ARCTIC CHANGE 2014

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Poster Abstracts

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POSTERS ABSTRACTS

AIR QUALITY MONITORING IN COMMUNITIES OF THE CANADIAN ARCTIC DURING THE HIGH SHIPPING SEASON WITH A FOCUS ON LOCAL AND MARINE POLLUTION

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The Canadian Arctic has experienced decreasing sea ice extent and increasing shipping activity in the recent decades. While there are economic incentives to develop resources in the North, there are environmental concerns that increasing marine traffic will contribute to declining air quality in Northern communities. In an effort to characterize the relative impact of shipping on air quality in the North, two monitoring stations have been installed in Cape Dorset and Resolute, Nunavut, and have been operational since June 1, 2013. The impact of shipping and other sources of emissions on NOx, O3, SO2, BC, and PM2.5 pollution have been characterized for the 2013 shipping season from June 1st to November 1st. In addition, a high resolution Air Quality Health Index (AQHI) for both sites was computed. Shipping consistently increased O3 mixing ratio and PM2.5 concentration. The 90% confidence interval for mean difference in O3 mixing ratio between ship and no ship-influenced air masses were up to (4.6, 4.7)ppb and (2.5, 2.7)ppb for Cape Dorset and Resolute, respectively. The same intervals for PM2.5 concentrations were up to (1.8, 1.9)ug/m3 and (0.5, 0.6)ug/m3. Ship-influenced air masses consistently exhibited degraded air quality by an increase of 0.1-0.3 in the high resolution AQHI compared to no ship-influenced air masses. The estimated percent ship contribution to NOx, O3, SO2, and PM2.5 were (12.9, 17.5)%, (16.2, 18.1)%, (16.9, 18.3)%, and (19.5, 31.7)% for Cape Dorset and (1.0, 7.2)%, (2.9, 4.8)%, (5.5, 10.0)%, and (6.5, 7.2)% for Resolute during the 2013 shipping season. Additional measurements in Resolute suggested that percent ship contribution to black carbon was (4.3, 9.8)% and that black carbon constituted 1.3-9.7% of total PM2.5 mass in ship plumes. Continued air quality monitoring in the above sites for future shipping seasons will improve the statistics in our analysis as well as characterize repeating seasonal patterns in air quality due to shipping, local pollution, and long-range transport.

VERTICAL STRUCTURE AND ENVIRONMENTAL FORCING OF PHYTOPLANKTON COMMUNITIES IN THE BEAUFORT SEA: VALIDATION AND APPLICATION OF NOVEL SATELLITE-DERIVED PHYTOPLANKTON INDICATORS

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The vertical dynamic of phytoplankton communities results from a subtle balance between the propagation of light through the water column and the upward flow of nutrient, themselves governed in turn by turbulence, advection and diffusion. The phytoplankton vertical structure, difficult to predict in both space and time, remains a challenge for satellite-derived primary production (PP) estimations, which are based on near-surface measurements only. For instance in the Arctic Ocean, the occurrence of subsurface chlorophyll a maximum (SCM) has been shown to introduce biases in estimation of PP integrated over the water column. These deep phytoplankton aggregations can generate large underestimates of satellite-derived PP, specifically in oligotrophic regions and in late summer, following the spring-summer bloom (e.g. August). The objective of the present study is to document these critical situations (i.e., bias in integrated-PP) (1) by examining the environmental forcing that drives the SCM dynamic and the phytoplankton community structure in one of the most oligotrophic and stratified Arctic region, namely the Beaufort Sea, and (2) by evaluating the performance of a regional empirical model that infers the vertical structure of phytoplankton (Ardyna et al., 2013). The results revealed interesting phytoplankton features such as the occurrence of (1) a surface chlorophyll maximum (SUCM; 0-20m) associated with the surface mixed layer in the shelf regions, (2) a SCM in shelf regions with high chl a concentration (SCM-shelf; 30-50m), and (3) a SCM in open water with a lower chl a signature (SCM-open; 50-70m). For each case (i.e., SUCM, SCM-shelf and SCM-open), distinct phytoplankton assemblages were observed, underpinning the role of different environmental forcing along the shelf-basin gradient. By applying our empirical model to in situ surface chl a measurements, we were able to

reproduce with a good accuracy the vertical chl a profiles in the Beaufort Sea during the Malina Cruise (July-August 2009), excepted for some cases where both a SUCM and a SCM coincide in the water column. Finally, new perspectives and operational applications (i.e. phytoplankton indicators) derived from the empirical model using satellite products are presented.

SPATIAL AND TEMPORAL VARIABILITY OF CO2 SPATIAL AND TEMPORAL VARIABILITY OF LEAF AREA INDEX AND NDVI IN A SUB-ARCTIC TUNDRA ENVIRONMENT

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Sub-Arctic tundra environments experience very short growing seasons, lasting only a couple of months during the summer. During these months there is a dramatic increase in land-to-atmosphere fluxes of carbon dioxide due to photosynthesis. Therefore, it is important to monitor the different characteristics of these ecosystems in order to build better predictive models of this net ecosystem exchange (NEE) of greenhouse gases. Current NEE models often use estimated values of the leaf area index (LAI), derived from remotely sensed measurements of the normalized difference vegetation index (NDVI). Due to the coarse resolution of the satellite images often used (pixel size of 0.5km^2 – 1.0km^2), and the fact that the amount of vegetation within these areas varies dramatically on the scale of just meters, LAI has been found to be a large source of error in these models. For this reason it is important to gain a better understanding of this vegetation variability on many spatial and temporal scales. This project has three main objectives in order to accomplish this. The first is to determine whether significant spatial and temporal variances exist in LAI, measured at the plot scale (~0.5m^2), between six different tundra vegetation communities. The second is it determine whether significant spatial and temporal variances exist in NDVI, measured within the same plots and time period. The third is to determine whether NDVI and LAI are significantly correlated, both at the landscape and community level. Field research took place at the Daring Lake Tundra Ecosystem Research Station (N64°52', W111°35') in central NWT over the months of June, July and August of 2013. Six sampling sites were established, each with different surface and vegetation characteristics. Significant spatial and temporal variances were found for within-community LAI and NDVI measurements. With the exception of the tall shrub vegetation community, no significant between-community variances were found for LAI and NDVI. At the landscape level a significant but moderate correlation between LAI and NDVI was found (r^2=0.258). At the community level stronger LAI-NDVI correlations emerged only within the Heath-Lichen (r^2=0.476), Tussock (r^2=0.563), and Tall Shrub (r^2=0.531) communities.

OCCURRENCE AND CHARACTERISTICS OF ARCTIC SKATE, AMBLYRAJA HYPERBOREA (COLLETTE 1879) (RAJIDAE), IN THE CANADIAN BEAUFORT

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The distribution of Arctic Skate in the western Canadian Arctic is poorly known, and previously documented as three confirmed occurrences. In 2012 and 2013, 71 specimens of A. hyperborea and 10 skate egg capsules (species yet to be confirmed) were collected during open-water season from the Canadian Beaufort Sea slope (200-500m depth) and basin (>500m – 1500m depth) habitats through benthic trawl sampling conducted aboard the F/V Frosti as part of the Beaufort Sea Regional Environmental Assessment (BREA) Marine Fishes Project (Aboriginal Affairs and Northern Development Canada & Fisheries and Oceans Canada). These occurrences extend the known range of A. hyperborea in the Canadian Beaufort Sea. Maps of the historic and current distribution of A. hyperborea and egg capsules provide insight into likely habitat preferences by life stage (i.e., maturity stage and sex). This collection represents the first comprehensive sample for the Beaufort Sea; a summary of morphological characteristics (n=36) are described and presented and placed in the context of other northern populations. Data include meristics, organ weights, colour patterns, key identification characters, and sexually dimorphic parameters. This basic knowledge provides the foundation for future work aimed at filling in knowledge-gaps on the life history of A. hyperborea in Arctic seas. That work includes trophic and energetic linkages within the Arctic marine ecosystem, diet, key life-stage characteristics (i.e. size and age at maturity), and habitat requirements will help inform future conservation-based management decisions preceding hydrocarbon development and climate change.

USE AND ANALYSIS OF COMMUNITY AND INDUSTRY OBSERVATIONS OF ADVERSE MARINE AND WEATHER STATES IN THE WESTERN CANADIAN ARCTIC: A MEOPAR PROJECT

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In Fall 2013, Atkinson and his team received funding from the federal government program "Marine Environmental Observation, Prediction and Response Network (MEOPAR)" and more recently, Transport Canada, to conduct a three-year project focussing on weather impacts and their associated adverse effects on ocean transportation in the Eastern Beaufort Sea region. The project objective is to have coastal communities, industrial/marine shippers, and operational/emergency response groups (collectively, "end-users") identify specific occurrences of problematic weather or wave events that interfere with any form of marine transport in the Western Canadian Arctic. These occurrences are being linked to broader atmospheric patterns. Marine transport includes travel on the water in all sizes of craft, from boats used in subsistence to sealift or tourism boats. Three communities in the Inuvialuit Settlement Region, Sachs Harbour, Tuktoyaktuk and Ulukhaktok, expressed an interest in participating in the study. Two site visits and interviews have been conducted since in March 2014, focussing on Ulukhaktok and Tuktoyaktuk. Initial interview and reporting work, and planning for instrument deployments, has taken place in these communities. Work with communities will continue for the duration of the project. Sachs Harbour was visited to present the project and begin the coordination process, and to have preliminary discussion of instrument needs. Northern Transport Co. Ltd., a major tug-and-barge operator in the region, was visited at their operations HQ in Hay River, NWT, and discussions held with their captains. The project has maintained bi-weekly contact with tug captains and community members when possible. Discussions in Inuvik with people from GNWT and Aurora Research Institute have also been held. This poster presents the approach by which these end-user observations provided fundamental guidance to the project, by providing insight and specific examples concerning how weather is affecting marine and shipping activities in the region. The Inuvialuit make routine observations of waves, storms, swell and weather that affect their marine transport and community activities. It is these observations that are providing direction to this project, by showing it what types of waves and local weather are problematic. These are things that only the community can identify.

CHARACTERIZATION OF THE NORTHERN SNOW ALBEDO WITH SATELLITE OBSERVATIONS

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Spring surface albedo at high latitudes in the northern hemisphere (NH) is subject to change due to diminishing seasonal snow cover. If a highly reflective snow-covered surface is replaced by a darker snow-free surface, the absorption of solar radiation increases, triggering a positive feedback loop: larger absorption enhances further warming. Air temperature, precipitation and vegetation can affect the snow cover properties and, consequently, snow reflectance, augmenting surface albedo changes. The goal of this work is to study a possible relation between satellite-derived surface albedo in the spring (March, April and May) and factors which may affect it. In this study we looked at the effects of snow cover fraction (SCF), air temperature, precipitation amount and frequency and vegetation greenness. The area of interest lies in the NH, north of 50 °N and covers all land territories, except Greenland and Iceland. The Moderate Resolution Imaging Spectroradiometer (MODIS) data on surface albedo, SCF, Enhanced Vegetation Index (EVI) and CRU TS3.21 gridded station data on air temperature, precipitation amount and frequency were used in the analysis. Monthly averages are compared. We found that SCF is the strongest variable affecting the land surface albedo during the spring season. However, we have also found that in large areas in both North America and Eurasia the albedo changed by up to ±0.2 in conditions of constant 100% SCF. Hence, we postulate that other factors, such as air temperature, precipitation pattern or vegetation, affect surface albedo changes. From the factors we looked at, the air temperature has the largest effect on the spring-time surface albedo for areas where SCF does not change. Our analysis shows that there is a threshold of about -15°C: when the monthly mean temperature exceeds this value, further warming decreases albedo. Despite of anticipation of positive correlation between precipitation amount or occurrence and albedo, there are vast areas where precipitation is negatively correlated with albedo. A possible reason for this observation could be the increased occurrence of rain or wet snow, rather than solid precipitation. The strongest trend in greening has been observed in subarctic areas. However, no significant correlation has been found on the regional level, with the exception of Northern Canada, with a significant negative correlation in March and a positive correlation in April.

A PERMAFROST TEMPERATURE REGIME SIMULATOR AS A LEARNING TOOL FOR SECONDARY SCHOOL INUIT STUDENTS

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The permafrost temperature regime simulator "Permasim" is part of a project named Life on permafrost in Nunavik: community planning empowerment. This project, in collaboration with Cégep de Trois-Rivières, Université du Québec à Trois-Rivières and Université Laval aims at developing a computer assisted approach to raise the level of permafrost education and knowledge among the Inuit in Nunavik. The expectations, or specific objectives, are 1- to use learning on permafrost, a component of their natural environment, as a pragmatic topic for science education at High School level and 2- help local administrators and leaders reach a higher level of practical permafrost knowledge so that they can better assume decision making in land management and community issues. The idea is to use local phenomenon, linked to the territory, to interest students not only about permafrost, but also about basic sciences (graphics, physics, mathematics and environment) with real-life situations that have practical significance. Thus, a mathematical based solution to produce a mobile educational application of thermal regimes for Nunavik communities was developed with "TONE", a one-dimensional finite element geothermal simulation model. This application was made for different types of soils (rock, till, sand, clay and peat) for each of the 13 communities (of 14) of Nunavik that is built on permafrost. Permasim simulates the evolution of the soil temperature profile over a period of one year. The climate data used to drive the simulations are from the Nodicana D collection (ground temperature) and the SILA network (air temperature). The simulations represent the basic scheme which can be expected for each village. Therefore applications in schools will be tailored at the community level; for instance in each school the students will have applications that match the climate conditions of their village. The simulated outputs are used to drive animated pedagogical and interactive computer applications to be used by the students. Users can choose the village, soil type and vegetation cover for which they want to create a simulation. They can also make comparisons between each soil and vegetation cover type for a village preselected. Permasim also simulates snow cover and its effect on the soil temperature profile in the period of one year. Permasim has already been tested with teachers of the secondary schools in Nunavik. They made very positive comments. As part of this conference we want to present Permasim to the audience in order to receive comments and suggestions.

WOLVERINE: A TRADITIONAL RESOURCE IN NUNAVUT

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Wolverine (Gulo gulo) is an important furbearer in Nunavut's culture and economy. Hunters have traditionally been reliant on fur for clothing and for income, due to the frost resistant properties of their fur. Wolverines occupy almost all areas of the territory. They are found in relatively low densities, have low reproductive rate, and designated as a species of Special Concern (COSEWIC 2014). In 2009, a wolverine harvest monitoring program was expanded to include wolverine carcass collection in the Kitikmeot and Kivalliq regions of Nunavut. The Nunavut Land Claims Agreement (NLCA) established Hunters and Trappers Organizations (HTOs) and Regional Wildlife Organizations (RWOs) with specific roles and authorities, and through these organizations Inuit are co-partners in Nunavut wildlife management, including wildlife research. Under the NLCA, furbearer harvest privileges are held by Inuit beneficiaries, however, local HTOs have the authority to approve and recommend non-beneficiary furbearer harvest. Nunavut hunters act as stewards of the land and provided through their local HTO a total of 373 wolverine carcasses between 2010 and 2013. The majority of wolverines were harvested during March and April, a period when the fur is in prime condition. Most of the harvest occurred within the community traditional harvesting areas. Sex ratio of the harvest was 2.2 males:1 female, a typical figure for northern areas. The high proportion of juveniles and yearlings (56%) and the low proportion of females (35%) among adults in the harvest may signal the importance of dispersal in the population dynamics of this species within the traditional harvesting areas. Based on our analyses of wolverines reproductive tracts, we estimated that females older than 4 years are the ones able to produce

most of the offsprings in the population, though females as young as 2-years were able to breed, almost a year and half before the median age of maturation (3.75 years). In terms of hunters perspective on wolverine relative abundance, out of 373 hunters, 256 wolverine hunters responded to the question about the status of wolverine population, and half of those respondents believed the population was stable (n= 128) while 49% (n=126) believed their local population was increasing. The spatial distribution, age and sex structure of the harvest will help elucidate the status of wolverine population. Over the long term, the increasing resource development on the tundra may adversely impact this species; hence, increased the importance of harvest monitoring of wolverine using Inuit hunters, their ecological knowledge and relevant skills and capacities. Key words: furbearer, wolverine, Gulo gulo, harvest, Nunavut, Inuit hunter, ecological knowledge.

SPATIAL VARIABILITY OF HAZARD RISK TO INFRASTRUCTURE, ARVIAT, NUNAVUT

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This project, formed in collaboration with the Government of Nunavut and Hamlet of Arviat, is part of continuous efforts to better understand spatial variability of land suitability for community built infrastructure in a changing Arctic environment. The western Hudson Bay region is currently facing numerous climatic and environmental changes: warming temperatures, permafrost degradation, loss of sea ice cover, isostatic rebound and coastal emergence. There is an urgent need to better understand the impacts of these changes and the effect they may have on the built environment, particularly at the community level. Knowledge needs are greatest in isolated, rapidly expanding communities with pre-existing infrastructure stability problems and infrastructure deficits. Arviat is the second largest community in Nunavut, built atop a prominent point protruding east into Hudson Bay. The point is bordered by two parallel esker ridges running west to east. Poorly drained ice and wave reworked glacial and marine sediment, and extensive wetlands and lakes, dominate to northwest of the point and between the two eskers. Abandoned tidal flats, raised beaches and isolated whaleback bedrock outcrops dominate southwest of the point. The original community, settled in the 1960s, was built exclusively atop the north esker: it has since expanded south, into the surrounding glacial and marine material and wetlands. Arviat is also an emergent, mesotidal environment with 4 distinct coastal zones. To address this knowledge gap, building on a rapid appraisal of landscape hazards completed in Arviat in 2009, we acquired new, in-depth information on the nature and extent of local ground conditions, coastal dynamics and the spatial distribution of hazard potential. Information was acquired, through remote sensing, fieldwork, and community consultation, on local relief, surficial geology, active layer and near-surface permafrost conditions, coastal geomorphology, and community built infrastructure. These results will be used to produce relative hazard distribution maps for each variable, ranking variables according to local relevance, and combining ranked variables into a composite hazard map for the community. One of the most pressing concerns identified during our community consultation efforts was the ubiquitous confusion regarding the decision making process behind built infrastructure development in the community. In light of this knowledge gap, information will be collected from relevant stakeholders to produce a decision making tree for built infrastructure development in Arviat. This decision making tree will be used to inform community members and government agencies of the underlying process that takes a building from idea to completion. It will also be used to determine where geotechnical information is most relevant during the decision making process, to avoid redundancy and inform future built infrastructure development. Results of our project, the composite hazard maps and a decision making tree, will be used to identify and delineate potentially unstable land, improve lines of communication between stakeholders, determine where relevant geotechnical information is needed, and ultimately inform decision making to improve community resilience in a changing environment.

BEYOND DATA ANALYSIS: LEARNING TO FRAMING RESEARCH IN POLICY RELEVANT FORMATS

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As the Arctic continues to experience rapid changes, both socio-economically and environmentally, understanding the resulting impacts and implications is necessary for developing

the predictive capacity needed to implement adaptation plans. As a result early career researchers (ECRs) are increasingly asked to translate their research into policy relevant formats and frameworks. However, there is little training or support for ECRs on how to construct bridges between their results and current policy needs. In academia, ECRs generally do not learn how to frame their research in formats that address priority areas in regional and federal Arctic policies. To address this gap in training, the Canadian national committee of the Association of Polar Early Career Researchers (APECS) has focused on providing training opportunities to help ECRs with understanding the links between policy and science. First, we highlight APECS Canada's 3-part webinar series with invited science advisors and policy analysts as well as our expanded mentor program, which includes practical work-placements in policy analysis. Second, we also review the benefits of building and sustaining partnerships with polar institutions, highlighting the growing collaboration between APECS Canada and the Canadian Polar Commission (CPC) and the tangible outcomes generated. Institutional relationships between ECRs and national and international organizations (e.g. Arctic Council and working groups etc.) can provide opportunities for learning while leveraging ECRs expertise and fostering new skill development in policy analysis. Overall, these training opportunities challenge ECRs to go beyond data analysis and topics covered in their graduate programs, and participate actively in bridging their own knowledge gaps regarding policy.

THE IRIS UMBRELLA REPORT: TOWARD A BETTER UNDERSTANDING OF THE CHANGING CANADIAN ARCTIC CLIMATE

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ArcticNet is planning to produce a synthesis of the four IRIS region reports due to be published by the end of 2017. This umbrella report will address Canadian politics and adaptation strategies at the federal level and will include an assessment of observed and projected Arctic climate change from the ArcticNet-Ouranos collaboration initiated in 2009. Since 2009, ArcticNet has worked in close collaboration with the Ouranos consortium to characterize regional climate and produce climate change scenarios for each IRIS region. This collaboration has contributed to the development of the climate and scenarios chapters for the IRIS impact assessments 1 and 2 (in prep.) and IRIS 4 (Allard and Lemay, 2012). The collaboration also involves activities that contribute to the umbrella report. For example, Ouranos recently completed an evaluation of commonly used Arctic gridded climate and reanalysis datasets (e.g. CANGRD, ERA-interim, CRU, NCEP and NARR) to obtain a better idea of the consistency and spread between datasets over the Canadian Arctic domain (Rapaic et al. 2014 in prep). This evaluation showed strong dataset coherence for air temperature but large differences for precipitation. Dataset coherence was also observed to vary regionally (e.g. lower coherence over the Canadian Arctic Archipelago) which has implications for climate monitoring in these areas. Other umbrella activities to be addressed in the ArcticNet-Ouranos collaboration include the evaluation of the current generation of regional and global climate models at simulating the climate of Arctic coastal environments, development of Arctic scenarios based on large model ensembles, and evaluation of scenario production methodologies for generating time series and extremes for Arctic applications.

A SPATIALLY CONTINUOUS ESTIMATE OF WATER LEVELS FOR CANADIAN TIDAL WATERS

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As a follow up to last year's oral presentation, 'A spatially continuous estimate of water levels for Canadian tidal waters', and in support of this years abstract submission, 'Applications of tidal water level models in the Arctic: hydrographic survey reduction and new definitions of the coastline' (Robin and Bartlett), this poster outlines the motivation, methodology and validation of the Continuous Vertical Datum for Canadian Waters (CVDCW) surfaces. The goal of this project is to develop a seamlessly varying surface connecting CD to the GRS80 ellipsoid in the NAD83(CSRS) reference frame by integrating ocean models, water level analyses and GPS observations at gauges, sea level trends, satellite altimetry, and a

geoid model. These continuous surfaces are particularly useful in the Arctic where both geodetic control points and tide gauge data are limited. Once operational, the CVDCW will enable the use of Global Navigation Satellite System (GNSS) technologies for hydrographers and navigators, allow easier integration of hydrographic and terrestrial data, facilitate research in storm surge modelling and climate change adaptation, and aid with practical issues such as sovereignty and the definition of the coastline. Surfaces are also developed for other low and high water tidal datum targets which define a large portion of the vertical between land and ocean and can be used to delineate flooding thresholds and inter-tidal ecosystem zones and boundaries.

FACTORS AFFECTING NEST OCCUPANCY AND REPRODUCTIVE SUCCESS OF ROUGH-LEGGED HAWKS: A TRADE-OFF BETWEEN PREDATION RISK, MICROCLIMATIC CONDITIONS AND NEST STABILITY?

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Permafrost thawing and increase in precipitation due to climate warming may augment the vulnerability of nesting structures to slope processes related hazards resulting in habitat loss for arctic-breeding raptors. It is therefore important to better understand how environmental factors influence nesting structures stability as well as nest occupancy and reproductive success in species strongly dependent on highly specific nesting structure. In cliff-nesting raptors, several physical characteristics of the nesting site may influence reproductive success, especially those linked to predation risk and microclimatic conditions. The rough-legged hawk (Buteo lagopus) is an avian predator of the tundra breeding on cliff edges, hoodoos or along steep hillsides, and they often reuse the same site for many years. Their nesting structures are exposed to geomorphological hazards (e.g. slope failure, rockfall, active layer detachment slides) and nest destruction has been previously reported as a cause of nesting failure in this species. The aims of this study are to 1) characterize nesting sites and their surrounding habitat to assess features that may affect their occupancy and reproductive success and 2) assess the vulnerability of nesting sites to geomorphological hazards. The study was conducted on Bylot Island, Nunavut, where a total of 78 nesting sites were monitored opportunistically during 2007 to 2014. Nests were revisited during the breeding season to determine reproductive success (clutch size, fledging success). Each nesting site was characterized by measuring several habitat features (e.g. altitude, aspect, substrate type, accessibility and slope) and by describing the local geomorphology and general landscape. Preliminary results show little association between habitat features and the probability of occupancy. However, we found a negative association between reproductive success and nest accessibility by mammalian predators such as the Arctic fox (Vulpes lagopus) and a positive one with southern exposure. This suggests that reproductive success is both influenced by predation risk and microclimatic conditions at the nest. We are currently developing a stability index of the nesting structure in order to examine its potential effect on reproductive success. Among the 78 nest structures monitored since 2007, 17% have been destroyed by geomorphological hazards whereas 2% have simply fallen. We also documented in details a nest collapse that occurred in summer 2014 due to a slope failure following a high precipitation event, which result in the death of several chicks. We will analyze these data with a Cox proportional-hazard regression model to investigate the effect of climatic variables on nest persistence. As the availability of good nesting site is likely limited for hawks, a change in their persistence may influence the distribution, density and breeding success of this species.

LIFE IN FRESHWATER AT THE TOP OF NUNAVUT: LIMNOLOGICAL STUDIES AT WARD HUNT LAKE (LATITUDE 83°N)

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Ward Hunt Lake is Canada's northernmost lake, located on Ward Hunt Island (83°05'N, 74°10'W), 6 km off the shore of the northern tip of Ellesmere Island. This region experiences a polar desert climate, with an average air temperature of -17°C and precipitation around 150 mm (Vincent et al. 2011). The lake is ultra-oligotrophic and perennially ice-covered, but record melting of more than 25% of its cover occurred in 2008 (Vincent et al. 2009), and complete loss of ice cover was recorded in 2011 and 2012 (Paquette et al. 2014). Given its extreme northerly location, Ward Hunt Lake is a sensitive indicator of global change. The objectives of our limnological studies in Ward Hunt Lake are to determine the structure and functioning of this remote aquatic ecosystem, and to better understand the nature and implications of ongoing change. Our

previous work has shown, for example, that that loss of ice cover over Ward Hunt Lake could have a major effect on the protist community, with a shift toward mixotrophic chrysophytes that would affect food web processes (Charvet et al. 2014). In August 2014, a 2.2 m thick ice layer covered the lake. The water column was inversely stratified with a bottom water temperature at 9.5 m of 4.9 °C. Oxygen levels dropped from just above air-equilibrium immediately under the ice (109 % saturation) to below saturation (57%) through most of the water column. No traces of macrozooplankton were observed, and the highest trophic level in the planktonic food web of this lake is likely to be microzooplankton, including heterotrophic and mixotrophic protists (Charvet et al. 2014). We observed chironomid larvae in association with mosses that had been transported to the shallow littoral zone of the lake, and these invertebrate communities may also play a role in carbon processing in this ecosystem. Earlier studies showed that microbial mats dominated by cyanobacteria occur across the rocky substratum of the shallow littoral waters of Ward Hunt Lake (Bonilla et al. 2005), and these communities were thought to be restricted to this edge zone. However, our survey of the lake by underwater video camera in 2014 revealed a surprisingly luxuriant community of cyanobacterial mats and mosses at the deepest site (10 m) of the lake. The loosely cohesive mats appeared to be 1 cm or more in thickness, with a thin surface layer of a pink coloured community and a thick blue-green coloured underlayer. This strikingly abundant community appeared to be cloaking the aquatic moss populations, and individual strands of moss extended through the mat into the overlying water. Our video survey of more shallow waters indicated the extensive, almost continuous development of thinner microbial mats across the lake floor, with moss communities restricted to isolated rocks. These shallow waters also had extensive accumulations of tube-like structures, suggestive of chironomid activity, but the exact nature of these is as yet unknown. These unexpected discoveries indicate that despite its extreme location, Ward Hunt Lake contains abundant life, and further studies are required to sample and identify these intriguing aquatic communities that appear to be thriving across the bottom of this far northern ecosystem. References: Bonilla et al. 2005. J. Phycol. 41: 1120-1130; Charvet et al. 2014. FEMS Microbiol. Ecol. 88: 550-564; Paquette et al. 2014 (in revision); Vincent et al. 2009. Polar Sci., 3: 171-180; Vincent et al. 2011. Ecoscience 18: 236-261.

SIMULATING LATITUDINAL BIOCLIMATIC GRADIENT BY MEAN OF LARGE LAKES COOLING EFFECTS ON THEIR EDGE HINTERLAND

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Water has a high specific and latent heat. This feature explains why it takes so much energy to raise water temperature and so long to get this heat out to warmth the air. Depending on their area (surface of water interfacing with atmosphere), water bodies have a persisting cooling effect on local climate during the warm season and tend to mild temperatures during the cold season, with the exception of the ice-pack season whereas exchanges of heat is very limited. Water volume is also an important factor, especially when a thermocline happens and limit the heat exchanges at the surface. It is generally recognized that the area of climatic influence of a waterbody is delineated by heat exchange (katabatic winds area) between the water surface and the surrounding land surface. In the Subarctic, during the ice-free period, temperature departures may reach up to 12°C during calm weathers. With a summer range of 4°C of local mean daily temperatures (May to July), within about 12 km of distance from the lake to the hinterland, the temperature gradient mimics that of 3 degrees of latitude in the same area. We hypothesize that lake-land interface represents a site model for simulating climatic features that characterises the latitudinal gradients along hundred ok kilometers. Observations on islands of large lakes indicated the occurrence of natural features that pertain to biozones located much further north; a clear demonstration of the cooling effect of the lake. For example, deep permafrost, polygons, krummholz, ice wedges, arctic flora components, are unusually found in the southern forest toundra ecozone, but they commonly occur on large lakes islands. By studying such effects at Clearwater lake (area 1270 km2), in Nunavik, we explore several indications of features that allow comparisons among local and regional bioclimatic gradients. The study is based on temperature records of 3 meteo stations (SILA network of CEN), automated dendrometers, water temperature and lake level measurements, periodic sampling and field observations. Measurement and sampling of water were also conducted during 2013 summer. Preliminary results show a huge contrast among the center on the lake and its surrounding among limnological conditions (increase of Dissolved organic carbon, turbidity, surface temperature, temperature gradient profile, microbial diversity and zooplankton abundance). Tree growth of the hinterland compare to islands show regular growth form compared to krummholz, much greater growth rates, early phenology of buds, gametogenesis, embryogenesis, elongation and cambial activity. Exploration of these preliminary results is conducted with the objective of a simulation of change with regional warming that can be transposed at the regional scale following the regional temperature gradient.

ESTIMATION OF PATCH SIZES IN MARGINAL DISCONTINUOUS PERMAFROST, YUKON TERRITORY AND NORTHERN BC.

