identify changes over time since industrial development, and identify any potential sources of pollution. Results show that metal concentrations co-vary with the natural and conservative metal Li, and were therefore interpreted to be dominantly controlled by changes in natural supply and energy conditions. When comparing post-oil sands development concentrations of metals with baseline conditions, we found that metals were generally within the range of natural variations based on pre-industrial metal-Li relations and 95% prediction intervals. However, concentrations of some metals

(arsenic, strontium and calcium) exceeded background levels during the mid-1950s. River-derived flooding did not occur at this time indicating that these metals were transported to the lake via the atmosphere. We suggest that high concentrations of these metals are associated with peak emissions from gold smelting. Interestingly, peak arsenic concentrations decreased rapidly by the late 1950s, which corresponds well with the timing of technological improvements to control air pollution from the Giant Mine in Yellowknife. The success of these efforts appears to be captured by rapid decline in arsenic concentrations in the lake sediment record and highlights the importance of responsible policies for environmental protection by industry. Importantly, our data provide the SRD community with an effective tool for ongoing monitoring of river sediment quality when knowledge of pre-industrial metal concentrations is unavailable.

THE BIGGEST, THE BEST, AND THE MOST IMPRESSIVE! KELP-URCHIN DYNAMICS IN THE ARCTIC AND THE DISCOVERY OF A KELP 'HOTSPOT' IN NORTHERN LABRADOR

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The relationship between herbivores and their preferred food sources is one that structures communities and environments in fundamental ways. This is of particular interest in situations where grazing has negative consequences for desirable ecosystems. Sea urchins are known globally for their destructive impacts on highly productive brown algae (kelp) and the associated assemblage of invertebrates and fish, often creating barren zones of low productivity and biodiversity. Ironically, urchins are also overfished in many regions of the world for their edible gonads. Green sea urchins (Strongylocentrotus droebachiensis) are one of the most widely distributed invertebrate grazers in the North Atlantic, and the dynamic equilibrium between urchin barrens and kelp beds has been intensively studied in boreal and temperate zones of Nova Scotia. In these regions, urchins destructively graze kelp beds but are periodically eliminated by extreme disease events which permit the reestablishment of the kelp beds. In contrast, in the subarctic zone of the Gulf of St. Lawrence (GSL), abundant populations of the green urchin prevent the development of large kelp beds and create barren zones that are relatively stable; large-scale disease events are rare or unknown and high population densities persist largely based on the transfer of nutrients via drift from shallow kelp beds. Very little is known of this community in the Arctic, and it was unknown whether diverse kelp beds or urchin barrens dominated these systems. SCUBA surveys during three cruises (2011-2014) sampled kelp and urchin biomass and densities at sites stretching from the Lower North Shore in the GSL north to Qikiktuarjuaq, Baffin Island. Southern and central Labrador contained extensive barren zones supporting high-density populations of urchins similar to the GSL with kelp largely restricted to the very shallow subtidal zone (<2 m depth). However, in northern Labrador extensive kelp beds with high biomass were found across a 100-km region with no or very few urchins found. At the sites in Baffin Island, urchins were more numerous and kelp decreased in biomass, although not to the exceptionally low levels regularly seen in the GSL. This work highlights an exceptionally interesting shift that occurs in nearshore subtidal habitats, a shift that is not due simply to the latitudinal gradient. The coast of Northern Labrador thus represents a uniquely rich and productive area with abundant and healthy kelp beds and low density or absent urchin populations. Understanding the pressures and forces that make this region so unique is essential in order to predict the response of this Arctic region to the changing climate.

LATITUDINAL TRENDS IN METHYLMERCURY BIOACCUMULATION IN ZOOPLANKTON FROM ARCTIC LAKES AND PONDS

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Methylmercury (CH3Hg+ or MeHg) is a highly toxic and mobile pollutant that is of concern in the Canadian Arctic. This form of mercury can bioaccumulate and biomagnify up through aquatic food webs, affecting both ecosystem and human health. Rapid climate change may increase the transport of nutrients and organic material into freshwater ecosystems, and hence increase aquatic productivity, which has important implications for nutrient stoichiometry and the trophic transfer of MeHg. This study examines latitudinal trends and stoichiometric constraints on MeHg bioaccumulation within freshwater zooplankton from Subarctic and Arctic lakes and ponds along a geographic and climatic gradient spanning 20° of latitude. Observations from the Canadian Arctic from Kuujjuarapik-Whapmagoostui (QC), Iqaluit (NU) and Resolute Bay (NU) are used to compare the levels of MeHg in

pelagic seston and zooplankton with multiple physicochemical variables, water chemistry, food resource quality, growth rates, and food web structure. Preliminary results show that mean MeHg concentrations in bulk zooplankton were significantly lower at the Arctic sites (mean = 51.5 ng g-1 dry wt) than at the Subarctic sites (mean = 93.0 ng g-1 dry wt) (t-test, p = 0.009). Combined data (n=15) from the first two sample years (2012-2013) shows that unfiltered MeHg concentrations in surface waters explain only half of the variation in MeHg concentrations found in bulk zooplankton from sites in Kuujjuarapik (QC) and Iqaluit (NU). Other abiotic and biotic factors (water chemistry, growth rates, food web structure) may also control the accumulation of MeHg within these aquatic systems. Our results also show that samples of sorted Daphnia sp. have consistently higher concentrations of MeHg than in bulk zooplankton at each site. For Kuujjuarapik (QC), average concentrations of MeHg range from 56?415 ng g-1 dry wt in bulk zooplankton and from 93?675 ng g-1 dry wt in sorted Daphnia. Our results confirm that this zooplankton group is a key vector for MeHg bioaccumulation and transfer within aquatic food chains. The results from Resolute Bay will also be presented. The latitudinal gradient of this study will allow a better understanding of the trends and environmental controls on methylmercury bioaccumulation and a better prediction of the effects of climate change on the mercury cycle.

THE FIRST COMPREHENSIVE ASSESSMENT OF THE COMMUNITY STRUCTURE AND HABITAT ASSOCIATIONS OF DEMERSAL MARINE FISHES IN THE CANADIAN BEAUFORT SEA

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Marine fishes play a critical role in energy transfer from lower (e.g., zooplankton, epibenthic invertebrates) and upper (e.g., seals, beluga) trophic levels in Arctic marine ecosystems. However, the distributions, habitat requirements and community structure of many Beaufort Sea marine fishes are not known, precluding effective regulatory management of hydrocarbon development in the region. Fisheries and Oceans Canada, Arctic Aquatic Research Division, led the first-ever comprehensive baseline investigation of offshore marine fishes and habitats in the Canadian Beaufort Sea during 2012 and 2013 as part of the Beaufort Regional Environmental Assessment (BREA). Benthic trawling was conducted at 90 stations spanning 20-1500m depths across the southern Canadian Beaufort Sea and Amundsen Gulf to establish baselines for fish diversity and relative abundances. Concurrent sampling of oceanographic parameters and sediment composition was also conducted at each fishing location. Fish community structure was assessed amongst all stations using hierarchical clustering methods and non-parametric multi-dimensional scaling (nMDS) to determine the presence of discrete species assemblages. Habitat parameters including depth, near-bottom salinity and temperature, and sediment grain size were assessed as explanatory variables for fish community structure using a non-parametric statistical approach. Herein, results are discussed in the context of regional-scale watermass structure, circulatory patterns and sediment composition. New information on the community structure and habitat associations of Beaufort Sea marine fishes informs regulatory processes associated with oil and gas exploration and development. Accrued knowledge and baselines will also aid in mitigation and conservation efforts by enhancing our ability to monitor and predict the effects of hydrocarbon development and climate change on this pivotal ecosystem component. Increased knowledge of key fish species and their habitat associations also provide a basis for oceans management and fisheries protection activities.

USE OF GENETIC METHODS TO MONITOR WILDLIFE POPULATIONS ACROSS THE NORTH – A NATIONAL DATABASE AND REPOSITORY

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It has been 10 years since we collected the first fecal sample from caribou and were able to successfully extract good quality and quantity of DNA. During that time, in collaboration with provincial, territorial and federal governments, Aboriginal communities, wildlife management boards and industry, we have analysed more than 20,000 samples, developed a suite of field, laboratory and analytical methods and have shown how genetic data can be used to generate information needed for management. The project collaborators have been proactive in recognizing the potential of this research and have made significant investment to assist with the development of these methods. As a result, we have developed a National Database and Repository to allow for greater collaboration and synergies between individual projects as well as a framework for large-scale and long-term monitoring to support

regional, territorial and national conservation programs (e.g. Circumpolar Biodiversity Monitoring Program, Species at Risk, Environmental Assessment). The use of non-invasive genetic methods for monitoring is cost-effective; it provides critical baseline data and means to assess short and long term changes in wildlife distribution, movement and demographic parameters. Furthermore, this baseline population data provides a foundation for expansion into adaptive genomics through employment of next-generation sequencing technologies. The increased use of these methods by many user groups will also likely trigger the development of field ready equipment to initiate sample processing, provide basic genetic testing and allow for the seamless transfer of sample metadata and tissue into the National Database and Repository.

MODELLING THE CALANUS COMPLEX IN RAPIDLY CHANGING ARCTIC AND SUB-ARCTIC SEAS.

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At a time when environmental research is challenged to keep up the pace of the ongoing changes in the Arctic, numerical models can speed up our understanding of the organization, functioning and the vulnerabilities of Arctic marine ecosystems. Major breakthrough will require innovative modelling techniques (e.g. evolutionary algorithms) and observation methods (e.g. in situ imaging of plankton and particles, individual-level data) but also to revisit carefully the basics of our approach. We will present the example of the modelling of the Calanus complex, a community of three copepod congener species typical of the Arctic and its ancillary seas: Calanus hyperboreus, C. glacialis and C. finmarchicus. The model we developed is capable of simulating the complete life-cycle and highly specialized strategies (diapause, capital breeding, iteroparity, etc) of each species. We used this model to study whether the species-psecific phenologies observed in the sub-Arctic St-Lawrence estuary and the Arctic Amundsen Gulf are optimal responses to their environmental forcing, in the context of a changing environment. Alongside the presentation of the main results of the model, we will illustrate some common problems faced (paucity of reliable data for parameterization, difficulty to access the Arctic) and possible solutions.

IMPLICATIONS OF ENVIRONMENTAL CHANGE TO ARCTIC FRESHWATERS

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Freshwater ecosystems of the arctic are highly susceptible to environmental change. The open water, productive period is only from late June to August; small changes in timing of ice break-up and freeze up of lakes can cause important shifts in breeding or emergence of aquatic animals. In this short window, the synchrony of environmental conditions with biological events can have significant consequences on the overall productivity of the system. However, climate is not the only agent of environmental change in freshwater arctic ecosystems. Drastic increases in the abundance of arctic geese in recent decades has resulted in widespread degradation of habitats in many areas and both the removal of vegetative cover from catchments and the direct input of nutrients into aquatic systems from goose faeces have the potential to influence primary productivity and species diversity in aquatic ecosystems. By carrying out field studies across a gradient of goose presence on Southampton Island, Nunavut, we characterised the influence of habitat degradation and direct input of nutrients from faeces into the aquatic system. I will present some ways the aquatic ecosystems are adapting to these environmental changes.

ADAPTING RESEARCH AGENDAS AND OBSERVING PROGRAMS FOR ARCTIC CHANGE MITIGATION AND RESPONSE

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Rapid Arctic environmental change has resulted in unprecedented challenges for Northern communities, ecosystems, and global systems. Timely detection of trends

and information-sharing are critical for planning and the development of mitigation strategies and adaptation. Here we presents a synthesis of data related to two types of response to Arctic change: 1) The response of the research community to societal needs for information around Arctic change; and 2) The response of stakeholder communities to engagement efforts designed to improve scientific observations for the purposes of adaptation, mitigation and management of Arctic change. In the first instance we focus on how the research trajectory has changed across all disciplines during the period from 2003 to present, and present quantitative data demonstrating a shift in orientation and purpose. In the second instance, using case studies, we illustrate how stakeholder engagement has been critical to framing objectives for and outcomes from environmental observing programs in ways that lead to solutions for coping with change.

THE ECO-POLITICAL COAST: UNDERSTANDING EXTREME FLOODING, MIGRATION, AND THE SOCIAL BARRIERS TO ADAPTATION

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Overall climatic change in the Arctic has multiple outcomes, including an increase in the extent and frequency of flooding. In Alaska, up to 86% of rural Native villages experience some problems with erosion and flooding. In some communities this flooding has become habitual and increasingly threatening to lives and infrastructure. In Shishmaref, Alaska this continual flooding has led to a community push for relocation. Government agencies, scientists, and local community members agree that relocation is the only permanent solution to habitual flooding – and yet relocating the village has proven extremely challenging, both politically and financially. This paper explores the socio-historical context that creates habitual flooding disasters in Shishmaref and explores what the barriers to successful adaptation are in Shishmaref today.

CHANGING CLIMATE, SNOWCOVER, SHRUBS AND HYDROLOGY IN THE WESTERN ARCTIC

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Dramatic shifts to many, if not all aspects, of the arctic snowcover regime are underway, with implications to permafrost, ecosystems and water resources. Although snow is of fundamental importance to the arctic system, our understanding of its interactions with soil moisture in the active layer, accumulation of black carbon in the snowcover, and shrubification of tundra for example, is limited. As a result, our ability to understand past changes and predict future snow regimes is also limited. To advance our understanding, field observations and analysis of existing data are being carried out at the Trail Valley Creek research watershed south of Tuktoyaktuk, NWT, in the Western Arctic. Numerous hydrological studies have occurred at this site since the early 1990's and as a result there are appropriate data sets to consider both past changes in snowcover and the complex interactions controlling these changes. This paper will focus on one example that illustrates complex, and unexpected, changes. Over the period of record, snowfall has decreased, shrub cover has expanded, and increasing air temperatures have resulted in an earlier start to the snowmelt period. Unexpectedly, these changes have resulted in a delay to both the start of snowmelt controlled streamflow and to streamflow over the entire melt period. This paper will outline these changes, consider the complex interactions that may be resulting in a delay in stream flow in spite of increasing air temperatures, and outline future research required to better understand these changes.

CLIMATE CHANGE AND YOUTH: EDUCATION AND ENGAGEMENT IN NUNAVUT

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One of the key objectives of the Government of Nunavut's Climate Change Section is to educate and engage Nunavut youth on climate change topics. Youth are a key focus of our outreach since Nunavut has a very large youth demographic. In their lifetime, Nunavut youth will have to deal with the impacts of climate change and learn to adapt to these changes. Youth outreach initiatives were recently completed in three schools in Arviat, Nunavut. Using educational best practices, the outreach incorporated three learning goals: knowledge, attitudes, and skills. This was achieved through combining didactic teaching, discussion, reflection, and interactive activities into the program. Support from the schools is key to successful programming. While climate change is a significant issue for the

Arctic, feedback from the schools suggests that environmental and climate change concepts are not sufficiently included in the Nunavut curriculum. When engaging youth in climate change, educational best practices can be used as a basis; however, the best practices need to be tailored for a Nunavut audience. Information uptake was greatest when practices included making relevant, real world connections, having hands-on learning, and using informal settings for youth to share their experiences. The youth outreach initiative was able to introduce climate change concepts to Arviat youth in an engaging setting. Further climate change programming will continue to use best practices and feedback from Nunavut outreach programs to enhance program impact. Next steps will include sharing climate change educational resources to expand programming across Nunavut.

SUMMER-TO-WINTER SEA-ICE LINKAGE BETWEEN THE ARCTIC OCEAN AND THE MID-LATITUDES THROUGH ATMOSPHERIC CIRCULATION

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Contemporary climate science seeks to understand the rate and magnitude of a warming global climate and their impacts on regional variability and teleconnections. One of the key drivers of regional climate is the observed reduction in end of summer sea ice extent over the Arctic. Changes in the Arctic sea ice extent have been dramatic; especially September Arctic sea ice extent has been rapidly decreasing and the year-to-year variations of sea-ice concentration over the marginal seas to the northern coast of Alaska and Siberia have declined since 1979. Recent low Arctic sea-ice extent is not limited to change over the Arctic Ocean but has also impacted weather and climate in mid-latitudes with atmospheric variability. The Okhotsk Sea has shown rapid declining sea ice in response to atmospheric greenhouse gas increases and global warming. Thus, research connecting sea ice variability between the Arctic and Okhotsk Sea is important for understanding recent dramatic evidence of climate change. We have investigated the year-to-year variations in sea-ice extent between the Arctic Ocean during summer-to-autumn and the Okhotsk Sea during winter. The September Arctic sea ice in the East Siberian Sea is positively correlated with variations of the maximum Okhotsk sea ice in the following winter. We have shown that the atmospheric circulation anomalies in relation to the sea ice both in the Arctic Ocean and the Okhotsk Sea are characterized by a seesaw-like SLP pattern between positive anomalies over the north of Siberia and negative anomalies over the North Pacific. A pair of positive and negative SLP anomalies over the East Siberian Sea and the Bering Sea act to increase sea ice extent over the East Siberian Sea through anomalous northeasterly advection from the north of Greenland to the Far East. The air temperatures at the 850-hPa height also become colder over the East Siberia and Arctic. Those patterns are suggestive of an enhanced transport of sea ice into the East Siberian Sea through wind anomalies from the north of Alaska to the East Siberian Sea. The SLP and air temperature anomalies regressed on the maximum Okhotsk sea ice index also show similar patterns that the seesaw pattern between positive anomalies over the Arctic and negative over the North Pacific Ocean and cold temperatures over the north of Siberia. The seesaw pattern is characterized by anomalous cold northerly advection from the Arctic Ocean to the Okhotsk Sea. The result is consistent with the negative air temperature anomalies over the East Siberian Sea and the Okhotsk Sea. The patterns of atmospheric circulation and air temperature anomalies in relation to the sea ice coverage both in the East Siberia and the Okhotsk Seas resemble those associated with the annual Arctic Oscillation (AO). The negative annual AO forms colder anomalies in autumn sea surface temperatures both over the East Siberian Sea and the Okhotsk Sea, which causes heavy sea-ice conditions in both seas through season-to-season persistence.

LONG-TERM OBSERVATIONS OF ATMOSPHERIC CO2, O3 AND BRO OVER THE TRANSITIONING ARCTIC OCEAN PACK-ICE: THE O-BUOY CHEMICAL NETWORK

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The Arctic environment is undergoing dramatic change. As part of the US NSF-funded Arctic Observing Network, the autonomous, sea-ice-tethered O-Buoys provide long-term measurements of atmospheric CO2, O3 and BrO as well as meteorological parameters, in addition to imagery, which are openly available to the community via the data portal ACADIS (http://www.acadis.org). The O-Buoy has bi-directional communication capabilities and transmits data hourly. Seasonal changes in Arctic atmospheric chemistry are influenced by changes in the characteristics and presence of the sea ice vs. open water as well as air mass trajectories, especially during the winter-spring and summer-fall transitions when sea ice is melting and freezing, respectively. The O-Buoy network provides the unique opportunity to observe these transition periods in real-time with high temporal resolution, and to compare them with those collected on land-based monitoring stations located. Due to the logistical challenges of measurements over the Arctic Ocean region, most long term, in-situ observations of atmospheric chemistry have been made at coastal sites around the periphery of the Arctic Ocean or islands near the coast, leaving large spatial and temporal gaps that O-Buoys can overcome. Advances in floatation, communications, power management, and sensor hardware have been made to the original design to overcome the challenges of diminished Arctic sea ice which have resulted in our longest deployments into the summer so far. We report preliminary investigations into questions pertinent to enhanced seasonal, interannual and spatial variability in atmospheric composition, changes in halogen and O3 chemistry as seasonal ice in spring enhance bromine chemistry, and enhancement of the atmospheric CO2 signal over the more variable and porous pack ice, among others.

SPATIAL AND INTER-ANNUAL CHANGES IN ZOOPLANKTON COMMUNITY IN THE WESTERN ARCTIC OCEAN DURING SUMMERS OF 2008?2013

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Recently, drastic reduction of sea ice during summer was observed in the western Arctic Ocean, and it is expected to have great effect on marine ecosystem. To evaluate effects of sea ice reduction on marine ecosystem, basic information on spatial and temporal changes in zooplankton community in the western Arctic Ocean is scare. In the present study, we evaluate spatial and inter-annual changes in zooplankton community in the western Arctic Ocean during summers of 2008, 2010, 2012 and 2013. Zooplankton samples were collected by vertical hauls of NORPAC net (mouth diameter 45 cm, mesh size 0.335 m) from 150 m depth or 5 m above the bottom to the surface at 36?63 stations in the western Arctic Ocean during 29 August?13 October of 2008, 2010, 2012 and 2013. At each station, temperature and salinity were measured by CTD casts, and chlorophyll a was measured with fluorometer. Zooplankton samples were preserved with 5% buffered formalin. In the land laboratory, wet masses of the samples were measured, and enumeration and identification (calanoid copepods to species and copepodid stage level) were made under a stereomicroscope. Based on log-transformed zooplankton abundance, cluster analysis (Bray-Curtis with connected by UPGM) was made. Multiple-regression analysis was carried out between NMDS plots and hydrographic data (latitude, longitude, depth, integrated mean temperature, salinity and standing stock of chlorophyll a in the net-towed water column). Zooplankton abundance ranged between 2,922?274,021 ind. m?2, and was greater in shelf region dominated by small copepod Pseudocalanus spp. Biomass ranged between 2.8?263 g WM m?2 and was also greater in the shelf region. Four zooplankton communities (groups) were identified by cluster analysis. Because the horizontal distribution of each group was well separated geographically, the groups were termed with Shelf, Northern Shelf, Slope and Basin. Shelf group showed the highest abundance, and dominated by the Pacific copepods, Pseudocalanus spp. and benthic larvae. Slope group was dominated by Arctic copepods, and Basin group was characterized by the occurrence of deep-sea copepods. As the results of NMDS and multi-regression analysis, their distributions were significantly correlated with the various environmental parameters: latitude, depth, integrated mean temperature, salinity and standing stock of chlorophyll a. The horizontal distribution patterns of each group were similar for 2008, 2010 and 2013. While in 2012, the Northern Shelf group, characterized by the less abundance and lower species diversity than those of Shelf and Slope groups, were occurred in the northern part of the Chukchi Sea. These spatial and inter-annual changes in zooplankton community would be related with the distribution of water masses and intensity of the sea ice extent in each year.

GAS PIPELINE INFLUENCE ON FUNCTIONING OF FROZEN PEATLAND SOILS (NORTH OF WEST SIBERIA, RUSSIA)

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Currently, there is an active exploration of Russia permafrost zone, especially on north of West Siberia. High vulnerability of ecosystems formed in the permafrost zone, made it necessary a detailed study of violations consequences. The aim of this study was to evaluate the impact of the gas pipelines construction on the functioning of frozen peatland soils in northern taiga of West Siberia. Along the Nadym - Punga gas pipeline (N65º 18' E72º 52'), during 2011-2012 were carried out stationary monitoring the active layer depth, soil temperature, as well as soil surface CO2 emissions and soil profile CO2 concentrations on disturbed sites of frozen peatland near the pipeline and on undisturbed sites. Typic Histoturbels soil is typical for undisturbed frozen peatlands, the active layer is 50-60 cm.. The area was exposed twice: in 1977 during the initial gas pipeline building and in 2004 when the pipe repairing. Width of the zone of mechanical violations along the pipe varies from 20 to 40 m. Soils of disturbed sites are characterized by complete or partial destruction of organic horizons, burial of organic horizons, disturbance of microrelief, strong soil profile turbation. Soils consist of a mixture of peat and sand horizons, permafrost is deeper than 3 m. Currently disturbed areas is actively overgrown with plant communities that are not typical for frozen peatlands. This is due to significant differences in hydrothermal regime as related to mechanical disturbances, and a direct effect of gas pipeline. Pipeline prevents free flow of wetland ecosystems water. Also gas pipeline is a "heater" because transports the warm gas and it has a significant impact on the temperature of the surrounding ecosystems. A significant increase in the depth of thawing of disturbed soil (generally to a depth of 2-3 m) was found. Average annual temperatures of disturbed soils are 2 times higher the average temperatures of the undisturbed soils. Summer temperatures of the disturbed soils are higher by 5-10°C. Disturbed soils are unfrozen for 2-3 months longer. This is due to the warming effect of the gas pipeline, reducing the influence of permafrost, absence of organic horizons. The difference in the temperature regime affects the indicators of soil CO2 production. The values of CO2 effluxes of undisturbed sites are low (80–100 mgCO2m-2h-1), indicating low biological activity of frozen peatland soils. CO2 effluxes of disturbance soils are 4–5 times greater than CO2 effluxes of undisturbed soils (350¬–600 mgCO2m-2h-1). The profile CO2 concentrations of the disturbed soils are 1.5–2 times greater than the CO2 concentration in the undisturbed soils. Relatively high values of soils carbon dioxide production in several disturbed sites can be explained by their greater heat supply that increase their biological activity. Also high impurity of mineral components and moisture reduction promote active peat mineralization. Thus, disturbance of soil cover caused by the gas pipeline building in permafrost zone, is accompanied not only by changes in the plant community and soil morphology, but also to changing regimes of soil functioning. A significant change in gas exchange of frozen peatlands cannot be underestimated, since the length of gas pipelines is very high in the Russian permafrost zone.

BETWEEN IDENTITY AND INTEREST: TWO MODELS FOR EXPLAINING PRIORITIZATION OF ARCTIC SECURITY IN THE ARCTIC FIVE

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Although academic work that addresses potential security problems in the Arctic in a comprehensive manner has been attempted, there are still some areas in which even comprehensive approaches to addressing Arctic issues are lacking. This is particularly evident when it comes to developing connections between the more discursive elements of the issue—that is, the ability of governments to draw attention to and prioritize Arctic security issues within their respective bureaucracies—and the manner in which each Arctic state is building a strategy to respond to the real-world concerns that affect its Arctic territory and interests. In this regard, my work will examine whether each state's view of the Arctic as a security problem is driven more by national identification with the Arctic versus basic protection of sovereign territory and exclusive economic zones. Preliminary research on this topic has demonstrated noticeable differences between the prioritization of Arctic issues in states that have high cultural attachment to the region (such as Canada and Norway) versus those who have low cultural attachment (Denmark and the United States). As such, I posit that there are clear differences between the ability of high-identification Arctic states to securitize and prioritize the Arctic region within national security discussions versus low-identification states. The impact of this research, therefore, not only speaks to theoretical questions regarding what drives behavior, but is also of great use to policy discussions regarding the development of national strategies for the Arctic region and understanding the goals and motivations driving Arctic security policy amongst the Arctic Five. I will thus approach this debate through three main questions. Firstly, how much does each state identify with the Arctic space on an overall cultural level? Secondly, how do each of the Arctic Five states conceive the region in the context of its own strategic outlook, and what steps is each state undertaking to address this? Thirdly, how does overall national identification with the region in affected states serve as a driving factor to prioritize Arctic security issues versus simply acting to protect sovereign territory and resources?

SHALLOW OCEAN CURRENTS UNDER MULTIYEAR ICE IN THE BEAUFORT SEA

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The shallow ocean current field under multiyear ice in the Canadian Arctic is not well described to date. In this study, shallow under-ice ocean velocities (0–60 m depth) were recorded with an acoustic Doppler current profiler (ADCP) deployed through multiyear ice in the eastern Beaufort Sea, first briefly in conjunction with an ArcticNet Amundsen expedition in August 2011, and then in an autonomous deployment which, between 11 April to 29 July 2012, drifted westward across the Beaufort Sea from 128 to 145oW. Surface winds and ice temperature were also recorded in both deployments. The shallow under-ice velocity profile is best described as a reconciliation between the atmospherically-forced Beaufort Gyre at the surface (currently prevailing anticyclonic), inertial and tidal motion (semidiurnal rotation) and flow of underlying Pacific-origin water (prevailing eastward and northward in the southern and eastern Beaufort Sea respectively). In particular, in late winter when local ice motion is determined by regional forcing of the aggregate pack, velocities down to 30 m depth closely follow the ice motion. We suggest that this is best explained as drag extending at least to the local median keel depth. By early July, inertial rotation dominates local motion of both ice and shallow water, and the general drift direction begins to correlate with local surface winds. Throughout the record, velocities near the limit of our ADCP record (in upper halocline, or Pacific-origin water) vary independently of ice motion and shallow currents.

THE DYNAMICS OF CLIMATE CHANGE VULNERABILITY IN THE SOUTHERN BAFFIN REGION, NUNAVUT

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This presentation discusses the Iqaluit Land-Use Monitoring Project, and its efforts to understand how climatic risks and change are experienced and responded to by Inuit harvesters in the Iqaluit region of Nunavut. It emphasizing the importance of longitudinal study design, real-time observations of human–environment interactions, community-based monitoring, and mixed methods. Fieldwork with Inuit harvesters in the southern Baffin region spanned five years, during which sixty-four semi structured interviews were conducted, ?22,000 km of land use Global Positioning System (GPS) data was collected, and ~100 biweekly interviews on land-use conditions and challenges were conducted. Information from local hunters was complemented by analysis of the historical records as well as instrumental data on regional climate conditions. Results indicate that environmental conditions are changing rapidly, affecting trail conditions, safety, and access to harvesting grounds. GPS data and biweekly interviews document real-time adaptations, with traditional knowledge and land-based skills, resource use flexibility, and mobility underpinning significant adaptability, including utilizing new areas, modifying trail routes, and taking advantage of an extended open water season. However, socio-economic and cultural change is enhancing dependency on external conditions, reducing the flexibility of harvesting activities, and affecting knowledge systems. Accordingly, current responses that are effective in moderating vulnerability may not be indicative of high adaptive capacity in the long term, with trajectories of maladaptation already in evidence.

DIET AND BODY CONDITION OF SOUTHERN BEAUFORT SEA POLAR BEARS IN A CHANGING CLIMATE: AVAILABILITY OF ONSHORE FOOD SOURCES OR LIMITATIONS TO TRADITIONAL PREY?

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Quickly changing climate and sea ice conditions have been linked to poorer body condition in southern Beaufort Sea (SB) polar bears (Ursus maritimus) and subsequent declines in subpopulation survival and size. Over the last decade, the proportion of SB polar bears that come ashore in the summer and fall has increased. While onshore, bears make use of bowhead whale remains from subsistence harvests, while those that remain on the sea ice that retreated far from productive coastal waters seem to persist using pelagic foraging strategies. In this study, we assessed the temporal relationship of climate (using the Arctic Oscillation (AO) index) and polar bear body condition to use of this onshore resource, bowhead whale, relative to their traditional main prey, ringed seal. We

used quantitative fatty acid signature analysis (QFASA) to assess the contribution of potential prey species, ringed seal, bearded seal, beluga whale, and bowhead whale to the diets of SB polar bears sampled from 2004 to 2012. Overall, diet estimates indicated that ringed seal (95% CI: 41-45%) and bearded seal (35-40%) were the predominant prey items, that bowhead whale consumption was lower (13-16%) and that beluga whale consumption was limited (4-6%). Nonetheless, diets varied by demographic group, season and year. Adult males consumed around twice as much bowhead whale as adult females and immature bears, whereas adult females consumed more ringed seal than adult males. Spring sampled bears ate more beluga whale, bowhead whale and ringed seal than fall sampled bears (fall sampling typically occurred prior to or just after bone piles became available). Conversely, fall sampled bears ate more bearded seal than spring sampled bears (71-77% versus 24-28%), suggesting a previously unrecognized seasonal importance of bearded seal to SB polar bear diets. Although year of collection was a significant factor, there were no significant temporal increases or decreases in spring or fall consumption of any prey species over the 2004-2012 time period. Instead, mean annual ringed seal consumption (but not other prey) in spring sampled bears was negatively correlated ($r2 = 0.73$, $p = 0.003$) with the previous winter AO index. That is, after highly positive AO winters, which result in subsequently lower summer ice concentrations, more open water and later onset of fall freeze, less ringed seal was measured in SB polar bear diets. These findings suggest that SB polar bears consumed less ringed seal when poor ice conditions prevented them from doing so, due possibly to less accessibility or to changes in ringed seal distribution or numbers under such conditions. Thus, it appears that onshore versus offshore resource use in SB polar bears is a function of changes in ice/access to their traditional prey. Body condition indices were generally negatively correlated with ringed seal consumption for both spring and fall sampled bears, suggesting that SB polar bears continuing to use the offshore foraging strategy may fare worse than those spending more time onshore.

A COORDINATED ARCTIC ECOSYSTEM CLASSIFICATION AS AN ECOSYSTEM TEMPLATE FOR MULTI-SCALAR DESIGN OF A PAN-ARCTIC MONITORING NETWORK.

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Canadian tundra and taiga biomes include a wide range of regional and local climates, topographic variability, surficial and bedrock geology, and geo-evolutionary history that together determine the composition, distribution, structure and productivity of terrestrial ecosystems across this vast area. The Circumpolar Biodiversity Monitoring Program (CBMP) Terrestrial Expert Monitoring Group (TEMG) is proposing to work with partners across the North to develop a coordinated approach to monitor and report changes in northern terrestrial ecosystems at a range of scales. This presentation will make the argument that a key piece required to underpin a successful experimental design for the TEMG monitoring plan is a standardized ecosystem classification system that organizes the broad variability in northern terrestrial ecosystems into a useful, hierarchical structure. The presentation will outline the structure of a northern terrestrial ecosystem classification system, will show how that proposed system is linked internationally to initiatives such as the Arctic Vegetation Archive, and will demonstrate the usefulness of such as system to the experimental design needs of the CBMP TEMG.

NUNAVUT, UQAUSIVUT, PIQQUSIVULLU NAJUQTIARLAVUT (CARING FOR OUR LAND, LANGUAGE AND CULTURE): EXPLORING LAND CAMPS AS AN EDUCATIONAL AND RESEARCH TOOL IN GJOA HAVEN, NUNAVUT

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This research takes place as part of a larger SSHRC-funded initiative entitled "Connecting Inuit Elders and Youth: Learning about caribou, community and well-being." This initiative is a collaborative project between the community of Gjoa Haven, Carleton University and Kitikmeot Inuit Association. Beginning in 2010, community collaborators identified a series of research priorities, including the use of land-based camps as the forum in which they wished research and learning to take place. The use of land camps are of great importance as Inuit knowledge, culture and values are deeply connected to the environment and the land. Three Elder-youth land camps were coordinated by a local planning committee, and hosted outside of Gjoa Haven (one on King William Island, and two on the mainland just South of the island), in consecutive summers (2011 - 2013). In addition, 40 semi-structured interviews were conducted in Gjoa Haven to learn more about relationships between caribou, community, well-being, and intergenerational knowledge

transfer. This portion of my Master's research is concerned with exploring land camps as research and education tools, and in particular how these camps facilitate not only explicit educational opportunities, but implicit knowledge sharing through interpersonal engagement and relational learning. The land camp is thus a place to put into practice the Qaggiq Model of Inuit knowledge renewal (McGrath, 2011). The land, language, culture, and living histories that make up the pillars of this model are central to the land camps. The camps are an opportunity for Elders, youth and others to come together in sharing and learning about land-based skills through practice, story telling, and sharing of history and experience. The use of Inuktitut language is also prioritized throughout the camps and during interviews with Elders in the community. Drawing on the methodological principles of naalangniq (listening well), pittiarniq (ethics of accuracy), ujjiqsuiniq (observation), and suliniq (personal congruence) (McGrath, 2011), I analyze interviews from the project and reflect on my own experiences in the camp and community to better understand the role that land camps can play in the Inuktitut knowledge renewal process. From preliminary analyses, the concept of najuqtiarniq, or the 'act of caring for', has emerged as an implicit ethic interwoven throughout discussions about relationships with language, land, and culture. This concept suggests that if we are to ensure continuity through generations then we must be caring for or ensuring the implied importance of all these connections within our communities. In this presentation I will discuss najuqtiarniq further, including how this act of caring is expressed through land camps. Uncovering the implicit values associated with this concept helps to explain how camps can be important experiences to support Inuktitut knowledge renewal, as well as building and strengthening relationships within the community, and between researchers and the community.

EXAMINING THAW POLYGONS AS CONDUITS FOR THE TRANSPORT OF NUTRIENTS TO ARCTIC LAKES

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Changes to catchment condition as permafrost degradation and terrestrial production increase under warmer temperatures may strongly influence the nutrient conditions and aquatic ecology of Arctic lakes. For example, increases in the active layer due to melting ice-wedges in permafrost can lead to increases in thaw polygon formations in lake catchments. These patterned ground formations may act as corridors for the transport of organic-rich sediments and dissolved inorganic carbon and nitrogen to lakes. This is predicted to lead to increased nutrient availability, water clarity, as well as enhanced benthic production. We can track the influence of changes to catchment condition by examining the geochemical and biological response through time using paleolimnological methods. Here, we examine subfossil chironomids, as well as organic carbon and nitrogen elemental and isotope compositions, from 210Pb-dated sediment cores collected from lakes in the Mackenzie Delta uplands region near Inuvik, NWT. We show a large increase in the abundance and diversity of chironomids in a lake with extensive polygon formations in its catchment compared to lakes without. This increase in aquatic production follows a significant increase in ?15N and a decline in ?13Corg, which we infer to reflect an increase in the transport of allochtononous dissolved inorganic carbon and nitrogen to the lake since 1960. These results are in contrast to the lake without thaw polygons in its catchment, which had lower production even though the region has warmed 2°C since 1960. We then quantify differences in production by comparing the distribution of chironomids in the surficial sediments from 20 additional lakes with varying amounts of thaw polygon formations in their catchments. This allows for a comparison in production inferred to reflect increased nutrient availability across a gradient of catchment condition. Our results indicate that increases in allochtononous nutrient transport to lakes susceptible to changes in catchment condition may be accelerating shifts in trophic structure with warming.

GLACIAL MELTWATER AND PRIMARY PRODUCTION ARE THE DRIVERS OF STRONG CO2 UPTAKE IN GREENLANDIC FJORDS

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Glacial meltwater input into high-latitude coastal systems is predicted to strongly increase with climate change, yet the impact of this glacial melt on the carbonate dynamics of fjord and adjacent continental shelves remains largely unquantified. The limited data presently available indicate that fjord systems that are affected by glacial melt are strong sinks of CO2, but the driving factors for this high CO2 uptake are not well understood. To resolve the different factors driving CO2 dynamics in the Godthåbsfjord (Greenland), an extensive sampling was set up during the period 2012-2013 covering a transect from the outer fjord to the glaciers. Measurements covered the full annual cycle of partial pressure of CO2 (pCO2), dissolved inorganic carbon (TCO2), alkalinity and pH, and alongside hydrographic measurements and biological data were collected. Measurements show strong undersaturation in the fjord throughout the year, with strong undersaturation in summer (pCO2 values of 100 to 200 µatm), leading to an average annual air-sea CO2 flux of -65 g C m-2 yr-1. Our data show strong effects of both primary production and glacial meltwater input on the carbonate chemistry in the fjord.