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Permafrost patch size, distribution and dynamics are fundamental characteristics of discontinuous permafrost. They are significant to spatial modeling of frozen ground at multiple scales, to infrastructure development, and to the assessment of the impact of climate change. However, little is known of their trends from the margins of the isolated patches through to the boundary between extensive discontinuous and continuous permafrost. This research focused on initiating measurements of permafrost patch size along a 1400 km transect in Western Canada. Sampling was undertaken in marginal discontinuous permafrost between Fort St-John, BC and Whitehorse, YT. A total of 10 study sites were examined during the summer of 2014. The sites were located along the Alaska Highway Corridor, for ease of access, and all were equipped with climate stations and permanent electrical resistivity tomography (ERT) arrays (James et al. 2013; Miceli 2012). The methodology used during fieldwork consisted of a combination of ERT, active layer measurements and near-vertical aerial photography. The previous year's climate data (air temperature, ground surface temperature, snow cover thickness and temperature at the base of the active layer) were downloaded during site visits. ERT was the main tool to assess patch boundaries. ERT uses the contrast in electrical properties in frozen and thawed ground to generate a two-dimensional image. Frost probing along the ERT profiles and at some sites, shallow boreholes, were used to interpret the resistivities recorded at each site. Experiments were conducted using a remotely-controlled airborne photography platform to explore the potential of this new technology in permafrost research. Post-processing of the ERT data will produce 2D profiles of the study sites with varying orientations (e.g. south-north/west-east), with topographic correction and permafrost boundaries delimited. The climate data will be added to an existing database for time series analysis. The current post-processing potential of the aerial images is unknown, but high-resolution imagery, high resolution DEMs, drainage analysis and volume analysis may be possible. All these datasets will be correlated to assess the major controls on permafrost patch size. Field observations suggest that there is a strong relationship between permafrost boundaries and topography, drainage, soils (including the organic mat), and past disturbance. Patch size appears to vary from a few square meters to hundreds of square metres, permafrost thickness at the sites varies from 1 m to more than 20 m and patch shapes are generally quite irregular. Patches generally comprised a main, large body of permafrost, with one to several smaller bodies adjacent to it. Ongoing data analysis is expected to establish whether spatial trends in permafrost patch size and characteristics exist along the transect or whether local factors are the primary controls.

COMICS, COMMUNITIES AND GEOSCIENCE – SCIENCE COMMUNICATION APPROACHES FROM THE YUKON RESEARCH CENTRE

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Since 2010, the Northern Climate ExChange (part of the Yukon Research Centre at Yukon College) and its partners have been using geoscience approaches to map landscape hazards in Yukon communities. By March 2014, we will have developed hazards risk rankings and associated maps for seven communities. After completion, however, the application of project results to community decision making is less assured – as with many projects, it is not uncommon to see our reports gathering dust on agency shelves, or to discuss project outputs in communities, only to find no collective memory that the project was ever carried out. The ultimate goal of our geoscience projects is to create useful, informative tools for community and government decision-making. To achieve this, we have dedicated some of our project resources towards identifying specific audiences, developing communication strategies, evaluating the effectiveness of 'typical' communication avenues employed (e.g., open houses, pamphlets), and developing novel communication approaches. The latter have included comics, targeted mail-outs, community-focused events, illustrative graphics, lay reports and interactive maps. In this presentation, we will describe our successes and failures, show examples of our communication products, and discuss the challenges and opportunities we have identified in developing clear, user-friendly, memorable communication products that keep our projects front of mind, and support their integration as effective tools in decision-making processes.

GEOHAZARD ANALYSIS OF THE ARCTIC INTER-ISLAND CHANNELS

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The Government of Canada's Northern Strategy envisions resource-driven development of the north, increased usage of transportation routes through the Canadian Arctic, and economic benefits flowing to northern communities. The safe and secure development of marine areas in the North requires an assessment of the potential for hazardous geological events (geohazards) such as earthquakes, submarine landslides and tsunamis. Marine geohazards are difficult to assess in the Arctic inter-island channels however due to the fundamental scarcity of data. Archived data at the Geological Survey of Canada and more recent data acquired during ArcticNet expeditions has resulted in a collection of multibeam, sub-bottom profiler, high-resolution seismic and sediment cores that is widely scattered over the region. The current understanding of the geologic framework is that the Arctic inter-island channels are comprised of bedrock overlain by discontinuous till. Thin glaciomarine sediments drape the till and/or bedrock. Discontinuous localized accumulations of Holocene sediment infill depressions with thickness varying from <1 to 10 m. Hydrocarbon venting features have been observed using multibeam and sub-bottom imagery in Barrow Strait. Understanding these features is important to establishing a baseline of natural hydrocarbons present in the waters of the Arctic inter-island channels. Multibeam and sub-bottom data can be used to determine the extent if the venting features on the seabed and their level of activity or inactivity. Glacial lineations are present on the seafloor of several of the inter-island channels of the Canadian Arctic Archipelago. The high slope angles associated with these features (which can be up to 60°) could pose a hazard to potential seabed infrastructure such as communication cables. Ice scours caused by icebergs or sea ice have been observed to water depth of 850m at the mouth of Lancaster Sound. These scours are of interest as present day iceberg keels have been observed to have a maximum draft of 450 – 500m in the Arctic. Ice scours in 850m water depth may have been caused during the last glaciation when sea level was about 100 m lower and glacial ice up to 1000 m thick was present in the area. The study of these deep water scours is important in order to distinguish them from the scours that are being generated from the present ice conditions. Slope failures have been observed in Eclipse Sound in north eastern Nunavut but additional multibeam data is required in areas where high seabed slope angles are present in order to determine the distribution of sediment failure in the region.

SATELLITE-BASED PRIMARY PRODUCTION MODEL FOR THE ARCTIC OCEAN

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The study of primary productivity in the Arctic using remotely-sensed data has evolved to address the special environmental conditions of the Arctic. Primarily, one must account for the unique bio-optical and physiological properties of Arctic phytoplankton due to the seasonal light regime and the high concentration of coloured dissolved organic matter, which impact the light budget in the water column. Previously, we have developed a satellite-based primary production model based on various satellite data (e.g., ocean-colour, sea ice concentration, cloud cover) and regional bio-optical algorithms (Bélanger et al. 2013). One of the main limitations of the model lies in its inability to resolve the vertical distribution of the phytoplankton biomass. Here, we present a new implementation of the Bélanger et al. (2013) model to address not only the vertical distribution of phytoplankton biomass, as indexed by chlorophyll-a concentration, but also the phenology of phytoplankton. This information is derived from statistical analysis of a large dataset acquired over several decades and in various regions of the Arctic Oceans. New bio-optical models, tuned using Arctic data, are introduced to improve our estimates of the decrease of light with depth. Application of our model to describe phytoplankton phenology and vertical structure yield better estimates of depth-integrated primary production and a new view on Arctic production.

EFFECTS OF RESOURCE DEVELOPMENT ON CARIBOU HABITAT AND CARIBOU MIGRATION INTERPRETED THROUGH TRADITIONAL KNOWLEDGE

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Aboriginal peoples want their ecological knowledge used in the management of wildlife populations. Their subsistence economy is grounded in their sense of security about their ability to access an abundant natural resource base. Any threat to that security base is a threat to the well-being and way of life of that community. The Mackenzie Valley Resource Management Act recognizes the importance of conservation to the well-being and way of life of the aboriginal peoples of Canada. In exercising its power, a board shall consider any traditional knowledge and scientific information that is made available to it. Under section 26.1(h) of the Mackenzie Valley Land Use Regulations, the Board has the express authority to impose conditions in a land use permit which relate to the protection of wildlife habitat. Thus, there is structure for traditional knowledge in the regulatory decision-making process for land and water use

applications. Resource exploration activities in the Colville Lake area of the Sahtu Settlement Area (SSA) began in the 1980s. Land use permits issued at that time contained very few terms and conditions relating to the protection of wildlife habitat. Caribou are an important component of subsistence harvesting for the Dene. The people of Colville Lake tell of the area's use and the region's importance to migratory Bluenose West barren ground caribou. Traditional Knowledge interviews conducted in the 1980s highlighted their concerns with respect to the disturbance that oil exploration was having on caribou migration routes, noting that "the caribou are starting to move away from a route that they used every year for the last hundred years. There's got to be a reason" (Marie Kochon, Colville Lake July 8, 1985). A workshop held in 2000 on co-management of caribou in the SSA identified habitat change as the greatest threat to caribou populations. Research priorities were identified that included the need to undertake traditional knowledge studies, and conduct research on the effects of development. At a 2014 GNWT workshop on Wildlife Cumulative Effects Monitoring, the delegates endorsed a question raised by one of the Elders: "there needs to be a Traditional Knowledge Study done on animals that disappear after development has occurred and then come back when development has finished. For example Colville Lake area had lots of oil and gas exploratory drilling and the caribou moved out, now they have returned." (Gabriel Cochon, Fort Good Hope September 3, 2014). Answers to this research question could guide resource development to mitigate negative effects on wildlife habitat and wildlife response to changes in habitat. The current task is to prepare a methodology and protocols to acquire traditional knowledge of long-term regional changes in caribou populations and the ecological factors that may influence these changes. A proposed research plan is presented.

SHIPPING IN THE CANADIAN ARCTIC: ANSWERING THE QUESTIONS OF WHO.

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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 development in marine-based industries such as cruise tourism, fishing, and bulk shipping. A number of questions still remain, though, before any major progression occurs, including the "who", "what", "when", and "where". The identified stakeholders perform a wide range of tasks of national, local and circumpolar relevance for citizen security, safety of activities, homeland protection...etc. The main research focus was to understand and map the relationships between the stakeholders (roles, interests in terms of traffic in the Arctic) and the existing policies in order to visualize where interests overlap and where the major gaps are.

BETWEEN PHYSICAL AND STATISTICAL MODELLING OF MOUNTAIN PERMAFROST

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Predicting the spatial distribution of permafrost in variable landscapes is challenging, particularly in mountain environments which have a high degree of spatial heterogeneity. This research implements the temperature at the top of permafrost (TTOP)-model to predict permafrost distribution for three study areas in southern Yukon and northern British Columbia. The TTOP-model applies scaling factors between air (Ta) and ground surface (Ts) temperatures (surface offset), and between Ts and the temperature at the top of permafrost (if present) (Tg) (thermal offset). The surface offset is mainly influenced by vegetation in summer and snow cover in winter, and the thermal offset is influenced by the soil and organic mat characteristics and the amount of unfrozen moisture in the active layer. The physical model predicts Ts and Tg at 58 weather stations throughout the study areas. The degree to which the model predictions are successful has been assessed by iterating a random sampling of half the input data more than 1000 times to predict the other half of the input data. A land cover classification enables a spatial model to be computed in addition to the numerical model. Using maximum, minimum, mean and upper and lower quartile values of the surface and thermal offsets a total of twenty five spatial predictions of TTOP have been made. These scenarios vary from very cold to very warm and are combined into a probability model of the presence or absence of permafrost in the three study areas which can be compared to previously developed statistical models.

CHANGES IN A BENTHIC ECOSYSTEM ON THE LAPTEV SEA CONTINENTAL MARGIN BETWEEN TWO CONTRASTING YEARS (1993 AND 2012)

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Rapid changes in the Arctic Ocean due to increasing temperatures and the loss of sea ice, will affect the entire Arctic marine ecosystem. A major challenge is the lack of baseline data and long-term observations, in order to assess changes in physical, chemical, and biological parameters over longer time scales. Here, we contrast surface sediment samples from the Laptev Sea continental slope sampled in two different years, about two decades apart. Samples from 1993 (Polarstern expedition ARK-IX/4), when the Laptev Sea was still largely ice-covered throughout the year, provide an ecological baseline against which ecosystem shifts can be assessed. In the past decade, a rapid decline in sea ice cover has occurred, leaving most of the investigated area ice-free during Arctic summer. The Polarstern expedition ARK-XXVII/3 returned to the study area in September 2012 to resample the same stations between 60 and 3400 m water depth. Our results suggest that environmental changes in the past two decades have led to a substantial increase in phytodetritus availability at the seafloor along the entire transect. Bacterial communities play an essential role in carbon and nutrient cycling at the seafloor, and we therefore specifically investigated changes in bacterial biomass, community structure and activity. Based on previous results, we expect the availability of organic matter to be a main driver of the structure and functioning of benthic bacterial communities (e.g. Boetius & Damm 1998, Deep-Sea Res. I 45:239; Bienhold et al. 2012, ISME J 6:724). While bacterial biomass (abundances) and overall community structure show no systematic changes between the two years, extracellular enzymatic activities seem to have increased as a result of higher food availability. Further analyses will show whether this has also led to an increased oxygen uptake at the seafloor. In addition, investigations of the bacterial community at higher taxonomic resolution, using next generation sequencing, will help to link specific taxa to changes in enzymatic activity, as well as to changes in environmental parameters. This study carried out in the framework of the ERC project ABYSS (no. 294757) provides insights into biogeochemical variations and bacterial community dynamics in a region dramatically influenced by global change over a time frame of two decades.

MEASURING CHANGES TO NUTRIENT AND PERSISTENT ORGANIC POLLUTANT BIOAVAILABILITY FROM PREPARING MARINE MAMMAL BLUBBER FOR HUMAN CONSUMPTION

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Marine mammal traditional foods (TFs) consumed by indigenous Arctic humans represent excellent sources of many nutrients, including omega-3 fatty acids (FAs). Unfortunately, these TFs also strongly contribute to these populations' high persistent organic pollutant (POP) exposure susceptibility. Though food preparation is known to cause appreciable changes to nutrient and POP concentrations in fish, little is known regarding the effects of preparation on marine mammal TFs. We will present methodology and preliminary results from investigating the impact of preparation methods on the concentrations of omega-3 FAs and POPs in TFs from one specific marine mammal: beluga blubber and muktuk (blubber/skin). To explore these issues, we are collecting fresh beluga blubber samples during the 2014 summer hunting season in Tuktoyaktuk, Northwest Territories, followed by subsequent sampling of the same individual(s) after each step in the preparation process. Our initial analyses focus on select nutrients (FAs – docosahexaenoic acid and eicosapentaenoic acid) and neutral POPs (polychlorinated biphenyls, dichlorodiphenyltrichloroethane, hexachlorobenzene, and hexachlorocyclohexane). We will utilize traditional lipid extraction and gas chromatography/mass spectrometry methods to quantify FA and POP concentrations in blubber tissue throughout the preparation process. However, we are additionally adopting an equilibrium tissue passive sampling technique, based on the negligible depletion - solid phase microextraction (nd-SPME) approach, to also determine blubber fugacities and fugacity capacities. Specifically, insertion of polydimethylsiloxane (PDMS) thin-film discs directly into blubber provides a means to assess blubber total POP storage capacity in addition to concentration data. Further, we expect that observed blubber phase separation caused by preparation processes to cause the resultant distinct oily liquid and solid phases to possess significantly different FA content and POP concentrations. Ultimately, we hypothesize that preparation methods will appreciably impact nutrient and POP levels in beluga blubber/muktuk, and hope that study results may help establish specific dietary recommendations to maximize nutrient intake while minimizing POP exposure from these popular TFs.

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.

CHANGES IN PHYTOPLANKTON TAXONOMIC COMPOSITION OVER TIME IN THE CANADIAN ARCTIC OCEAN

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Phytoplankton communities drive the carbon export from lower trophic levels to the top predators, harvested by the local communities. In the actual changing Arctic Ocean, the composition of phytoplankton is undergoing several changes that are not only altering the quantity of carbon available to the trophic chain, but also its quality. Phytoplankton size and species composition determine, in part, their photosynthetic performance, nutrient uptake characteristics, exudation, grazing and sinking rates. Systems that sustain production of large cells (> 5 µm) are considered to be high export systems that can support abundant pelagic and benthic populations of invertebrates, fishes and marine mammals. In contrast, ecosystems where small cells (< 5 µm) dominate are typically considered to fuel food web where little material is exported from the system, therefore not serving dependable human harvest. In the last decade, the diatom-dominated community of Baffin Bay has been replaced by a flagellate-dominated community, while the reverse change has been observed in Beaufort Sea. Moreover, the abundance of Phaeocystis pouchetii, a flagellate involved in the production of dimethylsulfide, has increased in the eastern Canadian the Arctic Ocean. The poster will discuss the details of these taxonomic changes along with the potential control of environmental variables on these changes.

LATE WISCONSINAN-HOLOCENE EVOLUTION OF THE CANADIAN BEAUFORT SHELF AND UPPER CONTINENTAL SLOPE

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The Late Wisconsinan-Holocene evolution of the central Beaufort Shelf and upper slope was reconstructed from the integration of multibeam derived seabed morphology, subbottom and shallow seismic profiles, sediment core stratigraphy, biostratigraphy and radiocarbon chronology. After 26 cal ka BP glaciogenic sediments flowing from the leading edge of the Laurentide Ice Sheet (LIS), located near present day shoreline, aggraded over an exposed Beaufort Shelf out to the limit of LGM sea level lowstand (in current water depths of approximately 100 m - current shelf edge). While the ice front was located in the present nearshore zone, over 25 m of outwash sands aggraded shelf-wide forming a large coastal plain. Biostratigraphic evidence supports an exposed, sub-polar coastal plain environment where sediment froze during deposition. Subsequently the cold based LIS advanced over the exposed frozen outwash plain as far north as the current shelf edge. LIS ablation resulted in significant meltwater/sediment discharge across the shelf and down slope. Outwash bypassed the frozen shelf and accumulated on the upper slope and in deeper waters. During or following this down slope progradation, meltwater discharge generated 4 linear cross-shelf erosional channels that were incised into the shelf sediments. The cross shelf Kugmallit meltwater channel continues down slope to more than 750 m water depth. On the shelf, sediments underlying the base of the Kugmallit channel are dated at 26 cal ka BP indicating the meltwater channel is younger than this age. On the upper slope more than 70 m of layered glaciomarine sediments drape the incised Kugmallit meltwater channel. These glaciomarine sediments are less than 26 cal ka BP and are inferred to be younger than the LGM (~21 cal ka BP). Deposition of these glaciomarine sediments down slope began to wane at about 16 cal ka BP suggesting the ablating LIS was still feeding sediment to the slope 100 km north of the present day shoreline at that time. Rising sea level from an LGM lowstand transgressed the shelf edge and eroded glaciomarine and outwash plain sediments. Erosion of these outwash deposits to 115 m below present sea level at shelf edge suggests an observed minimum depth of 115 m for the LGM sea level lowstand. Transgression of the shelf resulted in the deposition of thin interbedded sands, silts and clays. At 100 m water depth, at the current shelf edge, a mollusc shell-bed, indicating shallow water conditions, was dated at 10 cal ka BP. During much of the Holocene, and following transgression, marine muds were deposited to form a thin veneer of 0 to 6 m on the shelf, shelf edge and upper slope. These events correlate in terms of geological processes and chronology with the Late Wisconsinan-Holocene evolution of Amundsen Gulf and Banks Island. The presence of an ice stream in the Gulf and cold based ice sheet covering Banks Island and extending offshore, indicate a consistent regional pattern of LIS growth and retreat. This regional stratigraphy and chronology provide the necessary framework for assessing the timing and recurrence rates of seabed geohazards affecting Arctic offshore hydrocarbon development.

SEASONAL DYNAMICS OF ECOSYSTEM CARBON EXCHANGE FOR A WET SEDGE VEGETATION COMMUNITY, MELVILLE ISLAND, NU

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Along with rising temperatures, the Canadian High Arctic is likely to experience significant changes in precipitation patterns in coming years. Alterations to temperature and precipitation regimes will have widespread impacts on arctic ecosystems. Moisture regimes, impacted by modified precipitation patterns and active layer depth, play a significant role in vegetation community distribution and extent, thereby affecting landscape-scale surface-atmosphere carbon exchange. To predict future changes in net carbon exchange due to changing vegetation patterns, it is important to understand community-specific controls over carbon dioxide (CO2) exchange. Wet sedge meadows are the most productive communities in the High Arctic. Preliminary research suggests that this plant community is a net carbon sink over entire growing seasons, yet the key controls – and the scale at which those controls act – are not well understood. If warming of the High Arctic enhances wet sedge growth, we may observe increases in the percentage of land area occupied by wet sedge meadows, resulting in significant alterations to the carbon balance of high arctic landscapes. We examine the seasonal carbon exchange of wet sedge meadows and explore the potential for up-scaling local measures to the landscape scale. Three sets of paired (light and dark) automated CO2 exchange systems were positioned in three wet sedge sites at the Cape Bounty Arctic Watershed Observatory (CBAWO), Melville Island, NU. These systems recorded CO2 exchange every 30 minutes from early June to early Aug., 2014. These high frequency measurements were paired with static chamber measurements at 24 plots within the same three wet sedge areas to ensure adequate spatial representation. In conjunction with CO2 measurements, time-series NDVI data were collected to quantify the phenological stage of the wet sedge community through the growing season. Abiotic measurements of soil temperature, air temperature, photosynthetically active radiation (PAR), soil moisture, and active layer depth were also recorded at each experimental plot.

NDVI measurements successfully captured spring greening and peak summer biomass. We expect, therefore, that NDVI will provide a useful variable for modelling CO2 exchange in these communities. Soil moisture and temperature may also influence CO2 exchange through their impact on plant growth and soil respiration, although soil moisture is rarely limiting in these vegetation communities. Predictive models of ecosystem carbon fluxes will be created using NDVI data and environmental measurements as predictors of ecosystem carbon fluxes. This will allow us to evaluate the drivers of CO2 exchange in these communities –spatially and temporally – and facilitate predictions of NEE based on NDVI and/or additional biophysical variables. We will also evaluate the scale (largely temporal) dependency of these controls to improve predictions of annual carbon fluxes at the landscape scale.

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.

EFFLUX OF FROZEN PEATLAND SOILS AT FINE SCALE: THE RELATIONSHIP WITH PERMAFROST CONDITIONS AND THE COMPOSITION OF SOIL ORGANIC MATTER (RUSSIA, CALM SITE R1)

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The Circumpolar Active Layer Monitoring (CALM) program developed over the last decade as a leading edge in comprehensive efforts to study the impacts of climate change in permafrost environments. Monitoring of active layer thickness, soil moisture, soil and air temperature are typical for all CALM sites. In connection with this CALM polygons are convenient for the study of spatial and temporal variation of soil parameters at fine scales. What does determine biological activity and function of permafrost-affected soils of CALM? It's the main question of our work. The research CALM SITE R1 (Nadym Grid) (N65°20', E72°55') is located in north of Western Siberia (Russia, since 1997) within the zone of sporadic permafrost of north taiga. It is 1-ha (100m*100m)

grid consists of a square array of permanent stakes separated by 10 m (121 data points per grid for all measurements). For each point of CALM R1 site active layer thickness, carbon dioxide effluxes were measured in August 2013, 2014. Content of total organic carbon, carbon of water extractable organic matter (WEOC) and carbon of microbial biomass (MC) were measured in August 2013. Active layer thickness and soil CO2 effluxes are characterized by high spatial and low temporal variability. Active layer thickness varies from 45 to 195 cm (2013) and from 55 to 175 cm (2014); average thickness is 124 and 115 cm respectively. Strong spatial variation of this parameter related with the different soil cover and the organic layers dimensions. Areas with deepest thaw (more then 200 cm) are developed in large sedge-moss pools within peatlands and in bogs and were not included in calculations. In general, soil carbon dioxide emission is low and does not differ from year to year (145 ± 25 – 2013; 135±35 – 2014) mgCO2m-2h-1 (ranging from 10 to 350 and from 10 to 450 mgCO2m-2h-1 respectively). Average content of TOC in the upper 10 cm of soil is high (36,50±1,50%). Soil of CALM site is characterized with high spatial variation of labile organic carbon (WEOC) and the microbial carbon (MC) in organic layers of soils: average WEOC=0,27±0,05% of soil (ranging from 0,06 to 0,40 % of soil); average MC=3,00±0,20 mg g-1 soil (ranging from it varies from 0,11 to 6,55 mg g-1soil). The values of microbial biomass are high, but geocryological and hydrothermal conditions inhibit all soil biological processes. Based on the regression analysis among more than 10 characteristics (hydrothermal, geocryological, soil) for CALM R1 site was revealed a high and significant correlation soil carbon dioxide efflux only with 2 parameters: content of carbon of microbial biomass in the upper 10 cm soil layer (beta=0,965; p-level<0,05) and the active layer thickness (beta=0,333; p-level<0,05). So the main factors which determine the soil carbon dioxide production and carbon fluxes are the active layer thickness and the composition of soil organic matter. Underestimation of the spatial heterogeneity of soil and vegetation cover in the region of sporadic permafrost can lead to substantial distortion of estimates of the total greenhouse gases balance.

THERMAL DYNAMICS IN A HIGH ARCTIC RIVER

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Changes in river temperatures are caused by thermal energy exchanges at the interface between water and the atmosphere, and between water and the streambed. The thermal dynamics of rivers can play an important role in altering physical and biogeochemical processes and aquatic ecosystem function across a variety of spatial and temporal timescales. Within the stream system, hyporheic exchange is important because river water that enters subsurface areas, known as the hyporheic zone, eventually re-enter downstream where it may alter thermal and biogeochemical conditions. Hyporheic exchanges have been investigated in a limited way in Arctic settings, particularly in context of changing permafrost conditions. Deep active layer formation due to warming climate has affected ground and channel bed temperature regimes. We hypothesize that there is an increased exchange of water through the hyporheic zone in Arctic rivers due to active layer deepening, as well as the emergence of new subsurface flow pathways from adjacent slopes. In this study, river water and bed temperature patterns were used as a primary indicator of hyporheic and slope water exchanges in the West River at Cape Bounty Arctic Watershed Observatory (CBAWO), Melville Island, Canada (75º N, 109º W). Temperature data was collected through detailed longitudinal surveys along the river during the 2014 baseflow period to identify and locate lateral inflows and hyporheic exchange zones. At these sites, surface water chemistry and isotope sampling was undertaken, to determine the extent of surface water mixing and the potential influence on landscape and ecology. The baseline temperature profile of the West River recorded by eight stations demonstrated that there is a consistent diurnal and seasonal fluctuation of overall river temperature throughout July, which was influenced by external drivers such as solar radiation. The longitudinal temperature profiles indicate changes in the thermal fluxes of the river, some of which are indicative of hyporheic exchange through inputs of cooler or warmer water originating from snowmelt, precipitation, and/or streamflow. Residual ice and snow during the summer season further impacts the thermal conditions of the river by cooling downstream flow throughout the summer season. Two areas of prominent hyporheic exchange evolved substantially throughout the season, resulting in different temperature fluxes within highly localized areas. These results demonstrate some of the key processes that influence the thermal regime of a High Arctic river and will contribute to a greater understanding of how hyporheic and other water exchanges can influence stream hydrology, ecology and biogeochemistry.

INUUSUKTUT QAUJISARNILIRIJUT: INUIT YOUTH SEEKING TO GAIN HEALTH KNOWLEDGE

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Significant advances have been made in our understanding of Inuit health and well-being in all Inuit regions of the Canadian North in the last decade. The Qanuippitaa ? (Nunavik) and Qanuippitali ? (Inuvialuit Settlement Region, Nunavut, Nunatsiavut) Inuit Health Surveys provide critical insight into Inuit health and what affects it. However, youth were not included in those surveys and represent a significant gap in the understanding of Inuit health today. Inuit youth have particular health issues and needs, and Inuit health officials and communities have identified the importance of involving youth in the future of health research in the Arctic. Participants to an Inuit Health Survey planning workshop in Kuujjuaq in 2012 identified that "youth, for many reasons, need to be part of this whole process. Their health needs - both as identified from their perspective as well as from a perspective of experience – need to be fleshed out and considered in health survey/cohort planning." (Report from the Inuit Health in Transition Study: The Circumpolar Cohort Nunavik Planning Workshop). Participants also identified the focus on youth as a timely priority to address, as they comprise a large proportion of the Inuit population, and because of their important role in the future of their regions. Inuusuktut Quajisarnilirijut – Youth Seeking to Gain Knowledge - is a youth driven initiative created to produce health research for Inuit youth by Inuit youth. With support from the Nasivvik Centre for Inuit Health and Changing Environments and National Inuit Youth Committee, Inuusuktut Quajisarnilirijut was created in 2013 by a group of dedicated youth from Nunavut and Nunatsiavut, Canada, after a series of successful youth led research initiatives, including a pilot youth health survey held at the 2013 Inuit Youth Summit, a presentation at the 2013 ArcticNet ASM, and youth health training workshops and presentations. As the initiative grows, the goals of Inuusuktut Quajisarnilirijut are to : 1) engage Inuit youth in the research process, 2) provide Inuit youth with community health research training opportunities, 3) gather perspectives from Inuit youth about Inuit health research priorities, 4) Provide Inuit youth with access to health research information, as well as space for Inuit youth to engage in health and health research discussions and 5) move towards youth designed, youth lead, and youth engaged health research projects. Members of Inuusuktut Quajisarnilirijut will present an overview of the program and its activities to date, as well as future goals and opportunities for expansion. Results from program evaluation conducted with youth during an experiential training activity at the 2013 National Inuit Youth Summit in Kuujjuaq, Nunavik will also be presented

ATMOSPHERIC CONCENTRATIONS AND DEPOSITION OF HALOGENATED COMPOUNDS AT VILLUM RESEARCH STATION, NORTH GREENLAND

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Long range atmospheric transport of air pollutants to Greenland is a source of high level of heavy metals and persistent organic pollutants (POPs). The pollutants enter the food chain via atmospheric deposition and sea currents. Organochlorine compounds (OCs), polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs) and perfluorinated alkylated substances (PFAS) have been found to bio-accumulate and biomagnify in biota and humans in the Arctic. Atmospheric monitoring of persistent halogenated compounds has been undertaken at Villum Research Station, North East Greenland (81°36' North; 16°40' West) since 2007. The aim of the air monitoring program is to determine pollution levels and seasonal variations and to identify and quantify the source types that influence the atmospheric pollution and deposition in the Arctic. The deposition of ionic PFAS (perfluorosulfonates and perfluorocarboxylates) has been investigated since 2007 by collecting and analysing snow samples twice a year. The deposition of the other halogenated compounds (OCs, PCBs and PBDEs) has been investigated in two campaigns in 2013 (March and December) by collecting high volumes of snow (12 liters) and employing a specially designed sampler/extraction system. The results of snow analysis for PFAS show that perfluorocarboxylic acids (PFCAs) from C6 (perflurohexanoic acids, PFHxA) to C10 (perfluorodecanoic acid, PFDA) are mainly deposited. These compounds are most probably transported as their more volatile neutral precursors (as e.g. 6:2 FTOH, 8:2 FTOH and 10:2 FTOH), which are also detected in the atmosphere at the same location. OCs were also detected in snow at pg/L levels. The compound detected at the highest concentration was γ-HCH, followed by α-HCH and hexachlorobenzene (HCB). The same OCs detected in snow were also detected in atmospheric samples, but with different concentration patterns. Among the PCBs, CB-28 was found at highest concentrations followed by CB-8, CB-52 and CB-101. BDE-47 and BDE-99 were the PBDE found at highest concentrations followed by BDE-28 and BDE-100.

MAPPING BERRY PRODUCTIVITY AND ANIMAL ACTIVITY IN NUNAVUT: ONE STEP TOWARD UNDERSTANDING THE PLACE OF BERRIES IN THE ARCTIC BIOCULTURAL SYSTEM.

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Berry shrubs are circumpolar species that possess high nutritional value benefitting both animals and northerners. They are known to produce a large quantity of fruit each year but how environmental and climatic factors influence their productivity is poorly understood. Numerous animal species as well as contemporary Inuit rely on berries as a local source of nutrients and vitamins. During the summer of 2014, 30 study sites were visited in the vicinity of the communities of Kugluktuk and Arviat, Nunavut. Sites were chosen prior to fieldwork using a 30 m spatial resolution land cover map produced from Landsat images (Olthof 2009). In each land cover class, three sites were randomly selected to cover local environmental diversity. We measured environmental variables (soil moisture, slope, orientation, soil type), plant height, species cover, animal activity, and berry productivity in a 20 m*20 m plot at each site. We than evaluated the impact of the microenvironment as well as plant community structure and composition on animal and berry abundance. Spatial distributions of berry productivity and animal activity were map to evaluate areas that may be visited for berries. The next step to this project will be to assess the most popular berry picking sites in the vicinity of the two communities in order to evaluate the link between berries, animals and humans. Assessing ecological processes controlling berry availability and productivity while documenting its biocultural value will help inform decisions on land use and traditional activities in the Arctic. In the context of rapid environmental and cultural change, a better understanding of the place of berries in the Arctic food web will provide tools to anticipate and mitigate changing conditions.

D/H AND 18O/16O EVOLUTION DURING VAPOUR EXCHANGES BETWEEN THE ATMOSPHERE AND ICE-BEARING PERMAFROST IN THE COLD-DRY ENVIRONMENTS OF EARTH AND MARS

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In regions with mean daily soil surface temperatures less than 0°C (no active layer), such as in the upper McMurdo Dry Valleys of Antarctic and on Mars, the hydrological cycle is largely restricted to water vapour exchanges between the atmosphere and ice-bearing permafrost. Although the rates of vapour exchanges have been examined, both experimentally and numerically, the water isotope composition and evolution of ground ice formed by vapour diffusion into the permafrost is mainly unknown. That is because ice-vapour isotope fractionation factors at low temperatures are unconstrained. This research focuses on the dynamics of condensation, adsorption and sublimation of atmospheric water vapour into permafrost and the isotopic signature (D/H and 18O/16O) of the emplaced ground ice under different experimental conditions. The objectives of the study are to: 1) determine ice-vapour isotope fractionation factors at temperatures <-30C; 2) determine the environmental parameters affecting condensation and adsorption of water vapor in soil in cold and dry environments; 3) investigate the effect of deliquescent salts, like magnesium perchlorate, on vapor-diffusion rates between the atmosphere and the regolith; 4) measure the ice content profile in permafrost of ground ice formed via vapor-diffusion; and 5) measure the D-18O composition of ground ice during diffusion of atmospheric vapor (condensation and adsorption) in the soils. These objectives will be reached using an experimental chamber, where we will produce ground ice in 500-micron size glass beads. Preliminary results suggest that ground ice formed by vapour-diffusion has a δD-δ18O composition that plots along the meteoric water line, but is shifted well below it (extremely low D-excess values). Overall, the results will addresses fundamental knowledge gaps that are required to recognized the isotope signature of ground ice formed by vapour-diffusion and to characterize the water cycle in cold and dry environments.

DIETARY BENZO[A]PYRENE INDUCES CHANGES IN THE HEPATIC PROTEOME OF POLAR COD (BOREOGADUS SAIDA)

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Increased industrial offshore activities and production of oil and gas in northern waters raises the question of impact of

polycyclic aromatic hydrocarbons (PAHs) on key Arctic marine organisms. One of these is the polar cod (Boreogadus saida), which is the primary food source for Arctic marine mammals and seabirds, and there is a growing interest in using polar cod as fat and protein source in commercial aqua feed. In this work, we have explored the effects of dietary PAH exposure on the hepatic proteome of polar cod using benzo[a]pyrene (BaP) as a PAH model-compound. It has been suggested that a dietary route of exposure plays a significant role in the exposure of polar cod, but this has been given considerably less focus than the waterborne route. Polar cod were force-fed every third day during 14 days to a low (0.4 ± 0.16 µg/g fish) and high (20 ± 5.6 µg/g fish) dose of BaP mixed in Calanus finmarchicus (3-5% body weight); or Calanus finmarchicus with acetone (solvent control). Hepatic proteome samples were obtained and subjected to label-free LC-MS/MS analyses for identification of proteins responding to the BaP exposure regimes. Proteins were identified on basis of protein sequences predicted from the protein-coding region of the recently assembled polar cod transcriptome. Several proteins involved in biotransformation and stress proteins have been identified, including putative novel biomarkers of exposure to PAHs. Preliminary functional analyses indicate that several cellular pathways are affected by the dietary BaP exposure, including a strong response of enzymes involved in the biotransformation of xenobiotics. This study was financed by the Norwegian Research Council, the University of Tromsø, the University of Bergen through the POLARISATION project (# 214184). RNA sequencing, transcriptome assembly, annotation and gene and protein model predictions were performed in the Norwegian Institute for water Research SIS project "MolPOP" .

ALTERATIONS IN THE HEPATIC PROTEOME OF POLAR COD (BOREOGADUS SAIDA) AFTER DIETARY EXPOSURE TO BENZO[A]PYRENE

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Increased industrial offshore activities and production of oil and gas in northern waters raises the question of impact of polycyclic aromatic hydrocarbons (PAHs) on key Arctic marine organisms. One of these is the polar cod (Boreogadus saida), which is the primary food source for Arctic marine mammals and seabirds, as well as a commercially fished species in Russia for human consumption. In the present work, we have explored the effects of dietary PAH exposure on the hepatic proteome of polar cod using benzo(a)pyrene (BaP) as a PAH model-compound. It has been suggested that a dietary route of exposure plays a significant role in the exposure of polar cod, but this has been given considerably less focus than the waterborne route. Polar cod were force-fed every third day during 14 days to a low (0.4 ± 0.16 µg/g fish) and high (20 ± 5.6 µg/g fish) dose of BaP mixed in Calanus finmarchicus (3-5% body weight); or Calanus finmarchicus with acetone (solvent control). The hepatic proteomes were obtained from polar cod livers by homogenisation in a 7M urea; 2M thiourea lysis buffer (Fastprep 24). Multiplexed two-dimensional gel electrophoresis was applied using fluorescence difference gel electrophoresis (2D-DIGE) for mapping differentially expressed proteins. This was then combined with downstream MALDI-ToF mass spectrometry for protein identifications. Acknowledgement: This study was financed by the Norwegian Research Council and the University of Tromsø, through the POLARISATION project (# 214184) and Fellesløftet, and University of Bergen.

EVALUATION OF RECENT VEGETATION PRODUCTIVITY TRENDS USING HIGH RESOLUTION REMOTE SENSING AND DENDROCHRONOLOGY IN THE YUKON TERRITORY, CANADA

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Northern ecosystems have experienced significant changes in the distribution and density of vegetation, likely in response to climate warming. At a global scale, time series analyses of satellite data and tree ring-width (TRW) have proven effective in assessing Arctic and boreal vegetation productivity trends; however, there has been a fundamental lack of research examining the relationship between the two. To determine the relationship between satellite NDVI (normalized difference vegetation index) and TRW, a productivity trend map (1990-2013) for the Yukon Territory was generated using the AVHRR (Advanced Very High Resolution Radiometer) Alaska Composite dataset. Various "high greening" and "low greening" 1km2 pixels were selected for sampling of the dominant coniferous and deciduous species. Preliminary analysis of the AVHRR Alaska composite suggest a dominant greening trend in both Arctic and subarctic regions of the Yukon, as well as some correlation to coniferous TRW trends. Forthcoming analysis will examine a "mixed-species chronology" to determine whether the addition of a dominant deciduous species to a site chronology results in a higher correlation to the NDVI trend. Results from this study will provide a detailed vegetation change map for an understudied region of the Canadian North, as well as allow for a critical examination of both mixed-species chronologies and satellite sensor resolution on quantifying landscape

level vegetation change. Keywords: Remote sensing, NDVI, dendrochronology, boreal

DEFINING ARCTIC FISH FOOD WEB STRUCTURE USING DIETARY BIOMARKERS IN THE TARIUM NIRYUTAIT MARINE PROTECTED AREA

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Shingle point is a historical settlement and now an important modern day fishing and hunting area for Inuvialuit and Gwitchin in the Western Canadian Arctic. It is located at the outflow of the Mackenzie Estuary and is part of the Niaqunnaq (Shallow Bay) area that together with Okeevik Bay and Kittigaryuit Bay makes up the Tarium Niryutait Marine Protected Area (TN MPA). The TN MPA was established to protect belugas and their supporting ecosystem from anticipated impacts of industrial development. Shingle point and Shallow Bay provide an important habitat for multiple fish populations spanning across coastal and marine functional groups. Little is known about the trophic relations and the food web structure among the many fish and how they utilize their surrounding environment. Due to the importance of these fish species and the known contaminants that are persistent in the Arctic marine environment, understanding and monitoring this food web is an important component to preserving the TN MPA. Biochemical techniques have been used to characterize food web structure using dietary biomarkers. Stable isotopes (SI) and fatty acids (FA) can assist in defining feeding ecology and trophic positioning of consumers in a food web. Given the anticipated and ongoing changes driven by a changing climate it is important to understand the food web structure in association with the physical environment that support higher trophic level predators and the impact on their exposure to contaminants such as mercury. Thus, in this study we set out to a) develop food web and trophic positioning of coastal and marine fishes using dietary biomarkers; b) assess impacts on mercury levels in fish associated with trophic positioning, and c) evaluate shifts in feeding ecologies associated with large scale physical drivers such as temperature, the north Pacific and Arctic oscillations. Here we assess fish species collected from Shingle point from 2010 to 2014 using δ15N, δ13C, δ34S, to understand trophic positioning of species within a food web. Additionally, we will use 70 different FA identified in all species to bolster the SI data positioning of fish and prey. The use of dietary biomarkers to understand the feeding ecology associated levels of mercury and will provide a baseline, which will help to predict future trends as climate change persists.

LANDFORM-SEDIMENT ASSEMBLAGES IN A FJORD, SHELF TROUGH AND TROUGH-MOUTH FAN SYSTEM: SCOTT INLET AND TROUGH (NE BAFFIN ISLAND, CANADA)

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Multibeam echosounder, subbottom profiler and sediment core data acquired since 2003 by the CCGC Amundsen together with seismic records and core samples from the Geological Survey of Canada allow the reconstruction of Late-Quaternary ice flow and glacial history in the fjords and cross-shelf trough of the Scott Inlet area (northeastern Baffin Island, Arctic Canada). These combined datasets also provide a great opportunity to document a high-latitude fjord-to- continental slope glacial landsystem that has been strongly influenced by ice streaming during the last glacial episode. The study area can be divided into two physiographic regions: the Clark and Gibbs fjords and the Scott cross-shelf trough. In the fjords, multibeam mapping reveals a morphology that alternates between sills (bedrock or morainic) and sedimentary basins, with the presence of moraines from the side valley glaciers. Traces of paleo-ice-streams are observed in these two fjords, upstream of where they meet. Well-defined channels and terraces and what appear to be scars from mass movements are also observed in the two fjords. Offshore Scott Inlet, a deep (800 m) and large (30 km) cross-shelf trough incise the continental shelf. This trough is characterized by traces of a large paleo-ice-stream with an onset zones located off Clark, Gibbs and Sam fjords. Sedimentary basins are present in depressions within the trough. Five sedimentary units have been identified on the seismic data: 1- A basal unit with a non-penetrable reflector that can be either bedrock or a basal till, probably the Baffin shelf drift; 2- A unit with a series of parallel horizontal high amplitude reflections (observed only in the central sector of Clark Fjord); 3- A semi-transparent unit having little or no parallel reflections (Davis Strait silt); 4- A transparent unit corresponding to hemipelagic deposits that is present in the shelf trough (Tiniktartuq mud); 5- A series of parallel horizontal high amplitude reflections interpreted as estuarine sedimentation. During the last glaciation, the Scott cross-shelf trough favored the formation of an ice-stream that extended upstream into the inner sections of

Clark, Gibbs and Sam fjords, transferring large volume of glacial ice and glacigenic sediments to the continental slope to form an extensive trough-mouth fan. Deglaciation of the continental shelf from a late Foxe glacial maximum was completed by 15 ka BP (Praeg et al. 2007). During this stage, glacimarine conditions prevailed in the trough while ice was still grounded in the fjords. Ice retreat within the fjord occurred by steps as moraines sills represent periods of ice stabilisation during deglaciation. While ice retreated in the fjords, marine invasion of the fjords occurred, resulting in the deposition of a thick glacimarine mud layer. Ice retreat to the Cockburn moraines position at the fjord heads is thought to have been completed by 8-9 ka BP. Sedimentation similar to present-day conditions have then been reached, resulting in an estuarine depositional environment in Clark and Gibbs fjords and in a continental shelf depositional environment on Scott trough-mouth fan. Keywords: Glacial landsystems, Fjord, Cross-shelf trough, Trough-mouth fan, Baffin Island.

EFFECTS OF 45 YEARS OF HEAVY ROAD TRAFFIC ON PERMAFROST AND TUNDRA ALONG THE SPINE ROAD AT PRUDHOE BAY, ALASKA

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Two 200-m transects perpendicular to the Prudhoe Bay Spine Road were established north of Lake Colleen in 2014 to document the effects of the road on adjacent tundra, as part of the NSF's Arctic Science, Engineering, and Education for Sustainability (ArcSEES) project. The Spine Road is a heavily-used gravel road built in 1969 as part of the initial development of the Prudhoe Bay Oilfield. The road is currently 10-m wide (14.5 m including the berm) and 1 m above the surrounding tundra, built of gravel mined from the nearby Sagavanirktok River. We present a decadal time series of aerial photographs from 1949 to 2014. Prior to construction, in 1949, the study area was a level residual surface with no obvious signs of previous thaw-lake processes. A rather homogeneous network of low-centered polygons with less than 30 cm of trough-rim elevation contrast covered most of the area. Scattered thermokarst pits with either unvegetated water or aquatic sedge tundra occurred on both sides of the road, indicating high ice content of the permafrost (Walker et al. 1980). Transect 1, which extends to the NE of the road, is still an area of low-centered polygons, though thermokarst pits are now more common. Transect 2, which extends SW of the road towards Lake Colleen, is now an area of seasonally flooded high-centered polygons. An unsupervised classification shows the distribution of vegetation types in the Lake Colleen Study Area. Elevation of the transects ranged from 12.4 to 14.8 m above sea level. Vegetation height of non-water areas averaged 13 cm on the NE side of the road with a Leaf Area Index (LAI) of 0.5, with higher values on the flooded SW side: 21 cm height and 0.7 LAI. Thaw depths (measured in early August) were deepest close to the road, ranging from 105 cm to 29 cm at the far end of Transect 1. The dust horizon from the road traffic was quite evident in the soils, ranging from > 40 cm depth to none at 100 m distance on the NE side, but persisting out the full 200 m on the SW side, downwind from the prevailing NE summer winds. Permafrost characteristics of the transects are presented in a separate poster by Kanevskiy et al. Walker DA, Everett KR, Webber PJ, Brown J (eds.) (1980) Geobotanical Atlas of the Prudhoe Bay Region, Alaska, CRREL Report 80-14. U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Hanover, NH.

SPATIAL AND TEMPORAL PATTERNS OF NET CARBON EXCHANGE FOR A POLAR SEMI-DESERT VEGETATION COMMUNITY ON MELVILLE ISLAND, NU

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While studies across latitudinal gradients have shown decreasing levels of ecosystem respiration (ER) and net ecosystem exchange (NEE) of carbon dioxide in northern tundra ecosystems, few studies have explored the factors regulating NEE in High Arctic systems across the wide range of vegetation types. We have explored the spatial and temporal controls over CO2 exchange at the Cape Bounty Arctic Watershed Observatory (CBAWO) since 2008 in a range of plant community types. Key plant communities include polar semi-desert, mesic tundra, and wet sedge meadows. Between 2008 and 2014, CO2 flux was measured in mesic tundra by eddy covariance as well as static CO2 chamber measurements. While eddy covariance provides a high frequency measure of NEE for mesic tundra, it lacks the spatial resolution to separate carbon fluxes from other plant communities found in low abundance in the tower footprint. Static chambers lack the high temporal resolution provided by eddy covariance, but can

provide flux measurements specific to a plant community type. While mesic tundra is the dominant vegetation type in the tower footprint, at the landscape scale it only covers roughly 40% of the area at CBAWO. In 2013, we deployed eight ADC Automated Carbon Exchange (ACE) systems to quantify the contribution of the polar semi-desert plant community to the landscape-scale net carbon balance. As polar semi-desert plant cover varies at relatively small spatial scales, the chambers were distributed between areas of vegetation (18-51% cover) and bare soil. Measurements of NEE (in transparent chambers) and ER (opaque chambers) were made every 30 minutes from late May to late July. Biophysical measurements, including air temperature, soil temperature, and soil moisture, were collected in conjunction with the carbon exchange readings. During late July 2013, optical data were also collected, so the vegetation cover within the footprint of the ACE unit could be quantified. NDVI (Normalized Difference Vegetation Index) varied from -0.12 to 0.31 for sites representative of polar semi-desert, with the highest values occurring in a vegetated site, and the low value occurring on bare soil. Preliminary results indicate that the different CO2 fluxes measured by the ACE units are driven by variability in different biophysical factors. Ecosystem respiration correlated well with air temperature with R2 values ranging from 0.23 to 0.55. In the transparent chambers, where NEE is measured, the most important factor influencing CO2 changes throughout the season. In the early season, when ER is the dominant component of the NEE, air temperature appears to be the strongest predictor. As the season progresses and temperatures increase, photosynthesis becomes the dominant component of the NEE, and photosynthetically active radiation (PAR) becomes the best predictor of NEE. Our results suggest some threshold values above which temperature is a less important control over NEE in polar semi-desert High Arctic plant communities.

SUPPORTING REMOTE HEALTH CARE PROVISION IN A RAPIDLY CHANGING CLIMATE: A CASE STUDY FROM NUNATSIAVUT, LABRADOR

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Anthropogenic climate change has been an increasing concern for Inuit across Canada, and the rapid changes to ice thickness and extent, precipitation levels, weather patterns, and wildlife and vegetation dispersion are disrupting livelihoods and lifestyles for many. Evidence is continuing to emerge that these changes are also causing challenges to physical and mental health outcomes throughout the North. Remote health care providers and healthcare systems are on the frontlines of these climatic and environmental changes; yet, little is known about the extent of the pressures that will be placed on these systems. Working in partnership with the Inuit Community Governments of Nain, Hopedale, Postville, and Makkovik, and the Department of Health and Social Development, the Rigolet Inuit Community Government led a project examining the climatic and environmental determinants of mental health conducted in Nunatsiavut, Labrador, Canada. As part of this research, in-depth conversational interviews were conducted with 18 health professionals throughout all five communities of Nunatsiavut, including nurses, community health workers, social workers, and mental health and addictions professionals, to examine challenges related to providing remote health care within the context of a rapidly changing climate. Participants shared that climate change was directly and indirectly affecting the 'three Ps' – provision, providers, and patients – by amplifying already-present challenges in remote health care and by creating additional challenges related to shifts in climate and environment. This research contributes to growing research in climate-sensitive health adaptation across the North and, if incorporated into health planning at the local and regional levels, may assist in enhancing health care to support climate-sensitive health outcomes in remote communities across the North and enhance health care provision.

TUNDRA CARBON CYCLING FROM ECOSYSTEMS TO THE LANDSCAPE SCALE: A SYNTHESIS OF ONGOING TERRESTRIAL AND AQUATIC RESEARCH IN A CANADIAN LOW ARCTIC WATERSHED

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High latitude soils contain large quantities of organic carbon exceeding the combined pools of carbon stored in the atmosphere and in terrestrial plants. During climate warming, carbon from this vast pool of soil organic matter will be released at increasing rates to the atmosphere through enhanced microbial breakdown of terrestrially stored organic matter in the seasonally thawed soil active layer and dissolved organic matter transported to aquatic environments. Changes in organic matter cycling and transport will in-turn likely lead to vegetation changes towards a shrubbier tundra landscape, affecting tundra carbon storage potential and, thereby at least partially, counteracting enhanced trace gas emissions. The potential importance of tundra carbon cycling feedbacks to regional and global climate change has been the catalyst for interdisciplinary research conducted for over a decade at the Tundra Ecosystem Research Station, Northwest Territories, Canada (64052'N, 1110 35'W). Here, we report recent observations and assess how these may be linked across ecosystems in order to gain a better understanding of tundra landscape-level carbon exchange now and in the future. Terrestrial research near Daring Lake has primarily been focused on the four principal tundra vegetation types. Here, independent research projects include: 1) Identifying spatial and temporal dynamics determining within-plant community leaf area index and plot-scale normalized difference vegetation index (NDVI) and relating these measurements to satellite-derived NDVI; 2) Examining the influence of vegetation type on growing season carbon dioxide uptake and emissions; 3) Investigating the effect of winter snow accumulation and spring snowmelt date on summertime ecosystem carbon and soil nutrient cycling; 4) Quantifying late-winter and spring soil nutrient availability and volumetric water content and its impact on soil microbial communities. Additionally, research was conducted in ponds and streams intersecting the terrestrial study area. Here, carbon dioxide emissions from surface waters were quantified and important drivers of aquatic carbon dynamics were identified. Multiple ecosystems make up a landscape through a myriad of linkages and feedback mechanisms but ecosystem processes and function are typically investigated independently and distinctly from each other. With this poster we aim to show that multiple independent research projects, spanning diverse terrestrial and aquatic ecosystems around the Daring Lake study area, can be linked with regards to carbon cycling processes, and that the results of such an integrative approach may lead to broader insights on tundra landscape-level carbon balance.

ORGANIC CARBON DYNAMICS IN PERMAFROST THAW IN THE WESTERN CANADIAN ARCTIC

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Anthropogenic climate change has affected the Canadian Arctic cryosphere, accelerating the development of retrogressive thaw slumps (RTS) across the Western Canadian landscape. Much of this landscape is susceptible to thermokarst features, as it is underlain by ice-rich permafrost. The Peel Plateau is the area of focus for this research as high amounts of RTS activity has been recorded and the soil profile is rich in inorganic materials. The nature of the thawing substrate in Peel Plateau RTS is predicted to alter the carbon dynamics in ways that contrast with thermokarst features in organic-rich soils common in other Arctic regions. Retrogressive thaw slumps result from the thawing of ice-rich permafrost and develop due to ablation of ground ice exposed in the slump headwall. These disturbances can persist for several decades and individual disturbances can impact several hectares of terrain. RTS provide pathways for dissolved organic carbon previously inaccessible while stored in permafrost, to become available for either processing within soils, or loss through downslope transport, creating a relatively novel input source for the global carbon budget. As a result of the increase in abundance and magnitude of permafrost disturbances they are now recognized as an important biophysical variable influencing greenhouse gas exchange in the North. This research seeks, first, to examine the impact RTS have on carbon dynamics within stream ecosystems, and, second, to assess the fate of dissolved organic carbon released by through experimental manipulations. To accomplish the first research objective, water samples from upstream, downstream and within-slump sites have been collected and analyzed to map the effect of retrogressive thaw slumps on the delivery of terrestrially-derived dissolved organic carbon to stream ecosystems. To achieve the second research objective, the dissolved organic carbon has undergone experimental manipulations to determine the amount of bacterially- accessible dissolved organic carbon. A series of incubations comprising of four treatment groups were undertaken; treatments comprised of both environmental conditions to determine environmental availability of dissolved organic carbon and extreme laboratory conditions to determine total labile dissolved organic carbon. This research provides insight into how ecosystem processes, such as food web structure, may be affected by the presence and

development of retrogressive thaw slumps, and the degree to which the carbon flowing from Peel Plateau slumps to streams has the potential for conversion to carbon dioxide in arctic aquatic environments.

LOCAL INFLUENCES ON THE RATE OF AIR-SEA CO2 EXCHANGE WITHIN NORTHERN BAFFIN BAY

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The Arctic marine system is currently undergoing a dramatic transformation. Changes in sea ice structure/extent, freshwater inputs, ocean circulation patterns, and the seasonality of phytoplankton blooms and storms are all playing a role in modifying the Arctic marine ecosystem. Such changes will have a profound impact on the marine carbon cycle, and the air-sea exchange of CO2 within Arctic waters. This study aims to inform us on how the air-sea exchange of CO2 may respond to changes in the region's physical, chemical, and biological systems. We collected data for this project onboard the CCGS Amundsen during both the summertime 2013 and 2014 cruises. During both of these expeditions the ship ventured into northern Baffin Bay, through the region of the North Water (NOW) polynya, and further north into Nares Strait. The region of the NOW Polynya is one of the most biologically productive regions in the Arctic Ocean, and Nares Strait is a water body heavily influenced by calving glacial ice. We measured the partial pressure of CO2 (pCO2) both in the atmosphere and surface seawater continuously along the ships' track, to provide a complete picture of the CO2 gradient across the air-water interface throughout northern Baffin Bay. Ancillary measurements of seawater temperature, salinity, dissolved inorganic carbon, chlorophyll a, and oxygen isotope ratios (δ18O) will aid in identifying local factors affecting the seawater carbonate chemistry and the air-sea CO2 flux. A preliminary analysis of the data reveals a remarkable level of variability in surface seawater pCO2 over relatively small spatial and temporal scales.

TEMPORAL TREND STUDIES OF TRACE METALS AND ORGANIC CONTAMINANTS IN MACKENZIE RIVER BURBOT, FORT GOOD HOPE, NWT (1985-2014)

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As part of the Northern Contaminants Program core monitoring proposals, this study continues to assess long term trends of concentrations of bioaccumulating substances such as trace metals (e.g. mercury (Hg), selenium (Se), and arsenic (As)), organochlorine contaminants (OCs; e.g. PCBs, DDT, toxaphene) and new contaminants (e.g. brominated flame retardants (BFRs), fluorinated organic compounds (FOCs)) in Mackenzie River burbot (Lota lota) tissues collected at Rampart Rapids (Fort Good Hope, NWT) between 1985 and 2014. The goal of temporal trend monitoring is to be able to detect a 10% annual change in contaminant concentration over a period of 10-15 years with a power of 80% and a confidence level of 95%. This requires sample collection and analysis of a minimum of 10 fish annually for a period of 10 to 15 years. Due to the importance of burbot to the subsistence diet of northerners residing in the Sahtu Region and as a result of the availability of current data sets and archived samples, the Mackenzie River at Rampart Rapids was selected as a priority sampling location for long term temporal trend studies. Mean total mercury (THg) concentrations in muscle and liver over the entire data set were 0.355 ± 0.137 (n = 582) and 0.092 ± 0.078 (n = 569) ug g-1, respectively. Since the mid-1980s, an approximate 2- and 3-fold increase in THg concentration has been measured in muscle and liver, respectively. No significant correlation was observed between length and THg concentration in muscle or liver for either sex. Muscle THg levels remain below the recommended guideline level of 0.50 ug g-1 for commercial sale. Significant, 10- and 4-fold, declines occurred for both (alpha)- and (gamma)-HCH over 23 year time period between 1988 and 2013. Major PBDE congener levels increased significantly over the 19 years between 1988 and 2008; however, since that time they have been declining and are currently still approximately one order of magnitude less than those of PCBs. Since 1986, a consistent decline was observed in both PFOA and PFOS concentrations. Conversely, PFDA concentrations show consistent increase overtime. PFNA and PFUA levels peaked in 2003.

ACCEPTABLE HOUSING IN THE NORTHERN TERRITORIES AND ASSOCIATED REDUCTIONS IN YOUTH PHYSICAL AGGRESSION

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Background: Adolescence is a developmental stage that is particularly prone to physical violence and associated consequences. Adolescents in northern communities are an especially vulnerable population with rates of violent crime consistently higher in the Yukon, Nunavut, and the Northwest Territories as compared to the rest of Canada. This is also true for injuries due to fighting, assault, and maltreatment sustained in the North as compared to the rest of Canada. Assets such as supportive communities, plentiful natural resources, and safe physical environments have extensively been shown to promote adolescent health and reduce youth violence. One particular aspect of the physical environment that we seek to investigate is safe and acceptable housing and its subsequent relationship with reductions in youth violence. It has previously been identified that stable housing and increased numbers of decent homes in a community are protective against aggressive behaviours and victimization issues. However, a full analysis of the relationship between reductions in adolescent aggression and housing characteristics has yet to be proffered. Objectives: The three objectives of this study were: 1) To provide an in- depth profile of housing characteristics for a sample of communities in the three northern territories 2) To examine relations between community level housing characteristics and initiatives, and rates of non- aggression among adolescent populations also measured at the community level. 3) To examine relations between family housing composition and individual reports of non-aggression measured at the individual student level Methods: This study uses data from the 2009/ 2010 (Cycle 6) Health Behavior in School- aged Children (HBSC) survey, linked with 2006 Canadian Census data. HBSC in Canada assesses a variety of health behaviors and outcomes in nationally representative sample of 26,078 students in the 11 to 15-year-old age range. This study focuses on 3942 students within 80 schools located in the three northern territories. The data set provides includes information on physical bullying and physical fighting as well as family size, home composition, and the student's personal space in the home. This information was used to help profile housing characteristics. Further dwelling and household characteristics were taken from census community level data (2006) for all communities with an HBSC school. Results: This poster will outline the proposed study methods and provide preliminary findings. Access to the data is already available and analysis will be undertaken prior to December. Implications: This research has several implications for public health. First, by mapping the housing assets of a community, we intend to gain a greater awareness of the resources available in northern communities that contribute to better individual and public health. Second, by examining the role of acceptable housing as a protective factor for adolescent physical aggression, we hope to provide information that enables policy makers to assess how housing programs can lead to increases in the health of a community and individuals through violence reduction.

A COMPARISON OF RADIOSONDES, ON ICE METEOROLOGICAL TOWERS AND RE-ANALYSIS AND FORECAST WINDS OVER SEA ICE IN THE CANADIAN HIGH ARCTIC.

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Near surface winds in the Arctic are used to predict sea ice motion, study ocean-sea ice –atmosphere processes and general large scale circulation patterns. In order to study these processes generally data sets from ECMWF and NCEP/NCAR are widely used. This study compared the ECMWF and NCEP/NCAR reanalysis data sets with the independent data set of radiosondes and near surface on ice towers deployed during 2012, 2013 and 2014. Re-analysis data sets use all available data to produce wind fields over the high Arctic, unfortunately the lack of in-situ wind data over sea ice means reanalysis data sets have generally stronger winds speeds and large biases akin to those in coastal stations.