MODELING THE IMPACTS WARMING IN RECENT DECADES ON ECOSYSTEM CARBON EXCHANGE IN HIGHER LATITUDES OF NORTH AMERICA

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Rises in average air temperatures for the Arctic region in particular have been twice as rapid as the global average during the last century. Despite apparent warming in most arctic regions, its impact on net ecosystem productivity (NEP) remains uncertain. In this study, we used an ecosystem model ecosys to examine the effects of warming in recent decades on NEP and component fluxes (gross primary productivity (GPP) and ecosystem respiration (Re)) in northern higher latitudes of North America using long-term (1979 – 2010) climate data from the North American Regional Reanalysis (NARR) with 3-hourly time step at spatial resolution of 0.250 x0.250. At a site scale, CO2 fluxes modeled at mixed tundra and fen sites were compared with fluxes measured at eddy covariance towers from 2006 to 2009. Slopes and correlation coefficients from regressions of modeled vs. measured CO2 fluxes were 1.0 ± 0.1 and 0.7 – 0.8 for both sites in all years. At the mixed tundra site, rises in net CO2 uptake in warmer years with earlier snowmelt were constrained by midafternoon declines in CO2 influxes when vapor pressure deficits (D) exceeded 1.5 kPa, and by rises in CO2 effluxes with greater active layer depth (ALD). At the fen site, CO2 influxes declined less with D and CO2 effluxes rose less with warming, so that rises in net CO2 uptake in warmer years were greater than those at the mixed tundra site. When ecosys was applied to the North American arctic under weather recorded during the past 30 years, increases in NEP and leaf area index were modeled for most arctic ecosystems from increases in the length of growing season (LGS) attributed to warming in spring and autumn. This increasing trend in LGS was corroborated with similar trends observed from NDVI. Modeled ALDs also increased in most parts of the arctic at an average rate of 2.3 cm decade-1. Overall, modeled NEP increased at a spatially averaged rate of 0.22 g C m-2 yr-1. However long-term seasonal trends in component fluxes indicated that the rate of increase in Re was more than that of GPP in all seasons except summer. A particularly high carbon loss was modeled during greatest ALD in autumn which offset 34% of the carbon gains in spring. This loss indicated that further warming and consequent deepening of the ALD, which could expose some of the huge volume of carbon in the permafrost, could adversely affect the increases in NEP modeled under current warming.

SIGNATURE OF A JÖKULHLAUP EVENT IN A SUBARCTIC GLACIER OBTAINED WITH A STATIONARY ICE PENETRATING RADAR SYSTEM

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In 1957 the first deliberate ice penetrating radar sounding was made from an aircraft over the Ross Ice Shelf. Since then, the vast majority of radioglaciology studies have been carried out as spatial surveys on land, by air, and from space. By contrast, only a few instances of fixed-position temporal IPR deployments are found in the literature. Here we describe the design and field testing of a new stationary IPR system part of a broader research and development effort centered around instrumentation for glaciological monitoring including ice penetrating radars (IPRs). The system was deployed in July-August 2014 on the Kaskawulsh Glacier in southwest Yukon, ~0.5 km from an ice-marginal lake dammed by the glacier flank. The lake is known to drain annually in a subglacial jökulhlaup, making this a promising location in which to detect interesting time-dependent behaviour. The radar system was programmed to perform a series of soundings every 4 hours, while the lake level was monitored with a pressure sensor. The radar system

design was based on other IceRadar IPRs regularly used in spatial surveys, and could therefore capitalize on existing features of this operational system's software. Notably, a dual-input simultaneous sampling scheme allows the system to capture both a high resolution reflected signal and a full-amplitude air wave that can be used to detect fluctuations in glacier surface conditions or in transmitter power output. In its first deployment, the stationary radar system operated autonomously and continuously for 6 weeks before it was retrieved in September 2014. At the beginning of the deployment period, strong and stable internal reflectors are clearly visible. Over the course of the following 2 to 3 days, coincident with the most rapid phase of the lake drainage, these reflectors fade dramatically until nearly all internal reflectors disappear. The weeks that follow are characterized by a stable radar signal nearly free of internal reflectors. The striking synchronicity of the lake drainage and the marked change in radar signature demonstrates the ability of the system to detect time-variable changes in englacial properties. We speculate that significant changes in englacial water storage, several hundred metres from the margin of the draining lake, are responsible for the dramatic temporal change in the radar signal. It is concluded that stationary IPRs can be used to monitor temporal changes in hydro-glaciological conditions, and are particularly well suited to Arctic polythermal glaciers where the appearance and disappearance of water can produce clear time-varying radar signatures. Such monitoring would be particularly applicable to environments in which ice-ocean interactions are important, as well as for tracking ice-shelf thickness changes or the decay of ice islands.

INTRA-SEASONAL VARIABILITY OF THE BEAUFORT GYRE DERIVED FROM THE CRYOSAT-2/SIRAL MEASUREMENTS

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Decline of the Arctic sea ice cover faster than IPCC simulations has been observed in recent decades. Satellite observations have revealed that major areas of sea ice loss are the Canada Basin, Chukchi Borderlands (CBL), Siberian continental shelf and the Barents Sea shelf break. In the Pacific sector of the Arctic Ocean, a trigger of sea ice loss is thought to be the Pacific Summer Water coming through Bering Strait. Pacific Water through the Bering Strait enters the Arctic Basin via the Chukchi Sea. A major conduit of Pacific Water is the Barrow Canyon. Warm Pacific Water (i.e., PSW) is found in September and/or October. After intruding the Arctic Ocean, the PSW is transported by the clockwise Beaufort Gyre (hereafter, BG) and is delivered to CBL region during wintertime. In other words, the distribution and strength of the BG during wintertime is a key to understand where and when the PSW arrives in the Pacific sector of the Arctic Ocean. Hydrographic observations by the drifting/ice-mounted buoy and mooring are quite helpful to obtain in-situ measurements, however, it is hard to elucidate changing spatial and temporal distribution patterns of PSW. In the meantime, Kwok and Morison (2011) recently showed efficiency of the altimeter-derived dynamic ocean topography (DOT) for investigating the ocean circulation, even during wintertime. Unfortunately, the earth-observing satellite ICESat on which the Geoscience Laser Altimeter System was mounted, is no longer available because the ICESat's mission was completed in 2010. In this study, we investigated monthly DOT field derived from the measurements of the Synthetic Aperture Interferometric Radar Altimeter (SIRAL), which is mounted on the Cryosphere Satellite-2 (CryoSat-2). Moreover, we employed 1) the ice concentration and ice velocity datasets derived from the data observed by the satellite microwave sensors, the Advanced Microwave Scanning Radiometer for EOS (AMSR-E, mounted on the earth observing satellite AQUA) and AMSR2 (mounted on the satellite, Global Change Observation Mission 1st – Water (GCOM-W1)), and 2) the NCEP-DOE Reanalysis 2 sea level pressure, to examine sea surface stress field. DOTs derived from the Cryosat-2/SIRAL measurements show both inter-annual and intra-seasonal variability of the Beaufort Gyre during wintertime. Actually, the Beaufort Gyre responds to changing sea ice motion modulated by wind forcing. For example, intensification of the Beaufort Gyre and sea ice motion occurred from December 2012 to January 2013, simultaneously. In that case, the role of sea ice motion for the Beaufort Gyre is a driving force. However, the comparison of DOTs and sea surface stress field suggests us that sea ice motion also plays a role of the deterrent force to the Beaufort Gyre. From January to February in 2013, sea ice motion weakened due to weakened wind forcing, and then the spatial distribution of the Beaufort Gyre was modulated and the Beaufort Gyre weakened. Thus, the Beaufort Gyre in the wintertime is quite variable, and those results suggest that the intra-seasonal variability of the pathway of the PSW driven by the Beaufort Gyre, and the impact of the PSW on the process of sea ice loss.

PASSAGES: A CONCEPTUAL STUDY OF A RISK-BASED VESSEL TRAFFIC MONITORING AND MANAGEMENT SYSTEM FOR ARCTIC SHIPPING

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Although large areas of the Northwest Passage were clogged with ice this summer, the rate of sea ice loss in the Arctic basin during summer months continues to be about 10% per decade (National Snow and Ice Data Center: Arctic Sea Ice News & Analysis). As the ice melts more every year, there is the possibility of more traffic up North associated with various activities such as community resupply, cruise ship tourism, seabed mining, and offshore oil and gas development. Based on these projections, it is important to continually monitor vessel traffic in the Arctic to be able to provide government agencies and mariners with the degree of maritime domain awareness that they need to conduct safe operations and voyages in the North and to manage risks such as maritime accidents or spills or transiting of illegitimate vessels. The Canadian-German research project PASSAGES (Protection and Advanced Surveillance System for the Arctic: Green, Efficient, Secure) aims to specify the requirements and the design of such a monitoring system. The major characteristics of this project are: a broad analysis of the interests and needs of diverse stakeholders including government and commercial stakeholders as well as Northerners; an analysis of potential risks to and from the ships operating in the North; an investigation into a variety of different and complementary sensor systems (land-, air- and space-based) to create persistent monitoring of all vessels; a definition and characterization of anomalous ship behavior in the North; and improved risk modelling based on the fused information of all gathered sensor data and contextual information. The system is designed to link different stakeholder communities and provide each one with the information they need in a timely manner. The first part of this talk is dedicated to introducing the PASSAGES Project. We will walk through the process of defining the monitoring system, and explain its key attributes. In the second part of the talk, we will present an overview of the other presentations in the session and put them in the context of the session's objectives.

A VANISHING CRYOSPHERE: HYDROLOGICAL CHANGE AND IMPACTS ON TUNDRA ECOSYSTEMS

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The Arctic is undergoing an ecological regime shift and has passed the threshold for irreversible system change in terms of IPCC's Reasons for Concern. "Irreversible" is used here in the sense that it would require another ice age to restore. The presentation will focus on issues of cryosphere recession in arctic and alpine tundra: permafrost thaw and reduced snowbed distribution in time and space. Permafrost degradation is proceeding rapidly, particularly in areas where it is already discontinuous, with high confidence in detection as well as in attribution to climatic warming. Impacts on tundra ecosystems and their biodiversity are profound. Communities of plants and animals adapted to wet and dry permafrost (i.e., formerly frozen peat and mineral soils, respectively) accordingly change in different directions, where the main driver is a changing hydrological regime. Snowbed ecosystems are housing a high number of specialized plant and animal species, and in alpine tundra many of those are endemic to small areas, in some cases on the verge of extinction. Competition by invasive species from lower latitudes and altitudes pose an increasing threat. Besides of their importance for arctic and alpine biodiversity, snowbeds also provide important ecosystem services in the tundra landscape, e.g., for reindeer husbandry. Examples will be given from ongoing research in northern Swedish Lapland and alpine New Zealand. [This contribution is aimed for Topical Session T37, but certainly connects with T33, T38, and T43.] The author is lead author of IPCC AR5 WG II (2014; Chapter 18, "Detection and Attribution of Observed Impacts", and collaborating with the Chapter 28 team, "Polar Regions"). He was coordinating lead author for the biophysical part of the Arctic Resilience Report 2013 (Arctic Council).

NIKIGIJAVUT NUNATSIAVUTINNI (OUR FOOD IN NUNATSIAVUT): A COMMUNITY-BASED APPROACH TO ADDRESSING FOOD INSECURITY IN NUNATSIAVUT, LABRADOR

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Inuit families across Canada continue to face significant challenges accessing adequate, nutritious, and culturally-appropriate foods. Currently, there are a variety of food related programs designed to address barriers to accessing healthy and adequate food in northern Inuit communities. In Nunatsiavut, Labrador, both the Federal and Provincial Governments provide subsidies on food transport and sale through Nutrition North Canada, and the NL Air Foodlift Subsidy. Local initiatives have also been developed in Nunatsiavut communities in response to this issue. Community freezer programs, for example, are supported through the Nunatsiavut Government, Inuit Community Governments and other partners to increase access to safe, healthy and nutritious wild foods. In light of the continued food-related challenges and increased action on food security, there is opportunity for comprehensive food assessments in northern Inuit communities to inform strategies that aim to improve access to adequate, nutritious, and culturally-appropriate food. Since 2010, the Food Security Network of Newfoundland and Labrador (FSN-NL) has partnered with the Hopedale Inuit Community Government, and the Nunatsiavut Government to complete a Community-led Food Assessment (CLFA) as a way to facilitate community dialogue and planning to address challenges related to food, and develop community appropriate food programs. Based on Hopedale's experience, the CLFA process has been adapted for Inuit communities in partnership with Trent University and the Nasivvik Centre for Inuit Health and Changing Environments. With funding from the Public Health Agency of Canada's Innovation Strategy, this Project has now expanded to partner with Rigolet and Nain, Nunatsiavut, to carry out CLFAs and identify, implement and evaluate community driven food programs designed to address food insecurity. The goal of the NiKigijavut Nunatsiavutinni: Our Food in Nunatsiavut Project is to improve access to healthy wild, locally grown, and/or store bought foods in participating communities. Toward this end, the Project takes a respectful and community-driven approach to food assessments, program-implementation, and monitoring and evaluation. This approach aims to ensure that the Project is meaningful and relevant to the community, and can validly and reliably inform other northern food security strategies. As a case example, this presentation will feature the story of efforts to achieve this goal in Rigolet, Nunatsiavut. This will include an overview of the Rigolet CLFA process, and development and initial implementation of the Rigolet Community Food Action Plan that outlines community-driven programs intended to address food insecurity including a Good Food Box program, a Gardening Education and Mentorship Program, and a Hunter Support Program.

THE EVOLUTION OF NSF ARCTIC DATA MANAGEMENT: CHALLENGES AND LESSONS LEARNED AFTER TWO DECADES OF SUPPORT

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The US National Science Foundation has been providing data management support to the Arctic research community through the UCAR/NCAR since late 1995. Support began during the early planning phase of the Surface Heat Budget of the Arctic (SHEBA) Project. This support continues today with a major collaboration involving the National Now and Ice Data Center (NSIDC), NCAR/CISL and the UCAR Unidata Program in the Advanced Cooperative Arctic Data and Information System (ACADIS). These groups have managed thousands of datasets for hundreds of Principal Investigators. The datasets, including the metadata and documentation held in the archives vary in size from less than 30 kilobytes to tens of gigabytes and represent dozens of research disciplines. The ACADIS holdings alone include more than 50 scientific disciplines as defined by the Global Change Master Directory (GCMD) keywords. The data formats vary from simple ASCII to proprietary complex binary and images. A lot has changed in 20 years regarding the way data are collected due to improved data collection technologies, real time processing, complex data processing and storage capabilities and wide bandwidth communications. There have been some changes to data management best practices especially related to metadata, flexible formatting and interoperability with other archives to take advantage of new technologies, software and related support capabilities. ACADIS has spent more than 7 years working these issues and implementing an agile service for the community. One of the major challenges facing science in general and for Arctic data in particular is how foster trust and cooperation between nations that then allows the free and open exchange of data. The rich data coming from many nations conducting Arctic research must be allowed to be brought together to understand and assess the huge changes now underway in the Arctic regions. The ongoing Belmont Forum has offered as its main challenge to deliver knowledge needed for action to avoid or adapt to environmental change in the Arctic. One of their major themes is related to the study of these changes in the Arctic. The development of capable e-infrastructure (technologies and groups supporting international collaborative environments networks and data centers) to allow access to large diverse data collections is key to meeting this challenge. There are some very interesting challenges that we have been confronted with and overcome over the past 20 years. These are focused in the areas of evolving metadata standards, international data access and exchange and the techniques that

facilitate reuse of data. The authors will provide several specific examples of successes and failures when trying to meet the needs of an international community of researchers specifically related to Belmont Forum Work Package Themes regarding standards of data sharing and open data. The authors will provide details on the handling of these specific issues and also consider some other more subtle situations that continue to require serious consideration and problem solving.

MARINE MIGRATIONS AND HABITAT USE OF COMMERCIALLY EXPLOITED ANADROMOUS ARCTIC CHAR IN THE CAMBRIDGE BAY REGION AND IMPLICATIONS FOR FISHERIES MANAGEMENT

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Commercial fishing for anadromous (searun) Arctic char is an important economic activity for the hamlet of Cambridge Bay, which derives benefits from the biggest commercial quotas for char in Nunavut. Effective management of the resource, however, remains challenging due to the paucity of data on abundance and basic char biology. One major knowledge gap regards the marine migrations of the species and the potential mixing of stocks at the fishing locations. In 2013 and 2014, the Ocean Tracking Network installed an acoustic array with 43 acoustic receivers deployed over >200 km of coastline in the Cambridge Bay region to track the marine migrations of 120 Arctic char equipped with surgically implanted acoustic tags (Vemco V16). The array provided information on the timing of migrations in and out of freshwater, as well as in and out of Wellington Bay (where most fishing is concentrated). The technology used also allowed us to determine the depth and temperature preferences of char, which are interpreted with the help of data collected from several CTD casts conducted in the region. Despite the generally accepted knowledge that Arctic char spend the entire summer in the ocean, we documented forays into freshwater throughout the summer. We also documented extensive stock mixing in the marine environment, suggesting that fish from different rivers/stock utilize the same feeding areas in the marine environment. Some feeding areas appear more important than others, and there is a clear temporal segregation of when different feeding areas are used. This suggests that the critical marine habitats of char are extensive. This mixing of stocks was also documented to occur at the time when the fishery operated, demonstrating that most fisheries do not target a single stock. This has some important implications for fisheries management, which currently assigns quotas on a river-by-river basis.

THE PERSPECTIVE OF THE PHYSICIAN

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In spite of massive sums of money injected in healthcare for northern and aboriginal populations, significant health disparities persist between Aboriginal and non Aboriginal children. Inequalities in the social determinants of health are usually cited as responsible for the barriers to access health care. In this presentation, we suggest that the cultural gap between care giver and patient could also play a significant role in the access of Aboriginal children to Western type health care. We endorse the concept that culture qualifies as a social determinant of health . Up until now and probably for some years to come, the Inuit have relied heavily on Southern workers to access Western health services. Even though these non Inuit workers, may hail from a variety of cultures they have two points in common: their Western medical/paramedical training whether it be in medicine, nursing, social work or other and their, at least initial, unfamiliarity with the Inuit language and culture and language. Healthcare workers are not anthropologists. They most often have received no specific training in transcultural care or in Inuit culture. The average length of stay of a southern healthcare worker in the north is short, often not more than a few years. And experience has taught us that simple ignorance of the existence of cultural difference can frequently interfere with the quality of the patient-worker relationship, a relationship that is often essential for a successful outcome. This plain ignorance can lead to misunderstanding and foster premature judgment with unfortunate consequences. Medical history is the fundamental tool of healthcare professionals. To obtain a valuable history, words need to be exchanged. From this starting point, the worker will proceed to a focused physical exam, plan a diagnostic work up and eventually propose a treatment. Should words not be interpreted by the receiver in the meaning initially meant by the speaker, the whole edifice may fail, with failure often leading to dissatisfaction if not resentment. Sensitization of new workers to the importance of cultural differences as well as introduction to the culture and language of the Inuit people may contribute to improve access to health care.

CONTROL OF SEASONAL ACTIVE LAYER DEVELOPMENT ON SUMMER RUNOFF QUANTITY AND QUALITY IN A SUBARCTIC PERMAFROST ENVIRONMENT

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In subarctic permafrost environments, ecological productivity is often nutrient-limited, both in terrestrial vegetation and aquatic systems. The subarctic is experiencing significant climatic change, including rapid warming and changing precipitation patterns, which may result in changes in nutrient dynamics within terrestrial and aquatic systems and transport between them. Interactions between hydrology and permafrost are major controls on the transport and storage of nutrients in the landscape. Changes in nutrient dynamics may result in changes to vegetation growth, pond ecology, and food web stability in northern ecosystems. Understanding the relationships between hydrology, warming and nutrient dynamics will assist scientists in predicting how northern ecosystems will respond to climate change. Groundwater hydrologic pathways evolve seasonally as the active layer develops. Local controls on ground heat flux, such as moisture conditions, vegetation, and peat physical properties, result in differential rates of active layer development across landscape units, which subsequently affects runoff pathways in the landscape and into ponds. The objective of this research is to characterize changes in runoff quantity and quality through different pathways between peatlands and ponds over the duration of the thaw season as the active layer developed. Twenty-two ponds and five piezometer transects were instrumented to measure changes in hydrologic storage and water quality over two snow-free seasons in Churchill, Manitoba, located in the northwestern reach of the Hudson Bay Lowlands, in a zone of discontinuous permafrost. Hydrologic and nutrient concentration data collected at the thawing front of the active layer across multiple landscape units are presented throughout a full open-water season to characterize the evolution of hydrobiogeochemical processes. Varying thaw rates across landscape units (dictated by moisture and vegetative conditions) resulted in changing groundwater pathways throughout the season, and, changing groundwater pathways combined with precipitation events throughout the season resulted in temporally variable nutrient concentrations in runoff and ponds. These patterns are explored and the mechanisms behind them are discussed.

CIRCULATION AND HEAT SOURCES FOR GLACIAL MELT IN A WEST GREENLAND FJORD

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Recent warming of Subpolar Mode Water off west Greenland has been suggested to accelerate the mass loss from tidal outlet glaciers of the Greenland Ice Sheet. We present a comprehensive analysis of water masses, dynamics, and interannual hydrographic variability in Godthåbsfjord, a sill fjord in contact with tidal outlet glaciers on the west coast of Greenland. Through seasonal observations we recognize an intermediate baroclinic circulation mode driven by tidal currents and an associated important local heat source for the fjord. Four distinct circulation modes are observed in the fjord of which all can contribute to glacial ice melt. Further, we present the first seasonal hydrographic observations from the inner part of Godthåbsfjord, relatively close to and within 4 to 50 km of a fast-flowing tidewater outlet glacier. This region is characterized by a dense glacial and sea ice cover. Freshwater from runoff, subglacial freshwater (SgFW) discharge, glacial and sea ice melt are observed above 50-90 m depth. During summer SgFW and subsurface glacial melt mixed with ambient water are observed as a layered structure in the temperature profiles below the low-saline summer surface layer (<7m). During winter the upper water column is characterized by step-wise halo- and thermoclines formed by mixing between deeper layers and the surface layer influenced by ice melt. The warm (T>1°C) intermediate water mass is a significant subsurface heat source for ice melt.

CARBON FLUX IN SEA ICE: IMPLEMENTATION OF SEA ICE ALGAE IN A 1D BIOGEOCHEMICAL ECOSYSTEM MODEL

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Air-sea gas exchange is an essential process in determining the amount of carbon in the atmosphere, and primary producers in the euphotic zone play an important role in the oceanic uptake of carbon. One area of particular interest is the Arctic ocean, where in addition to the pelagic ecosystem, first-year sea ice provides an environment for ice algae to contribute to this exchange. In the past it had been assumed that sea ice acts as a cap to air-sea gas exchange, but recent studies have shown that carbon in the ice is taken up or released into both the atmosphere and ocean through biogeochemical processes during ice formation and melt and during ice algal growth. These processes need to be included in a representative air-sea-ice model of carbon exchange in the Arctic. The purpose of this study is to incorporate sea ice algae into a working ecosystem model set to conditions in the Arctic. The 1D General Ocean Turbulence Model is used for physical forcing along with a sea ice component. The ecosystem module is comprised of two phytoplankton, zooplankton, and nutient (nitrate and ammonium) compartments and detritus (P2Z2N2D). In addition, cycling of inorganic carbon, silica, and DMS are included. Sea ice algae are limited by nutrients as well as light and ice melt rate. In the Arctic, ice algae blooms are typically observed in late spring or early summer, when nutrients have not yet been depleted in the lower ice layer, and snow and ice allow sufficient light transfer to the bottom of the ice. Sensitivity analyses will be presented in order to compare the timing and magnitude of the spring bloom for the simulated ice algae to those from observations at key sites in the Arctic marine environment, including Resolute Bay and the Beaufort Sea.

LAST RESULTS FROM THE NUNAVIK CHILD DEVELOPMENT STUDY: RELATION OF PRENATAL EXPOSURE TO METHYLMERCURY TO CHILDHOOD INTELLECTUAL FUNCTION.

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Background. Although prenatal methylmercury exposure has been linked to poorer intellectual function in several studies, data from two major prospective, longitudinal studies yielded contradictory results. Associations with cognitive deficits were reported in a Faroe Islands cohort, but few were found in a study in the Seychelles Islands. It has been suggested that co-exposure to another contaminant, polychlorinated biphenyls (PCBs), may be responsible for the positive findings in the former study and that co-exposure to nutrients in methylmercury-contaminated fish may have obscured and/or protected against adverse effects in the latter. Objectives. To determine the degree to which co-exposure to PCBs may account for the adverse effects of methylmercury and the degree to which co-exposure to docosahexaenoic acid (DHA) may obscure these effects in a sample of Inuit children in Arctic Québec. Methods. Intellectual function was estimated in 286 school-age children from Nunavik whom umbilical cord blood samples had been obtained and analyzed for mercury and other environmental exposures. Results. Prenatal mercury was related to poorer estimated intellectual function after adjustment for potential confounding variables. The entry of DHA into the model significantly strengthened the association with mercury, supporting the hypothesis that beneficial effects from DHA intake can obscure adverse effects of mercury exposure. Children with higher prenatal mercury exposure were four times more likely to score below the clinical cut-off for borderline intellectual disability. Co-exposure to PCBs did not alter the association of mercury with intellectual function. Conclusions. This is the first study to document an association of prenatal mercury exposure with poorer performance on a school-age assessment of intellectual function, a measure whose relevance for occupational success in adulthood is well established.

MEASUREMENTS OF VOLATILE ORGANIC COMPOUNDS (INCLUDING DIMETHYL SULFIDE), AEROSOL PARTICLES, AND CCN IN THE CANADIAN ARCTIC: PRELIMINARY RESULTS FROM THE SUMMER 2014 NETCARE EXPEDITION ABOARD THE CCGS AMUNDSEN

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The Arctic in summer is a cloud condensation nucleus (CCN) limited environment, and the controls on aerosol number and composition, and thus cloud formation, are poorly understood. A potentially important player is dimethyl sulfide (DMS), a gas that through oxidation and condensation may be a large contributor to particle loadings in the Arctic. A better understanding of this and related processes is required in order to understand the region's changing climate. In order to advance that understanding, during Summer 2014 we deployed

instrumentation aboard the CCGS Amundsen, the Canadian research icebreaker. We participated in Legs 1a and 1b of the cruise, affording us observations in Baffin Bay, Lancaster Sound, and the Nares Strait. We collected on-line measurements with high time resolution of particle number, size and CCN activity as well as mixing ratios of volatile organic compounds (VOCs) including DMS. Here, we report preliminary results from this dataset, including very high mixing ratios of DMS at the mouth of Lancaster Sound.

ARCTICCONNECT: CONNECT THE NORTH

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ArcticConnect is a network-enabled platform for realizing geospatial referencing of information about the Arctic system derived from research, education, and private sector activities in the Arctic and Subarctic. ArcticConnect, housed at the Arctic Institute of North America (AINA), at the University of Calgary, will be an innovative network enabled platform (NEP) for arctic research and information sharing. ArcticConnect components build on and significantly enhance the value of the research holdings and infrastructure of the AINA and incorporate data and information from around the pan-Arctic. The ArcticConnect NEP will allow uptake of, access to, and sharing and collaborative analysis of data at multiple scales with CANARIE research network and cloud services. This data is derived from diverse sources ranging from sensors, both human and other, to publications, grey literature, and historic archives. It places heterogeneous data and information within a coherent geospatial platform consisting of four major components: Arctic Web Map (AWM) will provide an Arctic-specific web mapping tool allowing researchers to customize map projections for scientifically accurate visualization and analysis, a function that is critical for arctic system research but missing in existing web mapping platforms; it will also provide a visually appealing tool for education and outreach to a wider audience; Arctic Scholar (AS) will enable researchers, educators, interested private sector entities, government agencies, and the general public to access and share arctic data and information contained in assorted formats including publications, grey literature, research licenses, photo archives, field notes, and project metadata from arctic field stations; Arctic Sensor Web (ASW) will enable research stations around the pan-Arctic to connect their sensors, including those that provide near-real time data, to a cloud service for visualization, information sharing, and collaborative analysis; Arctic BioMap (ABM) will enable members of the scientific community and northern residents to contribute observations on arctic animal species for the purpose of biodiversity monitoring, assessment, research, management and education. ArcticConnect is unique because it captures data at multiple scales generated from a host of sensors, from human observers, from field experiments and research stations, from satellites and from publications, reports, photographs and even artwork. It will enable networking and interoperability of disparate datasets, and make information available across multiple applications and devices. This innovative approach to data management and accessibility will advance the science and education that is needed for decision making in a rapidly changing Arctic. Within Canada, ArcticConnect will link efforts among indigenous people, the research community, the private sector and government agencies engaged in the collection and use of northern environmental data, to improve management of and adaptation to a changing Arctic.

SEA ICE PRESSURE EVENTS IN THE HUDSON STRAIT FROM RADARSAT: IMPLICATIONS FOR WINTER SHIPPING IN THE EASTERN CANADIAN ARCTIC

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Resource extraction opportunities in the Canadian Arctic combined with improved navigation related to changes in sea ice has increased interest in winter shipping activities. One such region of winter shipping activity in the Canadian Arctic is Deception Bay, Quebec. The main shipping corridor is through Hudson Strait, a region where ice concentrations are typically between 9 and 10 tenths during winter months and where pressured ice is common and unpredictable. Pressured ice can hinder the progress or beset even ice-strengthened vessels, costing operators up to $60,000 a day in fuel and other expenses. Beset vessels can also cause environmental concerns related to unnecessary emissions and potential fuel spills. This situation also presents potential hazards to crews, and risks valuable cargo should the beset vessel be swept towards the coast or areas of shallow bathymetry. This study investigated pressured ice events in the Hudson Strait using RADARSAT-1 and -2 imagery for the winter shipping season from 1997 to 2012. Features hazardous to ships (i.e. leads, ridges, shear

zones and areas of land-fast ice) were identified on the imagery within the Hudson Strait shipping corridor and a 16-year time series analysis of these deformation events was constructed. Preliminary results indicate identifiable temporal and spatial patterns in ridging. Additionally, the frequency of ridging appears to be declining throughout the study period. The connection between besetting events and deformation features over the past 16-years were also explored. The outcomes of this work will aide in route selection and navigational decision-making and will help to better understand the influence of pressured ice on ship besetting events.

COMMUNITY-BASED PLANNING - AN INDIGENOUS APPROACH TO CLIMATE CHANGE, ADAPTATION, AND WATER GOVERNANCE IN THE YUKON RIVER WATERSHED

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Abstract: The Yukon River Inter-Tribal Watershed Council is an Indigenous grassroots organization, consisting of 70 First Nations and Tribes, dedicated to the protection and preservation of the Yukon River Watershed. Over 14 years, the Yukon River Inter-Tribal Watershed Council is providing Yukon First Nations and Alaska Tribes in the Yukon watershed with technical assistance, such as facilitating the development and exchange of information, conducting training, education and awareness programs to promote human and ecosystem health, along with developing research projects using an Indigenous Research Paradigm, social and physical science. As the result of these efforts, the Yukon River Inter-Tribal Watershed Council now maintains a database that includes over 14 years of water quality data at 49 sampling sites and 20 permafrost monitoring sites from Atlin, British Columbia to Kotlik, Alaska. Through these collaborations, signatory First Nations and Tribes created the Indigenous Observation Network (ION), the largest Aboriginal trans-boundary science and Traditional Knowledge network in the world, describing the past and current observed changes to landscape, subsistence activities, and water quality. Our interest is to build the capacity of First Nations and Tribes in the watershed to assess climate impacts on water systems and to incorporate traditional knowledge into water management decisions. In this presentation, we discuss the scientific data that has been collected through this network and will share insights about the overall health of the watershed. In addition, we provide valuable lessons learned developing Indigenous science research that addresses Traditional Knowledge, climate change adaptation, health and water governance. Resume: Edda A. Mutter 725 Christensen Suite 3 (907) 351-6265 Yukon River Inter-Tribal Watershed Council emutter@yritwc.org Anchorage, AK 99501 Professional Preparation U. of Alaska Fairbanks Arctic Env. Science Ph.D (2014) U. of Alaska Anchorage Env. Quality Science M.S. (2004) U. of Alaska Anchorage Biological Science B.S. (2002) Appointments Yukon River Inter-Tribal Watershed Council (YRITWC), Science Director (2014-pres) YRITWC, Brownfields Program Manager (2013) U. of Alaska Fairbanks, Research Assistant (2008-2013) U. of Alaska Anchorage, Term Instructor & Laboratory Coordinator, (2004-2008) U. of Alaska Anchorage, Research Assistant, (2002-2004) Federal Armed Forces, Bischofswiesen, Germany Paramedic Sergeant, (1992-1997) Research My research focuses on the fate and transport of chemical and microbial constitutes in the aquatic environment. My research determines the prevalence and diversity of pollutants in the Yukon River. I use Traditional Knowledge to describe changes to landscape, subsistence activities,and water quality. I want to increase First Nation and Tribal community-based water quality monitoring to measure contaminant concentrations in soil and water; to evaluate chemical transport via hydrological pathways, seasonal changes and Arctic and sub-Arctic environmental settings. Determining anthropogenic and natural pollutants in the Yukon River helps how to develop effective policy by understanding how human and environmental impacts affect water quality.

FRESHWATER PATHWAYS FROM THE CANADIAN ARCTIC ARCHIPELAGO TO THE SUB-POLAR NORTH ATLANTIC

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The Labrador Current carries freshwater from the Arctic, Greenland and Canadian north south along the western margin of the sub-polar gyre. Given the proximity of the region of deep water formation in the Labrador Sea to this fresh boundary current, many have speculated on the role high-latitude freshwater may have on the formation of Labrador Sea Water and the meridional overturning circulation. However, other studies have suggested that there is little offshore exchange along the Labrador margin, with most freshwater being mixed offshore in the region of Flemish Cap and the Grand Banks. Therefore we here focus on the question of how does this freshwater leave the boundary current system and where is it taken up into the Atlantic Ocean. We examine these questions using several eddy-permitting regional configurations of the NEMO coupled ocean/sea-ice numerical model ranging from 1/4 to 1/12 degree. As well as examining hydrographic properties and fluxes, we use the lagrangian float tool Ariane to examine the freshwater pathways and their variability. We find little offshore exchange

from the Labrador Current north of the Grand Banks and most of the freshwater exchanged offshore only enters the interior of the Labrador Sea after circulating around the sub-polar gyre via the North Atlantic Current and the West Greenland Current.

DEVELOPMENTAL TOXICITY OF LOW LEVELS OF CRUDE OIL WATER-SOLUBLE FRACTION ON POLAR COD (BOREOGADUS SAIDA) EMBRYOS

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With increasing anthropogenic activities in the Arctic and the risk of accidental oil discharges in ice covered waters, there is a need to investigate the effects of the water-soluble fraction (WSF) of crude oil on key ecological species such as the polar cod (Boreogadus saida). Indeed, this high Arctic fish species is known for having positively buoyant eggs, accumulating under the ice where spilled oil also is likely to accumulate. The objectives of the present study were thus to investigate the potential effects of sub-lethal levels of crude oil WSF on the embryonic development of polar cod. Upon collection of ripe adult polar cod in fjords around Svalbard, fish were stripped of eggs and sperm. Egg batches (n=5) from one or two females each were fertilised in vitro using one composite of sperm from 8 males and distributed to one of five incubators per treatment (control, low, medium, and high concentrations of WSF). The exposure set-up consisted of a flow through system connected to four oiled-rock columns. The starting water concentration of polycyclic aromatic hydrocarbons (PAHs, sum of 26 congeners) in the high treatment was 2.5 ug/L and had decreased below limits of detections after 1 week. Embryo development was followed for 38 days including daily mortality counts, pictures of control eggs, and weekly sampling for malformation and morphometric measurements (length and weight). There was a significant difference in egg batch quality with high mortality (up to 70%) and low hatching success (down to 10%) in 2 out of 5 batches. Mortality peaked during gastrulation starting at 7 days post fertilisation (dpf), independent of the treatment. Hatching occurred between 27 and 33 dpf. Hatched larvae showed significant increases in the occurrence and severity of yolk sac edemas and spine malformations, in addition to reduced cardiac activity with treatment. These effects were corroborated by a significant dose-dependent increase in the proportion of larvae that had sank to the bottom of the incubators compared to free swimming larvae at the end of the experiment. These data show significant sub-lethal effects on embryonic development of polar cod exposed to very low concentrations of PAHs from the WSF of crude oil (ng/L range). Additional analyses will include CYP1A immunochemistry and histological analyses. This is the first study investigating the sensitivity of early life stages of a key Arctic fish species to potential oil spills in ice covered regions. Toxicity data on early life stages are highly needed for risk assessment analysis to model population effects.

GENDER SPECIFIC REPRODUCTIVE STRATEGIES OF AN ARCTIC KEY SPECIES (BOREOGADUS SAIDA) AND IMPLICATIONS OF CLIMATE CHANGE

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The Arctic climate is changing at a unprecedented rate. What consequences this may have on the Arctic marine ecosystem depends to a large degree on how its species will respond both directly to elevated temperatures and more indirectly through ecological cascading effects. But despite an alarming recent warming of the Arctic with accompanying sea ice loss, reports evaluating ecological impacts of climate change in the Arctic remain sparse. Here, based upon a large-scale field study we first of all present basic new knowledge regarding the life history traits for one the most important species in the entire Arctic, the polar cod (Boreogadus saida). Furthermore, by utilizing regions of contrasting climatic influence (domains), we present evidence as to how its breeding stock and reproductive success is impaired in regions of strong warming. As the future Arctic is predicted to resemble today's Atlantic domains, we forecast changes in growth and life history characteristics of polar cod that will lead to alteration of its role as an Arctic keystone species. This will in turn affect community dynamics and energy transfer in the entire Arctic food chain.

NUNAVUT TUNNGAVIK INCORPORATED'S PARTICIPATION IN RESEARCH

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Nunavut Tunngavik Incorporated (NTI) has a keen interest in research that promotes collaboration and meaningful Inuit involvement, particularly research that addresses the priorities and needs of Inuit in Nunavut. NTI's involvement in research can range from direct participation with the planning and implementation of research, to the dissemination of research results and advising researchers on promising practices as it relates to public outreach. At the same time, NTI continues to work towards building sustainable research relationships with researchers, while also working to foster relationships with emerging researchers. NTI will provide an overview of research it's been involved in – exploring the forms of involvement, describing how research has contributed to better knowledge that informs policy development as well as lessons learned from a participatory research perspective. NTI will further describe its active role in the management of several research funding bodies such as ArcticNet, the Northern Contaminants Program (NCP), and Nasivvik.

KALAALIMERNIT: GREENLANDIC FOODS, CULTURAL IDENTITY AND CHANGES

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Rapid Arctic Transitions related to Infrastructure and Climate Change (RATIC) Workshop and Session at Arctic Change 2014, Ottawa, Canada, 8 - 12 December 2014 PhD project's working title: Kalaalimernit: Greenlandic foods, cultural identity and climate change. Objectives A Greenlander who has not eaten traditional Greenlandic food for a while experiences "a kind of insatiable hunger for just this taste," which conveys a deeper significance about the meaning of food. I propose to carry out research on the importance of Greenlandic food- kalaalimernit- for daily life and for Greenlandic society within a context of climate change and other contemporary changes, and I employ as a starting pointing the theoretical idea that "food is both nutrition and a mode of thought". My goal is to look at Greenlandic foods where the social, cultural and political identity as embedded parts. Food is not just about eating and nourishment, it is also about education, norms, custom and about identity and the very nature of being human. It is with food manners that a human first becomes exposed to complex forms of cultural socialization. Consumption of food and drink, are while being supply of energy for our bodies also a symbol, which tells us, for ourselves and for others who we are and where we are from. Food is in addition to being physically and symbolically nutrition, also an identity factor where we use food to link identity and memory together both in terms of our own life story and to bring together our life history and the social history. The inextricable link between food, personality and identity is evident in the literal meaning of kalaalimernit "a piece Greenlander" But what happens when this link is challenged and threatened? In this study, I am being concerned in particular with how and to what extent climate change affects kalaalimernit in modern Greenlandic society, both in terms of the production (i.e. hunting, fishing, and preparing) and consumption of kalaalimernit. But I am also placing this in a historical context in order to add depth to the contemporary understanding of hunting and fishing and the consumption of Greenlandic foods. Furthermore, I am examining kalaalimernit as fundament to sustainability of Greenlandic food production within conditions of greater self-government and economic independence. Two of my questions are: How will climate change and industrial projects affect Greenland´s aspiration to produce its own food in the future? And within a context of climate changes and large scale industrial projects, how are and can this contexts affect the use of kalaalimernit? Theoretical Framework and Methodology Based on where kalaalimernit is most significant and apparently challenged by climate change, I carry out empirically-based research about how kalaalimernit has been used and thought in the past, and how it is used and thought about today. In my fieldwork I use an ethnographic-inspired methodology that will combine participant observation and qualitative interviews with local people, various professionals concerned kalaalimernit, as well as participation in daily life, and the analysis of texts concerning legislation and other policy documents as well as archival research.