MONITORING MARINE BIODIVERSITY FROM EDNA; TEN YEARS OF THE COMMUNITY-BASED WILDLIFE HEALTH MONITORING PROGRAM IN THE SAHTU: LOOKING BACK AND MOVING FORWARD

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The Wildlife Health Monitoring Program began in 2003 in response to community concerns about wildlife health in the Sahtu. Community members indicated that they had concerns about the health and sustainability of wildlife and how disease and environmental change may affect them. The objective of the program is to work with local hunters to maintain an ongoing wildlife health monitoring program that is responsive to the

changing needs of the community and the changing health issues that emerge in wildlife. The program initially started with a view to collect baseline health measures of barrenground caribou, including body condition and pathogen prevalence and diversity. As a result of sample submissions by subsistence hunters the program has, to date, collected health data on 221 caribou from the Bluenose East and West herds, 26 woodland caribou samples and 84 moose samples. This has resulted in several new and significant findings, including the range expansion of the winter tick (in moose) and the identification of new parasitic diseases in caribou previously unknown to the Sahtu, such as Onchocerca cervipedis and Neopsora caninum. The past ten years have resulted in new techniques for monitoring caribou and the success of the program demonstrates that community-based wildlife health monitoring is tool that can be used for long-term monitoring of wildlife health, if hunters are trained appropriately and there is long-term commitment from both researchers and local government institutions. Today the program has extended to include measures of stress, with the hope that we can gain an enhanced understanding of how disturbance, stress

POTENTIAL EFFECTS OF CLIMATE CHANGE ON LANDSCAPE STABILITY AND COMMUNITY INFRASTRUCTURE IN KUGLUKTUK

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Rising temperatures associated with climate change will have a variety of impacts in northern areas. At Kugluktuk (formerly Coppermine), a hamlet situated along the coast of Coronation Gulf in western Nunavut, a warmer climate may enhance the potential impacts of landscape hazards, such as permafrost thaw and coastal erosion. As permafrost (soil that has remained frozen for two consecutive summers) with excess ground ice thaws, the soil column loses volume and compacts, resulting in ground subsidence. Infrastructure built on this unstable landscape may experience differential settling and structural damage. Although most of Kugluktuk is situated on exposed or shallow bedrock, where permafrost thaw has negligible impact, current infrastructure built on frost-susceptible sediments along the hamlet's northern section may be at risk. Permafrost in Kugluktuk is potentially further compromised by its saline nature, a legacy of the land once being submerged by higher sea levels following the last glaciation. Saline permafrost has reduced bearing capacity and thaws at a lower temperature than non-saline permafrost, thus presenting an even greater vulnerability under a warming climate. Coastal emergence has been occurring for millennia since the retreat of the Laurentide Ice. With projected climate warming and relative sea-level rise, Kugluktuk will likely experience a reversal of this trend and higher sea levels. Community infrastructure along the current shoreline may be vulnerable to flooding, especially during high tides or storm surges. In addition, the loss of sea ice, which protects the shore and absorbs wave-energy, will intensify erosional processes, especially on the western side of Kugluktuk where the coastline is most exposed to long wave fetch in Coronation Gulf. Overall, the combined factors of higher water levels and greater exposure to storms may increase the vulnerability of coastal infrastructure. Prior research in Kugluktuk has included surficial geology mapping and surveys of landscape stability. Current research planned for the community will include finer resolution mapping of surficial sediments with closer attention to permafrost conditions in unconsolidated sediments. Sampling and frozen ground characterization will include shallow drilling and test pitting to understand local stratigraphy, excess ice content and soil texture. The depth of the active layer (seasonally thawed ground) will also be recorded. Differential GPS surveys of the coastline will be conducted to assess the current state of coastal stability. An improved understanding of ground conditions and permafrost characteristics in Kugluktuk will help inform community decisions on future infrastructure development and planning.

NORTHWARD MIGRATION OF PHYTOPLANKTON BLOOMS DUE TO ICE RETREAT IN THE ARCTIC

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In a climate change context, as the ice pack cover is decreasing, it has become a priority to improve our knowledge of the ice edge phytoplankton dynamics. In this context, we followed a water mass, from when it exits the ice pack, in Kennedy Channel (81°N), down to northern Baffin Bay (77°N), in early August. Fractionated chlorophyll a (chl a) and primary production rates (0.7-5 µm, > 5 µm) were measured at 6 stations along this north to south transect. As the water mass moved southward, phytoplankton biomass, in the upper 100 m of the water column, increased from 9.8 mg chl a m-2 at the ice edge to 173 mg chl a m-2 in northern Kane Basin and then gradually

decreased to 9.2 mg chl a m-2 in northern Baffin Bay. We also observed a deepening of the maximum chl a as the water mass aged and the bloom developed. Stations at both end of the transect were dominated by small cells (53-64%) while large cells accounted for 80-88% of the total biomass at the other stations. Phytoplankton production showed a spatial pattern similar to that of chl a with daily rates ranging from 96 to 728 mg C m-2. The high concentration of pheopigments relative to chl a suggests post-bloom conditions in northern Baffin. These results show that the recent decrease of the ice coverage in Nares Strait favors the development of a phytoplankton bloom in the Kane Basin downstream of the Kennedy Channel ice edge in summer. Such bloom has never been recorded in this part of the Arctic, suggesting that its occurrence in 2014 is linked to the current warming and change in ice dynamics in the region.

BB POLAR

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Research to calibrate Arctic bivalves as indicators of environmental variations has been underway for the last decade. In the Observatory at the European Institute of Marine Studies (IUEM), we have demonstrated since 1994 that the King scallop (Pecten maximus) provides exceptional biological archives of the temperate environment Our group uses routine sclerochronology and sclerochemistry techniques, which allow us to depict the high frequency (daily) variations of the ecological conditions in the coastal waters of different areas of the planet. Recently, two Arctic bivalves have been added: another Pectinidae species, Chlamys islandica, and the Astarte spp. complex. For Astarte spp., we work in collaboration with our Canadian colleagues from ISMER/UQAR (Institut des Sciences de la Mer/Université du Québec à Rimouski). The originality of this project lies in the alliance of these two pan-Arctic species, allowing us depicting environmental variations at two different time scales. Indeed, Chlamys islandica has a life time of a couple of decades and can record the environmental variations at the daily scale whereas Astarte moerchi can live as long as a century and record these variations at the annual scale. Moreover, research in ecology serves the visual and plastic design. This project is the occasion for scientists and artists to work together around the climate change issues, transgressing the limits of each discipline.

THE EFFECT OF CLIMATE CHANGE ON SURFACE AIR RADIOACTIVITY CONCENTRATIONS IN THE ARCTIC

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As is the case globally, the Arctic has experienced a warming trend over the past century. In general, the amount of warming in the Arctic is greater than the global mean average, with most of the warming experienced in winter, where certain parts of the Arctic have averaged a 5 °C to 7 °C increase over the past four decades. This is particularly true in northwestern Canada, central Alaska, and eastern Siberia. Some regions have not warmed, or have even undergone slight cooling over the same period, such as eastern Arctic Canada and southern Greenland. Large sections of the central Arctic have no temperature time series for that period, so nothing can be said for those regions. The climate change could potentially mobilize radionuclides in the Arctic terrestrial environment and in glaciers. This may also affect radon emission from the ground, which is a major contributor to human exposure to natural radiation. A gradual warming of arctic areas leads to enhanced emissions of local radon, both Rn-220 and Rn-222, to the atmosphere. Pb-212 is a decay product of thoron (Rn-220, half-life of 56 seconds). Due to very short half-life of thoron, Pb-212 in the Arctic air can be almost exclusively of local origin. With a half-life of 10.64 hours, Pb-212 can diffuse some distance from the soil through the atmosphere. Rn-222 decays to Pb-210. Because it has a long half-life (22.3 years), Pb-210 can be transported over vast distances and remain in the atmosphere for extended periods of time. Surface air Pb-210 concentration in the Arctic can be of local origin and long-range transported from the south. The Yellowknife airborne particulate monitoring station (62.48°N, 114.47°W) in the Canadian low Arctic has simultaneously recorded both Pb-210 and Pb-212 for decades. A review of annual, summer and winter average Pb-212 concentrations in surface air for the past 10 years has demonstrated clearly that local radon emission has increased constantly over the years, and the effect is dominant in the

summer period. For the same time period, a slight increase in Pb-210 concentration is observed during summer period which may be caused by the gradual warming of arctic areas. Because majority of Pb-210 in air are due to long-range atmospheric transport from the south, the annual averages and averages over winter period seem to stay unchanged over the past ten years. Detailed analysis with recorded historical ground temperatures at the Yellowknife monitoring station will be presented in this paper. Further discussion will be given on the effect of climate change on surface air radioactivity concentrations in the Arctic.

CHINA'S TENTATIVE PARTICIPATION IN THE ARCTIC AFFAIRS AND ITS POLICY ORIENTATION

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As a signatory to the Svalbard Treaty, China has participated in the Arctic affairs since 1925. However, strapped by years of war and succeeding reconstructions, China's activity in the Arctic has been stalled for half a century. Until the central government introduced the reform and opening-up policy in the late 1970s, China became a contracting party to the United Nations Convention on the Law of the Sea, China then started its scientific research on the polar region. During the recent fifteen years, China launched six Arctic expeditions, with the latest one finished on September 23, 2014. Besides of the scientific expeditions, China's first close attention on Arctic affairs was drawn by the event of Russian flag planting in the North Pole in 2007. From 2008 to 2013, confronted by China's gradual consciousness of the hotter Arctic, suspicion and worries of "China Threat Theory" are quite prevalent among Arctic politics, media and academia. Even before China was granted as a permanent observer in the eighth ministerial meeting of the Arctic Council in 2013, rejection to its application still earned much approval. After that, China's relation with the Arctic formally entered a new age. Although China's rights in the Arctic Council is quite limited to "observation", China squeezed into a room full of Arctic stakeholders, and tentatively participated in the Arctic affairs. The advantage of playing a role in the Arctic affairs for China is not just the reduced cost of shipping through Arctic passages, or purchase of resource product, more importantly, by utilizing the Arctic passages, China could step into a vigorously growing high north economic zone and expand its interests in ocean shipping. The harsh weather, fragile ecosystem, and the corresponding strict Arctic environmental laws are all alerting China that its policy orientation should be adjusted to the Arctic unique situation and reflect its responsibility. The scientific expedition and protection of the environment is still China's primary mission other than utilizing Arctic passages and resources. By advancing the scientific research and environmental protection technology, China could lower technological and environmental barrier and prepare for further involvement in the Arctic affairs. As a responsible country, China should take environmental friendly activities and preserve a sustainable Arctic. Complying with the institutional mechanism in the Arctic, respecting the sovereignty and sovereignty rights of the Arctic states, and maintaining the sustainable development and traditional culture of the indigenous people should always be considered throughout China's Arctic activities.

ESTIMATING THE AGE STRUCTURE OF AN ARCTIC CARNIVORE POPULATION BY COMPARING TOOTH WEAR AND CEMENTUM LINE

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The earth is currently warming and polar regions are the place where this warming is proceeding at the fastest pace. The arctic wildlife is often presented as being highly at risk regarding changes in trophic food web produced by south species arrival and the arctic fox is playing a key role in this ecosystem. In this context, it seems clear that we need a study of the population dynamics and demographic specificity of this species. This type of studies require knowledge about the age structure. This information is usually difficult to assess and especially for wild arctic population of carnivores. The most accurate method found in the literature is the cement lines analysis but it requires tooth extraction which is really invasive. Here we propose to build a non-invasive method based on tooth wear coupled with cement lines count. Every summer since 2003, a population of arctic fox on Bylot Island, Nunavut, is monitored. Each year, individuals are captured and marked with ear tags, and a picture of their dentition is taken. Skulls have also been found opportunistically on the study area. Six observers characterized and quantified two times the tooth wear of 234 sets of pictures for the construction of a teeth condition index (179 captures and 65 skulls). The repeatability of this methods was evaluated by the statistic parameter called intraclass correlation factor (ICC). The ICC here was equal to 0.808, which signifies that the method is highly repeatable. The skulls allowed us to calibrate the teeth condition index with accurate age estimation by cement line count. The correlation tests between notations and real ages are positive and significant (respectively for

capture and skulls: Pearson's correlation coefficient: 0.795, p-value<0.001, and 0.783, p-value<0.001). This model allowed us to predict ages of foxes captured alive only with the teeth condition index. We classified the predicted ages following three age classes: young adults (yearling, 1 year old foxes), adults (2, 3 and 4 year old foxes), and older (5 years old and more). To test the model, we realised jackknife validations on the predicted ages. The accuracy of good prediction by the model is 71% (32/45). In the 13 cases when the model prediction did not fit the actual age, the discrepancy was never more than one age category. This non-invasive method allows us to pursue our population dynamic analysis.

EXAMINING THE DIET AND DIVING PHYSIOLOGY OF BEAUFORT SEA BELUGA WHALES

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Beluga whales (Delphinapterus leucas) are a sea-ice associated marine mammal and potential indicator species for Arctic climate change. The Beaufort Sea beluga population is one of the worlds' largest and is an important traditional harvest to the people of the Inuvialuit Settlement Region. During the summer, belugas migrate from the Bering to the Beaufort Sea and segregate by sex, reproductive status, and size into different habitats based on sea ice concentration. Changes in sea ice due to climate change may have indirect effects on the primary production of Arctic food webs and affect the availability of important lipid-rich prey, such as Arctic cod, to belugas. The resilience of Beaufort Sea beluga whales to climate change will depend on their ability to adapt to changes in prey dynamics. In this study, we established a baseline for health and physical condition of Beaufort Sea belugas and investigated dietary linkages using fatty acid signatures. Blubber was divided equally into three sections, the inner, middle, and outer layers for fatty acid analysis, under the hypothesis that fatty acids in important prey will be similar to those in the inner blubber layers. Potential prey species were obtained from the Beaufort Regional Environmental Assessment (BREA) program, the first comprehensive baseline study of marine fish diversity in the Canadian Beaufort Sea. We also examined oxygen storage capacity in belugas, by measuring hemoglobin, hematocrit, myoglobin concentrations, and spleen size. Fatty acids in beluga blubber were stratified with blubber depth, with the proportion of monounsaturated fatty acids lowest in the inner blubber layers and highest in the outer layers. On the other hand, polyunsaturated fatty acids increased with increasing blubber depth, and were found predominately in the inner blubber layers. Fatty acid signatures of potential prey species will be analyzed in comparison to the fatty acid signatures of the inner blubber layers of beluga. Physiological differences in oxygen storage capacity were found between adult male and female belugas, which may reflect differences in diving ability. The relationships between specialized diving physiology, behaviour, and diet will be used to predict vulnerabilities and responses of belugas to changing environmental conditions. Using my data, I plan to develop a bioenergetic model to calculate consumption rates of the beluga population in order to predict potential changes in prey dynamics on energetic requirements.

THE INFLUENCE OF A LONG-LIVED SEA DUCK ON THE COMMUNITY ECOLOGY OF ISLANDS IN THE CANADIAN ARCTIC

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Habitat availability and quality are two of the largest drivers of species distribution. Some animals, like the North American Beaver (Castor Canadensis), act as ecosystem engineers, directly or indirectly altering ecosystems. We aim to study if the Common Eider (Somateria mollissima) is acting as an ecosystem engineer by enriching the habitat of nesting islands through excretion, and thereby promoting plant growth and organic build-up on nesting islands. These changes may in turn benefit eiders and other species though facilitating access to freshwater by increasing the depth and the persistence of ephemeral ponds through the breeding season. This could improve nesting habitat and increase species richness. We aim to test if there are significant differences between the biological characteristics of similar islands with and without eider colonies, investigate the role of marine nutrient input through eider excretion, and establish minimum age estimates for the communities. We will use biological inventories, historical data, stable isotope analysis, radio-carbon dating, and spatial mapping techniques. We predict that islands with eider colonies will have more vegetation, deeper freshwater ponds, and a higher biodiversity than similar islands without large numbers of eiders. Early results from the initial field season indicate these predictions are correct. Suitable nesting islands are already limited by predator interactions, climate, and basic habitat requirements. With increases in shipping, exploration and predation pressure from Polar Bears (Ursus maritimus) in

Hudson Strait, understanding how eiders may be affecting their own ecosystems and possible nesting alternatives is crucial in ensuring they are properly managed as a harvested species.

SEA ICE AS A POTENTIAL INTERFACE FOR METHANE STORAGE AND TRANSFORMATION

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We present the CH4 concentration [CH4] in bulk sea ice from subarctic, land-fast sea ice in the Kapisillit fjord, Greenland. The bulk ice [CH4] ranged from 1.8 to 12.1 nmol L-1, which corresponds to a partial pressure ranging from 3 to 28 ppmv. This is markedly higher than the average atmospheric methane content of 1.9 ppmv. Evidently most of the trapped methane within the ice was contained inside bubbles, and only a minor portion was dissolved in the brines. The partial pressure of CH4 exceeded the atmospheric CH4 content and sea ice could potentially be a source of CH4 for the atmosphere. During periods of sea ice cover, CH4 can accumulate within or below the sea ice, and when the ice breaks up and melts during spring and summer, large CH4 fluxes to the atmosphere could be expected. While the CH4 from the seawater is accumulated within the sea ice cover, the sea cover provides an interface in which the methane could be stored and transformed over time by biogeochemical processes. Further studies based on longer times series and carbon isotope signatures δ13 CH4 will provide us the opportunity to study the potential methane oxidation rate within the sea ice cover. In the case of the CH4 being oxidised over time within the sea ice cover, the sea ice could provide an interface where CH4 is degraded and, hence, act as sink for oceanic CH4.

MOLECULAR DETECTION OF METHANOTROPHS AND METHANOGENS IN PERMAFROST THAW PONDS: IMPLICATIONS FOR GREENHOUSE GAS EMISSIONS FROM SUBARCTIC WATERS

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Greenhouse gas emissions from lakes may influence the global carbon cycle and constitute a positive feedback to global warming. The most abundant aquatic ecosystem types in the North are thermokarst lakes and ponds that arise from the thawing and erosion of permafrost soils. These ecosystems have the potential to mobilize large quantities of organic carbon that were previously stored in the frozen tundra soils. These waters have not been considered in global greenhouse gas budgets because of their small size, but they may be collectively important given their occurrence in large numbers throughout the circumpolar region. In the subarctic region of Quebec (Nunavik), these water bodies are increasing in size and abundance. Our ArcticNet/NSERC (ADAPT) project aims to define the microbial community structure of these ecosystems in order to better understand how they act as microbial bioreactors for the conversion of soil carbon to greenhouse gases. We are addressing the hypothesis that the net emission of methane by thaw ponds is affected by both production and consumption processes. This powerful greenhouse gas can be produced in anoxic condition by methanogenic Archaea, while methanotrophic Bacteria have the potential to oxidize methane under oxygenated conditions. Subarctic thaw ponds become thermally stratified during summer with an upper oxic surface layer and a bottom hypoxic or anoxic layer, which may be a propitious system for the development of both microbial processes. Our objective in the present study was to identify which micro-organisms contribute to the methane cycle, and the potential for methanotrophs to reduce methane emissions. Samples for microbial DNA and RNA analysis were taken in summer from the surface and bottom waters of thaw ponds distributed across a gradient of permafrost conditions in Nunavik, from sporadic permafrost in the south to discontinuous permafrost further north. These samples were subsequently analysed by DNA clone libraries and high throughput sequencing of RNA converted to cDNA to identify microbes involved in the methane cycle. Methanogenic Archaea of the genera Methanobacterium and Methanosarcina and within the order Methanomicrobiales were found in the surface

and the bottom of the ponds. Methanotrophic taxa belonging to gamma-Proteobacteria and Verrucomicrobia occurred in high abundance within the cDNA sequences, even in the hypoxic or anoxic bottom waters of the ponds. The potential activity of methanotrophs was assessed using quantitative PCR targeting the pmoA gene, which codes for one of the proteins in the enzyme complex responsible for methane oxidation. There was high variability in methanotrophic potential among the different sites, ponds and depths, but the pmoA gene was consistently present in bottom as well as surface waters. These results confirm that methane emissions from thaw ponds are likely tempered by bacterial methanotrophs, which even seem to persist in low or anoxic oxygen conditions. However the intensification of global warming may favor more prolonged periods of anoxia at all depths in the ponds, and oxygen availability may be an increasing constraint on the ability of methanotrophs to consume methane and reduce the net emission rates from these subarctic ecosystems.

PHYSICAL-BIOLOGICAL RELATIONSHIPS EVALUATED USING REMOTE SENSING IN THE HUDSON BAY COMPLEX

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Oceanic fronts are often areas of exceptional biological habitats. Using 25 years of satellite-derived daily sea surface temperature maps, we detected the locations where thermal gradients are the most often observed for the entire Hudson Bay Complex (including James Bay and Foxe Basin) during the ice-free period. Results show that important frontal areas are located near topographic features with very low frontal probabilities in the central part of Hudson Bay. There are many fronts in Western Hudson Strait, near northern islands, around the Belcher Islands, in James Bay, and along the coast of Western and Southern Hudson Bay. In Foxe Basin, fronts are localized around Prince Charles Island. The presentation will discuss the front generation mechanisms (convergence vs mixing) and their importance for phytoplankton biomass as estimated with SeaWiFS satellite remote sensing data. Fronts will also be linked with known bird colonies and marine mammals sightings.

STABLE AND RADIOCARBON ISOTOPE ANALYSIS TO DETERMINE PRESENCE OF BIODEGRADATION IN HYDROCARBON CONTAMINATED SITE, OLD CROW, YUKON

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The remote fly-in community of Old Crow relies heavily on the use of fuel storage tanks to supply both the motorized vehicles used in town and the airplane which brings food and supplies each day. As is the case with many arctic communities, heating oil is also stored in the same way above ground. In Old Crow, all the storage tanks are being kept on a tank farm above the Porcupine River, which is soon to be relocated further inland. However, over the years the land surrounding the existing site has become contaminated to an unknown extent with hydrocarbons which have leaked out during daily fuel transfers. The clean-up of the site poses a huge challenge both financially and physically due to the arctic locality since the contamination extends into the permafrost, but what if it can be remediated in-situ with little or no financial input? Natural attenuation of hydrocarbons, also known as biodegradation, can be recognized by distinct isotopic fractionation of carbon. Microbial breakdown would cause a Rayleigh-type enrichment of 13C in the residual hydrocarbons and depletion of 13C in the soil CO2. Also, the CO2 created during biodegradation would contain no 14C, so it would be expected that no 14C would be observed in the soil CO2.In this experiment, soil gas samples as well as both active layer and permafrost cores containing the hydrocarbons have been collected from the site in order to isolate carbon dioxide. The 13C/12C isotopic ratios and 14C concentration in the carbon dioxide and residual hydrocarbons will be determined geochemically in order to evaluate the potential biodegradation occurring at the site. If biodegradation is indicated by the results, it would be highly recommended to perform microbial research to classify the biodegradation and apply similar studies in other arctic localities faced with the same problem. Little is known about biodegradation of contaminants in permafrost regions, so this is a crucial first step for this form of arctic rehabilitation.

ASSESSING EXPOSURE PATHWAYS AND HUMAN HEALTH RISKS RELATED TO WASTEWATER TREATMENT IN INUIT COMMUNITIES

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Mitigating public health risks associated with wastewater management is a priority for communities worldwide. Remote hamlets of Nunavut typically use passive treatment systems. In these types of systems, wastewater is discharged into existing lagoons and wetlands and then treated using only natural environmental processes. Passive systems require minimal operation, maintenance or energy inputs, making them advantageous for the region in many regards. However, there has not been enough consideration of the human health risks associated with their use in Inuit communities. Inuit populations consume significant amounts of locally harvested wild food and raw drinking water. Additionally, the areas used for wastewater treatment may be inadvertently intersecting with travel routes and recreational spaces favoured by residents. These human-environment interactions create direct and indirect pathways by which people could be exposed to harmful pathogens originating from the treatment area. The purpose of this study is to examine these potential exposure pathways, as well as the magnitude of associated human health risk. To do so, we use a quantitative microbial risk assessment (QMRA) based methodology. A QMRA is a structured process, informed by ecological engineering and public health principles, designed to estimate the likelihood of an adverse health effect following exposure to infectious microorganisms. As this study is still in an early phase, the focus of this presentation will be on the development of a conceptual model and understanding of site-specific exposure pathways via data collected through interviews and problem scoping activities in three participating communities – Iqaluit, Pangnirtung and Pond Inlet. The final results of this work will characterize overall human health risks associated with wastewater treatment in each community and recommend interventions aimed at reducing harmful exposures if necessary. This will have direct implications for the future of wastewater management in Arctic communities. Furthermore, modelling and assessment techniques used may be applicable to other public health risks concerning human-environment interactions in Arctic communities.

THE INTERACTIVE EFFECTS OF FISH PREDATION AND CONSPECIFIC DENSITY ON SURVIVAL AND GROWTH OF WOOD FROG TADPOLES IN A SUBARCTIC WETLAND

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In nature, prey are often simultaneously exposed to predators and competitors. This can lead to conflicting demands and prey must balance the trade-off of survival and growth. Larval amphibians are model organisms to investigate this trade-off because individuals must metamorphose before a wetland dries. One such amphibian, the wood frog (Lithobates sylvaticus), has been the subject of multiple food web studies, but this experimental work has focused on wood frog larvae in more temperate climates. Therefore, we designed an enclosure experiment in a subarctic natural wetland near Churchill, Manitoba, Canada to investigate the interactive effects of conspecific density (50 or 100 tadpoles) and brook stickleback (Culaea inconstans) presence on survival and growth (mass at metamorphosis) of the wood frog tadpoles. We hypothesized that the effects of conspecific density on wood frog survival and growth would be dependent on the presence of fish predators. This hypothesis is based on our previous work that suggested that sticklebacks will consume tadpoles but consumption was likely size-specific. The fully factorial experimental design resulted in four experimental food webs: 1) 50 tadpoles without fish, 2) 100 tadpoles without fish, 3) 50 tadpoles with fish, and 4) 100 tadpoles with fish. The resulting four food webs were replicated three times and randomly assigned to experimental enclosures arranged into spatial blocks of a natural subarctic wetland. We found that wood frog survival decreased significantly in the presence of sticklebacks. The interactive effect of conspecific density and stickleback predation was marginally significant with a high proportion surviving with fish at high conspecific densities. Wood frog mass at metamorphosis decreased with conspecific density, but increased with stickleback presence. There was no significant interactive effect of conspecific density and stickleback presence on wood frog mass at metamorphosis. Our study highlights the importance of conspecific competition and stickleback predator presence on the development of larval frogs in a subarctic wetland. While previous work showed that sticklebacks had little effect on the survival of larval wood frogs, the present study shows

the relationship is somewhat more dynamic and complex. Specifically, our results demonstrate that brook sticklebacks can play a significant role in regulating larval wood frog survival and growth in a subarctic wetland, but their impact is likely dependent on tadpole density. Sticklebacks appear to become satiated and this may permit tadpoles to reach a size refuge. Our novel contribution adds understanding to the limited research on amphibian community structure in subarctic wetlands.

FACTORS CONTROLLING SURFACE TEMPERATURE DISTRIBUTION OVER THE MONT JACQUES-CARTIER PLATEAU AND THE RECENT EVOLUTION OF ITS ALPINE PERMAFROST BODY, THE SOUTHERNMOST IN EASTERN CANADA

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The summits of Chic-Chocs Mountains in the Gaspé Peninsula sector of the northern Appalachians appear as arctic biogeographical microcosms where topoclimate conditions are conducive to the presence of a typical periglacial environment. The existence of the alpine permafrost body of Mont Jacques-Cartier – the highest point in southern Quebec (1273 m a.s.l.) – was initially reported by Gray and Brown by way of a thermistors cable installed in a 29 m deep borehole drilled in September 1977. Initial results revealed that the permafrost body is contemporary but near the thawing point. Mont Jacques-Cartier is a particularly interesting site to study marginal alpine permafrost evolution under a changing climate. This kind of 'warm' bedrock permafrost is highly sensitive to minor regional climatic fluctuations and it has one of the longest permafrost-monitoring site in North America. The objective of the study was to acquire a detailed knowledge regarding the thermal dynamic and spatial-temporal evolution of the ground surface temperature (GST) and permafrost of Mont Jacques-Cartier. The study is divided into 2 steps: (i) the analysis of the interactions between the local environment (e.g. terrain factors, vegetation) and micro-climate (mainly air temperature, snow cover and wind) to identify the main factors which control the spatio-temporal evolution of GST using miniature data loggers; (ii) the understanding of the thermal response of the alpine permafrost body following the climate change using the dataset recorded by the thermistors cable and modeling its potential future evolution. The result showed that spatio-temporal variability of the GST over the Mont Jacques-Cartier is mainly correlated with the seasonal snowpack distribution. The plateau summit is characterized by near snow-free conditions due to the physiographic features of the site and the strong westerly winds. The thin (<35 cm) and wind-packed snow cover considerably reduces the insulating capacity of the snow cover on the alpine tundra zone. Furthermore, the boulders of the block-field and periglacial landforms present on the plateau protrude above the snow surface in winter which allows direct heat transfer between the ground and the atmosphere. Due to these particular ground surface conditions, the GST is highly correlated to the air temperature. A mean annual ground surface temperature (MAGST) slightly below 0°C is recorded in most of the sites located in wind-swept alpine tundra while the MAGST is largely positive in krummholz patches and leeward side of the mountain where the drift snow accumulations are thick. The long-term record [1978 to present] provided by the borehole shows that the internal temperature of permafrost follows a long-term rise of mean annual air temperature (MAAT) and MAGST with the same decadal fluctuations. The permafrost was affected by rapid responses to changes in surface warming signal because of the high thermal conductivity of the granitic rock. A warm side deviation of the temperature profile from 1978 to present (+ 0.5°C near the depth of zero annual amplitude) is observable and the thickness of the active layer increased by +0.5 m/yr from 2008 to present. If this recent warming trend continues, complete thawing of Mont Jacques Cartier is inevitable in the near future.

SPAWNING ECOLOGY OF A SUB-ARCTIC FORAGE FISH, CAPELIN (MALLOTUS VILLOSUS), IN THE EASTERN AND WESTERN CANADIAN ARCTIC

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Forage fish species lie at the core of marine food webs, as they prey on lower trophic levels (zooplankton) and in turn are eaten by top predators. By converting energy from lower trophic levels into food for higher trophic levels, energy flow through marine food webs is mediated through forage fish. In the Canadian Arctic, Arctic cod (Boreogadus saida) is a key forage fish species, transferring 75% of the energy from plankton to higher trophic levels. In the last decade, however, sub-Arctic forage fish species, especially capelin (Mallotus villosus), have increased in relative abundance, primarily shown through dietary shifts in seabirds, piscivorous fish (e.g. Arctic char) and whales (e.g. beluga). Capelin respond rapidly to

climatic change, with large-scale range shifts associated with relatively small changes in ocean temperature (2-4°C), and, thus, are considered a 'sea canary', or indicator of climatic variation in marine ecosystems. In the last decade, capelin have been reported to persistently occur at two coastal sites in the Canadian Arctic: Pangnirtung Fjord, Cumberland Sound in the east and Darnley Bay, Beaufort Sea in the west. Local residents in nearby communities (Pangnirtung, NU; Paulatuk, NWT) reported spawning-like behaviour, as described in sub-Arctic regions (e.g. Newfoundland). In summer 2014, we conducted pilot studies at each site to investigate the spawning ecology of capelin. Near-shore shoals of capelin were observed within a few days of sea-ice break up (late-June, early-July) at both sites. In Darnley Bay, capelin were captured primarily at Bennett Point (post-spawning females: n=187, mean total length ± SD, 132.9 ± 9.9, 110-159 mm; post-spawning males: n=92, 147.1 ± 7.7 mm, 124-164 mm) using trap nets nearby a cobble beach (July 13-19). Capelin eggs adhered to the trap net were also sampled. In Pangnirtung Fjord, capelin (post-spawning males: n= 76) were captured near-shore at three locations using a dip net (July 7-10). Capelin eggs adhered to sediment and rock were sampled at five sites within the fjord (July 7-20). Interestingly, timing of spawning was either before (Pangnirtung Fjord) or during (Darnley Bay) spawning of capelin off the northeast coast of Newfoundland. In addition, total lengths of capelin were comparable among locations and eggs appeared to be developing normally. Overall, this preliminary research indicates that capelin not only spawn in the Arctic, but are similar in many ways to sub-Arctic populations. As the persistence of capelin in the these Arctic regions is likely, there is a need to increase our understanding of the impacts that altered availability of forage fish species will have on multiple trophic levels within these marine ecosystems.

ARCTIC MARINE USE AND TRANSPORTATION PROJECT (AMUT)

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The Arctic is being redefined in ways that will shape Canada for the next century. Increased navigability of Arctic waters as a result of climate change is now intersecting with the global appetite for untapped natural resources available in abundance throughout northern Canada and visions of a new trade route through the Northwest Passage. Vessel traffic has grown substantially and has increased in areas that were previously inaccessible, testing our sovereignty and security, and bringing new challenges to Indigenous societies. The Arctic Marine Use and Transportation Project (AMUT) responds directly to this need, bringing together a strong team of scholars, and representatives from industry, government, and Indigenous groups to detail current and future use of the marine environment in Arctic Canada, identify opportunities and risks for the nation, and to establish best practices and policy options for effective Arctic marine governance. The project undertakes the development of an Arctic Marine Spatial Database and cutting-edge research in three thematic areas: 1) governance and management; 2) environment, risks and hazards and, 3) local use and economy. The research informs urgent policy needs currently challenging the Canadian federal government and local Inuit groups related to: the positioning of strategic shipping corridors; identification of appropriate tourism sites; inventorying areas of high use and regions of traditional and cultural importance; projecting future shipping trends; and, identifying risks for security, natural hazards, and human economic activity. The project integrates input from multiple disciplines and sectors of society. Our team assembles researchers from geography, anthropology, planning, environmental management, and engineering. Our partners and project contributors include several government agencies, private sector companies engaged in transport, trade, and tourism, as well as Indigenous organizations -- all which are key stakeholders in protecting the Arctic marine environment. These partners provide on-the-ground experience dealing with a changing Arctic ecosystem, the policy-operating environment, and an informed understanding of future needs. This poster will outline project activities and preliminary results.

WHERE TWO RIVERS MEET: INTEGRATING INDIGENOUS AND WESTERN KNOWLEDGE SYSTEMS FOR IMPROVED WATER MANAGEMENT AND RESEARCH IN THE NORTH

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Significant water-related concerns and challenges are faced by Indigenous communities across Canada, including

poor quality drinking water, issues of accessibility, inadequate infrastructure, improperly functioning waste and storm-water systems, and degraded ecological health of shared water systems. In the North, many of these issues are compounded by climatic and environmental conditions, including climate change. Increasingly it is recognized that in order to develop locally-appropriate, culturally-relevant strategies in dealing with these issues, a collaborative, integrative approach is needed that recognizes, values and engages local Indigenous perspectives, knowledge, and methodologies together with Western scientific advances and technology. Encouragingly, a number of projects exist or have been completed that have sought to include integrative methods in their approach to water research and management. What we have not had to date, however, is any systematic evaluation of these approaches to discover what has worked, what hasn't, and why. This project, part of a larger Canadian Water Network initiative, seeks to investigate the successes and challenges encountered in the adoption of integrative approaches in recent water-related projects by performing a systematic realist literature review and conducting in-depth structured interviews with researchers, and their community-based research partners, who self-identified as having included or attempted to integrate Indigenous and Western knowledge in their work. Participants were asked about their perspectives on Indigenous and Western knowledge, their relationship to water, the nature of the project in question (purpose, design, outcomes), the extent of community involvement and engagement in the project, and how this was (or was not) achieved. This poster presentation will provide a discussion of emerging themes and initial insights garnered from Northern community-based or community-led projects identified and evaluated in the study.

MICROBIAL DIVERSITY AND FUNCTIONAL POTENTIAL IN HIGH ARCTIC PERMAFROST SOIL FROM SPITSBERGEN, NORTHERN NORWAY

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Permafrost-affected soils contain a large reservoir of carbon and are among the most fragile ecosystems in which current microbial controls on organic matter decomposition are changing as a result of climate change. If the climate continues to warm and the permafrost thaws, converting from dry tundra to wetland bog and fen ecosystems, this carbon may become accessible to microbial degradation, and increases in anaerobic environments may have substantial feedbacks to the rate of climate change through the increased production of CH4, a greenhouse gas an order of magnitude more potent than the CO2 respired from aerobic soils. It is predicted that warmer conditions in the high Arctic will lead to a deepening of the seasonal active layer of permafrost, provoking changes in microbial processes and possibly resulting in exacerbated carbon degradation under increasing anoxic conditions. The viable and non-viable fractions of the microbial community in a permafrost soil from Adventdalen, Spitsbergen were subjected to a comprehensive investigation using culture-dependent and culture-independent methods. Molecular analyses using FISH (with CTC-DAPI) on a 237cm deep core, revealed the presence of all major microbial soil groups, with the active layer having more viable cells, and a higher microbial community diversity. Microbial communities were characterized based on 16S rRNA. It was observed that soil properties driving microbial diversity and functional potential varied across the permafrost table. We show that overall bacterial metabolic activity are the highest at the the active layer but present also deeper down the permafrost. Bacterial communities are highly diverse and structured as a function of both environment and depth, being more diverse in the active layer and transition layer. Community structure showed distinct shift of presence of bacterial groups along the vertical temperature gradient profile and microbial counts and diversity was found to be highest in the surface layers (decreasing with depth). Archaea were mostly methanogens, structured by environment and diverse throughout the layers. The resulting picture of the microbial community composition will allow us to better understand the microbial functional potential in Arctic permafrost thaw on the global climate system.

LANDSCAPE-SCALE VARIATION IN PLANT COMMUNITY COMPOSITION ACROSS YUKON TREELINES

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Plant species are projected to migrate upslope in subarctic alpine regions in response to ongoing climate change. These changes in community composition are expected have significant impacts on biodiversity and ecosystem processes at local to global scales, but specific predictions of change require a more thorough understanding of the factors that govern landscape-scale variability in species composition. To this end, we established elevational transects spanning the

forest-tundra ecotone on north and south-facing slopes at six sites in two different mountain ranges of southwest Yukon. Along each transect, we estimated the percent cover of all vascular plant species in quadrats and took measurements of soil temperature, soil moisture content, and active layer depth at regular elevational intervals. Preliminary data analysis indicates that south-facing slopes are distinctly separate from north-facing slopes in ordination space (non-metric multidimensional scaling), and that differences between aspects are driven primarily by soil temperature, which was highly correlated to first axis site scores, but also related to soil moisture and active layer depth. South-facing slopes showed a high degree of heterogeneity in composition from low to high elevation within each ecotone, while north-facing slopes were relatively homogeneous within ecotones, but varied markedly between sites with steep versus shallow slopes. These results support the notion that local topography can have a pronounced influence on the distribution of plant species and that it is important to understand the drivers of local and landscape-scale heterogeneity in species composition before making regional or global-scale predictions about future composition.

NATURE AND TRIGGERS OF SUBMARINE MASS FAILURE IN COASTAL WATERS OF SOUTHEASTERN BAFFIN ISLAND, NUNAVUT

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With recent advances in seabed mapping technology and its application in the Canadian Arctic, a world of submarine features has been revealed. Notable among these are submarine mass failures (seabed slides, debris avalanches, debris flows, turbidity currents). These are common and widespread features of continental and island margins, ranging from small-scale features (<100 m3) to enormous failures, such as the 3000 km3 Storegga Slide on the Norwegian shelf, affecting a seabed area of 95 000 km2 (20% larger than Scotland), with a runout distance of 800 km (Masson et al. 2006). The largest submarine failures have received more attention, understandably, than smaller features in inshore environments. Nevertheless they present important hazards as sources of local tsunamis in fjords and as threats to seabed infrastructure such as communication cables. Submarine landslides have been the cause of numerous fatalities in Norwegian fjords. Similar features are found in abundance in the many fjords and bays along the east coast of Baffin Island (Nunavut). They can be triggered in a number of ways, such as overloading by sediments (common on active delta fronts), seepage, excess pore pressure, undercutting of slopes, and seismic events. Of particular interest is the potential for triggering submarine mass failure by sea-level rise, both directly through increased overpressure and indirectly by induced seismicity (Smith et al. 2013). The easternmost coastal fringe of Baffin Island has experienced postglacial relative sea-level rise and is known to be a seismically active region. Through coring of sediments overlying submarine mass failure deposits, it may be possible to determine the ages of the failure events in relation to episodes of rapid relative sea-level rise. On the Cumberland Peninsula of eastern Baffin Island, submarine shoreline features have been mapped but not dated. Raised beach deposits have been studied to determine the glacio-isostatic emergence history in the region, but the features relating to submergence sit at the bottom of fjords. The coring and dating of submerged deltas in fjords along the Cumberland Peninsula will fill a critical gap in the sea-level history. Methods include mapping and characterizing the morphology of mass movement landforms; investigating causes of failure through site characterization; establishing a chronology of failure events through coring. References: Masson, D.G., Harbitz, C.B., Wynn, R.B., Pedersen, G. and Løvolt, F. 2006. Submarine landslides: processes, triggers and hazard prediction. Phil. Trans. Royal Society, A, 364, 2009-2039. Smith, D.E., Harrison, S., Jordan, J.T. 2013. Sea level rise and submarine mass failures on open continental margins. Quaternary Science Reviews, 82, 93-103.

SEASONAL SUCCESSION OF UNDER-ICE PHYTOPLANKTON IN CAMBRIDGE BAY, NUNAVUT

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With an on-going change in climate, there is a need to better understand how this change will affect natural systems. This is particularly true in the Arctic where climate warming is changing the icescape in an unprecedented fashion. With its largely bottom-up dynamics, the Arctic marine ecosystem will be greatly affected by a warming climate; however to what extent is currently unknown. A better documentation of the taxonomic composition of phytoplankton and its seasonal succession is thus of great importance to better understand how the Arctic marine food web will be affected by a warming climate. Our study seeks to contribute to this understanding through an examination of the seasonal succession of phytoplankton taxa in relation to key environmental factors from winter ice-covered conditions to ice break-up. To meet this goal, we collected a bio-physical time series dataset from a first-year landfast sea ice field site near Cambridge Bay as part of the 2014 Ice Covered

Ecosystem-CAMbridge bay Process Study (ICE-CAMPS) and then from the Arctic Research Foundation research vessel Martin Bergmann immediately after ice break-up. The time series dataset includes transmission of photosynthetically active radiation (PAR), hydrographic water column profiles, and discrete depth samples of nutrient concentrations and phytoplankton biomass (chlorophyll a and particulate organic carbon) and composition (via flow cytometry and light microscopy). Preliminary results show that there was a high phytoplankton diversity, yet low abundance within the under-ice water column during late winter (March). As the season progressed through melt, increased transmission of PAR led to a steady increase in phytoplankton cell abundance. By ice break-up a deep chlorophyll a maximum had formed and was associated with very high cell abundance.

FINDING THE SOURCE REGIONS OF SEA ICE MELTING IN THE MARGINAL ICE ZONE

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Each fall, new sea ice floes are formed in the Arctic Ocean and drift under the action of surface wind and water relative movement. Some of these floes will drift over short distances and melt during the next summer, while some will survive and become multi-year ice. One of the goals of this project is to use Lagrangian back trajectories to locate the source regions and drifting paths towards peripheral seas where the ice melts. The idea behind this is that, if thick ice is advected in a peripheral sea, it is less likely to melt the following summer than if the ice floe was thinner. Therefore, determining the source regions, which is a proxy for ice thickness, becomes really important. The completion of this work will yield a better understanding of the strength and/or limitation of global climate models predictions of the future ice edge position in view of complex ice dynamics.

CHRONOSTRATIGRAPHY CHALLENGES AND CLIMATE VARIABILITY STUDIES IN THE WESTERN ARCTIC OCEAN

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In the Arctic Ocean, sea-ice-albedo feedback is a key parameter for the Northern Hemisphere high-latitude climate, as well as the global climate system and oceanic circulation. During the past 30 years, satellite and oceanographic data indicate increasing temperatures and an accelerated reduction in the Arctic sea ice cover in summer, together with an overall decline of its volume and thickness. In this context, geochemical, mineralogical, sedimentological and magnetic data extracted from marine sediment cores may provide clues to document the natural climate cycle understand the processes controlling the long-term sea-ice variability and predict the effects global warming on the Arctic Ocean. However, the prerequisite for a paleoclimate study based on sedimentary sequences is the establishment of a reliable age model in order to transform the depth scale into an age scale. In the Arctic Ocean, Holocene paleoceanographic reconstructions are difficult to obtain due to lack of accurate chronologies. Indeed, radiocarbon datable material (such as mollusk and foraminifer shells) is rare or not well-preserved in marine sediment sequences from the Arctic Ocean. In addition, the radiocarbon reservoir effect is often poorly constrained and the 18O stratigraphy is affected by the release of brines during the formation of sea-ice. In this context, paleomagnetic data based on marine and lacustrine sediments, as well as global geomagnetic field models can be used in conjunction with radiocarbon to establish the chronostratigraphy of Holocene sedimentary sequences. Here we present the chronostratigraphic framework of several sediment core samples collected from the continental margin of the Chukchi and Beaufort Seas based on new high-resolution paleomagnetic data. That chronology will be used to develop a multi-proxy approach combining magnetic properties, elemental geochemistry, radiogenic isotope compositions (Sr-Nd), and sedimentary 231Pa/230Th ratios at high temporal resolution (centennial to millennial scales) in order to provide valuable information on the natural variability of the Arctic climate-ocean system during the Holocene.

A NEW DEGLACIAL AND DRAINAGE MODEL OF THE PINGUALUIT CRATER LAKE BASIN, NUNAVIK (CANADA)

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High-latitude lakes are recognized as excellent archives of past climatic and environmental variations owing to the

sediments they can preserve. In the Northern Hemisphere, most lakes have undergone erosion and/or remobilization of their sediments during the last glaciation, allowing the accumulation of only Holocene sediments. The possible existence of a subglacial lake in the Pingualuit Crater (Nunavik, Canada), a crater created by a meteoritic impact ~1.4 million years ago which was covered by the Laurentide Ice Sheet (LIS) during the Last Glacial Maximum, may have preclude glacial erosion of the bottom sediments (Guyard et al., 2011, Quaternary Science Reviews 30, 3892–3907). This characteristic makes the Pingualuit Crater Lake and its sedimentary record a unique opportunity to better understand Arctic climate and glacial dynamics during the Quaternary. To improve the understanding of the geomorphology and stratigraphy of the Pingualuit Crater, two expeditions were conducted in August 2010 and September 2012. These expeditions have allowed the acquisition of ~50 km of seismic profiles (using a 3.5 kHz sub-bottom profiler), which were also used to determine the bathymetry of the lake, and 35 surveys of high-resolution terrestrial topography (LIDAR - Light Detection And Ranging) covering the entire internal slopes of the crater. The topographic, bathymetric and seismic data were integrated to determine the elevation of drainage outlets and to identify the main sedimentation processes in the lake, which include mass movements, subglacial, proglacial and postglacial sedimentation. The high-resolution topography also permitted the identification of paleo-shorelines with the same altitudes, notably confirming the presence of a paleo-lake level at 545 m. Associated with the mapping of glacial and deglacial landforms from aerial photographs, the results from LiDAR data were used to develop a new deglaciation and drainage scenario for the Pingualuit Crater Lake and surrounding area. Based on the activation of seven outlets following the retreat of the LIS front towards the south-west, the model proposes three main phases of lake drainage leading to a lake level decrease by more than 50 m. Finally, as opposed to other high-latitude crater lake basins such as Lake El'gygytgyn in Siberia or Laguna Potrok Aike in Patagonia where high-resolution paleoclimatic records were obtained due to high sediment accumulation rates, the seismic data from the Pingualuit Crater Lake suggest extremely low sedimentation rates after the retreat of the LIS owing to the absence of inflowing tributaries.

THERMAL HABITAT PREFERENCE OF GREENLAND HALIBUT (REINHARDTIUS HIPPOGLOSSOIDES) IN THE NORTHEAST ARCTIC

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Greenland halibut are deep-dwelling flatfish found in the cold waters of the Atlantic, Arctic, and Pacific Oceans. This species currently supports one of Canada's most lucrative fisheries in the northwest Atlantic and Arctic regions, prompting interest by numerous northern communities to explore local waters for the presence of Greenland halibut to enable potential involvement in this growing fishery. Arctic ecosystems are predicted to display dramatic changes in the near future due to changing global climate conditions, with expected changes in temperature, salinity, pH, and sea ice extent. How these changes will impact fish distributions, abundance, and subsequent harvest potentials throughout the Arctic remains poorly understood. However, as temperature is a strong environmental-driver that often dictates the distribution of marine species, establishing thermal habitat preferences for commercially important species such as Greenland halibut could provide insight to both present and future biogeography. Catch rates of Greenland halibut captured using longline fishing gear in August-September of 2013-2014 were compared to bottom temperatures to establish thermal habitat preferences and distribution patterns within two Arctic fiords: Jones Sound and Cumberland Sound. Bottom water temperatures measured using a combination of CTD profiles and data storage tags attached to bottom fishing gear were used to characterize thermal habitat of each region. In all regions fish avoid waters comprising the sub-zero thermocline found in depths less than approximately 300m, with highest numbers found at depths greater than 600m. Bottom temperatures indicate Greenland halibut prefer water temperatures greater than 1.0°C, which could explain the low abundance of fish encountered in Jones Sound where the average bottom temperature at depths greater than 600m was 0.22°C. Therefore, at present bottom temperatures may limit the potential for emerging Greenland halibut fisheries in the waters surrounding Canada's more northerly communities.

DEVELOPMENT OF A FULLY-AUTOMATED ARCTIC LAKE MONITORING SYSTEM FOR HYDRO-ECOLOGICAL RESEARCH APPLICATIONS

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Average annual air temperatures in the Northern Hemisphere have been the warmest 30-year period of the last

800 years (IPCC 2013) and there is growing evidence that the Arctic terrestrial cryosphere is also being significantly altered and is highly susceptible to the effects of a rapidly changing and increasingly variable climate (IPCC 2007, 2013; SWIPA 2011; ACIA 2005). Permafrost temperatures have increased in the past few decades, and these increases have been attributed to increased air temperature and changes in the timing and thickness of snowcover (IPCC 2013). While freshwater systems and related hydro-ecological processes are particularly sensitive to changes in climate and related impacts on cryospheric components, the specific nature and the magnitudes of the effects on Arctic tundra lake ecosystem structure and function are not well understood. A major challenge in investigating hydro-ecology of lakes in the Arctic is that many locations are remote, often only accessible by helicopter or float plane. This makes visiting these sites frequently for monitoring purposes difficult due to the high logistical cost of conducting research in the North. Also, bad weather in summer and harsh winter conditions often interfere with planned field trips to research sites. In light of this, under the ArcticNet project "Hydro-ecological Responses of Arctic Tundra Lakes to Climate Change and Landscape Perturbation", we have developed and tested a prototype Arctic Lake Monitoring System (ALMS) comprising a fully-automated ice buoy and instrumented subsurface mooring system for continuous year-round monitoring (in real-time) of weather conditions, lake ice cover (initiation, growth over winter, breakup in spring), light penetration into the lake (through ice in winter), and lake water quality (chemistry, temperature, oxygen levels) at multiple levels in the water column. The first ALMS was tested over several years in an Arctic tundra lake near Inuvik, NT, and modifications were required to optimize the prototype system. A second ALMS has now been deployed into a lake near Cambridge Bay, NU, in association with the Canadian High Arctic Research Station (CHARS), and application of the ALMS is being considered for a pan-Canadian / pan-Arctic platform for long-term Arctic observing networks, and contributory to the developing pan-Arctic initiative Sustaining Arctic Observing Networks (SAON). This poster presentation provides an overview of the ALMS, steps taken and challenges overcome to develop the ALMS prototype, and how use of the ALMS contributes to our overall research program.

INTERRUPTION OF SPRING – SUMMER TRANSITION OF LANDFAST SEA ICE IN DEASE STRAIT, NUNAVUT, BY LATE SEASON SNOW STORM

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Sea ice energy balance and mass balance based on measurements taken in Dease Strait near Cambridge Bay, Nunavut, from 25 April to 27 June 2014, coincided with the seasonal progression from freezing to melting. This project was part of the ICE-CAMPS 2014 campaign. A micrometeorological tower was installed about 7 km offshore on the landfast ice (69°01'48.6"N and 105°20'10.8"W) and continuously recorded environmental conditions such as wind and atmospheric pressure, radiative and turbulent surface heat fluxes, and temperature profiles through the snow, sea ice, and upper meter of the sea water. Salinity and temperatures were further measured from extracted ice cores and snow pits. The sea ice cover in the study area was flat, approximately 180 cm in thickness and covered by ~33 cm of snow. Temperature profiles, time series, and schematic profiles of the study area portray the sea ice surface evolution from snow cover to melt pond cover associated with the changing environmental conditions and the overall warming trend. The seasonal progression to summer was interrupted by an unusual late season storm. The resulting deposition of snow kept the ice insulated and delayed the melt pond formation by ~2 weeks. Once initiated, snow melting proceeded rapidly flooding the cold flat ice cover. In this poster we present and discuss the thermal and mass balance evolution of the sea ice cover that enabled the extensive surface flooding to occur.

AN INVESTIGATION INTO THE IMPACT OF USING VARIOUS TECHNIQUES TO ESTIMATE ARCTIC SURFACE AIR TEMPERATURE ANOMALIES

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The Arctic is recognised as an important region in the study of climate change because of expected and observed changes in this region. Temperature changes are predicted to be more rapid in the Arctic compared to those predicted at lower latitudes and Arctic average temperatures have already warmed more rapidly than those over the rest of the world. However, monitoring Arctic temperature change is challenging, particularly in areas covered by sea ice for all or part of the year. Time series of global and regional mean Surface Air Temperature (SAT) anomalies are a common metric used to estimate recent climate change. SATs measured in meteorological stations are generally used to generate these time series over land and sea ice while for most of the ocean sea surface temperatures,

collected from in situ and sometimes satellite data, are used. But, in situ measurements of Arctic SATs are sparse, especially early in the temperature record, and the records are often short. There are many different techniques and methods that can be used to quantify SAT changes over the Arctic from sparse in situ measurements. How effectively do these techniques reconstruct Arctic SAT anomalies? The degree of difference arising from using five different techniques, based on existing temperature anomaly dataset technique, to estimate Arctic SAT anomalies over land and sea ice was investigated using ERA-Interim reanalysis data as a testbed. The largest errors for all techniques were found over Arctic sea ice areas and Greenland. This suggests a need to investigate additional data sources that can help improve the estimation of SAT anomalies over Arctic sea ice areas and Greenland. Techniques which interpolated anomalies were found to result in smaller errors than non-interpolating techniques relative to the reanalysis reference. Kriging techniques provided the smallest errors in estimates of Arctic anomalies and Simple Kriging was often the best kriging method in this study, especially over sea ice. Non-interpolating techniques provided the least representative anomaly estimates. Nonetheless, they serve as useful checks for confirming whether estimates from interpolating techniques are reasonable. The interaction of meteorological station coverage with estimation techniques between 1850 and 2011 was simulated using an ensemble dataset comprising repeated individual years (1979-2011). All techniques were found to have larger RMSEs for earlier station coverages. This supports calls for increased data sharing and data rescue, especially in sparsely observed regions such as the Arctic.

ARCTIC COMMUNICATIONS NEAR THE GEOSTATIONARY LIMIT

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The Polar Environment Atmospheric Research Laboratory (PEARL) is located at 80N in Canada's (very) High Arctic. It is operated as a 24/365 operation and therefore needs reliable communications. However there are no landlines or optical fiber to the site and so satellite communications are the only viable method. 80N is at the very limit of geostationary communications and the satellites are only just over the horizon. This places considerable constraints on the communications systems as the atmospheric path is extremely long a prone to fading and other problems. Despite this, the PEARL team has been able to devise methods of maintaining a communications channel 24/365 for transfer of data, voice communications and instrument operation and diagnosis. This has been a research problem in itself and development is still ongoing. Currently at PEARL we have an operational C-band system using vertical diversity and we are working on developing reliable ka-band systems. These systems have passed through a number of incarnations leading to the present implementations. This presentation will discuss the challenges of developing and operating communications systems in the (very) High Arctic and the operational solutions that have been found, new solutions that are being developed at the moment and newer satellite systems that may become available in the future.

WHY PEARL?

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Doing research in the High Arctic is expensive, slow and difficult, so the justification for doing it must be correspondingly compelling. Atmospheric research at the Eureka site (80N, 86W) in Nunavut has been ongoing at least since the early 1990s. The foundation of the Polar Environment Atmospheric Research Laboratory (PEARL) in 2005 has paced several dozen instruments in operation covering the atmosphere from the surface to approximately 100km. The rationale for the construction of PEARL was the need to collect atmospheric information at the highest research level in the Canadian High Arctic. It is important to test that rationale against reality and the progress made in the nearly 10 years since the foundation of PEARL. There are a number of ways in which success can be judged, ranging from the unique data sets that have been collected, through the new instrumentation and techniques that have been developed to the new science that has been discovered using data from the site. All this against a landscape of extremely fast-changing technology and an unrelenting harsh environment. In this talk, we will attempt to step back from the individual successes of the research at PEARL – some of which is discussed in papers and posters at this conference and consider the overall operational success of the enterprise: what have been the drivers of the most successful science, what are the developing needs of the next decade and how can these challenges be met? PEARL has been extremely successful for the last decade and answering these questions will guide us in the development of a solid program for the next decade.

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

20 YEARS OF ACTIVE LAYER MONITORING IN THE MACKENZIE VALLEY, NORTHWEST TERRITORIES.

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The Mackenzie Valley landscape is characterized by widespread permafrost terrain ranging from continuous on the Beaufort coastal plain to sporadic discontinuous in the south. The Geological Survey of Canada has maintained an active layer monitoring network in the Mackenzie Valley and Delta since the early 1990s for determination of annual maximum thaw depth and ground movement. The network currently includes 45 functional sites established in areas of representative vegetation and surficial material. Ten of these contribute to the Circumpolar Active Layer Monitoring network (CALM). Thaw tubes are utilized to determine maximum annual thaw penetration and maximum heave and subsidence of the ground surface. For some sites probing is also done on established CALM grids to measure thaw penetration at a given time and soil moisture content are also determined at specific grid nodes. Most sites are equipped with instrument to measure air and near-surface ground temperature. Active layer thickness in the Mackenzie Valley ranges from less than 50 cm in the north to greater than 100 cm in the southern region. North of Tsiigehtchic, departures from the 2003-2012 mean active layer thickness indicate thicker active layers in the 1990s followed by a thinning of active layers to 2005, with increasing thickness to 2012. North of treeline, a direct relation between air temperature and active layer thickness is evident where active layers in warmer years (1993, 1998, 2006) are on average ~3-9 cm thicker than the 2003-2012 mean; whereas cooler years such as 2004 are associated with thinner (average ~4 cm) active layer for most sites. South of treeline, greater site to site variability is observed and is a consequence of the insulating effect of the vegetation in summer and variable snow cover in winter. The moderating effect of ground insulation for these sites is apparent with a dampening of the active layer response to variations in air temperature although some of the warmer (1998) and cooler (2004) years are still noticeable with active layer on average ~5 cm thicker and ~6 cm thinner for

both years respectively. Since 2009 active layers have become thicker in all regions of the Mackenzie Valley. Changes in the active layer thickness influences surface stability through thaw settlement, frost heaving and water ponding. These effects also have implication for the load bearing capacity of the ground and, in some circumstance, slope stability. The monitoring network provides baseline information that is helpful for land use planning decisions, engineering design of infrastructure and for understanding the impacts of a changing climate on a permafrost environment.

INTRAGUILD PREDATION IN ARCTIC AND SUBARCTIC COPEPODS COMMUNITIES

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Communities of large copepods form an essential hub of matter and energy fluxes in Arctic and sub-Arctic marine food webs. They link primary production to higher trophic levels and play a key role in carbon export to the benthos. Copepods feed on ice algae and phytoplankton during the short productive season in summer and during this short period of time they convert primary production into large amount of lipid stores that are available for the higher trophic levels (like the Arctic cod) during the remainder of the year. Zooplankton communities in the Arctic seas are dominated in terms of biomass and abundance by the large congeners Calanus hyperboreus and C. glacialis, and the medium-sized Metridia longa. The sub-Arctic C. finmarchicus is also a key species presents in areas connected to the North Atlantic at the margin of the Arctic Ocean, and its distribution seems to steadily shift North in response to climate change. This handful of copepod species form a community whose structure and functioning are critical for marine ecosystems but curiously little is known about the interactions among those species. Copepods have the capacity to ingest their own eggs and nauplii (larvae) and those of other species. Intraguild predation (IGP), that we define here as the feeding of individuals of one species on the offsrpring of another species, could have an impact on recruitment. It could as importantly contribute to the resistance of the Arctic marine ecosystems to the invasion of boreal species as C. finmarchicus. Ingestion rates on eggs remain to be quantified and parameterized into life-cycle models of copepods to determine the impact of IGP on their fitness. Hence, my M.Sc. project is about quantifying IGP in Arctic and sub-Arctic copepod communities. My hypotheses are: I) M. longa intercepts and ingests C. hyperboreus eggs during winter II) C. hyperboreus ingests C. finmarchicus eggs during spring III) C. finmarchicus ingests M. longa eggs during spring and summer. Grazing experiments will be done at tree temperatures (2, 4 and 8°C) and three egg concentrations (5, 10, 30 eggs*l-1) representative of in situ conditions in order to characterize the functional response of females of these species. We will also test for the influence of an food source (phytoplankton) on the ingestion rate on eggs. Experiences will be held at Maurice-Lamontagne Institute on the St-Lawrence Estuary (SLE) shores in autumn 2014 and spring 2015. The SLE is an interesting site to carry on this study because there are some similarities to the Arctic per se (high seasonality, ice cover, cold water masses) and both Arctic and boreal copepod species co-occur in this system. I'm going to present preliminary results and previously unpublished data on the IGP between C. hyperboreus, M. longa and C. finmarchicus.