HIGHER HAIR CORTISOL LEVEL IN DECLINING AND DISEASED MUSKOX (OVIBOS MOSCHATUS) POPULATIONS IN THE CANADIAN ARCTIC: A FIRST STEP TOWARDS AN INTEGRATIVE INDICATOR OF HEALTH IN WILDLIFE

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Monitoring the health status and vulnerability of wildlife populations is important for maintaining biodiversity and ecosystem integrity. Current monitoring strategies often focus on individual parameters and work in isolation therefore do not evaluate cumulative effects, and may lack predictive ability. Changing conditions in the Arctic, emergence of new disease syndromes and recent muskox population declines, all highlight the need for improved health monitoring. In particular, integrative health indicators that can be included in community-based monitoring, with samples collected by the layperson, and easily stored and shipped, are desired. Glucocorticoids (the main hormones involved in the stress response) incorporated from serum into hair or feathers during growth serve as integrated, retrospective, biomarkers of medium to long term stress and prospective markers of survival in a variety of species. Our objective was to determine whether muskox qiviut (undercoat) cortisol levels were higher in muskox populations experiencing widespread die-offs associated with the emergent pathogen Erysipelothrix rhusiopathiae. We analyzed cortisol in qiviut from 49 muskoxen from affected populations (Banks Island and Victoria Island), and apparently unaffected populations (Paulatuk, Kugluktuk). Qiviut was collected from the rump of the animals in sport and community hunts during 2013-2014, and sex and age class (yearling or adult) were recorded. Cortisol was determined by liquid chromatography-tandem spectrometry. By means of a regression tree, we assessed whether the sex, age and population were related to the cortisol level in qiviut. The variables population and sex were retained in the regression tree. The model, with four terminal nodes, explained 25% of the total deviance. Animals from 'die-off' populations (Victoria (n=5) and Banks Island (n=15)) were classified in a single node with a higher mean level of cortisol (7.56 pg/mg) than animals from non die-off populations (Paulatuk (n = 14, mean= 4.67 pg/mg) and Kugluktuk (n= 14)). In the latter, the mean cortisol level was 5.18 pg/mg in females and 6.55pg/mg in males. This exploratory analysis shows that cortisol levels (stress) are higher in declining populations that experienced die-offs associated with Erysipelothrix rhusiopathiae. This bacterium is typically associated with stressful conditions and subsequent immunosuppression, thus its emergence suggests chronic stress in muskoxen, consistent with our qiviut corticosteroid findings. Cortisol levels do not seem to be dependent on the age class and the sex difference found in Kugluktuk may be due to a more balanced sex ratio in the animals sampled in this location. Future sampling should target a balance of both sexes and age classes in all locations to evaluate sex- and age-related differences. In light of these results, hair cortisol appears to be a promising indicator of health and environmental stress and its inclusion in community-based monitoring programs is important.

EXPLAINING VARIATION IN LIFE HISTORY TIMING ACROSS A SPECIES' RANGE: EFFECTS OF CLIMATE ON SPAWNING TIME IN ATLANTIC COD (GADUS MORHUA)

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The capacity of a species to tolerate and/or adapt to environmental conditions will shape its response to future climate change, including distribution and production changes at the northern limits of the species' range. Of the many life-history processes affected by climate change, timing of reproduction greatly influences offspring success and resulting population production. Here we explore temporal and spatial changes in spawning time for Atlantic cod (Gadus morhua) across the species' range (40 to 80°N). We estimate spawning time using a physiologically relevant metric that includes information on fish thermal history (degree days, DD). We employ spawning DD to identify temperature-independent trends in spawning time among populations that are consistent with the evolutionary history of the species (Neuheimer & MacKenzie, in press, Ecology) and adaptation to local growing season timing. We use our results to estimate expected spawning time under future climate regimes, and discuss the implications for cod ecology and management across the species' range, and in the greater ecosystem.

HORSE-BREEDERS IN THE ARCTIC

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Romanova Ekaterina, Nikiforova Vera. Horse-breeders in the Arctic. The report is devoted to the preservation and development of traditional forms of existence, adaptation mechanisms of horse-breeding culture in the extreme conditions of the natural environment of the North and its transformation in the modernization of the social and economic structure of society. At the present, report analyzes a unique phenomenon of the Arctic horse breeding people of Sakha (Yakutia), with its rich heritage and association with the early culture of the nomads of Central Asia. Field studies were conducted in the Arctic zone of Russia (Republic of Sakha (Yakutia). The main object of the study were private horse breeding farms involved in tabun breeding of Yakut horse. The study of the everyday life of herdsmen-breeders at the level of landscape researches, the traditional economy and mental characteristics showed that the organizing core of the whole culture of life-support systems of the northern Turks Sakha is horse breeding as a structure element of ethnic identity of the Yakuts. Studies have shown high degree of conservation of traditional beliefs and practices of the South as part of their everyday behavior. Field description of the life of breeders enables us to define them as custodians of the traditions and as translators of "collective memory" (This report was written by a grant of Russian Scientific Fund (project N 14-38-00031)

POLAR NIGHT FEAST: SEASONAL CHANGES IN BENTHIC COMMUNITY

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Marine benthic communities in shallow subtidal are often shaped by foundation species, and kelp forests are most common of them. At high latitudes, level of solar illumination is one of the most important factors affecting macroalgae assemblages. We aimed to trace seasonal changes in macrobenthic community associated with Saccharina latissima in high Arctic fjord. The material was collected in Kongsfjorden (78 56'N 11 56'E, west coast of Svalbard) in early October 2013; January and May 2014. We found that both species composition and abundance indices varied significantly between seasons (Jaccard index: Oct/Jan=0.5, Jan/May=0.25, May/Oct=0.45; total species number – 259). Astonishing but in January total density of benthic organisms was 10 times more than in October or May and total biomass was twice higher although these values were due to a few species (Shannon index: October=2.7, January=1.3, May=2.2). At each trophic level we found significant seasonal fluctuations. In January motile epifauna on S.latissima was dominated by grazer Margarites helicinus (47140±8800 ind.*m-2, 1194±288 g*m-2) found mostly at the distal part of the blade, and Caprella septentrionalis (1645±338 ind.*m-2, 238±26 g*m-2; for this species filter-feeding, scraping and predation were reported). Surrounding sediments were dominated by deposit-feeders Capitella capitata (27680±7540.6 ind.*m-2, 94±24.9 g*m-2) and Marenzelleria wireni (19493±5560.6 ind.*m-2, 27±8.5 g*m-2), and predator Harmathoe imbricata (160±130.6 ind.*m-2, 2.8±2.60 g*m-2). Suddenly in May abundance of M.helicinus declined 15 times and furthermore only one individual of C.septentrionalis was found. Abundance of C.capitata and M.wireni decreased more then 10 times while that of H.imbricata doubled – this could be explained by predator-prey interactions. In October abundance of common species corresponded to that in May except C.septentrionalis (1186±710.1 ind.*m-2, 26±14.6 g*m-2). Benthic community dynamic is influenced by shifts in abiotic factors, among which increasing of freshwater runoff and sedimentation are the most important in glacial fjords. However, both processes were reported to be typical for the Svalbard fjords only during summer. Among biotic interaction seasonal dynamics of foundation species is the crucial factor. During polar night at high latitudes primary production declines to zero level and growth zone of S.latissima is supplied by nutrients obtained due to autolysis of the distal part of blade (Dunton, Schell, 1986; Makarov et al., 1999). Thus decaying kelp tissue might attract grazers (probably due to stiffness reduction, or changes in exometabolite composition, or shifts in bacterial community) and also is a main source for detritus. In spring and summer high photosynthetic activity of kelp lessens detritus influx and hence influences the abundance of suspension- and deposit-feeders. Since secondary metabolites in macroalgae are often concentrated in actively growing region (Hay, 1996; Poore, 1994), one could suggest that grazers avoid this part of kelp thallus. Thus according to seasonal changes in biology, S.latissima seems to be a kind of battery of organic matter accumulated during light period of the year and given out during polar night that makes a feast for benthic fauna. This is a contribution towards the Marine Night project funded by the Norwegian Research Council (project number 226417).

REVISING OF TEMPERATURE HISTORY FROM GREENLAND ICE CORES: USING MODERN MEASUREMENTS TO UNDERSTAND PROCESSES CONTROLLING PROXIES.

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It is well known that the climate history of many millennia is recorded by the stable isotope ratios of ice from polar ice sheets. Indeed the use of stable isotope ratios of ice cores as a proxy for past temperature has been considered a gold standard in establishing regional climate change near proxy locations. It is also known that environmental factors other than temperature can significantly influence the isotopic ratios of ice. The advance of modern measurement technology now allows direct observation of the processes which set the isotopic composition of firn. At each step of the path, the isotopic composition can now be tracked: from ocean evaporation, atmospheric transport, microphysical exchanges in clouds, surface processes including wind transport of snow, diffusive exchanges within the snow pack and finally accumulation into firn. We present results from a three year field study at Summit camp which reveals that the previous interpretations of Greenland isotopic records as simply temperature fall short of their goal. Instead we show measurements which suggest the surface processes including snow metamorphism and interactions between at the atmospheric boundary layer and synoptic scale snow play a surprising large role in setting the isotopic ratio of the core. Recent modeling work highlights some previous ambiguities in the temperature history inferred from ice cores in relation to greenhouse gas concentrations. Our results suggest a mechanism by which the ambiguities can be resolved though better accounting for processes previously neglected.

HOLOCENE MASS MOVEMENTS IN AN ARCTIC LAKE: CAPE BOUNTY'S EAST LAKE (MELVILLE ISLAND, CANADIAN HIGH ARCTIC)

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High resolution hydro-acoustic surveys were undertaken in 2013 from a portable inflated boat to map the lakebed of East Lake (Cape Bounty, Melville Island, Canadian High Arctic) in order to reconstruct the history and sedimentation processes in the lake basin through the Holocene. High resolution swath bathymetry data reveal the presence of numerous mass movement deposits, mainly along the northern and western slopes of the lake, but are not present on the delta located along its eastern slope. Seismic stratigraphy, using a 12 kHz CHIRP sub-bottom profiler, allowed the identification of 4 acoustic units: 1) Unit 1 consists of the acoustic basement, interpreted as till; 2) Unit 2 consists of a transparent acoustic facies, interpreted as glacio-marine sediments; 3) Unit 3 consists of high-amplitude reflections and is related to varves identified previously using sediment cores; and 4) Unit 4 consists of chaotic to transparent reflections with a wedge shaped geometry and represents mass movement deposits. Mass movements deposits cover ~55% of the surveyed area of the lake (50% of the lake due to the presence of ice during the surveys at the beginning of August 2013). Previous studies in East Lake interpreted turbidites and mass movement deposits in sediment cores to be related to the delta discharging on the eastern slope. However, our data reveal that mass movements were mostly located on the western slopes, thus precluding high sedimentation rates from the delta as triggers. Earthquakes are a plausible trigger for the mass movements within Unit 2, although the nearest active seismic zone is located more than 150 km to the northeast. Other environmental factors, such as permafrost degradation, ice loading from seasonal lake ice and gas escape could also be triggers for these mass movements and cannot be ruled out.

CLIMATE CHANGE ADAPTATION IN THE INUVIALUIT SETTLEMENT REGION

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This presentation will give an introduction to Shannon O'Hara and her role as an IRA at the Inuvialuit Regional Corporation (IRC) in Inuvik, NT and explain the work that she has been involved with and aware of in her region in regards to ArcticNet and other scientific programs whose focus is on climate change, adaptation actions and strategies. The presenter will cover three types of climate change adaptation strategies currently being conducted in the ISR. These include 1) community based adaptation, where community members are adapting to climate change related problems through ad hoc or post change reactive actions, 2) projects that stem from researcher and community partnerships, which are most commonly academically led initiatives, and 3) community based research and monitoring programs, which are exclusively led by community members who are employed by local or regional organizations. Now, with each of these three methods outlined,

the IRA will delve into each method, and explain why each works and what types of challenges Inuvialuit have had with each. To conclude the presentation, the IRA will then introduce up to three examples of each type of adaption measure to illustrate to the audience the types of actions that have occurred in the ISR and whether they have been successful or whether they did not meet the needs to the community and/or region.

"I'D LIKE TO BE ABLE TO PASS THAT ON": THE CULTURAL AND ECOLOGICAL IMPORTANCE OF PLANT MANAGEMENT SYSTEMS IN MAKKOVIK, NUNATSIAVUT

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Indigenous systems of plant management are not often associated with northern areas. Most familiar examples of plant management by Indigenous peoples come from more southerly regions, and include extensive systems for the tending of wild and domesticated plants for foods, materials, and preferred habitats. Although comparatively more limited in scope and scale in the north, northern examples of plant management systems are being detailed by plant experts in the Inuit Community of Makkovik (Nunatsiavut, Labrador) as part of a larger research project that focuses on relationships between people and plants in Makkovik. This project began with preliminary research in 2012/3 to understand community priorities on the topic of people-plant relationships, and to identify useful research products and outcomes. Directed by this preliminary work, we are focusing on two interrelated research priorities from cultural and ecological viewpoints: documenting Makkovimiut plant knowledge and plant practices; and understanding the plant communities of cultural places. We began working with plant experts in July 2013, and the cultural knowledge that emerged during a year of discussions and apprenticeship formed the foundation for ecological fieldwork in summer 2014. For this presentation we focus on the topic of plant management. Examples of plant management practices in Makkovik include weeding and thinning feral rhubarbs, transplanting berry patches, and applying kelp as fertilizer to tended home-gardens. If we moreover consider "management" to be intentional planning towards achieving specific ends, then the plant management systems with the broadest impact in Makkovik are not those that promote growth or abundance of individual target plants or plant communities. They are instead the management systems that by design accomplish multiple ends by managing for broad ecological and social goals. Plant management systems in Makkovik are the largely implicit cultural norms and conventions that help direct active relationships with plants in Makkovik, and they reflect the cultural values that promote important community outcomes. Harvesting conventions are strongly directed by the needs of Elders, by respect for family places and community places, and also by views on overharvesting, wastefulness and sharing. Through managing plants, Makkovimiut cultivate the values that maintain an interconnected and supportive community. Culturally-important plants in Makkovik are typically accessible and abundant, which makes plant harvesting a generally non-contentious practice. Formalised management guidelines for plants may therefore be viewed as less important than for wildlife and fish. However, as roads and buildings continue to enlarge Makkovik's footprint, access to plants is changing. Plant communities are changing, too, with disturbance and new invasive species being noted in town. Elders describe their concerns that longstanding but unspoken management conventions are not intuitive to youth, and that many cultural norms around plants are also changing. In order to continue the successful management of plants and nurture the cultural values that are learned and expressed through relationships with plants, it is important that existing plant management systems underlie more formal institutional support for plant harvesting in Makkovik.

ENHANCING COMMUNITY-BASED MONITORING OF ECOSYSTEM CHANGES THROUGH THE INCLUSION OF LOCAL AND TRADITIONAL ECOLOGICAL KNOWLEDGE IN THE INUVIALUIT SETTLEMENT REGION, NT, CANADA

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Beluga whales (Delphinapterus leucas) from the eastern Beaufort Sea (EBS) stock travel through the coastal areas of the Inuvialuit Settlement Region (ISR) in the summer and early fall. Inuvialuit have harvested beluga from this stock for centuries and have contributed to community-based beluga monitoring

and research programs. The long-term monitoring of the EBS beluga stock has built a strong scientific understanding, including contaminant levels and trends, habitat use and diet. Recognizing the depth of knowledge about beluga whales held by the local and scientific communities, this study aims to build bridges between knowledge-holders to identify intersections where enhanced information could be obtained through the use of local ecological indicators. The key objectives of this study were to identify, evaluate and select local observation indicators that could be included in beluga monitoring programs to better understand beluga health and habitat use. In efforts to obtain direction on bridging knowledge and identifying appropriate indicators, the project engaged community members to share and record their perspectives and observations of beluga whales. We held focus groups and community meetings in the summer and fall (pre and post beluga arrival) in 2013 and 2014. In June 2013, focus groups were held in Paulatuk (n = 28), Tuktoyaktuk (n = 43) and Inuvik (n = 12), to identify observations made by Inuvialuit regarding beluga health and habitat use. Specifically, questions were asked about the observations made during harvesting, butchering and preparing beluga, which could be included in beluga harvest monitoring. Additional questions about observed habitat use were asked for the shore-based and boat-based beluga surveys. The outcomes from the initial meetings were used to develop semi-structured questionnaires for beluga harvesters and community members. Observations about harvested and migrating beluga whales were recorded in the ISR by community members at harvest camps. A series of synthesis workshops were held to review and interpret the recorded observations, fill in knowledge gaps, and select ecological indicators from a community perspective. Local ecological indicators could add valuable information to the interpretation of key biological and ecological aspects of belugas, including diseases, predation, diet and habitat use. Future steps include the evaluation of these observations for their potential to add knowledge about samples collected, which can assist in the interpretation or analysis of results. Bridging local and traditional ecological knowledge with traditional scientific knowledge for the co-production of knowledge about beluga whales may provide greater insight into how environmental change could impact the EBS beluga.

REMOTE OBSERVATIONS OF ENVIRONMENTAL CHANGE AT PROPOSED CACCON COMMUNITIES

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Some climate system components are changing at pan-arctic scales, as indicated, for example, by increasing air temperatures, shrinking September arctic sea ice extent or warming permafrost. At smaller regional to local scales, such changes may differ from global scale trends or have unexpected consequences due to local factors. These changes in the physical environment can have a strong impact on coastal subsistence communities that are heavily dependent on the land and sea for their livelihoods. When combined with existing stressors associated with demographic, cultural and infrastructure changes, the capacity for these historically very resilient communities can be stretched to the limit. The Circumpolar Arctic Coastal Community Observatory Network (CACCON) is a proposed network of community-based observatories sponsored by the International Arctic Science Committee (IASC) that seeks to cultivate a sustainable network of community-based knowledge hubs within which indicators of physical, ecological and social change are created, evaluated and exchanged. Most of the coastal communities identified for inclusion in the network are sites of previous and/or ongoing work being undertaken by CACCON investigators. Communities are drawn from across the Arctic and include representation from eastern and western Russia, western Alaska, eastern and western Canada, Finnmark, and Greenland. In this presentation we examine and compare existing records of physical change centered on each of the CACCON network sites. Specific physical parameters that will be presented include time series of air temperature and wind events, based on nearby station data (where available) and reanalysis data, and the duration of open-water, based on Special Sensor Microwave Imager (SSM/I) data distributed by Ifremer/CERSAT (2000). The timeframe of analysis will be 1992-2012, as determined by the availability of the SSM/I data. Together with comparisons of qualitative descriptions of the geomorphology, ground temperature regime and coastal dynamics for each site, our results will demonstrate the importance of regional geography and local geomorphologic setting in determining the consequences of observed changes at the local level. This work will also be able to link physical driver to response at the local scale. This will improve estimates of trajectories of change, which will furnish planners with more information to aid in adaptation planning.

PHENOLOGY MONITORING OF ARCTIC PLANTS IN THE CANADIAN ARCTIC ARCHIPELAGO

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Phenology is the timing of nature's seasonal events including the timing of flowering and fruiting. Plasticity enables plants to respond to climate change through phenological changes. Phenology-climate change research has focused on temperate regions and indicates plants are flowering earlier due, in part, to rising temperatures. Temperate region temperatures are rising predominantly in the spring, however Arctic regions are seeing unprecedented climate change with temperatures rising predominantly at the end of the growing season. To understand how Arctic plants are responding to climate change we must first understand their phenology. We monitored the phenological progression of Arctic plants through photography and field notes on a twice per week basis. In 2013, we recorded the start, peak, finish and duration of flowering, fruit set and seed dispersal of 53 plant species near Iqaluit, Baffin Island and 42 species near Lake Hazen, Quttinirpaaq National Park, Ellesemere Island with 27 species common to both sites. In 2014, we counted the number of flowers and dispersing fruit on 30 plants of each species near Iqaluit and Lake Hazen to obtain start, peak and finish of flowering and fruiting. Our analyses indicates species at Iqaluit start flowering earlier and finish flowering later but are in peak flower at the same time as at Lake Hazen. We also see a good correlation of the order of species' flowering times between Iqaluit and Lake Hazen. Our results will be used as a baseline for an Arctic plant phenology-climate change study using herbarium specimens collected in the Canadian Arctic Archipelago. Herbarium specimens record the timing of flowering and fruiting of plants species in the past and will allow us to investigate how the timing has changed over time and with temperature changes.

ARCTIC BIOMAP: DESIGNING AND BUILDING COMMUNITY-BASED SURVEILLANCE AND MONITORING SYSTEMS FOR THE ARCTIC

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The Arctic is undergoing unprecedented and accelerating system-wide environmental change much of which is still poorly understood. The analysis of observational data is key to explaining the interactions and feedbacks among the different components of the arctic system (physical, biological, and human) as well as to respond to arctic changes. It also requires wide stakeholder engagement in knowledge generation and knowledge transfer processes. An innovative approach to accessibility and data management is needed to advance the science and to improve management of and adaptation to a changing Arctic. Arctic BioMap is a data platform for citizen science/community-based Arctic change surveillance and monitoring program for assessment, research, management, and education. It will monitor (1) wildlife biodiversity and disease surveillance, (2) human health infectious disease and chronic disease surveillance, (3) environmental and health monitoring program for contaminants, and (4) map high risk areas. Monitoring the environment and the human and wildlife health is important for understanding the risks and benefits and for adaptation. Arctic BioMap will facilitate a forum for continuous exchange and communication among community members, scientists, resources managers, and other stakeholders, providing useful and useable community-specific information on environmental and health observations needed to inform management, and adaptation planning. Arctic BioMap will be a mechanism for building local capacity, directly engaging local residents in research relevant to resource management in a changing north, for raising awareness of environmental, health and social science research activities, and for addressing local concerns.

WATER TRACKS IN THE CANADIAN HIGH ARCTIC: PATTERNED GROUND CONTROL OF SLOPE HYDROLOGY AND THE ACTIVE LAYER THERMAL REGIME

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Patterned grounds and soil sorting are ubiquitous in high Arctic periglacial landscapes. They play an important role in nutrient and carbon burial, but little attention has been given to their impact on water flow pathways. This study focuses on the morphology of patterned ground and on the control they exert on water fluxes and on the thermal regime of the active-layer in a polar desert watersheds. The central hypothesis of our study is

that patterned ground formation on slopes regulates flow paths and active-layer development at the microtopographic scale and controls the delivery of meltwater runoff and suspended sediments transport dynamics. We examined these features along a slope on Ward Hunt Island in Nunavut (83.1°N, 74.2°W), measuring the morphology, hydrology and thermal regime of these features. In this system, sorted net formations evolve into sorted and non-sorted stripes. Preferential subsurface flow paths known as water tracks occur inside the patterned ground and are the principal conduits for water transport. Discharge and suspended sediment concentrations were measured in these water tracks as well as in a stream flowing from a snowdrift in order to compare their hydrologic behavior. Subsurface temperature measurements were also conducted in water tracks and inter-tracks (zones between water tracks). Our results indicate that the network of water tracks possess a hydraulic conductivity 4 orders of magnitude higher than the rest of the soils on the slope. Their hydrologic regime is similar to snowmelt runoff streams, with a peak discharge related to peak snowmelt. The water tracks can carry suspended sediment in concentrations up to an order of magnitude higher than in the snowdrift stream. This is due to rapid flow velocities in the water tracks allowing particle entrainment similar to soil pipe erosion. Water tracks therefore represent sub-surface streams with a strong soil erosion component. Our continuous thermal records showed temperatures up to 6°C cooler in water tracks than in inter-tracks, which resulted in a systematically shallower active-layer in water tracks. This finding is opposite to what has been found for other water tracks in Antarctica or Alaska where active layers can be up to twice as deep in water tracks. This raises questions on the role that flowing water may play in the development of the thermal regime of soils in extreme cold polar environments. On this High Arctic slope, the dark organic crust over inter-tracks contrasts with the thick mosses cover that isolate the water track soil, keeping the ground and the running water much cooler in the water tracks during the summer. Our results imply that the hydrological routing of meltwater can be dominated by microtopographic landforms generated by particle sorting processes. The channelling of this water into sub-surface streams promotes a rapid transfer of water downslope, increases the leaching of fines from sub-surface flow and prevents the development of a deep active-layer. This research shows the importance of local landscape variability on the hydrologic organisation of a watershed, and on sediment and heat transport in the High Arctic.

THE FUTURE OF PERMAFROST RESEARCH; CONTRIBUTIONS OF EARLY CAREER RESEARCHERS FROM THE EUROPEAN CONFERENCE ON PERMAFROST TO ICARPIII

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In June 2014, more than 75 Early Career Researchers (ECRs) attended the ECR Workshop 2014, a one-day event held prior to the 4th European Conference on Permafrost (EUCOP) in Évora, Portugal. One of the goals of this workshop was to elaborate future avenues of permafrost research from an ECR perspective during a forum with participants from various disciplines and countries. The outcome of this workshop is a "Permafrost Priority Sheet", which will be presented to the International Permafrost Association (IPA) and will contribute to the establishment of research priorities leading up to into the 3rd International Conference on Arctic Research Planning (ICARPIII) in 2015 in Toyama, Japan. This presentation will highlight some of the results that were obtained during the workshop, in a similar fashion as what will be presented at ICARP III. Additionally, it will focus on the organisation of the forum, the consultation process and the lessons learned from the overall experience. The results from this workshop took the form of research questions, from which five questions were elected by the participants as the most relevant at identifying gaps that need to be addressed in permafrost research. The broad range of topics include, engineering, remote sensing, traditional knowledge, massive ice, permafrost distribution, and more. Overall, these topics underscore the wide variety of specialties of the participants as well as the need for further research across

a spectrum of permafrost-related topics. To date, this operation has been a success largely due to the extensive collaboration between the Association of Polar Early Career Scientists (APECS), Permafrost Young Researchers Network (PYRN), and the ECR organisations of inter-disciplinary projects Changing Permafrost in the Arctic and its Global Effects in the 21st Century (PAGE-21) and Arctic Development and Adaptation to Permafrost in Transition (ADAPT). This workshop was an ECR initiative from the beginning to the end and is a great example of collaboration between National and International organizations. It also shows how ECR projects can be conveyed using existing networks and events in order to broadcast their opinions and increase their contribution to the future of Arctic science.

FREEZER SPACE AND FOOD SECURITY IN ULUKHAKTOK, NWT

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The research examined the vulnerability of an Inuit food system to climate change in the context of multiple socio-economic stressors through a case study of Ulukhaktok, Northwest Territories, Canada. The research approach, described by Ford (2009), draws upon vulnerability science to identify and characterize the human and non-human processes that shape food system vulnerability to climate-related conditions and identifies the presence of vulnerable groups. Notably, the research extends current understanding of food security in the Arctic beyond the direct effects of climate change on access and availability of country foods, to also include insights on food storage and entry points for policy to strengthen food systems in light of expected future climate change. Data were collected over a period of three months between July and October 2014. Data collection involved semi-structured interviews with open-ended questions with a cross-section of community members (n=35) and key informants (n= 6); and participant observation, with a particular focus on the attributes of the dual country/store food system including access, availability, quality, preparation, and storage. Preliminary analysis of the data indicates that availability of cold storage plays an important role in household food security, particularly in households with active hunters. Households with active hunters own more freezers than the community average for the main purpose of storing country foods (e.g. musk-ox, fish, caribou, ducks, muktuk). These households are important providers of country foods for households with less freezer space but have also had to limit their summer hunting activities to what can be stored in chest freezers in the absence of a functional community freezer or icehouse. The importance of storage in Inuit food security is expected to contribute to the growing body of knowledge examining the relationships between food security and climate change while providing new insights into the socio-economic dimensions of Inuit food security. The research is part of ArcticNet Project 1.1 Community Adaptation and IK-ADAPT (Inuit Traditional Knowledge for Adaptation to the Health Effects of Climate Change) supported by CIHR).

TRACKING CHANGE IN WILDLIFE HEALTH

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Traditional Knowledge (TK) is increasingly valued in long-term monitoring of wildlife health, particularly in northern Canada. This presentation discusses presents comparative research results (1998–2002 and 2010) about caribou and moose health based on research with ?utsel K'e First Nation, Northwest Territories (Canada). Elders' knowledge, harvester observations, harvest data and consumption data indicate a decline in the availability of barren ground caribou and range shifts of both caribou and moose during the study period. As resources for scientific monitoring become limited, there are important opportunities for greater community engagement in monitoring of diverse changes in arctic ecosystems including those associated with natural variability, climate change and the environmental effects of increasing resource development. To avoid the scientization of Traditional Knowledge, as cautioned by some scholars, there are important lessons to be learned on how to appropriately document, interpret and share Traditional Knowledge in ways that are respectful of the socio-cultural beliefs, practices and relationships that are its foundation

VULNERABILITY AND ADAPTATION RESEARCH IN THE ARCTIC

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This presentation reviews the use of "vulnerability" in the human dimensions of climate change (HDCC) research. The last decade has witnessed a rapid development of research examining the human dimensions of climate change in the Arctic. Increasingly, this scholarship is examining how climate change interacts with society, documenting impacts, vulnerabilities, and exploring opportunities for adaptation. To initiate adaptation, decision makers need to know the nature of vulnerability in terms of who and what are vulnerable, to what stresses, and in what way, and also what is the capacity of the system to adapt to changing conditions. In the climate change field, the term vulnerability refers to the susceptibility of a system (community) to harm relative to a climate stimulus or stimuli, and relates to both sensitivity to climate exposures and capacity to adapt. The concept of vulnerability can be operationalized in research using the "vulnerability approach," which seeks to describe the processes and forces that influence and structure vulnerabilities in particular places to help identify why vulnerability exists and to identify opportunities to support adaptation. The continued role and importance of vulnerability in HDCC research will be discussed and key features of the vulnerability approach will be highlighted in the context of advancing the HDCC research agenda in the Arctic.

The research is part of ArcticNet Project 1.1 Adaptation in a Changing Arctic: Ecosystem Services, Communities and Policy

NESTING DISTRIBUTION AND HABITAT SELECTION OF THE PEREGRINE FALCON IN NUNAVUT, CANADA

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In the Arctic, breeding distributions of many species are not well known, or even unknown, making it difficult for managers to know how species will be impacted by land-use or climate changes. One species of conservation concern, the peregrine falcon (Falco peregrinus), is frequently monitored by mining and industrial projects due to its history of sensitivity to human impacts. However, aside from local studies there has been no large-scale evaluation of peregrine falcon nesting habitat requirements in the North. This is important to wildlife managers since there is little to no a priori knowledge of the risk of encountering peregrine nesting sites in unsurveyed areas. Furthermore, investigating the contribution of climate to nest selection is essential since this species may also be showing negative responses to climate changes. The objective of our study is to determine the nesting habitat selection of this top predator in Nunavut and to predict their nesting distribution throughout this arctic territory. Throughout 1.6 million km2 (over 75%) of the territory of Nunavut north of the tree line, we used 40 years of nest data collected by industry, government, local observers, and university projects. Using remotely-sensed habitat information, including topographical features, vegetation coverage, distance to the coast, and average climate during the breeding season we modeled the peregrine nesting habitat selection at the landscape scale (~80 km2). Using the preferred nesting habitats, we then modeled the probable peregrine falcon nesting distribution throughout the tundra of Nunavut. As expected from previous studies, peregrine falcons preferentially nested in areas with the most rugged topography. However, we also found that higher than average summer temperatures were nearly as important to peregrines as available topography, and that they avoided areas with high summer precipitation. Using these preferred habitats, we then mapped the predicted distribution of peregrine falcons throughout the study area. Our predictions included areas which have never been surveyed in the past and represent more than the total known peregrine range in Nunavut. Knowing what criteria peregrine falcons use to select their nesting areas may help to anticipate their response to future land-use and climate changes in Nunavut. Such knowledge will allow managers to anticipate the areas that are the most critical to protect and the likelihood of species conflicts with the growing industrial sector in Nunavut.

PHYSIOLOGICAL AND ECOLOGICAL IMPORTANCE OF LIPIDS AND FATTY ACIDS OF THE DAUBED SHANNY POSTLARVAE (LEPTOCLINUS MACULATUS, FAMILY STICHEIDAE) DURING POLAR NIGHT IN SVALBARD

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Among ecological factors, temperature is considered as one of the leading in the Arctic, while the light is on the top of

interest in recent years due to the significant role in the life cycle of many organisms. The daubed shanny is widely distributed and ecologically important fish in the Arctic. It is known that Leptoclinus maculatus has unusual life cycle: bottom adults spawn in winter and postlarvae stay pelagic until 3 years using lipids stored in the special part of their body – "lipid sac" for their growth and development. The research is aimed to study the physiological and ecological importance of lipids and fatty acids in postlarval development of the daubed shanny during polar night in Svalbard. Samples were collected on the R/V «Helmer Hanssen» (UiT, Norway) in January 2014 (Kongsfjord, Svalbard). Young's of fish identified on 5 developmental stages – L1, L2, L3, L4, L5 according to C. Meyer Ottesen (2011) classification. The flesh of postlarvae (L1, L2 stage) and the lipid sac and the flesh of postlarvae (L3, L4 stage) were analyzed. Lipid classes (phospholipids, triacylglycerols, cholesterol, cholesterol esters+wax esters) and fatty acids of total lipids were identified using TLC and GC, respectively. Phospholipids classes were analyzed using HPLC. The abstract presents some highlights of the study. Total lipids and lipid classes were tissue-specific. Triacylglycerols dominated in the lipid sac (L3, L4 stages), whereas phospholipids were prevalent in the flesh of all postlarval stages. Triacylglycerols are high energetic and actively using by organism during food shortage periods. Muscle accumulated lipids mostly for own needs. Some variations observed in the phospholipids composition. Fatty acids (FAs) as lipid components have an ecological and physiological importance to adapt organism under environment changes. The 20:1(n-9) and 22:1(n-11) FAs dominated among energetic monounsaturated FAs, which were the major among FA groups. They was prevalent in the lipid sac (65.7% DW) compare to the flesh (35.4% DW) of L3 stage the postlarvae. These FA originated from copepods Calanus spp., synthesizing them de novo. Interestingly that 18:1(n-9) FA dominated in the flesh of L1 postlarval stage, being a biomarker of dinoflagellates and bacterioplankton (Viso, Marty, 1993) is available food for small fish. Among polyunsaturated FAs - 22:6(n-3) and 20:5(n-3) dominated and had a higher level in the flesh compare to the lipid sac. These FAs were dietary derived and mostly use to maintain the optimal functioning of membrane bilayer at low temperatures. Some scientists explained the higher level of 22:6(n-3) FA in the young's of fish by development of the visual system. Specific lipid and fatty acid composition the daubed shanny postlarvae allows to maintenance physiological activity of metabolic systems and reflect their processes of normal development and differentiation even during polar night at low temperatures and darkness. The research was supported by The President of the Russian Federation Grant NSh 1410.2014.4; The Presidium of RAS "Ecological and biochemical characteristics of sustainability of aquatic organisms in the Russian Arctic in the Era of climate change" project (2014-2016); «Timing of ecological processes in Spitsbergen fjords» project.

GEOMORPHOLOGICAL, ECOLOGICAL AND THERMAL TIME PHASES OF PERMAFROST DEGRADATION MOUND, TASIAPIK, NUNAVIK (QUÉBEC, CANADA).

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In order to make a quantitative assessment of ecosystem changes associated with permafrost degradation and to assess the speed of the changes, we selected six sample plots located on a silty ice-rich permafrost mound in Tasiapik valley, near Umiujaq, in Nunavik. The six plots are representative of the regional ecological time sequence associated with permafrost degradation which includes increasing active layer thickness, ground settlement, plant cover densification and snow cover change. Our objectives are 1- to determine the changes that occur in the flow of energy between the three layers of the ecosystem (vegetation / snow cover, active layer, permafrost) during the degradation of permafrost and the feedbacks that occur during evolution and 2- to quantify the rate of the transition by analysis of time-lapse aerial photographs and through dendrochronology on shrubs and trees. In order to respond to these objectives, the methodology follows the ADAPT protocol. Local micro-topography, height and species composition of the vegetation cover, thickness and composition of the organic horizons and soil moisture were measured on the six sample plots. The thickness and density of the snow cover were measured at saturation time in March-April 2013. Each sample plot was equipped with automatic data acquisition systems that continuously measured the humidity at -5 cm in the soil and the ground temperature at -5, -15, -30 and over -80 cm and at +20 cm in the canopy / snow cover. Soil samples collected from the active layer with an auger were brought back in the laboratory for chemical and particle sizes analysis and determination of ice and water contents. Permafrost was drilled to 3 m deep and cores were brought to the laboratory for CT-Scan analysis. The results show a quasi-exponential evolution of permafrost degradation factors in the last 30 years of the evolutionary sequence. The quantification of geomorphological, ecological and thermal variables highlights the critical thresholds that punctuate this development. The thickening of the active layer formed a thawed residual layer while pedogenic horizons have evolved from a thin and discontinuous layer to a thickness of about 65 cm. The mean height of shrubs increased by about 150 cm. Snow cover increased from virtually nothing to over 2 m. Temperatures at the interface between vegetation/snow and the ground surface evolved from negative to positive. Winter

heat fluxes through the snow/soil interface even suggest a slight heat input due to a possible increase in biogeochemical activity. The transformed ecosystem has become a sink where carbon is stored in the soil and in the biomass. The changes took place over a period of time of about 90 year; slow at the beginning and for a length of time, the rate of ecosystem change increased dramatically over the last 30 years following the rate of regional climate warming.

MELTING FRONTIERS: IMPERIAL OIL, CANADIAN PETROSCIENCE AND THE PERMAFROST ARCHIVE

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In the history of Canadian Arctic colonization, permafrost had been understood primarily as a civil engineering problem: the annual thawing and refreezing of its active and constantly mobile top layer posed problems of durability and stability for any infrastructural project, especially the paradigmatic northern pipelines. With the increasing presence of both military and scientific research stations in the Arctic during the Cold War, the understanding of permafrost and its possibilities changed. Cold War scientists, petroleum microbiologists and petroleum geoscientists, working together since the 1950s under the auspices of Imperial Oil, transformed the role of permafrost in the Canadian north. Rather than seeing it as a hindrance to northern expansion and resource exploration, they began to turn to permafrost sampling for information, understanding the analysis of its substrate materials (which include bedrock, sediment, organic matter and water/ice) as a way to reconstruct the complex climate history of the area. This paper examines how political imperatives, petroleum industry and government scientists worked together to construct permafrost as a climate archive through which radically changing notions of time and space not only came to shape current oil and gas projects, but also emphasized permafrost's contents as important northern actors. Contemporary narratives about climate, elaborated by organic matter and microbes drawn from the permafrost archive, have not only changed "Western" scientific approaches to the North, but also industrial and governmental rule in this 'energy frontier,' now facing the loss of its rich yet rapidly melting archive. This paper is based on archival research conducted in the Glenbow Museum's Imperial Oil Collection, in Calgary, Alberta.