THE NORTH WATER POLYNYA ICE BRIDGE

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The largest recurring polynya in the world, known as the North Water, opens up every spring between Canada and Greenland at the southern end of Nares Strait (~78°N). Its existence and recurrence are allowed by a combination of factors including the morphology of the coastline, the prevailing winds and current regime, and the hydromechanical behavior of sea ice. Considering the heterogeneity of the ice cover, the variability of atmospheric and oceanic forcings and the high nonlinearity of sea ice dynamics, the formation date and the duration of the bridge is inherently highly variable. However, in a context where the lower atmosphere warms and the thickness and age of the sea ice exported through Nares Strait decrease sea ice thickness and age decrease, the ice bridge and consequently how the North Water polynya ecosystem function will be affected. This paper presents an update of an historical database of the ice bridge life cycle built using ice charts from the Canadian Ice Service and the Danmarks Meteorologisk Institute. An analysis of the formation and break-up time of the polynya allows quantifying the natural variability, but also reveals that abrupt transitions may happen event though external forcings vary monotonously, suggesting that the polynya may disappear as a recurring sea ice feature, thus leading to profound transformations of the ecosystem.

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).

FIRST OBSERVATIONS OF OCEANOGRAPHIC CONDITIONS UNDER THE LANDFAST SEA ICE IN SOUTHEAST HUDSON BAY

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Hudson Bay has the largest freshwater drainage basin in Canada. Several of the main river outlets that discharge into both Hudson and James Bay are now regulated for the purpose of generating hydroelectricity. This development has led to a dramatic change in the seasonal peaks of freshwater runoff, from late spring to mid-winter. The Belcher Islands in southeast Hudson Bay are downstream from most of the freshwater runoff introduced into the Hudson and James Bay systems. This area is also known for its numerous polynyas, which play a significant role as winter habitat for birds (such as the common eider) and marine mammals (beluga). Inuit from Sanikiluaq travel and hunt in the area extensively. Because latent heat polynyas are 'ice factories' (or 'negative estuaries'), brine release in these areas normally enhances vertical mixing, which controls the replenishment of nutrients into surface waters and may result in the formation of deep waters. Increased amounts of freshwater in these areas in winter have the potential to disturb these important processes. During the last decade, community members of Sanikiluaq have raised concerns that the polynyas have been freezing up more rapidly, causing distress for the wildlife that rely on this seasonal habitat. In collaboration with the Arctic Eider Society, they have begun gathering traditional knowledge and visual documentation about the environmental conditions. However, scientific data about freshwater distribution and polynya processes in southeast Hudson Bay are scarce. In January-March 2014, we joined the collaboration with the Arctic Eider Society and Sanikiluaq. A mooring containing several temperature and salinity (CT) sensors and two current profilers was installed from the landfast ice southeast of the Belcher Islands and additional CT sensors were deployed beneath the ice at various other locations around the islands. CTD casts and water and ice-core sampling were conducted at various sites. The water samples were analyzed for salinity, oxygen isotope ratios ($\delta^{18}O$), and CDOM, to quantify the amount and components of the freshwater present (river runoff vs. sea ice formation/melt). Ice core records of $\delta^{18}O$ were used to derive a record of freshwater distribution throughout

the period of ice cover. Collectively, these data points begin to establish a baseline for winter oceanographic conditions and the freshwater budget in southeast Hudson Bay. We hope to expand this research to a larger network of sites in coming years.

RESULTS FROM COMMUNITY-BASED PERMAFROST MONITORING IN NUNAVUT

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Knowledge of permafrost thermal conditions is essential for sound design of infrastructure in the Canadian North and for ensuring its integrity under a warming climate. During the 2008 International Polar Year, the Geological Survey of Canada collaborated with Nunavut communities and the territorial government of Nunavut to establish six new permafrost monitoring sites in the Baffin Region communities of Pangnirtung, Clyde River, Igloolik, Pond Inlet, Arctic Bay, and Resolute Bay. In 2009, four more boreholes were drilled in the Kivalliq (Repulse Bay) and the Kitikmeot (Taloyoak, Gjoa Haven and Kugaaruk) regions of Nunavut. These monitoring sites were a key enhancement of the existing national permafrost monitoring network. Baseline permafrost information provided to community planners and engineers facilitates design and the development of adaptation strategies to cope with the impacts of climate change on community infrastructure and lifestyles. The majority of the boreholes were drilled in relatively undisturbed terrain consisting of sparse vegetation over a thin layer of mineral soil underlain by shattered or fractured bedrock. Ground temperatures are measured to depths of 15 m using a multi-thermistor temperature cable deployed in a borehole casing. A datalogger attached to the cable provides continuous data collection. As of summer 2014, five years of ground temperature data has been collected for the majority of the sites; some records have gaps due to datalogger or thermistor cable malfunction. Mean annual permafrost temperatures range from -5.2°C in Pangnirtung to -12.3°C in Resolute Bay. Since the initial boreholes were installed in 2008, mean annual permafrost temperatures have increased in all the communities. The warming varies from 0.03°C/year in Igloolik to 0.25°C/year in Resolute Bay with an average warming of slightly greater than 0.14°C/year for all 10 sites. Due to thin-to-nonexistent vegetation, snowcover and surface organic layer, ground temperatures are not strongly buffered by air temperature changes. Consequently, annual mean ground temperatures in these communities closely follow the warming trend observed in annual mean air temperatures over the last 5 years. Permafrost warming observed in these communities is consistent with long term-ground temperature records in other High Arctic boreholes.

ACCESSIBLE SCIENCE: A HANDS ON FIELD COURSE FOR NORTHERN STUDENTS

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Northern aboriginal secondary schools are experiencing high dropout rates and in several circumstances the majority of indigenous teenagers do not complete their secondary education. Since fewer still pursue post-secondary education many communities have a serious lack of qualified young people entering their workforce. It is important that the education system in northern communities inspire students and motivate them to stay in school and prepare them for employment upon graduation. To improve this success rate, education could include alternate ways to interest and retain students. In addition to basic literacy and numeracy a realistic goal is to strengthen the local work force by providing specialized knowledge in practices that are empowering and respectful to aboriginal traditions and the environment. This presentation outlines a proposed field course developed for the Naskapi Jimmy Sandy School in Schefferville, Quebec. The planned program is designed to guide instructors through the process of preparing Aboriginal students and young adults for the various environmental employment opportunities that are created in support of resource development. The long-term goals of the course are: (a) to help develop a motivated local workforce equipped with practical field skills and knowledge that will help today's youth take an active role in local natural resource industry; and (b) empower youth to become the decision makers of tomorrow. Aboriginal communities would greatly benefit by providing students (and teachers) with applied skills that are usually taught in earth science courses. Applying, a more hands-on, less didactic and more practical approach to learning skills those are in demand by industry-based field-work. Research is needed to determine specific knowledge-based skills that through co-management and co-operative learning will allow both northern aboriginal peoples and non-aboriginals to learn from one another. Key questions that must be addressed for the success of the program, include: How can indigenous youth in remote communities be trained to become decision makers in an effective co-management system, without being forced to leave their communities for training? What are the specific traditional values that may best take advantage of an adaptive two-way learning system for self-fulfilment and empowerment of aboriginal peoples? How can such a program be developed so that it will be recognized and accepted by all parties (aboriginal peoples, industry and academia) in a mining based northern community? In order to achieve these goals, there are several practical courses that could be taught in Schefferville in partnership with the McGill Subarctic Research

Station. Beginning with a field oriented course involving a series of modules that will provide knowledge and hands on instruction in a range of locally significant environmental topics and techniques. The key is to combine traditional knowledge and values with specialized local environmental science that will provide local indigenous students an advantage over non-indigenous applicants. In this poster we provide the design of a prototype course that we plan to implement once local approvals are completed.

COMMUNITY OBSERVATIONS OF SLUSH-ICE BERM PROCESSES IN COASTAL WESTERN ALASKA.

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This project engaged several Western Alaska coastal communities to describe types and formation processes associated with near-shore sea-ice phenomena during the fall freeze-up season. Commentary and indigenous and local observations were drawn from and analyzed through existing community observing programs (SIZONet and ANTHC-LEO) as well as from new interviews and meetings conducted under a recent project sponsored by Western Alaska Landscape Conservation Cooperative. Extensive work was performed to summarize, assess, and synthesize written and recorded observations and commentary. A primary result was identification of a range of slush-ice berm events that could be broadly categorized as "advective" or "in-situ". The subsequent form and durability of a slush ice berm deposited on the beach is a function of beach and coastline form, on-shore winds, water level (positive or negative surge), water temperature, air temperature, and the occurrence of snow. Berms exceeding 3 m in height were noted by some community members (Shaktoolik and Gambell). Berms can exert considerable impact on community life, presenting benefits as well as difficulties. Large, strong berms can aid a community by blocking erosive wave action and storm surge inundation. However, berms can also impede access to the ocean, restricting hunting activities. Large unfrozen berms present a hazard to cross by residents needing to gain access to the sea. Where specific dates of berm occurrences were available from interviews, synoptic weather analyses were undertaken to identify associate large-scale patterns of temperature and winds. Other near-shore ice occurrences include wind-driven piling of sea-ice and slush against the shore. This can also prevent marine access; such an event, lasting several weeks during prime hunting season, occurred in May 2013 (Gambell). This effort represents an example of engaging community observers in a focused manner to improve understanding of a physical process that could not otherwise be monitored. This talk will present examples of community commentary regarding coastal ice features, discuss impacts of berms on communities, and overview project results concerning berm classification; in particular, the difference between "advective" and "in-situ" slush-ice berms.

MYCOSPORINE-LIKE AMINO ACIDS IN SEA ICE COVERED ARCTIC WATERS

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Marine phytoplankton are known to produce mycosporine-like amino acids (MAAs) for protection against UV radiation. To assess whether the same strategy applies to sea ice-associated communities, MAAs were measured in algae communities associated with surface melt ponds, bottom ice, under-ice melt layer, and underlying seawater in a coastal Arctic bay. Six UV-absorbing compounds were detected as the spring melt progressed, four of which are attributed to MAA shinorine, palythine, porphyra-334, and palythene. The molecular identities of the other two UV-absorbing compounds (U1 and U2), whose absorption maxima located at the extreme ends of the known MAA wavelength range remain to be elucidated. Of particular importance is U1 which was observed only in melt-pond associated environments, suggesting a unique origin associated with snow or sea ice melt. The highest MAA concentrations were observed in the bottom 3 cm of ice under low snow covered areas just prior to complete snowmelt. Normalization to chlorophyll a content revealed that most of the MAA production was associated with the highest light environments, with the greatest concentrations in surface melt ponds. These results confirm that sea ice associated communities are capable of producing MAAs and that spatial and temporal variations in MAA production are highly dependent on UV exposure and are influenced by taxonomic composition. Our investigation is now focused on further understanding the taxonomic influence. Currently we are observing how MAA production is impacted in regards to phytoplankton size

classification and pigment concentrations. MAA production could play an important photoprotective role, both to individual species and the sea ice associated community as a whole, as the Arctic marine ecosystem responds to a changing climate.

RELATING ARCTIC TUNDRA – ATMOSPHERE CO2 EXCHANGE TO SATELLITE-DERIVED NDVI AT DARING LAKE, NT.

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Warming in the Arctic is predicted to alter vegetation composition and phenology resulting in changes in the Arctic's carbon cycle. Carbon dioxide (CO2) exchange between Arctic ecosystems and the atmosphere may be monitored as the net ecosystem exchange (NEE) of CO2 using eddy covariance systems. These systems provide a continuous measurement of NEE but only over a relatively small spatial scale depending on tower height (200 - 1000 m). Remote sensing provides a means to estimate CO2 uptake by the ecosystem over larger study areas. Temporal and spatial trends of vegetation productivity measured via the normalized difference vegetation index (NDVI) can potentially be used to infer CO2 exchange should the relation between the two variables be simply generalized over a complete growing season. To investigate this relation, CO2 exchange data and NDVI were collected at the Daring Lake Ecosystem Research Station, NWT (64°52 N, 111°35 W) over the course of the 2014 growing season. NEE was captured in 30 minute intervals using three eddy covariance flux towers in sedge fen, low shrub, and mixed upland tundra. Within the footprint of each tower, a series of nested sampling plots were established to provide measurement resolutions of 0.5 m, 5 m, 30 m, and 200 m. NDVI was measured manually at the plot-scale with concurrent measurements of leaf area index, biomass, and soil moisture for each measurement plot. For each measurement resolution, the temporal variations in field-based NDVI will be compared with related NDVI data derived from IKONOS, Landsat 8, and MODIS. The satellite derived NDVI data will then be compared with CO2 exchange metrics derived from the eddy covariance towers. We examine a number of factors that might influence these relationships including vegetation composition, form, percent cover, and soil moisture, for example. The ultimate goal is to determine the potential for various satellite NDVI-derived phenological indices for estimating interannual CO2 exchange in these three different tundra types in Canada's Low Arctic.

EXCHANGE OF DISSOLVED OXYGEN, SALT, HEAT, AND MOMENTUM AT THE ICE-OCEAN INTERFACE DURING LATE WINTER

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Turbulent exchanges under sea ice play an important role in ice mass balance, ice drift, biogeochemistry, and mixed layer modification. Here, we present underwater eddy covariance measurements of dissolved oxygen, heat, salt, and momentum fluxes under landfast first year sea ice near Cambridge Bay. The period of observation was limited to late winter/early spring (Apr. 20 – May 5, 2014), but revealed interesting insights about this key transition period. We observed a downwards flux of salt (desalination of the ice) throughout the period, which followed a distinct diurnal pattern whereby the strongest fluxes occurred at night. Heat flux also followed a diurnal pattern, with energy being transferred from the ocean to the ice at night, and vice versa during the day. Oxygen fluxes were persistently directed upwards, in contrast to the expected autotrophic nature of the under-ice community during this time period. We examine all of these fluxes in the context of the physical, chemical, and biological environment at the ice-ocean interface, and discuss how these observations might be used to better understand biogeochemical processes.

ASSESSING HOW CHANGING SNOWPACK CHARACTERISTICS MAY BE RELATED TO THE DECLINE OF THE BATHURST CARIBOU HERD.

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Over the past decade the Bathurst Caribou herd population dropped from approximately 450,000 to 25,000. This significant shift while not uniform among all circumpolar caribou herds (ref) is reflective of many of the herds in Canada and elsewhere. For example the George River herd in northern Quebec has dropped from over 750,000 to less than 50,000 over the same time period. The causes of this dramatic decline have been attributed to many variables including over hunting,

predation by wolves, reduction in food (lichen) availability due to forest fires, insect investation, mining operations etc. Elders and hunters in Wekweeti NWT, centrally located in the winter foraging area of the Bathurst herd, report that over the past several years there has been an increasing frequency of ice lense formation in the snowpack caused by brief thaw periods accompanied occasionally by some rainfall. The primary food source for barren ground caribou is lichen. Accessing this food source through the snow for several months is physiologically demanding especially so if the snow is deep, dense and contains ice lenses. For this part of Canada climate models forecast increasing winter precipitation and warmer temperatures for the next few decades conditions conducive to snowpack development that is physically demanding for caribou. The overall objective of this research is to understand and quantify the potential role that the changing snowpack has on caribou. Three sources of data are utilized to address this objective: 1. The Globsnow data set is used for two primary reasons: the first is to quantify spatial (winter-spring foraging area of herd) and temporal (daily: 1980-2012) changes in snowpack water equivalent (SWE); secondly this data set provides the opportunity of identifying periods of time through the snowyear when there is a high probability of ice lens formation; 2. the Government of the Northwest Territorie's Environment and Natural Resources Ministry has tracked 18 caribou (Bathurst herd) with satellite collars since 1986. This data is temporally intense and the assumption is that their spatial locations are representative of the herd at large; 3. Environment Canada's climate data for Wekweeti, Gameti and Rae Lakes (Bechoko) has been examined to highlight areas in the winter foraging grounds and periods of time when the probability of ice lens formation is relatively high. The spatial locations of forest fires in the NWT since 1965 have been documented. In terms of determining the relationship between caribou locations and snow conditions, the fire history is taken into account. Not all forest fires burn ground vegetation but if this occurs the caribou could avoid these areas for up to 60 years (time required for lichen regrowth). These varibles are taken into account when assessing year to year stress which the snowpack can have on the Bathurst caribou herd.

OVERVIEW OF THE WEST SIBERIAN COMPONENT OF THE ARCTIC VEGETATION ARCHIVE

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Vast data on vegetation was collected on the Yamal and Gydan peninsulas (Northwestern Siberia, Russia) since early 60s. The datasets reviewed here are considered to be the most available and complete for this region. S. Ektova and L. Morozova, Institute of Plant and Animal Ecology, UB RAS (Yekaterinburg), have one of the largest datasets (more than 690 relevés). Their research was carried out in the Polar Urals and the Southern, Middle and Northern Yamal Peninsula in 1990-2012. Their relevés include full lists of vascular plants and lichens and dominant bryophyte species. The datasets include additional information on 13 key sites with detailed description of lichen synusias (1600 plots). Eleven sites have phytomass data. The relevés have coordinates and some environmental information. K. Ermokhina, Earth Cryosphere Institute SB RAS (Moscow), has a dataset containing more than 600 relevés with full lists of species (vascular plants, lichens and bryophytes) from the Polar Urals, Southern, Middle and Northern Yamal Peninsula, and Gydan peninsula. Additional information includes GPS coordinates, cover of species, height of trees and shrubs (when applicable), environmental data (data on soils, permafrost, relief, exogenous processes, etc.). Forty-five plots have phytomass data, and about 200 plots have LAI data. The research was carried out in 2002-2012. 333 relevés were subjected to a preliminary classification analysis using Braun-Blanquet approach. In addition to the relevés dataset there is a set of 4607 photos taken from helicopters, which is held by K. Ermokhina and A. Mikheeva of Lomonosov Moscow State University. All photos include GPS coordinates and orientation data in ARCGIS project file. D. A. (Skip) Walker and colleagues, Alaska Geobotany Center, collected relevés from six locations along a North-South bioclimate transect of the complete Arctic bioclimate gradient that included the Yamal Peninsula and Franz Josef island. The data contain GPS coordinates of all plots, Br.-Bl. cover-abundance values and quantitative percentage cover for all vascular plants, bryophytes, and lichens, biomass (sorted by plant growth forms), mean NDVI, LAI, soil physical and chemical data, soil descriptions, environmental data and photographs of all plots, soils and landscapes. M. Telyatnikov of Central Siberian Botanical Garden SB RAS (Novosibirsk) holds the dataset of 680 relevés with full lists of species (vascular plants, lichens and bryophytes). The research was carried out on Polar Urals, South, Middle and North Yamal in 1987-1995. The additional information in dataset includes GPS coordinates, projective cover of species, height of trees and shrubs (when applicable) and characteristics of the relief and soils. Braun-Blanquet classifications of intrazonal grass communities (212 relevés of the dataset were involved) and dwarf shrub and moss tundras (246 relevés) were made by M. Telyatnikov and S. Pristyazhnyuk. Information from the available Russian Arctic Local Floras datasets (held by O. Khitun and O. Rebristaya) indicate that there is relatively good floristic coverage of much of Yamal, but still large areas with little geobotanical information from almost all the Gydan and Tazovskiy peninsulas, northwest and central parts of Nothern Yamal, central parts of Middle Yamal and southeast and northwest parts of South Yamal.

ANADROMOUS CHAR AS AN ALTERNATE FOOD CHOICE TO MARINE ANIMALS: A SYNTHESIS OF HG AND PERSISTENT ORGANIC POLLUTANT CONCENTRATION TRENDS.

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Studies conducted over the late 1970s to the early 1990s determined that mercury (Hg) and persistent organic pollutant (POPs) concentrations were low in anadromous char across Arctic and subarctic Canada including northern Québec and Labrador suggesting that they were a good food choice for northerners seeking to maintain a traditional diet while minimizing their intake of these contaminants. However these studies suffered from several limitations including small sample size, changing methods in POPs quantification, and provided no information on current conditions. Accordingly, under the Canada's Northern Contaminants Program, over 2004-2013, anadromous char populations were investigated at 20 sites across northern Canada for Hg, other metals and POPs (2004-2012) concentrations; life history characteristics also were assessed. Sites were sampled 1-9 times with trend assessments for POPs conducted at three sites; Hg trend assessments were possible at a greater number of sites because there were more historic Hg measurements from the commercial fishery and other assessments. Hg concentrations were extremely low in anadromous char muscle, typically <0.05 μg/g (wet weight) and, at each location, generally increased with fish length, age and nitrogen isotope (δ15N) ratio and decreased with condition factor and %lipid; correlations with carbon isotope (δ13C) ratio were inconsistent. Most POPs (e.g. HCH, chlordane, dieldrin, DDT) had average concentrations of <5 ng/g (wet weight) with PCB concentrations averaging 11.1+7.6 ng/g. While the data base for assessing time Hg time trends was limited, where temporal trends were detected, they were of increase on the long term (1970s, 1980s or early 1990s to the present) but of decrease on the short term (early 2000s to present) with Nain (Labrador) showing the converse pattern. Higher Hg concentrations were also related to lower condition factor and cooler springs. Chlordane and DDT concentrations declined by an average of 8.5%/yr and 10%/yr at Cambridge By over 1987-2012 and α- and γ-HCH by 10%/yr at Nain over 1998-2012; the temporal record at Pond Inlet was too short (2014-2012) to detect trends. Hg concentrations in anadromous char fillet also were in the general average for terrestrial browsing, grazing, omnivore and molluscivore birds, browsing terrestrial mammals and marine omnivorous birds and substantially lower than in omnivorous, piscivorous, and predatory marine mammals. Concentrations also were lower than in predatory fish. While our study confirmed that char can be a good food choice for those seeking to maintain a traditional diet while minimizing Hg and POPs intake, a review of the known knowledge of these anadromous char revealed large variations in population size with char abundance constrained in areas where freshwater habitat is limited particularly in small rivers with physical barriers to migration (e.g. waterfalls) and limited overwintering habitat.

CURRICULUM DEVELOPMENT AND DELIVERY FOR SCIENCE–TRADITIONAL KNOWLEDGE LEARNING ON ENVIRONMENTAL ISSUES IN THE NORTH: A REVIEW OF THE YUKON COLLEGE SOURCE WATER PROTECTION COURSE EXPERIENCE

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There is a growing recognition that communities cannot rely on technology to provide good quality water and must include strategies for protecting drinking water sources. This is especially the case in remote communities where resources to build and maintain water treatment facilities can be limited and where solutions must consider Arctic conditions. Source Water Protection planning is a community-based strategy for protecting the quality of drinking water that is more likely to be successful if communities can draw upon the best of available knowledges. Several northern Treaty and Land Claim Agreements mandate the inclusion of Traditional Knowledge in environmental decision-making. However, a recent literature review (Bohensky and Maru 2011) indicates that there is confusion around terminology for bringing together knowledges and a tendency to employ practices limited to 'box ticking.' This lack of clarity has implications not only for law and policy implementation, but also for educational efforts to develop the skills to incorporate multiple, including Indigenous, knowledges when addressing environmental concerns such as Source Water Protection. This presentation discusses the results of a case study of the Yukon College Source Water Protection and

Watershed Stewardship course that was cooperatively developed by individuals from Trent University in Peterborough, ON and Yukon College in Whitehorse, YT. The primary case study goal was to examine the conditions and factors influencing the development and delivery of such a course. The case study involved semi-directed interviews with individuals involved, and a document review of course materials as they were adapted over time. Insight is further gained from particular emphasis on the instructor's experience along with coherent conversations between case study team members. This approach allowed for the use of narrative inquiry methodology that resulted in themed stories and an interpretive narrative to describe the key lessons learned. From the outset, developers recognized the importance of including Traditional-and-environmental knowledges in a course about watershed stewardship and of exploring ways to teach students how to bring together multiple knowledges. The findings highlight the importance of the following factors in course development and delivery: • The development and maintenance of a repository of experiences or building blocks to support student learning that can be accessed as needed or as opportunities present themselves by an experienced instructor; • Experiential opportunities for gaining first hand experience with knowledges; • Prioritizing interaction with a variety of knowledge holders and practitioners whenever possible through the use of guest teachers, communication technologies, multi-media, and finally, readings; • Attention to what we call the 'conditions for emergence' in regards to those elements of the classroom environment that support the learning outcome of bringing knowledges together; • Focussing on the evolving teaching process and not a 'recipe' that can be directly transferred to other courses. Findings will interest and have implications for educators and others interested in curriculum design and delivery models and processes that facilitate the bringing together of Traditional-and-environmental sciences for learning and capacity enhancement to address Source Water Protection and other environmental concerns in the North and elsewhere.

IMPACTS OF CLIMATE CHANGE AND INDUSTRIAL ACTIVITIES ON ARCTIC MARINE FOOD WEB AND ECOSYSTEM SERVICES SUPPLY

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The effects of global warming are most intense in the Arctic. Such environmental pressures trigger major transformations in the marine ecosystem. The arctic marine biota is also threatened by increasing amounts of industrial activities such as shipping, mining, and oil exploitation. The perturbations that the arctic marine ecosystem will undoubtedly undergo in the next few decades will have major consequences on the ecological processes that produce ecosystem services, which maintain human wellbeing. This project aims to elucidate how the impacts of climate change and industrial activities will affect arctic marine food web as well as the supply of ecosystem services. Because the climatic stresses affecting the arctic marine ecosystem will have ecological, social and economic consequences, an integrated socio-ecological approach is required to fully understand the magnitude of the impacts. This integration will help establish a suitable management and adaptation plan. Firstly, we will describe the observed and predicted climate-induced changes in the arctic marine food web based on both scientific and traditional knowledge (TK). Secondly, we will assess the resulting impacts on the provisioning of ecosystem services, especially high quality food, and northern communities that depend on them. Finally, we will suggest ecosystem management solutions that will alleviate the consequences of climate change and anthropogenic activities on arctic marine fauna and Inuit communities. There is a need for multidisplinary research linking arctic marine ecosystem to Inuit societies; this integrated assessment of the impacts on ecological processes, ecosystem services and human wellbeing will help develop crucial knowledge to our management and adaptation.

TUNDRA RECLAMATION: DEVELOPING TECHNIQUES FOR SHRUB AND LICHEN REVEGETATION AT A DIAMOND MINE IN NWT

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Extraction of natural resources is a growing field in Canada and worldwide. Disturbances have left vast areas of land partially or completely stripped of vegetation, making them unstable, erosion-prone and unable to provide food or habitat for fauna. Shrubs and non-vascular species in biological soil crusts (e.g. lichens) are integral components of tundra ecosystems. Lichens form a large portion of the winter diet of caribou which are a staple food for many northerners. Without reclamation, it could take hundreds to thousands of years for disturbed areas from mining in the north to recover naturally due to extreme environmental conditions. Assisted revegetation seeks to accelerate plant establishment and growth on disturbed sites. Current reclamation practices are limited by lack of native plant material, harsh environmental conditions, high costs and lack of regulatory requirements. Researching innovative, cost

effective and sustainable methods to reclaim disturbed northern land and develop self-sustaining communities is imperative to conserve one of the few remaining natural environments worldwide. The objective of this research program is to develop and improve methods for collection, propagation and dispersion of native shrub and non-vascular species in harsh environments. All phases of research will include assessment of mechanisms and triggers to determine key physiological development necessary for revegetation. Shrub cuttings have high potential to create a consistent source of plant material to reclaim large areas in a timely manner. Shrub cuttings were collected from eight dominant tundra species and non-vascular species from Diavik Diamond Mine, Northwest Territories (~320 km northeast of Yellowknife). The first phase of this research investigated which species can develop roots after 60 days using common horticulture practices (e.g. soaking length, rooting hormone treatment) at different times of year (spring dormant, spring not dormant, summer not dormant, fall dormant). Preliminary results for cuttings collected in summer and fall indicate that there are species specific factors influencing rooting behaviour. For example, mountain cranberry had preferential root develop in summer, while birch and willows had better root development in fall. Other species did not show strong rooting behaviour at either time period for any treatment combinations to date. Future growth chamber experiments are expected to decipher treatment factors that can enhance rooting behaviour for cuttings collected at optimal time of year following completion of the spring collection experiments. Treatment choices were selected based on a review of scientific literature, common horticultural practices and ease of application. The second phase of this research will develop methods to accelerate non-vascular species propagation and dispersion for reclamation, as only limited research has been conducted due to their slow growth rates. Specific objectives for non-vascular species are to determine the effect of substrates, soaking lengths, fragment size and dispersal techniques on growth and survival of lichens and non-vascular communities in controlled and field settings. Preliminary results indicated that lichen fragment retention was enhanced with jute, lichens were more frequently associated with microtopography, and all treatments with dispersed lichen fragments had similar species frequency after one month.

VARIABILITY OF THE THICKNESS AND DEFORMATION OF PACK ICE IN THE CANADIAN BEAUFORT SEA AS MEASURED FROM BELOW WITH A DENSE ARRAY OF UPWARD LOOKING SONAR INSTRUMENTS

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The spatial variability of pack ice thickness, deformation characteristics over measurement periods of days to one year or longer are not well known. Satellite-based measurement scenes over large areas of pack ice are readily available, but these data do not provide information on the temporal variability of the pack ice, nor do they provide accurate measurements of sea ice thickness or deformed ice on horizontal scales of one to 10-30 m. Upward looking sonar (ULS) instruments operating from subsurface moorings provide more accurate measurements of sea ice thickness (±0.1 m) and deformation through continuous data collection of ice drafts at a time resolution of 1-2 s and a spatial resolution of 1 m. Continuous direct measurements of ice velocities are also obtained with a time resolution of 20 minutes. In this paper, we present analyses of ULS-derived observations of ice drafts, ice deformation parameters and ice velocities as obtained from an extensive array of 7-8 ULS moorings operated in water depths ranging from 73 to 1010 m in the outer shelf and continental slope region of the western Mackenzie shelf region of the Canadian Beaufort Sea. These data were collected as part of an ArcticNet-Industry environmental studies program from July 2009 to September 2011. The distance separation between individual pairs of mooring ranged from 4 km to more than 80 km. From these very extensive sea ice data sets, the spatial differences in sea ice properties are presented over monthly and full year time scales in both the cross-slope and along-slope directions. The sea ice properties that are analysed for spatial variability include: mean, maximum and modal values of sea ice drafts; the total distance of sea ice moving through each site; sea ice deformation attributes from identification of massive ice features and big keels including their frequencies of occurrence and their distribution of ice drafts, feature widths and cross-sectional areas; and ice velocity statistical distributions (mean, standard deviation, 90th, 95th, 99th and maximum speeds, modal and net flow directions) and episodes of particularly high ice drafts and of no motion. The results reveal considerable spatial differences in ice properties. For example, the occurrences of no-motion events is more frequent in the shallower inner-slope/outer shelf area than in the deeper offshore waters and are more frequent in the east vs. the west. The spatial differences in ice properties are related to regional ice dynamics processes.

LEGACY OF ECOLOGICAL LAND SURVEYS IN NORTHERN YUKON: PAST, PRESENT AND FUTURE

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Ecological land surveys in northern Yukon have informed the development of ecological mapping and classification tools for addressing management needs. In Yukon Territory, ecological land surveys began in the late 1970's, along with a wave of similar surveys across Canada. Through the 1980's and early 1990's funding for ecological land surveys became sporadic and un-sustained. In 2010, the Government of Yukon established an Ecological and Landscape Classification (ELC) program to carry on the work of the ecological land survey. The ELC program has built on 50 years of baseline ecological data collected in northern Canada. An ecological land survey organizes and maps baseline physical and biological data according to ecological similarity. This information can be used facilitate a range of interpretations for management purposes. Yukon Government of Yukon, in partnership with NRCan, Canadian Forest Service, received funding through the International Polar Year (IPY) initiative (2007-2010) to produce a vegetation classification of arctic regions of Canada. This involved acquiring existing vegetation plot data collected over the past 50 years, throughout the Canadian arctic and subarctic from published and unpublished sources; constructing a harmonized ecological database and analyzing the data to produce a preliminary arctic vegetation classification, as an extension of the Canadian National Vegetation Classification (CNVC). A Yukon Arctic Vegetation Classification was completed by the Yukon Government, with additional funding through the Inuvialuit Final Agreement (IFA). This classification is a component of Yukon's Bioclimate Ecosystem Classification Historic and contemporary ecological land surveys have been used in decision making and informing policy development. Given that we continue to use ecological information collected fifty years ago to address today's land management challenges, what will be our legacy be for future generations in a changing environment, and what role can researchers and government play?

EFFECT OF FOREST FIRE DISTURBANCES ON BIOGEOCHEMICAL CYCLING IN ACTIVE LAYER AND PERMAFROST SOILS, AASTERN MACKENZIE DELTA, NWT, CANADA

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The western Canadian Arctic is a particularly vulnerable region to climate change. Increases in air temperature and forest fire frequency are projected to affect the uppermost 2-3m of continuous permafrost by the end of the 21st century. The consequences of permafrost degradation with respect to aquatic and terrestrial ecosystems have been monitored at site-specific and regional scales. This research aims to determine whether forest fires impart a change in permafrost biogeochemistry, by releasing nutrients, and to assess whether time since this type of disturbance is a factor. The comparisons are possible given the study sites are all underlain by the same till blanket surface geology. Two burned sites were sampled among undisturbed sites in the eastern Mackenzie Delta. The burned sites experienced a forest fire in 1968 (near Invuik) and in 1999 (near Lynx Creek), whereas the unburned sites were sampled in proximity. At each site, active layer and permafrost cores were collected to depths of ca. 2m depths in order to assess the recovery of permafrost soils following this type of disturbance. An analysis of biogeochemical variations within the modern active layer and relict active layer was undertaken for comparison. Major soluble ions and trace metals were measured by means of ICP-AES and elemental analysis (EA). This study will provide some insight as to geochemical cycling within permafrost soil profiles.century.

INUIT TRADITIONAL KNOWLEDGE FOR ADAPTING TO THE HEALTH EFFECTS OF CLIMATE CHANGE

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The Inuit Traditional Knowledge for Adapting to the Health Effects of Climate Change (IK-ADAPT) project was

launched in May 2012. Funded through the Canadian Institutes for Health Research (CIHR), with co-funding from ArcticNet, IK-ADAPT combines scientific research and Inuit traditional knowledge to develop an evidentiary base to inform policy and programming needed to adapt to the health effects of climate change. Working with communities in the Inuvialuit Settlement Region, the Northwest Territories, Nunavut, and Nunatsiavut, as well as knowledge users at multiple levels, the project is examining ways to preserve, promote, and disseminate Inuit knowledge in order to prevent, prepare for, and manage the health impacts of climate change. Now in its final year, this poster documents results from projects conducted under IK-ADAPT, and identifies next steps for enhancing the resilience of communities and northern health systems in light of a rapidly changing climate.

DYNAMICS OF THE BOTTOM BOUNDARY LAYER ON THE UPPER SLOPE OF THE MACKENZIE SHELF: LINKAGES BETWEEN SURGES IN THE SHELF-BREAK CURRENT, SEABED EROSION AND SEDIMENT DISPERSAL

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Sediment mobilization on the shelf-break and upper slope region of the Mackenzie Shelf in the southeastern Beaufort Sea varies on monthly to inter-annual time-scales in response to oceanographic processes and is linked at longer time scales (decades to centuries) with the dynamics of subsea permafrost and associated gas venting . As part of the Beaufort Regional Environmental Assessment (BREA), taut-line moorings equipped with upward- and downward-looking ADCPs (Acoustic Doppler Current Profilers; Teledyne RD Instruments 300 -kHz and Nortek Aquadopp 1-Mhz), laser diffraction systems (Sequoia Laser In-Situ Scattering Transmissometer 100X) to record sediment volume concentration and size-distribution, temperature-salinity probes and optical backscatter loggers to measure turbidity and basic water properties, were used to monitor the role of short-term oceanographic processes in particulate matter resuspension, redistribution and redeposition on the upper slope. Here, we estimate the erosion potential of bed sediments and the magnitude of the resulting suspended load in relation to near-bottom current velocity and direction with the aim of calculating sediment fluxes and understanding the variability of sediment transport mechanisms within the bottom boundary layer (BBL; <15 m above the bed), based on the 2011-2013 BREA dataset (collected near the shelf edge at the Mackenzie Trough and in the central portion of the southeastern Beaufort Sea). Results revealed that near-bottom currents (from 140 to 150 m contours) at the shelf edge were characterized by recurring episodes of strong velocities (instantaneous speeds of up to ~50-60 cm s-1) that were the extension of higher current surges (~60-80 cm s-1) seen in the core of the shelf-break jet located at ca. 90-120 m depth. These current surges appear linked to the development of large-scale systems of strong winds (>15-20 m s-1) propagating across the western Arctic Ocean, such as during epic storm episodes recorded in November 2011 and September 2012, as well as during the extensive sea-ice fracturing event in March 2013 which extended from the northern coast of Alaska to Banks Island. High current velocities that translated into exceeded sediment erosion thresholds also resulted in elevated suspended matter concentration within the BBL (up to 100-1000 g m-3). The combined high-current/high-turbidity features were always observed as a sudden pulse with a total duration of a few days up to a week, implying that the resuspended material was rapidly advected with the current. Mean suspended load near the bed was about one order of magnitude higher in the Mackenzie Trough region than at the outer central shelf, suggesting that sediment resuspension is topographically enhanced and/or that sediments are more erodible in the vicinity of the trough. In conclusion, our results provide evidence for a coupled atmospheric-oceanic process linking storms passing from the Northern Pacific Ocean to the Beaufort Sea and resulting in high-velocity currents and sediment transport events near the bottom of the upper slope of the Mackenzie Shelf.

FINE-SCALE BOWHEAD WHALE TAGGING IN THE EASTERN CANADIAN ARCTIC.

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Bowhead whales (Eubalaena mysticetus) face an uncertain future as their primary prey is predicted to vary in quality and quantity over time because of climate change. However, it is unknown how future fluctuations in zooplankton species composition and abundance will affect the species. Currently, the diet and feeding behaviour of Eastern Canada-West

Greenland bowhead whales is not well known in Canadian waters. To gain an understanding of how bowhead whales make a living under current environmental conditions, we collected fine-scale dive behaviour data from bowhead whales in Kingnait Fjord (Cumberland Sound, Nunavut), a suspected summertime foraging ground in the Eastern Canadian Arctic. Four bowhead whales were tagged between 13-21 August with a short-term archival tag equipped with a time-depth recorder (TDR) (LAT1500, Lotek), VHF radio transmitter (MOD-050, Telonics) and an acoustic transmitter (V22P, VEMCO, Ltd.). Fine-scale dive behaviour was recorded using the TDR, and the acoustic and VHF transmitters were used for tracking and instrument retrieval. Tag attachment times were short (≤1.5 hrs) for 3 animals that did not display feeding behaviour. However, intermittent foraging behaviour may have been documented from one whale that was tagged for ~8 hrs. On average, this whale conducted dives (>15 m) lasting 8.6 mins (range: 3.33-13.12 mins). The whale's average maximum dive depth was 33.82 m (15.3-118.5 m). The whale spent 9.8% of its dive in the descent phase on average (1.2-79.8%) and 4.13% in ascent phase (2.1-10%). Dives analyzed from the TDR data, were mostly v-shaped (presumably exploratory) dives, during which the whale spent little time at the maximum dive depth. However, the whale also made some u-shaped dives, which may be representative of feeding bouts. During u-shaped dives, whales spend a greater proportion of their dive duration at maximum depth and are likely ingesting prey at this time. Bowhead whale foraging behaviour will be further studied in 2015 by collecting fine-scale co-located prey and dive data in Kingnait Fjord.

EASTERN CANADA-WEST GREENLAND BOWHEAD WHALE DIET AND FORAGING BEHAVIOUR IN CUMBERLAND SOUND, NUNAVUT.

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Changes in zooplankton species diversity and relative abundance are expected to occur as a consequence of climate change, which may affect the foraging success of bowhead whales (Balaena mysticetus). However, relatively little is known about bowhead diet and foraging ecology in the Eastern Canadian Arctic. Consequently, it is unknown whether these climate-induced changes in prey will negatively or positively affect bowhead whales. We sought to collect information about bowhead prey and feeding behaviour by opportunistically combining zooplankton and bowhead-dive data in Cumberland Sound, Nunavut in August 2013 and 2014. We tracked movements of bowhead whales and collected depth-temperature profiles using satellite telemetry from archival SPLASH tags in 2013 (n=1) and 2014 (n=1). We also collected zooplankton samples (n=12) near whales in Kingnait Fiord (in Cumberland Sound) using two 333-µm mesh conical nets (30 cm and 60 cm in diameter) fitted with a General Oceanics helical flow meter and temperature depth recorder (TDR). The nets were used to sample surface waters (0.5 m), and the water column using oblique (15 m) and vertical (180-200 m) hauling methods. We also conducted successive vertical tows of progressively shallower depth strata; and obtained zooplankton samples (n=16) in 2014 from discrete depths near bowhead whales using a 50-cm diameter close-open-close net equipped with a Sea-Bird TDR and Star-Oddi conductivity, temperature and depth recorder. Analysis of diving records from one whale tagged in 2013 indicated that it likely fed near the sea bottom in Kingnait Fiord (90% of its dives were deep at ~197 m and square-shaped, with bottom times exceeding >50% of total dive duration). Adjacent surface waters were found to be devoid of prey. However, vertical samples collected from depths >100 m contained high concentrations of Arctic calanoid copepods (i.e., Calanus hyperboreus and C. glacialis) compared to those collected from shallower depths. Zooplankton samples collected during August 2014 yielded similarly high densities of prey near the sea bottom of Kingnait Fiord. These results suggest that bowhead whales feed at depth on Arctic calanoid copepods in Kingnait Fiord during the summer. Future fine-scale tagging and zooplankton sampling will be conducted in 2015 to validate assumptions regarding bowhead foraging behaviour.

VEGETATION AND SOIL CONTROLS ON ACTIVE LAYER DEPTH BENEATH TALL SHRUBS IN THE LOW ARCTIC TUNDRA

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Climate change is expected to cause extensive vegetation changes in the low Arctic tundra which will play a significant role in altering the surface energy balance. A predicted increase in shrub growth with higher temperatures may amplify regional heating and contribute to permafrost thaw, or might shade the surface preserving permafrost and lessening active layer depth (ALD). However, our understanding of the direction and magnitude of these potential feedbacks remains uncertain

due to the spatial heterogeneity in vegetation across the landscape. Although some studies have shown that at present maximum ALD beneath shrubs is lower compared to adjacent open tundra communities, other research suggests that soil moisture has a large effect on the resilience and vulnerability of permafrost to climate change. Therefore, it is critical that we investigate the vegetation and soils controls of permafrost thaw to better predict how tundra ecosystems will respond to warming. This study was designed to examine ALD variability in a shrub tundra landscape the low Arctic and to identify the dominant vegetation and soil properties responsible for this variability. The experiment was conducted near the Tundra Ecosystem Research Station, Daring Lake, Northwest Territories (64°52'N, 111°34'W). Six sites were selected to represent the spatial variability in shrub cover and soil moisture content. We hypothesized that soil shading by shrub canopies would be the dominant factor responsible for reducing permafrost thaw. ALD was measured at all sites using a blunt metal probe. We also measured leaf are index, soil temperature at 5 and 15 cm depths, soil moisture, and incoming solar radiation above and below the canopy. Preliminary results showed that the site with the lowest maximum ALD (62.1 cm) was found at the dry shrub site with high percentage shrub cover (LAI 1.24). It was also found that the seasonal rate of ALD increase was the lowest at this site (0.7 cm/day) and the highest at the wet shrub site (1.1 cm/day) with high percentage shrub cover (LAI 1.44). While it is clear that shading by dense shrub canopies plays an important role in reducing soil temperatures and the energy available for permafrost thaw, high soil moisture content can alter the soil thermal regime and lead to higher rates of thaw and maximum ALD

EFFECT OF GLACIAL DRAINAGE WATER ON THE CO2 SYSTEM AND OCEAN ACIDIFICATION STATE IN AN ARCTIC TIDEWATER-GLACIER FJORD - TWO CONTRASTING YEARS

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The effect of glacial meltwater on the CO2 system was investigated in the tide-water glacier influenced fjord on Spitsbergen. We studied the variability of the total alkalinity, total dissolved inorganic carbon, dissolved inorganic nutrients, 18O, and freshwater fractions from the glacier front to the outer in winter 2012 (January, March and April) and 2013 (April) and summer/fall 2013 (September) in Tempelfjorden. The two contrasting years clearly showed that the influence of freshwater, mixing and haline convection affected the chemical and physical characteristics in the fjord. The seasonal variability showed the lowest calcium carbonate saturation state (Ω) and pH values in March 2012 coinciding with the highest freshwater fractions. The highest Ω and pH were found in September 2013, mostly due to CO2 uptake during primary production. Overall, we found that increased freshwater supply decreased Ω, pH and AT. On the other hand, we observed higher AT relative to salinity in the freshwater end-member in the mild and rainy winter of 2012 (1142 µmol kg-1) compared to AT in 2013 (526 µmol kg-1). Observations of calcite and dolomite crystals in the glacier ice suggested supply of carbonate-rich glacial drainage water to the fjord. This implies that winters with a large amount of glacial drainage water partly provide a lessening of further ocean acidification, which will also affect the atmospheric CO2 uptake.

A LONGITUDINAL COMPARISON OF REPRODUCTIVE SUCCESS OF HIGH ARCTIC TUNDRA PLANTS IN RESPONSE TO LONG-TERM EXPERIMENTAL WARMING

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Climate change is expected to have strong impacts on Arctic tundra plants. Over the last 20 years increases in vegetative growth have been observed as a consequence of both natural and experimental warming. Some studies found that seeds from warmed plots have increased germination, which indicates that sexual reproduction will be enhanced under future warmer climate conditions. Here, we ask whether the germinability of seeds increases with the duration of experimental warming. We assessed reproductive success of tundra plant species in response to long-term experimental warming. Growing season temperature for several plant communities at Alexandra Fiord, Ellesmere Island, Nunavut in the Canadian High Arctic was increased by open-top chambers (OTCs) since 1992. Seeds from warmed and control plots were collected and their germinability tested in the greenhouse at the University of British Columbia. We analysed germination data from seeds collected in 1993, 2004 and 2010. Total

cumulative germination and germination rate were compared between warmed and control plots as well as over the 17-year experimental period. Experimental warming generally increased germination. However, seed germinability varied strongly from year to year suggesting that interannual variation of environmental conditions has a strong influence on reproductive success. Although reproductive advantage of plants in warmed plots did not increase over the study period, altering interannual patterns show the importance of long-term experiments for predicting climate change impacts on High Arctic plant communities.

SHARING DATA FOR CREATING INFORMATION AND KNOWLEDGE AT CANADA'S POLAR DATA CATALOGUE

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The Polar Data Catalogue (PDC, https://polardata.ca) is Canada's growing source for data and information about the Arctic and Antarctica. The PDC works with scientists from a variety of Canadian and international programs to manage and serve online their research data outputs, including results related to physical, biological, social, and health sciences as well as policy and economics. Since its online launch in 2007, the PDC has been the archive and online access portal for research data and information stemming from the ArcticNet Network of Centres of Excellence, Canada's government program for International Polar Year, the Northern Contaminants Program of Aboriginal Affairs and Northern Development Canada, and other polar organizations. The collection has grown to 1,761 metadata descriptions of datasets and over 200 datasets encompassing nearly 165,000 files, including CTD, mooring, and other datasets from the Canadian icebreaker CCGS Amundsen. Our primary mandates are to securely archive these valuable datasets for future generations and to facilitate and encourage their immediate access by as many people as possible. Our targeted users are polar researchers and students, residents of northern Canada, northern decision makers, and any citizen interested in polar issues and information. To serve our users, the PDC website provides descriptions of datasets and free download of data files in their original formats as well as a simple viewer for displaying and querying selected spatial datasets in map form. In addition, the PDC hosts nearly 30,000 images of northern Canada and Antarctica from the RADARSAT satellites. These images are available for free download in a variety of formats for use in research and public display. The website of the Canadian Cryospheric Information Network (CCIN, https://ccin.ca, the parent organization of the PDC), hosts interactive visualizations of several snow and ice datasets that are pertinent to northern Canada. These interactive tools display map-based views of snow water equivalent across the Canadian Prairies and also the full Northern Hemisphere, showing actual snow on the land as well as anomalies from year to year. We also provide interactive maps showing ice freeze up, thaw, and thickness for dozens of lakes across northern Canada, including animations of the seasonal ice cycle for several years. The CCIN website also hosts a Kids section as well as a selection of videos and photographs which demonstrate and teach about cold regions and the people who live there. Our goal is to add new online visualization and collaboration tools so that the data in the PDC are easier to use and understand and people can make better decisions for their lives and for those they represent. To improve service to our users and utility of the data archive in the future, we seek input on the types of data and forms of display and access that are most beneficial to you.

STRUCTURE AND FUNCTIONAL ROLE OF MEIOFAUNAL BENTHIC COMMUNITIES IN THE ARCTIC

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In recent decades, the Arctic Ocean has undergone unprecedented changes, such as an increase in the surface temperature and reduced sea ice cover. These changes may cause changes in the intensity and spatial distribution of primary production and the nature of pelagic-benthic coupling. This could affect the amount and quality of organic matter that settles onto the seafloor, and the benthic communities that feed upon it. Potential impacts of climate change and human activities on benthic ecosystems in the Arctic are still difficult to assess because of the lack of baseline data. The meiofauna make an important contribution to the biodiversity of benthic communities and play a significant role in ecological processes and ecosystem functioning. They represent a food source for macro / megafauna benthic and demersal organisms and play a key role in the recycling of organic matter and its transfer to higher trophic levels. The present study aims to describe and compare the composition and structure of meiofaunal benthic

communities of the Arctic, to identify environmental factors and mechanisms underlying the different patterns of diversity and to explore the trophic links between primary sources, meiofauna and macrofauna. To reach these objectives, we collected benthic samples from July to October 2014 aboard the CCGS Amundsen. The study area extends from Baffin Bay (57 ° W) to the Chukchi Sea (167 ° W), in a latitudinal gradient from 68 ° N to 81 ° N. The baseline data provided will enable us to make further predictions on how climate change may affect the structure and functional role of meiofauna benthic communities which will modify trophic links in a changing Arctic.

REGIONAL PATTERNS OF ICE-WEDGE DEGRADATION SINCE THE MID-20TH CENTURY ACROSS NORTHERN ALASKA

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Ice-wedge polygons are abundant in the continuous permafrost zone of Alaska's North Slope, creating complex microtopography and strong, meter-scale contrasts in hydrologic regime, vegetation, and ground-ice conditions. Rapid and dramatic landscape changes have occurred in recent decades in the coastal plain of the eastern North Slope due to thawing of the uppermost portions of Holocene ice wedges. Thaw of the wedges results in ground subsidence (thermokarst) and the formation of flooded pits along the polygon margins. Secondary impacts, including thermal degradation of permafrost and spatially-variable flooding and drainage of polygon centers, affect areas well beyond the thermokarst pits themselves. Archives of historical (1948, 1955, 1971, 1977–1985) and modern high-resolution imagery support regional-scale detection of ice-wedge degradation across bioclimatic (north-south) and geomorphic (east-west) gradients spanning the North Slope. To characterize the timing and extent of ice-wedge degradation, we quantified the extent of small, flooded thermokarst pits evident in circa 1980 and modern imagery for a network of eleven 43 km2 study areas spanning the North Slope, including sites where we collected field data in 2010–2012. To distinguish thermokarst pits, we exploited near-infrared reflectance values, which are much lower for open water than for tundra vegetation. We focused our analysis on old, residual upland landscapes, where ice wedges have developed over long periods of time and surface water is usually only present in thermokarst pits. Our analysis indicated increases in the total area occupied by flooded thermokarst pits at 8 of 11 landscapes since circa 1980 (median +10.6%; maximum 77.8%). Increases in the extent of thermokarst pits were prevalent on the eolian sand sheet, and eolian silt deposits (yedoma.) Because the ice wedges underlying the North Slope have developed over millennial timescales, the changes observed over the past few decades appear to represent a directional change, rather than a cyclic process whereby local thermokarst is offset by ice aggradation elsewhere. Our results indicate an intriguing regional pattern of ice-wedge degradation, in that thermokarst pit development appears to have occurred earlier on the western North Slope, where residual uplands consist of alluvio-marine deposits. A possible explanation for this pattern is that the high salinity, and resultant lower melting point, of frozen marine sediments makes them more prone to climate-induced thaw. Future work involves remote-sensing and field-based approaches to identify drivers of the changes and regional patterns observed since the mid-20th century.

DEVELOPMENT OF A NEW EMERGING PORCUPINE CRAB (NEOLITHODES GRIMALDII) FISHERY IN SUBARCTIC WATERS. THE IMPORTANCE OF UNDERSTANDING PARASITE INDUCED NATURAL MORTALITY AND NEGATIVE EFFECTS ON REPRODUCTIVE POTENTIAL.

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The importance of baseline information on Arctic species has increased due to investigations revealing the effects of a warming climate on Arctic marine ecosystems. Science related to species with Arctic distributions can therefore provide insights into the current state of marine ecosystems and future effects of climatic warming. The Porcupine crab is caught traditionally in large numbers as bycatch in Arctic and sub-Arctic gillnet fisheries targeting deep water (>1000m) species such as Greenland halibut (Reinhardtius hippoglossoides). Although there is a long history of Porcupine crab as bycatch, very little is known about the biology and ecology of this species. The current study is part of a larger initiative that seeks to investigate porcupine crab life history characteristics, parasite infestation & biological effects, post-capture survival, and most appropriate capture gear. To conduct these investigations this study collaborated with a commercial gillnet vessel to maximize the information gained from industry, and the amount of data collected in the field. As there is currently no directed fishery for the Porcupine crab the information collected in this study will be of interest to science, industry, and fisheries management. In this sense, the results of this project can provide power to make informed decisions on the commercial potential of this species.

This discussion will cover data collected on the presence of a Rhizocephalan parasite (Briarosaccus callosus) on the Porcupine crab. More specifically, the extent of feminization incurred by male crabs, the reproductive effects incurred by female crabs, and the importance of spatial distributions of infection levels.

PARTICIPANT AND END USER PERSPECTIVES ON THE ARCTICNET INTEGRATED REGIONAL IMPACT STUDY (IRIS) AS A SCIENCE TO POLICY MECHANISM

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Our current understanding of how to effectively translate research results on urgent issues such as climate change into "action" or decision-making at various levels remains limited. Some have argued that it requires a number of linked elements (e.g. generation of leading edge science, strong relationships between members of the science community and policy community, effective and contextualized communication) in addition to a strategic understanding of the policy- and decision-making landscape and an understanding of the pathways and mechanisms through which to translate or connect science and action. To address climate change threats and take advantage of opportunities created decision-makers need access to the best available research and an innovative method through which to translate research results into informed policy and other decisions. ArcticNet has been using the collaborative production and dissemination of 'Integrated Regional Impact Studies' (IRIS) as a science to policy tool in each of four regions of the coastal Canadian Arctic. This project has explored and reviewed the IRIS process as a science to policy mechanism. Using the case study of the IRIS-4 process in Nunavik and Nunatsiavut it has examined the factors that have influenced its conduct, process and outcomes. Ten researchers and IRIS leaders and 7 intended end users were interviewed between November 2013 and April 2014. Interviews explored respondents' perspectives of the value, challenges and benefits of the IRIS process its resulting products. Interviewees were also asked about the impact of the IRIS process on research and policy in the region and whose responsibility this bridging process should be. Participant observation of IRIS meetings and a review of documentation were used to complement interviews Inexperience with the policy context, time constraints and a perceived disconnect between the ultimate goal and conduct of the process were identified as challenges by interviewees. Researchers reported significant benefits in the face-to-face meetings, well-focused small working group approach and reception of clear direction from regional stakeholders involved. Researchers' increase contact and relationships with northern communities was not reported to be something that the IRIS process necessarily facilitated – rather this was already happening prior to ArcticNet and is indicative of larger trend in northern research. Intended end users identified a need to ensure that scientific knowledge is balanced with local knowledge and priorities. They also emphasized the importance of partnering with scientists throughout the process. Many pointed to the value of having centralized, easily accessible databases or information resources for policy- and decision-making. Some participants involved in IRIS-4 processes perceived it to be the role/responsibility of social scientists to bridge the gap between research and policy An a priori understanding of the science-policy process may facilitate the design of research that is most likely to be used beyond the science community that generated the knowledge. The analysis of IRIS-4 suggests that this outcome was achieved after the fact, which is another alternative, although perhaps less ideal. However, the IRIS process in Nunavik and Nunatsiavut has overall been perceived to positively promote/support science impact on policy by researchers and policy-makers involved.

EVALUATION OF THE NASIVVIK CENTRE FOR INUIT HEALTH AND CHANGING ENVIRONMENTS: IMPACTS OF THE PROGRAM ON CAPACITY ENHANCEMENT IN THE FIELD OF INUIT ENVIRONMENTAL HEALTH RESEARCH

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A number of research and training programs in the Arctic and elsewhere have adopted a mandate that includes "building capacity" at a community or regional scale. However, very few have identified what is specifically meant by this term and fewer

have engaged in evaluation to report on their ability to meet this goal. Established in 2002, the Nasivvik Centre for Inuit Health and Changing Environments is a multidisciplinary research and training centre funded by the Canadian Institutes of Health Research-Institute of Aboriginal Peoples' Health, and one of nine Network Environments for Aboriginal Health Research (NEAHR) across Canada. Based at Laval and Trent Universities, with Inuit Research Advisors in each Canadian Inuit region, the Nasivvik Centre is focused on enhancing capacity in Inuit health research in key environmental health areas of importance to Inuit communities. 'Enhancing' capacity is purposefully used by the Centre to recognize that capacity already exists in Inuit communities for research and other forms and processes of knowledge generation. For the past 12 years the Centre has actively engaged Inuit and non-Inuit students at the undergraduate and graduate levels as well as community individuals through strategic funding initiatives, research support and training opportunities. As the Centre's CIHR funding comes to a close, it is currently engaging in a process of evaluation to assess the impact of its initiatives in light of Centre objectives, particularly the overarching theme of capacity enhancement (CE) in Inuit environmental health research. This program evaluation seeks to better understand the collective impact of the operations and initiatives of the Centre and the factors influencing this process of capacity enhancement for research in the North. The first stage of this program evaluation is to gather insights from recipients of Nasivvik graduate scholarships. Key themes of CE were drawn from CIHR-IAPH documents, minutes of Nasivvik Centre discussions with Board representatives from Inuit organizations, and the literature. These themes were used to inform the development of an in-depth qualitative survey which was administered to a target group of past graduate student award recipients. Results from this initial survey were then used to inform the construction and application of a multiple-choice survey distributed to all Nasivvik scholarship recipients. The survey is one component of a larger program evaluation on CE being conducted by the Centre to document and describe the initiatives, activities, and operations of Nasivvik and their impacts at various scales. This evaluation will allow the Centre to reflect on the last 12 years of operation and make recommendations for its own, or others', future initiatives intended to enhance capacity related to research in the Arctic and elsewhere. *Our colleague and close friend, Dr Dewailly passed away during the conduct of this study. He was the founder and co-director of the Nasivvik Centre since its inception in 2002. This evaluation and reporting of the successes and challenges of the Centre are dedicated to his memory and dedication to the notion of capacity building for Inuit environmental health issues in the Canadian Arctic.

MEASUREMENT OF PERMAFROST GREENHOUSE GAS EMISSIONS THROUGH A NEW AUTOMATED SYSTEM OF CLOSED CHAMBER

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Over the past 30 years, the Arctic has experienced a rapid increase in surface temperatures, which has lead to important consequences such as the beginning of permafrost thaw. Permafrost thaw is expected to contribute to increased emissions of greenhouse gases (GHG) such as methane (CH4) and carbon dioxide (CO2) through enhanced ecosystem respiration and soil carbon consumption, with potentially a feedback effect on climate warming. Such emissions have been quantified indirectly through mathematical models and from sporadic field measurements using portable gas chambers. However, modeling still holds a lot of uncertainty and direct measurements with chambers are both labor-intensive and time-consuming. At the moment, there are only few means of directly measuring permafrost GHG emissions over long periods of time without an operator and at small costs. The main objective of this project was to measure permafrost CO2 and CH4 emissions in a polygonal peat bog located in Salluit, Nunavik. In order to assess the future impact of warming on arctic carbon fluxes, GHG emissions were measured under the current climatic conditions and inside an open-top chamber (OTC), which can reproduce the climatic conditions expected in about 50 years. In addition, the spatial variations of GHG emissions over the network of ice wedges, from dry tundra polygon centers to wet troughs where ice is decaying, were studied in order to determine the effects of soil water saturation on GHG emissions and composition. This project also aimed to test a new instrumentation developed at CEN: a closed chamber automated system. The goal was to design and build a system capable of taking precise measurements over long periods of time with low-cost gas sensors instead of using conventional ways to measure carbon concentrations such as an infrared gas analyzer and gas sampling with a syringe. In addition, the system was designed to operate autonomously and maintain the integrity of the studied sites. Four automated closed chambers were used for the project. Three of these chambers were on polygons centers where the soil is relatively well drained. The first site was used for the chamber in natural conditions (Cn) and the second one for a chamber inside an OTC (COTC). On the third well-drained site, surface

vegetation inside the chamber was cut in order to roughly measure GHG emissions emitted from the soil alone (Csoil). The fourth chamber was installed between two polygons, i.e. on an ice-wedge where permafrost is degrading and soil is permanently water-saturated (Csat), to evaluate the effects of spatial variations within the study site on GHG emissions. Two chambers were operated every day, alternating between chambers each day. The chambers were closing for 30 minutes three times a day (7h30, 13h30, 19h30). Manual measurements and independent measurements with a commercial gas chamber were also taken in order to compare the accuracy and precision of the new instrumentation. Preliminary results show that the new automated system tends to underestimate CO2 fluxes, but that the trends of carbon emissions are similar to the commercial chamber. The greatest CO2 emissions came from Csat, followed by COTC, Cn and Csoil. Carbon dioxide fluxes from Csoil were more than half the emissions of Cn, suggesting that the soil is the main CO2 emitter.