DISCRETE GLOBAL GRID SYSTEMS: A STANDARD FOR SHARING MULTI-SOURCE ANALYSIS AND MODELING

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There is an explosive growth of both the variety and the volume of interesting data sources along with an understanding of tremendous societal benefit. Sensors swarm around the Earth and connected devices scan our environment. The trend to open data dissemination is another positive development. However, geo-scientific data has already exceeded the petabyte-scale barrier and is rapidly heading toward the Exabyte-scale barrier. Converting this massive amount of data into timely information and decision support products is dependent on the capacity of the scientist to rapidly analyse this data in a transparent and repeatable fashion. The challenges of high velocity, high volume (> a terabyte per day) data is requiring those focused on combining and using these large data sources to rethink the way they store data in order to make best use of it. In the Polar Regions the challenges of data integration are particularly difficult in part to conventional data projections and gaps in data collection. A new Open Geospatial Consortium Standard is proposed that recognizes the value of sharing and using geospatial data on a discrete global grid system (DGGS). Although these tessellation based data structures have been theorized and explored, practical experience using these systems are not well documented. This paper describes a full implementation of a DGGS developed by the PYXIS innovation and used through several OGC and international Group on Earth Observation (GEO) testbed and pilot projects. The DGGS used was a complex hexagonal equal area Earth partitioning known as the ISEA3H. The ISEA3H has been shown to have optimized properties for retaining data sampling across the entire globe, including Polar Regions, an attractive basis for rapid on-demand data integration – combining vector (feature) and raster (coverage) encodings - across multi scale, frequency and temporal domains sufficient for complex Earth science and environmental analysis and modelling. Indexing and tiling structures developed for the ISEA3H DGGS are used that demonstrate efficient tiling for multi-source visualization, storage, processing, and transmission for an on-line distributed data system. The authors believe that without viable alternatives, continued ad hoc adoption of Web Mercator - a low fidelity alternative standard to a well-developed DGGS - as a basis for scientific data visualization and analysis will persist.

YOUTH-IDENTIFIED PROTECTIVE FACTORS FOR MENTAL HEALTH AND WELL-BEING IN A CHANGING CLIMATE: PERSPECTIVES FROM INUIT YOUTH IN NUNATSIAVUT, LABRADOR

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The Canadian Arctic is experiencing rapid changes in climatic conditions, with implications for Inuit communities widely documented. Youth have been identified as an at-risk population, with likely impacts on mental health and well-being. This study identifies and characterizes youth-specific protective factors that enhance well-being in light of a rapidly changing climate, and examines how climatic and environmental change challenges these protective factors within Northern Labrador. This research was led by the Rigolet Inuit Community Government, in partnership with the other Nunatsiavut Inuit community governments of Nain, Hopedale, Postville, and Makkovik and the Department of Health and Social Development. In-depth conversational interviews were conducted by local research coordinators with youth aged 15-25 from the five communities. Five key protective factors were identified as enhancing their mental health and well-being: being on the land; connecting to Inuit culture; strong communities; relationships with family and friends; and staying busy. Changing sea ice and weather conditions were widely reported to be compromising these protective factors by reducing access to the land, and increasing the danger of land-based activities. This work contributes to existing scholarship on Northern climate change adaptation by identifying factors that may enhance youth resilience and, if incorporated into adaptation strategies, may contribute to creating successful and effective adaptation responses and to fostering adaptive capacities.

MECHANISMS OF ZOOPLANKTON DIEL VERTICAL MIGRATION IN YOUNG SOUND FJORD DURING THE POLAR NIGHT

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Young Sound is located in Northeast Greenland at ~74°N and represents a relatively deep (340 m) and long (~90 km) high latitude fjord with a 40 m deep sill at the mouth. Young Sound is covered by land-fast ice from late October to the beginning of July. During winter, the land-fast ice extending off the fjord mouth by 10-30 km completely eliminates wind stress on the water column. Further offshore in the transition zone between the land-fast ice and pack ice, one of the most prominent polynyas in northeast Greenland is maintained during winter by sustainable northerly winds. During winter 2013-14, 4 land-fast ice tethered oceanographic moorings equipped with 300 KHz ADCP were deployed in Yong Sound. The backscatter intensity time series from one of ADCP mooring deployed in the fjord interior shows signature of the zooplankton diel vertical migration during polar night below the land-fast ice 20-110 cm thick with snow cover up to 50 cm. Furthermore, there was observed interaction of vertical migration with water dynamics. During the period of polynya induced estuarine-like circulation, the vertical migration signal is substantially disrupted. During mooring deployment and recovery, we observed a subsurface warm layer centered at 13/28 m which could be the target of the zooplankton as a potential source of phytoplankton. Normally diel (diurnal) vertical migration of zooplankton occurs in 24 hour period when the organisms move to illuminated zone (epipelagic or daylight) at night and return to twilight (mesopelagic) zone during the day following the daylight cycle. In the case of Young Sound mooring, such migration was observed during the polar night below the land-fast ice covered with thick snow cover. Different explanations for the mechanism of this migration during the polar night period were proposed in literature . One of explanations given in recent papers was that even during the polar night, Diel vertical migration is regulated by diel variations in solar and lunar illumination, which are at intensities far below the threshold of human perception. However, for Young Sound this mechanism is very unlikely taking into account snow thickness and ice depth. So we are looking into better explanation of diel vertical migration during the polar night season in Young Sound case.

ATLANTIC WATER IN THE EARLY HOLOCENE CANADIAN ARCTIC: THE PLANKTONIC FORAMINIFERA (NEOGLOBOQUADRINA PACHYDERMA) SIGNAL OF THE NORTHWEST PASSAGE

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Four marine sediment records (piston cores) from the central Canadian Arctic Archipelago (CAA), investigated for sedimentology, micropalaeontology, and biogeochemistry (52 AMS radiocarbon dates), uniformly show the prominent early Holocene (~10 cal ka BP) appearance of planktonic foraminifera immediately following deglaciation. These planktonic populations are exclusively composed of Neogloboquadrina pachyderma [sensu Darling et al. 2006 = Neogloboquadrina pachyderma sinistral (Ehrenberg 1861)], and include several morphotypes previously described from the Arctic Ocean, as well as some aberrant, right-coiling forms (not Neogloboquadrina incompta). Today, planktonics are rare in the central CAA, rather dwelling in adjacent offshore areas influenced by Atlantic water, such as Baffin Bay. The early Holocene planktonics signal is interpreted as reflecting the inflow of deep Atlantic-sourced water into the archipelago, likely facilitated by higher deglacial sea-levels (due to glacio-isostatic depression) which permit increased flow across inter-channel sills at the CAA entrances. The planktonic influx intervals are accompanied by the benthic foraminifer Cassidulina neoteretis, an indicator of chilled Atlantic water, and ostracods (marine Arctic and sub-arctic inner to middle-shelf species; Cytheropteron paralatissimum, Heterocyprideis sorbyana). Collectively, this indicates an early Holocene oceanographic circulation and water mass structure different from today, marked by greater oceanic connection to adjacent basins, notably Baffin Bay. Though the precise pathway of Atlantic water is cryptic, an eastern source via Baffin Bay Atlantic Water is likely, given shallow palaeo-water-depths to the west across the oceanographically critical Lowther sill. As glacio-isostatic rebound progresses, deeper waters carrying planktonics are progressively excluded from the central CAA as channels and sills shoal. Essentially modern oceanographic circulation is established by ~6 cal ka BP. This early Holocene planktonics peak is noted throughout Parry Channel (the main east-west axis of the Northwest Passage), from Lancaster Sound in the east to as far west as southern McDougall Sound/Barrow Strait. This suggests planktonic foraminifera can constitute a valuable regional marker for the entry of Atlantic-derived oceanic waters upon deglaciation into the CAA. Furthermore, the signal highlights the potential for major oceanographic change in complex archipelago settings occurring independently of climatic forcing.

PANABIO – A STRATEGIC APPROACH TO LARGE-SCALE DATA INTEGRATION, ANALYSIS AND MODELING BY MEANS OF A GEO-REFERENCED INFORMATION SYSTEM FOR PREDICTING THE RESPONSE OF BENTHIC BIOTA TO CLIMATE CHANGE

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Arctic marine biota are affected profoundly and at large scales, albeit with distinct regional differences, by accelerating environmental change, such as ocean warming and acidification, ice-shelf and sea-ice decline. Moreover, increasing human activities, such as exploration/exploitation of ressources (fossil fuels, fish, etc.), ship traffic, and tourism, add further pressures on them. Substantial effects are expected, leading to shifts in key ecosystem functions and services (e.g., biodiversity, trophic interactions, carbon and nutrient cycling, calcification). To understand, predict and mitigate the profound ecological consequences of these environmental changes, there is a need to describe the ecological status quo in terms of structural and functional properties, on both regional and pan-Arctic scales. Moreover, the assessment of shifts in ecosystem functioning and ecosystem services require the ability to identify and analyze the relationships between environmental drivers and ecosystem functions in both time and space. To address this challenge, we propose to conceive, develop, implement and utilize a pan-Arctic knowledge system on benthic biota (PANABIO), which integrates reliable, quality-controlled and geo-referenced data on marine communities with environmental information (observation and model data) at high spatial resolution and modeling tools. A close international cooperation of researchers is required to combine data and expertise in a joint

cross-disciplinary effort to establish such a system. With the option of coupling to models of species distribution patterns and organism energetics, as well as to dynamic climate and oceanographic models, PANABIO would allow for (a) providing ecological baseline data to gauge ecosystem changes against, (b) analyzing coupling mechanisms between environmental drivers and ecosystem functions/services on regional and pan-Arctic scales, (c) developing future ecosystem scenarios in response to external forcing, and (d) creating online stakeholder-oriented visualization and analysis tools. In our presentation, we will (i) review ongoing/planned efforts of large-scale data integration at our institutes and the international level, (ii) describe fields/opportunities of international and transdisciplinary collaboration in such efforts, (iii) showcase advantages and possible applications, (iv) outline some technical aspects (needs, resources, properties, standards, etc.) of a publicly accessible pan-Arctic knowledge system, and (v) identify priority issues (technical, legal, etc.) to be solved yet. The talk will demonstrate the huge benefits of pan-Arctic data-integration efforts to advance our knowledge and understanding of processes determining the distribution of benthic species and communities in the changing Arctic.

ARCTIC SAR: BENEFITS OF WARGAMING AND TABLETOP EXERCISES

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Arctic nations face significant challenges in successfully implementing the 2011 SAR agreement. These challenges include the issue of maritime domain awareness, the potential jurisdictional issues that may arise between neighboring states, and the high costs of fielding and maintaining polar-capable SAR assets. This brief list includes problems of a scientific/geographic nature, legal nature, and economic nature, indicating the multifaceted implementation challenge posed by SAR. Innovative public-private arrangements are often pointed to as ways to address some of the unique Arctic implementation challenges. For example, oil companies working offshore will have SAR-type capacity, which potentially could deploy in response to a SAR emergency. However, legal considerations will have to be addressed in order to ensure smooth operation of such innovative and unusual policy arrangements. Testing and refinement of novel arrangements will be critical to ensure that in the case of an emergency, cross-sectoral response activities are well-coordinated and constitute an improved SAR scenario. Building an adequate and effective SAR system will require innovation to address the major hurdles present. Wargaming may offer a useful tool for assessing SAR capacity and challenges. However, wargames must be designed and run properly to contribute to learning outcomes. Tabletop wargaming may enhance the annual Arctic Shield exercise conducted by USCG, enabling lower-input and more frequent analysis of SAR capacity. Arctic Shield is intended to advance four objectives: (1) provide a framework for performance of USCG missions in the Arctic; (2) advance Arctic maritime domain awareness; (3) improve preparedness and response capabilities; and (4) test capabilities and refine requirements. In addition, U.S. and Canadian forces conducted an onshore SAR exercise October 2013 designed to assess response to a plane crash along the shared border. A tabletop exercise involving representatives from all eight Arctic Council member states was conducted in October 2011. Further exercises are likely through the Arctic Council venue. This paper addresses the potential of wargaming-type exercises to inform and strengthen the development of such arrangements, through an analysis of past exercises involving the U.S., Canada, and partners, as well as through a grounding of wargames and tabletop exercises in the theoretical literature.

FOOD INSECURITY IS ASSOCIATED WITH SHORTER STATURE IN INUIT CHILDREN FROM NUNAVIK

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Background: Food insecurity is elevated in the Inuit-inhabited areas of Northern Canada, with prevalence often surpassing half of the population. Households with young children are substantially affected. In other parts of North America, food insecurity has been associated with nutritional deficiencies that may affect development and growth. Globally, food insecurity is associated with malnutrition and stunting. In this study, we assessed the relationship of food insecurity to stature in Inuit children from Nunavik, while accounting for iron deficiency and exposure to environmental contaminants. Methods: Our study population was comprised of a cohort of 294 school-aged Inuit children from Nunavik. Food insecurity was determined by interviewing the children's mothers, while iron deficiency and stature were obtained through blood biomarkers (e.g. iron status) and anthropometric measures.

The relationship of food insecurity to height (cm) was analyzed with a general linear model. Statistical models controlled for age, sex, prenatal exposure to lead and postnatal exposure to polychlorinated biphenyls. Results: Half of the children were food insecure (50%, n=145) and one-third had iron depletion (n=97). According to Canadian growth standards, close to 20% of children were in the shortest tertile for their age (n=54). Those children who were food insecure were significantly shorter, by about 2.5cm, compared to their food secure peers ($p<0.01$). Taking into account iron deficiency, a measure of malnutrition, did not change the association. However, statistically adjusting for exposure to environmental contaminants did moderately attenuate the relationship, suggesting that certain environmental contaminants may also be associated with linear growth in children. Conclusion: This is the first study to look at the effects of food insecurity on school-aged Inuit children and the only study of this population to examine the association between food insecurity and stature. It shows that food insecurity is a highly prevalent problem and is linked to slower linear growth in school-aged children.

THE IMPORTANCE OF ALTERNATIVE PERSPECTIVES IN THE INTERPRETATION OF BIOLOGICAL VARIATION

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Caribou occupy a central place in the livelihoods and identities of Aboriginal people and display substantial variation across their distribution. Understanding how caribou are spatially structured on the landscape is a question of interest to managers, ecologists, and First Nation hunters. Our main objective is to bring together traditional knowledge of Sahtú,/ Dene and Métis and non-invasive population genetics to understand how diverse perspectives organize, interpret and recognize patterns of caribou variation, within and between ecotypes, in the Sahtú Region of the Northwest Territories. We used a multidisciplinary community-based participatory research framework to equitably involve community partners, draw on their knowledge and experience, share decision-making responsibilities, and build capacity. Caribou fecal pellets were collected non-invasively in collaboration with local community members during the winters of 2013-2014 for genetic analysis. Focus group meetings with the Renewable Resources Councils, elders, and a local advisory group were essential to build a comprehensive understanding of the origin, behaviors, dynamic interactions, and spatial structure of caribou across the region. Dene perspectives and categorization systems helped to deepen our understanding of caribou variation. Dene people classify boreal woodland caribou based on unique behaviors and morphology that can be differentiated from barren-ground or mountain caribou. Elders are also able to identify a specific type of caribou in the Mackenzie Mountains, unknown to Western science, that migrate long distances and can be identified by particular markings. Analysis of 10 microsatellite markers also suggests that boreal woodland caribou display significant genetic structure and can be differentiated from other types. Mitochondrial DNA analysis sheds light on the ancient lineages and evolutionary processes that may generate and maintain essential variation. Through partnerships that respect the lives and experiences of people that depend on the land, our study supports the development of robust descriptions of caribou populations that reflect biodiversity and promote alternative ways of relating to caribou in Canada.

FLOWERING TIME AND HISTORICAL CLIMATE HELP EXPLAIN PHENOLOGICAL RESPONSES OF ARCTIC AND ALPINE PLANTS TO CLIMATE CHANGE

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The phenology of vegetation in cold regions is strongly affected by temperature, and thus is predicted to be particularly sensitive to climate warming. Previous studies have found that Arctic and alpine plants advance phenological events in response to warmer temperatures. However, responses differ between life forms, species, and study locations, with some plants shifting dates of flowering and flower senescence more than others. Identifying the underlying mechanisms and consequences for the varied phenological responses of tundra plants is integral for predicting how vegetation will respond to climate change in the future, and how this may alter the function and structure of these systems and the food webs they support. To ascertain the broad factors that may be controlling tundra plant phenological changes at a global scale, we analyzed phenological responses of over 147 species, at 14 sites, and up to 20 years from Arctic and alpine ecosystems around the world. We predicted that phenology of plants which flower later in the season would be more sensitive to warmer temperatures than early-flowering species. Phenology of late flowering species may be more responsive to cumulative degree days, whereas phenology of early flowering species is probably more dependent on timing of snowmelt. Additionally, we predicted that phenology of plants growing in regions with historically colder summers would be more sensitive to changes in temperature than phenology of plants from warmer tundra ecosystems because in colder habitats small absolute changes in temperature represent large relative increases in a plant's thermal budgets. Finally, we predicted that species with higher phenological sensitivity would selectively benefit from warmer temperatures, and increase in abundance at tundra sites that have warmed over time. To measure phenological sensitivity, we compared the day of year of a phenological event (flowering or flower senescence) to thawing degree days from snowmelt through the end of June for each species by site combination. Tundra plants that flowered later in the growing season had greater phenological sensitivity to temperature change compared to those that flowered earlier based on preliminary analysis. Further, later-flowering plants from the coldest tundra sites had the highest phenological sensitivities. Greater phenological sensitivity was also positively correlated with increasing abundance of a species over time, with phenologically sensitive plants from the coldest sites experiencing the largest increases in abundance. This interaction indicates that later flowering plants in colder tundra regions may disproportionately benefit from warmer temperatures, while early flowering species may not alter phenology to the same extent, or increase in abundance, with a changing climate. Several common woody plant species are late flowering, and this may explain in part the widespread observation that some shrub species are increasing in abundance in Arctic and alpine ecosystems. These results reveal that the relative flowering time of a species can help predict phenological responses, and partially explain changes in plant community composition over time.

LINKING WILDLIFE AND HUMAN HEALTH THROUGH A HANDS-ON WORKSHOP; AN ASSESSMENT OF CONTAMINANTS RESEARCH EDUCATION

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Assessment is a critical component to developing and improving effective educational programs that meet both the student needs, and the larger learning objectives. With increased calls for educational programs in the Canadian Arctic, there is a growing need to assess information delivery, and how this is being received by students. An integrated contaminants communication and research training workshop was held for students of the Nunavut Arctic College's Environmental Technology Program and members the Northern Contaminants Program (NCP) Nunavut Environmental Contaminants Committee; both of whom are or will soon be critical "frontline" workers who community members turn to for information about contaminants in country food. Effectively comprehending, distilling, translating, and disseminating contaminants information requires familiarity with broad ranging concepts and terminology, in disciplines that range from human health risk assessment to environmental chemistry. Our unique training initiative strives to integrate the diverse learning components of contaminants discourse, which are typically fragmented and isolated in most curricula. The training combines lectures, interactive lab activities, and group discussions. During the course of the workshop the participants learned how contaminants trend monitoring programs are designed and conducted, and were trained in specific methods for wildlife tissue sampling. Participants also discussed contaminants communication strategies for audiences in Nunavut. Additionally, participants were shown traditional uses for animals, including use of the meat as country food. The workshop was delivered by a team of experienced elders, instructors, researchers, and community members with the goal of increasing student exposure to both cultural and research components. The long term goals of the project are to increase the capacity of Nunavut's future environmental practitioners to effectively communicate contaminants information to community members, and to build core understanding of contaminants research among Nunavut's future environmental

managers and decision makers. In order to assess if these goals are being reached through the workshop efforts, we have begun an assessment of how the workshop informs the students about contaminants research in the north, and increases their awareness of northern contaminants research. We used workshop entrance and exit surveys to track how student's perceptions and knowledge on contaminants change over the course of the workshop. We used both a formative and summative approach that allows student views to shape the workshop, as well as assess the overall goals.

SHARING NUNATSIAVIMMIUT KNOWLEDGE IN SUPPORT OF REGIONAL LAND USE PLANNING AND POLICY DEVELOPMENT: KNOWLEDGE MODELING AND VISUALIZATION FOR MEDIATING CONCEPTS AND EVALUATING DATA.

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Understanding and managing the use of land is a challenge that requires the union of comprehensive knowledge, sound policy, and action. This challenge is particularly important in local and regional geographies in the Arctic and sub-Arctic. The North is experiencing rapid environmental, social and economic change. This change is creating pressures on traditional, existing and future uses of land while raising questions about establishing equitable and sustainable land use management regimes that can support long-term development of a region. In the Inuit region of Nunatsiavut, Canada, Nunatsiavimmiut knowledge and land use practices are living, dynamic systems. The embodied and orally transmitted forms of Inuit knowledge are highly effective in local geographic and cultural contexts, however broadly sharing this valuable knowledge can be a challenge. Local and traditional knowledge are being documented using tools such as Geographic Information Systems, however the constraints of data models, limited methods of representation, and expertise required to use GIS represent barriers to access for community members and policy makers alike. In this project, geography and geographic concepts provide a starting point for linking Inuit knowledge (Nunatsiavut) with local decision makers, younger generations, and members of the scientific community. Using existing or newly documented Inuit knowledge we are working with knowledge holders to organize the documents conceptually and then generate a model that is stored in an information system (an ontology). To promote knowledge sharing and enable the evaluation of data we have developed an integrated visualization and mapping tool that allows land use planners, community members, and other interested parties to access the ontology and learn more about Nunatsiavimmiut and scientific knowledge. An interactive concept map is used to visualize hundreds of concepts, terms and relationships and provide the end user with a better understanding of the knowledge domain. Simply visualizing concepts, though, does not fully address the requirements of the land use planning process where decisions about particular places or regions must be made using location specific knowledge. Thus, the concept visualization tool is integrated with a web-based mapping system to support the visualization of specific, mapped instances of geographic features (e.g. wildlife feeding grounds, estimated range areas). The mapping system also links to multimedia representations of concepts and features. Understanding change over time is critical, and thus the tool includes the ability to filter results on both the concept and geographic maps based on when a concept or geographic feature existed. The tool is primarily designed for non-expert users to allow them to see and evaluate the broad range of different concepts and data that are characteristic of land use planning and management processes. However, underlying the user front end is a technical framework that promotes interoperability with other systems (e.g. data centres, individual researchers, across planning organizations etc.). We conclude with a discussion of a growing connections between Nunatsiavimmiut knowledge holders, scientists and policy makers in the land use management process regionally as well as connections to national and international communities.

A COMPONENT BASED ARCHITECTURE FOR EXPLORING AND SHARING LOCAL AND TRADITIONAL KNOWLEDGE ACROSS DISCIPLINES

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The Exchange for Local Observations and Knowledge of the Arctic's (ELOKA) mission is to provide data management and user support services to facilitate the collection, exchange,

use and preservation of local observations and knowledge of the Arctic. Over the course of our projects, we have worked with partners to develop a modular, component-based system that is designed to enable cross-disciplinary research in physical and social sciences. The system is being leveraged to enable data access through easy to use interfaces as well as supporting interoperable data exchange and long-term archiving. End users can explore data using a variety of interactive, multimodal tools. Interactive maps allow users to visualize geographic data while at the same time linking to associated multimedia that provides an extended view and understanding of space and place. Spatiotemporal display is supported providing the ability to recognize change over time. Multimedia representation is used to allow residents of the Arctic to share knowledge through narrative in their own language (i.e. Inuktitut), while concurrent translations enable others in broadening their understanding. Through collaborative research, advanced visualization tools connect knowledge domains through semantic modeling and linked data. At the core of ELOKA's interactive mapping and multimedia management capacity is the Nunaliit Atlas Development Framework. Nunaliit provides us with advanced representation capabilities, access control tools, support for user contributed content management, and a "RESTful" service interface. The document-oriented database underlying the Framework provides other system components with ready access to data. This is proving to be powerful for data and knowledge sharing as, through collaborative research with the Semantic Sea Ice Interoperability Initiative we link data from atlas applications with other data using semantic web and linked data tools. Underlying the system is a set of foundational tools. A metadata catalogue with browser and service interfaces supports data documentation, discovery and ultimately access. A long-term archiving and preservation tool based on the Data Conservancy System software enables operations that ensure that data will be accessible for future generations even as technology changes rapidly. The preservation systems can connect to other components including Nunaliit-based atlases. All of these components are increasingly linked together using a micro-services approach supported by open standards and specifications (e.g. OpenSearch, Open Geospatial Consortium Web Map Services and others). This provides linkages across disciplines and knowledge domains both within and outside of ELOKA systems.

AN OVERVIEW OF THE MARINE FISH BIODIVERSITY OF THE CANADIAN BEAUFORT SEA.

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Extensive sea ice, logistical considerations and high costs have limited active sampling for fishes in ice-covered Arctic seas including the Canadian Beaufort Sea (CBS). Until recently, most research regarding fishes in marine habitats was focused upon coastal and nearshore shelf habitats (to ~150m depths) particularly in southern areas influenced by the Mackenzie River outflow. Prior to 2003, 68 fish species (~20 anadromous or sea-run, 48 marine) had been documented from the area. Two research programs focused upon understanding marine fishes and their habitat associations have been delivered by Fisheries and Oceans Canada in the past decade: Northern Coastal Marine Studies (NCMS; 2003-2009) deployed from the CCGS Nahidik focused upon the Mackenzie Shelf and sampled to ~150m depths, whereas the more recent Marine Fishes Project (MFP; 2012-2014) deployed from a chartered ice-capable fishing trawler (FV Frosti) extended this research to offshore deep water areas (to 1515m depths) from the Alaskan border eastwards into Amundsen Gulf and northwards to approximately 73 degrees N. Sampling in the NCMS program incremented known marine fish diversity of the CBS by four species; two of these were new to the Canadian fauna. The 2012 and 2013 MFP sampling has added a further 15 species to the complement in the CBS, eight of which are new to Canadian waters. Species new to Canadian waters exhibit affinities with those in waters west of the CBS (i.e., Bering, Chukchi or Alaskan Beaufort seas); those new to CBS but previously known from Canadian waters generally exhibit affinities with eastern Arctic and Atlantic areas. Total known fish faunal diversity for the CBS is now 67 marine species (+20 anadromous species). Species with western zoogeographic affinities most likely represent shifts associated with climate change (shallower locations) or new records of previously present species (deeper locations); those with eastern affinities may represent species previously present but unrecorded in the area due to limited previous sampling in deeper areas. In keeping with generalities observed for the Arctic Ocean and adjacent seas, the majority of marine fish diversity is associated with benthic habitats. Fish sampling (benthic and mid-water trawling) for the MFP was complemented by sampling of oceanographic conditions, lower trophic productivity, zooplankton, epifauna, sediments and infauna, and hydroacoustic assessment of pelagic areas that enable follow-on studies of trophic linkages, habitat associations and biomass (pelagic) estimates. Repetitive sampling of key stations on the Mackenzie Shelf (40m depth) to offshore deep water locations (1000m depth) also allows for inter-annual comparisons linking the NCMS and MFP research with large-scale drivers such as climate and ecosystem shifts. Information baselines regarding fish diversity, trophic and habitat associations, biological characters and key contaminants also provide the context within which sound regulatory and management decisions may be made in the coming decades. Heavy sea ice in 2014 precluded planned sampling in northern

and deeper (2000m) offshore areas, thus substantive survey work is still required for large areas of the CBS to establish complete base lines against which future changes and stressors may be assessed.

NORTHERN COASTAL SUSTAINABILITY: SUSTAINABILITY OF WHAT, FOR WHOM, AND HOW?

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A diverse body of literature conceptualizes sustainability and sustainable development and discusses their importance on local, regional, and global scales, with a considerable portion of scholarship being developed outside of Northern regions. The first part of the presentation discusses whether differences exist between Euro-American models of sustainability on the one hand, and concepts of sustainability pertaining to coastal communities in the circumpolar Arctic and Subarctic on the other. Mainstream definitions of sustainable development have been implemented in numerous regional and national sustainability strategies throughout industrialized nations since the late 1980s. However, there is substantial criticism on concepts of sustainable development in general, and its application in the Arctic specifically. This criticism in part relates to technocratic, top-down approaches and the real or perceived focus on economic performance and growth over environmental and sociocultural matters; it is, in other words, a critique on the overall maintenance of a status quo that is inherently unsustainable. In addition, regimes to address sustainability challenges globally, such as the Kyoto Protocol to the United Nations Framework Convention on Climate Change so far have failed to produce convincing results. We argue that to address sustainability challenges in northern coastal regions, it is important to recognize place based methodologies and epistemologies, including world views or philosophies of indigenous populations that may be inherently sustainable, and include the identification and implementation of locally grounded tools, processes, or strategies. The second part of the presentation discusses specific approaches to investigate northern coastal sustainability, and whether there are means to share knowledge or applications among communities and regions. We will present SakKijânginnatuk Nunalik, the Sustainable Communities Initiative (SCI) in Nunatsiavut, northern Labrador, as a case study for illustration. The SCI is a co-creation for sustainability project including partners from governmental, academic, and private sectors with the overarching goal to ensure individual and community well being in climate adapted communities along Labrador's northern coast. It holds at its foundation the importance of processes that are locally appropriate and that reflect local values. The presentation concludes with an outlook on how approaches to meet sustainability challenges in Arctic and Subarctic coastal regions can contribute to non-Northern sustainability research and concepts. In other words: how can northern coastal sustainability be made relevant for matters not specific to northern coastal regions?

MINE CLOSURE, LOCAL WELL-BEING AND CARIBOU LIVELIHOODS: WHAT PATHWAYS TO SOCIO-ECOLOGICAL RESILIENCE IN MINE-IMPACTED INUIT COMMUNITIES?

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Our presentation will address the implications of mine closure on local well-being in the Inuit community of Qamani'tuaq, Nunavut. Mining development in the Arctic is commonly presented as a generator of employment and development in Canada's isolated north. However, the scenario "mine closure" is little emphasized in IBA (Inuit Benefit Agreement) contracts and remains understudied in the academic literature. There is a recognized need to explore future mining scenarios from an Inuit perspective and identify the conditions for community resilience after mining. In response to locally defined research questions, we investigated the potential impacts of mine closure at Qamani'tuaq, with a focus on caribou futures. We utilized a Participatory Action Research (PAR) framework, adapted to an Inuit context and analyzed our results using Socio-Ecological Resilience (SER) theory. An inland Inuit community traditionally dependent on caribou hunting and fishing, Qamani'tuaq has been affected since 2007 by a gold mine, operated by the company Agnico Eagle. The mine has transformed local socio-ecological dynamics and also raised concerns over the negative socio-economic impacts. Mine closure in 2017 may once again signify major changes and needs for adaptation. Participants defined five key criteria for local "well-being": Family Life, Jobs and Income, Food Independence, Health and Well-Being, and Learning. These were then used to evaluate quantitatively and qualitatively the range of potential impacts of mine closure. Our results show that the closure of the Meadowbank mine could not only cause job losses but also generate "domino effects" in all five aspects of local well-being. In a "worst case" scenario, mine closure could occasion job losses that place new stressed on families. In a "best case scenario", mine closure is envisioned to occasion a recovery of the land, a return of the caribou herds that have been far from town, and an opportunity to explore new

businesses and development paths. We also studied the factors contributing to community resilience (the ability to maintain well-being) after mine closure. Participants hoped for adequate job transfer opportunities for mine workers. Yet they also underlined as fundamental to resilience the existence of social supports, essential infrastructures and services. Mine corporate social investments (CSI) could make a contribution in this area. Agnico Eagle demonstrates a great openness to reflect on possible strategies to boost resilience. At the level of cultural and food system resilience, the conservation of traditional ecological knowledge (TEK) emerged as fundamental. Areva's current proposal to begin uranium extraction in the calving grounds of the Beverly caribou herd therefore falls into serious question, as it threatens to undermine subsistence livelihoods and the resources foundational to community resilience. The potentially widespread socio-economic consequences of mine closure (and future uranium projects) pose an important point for reflection on the limits of corporate social responsibility. To what degree do mining companies have a responsibility to prevent or compensate for changes in a socio-ecological system changes that are indirectly caused by their activities? We will open up a critical discussion of this and other questions linked to long-term mining impacts and caribou livelihoods.

FALL MIGRATION AND WINTER HABITAT USE OF AN ARCTIC TOP PREDATOR : THE SNOWY OWL

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In migratory species, a good understanding of migratory connectivity (i.e. the linkage between areas used at different stages of the annual cycle) is important because their breeding and non-breeding sites are often very distinct, both spatially and ecologically. Interactions between these stages occur through carry-over effects (i.e. events occurring in one season that affect subsequent ones) and can have serious consequences on survival or reproductive success. We studied the movements from breeding to wintering sites of an Arctic top predator, the Snowy Owl, to shed some light on their post-breeding movements and winter habitat use and site fidelity. Snowy owls feed primarily on lemmings during the summer, a prey showing strong population cycles in the Arctic. Considered an erratic migrant, owls adopt various migration strategies: some birds migrate to the Canadian Prairies in winter where small mammals thrive, but many also stay in the Arctic all winter long, making extensive use of sea-ice and likely feeding on seabirds wintering in polynyas. Due to their recurrent nature and their use by seabirds, several polynyas represent a potentially more predictable food source for owls in winter than small mammals. Thus, we hypothesized that food predictability affects Snowy Owl migration strategies, and predicted a greater fidelity to wintering habitats (due to more predictable resources, i.e. seabirds) than to summer habitats (less predictable resources, i.e. lemmings). To verify this hypothesis, we equipped 23 owls with satellite transmitters at three breeding sites in the eastern Canadian Arctic (2007: Bylot Island, NU 73oN 80oW, N=12 females; 2011: Mary River, NU 71°N 79°W, N=1 male; 2013: Deception Bay, Nunavik, QC 62°N 74W, N=10 females). Birds tracked for at least 12 months were selected for the analyses (N = 18). We used spatial statistic tools to estimate home ranges, distance travelled, site fidelity and winter habitat use (terrestrial vs marine). We also related the tracking locations to environmental data (e.g. sea-ice cover) using the Movebank Environmental Data Automated Track Annotation System. Our preliminary results confirm a high individual variability in the post-breeding movements of owls and that fidelity to wintering sites is higher than to breeding sites. Individuals were also very consistent in their winter habitat choices, leading us to believe that 2 ecotypes of Snowy Owl may coexist: the terrestrial and the marine one. The greater faithfulness to wintering than breeding sites agrees with the idea that predictability of resources is a major determinant of habitat selection. Changes currently occurring to both the terrestrial and the marine ecosystems thus have the potential to affect this top predator of the tundra.

APPLICATIONS OF A SEAMLESS HYDROGRAPHIC DATUMS IN THE ARCTIC: IMPROVED HYDROGRAPHIC SURVEY REDUCTION AND A NEW SET OF COASTLINES.

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The Canadian Hydrographic Service in collaboration with the Canadian Geodetic Survey recently completed a set of tidal water level models as part of the Continuous Vertical Datum for Canadian Waters (CVDCW) project. The CVDCW connects tidal water level datums (high and low water levels, chart datum, etc.) to a national geodetic reference frame for all Canadian tidal

waters. In the past, this was possible only at tide stations which had been surveyed with GPS or by leveling. The CVDCW captures the spatial variability of tidal water levels between stations and offshore by integrating ocean models, tide gauge records, GPS observations, sea level trends, satellite altimetry, and a geoid model. In addition to its use for hydrography, the CVDCW will allow easier integration of hydrographic and terrestrial data by linking them through a common reference frame. Thus it can provide a baseline for storm surge and sea level rise estimates, help delineate flooding thresholds and inter-tidal zones, and aid with practical issues such as sovereignty and the definition of coastlines. Our presentation will begin with a brief overview of the CVDCW. We will then show how the CVDCW improves over traditional multibeam survey reduction methods, using examples from recent surveys in the Arctic where the tidal regime is poorly sampled. Finally, we will present preliminary results of a project to combine CVDCW surfaces with LiDAR data from Victoria Straight, which define a set of shorelines representing high and low water lines.

INUIT NUNANGAT UNIVERSITY: ISSUES AND PROSPECTS

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Canada is the only Arctic Country without a University in its Arctic region. Inuit and Northerners have been advocating for the creation of a Northern/Arctic/Inuit University for many years and it appears as one of ten recommendations in the 2011 National Strategy on Inuit Education. In 2010 the Walter and Duncan Gordon Foundation sponsored consultations on the idea of creating a northern university and concluded that there was broad support for the idea in order to build research capacity, expand post-secondary opportunities and research in the North. During this roundtable, the panelists will address the idea of a Northern/Arctic/Inuit University and try to answer the following questions: - What recent developments in the North have created the right conditions for establishing a university in Inuit Nunangat? - What factors contributed to the establishment of other circumpolar universities? - Given that a number of reports and studies have already affirmed the idea of an Arctic university, what steps have to be taken next to advance the idea forward? - What model of University is best suited to Inuit Nunangat? - How should this/these university(ies) be structured, funded and sustained? - How can the Arctic research community support an initiative to establish a University in the Arctic?

ANALYSIS OF THE JOINT SNOW AND ECOSYSTEM EVOLUTIONS IN NUNAVIK TUNDRA AND TAIGA AREAS (QUÉBEC CANADA) OVER THE LAST 35 YEARS USING SATELLITE DATA

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This study presents a spatial-temporal analysis of the joint evolution of the increase of shrubiness and the dynamics of snowmelt in Nunavik, Quebec, Canada. This zone is characterized by the complexity of the interactions of multiple changes of temperature, snow cover and vegetation growth. The first part of this communication presents the temporal evolution of these changes. The analysis required the use of a large database on climate, satellite data and ground cover at multiple scales over a period of up to 60 years, from 1950 to 2012. The second part of the study consists of a spatial high-resolution analysis of the influence of the fraction of shrub cover on snowmelt. The analysis and interpretation of the results clearly show a significant climate change over the study area, studied from three latitudinal transects corresponding to tundra, open taiga and forested taiga. A significant warming of 0.75 ° C and 1.57 ° C per decade was experienced between zones 1 (tundra) and 3 (forested taiga) respectively. The maximum annual snow depth on the ground decreased over the 3 zones studied while winter precipitations increased in zones 1 and 3 over the last 45 years. The results show a significant increase in shrub vegetation in zones 2 and 3. The impact of the vegetation on snow was analyzed with melt duration (from melt onset to complete melt). It appears clearly that the vegetation triggers the melting process earlier and significantly extends the melt duration (+600%). However, the impact of vegetation does not delay the date of the snow cover disappearance. The high-resolution spatial analysis showed that shrubs cause an earlier snow cover disappearance date than bare soil. This study clearly demonstrates that vegetation growth resulting from global warming impacts the snow cover dynamics, which are also affected by global warming. A thorough study of the processes with in-situ measurements supported by models would help gaining a better comprehension of these phenomena.

QUANTIFYING EMERGING LOCAL ANTHROPOGENIC EMISSIONS IN THE ARCTIC REGION: THE ACCESS AIRCRAFT CAMPAIGN EXPERIMENT

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Arctic sea ice has decreased dramatically in the past few decades, which has opened the Arctic Ocean to transit shipping and hydrocarbon extraction. These anthropogenic activities are expected to increase emissions of air pollutants and climate forcers (e.g. aerosols, ozone) in the Arctic troposphere significantly in the future. However, large knowledge gaps exist how these emissions influence regional air pollution and Arctic climate. Here we present an overview on the ACCESS (Arctic Climate Change, Economy, and Society, a European Union Seventh Framework Programme project) aircraft campaign, which primarily focused on studying emissions from emerging Arctic pollution sources. During the ACCESS campaign in July 2012, the DLR Falcon was based in Andenes, Norway, and was equipped with a suite of trace gas and aerosol instruments (black carbon, ozone, as well as other trace species). During nine scientific flights, emissions from different ship types (e.g. cargo, passenger, and fishing vessels) and a variety of offshore extraction facilities (e.g. drilling rigs, production and storage platforms) were probed off the Norwegian Coast. The emissions from these increasing pollution sources showed distinct differences in chemical and aerosol composition. To put the emerging local pollution within a broader context, we also measured sulfur-rich emissions originating from industrial activities on the Kola Peninsula and black carbon containing biomass burning plumes imported from Siberian wildfires. An overview on the trace gas and aerosol properties will be presented with a focus on different emission sources, and discuss the influence of future local anthropogenic activities on the Arctic air composition by combining measurements with model simulations.

EFFECTS OF LEMMING CYCLES ON REPRODUCTIVE SUCCESS OF ARCTIC-NESTING BIRDS USING DIFFERENT ANTIPREDATOR STRATEGIES

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In the circumpolar Arctic, ground-nesting birds usually exhibit reproductive success that varies greatly year after year. The alternative prey hypothesis suggests that fluctuations in reproductive success should be linked indirectly to lemming abundance cycles through changes in abundance and behavior of shared predators, such as the arctic fox. Despite its importance for our understanding of trophic interactions in the tundra ecosystem, empirical data supporting this hypothesis are limited, especially in the Canadian Arctic. Moreover, such indirect effects of lemmings on avifauna most likely vary among species presenting different reproductive strategies, including a wide variety of antipredator behaviors. Our objective was to investigate the indirect effects of lemming population cycles on interannual variation in reproductive success of birds breeding on Bylot Island, Nunavut. We benefited from up to 19 years of nest-monitoring data for several species (including three shorebirds species, the lapland longspur and the greater snow goose). Simultaneously, we monitored lemming and arctic fox populations. For all bird species, nest daily survival rates and lemming abundance were positively related and the strength of this relationship tended to vary between species. This indicates that some species are less vulnerable to changes in predation pressure due to lemming cycles. Using the longer time-series of goose and longspur nest monitoring, we also tested for a time-lagged effect of lemming abundance. We found evidence of a negative effect of lemming abundance recorded the previous year on nest success, but for greater snow geese the lagged effect faded during lemming peaks. Such delayed effects are most likely the result of higher adult arctic fox abundance in years following lemming peaks. However, arctic fox and lemming abundance were also positively correlated, so that the high bird nest success rates observed during lemming peaks also occurred when arctic fox abundance was the highest. This suggests that the dominant mechanism of the alternative prey hypothesis on Bylot Island is not the change in abundance of arctic fox, but rather a prey switching behavior from lemmings to bird eggs by foxes when lemmings are scarce. Our results thus support the alternative prey hypothesis while (1) emphasizing interspecific differences in how lemmings affect bird reproductive success and (2) highlighting the importance of the prey-switching behavior of shared predators for alternative preys in the arctic tundra. A better understanding of the indirect trophic interactions between lemmings and migratory birds is essential to deepen our comprehension of arctic ecosystems, especially in a context where climate change may affect the dynamics of lemming populations.

UNIVERSAL PERMAFROST DISTURBANCE SUSCEPTIBILITY MODELLING FOR A REGION IN THE CANADIAN HIGH ARCTIC

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Permafrost slope disturbance such as active layer detachments and retrogressive thaw slumps are a major concern for arctic communities and resource development as warming temperatures have led to increasing permafrost degradation. In order to effectively assess and mitigate permafrost disturbance risk, disturbance-prone areas can be predicted through the use of susceptibility modelling. Permafrost disturbance susceptibility modelling is a quantitative assessment of the relationship between the distribution of past permafrost disturbances and a set of influencing terrain attributes that may cause slope instability. In this study we develop a universal permafrost disturbance susceptibility model using a limited disturbance inventory to test the applicability of the model for a broader region in the Canadian High Arctic. Additionally, we use the model to explore the effect of influencing terrain parameters on disturbance occurrence. To account for a large range of landscape characteristics, the model was calibrated using two locations, the Sabine Peninsula, Melville Island, NU, and Fosheim Peninsula, Ellesmere Island, NU. Spatial patterns of disturbance were predicted with a generalized additive model (GAM) calibrated using disturbed and randomized undisturbed locations from both locations and GIS-derived terrain predictor variables including: slope, potential incoming solar radiation, wetness index, curvature, elevation and distance to water. GAMs relate a disturbance inventory to a series of predictor variables (i.e., radiation and terrain variables), to predict areas where disturbances are most likely to occur. The model was validated for the Sabine and Fosheim Peninsulas using independent datasets while the potential to transfer this model to independent sites was assessed at Cape Bounty, Melville Island, NU. Susceptibility models were spatially interpolated at each location to produce permafrost disturbance susceptibility maps identifying areas with a high, moderate and low susceptibility to disturbance. The universal model validated well for both calibration sites (Sabine and Fosheim Peninsulas) with predictive powers (% of correctly classified disturbed and undisturbed samples) of 73% and 90%, respectively. The model was applied directly to Cape Bounty without calibration and validated with a predictive power of 70%. Terrain attributes associated with disturbance initiation were similar regardless of the location. Disturbances commonly occurred on slopes between 3-8°, below marine limit, and in areas with low potential incoming solar radiation. Universal permafrost disturbance susceptibility maps generated as a result of this research provide a first step in hazard and risk assessment. The applicability of this approach is promising for land-management and decision making in remote areas where detailed information on disturbance occurrence is unavailable. Furthermore, permafrost disturbances are climate-related features and act as indicators of past and contemporary climate variations. The relationship between their spatial occurrence and influencing terrain attributes has provided us with valuable information on the mechanical and climatic mechanisms driving disturbance.

FLORISTIC DISCOVERIES AND BIODIVERSITY OF THE CANADIAN ARCTIC VASCULAR PLANT FLORA

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Exploration of the vascular plant flora of the Canadian Arctic has been ongoing for almost two centuries, yet substantial gaps remain in our floristic understanding of this large and difficult-to-access region. Detailed information on the diversity and distribution of Arctic plants is urgently needed to understand the potential impacts of climate change on the region's flora. Since 2008 we have been conducting detailed floristic surveys in botanically-understudied regions of the Canadian Arctic: in Tuktut Nogait National Park and vicinity, mainland Northwest Territories; on Victoria Island, the largest island in the western Canadian Arctic Archipelago; in Katannilik Territorial Park along the Soper River on southern Baffin Island, Nunavut; and along the lower Coppermine River and in Kugluktuk and vicinity, Nunavut. The comprehensive baseline data of our >5000 new collections – housed in the National Herbarium of Canada and with duplicates distributed to other herbaria nationally and internationally – adds important new knowledge to our understanding of Arctic plant biodiversity, which may inform future terrestrial monitoring efforts by identifying areas that contain rare species or unique habitats, for example. Many of our collections represent first records for specific areas, including major and minor range extensions for the Canadian Arctic Archipelago, Victoria Island, the western Arctic, the Coppermine River valley, and southern Baffin Island. Other collections represent the second or third collections of poorly-known species at the edge of their ranges in the Canadian Arctic, and many fill in gaps in the known distributions of Arctic species. We review our floristic work in the context of current understanding of the Canadian Arctic flora, and identify other underexplored Arctic regions of Canada that would benefit from future floristic study.

THE LAST ICE AREA: A TEMPLATE FOR RESILIENCE

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Arctic sea ice provides the infrastructure for unique ecosystems that support many species, including humans. Global Climate Models project that by mid-century, multi-year summer sea ice will be restricted to parts of the Arctic Archipelago and northern Greenland; a loss of approximately

85% of summer sea ice habitat compared to the 1980-2000 time period. The future region of remnant sea ice is the Last Ice Area, a modern day refuge in these times of global warming. The continuing trajectory of ice loss will transform the Arctic marine ecosystem from one dominated by multi-year, thick sea ice to an ecosystem dominated by thin seasonal sea ice and open water. The loss of multi-year sea ice and decline in the overall ice extent will affect the structure, functioning and biodiversity of the oceans, and it is possible that entire ecosystems will be lost. Sea ice obligate and associated species may become limited in distribution to the Last Ice Area. Management of this future refuge to ensure protection of sea ice habitat for ice dependent species is important not only for biodiversity conservation but also for Inuit whose culture is closely linked to the sea ice. The Last Ice Area project, sponsored by WWF, has supported diverse research projects aimed at creating and synthesizing knowledge about the Arctic Archipelago and northern Greenland. Many of these projects were recommended by representatives of local people from Greenland and Canada. The research included: scaled down regional sea ice projections for the Last Ice Area; an Inuit knowledge of seals workshop; an ICC discussion paper on appropriate management tools for the region; and narwhal and polar bear field studies. This presentation will discuss the process of engaging communities and northern representatives on the Last Ice Area project, development of research priorities, and how these efforts have led to ideas for adaptive management in the Last Ice Area.

SCIENCE OUTREACH: WHAT ARE WE TRYING TO ACHIEVE, AND CAN WE DO BETTER?

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The polar science community is full of enthusiastic scientists and educators who love to engage with a wide variety of people and share their passion for the polar regions and polar science. In fact, between the science and the outreach we're so busy talking about what we do that we sometimes forget to think about why we're doing all this great stuff… or what's so great about it. What would success look like and how could this be measured? How can we share our successes, learn from our mistakes, and improve as a community? While there is an excellent culture of accountability in both formal and informal science communication sectors, the same rigour is not applied to the majority of 'outreach' activities that are initiated by the science community. Many of these activities are undertaken based on 'what feels right' and opportunism, and are proclaimed to be a success based on little or no formal evaluation. In addition, they are often treated as a voluntary activity on top of an already-busy workload (not integrated as a core part of a scientists job) and so any additional time investment beyond delivery of the activity itself is rare. As a result, much of this work goes undocumented, is not evaluated from the perspective of the science community, and is rarely subject to peer-review and its associated benefits, including professional rewards. As an example, an estimated 14 million people in 70 countries heard about the International Polar Year 2007 – 2008 through it's associated outreach activities. But what did this actually achieve? We don't know. Not really. We know people had fun. We think some kids were inspired. We know that lots of people heard of IPY where they hadn't before. But very few of us carried out any serious evaluation or assessment of our outreach, or worked with researchers who have these skills. While the science community is busy doing outreach, there is a well-established field in social science that spends a lot of time thinking about outreach. But unlike in other disciplines, the do-ers and the thinkers rarely talk to each other – to the detriment of us all. This talk will explore the different perspectives and roles in science outreach and public engagement, as well as new opportunities that could encourage science communication theory and practice to better inform each other.

CHARACTERIZING SNOW ACCUMULATION AND MELTS, AND FLOW VARIABILITY IN THE ATLIN LAKE BASIN, BRITISH COLUMBIA AND YUKON, CANADA

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Snow is an important hydrological component in northern cold-mountainous basins. The interactions between weather, climate, terrain and land cover results in complex patterns of different snow accumulation and melt, interception, and infiltration through frozen soil; the resulting flow patterns are thus also complex. This study is performed to understand the basin-scale hydrology of snow in the 7000 km2 Atlin Lake basin of southwestern Yukon and northwestern British Columbia. Landcover in the basin varies with elevation, from shrubland and forest in the east to bare rock and glaciers in the west. Of the nine percent of the basin covered by glaciers, the largest and hydrologically most significant is the Llewellyn Glacier. The Cold Region Hydrological Model (CRHM), which applies physically-based hydrological and energy balance equations, is used in this study. The results will indicate the role of land cover,

climate and terrain on snow accumulation and melt patterns and flows, and will identify the components that exert the greatest control on water balance behaviors in the study area. Recommendations for future analyses will also be discussed.

ABORIGINAL COMMUNITIES, TRADITIONAL KNOWLEDGE, AND THE ENVIRONMENTAL LEGACIES OF EXTRACTIVE DEVELOPMENT IN CANADA

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In northern Canada Aboriginal traditional knowledge (TK) has in the last 40 years been formally incorporated into state-driven wildlife management and in some cases approval processes for industrial projects. Yet, as the environmental legacies of northern development proliferate, questions remain about how successfully Aboriginal TK has been included in and applied to issues of remediation, reclamation and restoration at former industrial sites. This paper will focus in the high profile case of the Canadian government's attempt to remediate arsenic contamination at the former Giant Mine. This abandoned mine contains 237,000 tons of this toxic material stored underground adjacent to Yellowknife and the Dene communities of Dettah and Ndilo. While the Giant Mine Remediation Project has indicated a desire to incorporate traditional knowledge into the reclamation project, the complex technical nature of the process, and a fundamental misunderstanding about the epistemological basis of Aboriginal TK, has prevented anything more than token inclusion of such knowledge. Using transcripts from the recent environmental assessment of the project, we argue that proponents of remediation projects fail to acknowledge that Aboriginal TK is not simply a storehouse of scientific data on plants and animals, but is woven together with historical memories of rapid social, economic and environmental changes associated with northern development projects. In the case of Giant Mine, memories of historic air and water pollution problems at Giant Mine (issues that caused extensive sickness and death in Dettah and Ndilo) have fuelled local concerns about the risks associated with storing arsenic at the site. Aboriginal TK incorporates memories of the land before mining and also the lived historical experience of environmental injustice to the toxic by-products of mining. These perspectives should be acknowledged and incorporated into planning processes for remediation projects in the Canadian North.

WHERE ARE THEY NOW? A CASE STUDY OF INTERNATIONAL TRAVEL SUPPORT FOR EARLY CAREER RESEARCHERS

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To help maintain the continuum of knowledge in polar sciences that was established during the 2nd International Conference on Arctic Research Planning (ICARP) and the International Polar Year (IPY), it is of great importance to continue to support the next generation of researchers. Many organizations are working on initiatives that allow early career Arctic researchers to discuss their ideas, work together, and exchange information with an international and renowned group of Arctic scientists. Yet, the evaluation of how effective these initiatives are is still lacking. To aide in assessing how past support has influenced early career Arctic researchers and potentially enhanced future opportunities, the Association of Polar Early Career Scientist (APECS), the Climate and Cryosphere Project (CliC) and International Arctic Science Committee (IASC) are working together to use IASC funding of early career researchers as a case study to assess the value of travel support for early career researchers. As a contribution to ICARP III, the "Where are they now?" Project investigated the subsequent career paths of early career researchers that received travel funding from IASC since the start of the most recent IPY (2007-2008) until 2013. IASC provided travel support for 287 early career researchers during this time. A survey was sent to each of these researchers and 132 people responded, a 45.9 % response rate. Results from the survey indicate that 90% of these researchers are still active in Arctic work. Preliminary qualitative results indicate that travel support was beneficial to both the research and careers of the early career scientists responding. Responses from survey participants provided details on the specific impacts of travel support to various meetings and included suggestions on how funds could be better used in the future. Results will help form new standards for supporting the next generation of Arctic researchers.

AUTOMATED ZOOPLANKTON IDENTIFICATION FOR BAFFIN BAY AND ADJACENT WATERS – COMBINING IN-SITU IMAGING, MACHINE LEARNING AND TAXONOMY TO GAIN INSIGHTS INTO THE FINE-SCALE DYNAMICS OF ZOOPLANKTON

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Zooplankton are a key element in Arctic marine food webs. Linking the primary producers with higher trophic levels (fish, marine mammals, seabirds). Traditional methods used to capture zooplankton (i.e. nets) integrate or roughly stratify the water column, and do not provide the necessary spatial resolution for studying the dynamics of the fine-scale vertical distribution of zooplankton taxa and associated environmental parameters. The lack of resolution from traditional zooplankton samplers can be overcome with the "Lightframe On-sight Key species Investigation" (LOKI) system, a camera system capable of in-situ optical imaging of zooplankton species. Moreover, the statistical analysis of imaged zooplankton has many advantages over traditional analysis of zooplankton samples, giving an error estimate for zooplankton abundance and ultimately making the results more reliable. These results can then for example cater towards better ecosystem models with reduced uncertainty. Here, we present a set of machine learning models, based on LOKI imagery and their analysis, that allow for an automatic identification of zooplankton and their developmental stages in Baffin Bay and adjacent ecosystems. In addition to model development and validation, insights into the fine-scale vertical distribution of selected zooplankton taxa will be given based on data collected during the 2013 ArcticNet cruise onboard the CCGS Amundsen.

POPULATION DIFFERENCES IN INTER-CONTINENTAL MIGRATION DRIVES BODY SIZE EVOLUTION, CONTAMINANTS EXPOSURE, AND RESPONSE TO ICE BY ARCTIC BREEDING LOONS.

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Three species of loon (family Gavidae) occur in low densities across much of the North American Arctic. Despite their conspicuous ecology (vocal territorial rulers of tundra lakes) and conservation concerns (G. adamsii currently being evaluated for Endangered Species Act protection), they remain little studied. Migration behavior, pathways, and population delineations have not been examined due to a nearly complete lack of marking efforts. Beginning in 2000, we initiated a project to define these migration attributes. Over the next 14 years, we deployed satellite transmitters on 38 Red-throated Loons (G. stellata) across four populations in Alaska and 85 satellite transmitters on Yellow-billed Loons (G. adamsii) across 4 populations in Alaska and Canada. More northerly nesting populations migrated to east Asia whereas more southerly populations stayed within North America, wintering along the Pacific coast from southern Alaska to the Baja Peninsula of Mexico, with breeding latitude correlated with wintering latitude. Migration to Asia was substantially longer (6000 km) than migration within North America. Migrants to Asia incurred greater exposure to contaminants than those wintering in North America. Toxicity of PCBs in eggs of Red-throated Loons was an order of magnitude higher in Asian migrants. For Yellow-billed Loons, exposure to mercury was greater for birds wintering farther west (i.e., Asian migrants). For loons breeding in interior Canada, substantial plasticity in migration route and distance was evident. Most migrated to marine wintering habitats via relatively short migrations (< 1800 km) over mountainous habitats with few lakes, whereas others migrated to the same wintering areas but via a marine routing that tripled the travel distance. Some individuals even used these dramatically different migration pathways in different seasons. Overall, interior short-distance migrants were 20% smaller and genetically different from long-distance coastal migrants. Evolution for smaller body size for this population was likely driven more by the comparative lack of stopover sites during migration than by the total migration distance. For loons breeding in northern Alaska, where open marine waters were within 200 km of breeding sites, timing of arrival at the breeding area was fairly synchronous and corresponded with the opening of moats on lake perimeters when ice covered > 90% of lake surface areas. A few days delay in arrival resulted in a substantial increase in the probability of losing their territory from the year before. Timing of arrival was much less synchronous for loons migrating over mountains, perhaps indicating that cues to the phenology of breeding sites were less readily available. For this heavy bodied family of birds, energetic costs and total time in migration are substantial, encompassing up to half of each year.

THE DESIGN AND BUILDING OF CULTURALLY APPROPRIATE NORTHERN HOUSING

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Over the past ten years a number of projects across the Canadian north and Alaska have made important inroads in delivering designs for northern housing that better address the unique needs of northern indigenous peoples, while also delivering housing that is significantly more energy efficient and better suited to the harsh northern environment. A range of prototype projects have begun to provide alternative models for the design of northern housing, as well as different building approaches to delivering super energy efficient housing. In order to address rising construction and land development costs, a significant issue in all northern jurisdictions, northern housing agencies have identified the need to move towards the design and construction of multi-unit housing. With a strong social/ cultural preference towards single family homes, the challenges of delivering more culturally appropriate multi-unit housing has emerged as an important part of this process. This presentation will explore recent examples of culturally appropriate energy efficient housing that has been designed and built in the north. This will include an examination of some of the design process and the use of charrettes to bring local perspectives and input into the design process, and some of the important cultural ideas that have been incorporated into the designs. The presentation will focus on recent work being carried out the design of a multi-unit residential building that is being designed for the Inuit communities of Nunatsiavut in northern Labrador, examining the ideas and issues identified in the design charrette and how these ideas were incorporated into the design of the building. The presentation will also include an overview of recent work on housing projects being carried out by the Cold Climate Housing Research Center in Fairbanks Alaska. As part of the overview of these projects, the presentation will also examine the issue of energy efficiency and the importance of developing super energy efficient housing for northern communities. This is a significant issue both for the long term sustainability and survivability of northern communities. An examination of the potential for the use of alternative energy sources, particularly solar, will be included in this aspect of the presentation. The reduction of energy consumption in buildings has been identifies by the governments of the northern territories as an important and significant aspect of the northern climate change adaptation strategy that includes targets for the reduction of greenhouse gases and their impact on the environment.

LATEST DEVELOPMENTS AND EXPERIENCES IN HIGH-ARCTIC SEABED SURVEY

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Seabed survey in the Arctic presents several unique challenges for traditional seabed survey technologies and techniques. Subzero water temperature, remote location and accessibility, and the prevalence of sea ice impede traditional towed system surveys. Less than 10% of the Arctic has been surveyed for existing nautical charts, which results in a significant amount of unknown seabed bathymetry. As a result, surface vessels with hull mounted or towed sonar systems may not be able to operate in uncharted areas due to the high risk of running aground. The latest generation Autonomous Underwater Vehicles (AUVs) offers a number of advantages when compared to surface vessels with towed sonar or hull-mount sonar. AUVs are capable of flying close to the seabed at constant altitudes for high-resolution imaging, carrying a variety of acoustic, optical and magnetic sensor payloads. AUVs are also highly maneuverable, and using forward looking sonars, can operate safely in areas of unknown bathymetry with no risk to human operators. In addition, untethered AUVs can operate under ice shelves and in regions of high density sea ice, and provide both downward looking seabed bathymetry and upward looking 3D ice thickness measurements with technologies such as Interferometric Synthetic Aperture Sonar (InSAS). InSAS delivers ultra-high range independent image resolution with 3D seabed bathymetry at higher Area Coverage Rates (ACRs) and resolution than can be achieved with traditional physical aperture limited sidescan sonar. The along track resolution is achieved by synthesising the required aperture length by moving a physical aperture while sampling the field of view. The result is a compact power efficient solution ideally suited for use on Autonomous Underwater Vehicles (AUV) for high resolution, large area seabed and ice profile survey. In August 2014, Kraken Sonar Systems participated in an Arctic expedition led by Parks Canada to search for the missing ships from Sir John Franklin's ill-fated 1846 expedition to locate the Northwest passage. The expedition team used a Kraken InSAS system, installed onboard the Arctic Explorer AUV owned by Defense Research and Development Canada (DRDC). Results from the expedition will be used as a demonstration of the benefits and developments of AUVs with InSAS for high-arctic surveys, including the fusion of ice keel measurements with seabed bathymetric measurements.

CANADA'S NORTHERN CONTAMINANTS PROGRAM – FROM SCIENCE TO POLICY ACTIONS

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For the past twenty years Canada's Northern Contaminants Program (NCP) has coordinated research and monitoring on transboundary pollutants in the Canadian North. The primary objectives of the program have been to a) inform and influence the development of policies and regulations that reduce sources of long-range pollutants; and b) provide information to health authorities for the development of public health advice and to Northerners so they can make informed dietary choices. Research and monitoring has addressed scientific questions related to all aspects of contaminant cycling and impacts in northern ecosystems, from long-range sources and transport to ecosystem and human health risks. Results are periodically synthesized and published in comprehensive assessments. The most recent of these NCP assessments titled Mercury in Canada's North and Persistent Organic Pollutants in Canada's North have been released in 2012 and 2013 and the Contaminants in the Canadian Arctic: Summary for Policy Makers is now available for distribution at this conference. To ensure that NCP science remains policy relevant and that results are effectively incorporated into policy development processes, the program engages a multidisciplinary and multi-jurisdictional Management Committee that oversees all aspects of the program. Through the NCP Management Committee, which is comprised of federal, territorial, provincial, academic and northern Aboriginal organization representatives, and other national, regional and international networks, the NCP is able to maximize the relevance of its science program to a multitude of stakeholders who share an interest in protection of the Arctic environment and the health of its people. NCP continues to support northerners and deal with food safety issues. Participation in international science and policy initiatives however is an essential way in which the NCP has been able to expand the influence of its science to international policy makers. The NCP and associated scientists work very closely with the Arctic Council's Arctic Monitoring and Assessment Programme, and provide circumpolar leadership on numerous Arctic science issues. Most recently NCP scientists made a substantial contribution to the 2011 AMAP mercury assessment, co-led by Canada and Denmark and now to the AMAP Human Health and POPs assessments, both also co-chaired by Canada (and Norway and Sweden, respectively). NCP results have also fed directly into UNEP negotiations towards global agreements, including the 2001 Stockholm Convention on POPs and recently the 2013 Minamata Convention on mercury. The NCP influenced both the Canadian and Arctic Council positions at the Intergovernmental Negotiating Committee meetings to focus on reducing the main sources of atmospheric emissions. This presentation will further describe how the NCP has addressed the issue of POPs and mercury in the Canadian North, and how science has been used to inform and influence the development of policies aimed at reducing contaminant related risks to ecosystems and people.

ENVIRONMENTAL PROTECTION IN ARCTIC WATERS: CHALLENGES AND OPPORTUNITIES

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MICROBIAL WATER QUALITY IN APEX RIVER FROM 2009 TO 2012: INSIGHTS FROM COMMUNITY BASED MONITORING

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Climate change is expected to create conditions that will increase the densities and diversity of microbe pathogens in Arctic community drinking water supplies. Microbes in surface waters are highly variable both temporally and spatially, however, little long term empirical information exists on the microbial condition of the many lakes, rivers, streams that are used as traditional drinking water sources by Nunavut residents. Nunavut community residents have noted wide ranging changes in traditional indicators of surface water quality; these observations prompted calls for more analytical expertise, training and facilities in Nunavut to better monitor water quality and to identify potential health risks associated with changing conditions. This presentation will share results and lessons learned from a monitoring and training program initiated by Nunavut Research Institute (NRI) in 2009 to track indicator bacteria (total coliforms and Escherichia coli) in the Apex (Niaqungut) river of Iqlauit Nunavut. Apex river drains a small catchment (60km^2) and is an important traditional drinking water source for residents of Iqaluit. The watershed supports diverse recreational uses including hiking, camping, swimming, and dog-walking. Apex has also been identified as a future supplementary water supply for the community's public drinking water system. NRI staff and students of Nunavut Arctic College (NAC)'s environmental technology program collect and test Apex water samples river regularly during the annual ice free period (usually early June to mid October). Samples are processed at the NRI water laboratory using defined substrate technology (Colilert™) which allows for rapid and simple detection and enumeration

of total coliforms and Ecoli in surface water. 248 samples were tested from 2009 to 2013, with total coliforms present in all samples at densities ranging from 2 cfu/100ml to as high as 2519cfu/100ml. Ecoli was detected in only 10% (26) samples at very low densities (<7cfu/100ml), suggesting the river remains in a relatively pristine state. Coliform densities demonstrate year to year variability in their range, maximum, minimum, and mean concentration. The timing of the peak coliform densities, and the seasonal trend from freshet to baseflow also varies interannually. The relationship between coliforms and hydrologic variables such as such as water temperature, river discharge and rainfall is complex. Our project has demonstrated that community members with minimal training and professional support are able to use defined substrate technology proficiently to provide accurate, reliable, and useful estimates of indicator bacteria in important water resources. The close proximity of NRI's analytical facilities to Apex river has reduced the time and effort required for sampling, enabling us to integrate the monitoring activities into NRI's busy summer research schedule. Opportunistic collaboration with other research initiatives has provided access to additional funding logistics support, and valuable technical expertise to help expand the scope of our monitoring efforts, and to develop analytical tools to interpret our results. Monitoring results have been shared with Iqaluit municipal engineers, and with public health officials.

INLAND TLINGIT OF TESLIN, YUKON: CLAN ORIGIN STORIES OF MOTHER.

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Why did Mother's sister say she was one clan when we always knew her to be another clan? Mother, Emma Joanne Shorty (nee Sidney), a mission school survivor, is an inland Tlingit from a Raven moiety clan. Mission schools, government policies and western institutions have very nearly made obsolete the importance and historical significance of Mother's clan stories, especially in light of validating that we are Tlingit and of defining traditional knowledge at intergovernmental policy levels such as Arctic Council. I am a PhD candidate and my research is on Mother's clan stories. Catherine McClellan surmises that the Koo?hittaan are Athabaskan speakers because the Koo?hittaan people that she interviewed in the 1950s discuss a migration towards the coast of Alaska from Teslin, Yukon. My dissertation documents the stories and the story-gathering processes of published and private holdings on Mother's clan stories. My dissertation includes literature and oral history reviews, especially on those who have knowledge about the Koo? connections to the Inland Tlingit from Teslin, Yukon. The research quest of who are my mother's clan brought me to Teslin, Yukon, Canada and Juneau, Sitka, and Angoon, Alaska, USA. This indigenous-led research focuses on my mother and her clan stories because Tlingit people follow a matrilineal system. Tlingit literacy constructs are transmitted despite my rudimentary understanding of Tlingit language and literacy, property, family, ancestors, history, songs and values. I am an insider and an outsider to my culture. I am Tlingit and I do not understand enough Tlingit to follow a Tlingit story. Tlingit elders value the perpetuation of culture and histories in our Tlingit languages. From an insider perspective I am privileged to hear, to learn, and to retell mother's maternal clan stories. Relearning the stories required a review of outsider works, including Tlingit ways of understanding history and images. My topic generates Tlingit knowledge about Mother's clan and informs who we are as Mother's offspring. Today, we need access to our local and indigenous histories, as well as access to our stories, which connect us to the land and her resources. The inland Teslin Tlingit has responded to history by recording, validating and commissioning research on the inland Tlingit people. Teslin Tlingit elders and knowledge bearers are busy developing curriculum, implementing social justice schemes as per Tlingit paradigms, and ensuring that the people are governed using Teslin Tlingit constructs. My study examines the impact of knowing our indigenous history at intergovernmental forums like public education and Arctic Council. As a result of this research Tlingit ways of documenting history are discovered and Tlingit research (literacy) frameworks are revealed.

EFFECTS OF SHORT-TERM EXPERIMENTAL WARMING AND DECIDUOUS SHRUB GROWTH ON PERFORMANCE OF THREE DWARF BERRY SHRUBS IN SUBARCTIC CANADA

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Dwarf berry shrubs are an important compositional, structural and functional element of treeline and tundra ecosystems globally. Such ecosystems are undergoing rapid changes linked to increased climate variability and warming,

and many of these changes could be contributing, directly or indirectly, to increased variability in berry shrub performance (growth and fruit production). Climatic changes with documented effects on berry shrub phenology and performance include increased temperature and precipitation, enhanced UV-B radiation, extreme winter warming, thawing and icing events, and earlier snowmelt timing. However, other secondary community-level changes that are also occurring in response to climate variability may play an equally important role. This is potentially true of tundra shrub expansion, which has been widely documented for upright deciduous shrubs. Taller and more widespread deciduous shrubs could alter the performance and distribution of berry shrubs by changing species interactions in a shared local resource pool. A thorough understanding of this relationship is required to respond and adapt to changes in berry resources, as berries represent an essential natural and cultural resource for northerners and wildlife alike. Here, we present a multi-species, multi-site analysis on the relationship between upright deciduous shrubs [primarily dwarf birch (Betula glandulosa)] and three dwarf ericaceous berry shrubs [bilberry (Vaccinium uliginosum), redberry/lingonberry (Vaccinium vitis-idaea) and crowberry (Empetrum nigrum)] under experimental warming conditions. We predicted that 1) experimental warming will increase deciduous shrub abundance and canopy structure among sites, resulting in an overall decrease in berry shrub fruit production and 2) sensitivity to upright deciduous shrub growth will depend on berry shrub capacity for upright growth. For example, berry shrubs with truly prostrate growth forms will exhibit the greatest declines in fruit production, whereas those that can compete vertically for available light will be less affected. Passive open-top warming chambers (OTC) with paired control plots were established in five locations across subarctic Canada: Nunavut: Qamani'tuaq (N=20); Nunavik: Kangiqsujuaq (N=12), Kangiqsualujjuaq (N=14 and N=12); Nunatsiavut: Torr Bay (N=30) and Nain (N=9). Warming experiments were established in 2008-2009, and sites were re-sampled in summer 2011. Vegetation was sampled following the CANTTEX pin-drop protocol, and soil temperature was monitored throughout each year. Berries were harvested from OTC/control plots at the end of each growing season to estimate fruit production among species and across sites. We used generalized linear mixed hurdle models to examine effects of warming on overall plant growth, and to test the effect of abiotic conditions and biotic interactions on the presence/absence of fruit and fruit production among berry shrubs. Baseline data show a latitudinal gradient in deciduous shrub abundance and that local variation in climate and site characteristics plays an important role in berry production across sites. We also detected an underlying negative effect of dwarf birch structure on berry occurrence and fruit production within control plots. After two and three years of experimental warming, we detected changes in berry plant structure and fruit production, which is partly attributed to changes in dwarf birch abundance and height.

SURVIVING AND THRIVING IN A CHANGED ARCTIC - INUIT VISIONS FOR THE FUTURE OF THEIR COMMUNITIES

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The efforts of Inuit within many fora including the Arctic Council and ArcticNet are invaluable for decision makers and for Inuit themsleves. The AACA process will provide timely integrated information for evidence based decision making and will support Inuit to not only survive but thrive in the changed Arctic.

The Arctic is no longer emerging as a globally important region. The Arctic has emerged. No longer is climate change the driving force for Arctic decision making, the climate has changed. Today global commodity prices for natural resources are the variables influencing research directions, policy and decision making. This new reality and understanding is crucial for Inuit if we are to have a say in the future of Inuit Nunaat. The Arctic and its peoples have proved the value of their engagement and the knowledge they bring to the table and are now central to many global environmental and economic decisions – this must be true in Canada as well.

For the last two decades, the essential role the Arctic plays on the global stage has been a focal point in media and at negotiating tables all over the world. This has provided Inuit, at times, the opportunity to underscore the importance of evidence based decision making and the need to use the best knowledge available. To go slow and make decisions which will enhance the future of the Arctic and its peoples rather than erode it. The understood significance of western and Inuit knowledge related to environmental change, social and economic change, and human well-being in the Arctic is a critical step toward an improved understanding of how best to respond, adapt, mitigate and yes, take advantage of the changing Arctic for Inuit communities, the Canadian environment, economy and broader global interests .

THE CONCEPTS ICE-OCEAN PREDICTION SYSTEM

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This presentation provides an overview of a suite of coupled ice-ocean prediction models being developed by the Canadian Operational Network of Coupled Environmental PredicTion Systems (CONCEPTS), a tri-departmental initiative between Environment Canada, Fisheries and Oceans Canada and National Defense, with a partnership with the French operational oceanography centre Mercator-Océan. The Global Ice Ocean Prediction System (GIOPS) has been implemented for operation at the Canadian Meteorological Centre (CMC). GIOPS provides ice and ocean analyses and 10 day forecasts daily at 00GMT on a global 1/4° resolution grid. GIOPS includes a full multivariate ocean data assimilation system that combines satellite observations of sea level anomaly and sea surface temperature (SST) together with in situ observations of temperature and salinity. In situ observations are obtained from a variety of sources including: the Argo network of autonomous profiling floats, moorings, ships of opportunity, marine mammals and research cruises. Ocean analyses are blended with sea ice analyses produced by the experimental Global Ice Analysis System. Atmospheric fluxes for 10 day forecasts are calculated using fields from CMC's Global Deterministic Prediction System. Besides GIOPS, a number of ice-ocean prediction models for regional and coastal oceans, with significantly higher spatial resolutions, are under development. The performance of these models in simulating the variability of sea-ice, hydrography and circulation in the Arctic Ocean will be presented.

CHANGING THERMAL STATE OF PERMAFROST IN NORTHERN CANADA

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Change in permafrost temperature is an important indicator of the state of permafrost and of a changing climate. Permafrost temperatures have been measured in boreholes across northern Canada for three decades. The International Polar Year (IPY) provided the opportunity to enhance the permafrost monitoring network which now consists of over 150 boreholes representing the wide range of vegetation, geological and climate conditions within the Canadian permafrost regions. A snapshot of the thermal state of permafrost was also developed during IPY (2007-09) that provided a baseline against which future change can be measured. Recent permafrost temperatures measured in 2013-14 are compared to the IPY snapshot to evaluate the change in permafrost thermal state that has occurred since IPY. This change is also examined in the context of the longer term record for some monitoring sites. Current ground temperatures, measured at or close to the maximum depth of season variation, at many sites are higher than those measured during IPY. However, the greatest change is found in colder permafrost especially in the eastern and High Arctic. For example at sites established during IPY in the Baffin region of Nunavut where permafrost is at temperatures between -5 and -15°C, current temperatures at 15 m depth are up to 1°C higher than during IPY. Although the records for these sites are short, this recent change in permafrost temperature is consistent with that observed in the longer record for Alert in the High Arctic which shows a general increase in permafrost temperature since the 1980s with a greater rate of increase (about 1.5°C per decade at 15 m depth) since 2000. Records from Alert indicate that some of the highest air temperatures have occurred since 2000 with 2009-2012 being among the warmest years to date. This recent warming is also likely responsible for the increase in permafrost temperatures observed over the past decade. Change in permafrost temperatures since IPY has been smaller in northwestern Canada. For sites in the continuous permafrost zone of the northern Mackenzie region, increases in permafrost temperature are generally less than 0.2°C. In warm permafrost in the discontinuous zone of the Mackenzie Valley and southern Yukon, little or no change in permafrost temperature has been observed. The longer records available for sites in the Mackenzie Valley indicate a general warming of permafrost since the 1980s but temperatures have increased at a lower rate since 2000 partly due to lower air temperatures following a peak in 1998. At sites where permafrost is at temperatures close to 0°C, heat energy is largely used to thaw the ice in the ground, resulting in degradation of warm permafrost since IPY. In general, warming of permafrost is continuing across northern Canada. These changes in permafrost thermal state and degradation of warm

permafrost have implications for ecosystems, infrastructure and communities. The ongoing data collection from the monitoring network provides essential information to plan and adapt to these changes.

COMPOSITION, DIVERISTY AND VERTICAL STRUCTURE OF THE ZOOPLANKTON COMMUNITY IN THE BEAUFORT SEA

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We studied the zooplankton communities of the Beaufort Sea as part of a multi-year and interdisciplinary effort to characterize the physics and biology of the Beaufort Sea. Knowledge of the composition and spatial distribution of the zooplankton community is essential given their importance as trophic links, as is establishing foundational data in light of global change and increased oil and gas industry interest in the Arctic region. This work is part of a multi-year dataset (2010-2014) that provides a modern reference point from which future change may be gauged. Zooplankton were sampled along cross-shelf transects from depths of 20 to 1000 m between Camden Bay and the Mackenzie River during August 2013. This study represents the first depth-stratified examination of these communities. In total 92 taxonomic categories were documented, with the greatest diversity observed in the copepods (46 species). Over 50% of the abundance and biomass was concentrated in the upper 100 m where the community was dominated by a guild of Arctic taxa, including Calanus species, Oithona similis, and the Pseudocalanus species complex. The presence of euryhaline taxa such as Limnocalanus and Eurytemora reflected the freshened surface water observed in the study region. Pacific expatriates such as Neocalanus cristatus and Eucalanus bungii were also present in low abundances. Abundance and biomass generally decreased with depth, with the exception of a slight increase in both parameters observed in the transition to Atlantic water (200-300m). The community exhibited a layered structure that was highly correlated with salinity and depth (Spearman correlation = 0.83).

THE TAIGA PLAINS RESEARCH NETWORK: OBSERVING NET CARBON, WATER AND HEAT EXCHANGES ACROSS A LATITUDINAL PERMAFROST GRADIENT IN NORTHWESTERN CANADA FOR IMPROVED UNDERSTANDING OF HIGH LATITUDE ECOSYSTEM RESPONSES TO CLIMATE CHANGE

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Given their large global coverage (~22%), high latitude (i.e., boreal, subarctic and arctic) ecosystems exert substantial influence on regional and the global climate systems through the land surface energy balance and the land surface-atmosphere net exchanges of well-mixed and long-lived greenhouse gases (e.g., carbon dioxide [CO2], methane [CH4]), respectively. These land surface-atmosphere interactions of high-latitude ecosystems are partly influenced by the spatial and temporal dynamics of permafrost, i.e., by perennially cryotic ground, underlying an active (i.e., seasonally thawed) layer. A wealth of studies has demonstrated that high latitude ecosystems with permafrost are undergoing rapid changes in composition, structure, functioning, extent and spatial distribution in response to climate change and associated increasing atmospheric CO2 concentrations, warmer air temperatures, and altered precipitation patterns. For example, the northward movement of the boreal forest treeline into areas presently occupied by subarctic woodlands and arctic tundra in the continuous permafrost zone (>90% in areal extent) is contrasted by rapidly decreasing boreal forest coverage in the discontinuous (50-90% in areal extent) and sporadic permafrost zones (<50% in areal extent) where boreal forest with ice-rich, relatively warm and thin permafrost is replaced by permafrost-free peatland and lake ecosystems. Through various resulting positive and negative climate system feedbacks, these ongoing changes will have important implications on how high latitude ecosystems across pan-Arctic interact with the atmosphere. To provide better understanding on the mechanisms of high latitude ecosystems' responses to today's changing climate, the Taiga Plains Research Network (http://taigaplains.ca/) initiated eddy covariance measurements of net carbon, water and heat exchanges at four research sites (from south to north: Scotty Creek [near Fort Simpson] – Smith Creek [near Wrigley] – Havikpak Creek – Trail Valley Creek [both near Inuvik]) along a 1000-km permafrost gradient (from south to north: sporadic – discontinuous – continuous) across the Taiga Plains, Northwest Territories, Canada. With this contribution, we introduce the

regional network of eddy covariance towers to the ArcticNet community, present the first two years of measurements, and discuss the link of our efforts to various ongoing and proposed high latitude research programs and projects.

COLLABORATING THOUGH DATA - ASSEMBLING THE PUZZLE PIECES OF THE ARCTIC ATMOSPHERE

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In the Arctic, advancing our understanding of the rapidly changing environment through research integration must embrace the challenges posed by the interdisciplinary, inter-agency and international context of Arctic research, spanning needs from basic understanding to decision support. Among other things, progress in this research context relies on the skillful scientific integration of diverse environmental observations. When assembling such a large and complex puzzle, a reasonable first question is, "Where are all the pieces?" In other words, to be integrated, observations must first be discoverable. For the International Arctic Systems for Observing the Atmosphere (IASOA), a consortium of 10 independently funded, atmosphere observatories circling the Arctic, a lack of integrated data access across observatories was hindering collaborative science objectives. The IASOA steering committee was initially skeptical of the value of developing a data portal for the collaboration. A high level concern was how such a small, research-driven collaboration would create and maintain all that metadata – hundreds if not thousands of unique descriptions. The good news was they didn't have to. IASOA was able to use a highly leveraged approach to design and populate its data access portal based on harvesting the relevant metadata from existing collections. Most IASOA observatories are already active partners in global networks with robust data management capabilities such as Global Atmosphere Watch (GAW) and the Baseline Surface Radiation Network (BSRN). IASOA observatories are also funded and maintained by sponsor agencies with their own long-term repositories. Automated harvesting hits roadblocks when repositories have made incompatible decisions in their metadata formats and keyword vocabularies. IASOA needed to work across 10 global network repositories and as many large institutional and project-level repositories to identify commonalities and integrate these into its harvesting process. As a result of existing efforts to move towards standards, IASOA was able to rapidly assemble metadata for nearly 1000 datasets and to share considerable knowledge among the contributors to the benefit of both the portal and the large repositories. IASOA has now moved from finding pieces to assembly through its expert group structure. The enabling cyberinfrastructure of the data access portal will continue to underpin these essential expert collaborations.

PALEOMAGNETISM IN THE CANADIAN ARCTIC

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Along with the dramatic decrease in global geomagnetic field intensity, recent observations demonstrate that the geomagnetic field in the Arctic has dramatically changed over the last century. This change is best illustrated by the recent migration of the North Magnetic Pole, which has been in the Canadian Arctic for the last 400 years, into the Arctic Ocean. Because historical records are short, paleomagnetic studies are needed to put these recent Arctic geomagnetic changes into a proper temporal context. Here, we will present an overview of Arctic geomagnetism, paleomagnetism, and recent efforts to move our understanding forward by looking at recent or emerging high-resolution Holocene and Late Pleistocene marine and lacustrine sedimentary records from the Canadian Arctic. We will highlight the implications of these recent records for chronostratigraphy in the Canadian Arctic, as well as for the understanding of geomagnetic field behaviour in an area of recent and possible future dramatic geomagnetic changes.

THE NET EXCHANGE OF CARBON GREENHOUSE GASES WITH CANADIAN HIGH ARCTIC LANDSCAPES DURING THE SUMMER GROWING SEASON

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A rapidly warming and wetting Arctic climate is changing the net ecosystem exchange (NEE) of the greenhouse gases

(GHGs) carbon dioxide (CO2) and methane (CH4) with polar landscapes. Assessments of northern terrestrial NEE have focused mostly on the rich peatland landscapes of the low Arctic, with far fewer studies from expansive, but sparse, high Arctic polar landscapes. Consequently, how these ecosystems may respond to a warming and wetting climate is still a key gap in our understanding of global carbon feedbacks. We used multi–season eddy covariance and static chamber measurements to quantify summer growing season NEE of CO2 and CH4 on contrasting polar desert and meadow wetland landscapes near Lake Hazen on northern Ellesmere Island (81ºN), in Canada's high Arctic. We also used variation in contemporary NEE and environmental conditions to improve our understanding of potential future carbon cycling in a warmer and wetter high Arctic climate. During a typical growing season, we found that a dry polar desert landscape consumed –0.06±0.01 g C–CO2 m-2 d-1 and strengthened concurrently with increasing soil moisture. CO2 accumulation rates were similar to other high Arctic sites and consistent with cold, barren soils with weak plant growth. CH4 consumption rates (–0.001±0.000 g C–CH4 m-2 d-1) were strong, positively associated with soil temperature, and were similar to dry temperate locations, likely because of suitable landscape conditions for soil gas diffusion. With a nearly constant supply of water, the productive meadow wetland accumulated 11 times more CO2 (–0.71±0.14 g C-CO2 m-2 d-1) than the desert during the growing season and coincided strongly with increasing soil temperature. CO2 accumulation was comparable to landscapes much further south, owing to continuous 24–hour daylight and typically clear–skies surrounding Lake Hazen. However, the wetland was a weak net emitter of CH4 to the atmosphere (+0.001±0.0002 g C-CH4 m-2 d-1), compared to many other Arctic wetlands. Low CH4 emissions were likely due to a shallow organic soil layer, and thus limited carbon resources for methanogens. Because dry soils comprise the majority of land area in the high Arctic, we suspect that these landscapes are currently a net sink of carbon GHGs during the summer growing season, and that a warming and wetting climate should reinforce the sink strength of CO2 and CH4 on these landscapes.

RAPIDLY CHANGING SUMMER ICE CONDITIONS ON THE WORLD'S LARGEST HIGH ARCTIC LAKE (LAKE HAZEN, NUNAVUT, CANADA)

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Human-induced climate change is altering polar watersheds at unprecedented rates. Current climate models predict that in the Canadian high Arctic, temperatures are projected to rise 3-5oC over most Arctic land areas by 2100, but up to 9oC in the very northern Canadian Arctic Archipelago. Mean annual precipitation is projected to increase ~12% for the Arctic as a whole over the same period, but up to 35% in localized regions where the most warming will occur. Such warming and wetting, coupled with extended growing seasons, is anticipated to greatly alter the energy balance of Arctic landscapes, resulting in glacial melt, permafrost thaw, altered surface runoff, and increased net primary production (NPP) in watersheds and freshwaters. In fact, not only are these changes anticipated, but most are already occurring in the Lake Hazen watershed, located within Quttinirpaaq National Park, northern Ellesmere Island, Nunavut. In this presentation, we will focus on the rapidly changing lake ice conditions that are occurring on Lake Hazen. Using MODIS snow cover and surface emissivity products, we analyzed lake surface temperatures and the phenology of lake ice cover for the period of 2000-2012. In general, the start of ice breakup begins in late May/early June at the shallow southeastern end of the lake, as well as moating along its shoreline. Typically this initial melting phase continues until mid June, at which time ice cover stabilizes at about 30%. If Lake Hazen subsequently goes ice-free in a given year, a second phase of ice-melt begins mid July, typically initiated by high winds, resulting in ice free conditions between late July and mid-August. Ice begins building back on the lake surface in late August/early September, and by early October, is totally frozen over. Specifically, for the period 2000-2012, monthly mean lake surface temperatures for May, July and September increased on average by 0.13, 0.11 and 0.06 °C yr-1, respectively. Increased warming in the spring resulted in the onset of ice break-up arriving earlier in the season by an average 0.9 d yr-1, whereas relatively less warming in September resulted in freeze-up starting 0.3 d yr-1 earlier. In addition to changes in the timing of break-up and freeze-up, Lake Hazen is experiencing a shift towards increased open water conditions. Mean ice-free area on the lake from 5 May (prior to the onset of break-up) to 5 September (after which cloud cover frequently interfered with MODIS data acquisition) increased by an average of 3 km2 yr-1 (or 0.5% yr-1) from 2000-2012. Full ice-off on Lake Hazen has also become more frequent over the past decades; between 1985-95, 1996-2005 and 2006-12, Lake Hazen went ice-free 60%, 80% and 88% of the years, respectively. We will highlight how unique wind and dust storms in late May/early June 2014 had a large impact on the albedo of Lake Hazen surface snow, and the way in which that subsequently impacted lake ice conditions and how snowmelt drained into the surface of the lake.

MERCURY DYNAMICS IN THE RAPIDLY CHANGING LAKE HAZEN WATERSHED (QUTTINIRPAAQ NATIONAL PARK, NUNAVUT, CANADA).

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Methylmercury (MeHg) is a globally relevant neurotoxin that bioaccumulates in organisms and biomagnifies up the food chain. In the Arctic, higher trophic level freshwater fish (e.g., Arctic char) are an important part of the local diet, making MeHg of concern for human health. While we recognize many of the factors that control MeHg production and degradation in Arctic freshwater systems, we have yet little understanding of how watershed processes like snow and glacial melt influence MeHg loadings into high Arctic lakes. Given temperature and precipitation increases predicted for the Arctic due to climate change, understanding meltwater MeHg inputs to freshwater systems is critical for predicting the quality of future Arctic freshwater resources. We examined snowmelt impacts on watercolumn MeHg and THg concentrations of the world's largest Arctic lake by volume, Lake Hazen (81.8°N, 71.4°W). In spring 2014, we sampled snow on the lake surface, three snowmelt-fed streams/rivers and the watercolumn before and after snowmelt for Hg and general chemistry. Sediment cores were also analyzed for both total mercury (THg) and MeHg. Low snowfall allowed for continuous mobilization of dust from the landscape throughout winter 2013/2014, resulting in two distinct snow types on the lake, which differed principally in their particulate loads. Despite higher MeHg concentrations in the dark snow (3.96 ± 3.15 ng L-1 in dark vs. 0.62 ± 0.21 ng L-1 in light), atmospheric loadings to the light snow were higher due to greater snow volume. Throughout the snowmelt sampling period, stream MeHg concentrations decreased at all 3 sites, suggesting the settling out of particulate matter and possible dilution of snowmelt by early glacial run-off. Potential sources of MeHg in the snow will be discussed. Snowmelt inputs to the lake increased watercolumn MeHg concentrations right below the ice from 0.02 ng L-1 to 0.08 ng L-1, but MeHg remained low throughout the remainder of the watercolumn (0.008 ± 0.004 ng L-1 below 5 m). Core THg concentrations are remarkably consistent in the top 10 cm, which may reflect the dominance of a single source (glacier) of THg to lake sediments since 1994. Although MeHg is not preserved in sediments, peaks in the profile suggest zones of active methylation. Melt and watercolumn THg concentrations will also be presented, as will supporting results from 2012 and 2013. In summer 2015, we will examine glacial meltwater inputs to Lake Hazen by sampling several glacial inflows to the lake. Our results thus far suggest that increasing inputs from snow and glacial melt to high Arctic freshwater systems could increase watercolumn Hg concentrations, potentially making more MeHg available for uptake into the foodweb

DECENTRALIZED "INFRASTRUCTURE APPLIANCE" TECHNOLOGY

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For 15 years Architectural & Community Planning Inc. has been involved in the conceptual design, product development, manufacturing and marketing of decentralized, stand-alone utility systems. Certain parts of these infrastructure systems are proprietary technologies while other parts are developed using readily available off-the-shelf technologies. • Initially the product development was supported by Canada Mortgage and Housing Corporation and Industry Canada for installation in remote hard-to-service locations (FN communities, subdivisions, cluster housing projects). • The lack of acceptance (no early adopters came forward) of decentralized utility systems in these proposed markets combined with the challenges of creating and marketing a perceived disruptive technology, forced the company to change course --- looking at alternate markets outside of remote communities. • Based on market research, the company has carved out a successful business model of designing, manufacturing and leasing utility-in-a-box utility systems to western Canadian oilfield and resource extraction installations. The underlying premise is self-explanatory: a remote location off-grid man camp in the resource extraction industry has the same infrastructure challenges and requirements as a small remote community – the technology is transferable, open to site specific adaptations. • Following a 10 year improvement process of the infrastructure technology and gaining operational, installation and leasing experience the utility appliance is now better positioned for introduction into the remote and arctic marketplace. By now 250 units – in different configurations - have been introduced into the Canadian marketplace; the majority of these units are leased in industrial resource extraction locations -- but several of these appliances are installed in remote research stations and tourism facilities in cold-climate regions of Canada -- including several arctic locations. The proposed presentation will address and discuss the following issues in more detail: • Description

of the technology components / a broad-stroke-assessment of success and failure of chosen technology components: Duplexing of critical equipment for redundancy and operational safety Ease of equipment maintenance and exchange Well developed "plug-and-play technology approach" to upgrade or downgrade equipment as required Creating beneficial synergies / complexity of creating synergies / are synergies actually beneficial or disadvantageous to user acceptance? • Integration models of utility-in-a-box decentralized infrastructure modules into the currently existing arctic infrastructure systems – increasing and solidifying energy security: Sale of module versus "infrastructure-for-lease" options; the issue of "stranded orphans", "stranded assets" and recovering stranded assets "Critical mass" requirement to warrant decentralized utility-in-a-box installations; third party maintenance and appropriate costing models for locally controlled and operated leasing operations • The general development process to bring a perceived "disruptive technology / disruptive innovation" into the marketplace • Development of a new infrastructure model: " infrastructure–for-lease" and the associated ownership, leasing, operational and financial challenges • Community based social impacts of adapting "stand-alone-decentralized-utility systems"

THE NUNAVUT FOOD SECURITY COALITION'S VALUE TOWARD AND NEED FOR FOOD SECURITY RESEARCH

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While food insecurity affects populations worldwide, it is a particularly urgent public health issue for Inuit in Nunavut. Rates of food insecurity are at critical levels in the territory, as the 2007-2008 Inuit Health Survey reported that nearly 70 per cent of Inuit households in Nunavut are food insecure. This is over eight times higher than the national average, and among the highest documented food insecurity rates for an indigenous population in a developed country. Increasing food security in Nunavut is a both a public and political priority, with the Nunavut Food Security Coalition leading the work on this important social issue. The Coalition is a collaborative group of government departments, Inuit organizations, non-governmental organizations, and the private sector that is working together to improve food security in the territory. In May 2014, the Coalition released the Nunavut Food Security Strategy and Action Plan 2014-16, which will guide the work of its member organizations. The Strategy and Action Plan outline a common agenda so that efforts can be coordinated and sustained, leading to greater impact. While it is hoped that the Coalition's actions will indeed contribute to its collective vision of a food secure Nunavut, it raises the question as to how we will know whether or not this goal is being actualized. There is currently a lack of comprehensive, reliable, longitudinal research that describes food security in Nunavut. The robust nature of the 2007-2008 Inuit Health Survey has lead it to be endorsed by the Coalition, but, as a one-time survey, only represents a specific point in time. On the other hand, the Canadian Community Health Survey and Aboriginal Peoples Survey are ongoing, but have methodological concerns that lead the Coalition to use these data with caution. Given such high interest in this issue – locally, territorially, nationally, and even internationally – this poses a concern in terms of our ability to evaluate necessary progress. One of the Coalition's Action Plan items is to "establish relationships with research institutes and academic institutions to enhance relevance of food security-related research." The Coalition is looking to build upon the existing evidence base by encouraging the continuation of community-based studies that contribute to a greater understanding of the causes of and solutions to food insecurity at the local level, but also by advocating for a territorial food security survey that would help to monitor this critical issue in Nunavut. It is hoped that this can be done through partnerships with the ArcticNet research community.

SPATIOTEMPORAL VARIATION IN HIGH CENTRE POLYGONS AND ICE WEDGE MELT PONDS IN THE TUKTOYAKTUK COASTLANDS.

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Climate warming has the potential to alter the structure and function of Arctic ecosystems in ways that are not fully understood. Polygonal peatlands are a widespread feature of Arctic landscapes that are sensitive to warming ground temperatures because of high ground ice content. The dynamics of polygonal terrain are of particular interest in the Tuktoyaktuk Coastlands, Northwest Territories, where mean annual ground temperatures have increased between 1 and 2°C over the last 40 years and high-centre polygonal terrain comprises 10% of the terrestrial landscape. To investigate broad-scale factors affecting ice wedge dynamics in the Tuktoyaktuk Coastlands,

we mapped the distribution of high-centre polygonal terrain and ice wedge melt ponds using 2004 airphotos. Historical melt pond distribution was assessed using airphotos from 1972, and thermokarst activity in polygonal terrain adjacent to anthropogenic disturbances was also documented using airphotos. GIS investigations showed that polygon fields are widespread and larger in the northern part of the study area, where organic deposits are more abundant and conditions for thermal contraction cracking are most favourable. Spatial variability in the density of polygonal terrain also corresponded to landscape-scale variation in topography, drainage, and surficial materials. Contemporary melt pond mapping and thermokarst assessments following anthropogenic disturbance showed that ice wedges at higher latitudes are more susceptible to degradation, with large increases in the severity of thermokarst north of 69.4°N, due primarily to the presence of larger and more abundant ice wedges. Comparisons of melt pond area between 1972 and 2004 showed that polygonal fields south of 69.4°N have exhibited little to no net change, whereas those north of 69.4°N have shown large increases and decreases in area. Spatial variability in the change in melt pond area, and lower than average total precipitation in 2004 suggests that these changes resulted from ice wedge degradation and not increased precipitation.

ARCTIC WATER CYCLE: NEW CONSTRAINTS FROM WATER VAPOR ISOTOPE MONITORING

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Due to the role of water vapor and clouds in positive feedback mechanisms, water vapor is a key player in the future Arctic climate. Ecosystems and human societies are vulnerable to climate change through even minor changes in precipitation patterns, including the occurrence of extreme events. It is therefore essential to monitor, understand and model correctly the mechanisms during transport of moisture, at the regional scale. The relative abundance of heavy and light water in the atmospheric moisture is affected at each phase change, because of their molecular properties (diffusivity and saturation vapor pressure). As a result, the isotopic composition of water vapor provides an integrated tracer of water cycle processes involved in evapo-transpiration, moisture transport, and cloud formation. Second order tracers such as deuterium-excess can carry a signal related to moisture origin. A correct representation of these water cycle processes is expected to play a key role in predicting the future Arctic climate. Because water stable isotopes are incorporated in a growing number of regional to general atmospheric circulation models, such data can be used to benchmark atmospheric model results with a focus on the Arctic hydrological cycle. We present here results from international efforts to obtain water vapor measurements in the Arctic, using a network of land stations and ships. This presentation will highlight the specificities and complementarities of observations so far obtained from different sites (Greenland, Iceland, Svalbard, Siberia and research ships), calling for an international coordinated monitoring network. Moreover, we report results from comparison with isotope-enabled general circulation models (nudged to re-analysis products), documenting poor performance in correctly representing several key processes associated with the spatio-temporal variability of deuterium-excess. The comparison of different stations, and calculations based on Lagrangian back-trajectories are used to diagnose the spatial footprint of each station, arguing for an expanded and structured water vapor isotope-monitoring network in the Arctic. A case study focused on the atmospheric river event of July 2012 leading to widespread melt at the surface of the Greenland ice sheet demonstrates the added value of synchronized measurements along a north Atlantic-Arctic transect. We use concomitant in-situ water vapor isotope measurement in the mid-latitudes (Bermuda), South Greenland (Ivittuut), and North-West Greenland (NEEM) together with remote sensing (satellite) water vapor isotope products and isotope modeling to characterize the moisture origin and atmospheric hydrological processes acting during this major extra-tropical storm. We argue for the importance of observations of these type of events, since the polar amplification of global warming very likely will lead to increased activity in extra-tropical cyclonic activity and atmospheric river events. Steen-Larsen, H. C., Johnsen, S. J., et al. (2013). Atmospheric Chemistry and Physics, 13(9), 4815–4828. Bonne, J. L., Masson-Delmotte, V., et al. (2014). Atmospheric Chemistry and Physics, 14(9), 4419–4439. Bastrikov, V., Steen-Larsen, H. C., et al. (2014). Atmospheric Measurement Techniques, 7(6), 1763–1776. Bintanja, R., & Selten, F. M. (2014). Nature, 509(7501), 479–482. Steen-Larsen, H. C., Masson-Delmotte, V., (2014a). Climate of the Past, 10(1), 377–392.

ATMOSPHERIC MERCURY IN THE CANADIAN ARCTIC – HOW LONG TERM MEASUREMENTS CAN TELL US ABOUT CHANGE?

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It has been almost 20 years since atmospheric mercury (Hg) was first measured in the high Arctic at Alert, Nunavut under the Northern Contaminants Program (NCP). Eighteen years of gaseous elemental mercury (GEM) data and 12 years of atmospheric speciated Hg data which includes GEM, reactive gaseous mercury (RGM) and particulate mercury (PHg) have been collected. In addition, 15 years of springtime snow collection at Alert and 7 years of GEM data have been measured at Little Fox Lake, Yukon. This significant amount of data has been investigated in depth over the past 3 years and show some interesting trends and observations. A 0.9% per year decrease in annual GEM levels has been reported at Alert between 1995 and 2011. This annual decreasing trend is lower than what has been observed at other sites in more temperate latitudes. While this decreasing trend could be considered a positive reflection of a decrease in northern hemispheric or global emission levels, monthly trend analysis reveals that the story is not quite as exciting. A recent analysis of the speciated Hg shows that there is an increasing year-over –year trend in either RGM or PHg at Alert from March to July. This is significant because April and May are the time period in Alert where the highest deposition of Hg occurs to the snowpack and these species have a higher propensity for deposition than GEM. Thus, the long term changes in GEM may reflect changes in the atmospheric chemistry in addition to changes in emissions. Results from this long term research program in the Canadian high Arctic will be presented.

WHAT SEA-ICE BIOGEOCHEMICAL MODELLERS NEED FROM OBSERVATIONALISTS

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Knowledge of the role sea-ice biogeochemical processes play in local and global systems is severely limited by our poor confidence in numerical model parameterisations representing those processes. Improving those parameterisations requires communication between observationalists and modellers to both guide model development and improve the aquisition and presentation of observational results. In addition to more observations, we need conceptual and quantitative descriptions of the processes controlling, e.g. primary production and diversity of algal functional types in sea-ice, ice algae growth, release from sea ice, remineralisation, transfer and emission of gases (e.g. CO2, DMS, CH4, BrO); incorporation of Fe, alkalinity and DIC in growing sea ice and later release; CaCO3 precipitation in sea ice; flushing and nutrient supply for sea ice ecosystems; and radiative transfer in sea ice. We will present some guidelines to help modellers, and observationalists improve the integration of measurements and modelling efforts and advance towards the common goal of understanding the biogeochemical processes involved and their impacts on environmental systems. As a final conclusion we will paint a picture of what makes a five star observationalist - from a modeller's perspective... This work is a product of the SCOR working group 140, Biogeochemical Exchange Processes at the Sea-Ice Interfaces (BEPSII).

MODELLING BIOGEOCHEMISTRY IN THE CANADIAN ARCTIC

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The 5th Coupled Model Intercomparison Project (CMIP5) includes for the first time a variety of Earth system models (ESMs, model systems with fully coupled atmosphere, ocean, sea ice and land components including interactive biogeochemical modules for all components), allowing the study of future projections of the marine carbon cycle and ecosystem behaviour. However, the still fairly coarse horizontal

and vertical resolution restricts the ability to resolve biological or chemical processes happening in the euphotic zone as well as small-scale physical processes important for biogeochemistry. Model skill for biogeochemical variables in global ESMs is still low, especially for the Arctic, where observational data are few and seasonally biased, and where shelf areas and narrow passages are common features. We will provide an update of results from ESM intercomparison studies in the Canadian Arctic which show both consistent trends (e.g. acidification) as well as differences (e.g. future primary production, vertical structure, regional distribution) between the models.We will discuss the shortcomings in ESMs and improvements obtained with the application of higher resolution regional models. In addition we will highlight the use of 1-D models in the development of model parameterizations.

INTEGRATED REGIONAL IMPACT STUDY (IRIS) OF THE WESTERN AND CENTRAL CANADIAN ARCTIC

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ArcticNet's Integrated Regional Impact Study (IRIS) of the western and central Canadian Arctic, specifically the Inuvialuit Settlement Region of the Northwest Territories and the Kitikmeot region of Nunavut, aims to ultimately assist decision-makers in formulating strategies to cope, adapt, and even benefit from the impacts of climate change at a regional scale. Inuit Organizations, researchers, government agencies and community members have come together to compile a Regional Impact Assessment (RIA) of the western and central Canadian Arctic, a report encompassing all available knowledge of climate change and other stressors in the Arctic and spanning a multitude of topics directly relevant to the way of life for people who live and work in the region (human health, food security, safety, culture, resource exploitation and socio-economic development, wildlife and environment, infrastructure). The RIA includes meteorological and oceanographic modelling results for the year 2050, traditional knowledge, highlights from other Arctic reports (e.g. AMAP, CAFF), and a synthesis and recommendations section specifically written for policy makers, resource managers, and other decision makers. The knowledge presented throughout the RIA will be incorporated into the Bering/Beaufort/Chukchi assessment report under the AMAP-led Adaptation Actions for a Changing Arctic project.

QUANTIFYING CARBON USE EFFICIENCY AND ALLOCATION IN TUNDRA VEGETATION; DO DOMINANT SHRUB TYPES DIFFER?

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Changes in vegetation distribution have been documented in many Arctic regions but our understanding of how these changes, for instance increases in shrub abundance, might impact the storage and turnover of carbon is limited. Recent studies suggest, for example, that greater vegetation productivity is not always associated with greater ecosystem C storage. An understanding of the key controls over ecosystem C allocation and carbon use efficiency (CUE, the proportion of photosynthetic carbon gain incorporated into plant tissues, versus that immediately respired), is crucial in understanding net CO2 exchange especially under conditions of vegetation change. We use 13C pulse-labelling to trace the fate of recently photosynthesised carbon in vegetation dominated by two common Arctic shrubs, Betula nana (dwarf birch) and Alnus viridis (green alder) just above the Arctic treeline in NW Canada. We quantify the amount of 13C assimilated, and the proportion of assimilate returned to the atmosphere via respiration versus that allocated to plant tissues. This enables an analysis of the contrasting carbon-use-efficiencies and aboveground versus belowground allocation patterns in the two shrub types. We use the field data to address the hypothesis that belowground C allocation in A. viridis (a symbiotic nitrogen fixing species) is a smaller proportion of gross photosynthesis, as this species supports less extensive ectomycorrhizal networks compared to B. nana. This is the first tracer study comparing carbon allocation in N-fixing vs. non-N-fixing vegetation types and provides important data for predictive modelling of Arctic greenhouse gas balance in a region where the abundance of alder has increased dramatically over the last decades.

YUKON CLIMATE CHANGE INDICATORS & KEY FINDINGS - BRINGING TOGETHER SCIENCE, LOCAL KNOWLEDGE AND DECISION MAKERS.

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Recently the Northern Climate ExChange at the Yukon Research Centre was called upon to bring together science alongside local and traditional knowledge to inform action planning, progress management, public reporting and outreach activities on climate change. The "Yukon Climate Change Indicators & Key Findings 2014 Report" is an evidence-based science and traditional knowledge synthesis meant to support policy makers. Specifically this report will assist in the development of an updated climate change action plan as well as the climate change section of the State of the Environment Report. Emphasis has been placed on ensuring that climate change indicators and implications are relevant for Yukon communities. This presentation will briefly outline highlights of the report and then focus on the process of integrating science with local knowledge, ensuring credibility, relevancy, and engagement.

COMPOSITION MEASUREMENTS AT THE POLAR ENVIRONMENT ATMOSPHERIC RESEARCH LABORATORY

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This research program "Probing the Atmosphere of the High Arctic" (PAHA) addresses the issue of the variability of the atmosphere in the Canadian High Arctic using measurements made at the Polar Environment Atmospheric Research Laboratory (PEARL), located at Eureka, Nunavut (80N, 86W). One of the three major research themes for PAHA is Composition Measurements. High-quality time series of measurements, along with critical analysis and evaluation, are essential as a means to improve our understanding of the changing Arctic atmosphere. This theme encompasses four projects: Greenhouse Gases Related to the Carbon Cycle; Ozone and Related Species; Biomass Burning and Continental Influence on the Arctic; and Clouds, Aerosols and Precipitation. This presentation will provide an overview of the PAHA Composition Measurements theme, with a focus on tropospheric trace gas measurements made by UV-visible and Fourier transform infrared spectrometers at PEARL. These measurements include (i) column-average dry mole fractions of the greenhouse gases CO2 and CH4 acquired as part of the Total Carbon Column Observing Network; (ii) tropospheric ozone and BrO used to investigate the origin and occurrence of bromine explosions and their impact on the surface ozone budget at Eureka, including evidence of transport from the Beaufort Sea in April 2011; (iii) tropospheric pollutants and biomass burning products that provide information about the sources, transport, and variability of air quality in the Arctic; and (iv) water vapour concentrations used to assess seasonal variability and the water vapour budget in the high Arctic. Each of these studies will be briefly discussed in the context of changing Arctic tropospheric composition.

OBSERVATIONS AND MODELLING OF ARTIC AEROSOLS DURING THE IAREA PROJECT CAMPAIGN ON SPITZBERGEN IN MARCH 2014

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In the frame of the iAREA projects (Impact of absorbing aerosols on radiative forcing in the European Arctic) a field campaign was undertaken in March and April 2014 on Spitzbergen. Analysis of measurements was supported by the GEM-AQ model simulations. The iAREA project is combined of experimental and theoretical research in order to contribute to new knowledge on the impact of absorbing aerosols on the climate system in the European Arctic (http://www.igf.fuw.edu.pl/iAREA). The GEM-AQ model is a chemical weather model. The core of the model is based on a weather prediction model with environmental processes (chemistry and aerosols) implanted on-line and are interactive (i.e. providing feedback of chemistry on radiation and dynamics). Numerical experiments are performed with the computational grid resolution of ?15 km. The purpose of the modeling part of the campaign was to assess model configuration for further studies in the frame of iAREA. The base chemical forecast was undertaken with standard emission fields derived from EDGAR and GEIA inventories. For an alternative setup emissions developed by

NILU in the ECLIPSE project were used. We will present evolution of modelled profiles of meteorological parameters and pollutants concentrations for the location of two measurement stations on Spitzbergen. Special focus will be on the differences in vertical distribution of PM10 and AOD. Measurements and model results will be discussed in the context of changing synoptic conditions in the Arctic.

ICE FREEZE-UP AND BREAK-UP DETECTION OF SHALLOW LAKES IN NORTHERN ALASKA WITH HIGH TEMPORAL RESOLUTION SPACEBORNE SAR

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Lake ice phenology (timing of ice-on and ice-off) provides an unequivocal evidence of recent changes in climate conditions at northern high latitudes. Accurate identification of freeze onset and end of melt, and thus the duration of the ice season, is fundamental in evaluating the extent to which shallow Arctic lakes have been impacted by the contemporary changing climate. While large lakes across the Arctic are currently being monitored through satellite observations, there are extremely sparse and mostly non-existent records tracking the changes in small high-latitude lakes. While detection of frozen and grounded ice on shallow lakes was enabled by the use of Synthetic Aperture Radar (SAR) data as previous studies have shown, detection of both freeze-up and break-up dates for these lakes has not yet been investigated. Opportunities exist to develop a lake-ice monitoring network for small Arctic lakes by exploiting the existing observations from heritage C-band SAR missions (the European Remote Satellite (ERS) satellites – ERS-1/2, ENVISAT's Advanced Synthetic Aperture Radar (ASAR), RADARSAT-1/2) as well as data from the newly launched Sentinel-1a, with daily acquisitions and the upcoming RADARSAT constellation. These missions, complemented with data from upcoming optical sensors (e.g. Sentinel-2 Multi Spectral Instrument) will not only improve detection of ice cover conditions of Arctic lakes but will also provide the opportunity to develop an Arctic-wide Earth Observation-based lake ice monitoring system. The temporal evolution of the backscatter coefficient, sigma-nought (?0) from ASAR, with frequency of acquisitions from 3 to 5 days, was analyzed in order to monitor the ice phenology on shallow Alaskan lakes between 2005-2011. Results show that detecting freeze and melt onset, as well as the end of the ice season, can be derived using the ?0 from ASAR. Employing an ice phenology algorithm based on the assessment of the temporal evolution of ?0, the study aimed to determine the ice-on and ice-off dates. ASAR observations were compared to freeze-up and break-up dates simulated with the Canadian Lake Ice Model (CLIMo). Results indicate that CLIMo simulations for both freeze-up and break-up were highly correlated with the ASAR backscatter values of the selected pixels, with a mean difference of 0.6 days for freeze-up and 3.8 days for the start of break-up. ASAR ?0 also indicates that during the seven-year period, the latest freeze onset occurred in 2008 and the earliest ice melt started in 2009 thus making the 2008/09 the shortest ice season between 2005-2011. A decrease in the number of ice days during the 2008/09 season could be explained by the higher snowfall (250 mm) during the 2008 ice formation and the warmer mean May air temperatures (25.5 °C) during the 2009 ice break-up

THE MARINE ENVIRONMENT OVER CENTURIES PAST: USING MULTI-CENTURY CRUSTOSE CORALLINES AS BIOLOGICAL TEMPERATURE LOGGERS THROUGHOUT THE N. ATLANTIC

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Over the last half century, changes in the near-coastal arctic marine environment have been dramatic and accelerating. Sea ice has declined and maximum summer sea surface temperatures (SST) have increased throughout the upper northern latitudes. Virtually all arctic models predict a continuing decrease in sea ice cover over the next half-century, with the more extreme models predicting ice-free arctic summers within the next two decades. However, we have very few temperature data for the arctic that go back more than a few decades, thus we rely on temperature proxies. Two common proxies in the arctic include ice-cores and sediment cores. While both of these techniques are enormously valuable, neither can inform us directly about the coastal marine environment. Ice cores measure atmospheric conditions and sediment cores typically come from below the photic zone and have very poor temporal resolution. What we lack is a good environmental proxy for the shallow water (i.e. photic zone) marine environment. Better environmental data with longer time scales will greatly improve our understanding of the

arctic environment. Clathromophum compactum, is a long-lived red coralline algae found throughout the subarctic and arctic on both sides of the Atlantic. Under ideal environmental conditions, individuals can exceed 1700 years in age. As part of its natural growth and development, C. compactum deposits annual layers of calcium carbonate as a calcite matrix. Trapped within this matrix are Mg ions, and the ratio of Mg:Ca is strictly a function of the surrounding temperature at the time of deposition. Using microprobe technology, we can analyze the temperature of the surrounding water at 2-week intervals throughout the entire lifespan of the organism. Because corallines are both sedentary and subtidal, they provide a bi-weekly in-situ climate record for a distinct locale and depth. Further, changes in cell growth can be used to infer the date when the sea-ice broke up each year. To date, we have collected samples at ~60 locations in the Canadian North Atlantic, stretching from Qikiqtarjuaq, Baffin Island to Belle Isle, Labrador. The majority of these specimens were collected off the outer coast of Labrador. Our oldest specimen collected is 1720 years old and seven different sites have yielded corallines at least 500 years of age. Additionally, more than half of the sites we sampled have yielded specimens dating back to at least 1900, suggesting multi-century specimens are fairly easy to find. Temperature proxies obtained from C. compactum samples will dramatically improve the shallow-water temperature record throughout the arctic and subarctic. This increase in spatial and temporal resolution is crucial for increasing both the accuracy and precision of arctic models. Finally, application of corraline temperature proxies across a broad geographic region can be used to document changes in the occurance and location of critical oceanic components like the Labrador Current.

CONTRIBUTION OF ICHTHYOPLANKTON SURVEYS TO THE ASSESSMENT OF VARIABILITY IN SPATIOTEMPORAL OCCURRENCE PATTERNS OF FISH IN THE SOUTHEAST BEAUFORT SEA

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We described current trends in fish communities of the interior Arctic Ocean through the assessment of variability in occurrence and species composition of ichthyoplankton in the southeast Beaufort Sea between the summers of 2002 and 2011. Larval and juvenile fish were sampled using square-conical nets towed obliquely in the upper water column (<100 m) between June and September. Gadidae consisting of Boreogadus saida and Arctogadus glacialis numerically accounted for >75% of total catches independent of sampling month. Cottidae and Liparidae usually followed Gadidae, together representing 9–94% of non-gadid species by numbers. The majority of dominant and subdominant species occurred ubiquitously through the sampling area, whereas Gymnocanthus tricuspis (Cottidae), Liparis gibbus (Liparidae), and Leptoclinus maculatus (Stichaeidae) occurred primarily on the Mackenzie Shelf. In contrast, Triglops nybelini (Cottidae) distributed mainly in the Amundsen Gulf, which was characterized by relatively high salinities (>25). An exceptional event was observed in September 2011, when Ammodytes hexapterus (Ammodytidae) numerically accounted for 67% of non-gadid species. In the southeast Beaufort Sea, summer ichthyoplankton was characterized by the overwhelming dominance of Arctic gadids as well as the frequent occurrence of Arctic cottids and liparids. However, the sudden occurrence of A. hexapterus may spell for major upcoming changes in fish community. Our results show that ichthyoplankton sampling may allow detecting the successful reproduction of new species in a given area and thus forecasting species invasions in the Arctic basin.

HOW MUCH FOR THE NIGHT? ENERGETIC COSTS OF OVERWINTERING FOR THE ARCTIC COPEPOD CALANUS GLACIALIS

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The copepod Calanus glacialis comprises up to 80% of the zooplankton biomass in Arctic shelf seas and plays a key role in Arctic marine ecosystems. It is primarily a grazer, accumulating essential polyunsaturated fatty acids from its algal diet as well as converting low-energy carbohydrates and proteins in algae into high-energy wax ester lipids. It is able to survive long periods without food by descending to depth and lowering its metabolism to a minimum, a state referred to as diapause. Although C. glacialis may be in this physiological state for up to 8 months each year we know very little about the energetic costs required during diapause. We therefore initiated an extensive

field campaign in a high-Arctic fjord, sampling the local population monthly from June 2012 to July 2013. Monthly carbon demand was estimated by measuring respiration, image analysis was used to analyse variability in lipid content over the season. The carbon demand during winter differed among C. glacialis CIV, CV, females and males, with CV and adults being active much earlier previously assumed. Lipid reserves in CV and females remain largely untouched throughout autumn but decrease from January on, most likely to fuel moulting and maturation. The C. glacialis population declined steeply from January to May suggesting that individuals may run out of energy stores during winter. Of the overwintering stages, only CIV seems to stay in diapause over an extended period, utilizing little of its lipid storage from fall through winter.

ATMOSPHERE - SURFACE FLUXES ESTIMATED FROM DIFFERENT MEASUREMENT TECHNIQUES OVER SNOW COVERED SEA ICE

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Carbon dioxide flux measurements in ecosystem science are mostly conducted over terrestrial areas by eddy covariance technique or the closed chamber method. Both methods are becoming more frequently used over sea ice and snow covered surfaces. Comparisons between eddy covariance and chamber methods have been carried out over terrestrial surfaces, but carefully designed inter calibration experiments over sea ice and snow are still needed to assess differences and uncertainties. Here we present one of the first comparisons of fluxes over snow covered sea ice estimated from the eddy covariance technique and the chamber method. The measurements were carried out at Young Sound in Northeast Greenland from May 28th to June 28th 2014 starting just before snow started to melt. The comparison shows in general higher fluxes obtained by the eddy covariance method (often a magnitude higher) but the methods mostly agree on the flux direction. However the disagreement varies depending on meteorological and surface parameters. The flux divergence in relation to varying parameters will be presented and possible causes will be discussed.

ARCTIC CLIMATE, FISHERIES AND STOCK ASSESSMENT: DO THEY INTERSECT AT ALL?

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The relationship between climate variation and fisheries has been acknowledged for a long time, most notably with Cushing's book on the subject over 30 years ago, but the actual application to stock assessment and hence advice on fisheries harvest is for the most part lacking. This is not because stock assessment biologists do not understand that fish grow a part as a function of ambient temperature but rather that few acceptable tactical models incorporating temperature into stock assessment calculations are yet to be developed. Why? We present a thesis that climate predictions are too imprecise to be incorporated successfully into fisheries stock assessment. We review the few approaches to the practical application of a temperature variable into assessment and present an example featuring Arctic Charr, Salvelinus alpinus and a variant of a surplus production model. We discuss how climate predictions could be coupled with growth functions based on degree-day calculations and thus used in formal stock assessment within age structured models.

ADVANCING FOOD SECURITY AND SUSTAINABLE AGRICULTURE IN THE CIRCUMPOLAR NORTH

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Key conclusions will be presented from the first joint conference of the Circumpolar Agricultural Association and

the UArctic Northern Food Security Thematic Network, held in Girdwood, Alaska, Sept. 29 – Oct. 3, 2013 (www.uaf.edu/cac). There were approximately 140 delegates from across the circumpolar north (USA, Canada, Norway, Iceland, Finland and Japan). The conference included First Nations communities, 9 invited speakers sponsored by the OECD Co-operative Research Programme with four University of the Arctic Thematic Networks: Geopolitics, Arctic Health, Managing Small and Medium Sized Enterprises in the North, and Northern Food Security. Specific conference and summit objectives were: 1. Educate world leaders on the critical nature of food supplies in the Circumpolar North; 2. Initiate collaboration among stakeholders within the food chain; 3. Stimulate awareness of the economic value of northern regional food; 4. Discuss the barriers/challenges/opportunities of expanding the regional food economy; 5. Formulate solutions and develop a strategy for sustainable northern regional food economy. Subsequent projects including data base development as well as success stories on expanding local food production/supply into the main stream retail market, and development of low light tolerant food crops will also be presented.

ICE FAILURE MECHANICS FOR ARCTIC ENGINEERING APPLICATIONS

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Changing ice conditions have significant implications for coastal communities in the Canadian North. These effects range from impact on traditional hunting and fishing practices, to effects on safe on-ice transit, to impacts on community re-supply and search-and-rescue operations. In addition, these changes also affect coastal infrastructure, aids to marine navigation, and associated Arctic shipping traffic. Renewed interest in the development of oil and gas, as well as mineral resources in Northern regions is also an important consideration. For Arctic engineering applications associated with the above activities, research to improve understanding of ice failure mechanics is important in ensuring safe, economical designs. For vertical-walled structures, ice crushing pressures are frequently used in modelling extreme ice loads of interest for design. For ships and sloped structures, flexural ice failure dominates. Environmental driving forces may also limit design loads, and characterization of these phenomena in the context of design and operations is essential. To support on-ice activities for traditional use, as well as operations near ports, shipping lanes or offshore facilities, driving forces and sea ice processes over scales ranging from 10^2 m to 10^4m must be considered. From a structural perspective, engineers are typically most concerned with local design pressures and global design loads. Local design pressures correspond to a length scale of 10^-1 m to 10^0 m and are used to determine appropriate levels of local structural reinforcement. Global design loads correspond to a length scale of 10^0 m to 10^2 m and refer to the total required levels of resistance the structure must provide to ensure foundation stability or to maintain course (for ships or floating structures). For ice-structure interactions at speeds greater than a few mm/s the ice crushing process, which is associated with local spalling and pressure softening processes in the ice (on scales of order 10^-3 m to 10^0 m) play an important role in the localization of contact into zones of intense pressure through which the majority of ice loads are transmitted to the structure. In this presentation, the authors discuss relevant ice mechanics associated with the scales of interest from an engineering perspective and ongoing research efforts to bridge understanding of the processes acting over these scales.

BRIDGING THE GAP BETWEEN ARCTIC SCIENCE RESEARCH AND POLICY THROUGH FILM

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Creating international policy for implementing laws and practices related to the impacts of present and future climate changes has been a challenge. Scientific data, some of it inconsistent with varying data sets of time and location, have been difficult for the policy-makers, locally as well as internationally, to assimilate and use in creating definitive policy. In my own climate research in the polar regions, documenting this data in film proved to provide a medium that improved understanding and accessibility to this complex information. Invited by the United Nations to present my two documentary films, The Antarctica Challenge and The Polar Explorer, to delegates, negotiators and world leaders attending the UN Framework Conventions on Climate Change in Copenhagen (2009) and Cancun (2010), policy-makers eagerly responded to the data contained in the films and accelerated the policy-writing process. In particular, international policy-makers have proven to prefer receiving their information through film rather than through text as it provides a visual context that aids in the comprehension of material usually difficult to understand by the untrained audience. Additional film presentations were made to great extent through the conferences' social media. Facebook, Twitter and YouTube resulted in close to 60,000 views of the film during the COP15 climate summit in Copenhagen. After

two rounds of drafts, a new resolution addressing the imminent threat of rising sea levels was adopted: Enhanced Action on Adaptation: Section 2, Subsection 25, based primarily on footage I shot of the Petermann Ice Island during a research expedition across the Northwest Passage conducted by ArcticNet in October, 2010. Since 2008, I have working closely with the world's climate change scientific communities and the United Nations using filmed reports of research in the field to aid and assist policy-makers in understanding. This achievement has been recognized with the presentation of the Queen's Diamond Jubilee Medal, the Stefansson Medal (the Explorers Cub) and the Gemini Humanitarian Award (Academy of Canadian Cinema and Television). As a result of this success, the UN has established a partnership with me to provide a new film each year for presentation at its COP conferences. Focused on climate change research around the world, the film series brings the latest findings on climate research, not just in the polar regions but around the world. The series is in its fifth year and feedback from both the scientific community and UN policy-makers is continually fine-tuning this new and powerful communications tool. My Master's research is to study the evolution of the documentary film as a data delivery system bridging the gap between scientists and policy-makers through film. On May 13, 2014 I presented a poster on this research at the Science and Cities Symposium at the University of Western Ontario in London, Ontario, sponsored by the Ontario Climate Consortium. I presented it under the conference theme of "Connecting with the Climate – A Communications Challenge". Mark Terry, Master's Candidate (Humanities), York University, October 1, 2014 Email: terrma@yorku.ca. Tel: 416-899-5855 http://gradstudies.yorku.ca/2014/09/lifelong-york-member-comes-full-circle/

THE SOCIAL IMPACTS OF MINING ON INUIT WOMEN IN QAMANI'TUAQ, NUNAVUT: A QUANTITATIVE ANALYSIS

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An open pit gold mine near Qamani'tuaq (Baker Lake), Nunavut, has been in operation since 2010 and is scheduled to close, earlier than anticipated, in 2017. The original Inuit Impact Benefit Agreement, signed by the Kivalliq Inuit Association and Agnico-Eagle's Meadowbank mine, identified likely social impacts, such as increased substance use, domestic violence, and overall challenges to community wellness. Money was then committed to mitigating these impacts. However, the community has never seen where or how these funds have been used. Quantitative research was done with Inuit women in Qamani'tuaq. The research is the product of a questionnaire developed with Inuit women following week-long popular education training. Sixty questionnaires were then administered to Inuit women, by Inuit women in the community. Women comprise about 45% of the 166 permanent Inuit employees at the mine. The researchers reported the results back to the community in September 2014. While some women reported that working or having a family member working at the mine had improved their quality of life, many women recounted difficulties they were having taking full advantage of employment opportunities. Impacts were intersectional. Income from mine employment has contributed to increased substance abuse which, in turn, has contributed to problems associated with jealousies and family disputes, sometimes leading to violence. A lack of adequate day-care facilities where Inuktitut is spoken was identified as crucial to women's access to employment. Addictions were identified as the number one 'problem' that has been amplified by the mine. Notable results from the survey included observations about the racist treatment of Inuit employees by Qablunaat mine workers from southern Canada, incidents of sexual harassment, increased STIs and prostitution. Knowledge of human rights – in particular pregnancy and employment – emerged as a significant concern. There was little recognition among those interviewed and participating in the research of the implications for the community when the mine is shut down. It appears that little planning has been done for this eventuality. The paper examines factors inhibiting a better consideration of social impacts on Inuit women and families, and highlights the importance of this quantitative data in light of literature and research reviewed.

UQAUSIVUT QANUINNGITSIARUTIVUT ("WORDS ARE AN INTEGRAL PART OF OUR WELL-BEING")

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How can non-Inuit working in the medical sector get closer to the Inuit perceptions of health, well-being and wellness considering that these experiences are in most cases expressed in Inuktitut? How can non-Inuit healthcare workers enter a way of thinking avoiding reasoning from their own language, which may lead to interpretation errors or distortion of meaning? Indeed, Qallunaat ways of conceptualizing reality, and thus their languages, are not necessarily those of the Inuit and vice versa. Much more than just communication tools, languages are in themselves true systems of integrated knowledge showing their

own classifications and categories. A set of values lies behind words and for sure words have a cultural dimension. But, as said by Jaiku Pitsiulaaq and Aalasi Juumi:"Words are also very powerful. They have always been cleansing. They can shatter lives but they can heal. Words are what has made us Inuit." (Iqaluit, Nunavut). The strong belief that spoken words can heal is widely shared among Inuit. We will emphasise this point. It will also be worthwhile to get closer to what Inuit mean when they say — as Taamusi Qumaq from Puvirnituq did — that sickness is like a skilled worker (pisitialuk) as sneaky as a thief who never act in broad daylight (tiglisuuq), that pain stops as bad weather calms down (ikullaumijuq), that good health can be stolen (tiglitaujuq) and returned to his owner (satuijuq). These expressions and many more are part of Inuit perceptions of health. They merit consideration especially in cross-cultural settings.

RECENT, UNPRECEDENTED ENVIRONMENTAL CHANGE IN THE COASTAL MACKENZIE DELTA OF CANADA'S WESTERN ARCTIC: A MULTIDISCIPLINARY ASSESSMENT OF THE IMPACTS OF STORM SURGE ACTIVITY

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Arctic coastal ecosystems are undergoing a period of rapid change related to direct and indirect human activities. As coastal ecosystems are of particular importance for northern communities, in addition to representing one of the most rapidly growing regions for resource extraction and infrastructure development, understanding the potential for ecosystem alterations due to climate change is essential. Arctic delta ecosystems are often considered to be hotspots of biodiversity in the north, and thus these systems are particularly susceptible to the impacts of climate warming. The Mackenzie Delta, in Canada's western Arctic, is an ecologically and culturally significant ecosystem and the second largest delta in the circum-Arctic. The Mackenzie Delta is a vast, low-lying environment, and thus this region is particularly susceptible to the impacts of marine storm surges, originating in the Beaufort Sea. The Inuvialuit, who continue to use the Mackenzie Delta for traditional practices such as hunting and trapping, identified an area of the western, outer alluvial plain that was impacted by a large storm surge in September of 1999. We will present the results of a multidisciplinary assessment of the ecological changes to the coastal aquatic and terrestrial ecosystems of the outer Mackenzie Delta as a result of this storm event, as well as a paleoenvironmental perspective on the history and likely drivers of storm surge activity in the region. Research based on multiple lines of evidence suggest that the 1999 storm was unmatched in terms of its ecological impact over the recent past, resulting in terrestrial vegetation mortality and the salinization of the aquatic ecosystems in the impacted zone. Long-term lake sediment records suggest the storm's impact was likely unprecedented over at least the last millennium. Community composition at multiple aquatic trophic levels was altered coincident with the saltwater inundation in 1999, and no evidence of recovery has been inferred, despite more than a decade of time since the event. Lake sediment-based inferences suggest that storm surge impacts on the outer Mackenzie Delta are strongly related to recent regional and hemispheric temperature increases, and in particular, recent decreases in sea ice extent. This research has implications for understanding the potential impacts of climate change on this, and other, low-lying coastal ecosystems in the future.

OCEAN ACIDIFICATION ELICITS DIFFERENT PHYSIOLOGICAL RESPONSES IN ARCTIC AND BOREAL POPULATIONS OF THE COPEPOD PSEUDOCALANUS ACUSPES

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Anthropogenic emissions cause the global CO2 partial pressure (pCO2) to increase, and atmospheric models predict a pCO2 of ca. 1000 µatm by the year 2100. About one third of emitted CO2 is absorbed by the world's oceans, causing a decrease in ocean pH (called ocean acidification, OA). In this respect, the Arctic constitutes a particular concern. The Arctic Ocean is already at the brink of carbonate undersaturation due to its high levels of dissolved inorganic carbon. Furthermore, melting ice and increased Atlantic water inflow is reducing the salinity, and this reduces the pH buffer capacity of the Arctic Ocean water. Future pH decreases are therefore predicted to be particularly harsh in the Arctic. The question then remains: are Arctic populations suited to meet the physiological challenges of these changes? We investigated OA effects in Arctic and boreal

populations of the same invertebrate species, the planktonic copepod Pseudocalanus acuspes. Copepods of the Pseudocalanus genus constitute major prey for a wide range of fish species and they occupy key positions in the Northern Atlantic and Arctic marine food webs. We found significantly different effects of OA on feeding and metabolism in the Arctic and boreal populations. In the Arctic population, feeding rates were maximal at an intermediate pH (7.80) whereas they were highest at a high pH (7.95) in the boreal population. Secondly, we found significant interactions between the effects of pH and prey concentration on both feeding rate and respiration rate in both populations. Thus, P. acuspes react differently to OA depending on the availability of phytoplankton prey. But more surprisingly, the interactions between pH and prey concentration were themselves different between the Arctic and boreal populations. In conclusion, metabolic OA effects may depend on the nutritional level of the individual and moreover, the effects seem different in populations from the Arctic than in populations from lower latitudes.

THE INFLUENCE OF CLIMATIC AND PHYSIOLOGICAL PERFORMANCE ON POPULATION DYNAMICS OF MYTILUS EDULIS IN WEST GREENLAND

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Climate change is predicted to facilitate a northward expansion of temperate species into the Arctic. In Greenland, the north-south orientation of the West Greenland coast provides an ideal opportunity to study the impact of climate change on marine species population dynamics and distributions. The blue mussel (Mytilus edulis) has recently expanded its northern distribution in Greenland and is considered to be a sensitive indicator of climate changes. Blue mussels could be a species that would respond to a warmer climate by increased abundance and growth rates in the Arctic. However, adequate data on current distribution and physiological performance of blue mussels in the Arctic is lacking, and knowledge of how "climate" in a broad sense specifically influence population dynamics of this species is unknown. Here, we present data on abundance, age and mortality of blue mussels in West Greenland. We supplement our data with physiological measurements on freezing tolerance and aerobic metabolic performance of intertidal specimens. We hereby attempt to identify links between temperature and physiology and how this might translate into population dynamics in this region of the Arctic. Results show an overall decline in blue mussel abundance along the coast from south to north Greenland. Physiological adaptation and plasticity of blue mussels was found across latitudes spanning from the temperate to the High Arctic region. Combined our results indicate that low ocean temperature per se does not constrain metabolic activity and distribution of Mytilus in the Arctic; rather we speculate that maturation of reproductive tissues, larval supply and annual energy budgets are the most relevant factors influencing Mytilus populations near their northern distributional edge in the Arctic.

MUSKOX HEALTH SURVEILLANCE IN THE CANADIAN ARCTIC: LESSONS LEARNED FROM A PARTICIPATORY APPROACH IN THE COMMUNITY OF IKALUKTUTIAK.

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Muskoxen (Ovibos moschatus) are a species of the Arctic that is central to the lives of many northern inhabitants and a key component of the Arctic ecosystem. Recent evidence of population declines and mortality events reported both on Victoria and Banks Islands (Canadian Arctic) have raised concerns about the health status of muskox populations. As part of a project focused on the development of a community-based muskox health surveillance system based out of the hamlet of Ikaluktutiak (Cambridge Bay, Victoria Island, Nunavut), we applied qualitative participatory methods in order to incorporate Indigenous and community knowledge into the surveillance system and design the program from the community perspective. During summer 2014 (July-September) we performed semi-structured interviews with 30 community members (elders, hunters, and women). Participants were recruited through purposeful sampling and the snowball technique in collaboration with the local Hunter and Trapper Organization and the Kitikmeot Inuit Association. Sample size was determined by the thematic saturation approach. Interviews, ranging between 1 and 2 hours, were audio recorded and field notes were collected in order to allow a rigorous analysis. Proportional piling and mapping exercises were used to gather

data about muskox importance in the context of the traditional food system (TFS) and muskox population distribution and changes over time, respectively. Thematic content analysis and descriptive statistics were applied. Participant observations ranged from the importance of muskoxen for the community to perceptions of muskox population abundance, health and diseases, and ecological and environmental factors influencing muskox health. Preliminary results reveal that country foods still represent on average 56% of the annual diet of the participants and, in this context, muskoxen currently represent the third most important country food after caribou and fish (caribou = 30%; fish = 28%; muskox = 11%). Participants indicated that muskoxen, in addition to their significance as country food often shared with all the community, are also important from a traditional and cultural perspective and for community development. Participants observed a decrease in muskox and caribou numbers during the past few years (ranging from 10 to 3 years ago) in the study area. Environmental changes, including climatic changes and shifts in the distribution ranges and abundance of other species, anthropogenic disturbance, and diseases are among the factors that participants indicated as determinants for muskox health. Qualitative observations on muskox diseases were also recorded and will be used to inform the surveillance system. This work highlights the importance of qualitative participatory methods in gathering local and traditional knowledge. It also provides novel insights regarding the integration of Indigenous and community knowledge in the context of wildlife health surveillance with a perspective towards co-management.

COMMUNITY-COLLABORATIVE RESEARCH: A BRIDGE CONNECTING NORTHERN SCIENCE AND POLICY

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Northern ecosystems and communities are undergoing unprecedented and rapid changes driven by environmental, socioeconomic, and political pressures. In order to adapt to a changing landscape, northern communities are in urgent need of knowledge to guide proactive policies and develop adaptation strategies. The gap between science and policy however is often substantial and in need of accessible bridges. Here, we propose community-collaborative research to be a useful platform that can act to effectively connect northern researchers to emerging community priorities and research needs. Community-collaborative research, broadly defined as research approaches that involve engaging local community members in the research process with the goal of sharing or co-generating knowledge to understand complex problems and bring about change through policy, is gaining popularity among researchers from all fields as a method to ensure relevance of research while building northern capacity. Here, we propose a conceptual model of key themes important for developing community-collaborative research relationships. This model is developed from the analysis of personal experiences, questions, and recommendations from over 46 Early Career Researchers (ECRs) from 28 different institutions across 10 countries, which were expressed during a session on Community-driven research at the 2012 IPY Conference in Montreal. During the session, ECRs identified that a foundation of mutual trust was essential for creating and maintaining genuine collaborative efforts that facilitate knowledge exchange. ECRs also acknowledged the need for collaborative efforts to occur at the initial stages of the research process in order to incorporate community perspectives in hypothesis creation and thus ensure research relevance. Additionally, it was recognized that forging these types of partnerships is often beyond the graduate thesis and knowledge-base of ECRs. Thus, we provide several practical recommendations on how to facilitate relationship-building processes in northern communities to ensure that northern research continues to be collaborative and remains policy-relevant.

RECENT CLIMATIC WARMING AND PERMAFROST DEGRADATION ON THE MONGOLIAN PLATEAU

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The pronounced climatic warming at eight representative stations in permafrost regions of central Mongolian Plateau during 1961-2013 is identified. The linear trend and non-parametric Mann-Kendall trend analysis results indicate that abrupt warming for mean annual air temperature took place in 1994 and for summer air temperature in 1997 in the study regions. Different with the warming trend in the whole country, the summer warming is more pronounced than the winter warming in the permafrost regions. And a slight cooling trend was found during the last 2 decades. The mean annual ground temperature of permafrost has increased at a rate of 0.20 oC/decade and the active layer thickness has increased at a rate of 7.3 cm/yr during the last decade on the Mongolian Plateau, consistent with the dramatic climatic warming over the same period. The thermokarst landform is a direct indicator of permafrost degradation, which distributed extensively in this region.

ENABLING COMMUNITY-DRIVEN RESEARCH IN NUNAVUT THROUGH REINVESTMENT OF REVENUE BY INUIT-OWNED ENTERPRISES

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Arctic Fishery Alliance (AFA) is Nunavut's only 100% Inuit-owned fish harvesting company. The company was established in 2008 as a partnership between the four Hunter and Trapper Associations (HTAs) and four community trusts of Arctic Bay, Grise Fiord, Qikiqtarjuaq and Resolute Bay. Today, AFA owns two 100' vessels – the Suvak and its sister ship the Kiviuq 1 – and harvests turbot (Reinhardtius hipposglossoides) in NAFO divisions 0A and 0B with quotas allocated by the Nunavut Wildlife Management Board. Since its formation, AFA has been committed to ensuring that the benefits from its commercial fishery harvesting activities are directed to the residents of its communities in particular but also to all residents of the Territory. One of the mechanisms for returning the benefits from Nunavut's offshore fishing resources to the Nunavummiut has been through investing in marine research in Arctic waters adjacent to Nunavut. For such studies, AFA uses its own investment to leverage additional funding from various federal, territorial agencies. Over the course of the past two years, AFA has invested in several marine research initiatives including a socio-economic feasibility study on the benefits of a commercial deepwater port in Nunavut, an investigation into the size selectivity effects of various fishing gear on turbot (R. hipposglossoides), as well as several exploratory fisheries. Recommendations for AFA's research investments originate in the four communities and are approved by the company's Board. In this presentation, AFA will describe its model for community-driven research in the Arctic. Particular attention will be paid to the mechanisms by which the communities, trusts and HTAs are engaged and consulted throughout the process. The successes and challenges of this approach will be discussed.

MEASURING ATMOSPHERIC COMPOSITION IN THE ARCTIC USING INFRARED EMISSION SPECTROSCOPY: FILLING THE POLAR NIGHT KNOWLEDGE GAP AT EUREKA, CANADA.

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The Canadian High Arctic experiences prolonged periods of total darkness in the winter and continuous daylight in the summer, influencing the atmosphere and its composition in ways that are still not fully understood. The Canadian Network for the Detection of Atmospheric Change has equipped the Polar Environment Atmospheric Research Laboratory (PEARL, Eureka, Nunavut, Canada, 80°05'N, 86°42'W) with several spectrometers that measure atmospheric composition. One of these instruments, the Extended-range Atmospheric Emitted Radiance Interferometer (E-AERI), is a ground-based Fourier transform infrared (FTIR) spectrometer that measures the absolute downwelling infrared emission from the atmosphere between 400 and 3000 cm-1. A number of trace gases have emission features in this region, enabling simultaneous measurements of their total column abundances. The E-AERI has a moderate resolution of 1 cm-1 and a high sensitivity to the lower troposphere. It was installed at PEARL in October 2008. E-AERI spectra provide information about radiative balance, budgets of trace gases, and clouds properties in the Canadian High Arctic. A similar instrument, the University of Idaho's Polar AERI (P-AERI) was installed at PEARL from March 2006 to June 2009. Measurements are taken by the E-AERI every seven minutes year-round (P-AERI measurements were made at sampling times of ~30 seconds), including polar night when the solar-viewing spectrometers at PEARL are not operated. This allows E-AERI and P-AERI measurements to fill in the

gap in the PEARL dataset during this night-time period when less is known about atmospheric composition. Total columns of CO, CH4, N2O and O3 have been retrieved from 2006 to 2014 (except in 2010) using the new SFIT4 algorithm. These measurements are used to investigate the annual, seasonal and diurnal variabilities of these four species in the Canadian high Arctic.

BLOOM DEVELOPMENT IN PACIFIC-DERIVED WATERS DIVERGING FROM AN ICE ARCH IN NARES STRAIT

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During the joint ArcticNet/Netcare/GreenEdge 2014 expedition of CCGS Amundsen to northern Baffin Baffin, we conducted an experiment to follow the biogeochemical evolution of surface waters as they flowed away from an ice arch located in Hall Basin (Nares Strait). The experiment was designed to elucidate ice-edge processes under a "divergent" scenario, i.e. one in which waters that spent a long time under a consolidated ice pack unambiguously move away from a well-defined ice boundary. Under the simplifying context of the narrow, advective conduit provided by Kennedy Channel, we were able to substitute time for space and provide temporal scaling of biogeochemical transformations in the southbound water mass. This overall setting permitted straightforward understanding of biological processes and their relevant time scale, without the complications inherent to complex flow patterns and heterogeneous ice conditions at "diffuse" ice edges. In this collaborative presentation, we provide preliminary results on water-mass properties, nutrient availability, the build-up and demise of algal biomass, primary production and its vertical distribution, nitrogen use and the production of dimethylsulfide. These results are contrasted with those of the North Water Polynya Study (1997-1999), when an ice arch reliably formed in Kane Basin, roughly 350 km to the south of Hall Basin.

IMPACT OF BOREAL FIRE EMISSIONS ON ATMOSPHERIC COMPOSITION IN THE ARCTIC

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Large wildfires affecting boreal forests every year are a significant source of atmospheric pollutants, including greenhouse gases and aerosols. Among the emitted species, most have long enough lifetimes to be transported over thousands of kilometres, in particular towards the Arctic. Quantifying their impact at regional and hemispheric scales is thus critical. Therefore, precise calculation of emissions is required, in order to include a realistic perturbation in chemistry-transport models and understand the relative contributions to the observed variability of trace gases and aerosols. The emission altitude is another parameter strongly influencing their impact since pyroconvection, triggered by the large heat released by fires, can inject emissions up to the free or upper troposphere. In this presentation, the APIFLAME emission model will be presented. The variability of fire activity in boreal regions (Canada and Russia) as observed from space during the past decade, and the associated emissions will then be discussed. The strong link between fires and the long-range transport of key trace gases (CO, NO2) and aerosols (through the observed aerosol optical depth) will be shown, here again based on satellite observations, with a focus on the summer of 2013. Finally, an analysis of the influence of pyroconvection on the long-range transport of fire products will be presented for the case of the summer of 2008, using global model simulations and in situ observations from the POLARCAT campaigns.

NUTRITION NORTH CANADA IN THE CONTEXT OF THE BROADER FOOD SECURITY DIALOGUE

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On May 21, 2010, the Government of Canada announced that the Food Mail Program would be replaced by Nutrition North Canada following a multi-year transition period. Nutrition North Canada is a market-driven model, designed to ensure that healthy foods are more accessible and affordable to Canadians living in isolated Northern communities. During the period of transition from Food Mail to Nutrition North

Canada, the issue of food security in the North began to draw greater public attention than ever before, with the program sometimes serving as a lightning rod for concerns about cost of living in the North. This presentation will discuss how the transformation of Nutrition North Canada intersects with broader food security issues and the impact of that broader dialogue on the program.

THE 2013 MINAMATA CONVENTION ON MERCURY: WILL IT PROTECT THE ARCTIC ENVIRONMENT?

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The Minamata Convention on Mercury, adopted at a diplomatic conference in Japan 9-11 October 2013, aims to curb the long-range transport of mercury into the Arctic. After highlighting the role of Arctic Council States in laying the scientific and political foundations for negotiation of the new treaty, this presentation will review what might be described as two mercurial realities in the wake of the Convention, the offering of substantial mercury pollution reduction promises and the raising of numerous implementation challenges. Promising approaches of the Minamata Convention to be described include: • Phasing-out of primary mercury mining for each Party • Restricting exports of mercury to non-Parties • Phasing-out by 2020 listed mercury-added products, such as batteries (except for certain button batteries), switches and relays, some fluorescent lamps, and cosmetics and soaps • Prohibiting the use of mercury in listed manufacturing processes, specifically, in chlor-alkali and acetaldehyde productions (by 2025 and 2018 respectively) • Restricting the use of mercury in various manufacturing processes such as the production of vinyl chloride and polyurethane • Requiring national action plans to reduce and where feasible to eliminate the use of mercury and the releases of mercury from artisanal and small-scale gold mining • Controlling and reducing mercury emissions to the atmosphere for listed point source categories, such as coal-fired power plants and waste incineration facilities Key implementation challenges to be highlighted include: • Getting countries to ratify the Convention in a timely manner with 50 ratifications/acceptances required for the Convention's entry into force • Ensuring adequate financial and technical assistance to developing countries in light of the Convention's overall voluntary funding approach • Phasing-out primary mercury mining in a timely way since the Convention allows a 15 year phrase-out period from the time of entry into force of the Convention for a Party • Controlling the use of exemptions available to Parties to delay by five years and possibly 10 years the phase-out dates for mercury-added products and using mercury in chlor-alkali or acetaldehyde production • Ensuring effective reduction of mercury emissions and releases in light of the broad flexibility and discretion left to Parties in taking management measures • Developing guidance on what constitutes best available techniques and best environmental practices for controlling emissions and releases • Forging national implementation plans as implementation plans are optional under the Convention The presentation will conclude with an overall assessment of the Minamata Convention and its potential for protecting human health and the environment in the Arctic.

TEMPORAL VARIABILITY IN DYNAMIC DISCHARGE FROM THE QUEEN ELIZABETH ISLANDS, CANADIAN ARCTIC

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The Queen Elizabeth Islands (QEI) of the Canadian high Arctic contain ~14% of the Earth's glacier and ice cap area, and have been identified as one of the largest contributors to eustatic sea-level rise outside of Greenland and Antarctica. Recently, Van Wychen et al. [2014] found that the QEI contributed ~2.6 Gt a-1 of glacier ice to the ocean in winter 2012. However, the widespread occurrence of surge-type glaciers and associated dynamic flow variability within this region means that this estimate is likely to vary temporally. To assess this, we use speckle tracking of RADARSAT-1 (8 m resolution) and RADARSAT-2 (3 m and 8 m resolution) imagery to determine the velocity structure of the major glaciers in the QEI each winter between 2000 and 2014. Surface velocities are then combined with historical and current measurements of ice thickness at the grounding line of all tidewater glaciers to determine annual mass losses via dynamic discharge. This analysis allows for the temporal variability in ice flux from the major glaciers in the QEI to be determined, provides bounds to estimates of ice loss via dynamic discharge, and enables the impact of surging on dynamic discharge estimates to be assessed. In a wider perspective, this case study allows for a determination of how representative a regional ice flux estimate taken from a single winter is of a long-term calving rate. Van Wychen, W., D. O. Burgess, L. Gray, L. Copland, M. Sharp, J. A. Dowdeswell, and T. J. Benham (2014), Glacier velocities and dynamic ice discharge from the Queen Elizabeth Islands, Nunavut, Canada, Geophys. Res. Lett., 41, doi:10.1002/2013GL058558.

TRACKING THE OUTPUT AND USE OF SCIENTIFIC KNOWLEDGE GENERATED FROM GOVERNMENT-FUNDED RESEARCH ACTIVITIES: BUILDING A CASE FOR FUNDING CONTINUITY

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As resources become more limited, there is an increasing pressure to account for funds invested in scientific activities by tracking the results achieved and the impacts of those activities. The Chemicals Surveillance Bureau (Healthy Environments and Consumer Safety Branch, Health Canada) has developed a database to track performance indicators - knowledge transfer activities including publications, presentations, and examples of data use - resulting from monitoring and surveillance projects funded under the Chemicals Management Plan (CMP). This includes human health studies under the Northern Contaminants Program, the biomonitoring component of the Canadian Health Measures Survey, and other studies funded under the CMP Monitoring and Surveillance initiative. The main objective of this database is to track and report on the output from CMP-funded projects and demonstrate the value of the program's funding investments. Knowledge transfer activities are essential to help stakeholders inform their regulatory and public health actions. Tracking project output ensures these activities continue to align with the program's mandate, and provides evidence of the relevancy of funded activities to stakeholders and how the data generated is meeting their needs. This presentation will describe the type of performance indicator information collected, the approach for collecting the information, and how it is used to report on the alignment of activities to the overall funding program.

COUPLING OF PHYTOPLANKTON AND BACTERIAL PRODUCTION IN ATLANTIC WATERS WEST OF SVALBARD

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Phytoplankton and heterotrophic bacteria play a crucial role in the balance between primary and secondary production in planktonic systems. A thorough understanding of modern patterns and drivers of production is therefore needed if we are to predict the future productivity in a low-ice Arctic Ocean. Yet, combined measurements of phytoplankton and bacterial production of Arctic marine systems are still limited. Here we present phytoplankton particulate and dissolved production rates for different size fractions in combination with bacterial production for a variety of stations along the West Spitsbergen Current and including the marginal ice zone, measured within the framework of the Norwegian research project "CarbonBridge" in spring and summer of 2014. Strong gradients in water column stability, biomass and production were found, representative of conditions typical of Arctic systems during different stages of the growth season. The observed patterns in phytoplankton and bacterial production are discussed in relation to their position in the West Spitsbergen Current, sea ice and physical conditions.

THAW LAKES AND PONDS: OASES OF BIODIVERSITY AND BIOREACTORS FOR CARBON PROCESSING IN PERMAFROST LANDSCAPES

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Permafrost thaw lakes and ponds (including thermokarst systems) are the most abundant type of freshwater ecosystems throughout the circumpolar North, and are undergoing rapid changes as a result of climate change. Our aim is to develop an improved understanding of these waters as oases of microbial biodiversity in the northern landscape, and as biogeochemical reactors that emit greenhouse gases. Profiling of thaw lakes in the Low Arctic, eastern Hudson Bay region (Nunavik) revealed that they are highly stratified despite their shallow depths, with anoxic bottom waters in summer. A year-long deployment of oxygen sensors showed that this anoxic zone expands to the entire water column in winter, which would favour methanogenesis and suppress methanotrophy. CO_2 and CH_4 were well above air equilibrium in summer and late winter, and funnel assays showed strong ebullition fluxes of both greenhouse gases to the atmosphere, the highest fluxes occurring in an organic-rich palsa site. The subarctic thermokarst waters host different types of bacterial photosynthetic communities. Mat-forming taxa were rare because of the strong underwater attenuation of light, however colonial cyanobacteria and also picocyanobacteria were present, the latter in high abundance.

Both flow cytometry and HPLC pigment analysis also indicated the high abundance of green photosynthetic sulphur bacteria in the anoxic bottom waters, consistent with earlier molecular assays (Rossi et al. 2013). These subarctic waters also contain abundant methane-producing Archaea and methane-oxidizing Bacteria (Crevecoeur et al. 2014). Shallower and smaller ice-wedge ponds in the High Arctic (Nunavut) had hypoxic conditions favoring elevated CH4 fluxes, which were highest at sites of pronounced thermokarst erosion. The larger polygonal ponds in the High Arctic also emitted methane, but contained well-developed cyanobacterial mat communities and were net CO2 sinks. Pyrosequencing data showed the presence of both acetotrophic and hydrogenotrophic methanogens in pond sediments, while stable isotopes indicated the dominance of acetotrophic methanogeny in summer. 14C dating indicates that old carbon is released by ebullition from deeper thermokarst lake (with talik) while shallower ponds present variable ages and uncoupled pathways of production for CH4 and CO2 (Bouchard et al. 2014). Experiments at Bylot Island in the High Arctic indicated the importance of photochemical processes affecting organic carbon lability in these waters. Lability experiments on different soils from ice-wedged pattern landscapes show a complex response in the consumption and production of O2, CH4 and CO2 (Preskienis et al. 2014). References: Bouchard F., Preskienis V., Laurion I., Fortier D. 2014. Impacts of permafrost degradation processes on aquatic system biogeochemistry, Bylot Island, Nunavut. Arctic Change Ottawa; Crevecour S., Vincent W.F., Comte J., Lovejoy, C. 2014. Molecular detection of methanotrophs and methanogens in permafrost thaw ponds: Implications for greenhouse gas emissions from subarctic waters. Arctic Change, Ottawa; Rossi, P-G., Laurion, I., Lovejoy, C. 2013. Distribution and identity of Bacteria in subarctic permafrost thaw ponds. Aquat. Microb. Ecol. 69: 231–245, 2013; Preskienis V., Bouchard F., Laurion I., Fortier D. 2014. Greenhouse gas emissions from Arctic lakes and ponds as influenced by carbon lability. Arctic Change, Ottawa.

NEW CONTAMINANTS IN THE GREENLAND AMAP CORE PROGRAMME: APPROACHES AND RECENT RESULTS

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Several countries undertake monitoring of persistent organic pollutants (POPs) in the Arctic environment, with the primary objective to document temporal changes. The Danish/Greenland AMAP Core Programme monitors a wide range of halogenated POPs in key species of Greenland. Some of the time-series started in the middle of the 1980s and allow us to study the impacts of environmental changes on contaminant trends. Regulations and POP classifications can trigger the use of alternative substances of which little environmental information is available. Many compounds are stable enough to be transported to the Arctic and to bioaccumulate and biomagnify in food chains, thus potentially causing new and additional POP issues. The transport of these semi-volatile compounds might be enhanced in a warming climate. Thus, the AMAP Core Programme and related activities also have the objective to identify and study new potential contaminants of the Arctic. While these studies primarily serve the protection of the Greenland ecosystems, they also generate data on long-range transport and bioaccumulation, which have, for example, been used by the POP Review Committee of the Stockholm Convention. In a first step to identify new potential contaminants of the Arctic, we have reviewed the literature, with a focus on novel flame retardants, current-use pesticides, miscellaneous halogenated compounds (hexachlorobutadiene, octachlorostyrene, pentachlorobenzene, polychlorinated naphthalenes), phthalic acid esters, siloxanes and musk compounds. While long-range transport could be shown for all compounds, bioaccumulation in Arctic animals was mainly indicated for some novel brominated flame retardants, dechlorane plus, short-chain chlorinated paraffins (SCCP) and endosulfan/endosulfan-sulfate. Since bioaccumulation data are only just emerging for some compounds, this list presents a snapshot of the current literature. The empirical work to identify new contaminants under the AMAP Core Programme has included screening studies and retrospective time trends, based on samples of an environmental specimen bank maintained by the programme. Retrospective studies of e.g. hexabromocyclododecane (HBCD) showed increasing trends in ringed seals (Pusa hispida), which resulted in a decision of regular monitoring of HBCD. Screening studies have just been performed for SCCP, dechlorane plus and a range of novel brominated flame retardants (DPTE, BTBPE, DBDPE, TBB and TBPH) in East and West Greenland ringed seal blubber as well as in polar bear adipose tissue (Ursus maritimus), black guillemot eggs (Cepphus grylle) and glaucous gull liver (Larus hyperboreus) from East Greenland, documenting the presence of these compounds in Arctic wildlife species. Furthermore, a retrospective time trend has been performed for endosulfan (including endosulfan-sulfate) in ringed seals from East Greenland, covering ten years between 1986 and 2012. The presentation will show results of the literature review, the screening studies and the retrospective time trends. It will thus provide new data on emerging contaminants in Greenland, which might increase in concentrations in the future, as a potential consequence of increased use and changing

environmental conditions. Thus, the prompt and reliable identification and analysis of new contaminants in the Arctic is going to gain importance and will benefit from coordinated efforts among the circumpolar countries.

RAPID ARCTIC TRANSITIONS RELATED TO INFRASTRUCTURE AND CLIMATE CHANGE (RATIC): A CASE STUDY FROM PRUDHOE BAY, ALASKA

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The RATIC workshop and special session at AC2014 address the combined consequences of expanding networks of infrastructure and changes related to climate in the Arctic. During this session, research will be presented from site-specific case studies of expanding networks of infrastructure across the Arctic, including the Prudhoe Bay oilfield, Alaska; the Bovanenkovo gas field, Yamal Peninsula, Russia; and Arctic Canada. A primary challenge to developing an approach to adaptive management of oil and gas infrastructure expansion is comprehensive documentation of the changes that have already occurred. The first and most straightforward element of change analysis is an historical analysis of physical changes to the landscape. Alaska's North Slope oilfields are the oldest and most extensive industrial complex in the Arctic. Following the discovery of oil at Prudhoe Bay in 1968, environmental studies periodically documented the changes resulting from the rapidly expanding network of roads and oilfield facilities. A baseline of terrain information was interpreted from 1949 aerial photographs taken by the U.S. Navy. The International Biological Programme's (IBP) U.S. Tundra Biome study began documenting the effects of development at Prudhoe Bay in the 1970s. Aerial photographs and Infrastructure mapping were done nearly annually by the oil industry, starting in the 1980s. An integrated mapping approach documented the historical changes to both infrastructure and the landscape as the oilfield expanded. A recent paper, published in Global Change Biology, presents the 62-year history of infrastructure as well as the spread of indirect effects such as road dust and infrastructure-related flooding. The biggest surprise from this analysis was the rapid thawing of ice-wedges and formation of thermokarst features that occurred between 1990 and 2010, most extensively in areas adjacent to infrastructure but also in areas remote from infrastructure, which is likely a response to a series of recent exceptionally warm summers. The thermokarst typically resulted in more topographically diverse terrain. In summer of 2014, researchers began an in-depth field analysis of the long-term (42-year) effects of infrastructure to the permafrost, topography, hydrology, soils, and vegetation along the Spine Road, the oldest most heavily traveled road at Prudhoe Bay. Early results of this study are presented in a poster at this conference. The local communities perceptions of the changes related to development are presented in another poster. Forty-six years after the discovery of oil at Prudhoe Bay, we are still learning about the ecological consequences of large-scale infrastructure expansion and the impacts of climate change in ice-rich permafrost environments. The authors who were involved with the Tundra Biome studies in the 1970s could not foresee the changes that occurred, but the baseline studies provided a means to document the transitions to the present. The results will provide a basis for new methods to monitor future changes to permafrost and the regional social-ecological systems. The goal is to use the results presented at AC2014 to develop an action plan to address adaptive approaches that utilize state-of-the-art science, modeling, engineering, and education that lead to sustainable management of infrastructure in the Arctic.

PRODUCTION OF METHYL MERCURY IN ARCTIC SEAWATER

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Mercury (Hg) in the Arctic marine ecosystem is a hot topic due to its high toxicity and biomagnification in the food web, and the main culprit of both features is monomethylmercury (MMHg). While major progress has been made with respect to the distribution and speciation of Hg in the atmosphere and biota, much less is known about the source and distribution of MMHg in the Arctic seawater, which is the primary exposure pathway for Hg to marine biota. In a recent study carried out in the Beaufort Sea, we have reported enhanced methylmercury production in a subsurface layer where

local and recent organic matter (OM) is remineralized. Here we report further studies in Baffin Bay and the Canadian Arctic Archipelago to uncover the processes involved in the sub-surface mercury methylation. The total Hg concentration in seawater from these regions ranges from 0.25 to 2.9 pM, and is higher in Baffin Bay than in the Canadian Arctic Archipelago. The vertical distribution of total Hg in both regions is"C-shaped, with higher concentrations in the surface and deep water. Total methylmercury concentration in seawater at stations analyzed so far shows similar distribution pattern to that in the Beaufort Sea with a sub-surface peak. Preliminary incubation experiments have been carried out to test whether the sub-surface methylmercury is produced in reducing microenvironments in the water column.

QUANTIFYING THE EFFECT OF DIETARY TRANSITIONS IN THE NORTH ON HUMAN EXPOSURE TO PERSISTENT ORGANIC POLLUTANTS

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For aboriginal human populations in the Arctic, the main route of persistent organic pollutant (POP) exposure is via traditional food consumption. Previous work by our group indicated that an ongoing dietary transition away from traditional foods and toward imported foods contributes to decreasing POP exposures observed in these populations. To further explore this issue, we expanded the human food chain bioaccumulation model ACC-Human Arctic by including models for organisms deemed to be important elements of a traditional Northern diet (beluga whale, narwhal, caribou). We then parameterized the expanded model to simulate POP intake in two specific aboriginal populations in Canada's North (from the Inuvik region, Northwest Territories and Baffin Island region, Nunavut). Using dietary survey information from initial and follow-up biomonitoring campaigns in both communities, we simulated POP exposures for each individual study participant. We found that the amounts and frequencies of traditional food consumption were the most important predictors of POP exposure. Further, both declining Arctic environmental POP contamination and reduced traditional food consumption contributed significantly to the decrease in human POP concentrations between the initial and follow-up study. Ultimately, our model approach allowed us to characterize the roles of POP emission reductions and dietary transitions in influencing historical POP exposures among two specific Northern communities, and further underscored the importance of accounting for dietary transition behavior in future POP biomonitoring within these populations.

SHARING INUIT VALUES

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The Nunavik Regional Board of Health and Social Services, located in Kuujjuaq, created a few years ago a Department devoted to Inuit Values and practices. The main concepts put forward were, and still are: autonomy, respect, participation, appreciation of human resources and collaboration with diverse partners. Among various programs, projects and initiatives - many of them providing opportunities for youth - we can mention traditional adoption recognition, Resolution Health- Support Program under the Indian and Residential Schools (IRS) and Emotional Health-Support Program for former students of residential schools and their families, Midwifery working group (a number of Inuit midwives have completed their midwifery program), Prevention of Elder abuse in partnership with the Kativik Regional Government (KRG), projects concerning mental health, healthy babies, healthy living environment. Considering that all initiatives keep a strong cultural component and taking into account that Inuit collaborate with non-Inuit partners, there is a real concern about how Inuit perspectives can be shared with non-Inuit.

CIRCUMPOLAR BIODIVERSITY MONITORING PROGRAM (CBMP) – MARINE PLAN IMPLEMENTATION – RECENT RESULTS AND FUTURE PRIORITIES

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The Arctic Marine Biodiversity Monitoring Plan (the CBMP-Marine Plan) is one of four pan-Arctic, long-term, integrated biodiversity monitoring plans under the Conservation of Arctic Flora and Fauna (CAFF)'s Circumpolar Biodiversity Monitoring Program (CBMP). Implementation of the CBMP-

Marine Plan has been underway since its endorsement by the Arctic Council in 2011. This presentation will provide a selection of recent results from the CBMP-Marine Steering Group and Expert Networks, including information on key marine biodiversity indicators at different trophic levels, data management, and collaborative activities. The presentation will also describe CBMP-Marine's future focus in implementing recommendations of the Arctic Biodiversity Assessment, producing a State of Arctic Marine Biodiversity Report, and contributing to broader global initiatives. The CBMP-Marine Plan strives to provide comprehensive and timely circumpolar information on Arctic marine biodiversity to decision makers. Implementation is currently co-led by Greenland and Norway.

ICE-CAMP DAY 2014; AN OUTREACH EXPERIMENT IN CAMBRIDGE BAY, NU INVOLVING SCIENTISTS, KIILINIK HIGH SCHOOL, AND SCHOOLS ON BOARD.

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Schools on Board is a national ArcticNet outreach program based out of the University of Manitoba that bridges Arctic climate change research with high school environmental and science education. Creating unique learning opportunities through connecting scientists, students and teachers together is at the core of the program. Schools on Board worked with scientists based out of Cambridge Bay, NU for the Ice Cover Ecosystems – CAMBbridge Bay Processes Studies (ICE-CAMPS) and teachers form Kiilinik High School to create a unique learning opportunity for 40 high school students and 5 teachers. ICE-Camp day was based on the successful model of our Arctic Science Day where 200 high school students attend. The intent of ICE-Camp Day was to inform local high students about what scientists are studying in their community and why, to provide an opportunity learn and experience first hand how to sample (ice coring, zooplankton tows, snow sampling, ect.), to create interest in science and research, and to initiate a meaningful relationship between scientists, the school and community. ICE-Camp day was successful bringing positive responses from students, teachers and members of the community.

FIELD AND MODELLING INVESTIGATIONS OF PERMAFROST CONDITIONS IN THE LABRADOR REGION OF NORTHEASTERN CANADA

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The Labrador Permafrost Project was launched in 2013 with the goal of enhancing knowledge of the distribution and dynamics of permafrost in the Labrador region of northeastern Canada. Given recent regional warming (e.g. Way and Viau, in press), it is probable that changes in the distribution and thickness of regional permafrost are already occurring. Quantifying these changes is not possible at present, however, because there is little information on the regional distribution of permafrost apart from surveys completed several decades ago (e.g. Brown, 1979). Evaluating the vulnerability of infrastructure to permafrost thaw under future warming scenarios is a priority given the presence of discontinuous permafrost in some Labrador communities and the increasing likelihood of resource exploitation in northern Labrador. The main objectives of the Labrador Permafrost Project are to evaluate the current distribution of permafrost across the region's complex terrain and to predict how permafrost dynamics may change in the future. A total of 34 monitoring stations have been established across latitudinal and coastal-continental gradients along the existing road network to disentangle the complex interactions between climate, topography and permafrost. These stations each measure air and ground temperatures, in addition to snow-depth, providing information on local-to-regional scale permafrost controls. Spatial interpolation of data collected from these loggers will be used with existing meteorological, vegetation, topographic and surficial geology data-sets to model the regional distribution of permafrost using a Labrador-wide temperature at the top of permafrost [TTOP] model (e.g. Gisnas et al., 2013). The accuracy of this predictive model will be assessed using a variety of methods including geophysical (DC electrical resistivity tomography [ERT]), thermal measurements (boreholes, ground temperature loggers) and direct field observations of permafrost presence or absence (frost-probing, instantaneous ground temperatures). The impacts of future warming on regional permafrost conditions will be investigated using both TTOP and thermal modelling based on future and historical climate warming scenarios. In southern Labrador, thermal modelling will be coupled with data collected from ground temperature measurements at three shallow boreholes (~4.2-5.7 m depths) established in August of 2014 in palsa complexes along the Labrador Sea coast in Blanc Sablon, Red Bay and Cartwright. Field investigations during the summers of 2013 and 2014 indicate that the southern fringe of the discontinuous permafrost zone is controlled by localized factors

such as soil composition, drainage, snow depth and vegetation cover. The southernmost occurrences of permafrost are in palsa mire complexes in the coastal environments and on wind-blown mountaintops above the regional treeline. Northwards, permafrost conditions coincide with both tundra landscapes and coastal environments where local-scale variability in snow cover and soil composition make permafrost highly discontinuous. ERT surveys in two coastal Labrador communities revealed large patches of permafrost with thicknesses exceeding 18 m within the community boundaries of Nain and numerous small peatland patches of permafrost up to 5 m thick in Cartwright. Future work will focus on the transition between extensive discontinuous and continuous permafrost and coastal-inland gradients in north-central Labrador.

THE INFLUENCE OF THERMOKARST ON POTENTIAL DECOMPOSABILITY OF SOIL ORGANIC MATTER IN A TAIGA AND TUNDRA SETTING IN NE RUSSIA

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Permafrost regions play a key role in global carbon budgets because of the size and vulnerability of their soil organic carbon (SOC) stock. Climate change is expected to raise soil temperatures resulting in an increased soil organic matter (SOM) source available for decomposition. Mineralized in the form of greenhouse gasses (GHG), this carbon can cause a positive feedback for further climate change. Thermokarst lake formation show a cyclic behaviour starting with ice melt, lowering of the permafrost table, ground surface subsidence, the formation of wetlands and eventually thermokarst lakes. In time, these lakes often drain either by proceeding permafrost degradation and talik formation, or by being cut into by another water body or drainage channel. The potential decomposition (quality) of SOM is of great importance to predict potential GHG release from permafrost regions and model global climate scenarios. Thermokarst development is often considered an important factor in permafrost degradation and increasing availability of SOM for decomposition. However, the influence of past thermokarst events and thus episodes of increased decomposition, is less understood. What is the difference in SOM between sites that have undergone former thermokarst cycles and sites that have not? Will there be a different response in decomposition upon climate change for these different land surface types? Two Siberian field sites, Spasskaya Pad (boreal forest) and Kytalyk (tundra), both with extensive active and relict thermokarst features, have been sampled. Simple geochemical characteristics that might be indicative of potential decomposition have been determined for all groups and will be compared. A comparison of results from permafrost affected and intact areas are presented and discussed.

COASTAL CHANGE IN THE CANADIAN BEAUFORT SEA – FINDINGS AND OBSERVATIONS BASED ON THE SYNTHESIS OF COASTAL GEOSCIENCE DATA TO SUPPORT BREA

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The Geological Survey of Canada has been funded under the Beaufort Regional Environmental Assessment (BREA) initiative to synthesize information on coastal and nearshore seabed conditions critical to the planning, site selection, regulation and management of harbour facilities (from the Alaska/Yukon border to Cape Dalhousie) in support of Beaufort Sea oil and gas activity. Targeted datasets from 40 years of coastal geoscience research by the Geological Survey of Canada were compiled and analyzed to define data gaps and future data needs. One of these key datasets is the coastal monitoring database which contains the horizontal position and vertical profile of the coastline at specific sites across the region. A small field program was conducted in the summers of 2012, 2013 and 2014 to update rates of coastal change at selected monitoring sites along the Yukon, Mackenzie Delta, Richards Island and Tuktoyaktuk Peninsula coasts. Thirty five sites were surveyed, including several that were re-established after an absence of over 20 years. The coastal change assessment across the region combined shoreline positions established from historical air photos and more recent satellite imagery with ground-based surveys at coastal monitoring sites. These data highlight processes of change over time at specific sites. Much of the coastline is known to be eroding at long-term rates of 1-2 m/yr (with rates in excess of 20 m/yr in some places). Past studies using historical air photos have suggested that decadal rates of change for this region have remained relatively constant over the last 50-60 years. New data suggest accelerated erosion over the past 10-15 years on some portions of the coast. At Pelly Island, an upland tundra remnant seaward of the Mackenzie Delta front, portions of the coast have experienced almost 1000 m of retreat since 1950. Between 1950 and 1985 the coastline retreated at an average rate of 9.4 m/yr; over the past 14 years, however, erosion rates have increased to 14.2-15.5 m/yr. This may result from some or all of an increase in the magnitude

and frequency of storms, increased extent and duration of open water, rising relative sea level, changes in storm frequency and magnitude, or ground temperature warming leading to greater slope instability linked to the thaw of ice-rich sediments. East of Kugmallit Bay, the coast of the Tuktoyaktuk Peninsula contains areas dominated by large wind swept sand dunes that have experienced much lower shoreline retreat (1-2 m/yr) relative to Pelly Island. Coastal sediments in this area appear quite mobile with the re-orientation of spits and sand dune migration onto the thermokarst rich coastal region. A better understanding of coastal change and its relationship to the changing morphology of coastal and inland waterways will aid in future decision-making for development and management of one of the most rapidly changing coastlines in the world

SEDIMENTATION IN TUKTOYAKTUK HARBOUR AND APPROACHES, NORTHWEST TERRITORIES

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Located in the southeastern Beaufort Sea, Tuktoyaktuk Harbour has been identified as a valuable natural harbour and has provided a staging and over-wintering area for the offshore oil and gas industry since the early 1970s. The viability of the harbour and community depend on the safe passage of ships through a confined channel leading into the harbour. The only navigable entrance to the harbour is at the east end of Tuktoyaktuk Island where minimum water depths range from 4 to 6 m. Harbour dredging created a narrow trench of deeper water (5.5-6.0 m) about 100 m wide by 750 m long. Comparison of dredge depths (circa 1981) and Nautical Charts (circa 1973) to higher resolution multibeam surveys between 2004 and 2009 indicates recent sedimentation within the dredged channel. The bathymetry also revealed keel drag marks on the seabed, suggesting that the water depths are too shallow for the vessels currently using the harbour. Thus there is a pressing need for more information on nearshore and harbour sediment transport, sediment sources and rates of supply, and annual rates of accumulation on the seabed and harbour floor. To answer these questions, we used shallow seismic reflection profiles, acoustic doppler current profile (ADCP) and turbidity sensor data, shallow seismic reflection profiles, coring systems, and radiocarbon dating to gather information on current velocities and harbour-mouth circulation, suspended sediment concentrations, and acoustic stratigraphy, lithology, and chronology of seabed deposits. Sediments accumulating in Tuktoyaktuk Harbour may be derived from the Mackenzie River plume, from erosion and transport of sediments along the outer coast, from erosion of the harbour shoreline, or all three sources. The volume of material derived from the harbour shore is small in relation to the potential supply from the other two sources. Retreating at rates of ~2 m/yr, Tuktoyaktuk Island delivers in the order of 115 m3 of sediment to the nearshore system on an annual basis. Seismic reflection profiles collected by the Geological Survey of Canada (GSC) in 2012 and 2014 revealed that nearshore sediments outside the harbour are being deposited and preserved in drowned thermokarst lake basins and as a prograding wedge of clinoform deposits infilling the dredged approach channel. Targeted sediment cores collected in 2014 will be used to validate the stratigraphic interpretation and quantify sedimentation rates and sources of material. The residence time of water in Tuktoyaktuk Harbour is also of interest as a basis for estimating the retention rate for suspended sediment (silt and clay) in water from the Mackenzie Delta plume. Seabed instrumentation (ADCP, wave gauge) and targeted water samples suggest that both semidiurnal tidal currents and subtidal water exchange (related to meteorological effects including storm surges) play a role in sediment transport in and out of the harbour mouth at Tuktoyaktuk. Although the astronomical tidal range is very small (0.3 m), our measurements show up to 60 cm/s current speeds near the seabed in the eastern entrance to the harbour. Asymmetrical bedforms on the channel floor, observed in multibeam data, provide evidence of current-driven bedload transport (primarily sand) in the harbour mouth.

"WE ARE BUILDING A CRITICAL VOICE TOGETHER": THE SECOND NUNAVUT MASTER OF EDUCATION PROGRAM 2010 – 2013

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Graduate degrees in education enable Inuit to become researchers, emerging scholars, and leaders in education. Thirty-seven Inuit educators completed the Nunavut Master of Education program offered by the University of Prince Edward Island between 2006-2013. This presentation shares results from formal research on the second offering of the three-year program. Findings show that graduates reported enhanced critical thinking skills and leadership abilities through improved confidence and voice. Graduates also demonstrated strong commitment and interest in Elders and Inuit knowledge. Research revealed the benefits and importance of supporting Inuit educators to complete graduate studies in the North with colleagues. Given the implementation of the National Strategy

on Inuit Education, the ongoing legislative and policy changes in Nunavut, and the recent financial contribution to create a university in the Territory, skilled Inuit researchers and leaders are required in order to provide a sustainable future for the Territory.

MULTIPLICITY AND ADAPTATION: ENVIRONMENTAL SECURITY AND ADAPTIVE GOVERNANCE IN THE CANADIAN ARCTIC

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The Canadian Arctic has long been seen as a pristine region—as harsh and inhospitable, as it is breathtaking. Far removed from smog-filled urban centres and the smoke stacks of industry, the Arctic has largely managed to escape the conscience of decision-makers and the footprint of international economic development and global population growth—until now. Climate change is rapidly changing the face of the Arctic and this is forcing us to re-evaluate the potential for environmental change and the way in which arising "scarcities" will be addressed. Environmental security in the Arctic has, until recently, been an issue confronted on a limited basis. A low population, harsh climate, and distance from the comparatively bustling regions of the south have all contributed to limited activity and, as such, initiatives have been restricted to those designed to mitigate pollution and its broader effects. Climate change is shaping a new Arctic environment that will be the stage for new resource development, expanded shipping, the arrival and departure of species, and the transformation of the northern way of life. As climate change continues to transform the Canadian Arctic, there remains an imperative to monitor and manage these changes through science and governance. While the government has committed substantial funding towards science and research initiatives, the government has struggled to apply the knowledge and data it has collected in order to create usable science and relevant policies capable of mitigating harm caused by change.

INVESTIGATING EXPOSURE TO ANTIBIOTICS IN PARTICIPANTS OF COMMUNITY H. PYLORI PROJECTS IN ARCTIC CANADA

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Helicobacter pylori organisms are bacteria that colonize the stomach. Chronic H.pylori infection induces chronic inflammation of the stomach lining, which increases the risk of peptic ulcers and gastric cancer. Residents of Canadian Arctic communities are disproportionately affected by H.pylori and associated disease; control efforts are hampered by frequent failure of standard treatment in this region. Canadian H.pylori treatment guidelines recommend the use of standard triple therapy, which includes two antibiotics and a proton-pump inhibitor. Treatment failure occurs more frequently with antibiotic-resistant strains of H.pylori, believed to proliferate under conditions of frequent exposure to antibiotics at doses that are not effective in eliminating H.pylori, such as from treatment for other infectious illnesses. Overuse of antibiotics may be particularly common in Arctic communities due to the limited availability of diagnostic technology, leading to dispensation of antibiotics prior to confirmed diagnosis. This analysis aims to describe the rate of antibiotic dispensation in Canadian Arctic communities with high H.pylori prevalence in association with factors of interest and to compare this rate to that of the Edmonton outpatient population. This analysis used data collected as part of community-driven research on H.pylori infection conducted by the CANHelp Working Group in Canadian Arctic communities where H.pylori prevalence ranges from 57-69%: Aklavik, NT, Old Crow, YT, Tuktoyaktuk, NT and Fort McPherson, NT. A chart review form was developed to standardize collection of information from medical charts during the 5-year period prior to enrolment for each participant; enrolment occurred during 2007-2012. Collected data included: demographic factors, frequency of antibiotic prescriptions, type of antibiotic prescribed and reason for the prescription. Data on the dispensation of antibiotics in Edmonton, Alberta from 2010-2013 were obtained from the Interactive Health Data Application (IHDA) which incorporates data the following sources: Pharmaceutical Information Network (PIN) Database, Alberta Health Care Insurance Plan (AHCIP) Adjusted Mid-Year Population Registry Files, and Alberta Health and Wellness Postal Code Translation File (PCTF). To date, 5-year antibiotic prescription histories have been collected for a total of 297 participants across the four participating communities. The average number of antibiotic prescriptions per participant within the 5-year review period was 4.6 (95% CI: 4.1, 5.1) with a higher average observed for females (5.6; 95% CI: 4.8, 6.4) compared to males (3.4; 95% CI: 2.9, 4.0). Antibiotics were most commonly prescribed for the treatment of bacterial vaginosis and urinary tract infection in females and otitis media (middle ear infection) and dental abscess in males. The

antibiotic prescription dispensation rate across communities was 0.95 per person-year (95% CI: 0.89, 1.0). Conversely, the dispensation rate for antibiotics in Edmonton was 0.562 per person-year (95% CI: 0.561, 0.563). The rate difference comparing the northern community residents to the Edmonton population is 0.38 per person-year (95% CI: 0.33, 0.43). This preliminary analysis estimates a notably higher antibiotic dispensation rate among residents of Arctic communities relative to the Edmonton outpatient population. Future analysis will compare antimicrobial use across meaningful factors such as age, sex, and community.

UNDERSTANDING THE ACQUISITION AND USE OF INUIT KNOWLEDGE INCLUDING HUNTING AND LAND SKILLS AMONG INUIT YOUTH IN IGLOOLIK, NUNAVUT, CANADA: SIGNIFICANCE FOR CULTURE AND SUSTAINABLE ARCTIC FOOD SYSTEMS

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This research project seeks to understand present-day Inuit youths' acquisition and use of Inuit knowledge (Inuit Qaujimajatuqangit) particularly traditional and modern hunting and land skills and knowledge in Igloolik, Nunavut, Canada. Focus is placed on the knowledge and skillsets involved in hunting for spring ringed seal (upirngaq nattiq), summer walrus (aujaq aiviq) and summer caribou (aujaq tuktu), which are important country foods for Igloolingmiut (people of Igloolik). The research, undertaken between June and August of 2014, involved two parts: 1) detailed interviews with Elders and Youth and 2) observing hunting trips. Discussions with local Elders and excellent hunters first led to an understanding of the traditional and modern knowledge and skills involved in the safe and successful hunting of the aforementioned animals, including but not limited to: navigation, travel, camping, hunting, post-harvest activities and tool-making. Participant observation involved accompanying Elder-Youth camps and family trips on hunts to deepen understanding and contextualize the knowledge and skills involved in the seasonal hunts. Detailed, semi-structured interviews using maps were then conducted with the youth participants of the Elder-Youth camps to document: 1) their present understanding of the aforementioned knowledge and skills 2) their self-reported levels of capability in performing different skills 3) the ages at which they first observed a skill and first performed a skill hands-on 4) who they learned from 5) their experience of participating in an Elder-Youth camp and what more they would like to learn in the future. The youth participants of the Elder-Youth camps among other youth in the community were interviewed as they had previous experience in seasonal hunting of ringed seal, walrus and/or caribou. In addition to youth interviews, semi-structured interviews were conducted with several local Inuit Elders to listen to and document their local knowledge including their stories and knowledge of hunting and living on the land in both past and present. These interviews were audio-recorded in Inuktitut and will contribute to Igloolik's Oral History Project. Furthermore, a photo project of the Elder-Youth hunts was co-directed and co-shot by youth participants, producing a 300-photo printed album now belonging to the community which seeks to inspire youth to go hunting. The results from the youth interviews show that this group of Igloolik youth have extensive and varying breadths of understanding and varying self-reported levels of capability with regard to the traditional and modern hunting skills and knowledge needed for safe and successful hunting of spring ringed seal, summer walrus and summer caribou. The results of the project aim to: 1) encourage Igloolik youth to become even more skillful hunters 2) improve community knowledge of which skills youth can be better at and then focus on teaching those skills 3) develop community-led actions such as contributing to curriculum at the local schools, Elder-Youth camps and radio spots to further strengthen traditional knowledge transfer and 4) lead to policy improvements in education, food and hunting. The ambitions of this project are to support Inuit culture and to strengthen Inuit access to country food.

PERMAFROST CATCHMENTS IN TRANSITION: HYDROLOGICAL CONTROLS ON CARBON CYCLING AND GREENHOUSE GAS BUDGETS

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The Arctic is undergoing rapid climatic change, with dramatic consequences for the cryosphere, including reductions in the depth, extent and duration of sea ice, and seasonal snow cover on land, retreat of ice sheets/glaciers, and melting of permafrost. This is important not only for local and regional ecosystems and human communities, but also for the functioning of the entire earth system. Evidence is growing that organic matter frozen in permafrost soils (often for many millennia) is now thawing, making it available for decomposition by soil organisms, with the release of carbon dioxide (CO2) and methane (CH4), both greenhouse gases (GHGs), as by-products. Unfortunately, the interacting biological, chemical and physical controls on CO2 and CH4 emissions from permafrost (and melting permafrost) environments to the atmosphere are the subject of much speculation because the scientific community does not know enough about the interactions between C and water cycling in permafrost systems. Warmer and drier soils may release more CO2, while warmer/wetter soils might release more CH4. Permafrost thawing also causes changes in the way water flows though the landscape (because frozen ground if often impermeable to water), and some areas may become drier, while others wetter. How the relative proportions of CO2 and CH4 emissions change, and their absolute amount, is critical for the overall 'global warming potential' (GWP) because these two gases have different potency as GHGs. Release of C from soils into freshwaters also needs to be taken into account because down-stream 'de-gassing' and decomposition of organic materials also influences releases of CO2 and CH4 from freshwater, or delivery of C to lakes/oceans. All-in-all, predicting the GWP of permafrost regions is scientifically challenging, and the interactions between the water (hydrological) and C cycles are poorly known. Here we present an on-going project which highlights the key role that hydrological processes play in landscape-scale C fluxes in permafrost landscapes under transition. Our fieldwork is focused at Trail Valley Creek in Northwest Territories, Canada, where we are measuring the capture of C from the atmosphere (through photosynthesis), its distribution in plants and soils, and the biological, physical and chemical controls of C transport and delivery from soils to freshwaters, and ultimately to the atmosphere as CO2 and CH4. In essence we aim to 'close the C cycle'. Field-based measurements of key processes in the water and C cycles, including geochemical tracer and 'natural abundance' C, hydrogen and oxygen isotope approaches, are being linked by computer modelling. The project team, together with partners in Canada, the US and UK, is in a unique position to link the water and C cycles in permafrost environments under transition, and our aim is to deliver essential scientific knowledge on the potential consequences of climate warming, and permafrost thawing, for GHG emissions from northern high latitudes.

CONTAMINATION OF STORED DRINKING WATER AND ASSOCIATIONS WITH ACUTE GASTROINTESTINAL ILLNESS IN A CANADIAN INUIT COMMUNITY

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One of the highest self-reported incidence of enteric illness in the global peer-reviewed literature occurs in Inuit communities in the Canadian Arctic. This high burden of illness could be, in part, due to the common practice and preference of collecting untreated brook water in large plastic containers for later consumption. This research attempts to understand drinking water collection and storage practices, potential risk factors for contamination, and the possible association with self-reported acute gastrointestinal illness (AGI) in order to inform safe water management practices in the Inuit community of Rigolet. The study included a census survey in Rigolet, Nunatsiavut in June 2014 that examined self-reported AGI and various household practices related to water, including its collection at source, storage, and consumption. Samples were collected from all identified drinking water containers in homes and analyzed for most probable number (MPN) of E.coli and total coliforms. Water temperature, turbidity, and physical characteristics of storage containers were also recorded during the sampling process. Prevalence of AGI in the community during the month before the survey was 18.9% (95% CI 14.1%-24.4%), which is substantially higher than in other parts of Canada. While treated tap water is available in homes, 83.4% (95% CI 78.0%-87.7%) of community members stored their drinking water in containers, and analysis showed that 1.2% (95% CI 0.3%-4.9%) of this stored water tested positive for E. coli, and 24.7% (95% CI 18.6%-32.0%) tested positive for total

coliforms. Further statistical analysis will explore associations between drinking water collection and storage practices, water container contamination, and self-reported AGI outcomes. The ultimate goal of the study will be to use the generated knowledge to inform sustainable interventions, while developing the community's capacity to understand and identify potential factors increasing the risk of waterborne disease.

SOIL NUTRIENT PULSES IN THREE LOW ARCTIC VEGETATION TYPES DURING THE WINTER-SPRING TRANSITION PERIOD

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Plant growth is primarily nutrient limited across the low Arctic tundra. As a result, increases in soil solution nutrients, especially if increases occur at the onset of the growing season, could mean an increase in nutrient availability for vegetation and yield enhanced productivity. The magnitude of nutrient increases, the timing and the effect on plant productivity, however, may be dependent upon the vegetation type present. Recent work at the mesic birch hummock in the low Arctic suggests that soil microbes may lose their cytoplasmic nutrients during the winter to spring transition. Counter-intuitively, there was no corresponding increase in soil solution nutrients suggesting that nutrients are either leaving the system or are immediately acquired by plants. Interestingly, the simultaneous declines in microbial and soil solution nutrients, at least in 2008, were matched with a sudden increase in volumetric water content (VWC) when mean ambient air temperatures rose above 0oC and conditions were favourable for snowmelt. Is it possible that any increases in soil solution nutrients from the soil microbial community are diluted and thereby masked by an influx of snowmelt water to the organic layer? In this talk, I will investigate the following questions: (1) Are the soil microbial communities in three major low arctic vegetation types sensitive to increases in VWC that correspond with a rise in mean ambient air temperature above 0oC, a rise in soil temperature and the onset of snowmelt during the winter to spring transition period? (2) Are declines in microbial biomass matched with a simultaneous decrease in soil solution nutrients? (3) What does this indicate about nutrient availability for these vegetation types at the beginning of the growing season? Soil samples were collected from the dry heath, mesic birch hummock and the tall birch between May 5th and June 18th 2014 at the Tundra Ecosystem Research Station at Daring Lake, NWT, Canada. Soil solution and microbial nutrients were extracted and analysed for ammonium, nitrate, phosphate, dissolved organic nitrogen and dissolved organic carbon at Queen's University. To accompany these results, I analyzed the mean ambient air temperatures, VWC and soil temperature data from the past six years. Preliminary results suggest that regardless of vegetation type or year, VWC does correspond with the first late winter rise in mean ambient air temperatures above 0oC and a rise in soil temperature, possibly as a result of percolating snowmelt water. Not only does this pattern occur between vegetation types at the same time annually, but when VWC increases, the similar nitrate concentrations in the soil solution of all three vegetation types simultaneously decline. Consequently, we conclude that biogeochemical pulses during the winter-spring transition period may not differ between vegetation types in the low Arctic and that any increases in soil solution nutrients may flow away from the source to lower elevations and/or adjacent water bodies leaving little for plant uptake during the growing season.

RISK AND UNCERTAINTY IN THE CITY OF IQALUIT 'DUMPCANO': IMPLICATIONS FOR ARCTIC WASTE GOVERNANCE

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On May 23rd, 2014, Iqaluit, Nunavut's municipal dump spontaneously caught fire for the fourth time in under a year. The deep-seated dump fire, which became known colloquially as the Iqaluit 'dumpcano', burned consecutively for over three and a half months. During this time, smoke from the dump fire periodically entered the community causing various environmental and human health concerns. Government policies and directives aimed at managing risk simultaneously rejected and reinforced the public's concerns. The Territorial health department, for example, repeatedly stated that the situation was not a public health emergency, yet instructed children, elderly persons, women of childbearing age, pregnant women, and those with respiratory issues were to limit exposure to the dump smoke. Similarly, air quality monitoring by government scientists indicated that, despite contaminant concentrations being above the acceptable limit for many southern provinces, the amount of exposure would not likely result in long-term impacts to the health of Iqaluit's residents. The government's messaging along with its scientific framing was largely rejected by the public: schools shut down due to children complaining of headaches; several major community events were postponed due to dump smoke; employers handed out gas masks to workers; a community activist group formed; and many families evacuated South. This research draws on ethnographic fieldwork that was conducted in Iqaluit from June-September, 2014. Fieldwork included archival research at municipal and territorial government archives, participant

observation at formal and informal sites of waste management (e.g. the Iqaluit dump, city council meetings, public hearings, etc.), and semi-structured interviews with over 30 stakeholders interested in Iqaluit's waste management. Respondents included: municipal, federal and territorial government officials; local Iqaluit journalists; members of the activist group 'Iqalummiut for Action'; local composters and recyclers; tourists; current and former Iqaluit city councilors; and various non-participating publics. I argue that the community's rejection of the government's messaging about contaminants speaks less to the public's (in)ability to understand science, and more to the uncertainties that are both inherent to, and caused by, modernity. Additionally, Nunavut's recent (and ongoing) history of colonialism has engendered distrust amongst many community residents towards the political and government officials responsible for risk management. This paper draws on Ulrich Beck's risk theory and other environmental studies of risk, uncertainty, and colonialism, to critically consider the role of science and policy in the management of risk perception. Using the Iqaluit 'Dumpcano' as a case study of an acute social/political/and environmental event, I posit that cultural and historical factors, as well as the limitations of scientific knowledge, must be acknowledged when implementing science-based policy related to risk management.

ANALYSIS OF THE STATE OF TERRESTRIAL MONITORING IN NORTHERN CANADA

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Environmental monitoring is integral to planning safe and sustainable resource development in northern Canada and to understanding the causes and consequences of rapid change. However, to date the efficiency and effectiveness of monitoring in northern Canada has been limited by a lack of coordination and gaps in coverage. In order to identify opportunities for increased collaboration of existing networks as well as priority areas for future investment, it is necessary to take stock of the current state of environmental monitoring in northern Canada. In support of SAON Canada and the broader arctic monitoring community, the Canadian Polar Commission conducted an analysis of the current state of monitoring in the Canadian North. This analysis began by developing an inventory of monitoring programs in the areas of atmospheric, cryospheric, marine, freshwater, terrestrial, and human health, which altogether included over 500 programs and will continue to grow. Detailed geographical information on the sites or regions of monitoring was then collected for as many programs as possible, and this was used to conduct a geographical gap analysis in the monitoring of a diversity of biotic and abiotic variables as well as to identify synergy opportunities. The gap analyses of terrestrial flora and fauna will be presented here, as well as abiotic variables of greatest relevance to understanding terrestrial ecological change, such as air and soil temperatures, precipitation, active layer depth, snow cover, andd local hydrology. This presentation will conclude with important synergies that were identified across these monitoring networks and concrete recommendations for how to leverage the existing networks to increase the spatial and temporal coverage of terrestrial monitoring in the North.

RESPONSE OF BACTERIOPLANKTON COMMUNITY STRUCTURE TO ACIDIFICATION IN THE ARCTIC OCEAN

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The influences of ocean acidification on the ocean pelagic ecosystem was tested by so far the largest CO2 manipulation mesocosm study (European Project on Ocean Acidification, EPOCA), performed in Kings Bay (Kongsfjorden), Spitsbergen. The bacterial diversity was investigated using DNA fingerprinting, clone library analysis and high-throughput sequencing of bacterioplankton samples. Our data revealed that general bacterial diversity, taxonomic richness and community structure were influenced by the variation of productivity during the time of incubation, but not the degree of ocean acidification. The phylogenic molecular ecological networks (pMENs) which based on random matrix theory (RMT) showed the nodes and connectivity of microbial community decreased along the increase of pCO2 concentration. Our results indicated the elevated pCO2 significantly reduced the interaction among the microbes in the Arctic Ocean, which suggested an instable ecosystem under a high pCO2 concentration. In addition, the topological structures of the phylogenic molecular ecological networks significantly correlated with biological and chemical variables. Our study suggests that ocean acidification affects the development and interaction of bacterial assemblages and potentially impacts the ecological function of the bacterioplankton in the marine ecosystem.