FATTY ACIDS AS DIETARY TRACERS IN BIVALVE BATHYARCA GLACIALIS (GRAY, 1824) FROM CONTRASTING TROPHIC REGIONS OF THE CANADIAN ARCTIC ARCHIPELAGO

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Total primary production is expected to increase in the Canadian Archipelago in response to the reduction of the sea ice cover due to climate change. Several authors suggest future dominance of pelagic ecosystems and a reduction of organic matter inputs to the benthic compartment. The Canadian Arctic is characterized by contrasting trophic environments in both coastal and bathyal domains. In this context, we used the fatty acids trophic markers methods on a filter-feeder mollusk bivalve (Bathyarca glacialis, Gray, 1824) to test the following hypotheses: i. in bathyal systems, the pelagic-benthic coupling is lower, ii. bivalves mainly feed on bacteria and / or detritus in bathyal areas while in shallow waters pelagic phytoplankton food sources are preferred, iii. bivalves can adjust their membrane fluidity in response to depth and temperature by modulating their PUFA (polyunsaturated fatty acids) contents. In October 2010, during an ArcticNet campaign in northern Baffin Bay and Lancaster Sound, specimens of B. glacialis were sampled in two bathyal zones (> 560 m), were surface waters are characterized as eutrophic (based on dominance of diatoms). In August and September 2011, other specimens were collected in oligotrophic shallow (<70 m) environments (food system based on flagellates) of the Beaufort Sea and Larsen Sound. The fatty acids of the neutral fraction of the tissues were extracted, identified and quantified by gas chromatography-mass spectrometry (GC-MS). While bacterial or detrital markers were expected, the fatty acid profiles with high proportions of 16:0, 16:1ω-7, eicosapentaenoic acid (20:5ω3), arachidonic acid (20:4ω6) and docosahexaenoic acid (22:6ω3) show that bivalves mainly feed on the microalgae produced in the photic zone and exported to the bottom, suggesting a strong pelagic-benthic. However, strong differences were observed between neutral fractions' FA profiles of bivalves living either in oligotrophic flagellates- (higher proportions of diatoms fatty acid markers) or in eutrophic diatoms-based systems (mainly flagellates food sources and significant proportion of zooplankton and bacteria). Polar fractions' FA profiles also strongly differed between coastal and bathyal populations. We discuss how local environmental conditions can explained such patterns.

BIVALVE ASTARTE SPP. IN A SUBARCTIC FJORD: COULD THE SHELL BE USED AS BIO-ARCHIVES OF PRIMARY PRODUCTION AND THE DIET CHARACTERIZED FROM TISSUES?

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Identifying organisms' diet is relevant for understanding and predicting consequences of potential biotic and/or abiotic modifications on trophic food web. In general, total primary production is expected to increase in the Canadian Arctic Archipelago in response to the decrease of the sea ice

cover. Several authors suggest a future dominance of pelagic ecosystems, causing the reduction of organic matter exported to the benthos. Environmental monitoring is therefore crucial to assess climate change impacts on the Arctic marine ecosystem. The use of biological archives may constitute an interesting approach for a follow-up over long time periods. In this context, the main objectives of our study are: (1) to analyze the barium-to-calcium ratio (Ba:Ca) ratio from shell cross sections to use it as proxy of primary production and (2) to use complementary trophic methods as fatty acids (FAs) markers, isotopic analyses on bulk material and on specific FAs to determine the actual diet of the bivalve Astarte spp. We sampled Astarte spp., a long-lived sessile bivalve, from a depth of 55 m and its potential food resources (particulate organic matter, surficial sediments and six macroalgae species) during two field surveys in May and September 2013 in a subarctic fjord (Kobberfjord, SW Greenland). Thick sections were cut from the left valve of 11 specimens for geochemical analyses. Cross-sections were gently ground down, polished and analyzed to measure Ba:Ca ratio, using laser ablation ICP-MS. FAs of bivalves' digestive gland, as well as the potential food samples were extracted, quantified, and identified with GC-MS methods, and carbon isotopic ratios were determined on must abundant FAs with GC-IRMS analyses. Bulk carbon and nitrogen stable isotopes analyses were also performed on supplementary samples. Ba:Ca time-series were characterized by a relatively stable background level punctuated by many sharp peaks. We will see if the Ba:Ca ratio can reflect phytoplankton blooms and if consequently Astarte spp. can be used as bio-archives of primary production variations over long period. Non-metric dimensional scaling (nMDS) analysis on total FAs profiles shows a strong differentiation between each potential food resources and digestive glands. Seasonal effects in digestive glands FAs profiles are related to a relative higher proportion of FAs markers of microalgae during May, whereas FAs markers of zooplankton and bacteria are more abundant during September. FAs markers of brown macroalgae as C18 polyunsaturated FAs (particularly C18:4ω3) are also present in digestive glands of Astarte spp. Stable isotopes results will also be compared to FAs results to determine the dominant origin of sea ice vs. pelagic microalgae in the bivalve's diet. The effect of climate change on such filter feeders, via potential changes in the pelagic-benthic coupling will be discussed.

HABITAT SELECTION OF ARCTIC-NESTING ROUGH-LEGGED HAWK AND PEREGRINE FALCONS BREEDING NEAR THE BAFFINLAND IRON MINE ON BAFFIN ISLAND, NUNAVUT

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There is rapidly growing economic interest in developing natural resources in Arctic and Sub-Arctic regions of Canada. Industries engaged in resource extraction or exploration are typically required to identify valued ecosystem components (VECs) that may be affected by their activities, and develop VEC-specific plans to monitor and mitigate impacts via restoration and/or offsetting initiatives. Raptor species are routinely considered to be amongst the most important VECs. The aim of our research was to build landscape level models to identify and quantify the relative importance of factors that influence nesting habitat selection of Peregrine Falcons and Rough-legged Hawks, and predict their distribution in the vicinity of the Baffinland Iron Mine in north-west Baffin Island, Nunavut. Resource selection functions (RSF) are often used to estimate and predict habitat most often used by free ranging wildlife species ; however RSFs are rarely validated using data independent of those from which models were built. We conducted aerial surveys from 2006 to 2013 and identified 172 Peregrine Falcon nests and 160 Rough-legged hawk nests. We used these survey data to construct habitat selection models at three relevant spatial scales (Nest site, Seasonal home range, Landscape) using paired logistic regression with landscape teledetection data. Field model validation was performed in 2014 in 6 locations adjacent to, but distinct from the regional foot print associated with mining exploration and development. Comparison of predicted versus observed nest site selection will be done by calculating correlation coefficient and fitting linear regression for each species and scale. Preliminary results indicate that resource selection for both species varied with scale. Our models indicate that topography (landscape ruggedness) is important at fine scale habitat selection, while land cover (distance to water, greenness index) is more important at broader scales. These findings demonstrate the selection of nesting habitat at small scales and foraging habitat at larger scales. Maps will be used to visualize the relative nesting occurrence for Rough-legged Hawks and Peregrine Falcons in an effort to contribute to monitoring of raptors breeding within the foot print associated with Baffinland Iron Mine.

USING STABLE ISOTOPES TO TRACE MERCURY TRANSFER ACROSS A SALINITY GRADIENT WITHIN THE HUSKY LAKES, NORTHWEST TERRITORIES, CANADA

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Mercury can accumulate in apex-predator fish muscle to concentrations exceeding those considered safe for subsistence consumption by humans. Fish species such as Lake trout are typical apex-predators of Arctic lakes and can be a significant source of food for local indigenous peoples. The influence of abiotic factors and biological parameters on Hg accumulation in apex-predators are not well understood. Further, a good understanding of sources of Hg to and processes within water column and food webs is still lacking. Our study investigates the interactions of water column, food webs and Hg transfer in aquatic systems along a salinity gradient in the Inuvialuit Settlement Region (Canada). The selected Husky Lakes, Yaya, and Noell Lake ecosystems represent a range of water column and ecological characteristics, as well as Hg delivery (marine-, riverine- or freshwater-derived). We investigate how those characteristics affect Hg transfer and fractionation. All lakes are frequented by the Inuvialuit communities Inuvik and Tuktoyaktuk for subsistence fishing. Sampling includes surface water, benthic and pelagic invertebrates, tissues from harvested fishes, and non-target fishes. Biological parameters of fishes (age, length, weight, diet) are recorded and invertebrates separated by species. Sample analysis includes total Hg (THg), monomethylHg (MeHg), and stable isotopes of carbon (δ13C), nitrogen (δ15N), and Hg (δxHg) and otolith microchemistry. Hg IRs are analyzed by multi-collector inductively coupled plasma mass spectrometry (MC-ICP/MS). Hg mass independent fractionation (MIF; Δ199Hg) and mass dependent fractionation (MDF; δ202Hg) was calculated and evaluated against conditions in the water column, food web transfer and the potentially difference in Hg delivery. We demonstrate that MIF varies in Lake Trout from different lakes up to ~2‰; We will present new results from this multidisciplinary study and discuss our preliminary findings with particular focus on implications for future research efforts in a changing Arctic environment.

HISTORICAL ECOLOGY FOR RISK MANAGEMENT: YOUTH SUSTAINABILITY (HERMYS)

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Current team consists of the following researchers and community partners: Anne Garland (DHS CREATE, ARIES, UMD, Historical Ecology/Archaeology), Kathleen Fischer (ARIES, Oceanographer), E. Moore (South Mtn. CC, Geology), Michael Brady (Geography, Rutgers University), Hollis Yenna (PolarTREC HS Teacher), Sian Proctor (PolarTREC CC Faculty, Geology), Anne Jensen (UIC Senior Scientist for Cultural Resources), Fredrick Brower, Robin Smith, and James Kilioni (North Slope Borough Risk Managers and Disaster Coordinator), Laura Thomas(Ilisagvik Community College Cooperative Extension), and David Ongley (Tuzzy Consortium Library Director). Applied Research in Environmental Sciences Nonprofit, Inc. (ARIES), Barrow Arctic Science Consortium (BASC), North Slope Borough (NSB) Risk Management, Tuzzy Consortium Library, and Cooperative Extension of Ilisagvik Community College are collaborating to implement a historical ecology model for the North Slope Coastal Region of Alaska. Historical ecology is an applied research program that focuses on interactions of people and their environments (social-ecological systems) in both time and space to study its accumulated effects. The research can be applied to community landscapes that assist management strategies including environmental conservation, ecosystem services, and hazard mitigations. The emphases align with the ARIES mission that combines research, education and community outreach, the Inupiaq Learning Framework, and the eco-heritage indicator of the CRIOS model (Cumulative Regional Integrated Operability Score. http://www.ariesnonprofit.com/ARIESprojects.php). The Inupiaq Learning Framework (http://www.inupiatheritage.org/our-culture) and the HERMYS model align since includes the integration of historical, social and natural sciences. The project emphases are: o compile bibliographic database of historical resources of both social and natural sciences, o conduct historical examinations of the shoreline for a time-series baseline, o develop simulation models to demonstrate socio-natural cycles of change for the North Slope shorelines, o study historical ecology of the shoreline with interactive mapping and a web based database to assist academia, industry, regional government, and local communities for socio-cultural and environmental management purposes, (BAID partner, http://prodgis02.utep.edu/baidutep/) o assemble an integrated team with interested researchers, industry, community planners, Native corporations for risk mitigation, decision making, participatory research, educational products, age-level activities, and community service learning such as Community Based Monitoring, PolarTREC (http://www.polartrec.com/expeditions/historical-ecology-for-risk-management-2014) , Teen CERT(http://www.fema.gov/community-emergency-response-teams/teen-community-emergency-response-team), Youth Camps of Ilisagvik Community College and Cooperative Extension.

IMPORTANCE OF PRIMARY PRODUCTION BY SEA-ICE ALGAE IN A CHANGING ARCTIC

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Sea ice forms an extensive shield over the ocean surface each year and presents a unique, highly structured habitat for microbial assemblages. Algal communities are known to flourish in such cryo-ecosystems where they contribute significantly to the annual primary production in many parts of Arctic Ocean. Few data of primary production (i.e., photosynthetic production of organic carbon) were reported for sea-ice algae of highly productive areas such as the North Water, northern Baffin Bay. In this study, we investigate an extensive data set describing the sea-ice algae environment, biomass and production over a complete sea-ice season in the North Water to better understand the factors that modulate the production of organic carbon by ice algae. The overarching goal is to gain a finer estimation of their contribution in sustaining higher trophic levels (e.g., crustaceans, fishes and aquatic mammals) in Arctic ecosystems. Ice cores were collected from April to June 1998 at 39 stations on drift (or pack) ice and at one station sampled four times on land-fast ice. At each station, we measured the percent cloud and ice cover, incident photosynthetically active radiation (PAR), air temperature, snow depth, and surface water temperature and salinity. The sea-ice habitat at a given station was described in terms of salinity, thickness, sub-ice PAR, and nutrient concentrations. Biological variables measured in sea ice were: chlorophyll a concentration (chl a, an algal biomass proxy); particulate organic carbon and nitrogen content; and primary production of both total (i.e., dissolved plus particulate) and particulate forms. All biological variables were measured for the total and the large (> 5 µm) algal assemblage. Primary production rates were estimated using the standard technique of photosynthesis versus irradiance (so-called P-E curves) using 14C-uptake measurements. Preliminary results show that although algal biomass in sea ice was low (median 5 mg of chla per m2) when compared to 38 published studies of Arctic sea ice (median 31 mg of chl a per m2; review of Arrigo et al. (2010) in Sea Ice, Thomas and Dieckmann [eds]), the daily primary production rates in the North Water (1 to 381 mg of C per m2 per day) were within the same range (0.5 to 463 mg of C per m2 per day). Higher rates were obtained when considering both the dissolved and particulate primary production (2 to 596 mg of C per m2 per day), emphasizing the need for accurate measurements of the total organic carbon production. These data are of high interest as they were collected in 1998, prior to the rapid decline of the Arctic sea ice under global warming, and thus will contribute to our overall comprehension of the global carbon cycle in a changing Arctic.

THE FEEDBACK OF SHRUB EXPANSION TO SOIL CARBON EMISSION IN ARCTIC TUNDRA

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The Arctic tundra ecosystems contain about one third of the global terrestrial ecosystem carbon and play an important role in the global carbon cycle. Atmospheric warming due to climate change is expected to cause important shifts in tundra vegetation composition. A growing body of empirical evidence has documented the increase in shrub abundance and size in various Arctic tundra ecosystems. Changes in Arctic species might feedback positively or negatively to carbon cycle in various ways, one of which is to alter soil carbon emission. A series of experiments in low Arctic tundra near the Tundra Ecosystem Research Station, Daring Lake, Northwest Territories (NWT) (64°52'N, 111°34'W) were conducted to analyze the potential feedback of shrub expansion to soil carbon emission. We hypothesized that shrub coverage increase will cause a shading effect which will reduce soil temperature, thus decrease soil respiration rate. Three tundra sites along a gradient of increasing shrub coverage (17% - 64%) were chosen. A Li-COR 6400 with soil chamber was used to measure soil respiration rate in 6 plots at each site. Soil temperature, soil moisture and soil nutrient availability were also measured in all plots. Preliminary results showed that: 1) the site with higher shrub coverage had lower soil temperature at 2cm, 5cm, 10cm depth, 2) during the growing season, the variability of soil respiration rate showed a similar overall pattern at three sites, but the site with more shrubs had higher averaged soil respiration rate (3.04 µmol m-2 s-1) than the other two sites (2.4µmol m-2 s-and 2.64µmol m-2 s-1). 3) accumulated growing season CO2 emission increased with higher shrub coverage; the seasonal total values were 11.60, 12.81, 14.73 mol CO2 m-2 for least, intermediated and most shrub cover, respectively. Together, these results demonstrated that the shading effect of increased shrub coverage on soil respiration might be offset by the active effect of increased soil nutrient availability on soil respiration.

INORGANIC CARBON DYNAMICS OF MELT POND-COVERED FIRST YEAR SEA ICE IN THE CANADIAN ARCTIC

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Melt pond formation is a common feature of spring and summer Arctic sea ice, but the role and impact of sea ice melt and pond formation on both the direction and size of CO2 flux between air and sea is still unknown. Here we report on the CO2-carbonate chemistry of melting sea ice, melt ponds and the underlying seawater as well as CO2 fluxes at the surface of first year landfast sea ice in the Resolute Passage, Nunavut, in June 2012. Early in the melt season, the increase of the ice temperature and the subsequent decrease of bulk ice salinity promote a strong decrease of the total alkalinity (TA), total dissolved inorganic carbon (TCO2) and partial pressure of CO2 (pCO2) within the bulk sea ice and the brine. As sea ice melt progresses, melt ponds form, mainly from melted snow, leading to a low in situ melt pond pCO2 (36 µatm). The percolation of this low pCO2 melt water into the sea ice matrix dilutes the brine resulting in a strong decrease of the in situ brine pCO2 (to 20 µatm). This initial low in situ pCO2 observed in brine and melt ponds results in air-ice CO2 fluxes ranging between -0.04 and -5.4 mmol m-2 d-1 (negative sign for fluxes out of the atmosphere into the ocean). As melt ponds strive to reach pCO2 equilibrium with the atmosphere, their in situ pCO2 increases (up to 380 µatm) with time and the percolation of this relatively high concentration pCO2 melt water increases the in situ brine pCO2 within the sea ice matrix as the melt season progresses. As the melt pond pCO2 increases, the uptake of atmospheric CO2 becomes less significant. However, since melt ponds are continuously supplied by melt water their in situ pCO2 still remains under-saturated with respect to the atmosphere, promoting a continuous but moderate uptake of CO2 (~ -1 mmol m-2 d-1) into the ocean. Considering the minimum and maximum Arctic sea ice extents during the melt period (90 days), we estimate an uptake of atmospheric CO2 ranging from 7.3 to 16.4 Tg of C yr-1 due to the sea ice melt pond dynamics. This additional uptake of CO2 associated to Arctic sea ice needs to be further explored and considered in the estimation of the Arctic Ocean's overall CO2 budget.

TOWARD CLIMATE CHANGE SCENARIOS FOR CANADIAN ARCTIC COASTAL ZONES WITH MORE REALISTIC INTER-VARIABLE DEPENDENCE

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Current and future climate change is and will be especially pronounced in the Arctic regions and, in order to improve impact studies, we need to produce more realistic climate scenarios, especially for the coastal zones where most of the northern residents live. One important aspect of local climates, in the Arctic as well as elsewhere, is the inter-dependence between temperature and precipitation. This inter-dependence is often complex and can be described in part by simple correlations and more completely by bivariate probability distributions (i.e. copula models). However, up to now, few studies have investigated whether climate models are able to realistically reproduce this climatic characteristic and how to develop climate scenarios where the temperature-precipitation inter-dependence is well reproduced. Here, we compare this inter-dependence in observations and model outputs at Canadian Arctic coastal sites and we propose a method to improve the local climate scenarios based on a two dimensional statistical adjustment and downscaling. More specifically, we use the gridded interpolated Canadian database of daily minimum and maximum temperatures and precipitation for 1950-2010 as benchmark to assess the inter-dependence realism in an ensemble of model simulations from the Coupled Model Intercomparison Project Phase 5 (CMIP5). Subsequently, we investigate how model temperature-precipitation copula structures at the study sites are modified by a conventional and the proposed two dimensional post-processing techniques in order to generate climate scenarios. Future improvements and recommendations are also discussed, as well as causes (e.g. seasonal extent of sea ice cover) for spatial and seasonal patterns in the observed temperature-precipitation inter-dependence.

ATMOSPHERIC DMS CONTRIBUTION IN AEROSOL GROWTH AND ACTIVATION IN THE ARCTIC

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Atmospheric Dimethyl Sulfide (DMS) and its oxidation products have a key role in aerosol formation and growth in the Arctic. Aerosols drive significant radiative forcing and affect climate by scattering/reflection of solar radiation or affecting clouds and precipitation. For this study, DMS was measured on board the Canadian Coast Guard Ship (CCGS) Amundsen in the Arctic during July 2014 in the context of the NETCARE (Network on Climate and Aerosols: Addressing Key Uncertainties in Remote Canadian Environments) project. In addition, size-fractionated aerosols and fog/rain samples were collected to study the source of sulfate using the chemical and isotopic composition of sulfate aerosols. The results are expected to address the contribution of anthropogenic and biogenic sources of sulfur aerosols using isotope ratios (34S/32S) and explain the contribution of DMS oxidation in aerosol activation in the Arctic summer. Preliminary results from the measurement campaign for DMS and its oxidation products in air, fog and precipitation will be presented.

PHYLOGENETIC HOST-PARASITE SPECIFICITY IN APHIDS OF CHURCHILL

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Relationships between plants and insects comprise much of the ecological interactions that shape our environment. Host-specificity can often drive speciation and extinction and is therefore of interest to taxonomists. Aphids are an example of a host-specific, phytophagous insect in which co-evolution and host switching are thought to drive co-speciation. I hypothesised that if co-evolution leading to co-speciation between host plants and their aphid species result in interaction-specific co-adaptations, then aphid species in Churchill, Manitoba will be highly host-specific by association and phylogeny. Aphids were collected in Churchill, Manitoba over two summers, and a section of the COI mitochondrial gene was sequenced. These sequences were used to create a maximum likelihood phylogenetic tree. Similarly for the plants, sequences for a section of each of three genes: ITS2, rbcLa and MatK were mined from the BOLD project [MKPCH] and a maximum likelihood phylogenetic tree was created using a concatenation of these three sequences. R and Core-Pa were used to statistically assess the specificity of the associations. The picante package in R revealed significant independent clustering of aphids species on two plants: Labrador tea (Rhododendron groenlandicum) and Blueberry (Vaccinium uliginosum), and significant dispersion of aphids species on salix spp. The Core-Pa output did not show evidence of co-speciation, but there was significant evidence of a lower number of host switching events than were expected from random associations. Studying the host-parasite-specificity on the level of phylogeny will allow us to make inferences about the specific adaptations that allowed for the radiations of the specific groups and give us more agricultural insight into potentially threatening aphid groups.

ICEMAP250 : HIGH-RESOLUTION SEA ICE MAPS USING MODIS

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Climate change in the Arctic region causes the sea ice cover to evolve at a rapid rate and in sometimes unexpected manners.To be able to monitor adequately this rapid evolution, tools with fine temporal and spatial resolution are needed to complete and validate the information provided by sea ice models. National ice services provide high-quality, low spatial resolution ice conditions maps during the key periods (Freeze-up & Melt), but lack the day-to-day availabilty and finer spatial resolution necessary to make local-scale monitoring possible. In order to build more complete time series of sea ice conditions and to cope for gaps in SAR data availability, the use of MODIS imagery, available on a daily basis since 2000, is an excellent alternative. The IceMAP250 algorithm is an adaptation of the original IceMAP algorithm, first developed by NASA (Hall et al., 2001) and based on MODIS optical, thermal and infrared imagery. It can provide sea ice presence maps at 250m spatial resolution for every day of the year, covering the entire arctic region, depending on MODIS images availability and cloud-cover masking. The maps are created following an expert system scheme mainly based on spectral thresholds applied on specific MODIS bands (2,4,6) and on the Normalized Difference Snow Index (Dozier, 1989). A serie of conditions are verified in order to decide if there is presence of sea ice or not for every cloud-free pixel of the MODIS image. To give IceMAP250 its 250m spatial resolution capabilities, all original 500m spectral bands (4 & 6) used in the algorithm are downscaled to a 250m spatial resolution using a focal regression-based downscaling

algorithm developed by the Canada Centre for Mapping and Earth Observation (Trishchenko et al., 2006) and a nearest neighbors linear regression method is used to downscale ice surface temperatures from a 1km spatial resolution to 250m, using the Normalized Difference Snow Index (NDSI) as explanatory variable. Results show excellent performance and agreement with spatially concordant Synthetic Aperture Radar (SAR) based sea ice presence maps and provides finer spatial resolution information in areas where it is particularly important such as coastal area where the major infrastructures and northern communities are found. The major limitation of the algorithm is, as it was for the original IceMAP approach, the impact of the cloud cover on the area where ice mapping is possible. IceMAP250 approach is actually tested on Hudson Bay and Strait, where a lot of validation data and maps are available. All SAR images used to validate IceMAP250 sea ice presence maps are from the RADARSAT Polar Science Dataset available from the Canadian Cryospheric Information Network (CCIN). IceMAP250 is developped as part of the IcePAC Project, funded by Natural Resources Canada - Canada's Regional Adaptation Collaborative Program, in collaboration with the OURANOS Consortium. All maps and results from the IcePAC project are to be available on an open-access online atlas interface.

ASSESSING RECENT CHANGES IN THE DYNAMICS OF THE POLEWARD ATLANTIC WATER FLOW OFF WESTERN NORWAY FROM A FJORD SEDIMENT ARCHIVE.

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Sills at the entrance of Norwegian fjords create semi enclosed basin that are linked to the Norwegian Sea and react sensitively to local and regional climate changes. Hence the hydrology of the Trondheimsfjord, central Norway, is affected by the horizontal and vertical structure of the the main surface ciculation features over the nearby shelf, and by freswater discharges through river inlets into the fjord. Both the shelf surface circulation and precipitations over western Norway are driven by wind patterns (strength and direction) over the eastern Nordic Seas. Benthic stable isotope and elemental (major elements) records obtained from a sediment archive at the fjord entrance hold keys to illustrate past (last 2000 years) modifications in the dynamics of the estuarine circulation over the fjord sill. Our results suggest that changes in the water column structure at the fjord entrance were organized according to the timing of some of the major climatic period of the late Holocene, among which the Medieval Climate Anomaly and Little Ice Age. We show, according to NAO-related wind processes, that past changes in the flow strength of the Norwegian Atlantic Current can be reconstructed from proxy records obtained in shallow settings such as fjord sills in coastal Norway.

MODELLING REGIONAL AIR QUALITY IN THE CANADIAN ARCTIC: IMPACT OF NORTH AMERICAN WILDFIRE AND ARCTIC SHIPPING EMISSIONS

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The Arctic is recognized as one of the key areas of the globe, both in terms of its sensitivity to climate change, and by the increasing economic activity associated with the opening up of Arctic waters in a warming climate. Environment Canada is undertaking an initiative to develop an air quality prediction capacity for the Canadian North and Arctic region, in the context of assessing the impacts of the current and future air contaminant emissions from shipping and other sources on the northern environment and human health. In this study, using an on-line air quality prediction model GEM-MACH, simulations were carried out for the 2010 northern shipping season (April – October) over a regional Arctic domain. North American wildfire emissions and enhanced marine shipping emissions (based on comprehensive inventories) were developed and included in the simulations. Model simulations were evaluated against available observations from various monitoring networks. Analysis was carried out to investigate relative contributions from different sources (e.g., North American wildfires and Arctic marine/shipping) to ambient concentrations of various pollutants and depositions of sulfur, nitrogen, and black carbon in the Canadian Arctic and northern regions. Preliminary results from this study will be presented.

ORGANIC MATTER ACCUMULATION IN SEDIMENTS FROM HUDSON BAY - A HIGH-RESOLUTION RECORD OF CLIMATE/WATERSHED PROCESSES OVER THE LATE HOLOCENE

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A high-resolution record of organic matter accumulation in sediments from a combined gravity-piston core was collected from a site located at a water depth of 104 m inside Nastapoka Sound in the south-eastern region of Hudson Bay. The drainage basins in this region of Hudson Bay coincide roughly with the present-day tree line location and are within the forest-tundra transition zone. CAT- Scan and multi-sensor core logger data revealed relatively uniform sediments throughout the core. 14C-based geochronology indicates that the combined record extends to ~3200 cal BP and that accumulation rates were relatively constant (0.1-0.2 cm/y). Organic carbon, inorganic carbon and nitrogen contents display down-core variability consistent with changes in organic matter inputs but overall relatively stable depositional conditions over the last 3,000 years. Compositionally, we measured steady increases in the carbon:nitrogen ratios and lignin phenol content of sedimentary organic matter from 3200 cal BP to present consistent with enhanced inputs of vascular plant-derived organic matter. Lignin compositions (i.e. S/V and C/V phenol ratios) throughout the core are consistent with contributions from a mixture of conifer and angiosperm non-woody plant sources. Steady decreases in both S/V and C/V phenol ratios since 3200 cal BP to the present indicate enhanced contributions from conifer-dominated vegetation and are consistent with a steady expansion of boreal forests (white and black spruce) over shrub -dominated tundra (dwaf birch, willows, sedges) in this southern Arctic region over the late Holocene. No clear trends in the ratio of combustion products over lignin products are evident, suggesting a low fire frequency in the area during the covered time span of the record.

ARE MELT PONDS A SIGNIFICANT SOURCE OF DIMETHYLSULFIDE FOR THE ARCTIC ATMOSPHERE IN SPRING?

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Dimethylsulfide (DMS) is an important climate-active trace gas. It's oxidation products in the atmosphere contribute to the formation of high-albedo clouds that participate to the radiative balance of the Earth. In the Arctic atmosphere, low particle content in early summer increases the occurrence and the impact of DMS-derived aerosol formation. Ice covered oceans provide complex and dynamic environments where DMS, it's precursor dimethylsulfoniopropionate (DMSP) and dimethylsulfoxide (DMSO) are produced by phytoplankton as well as ice algae. In a context of advanced and increased ice thaw, melt ponds could also become a significant source of DMS in the Arctic during the melting period. They cover from 50% up to 90%, of the ice sheet in some regions. DMS measurements in melt ponds are very scarce. Here, we present data from two campaigns conducted in the Canadian Arctic Archipelago. In 2012, the monitoring of two land-fast first year ice melt-ponds was conducted offshore near Resolute, Nunavut (74°43.613'N ; 95°33.496'W). In 2014, ten melt ponds with a wide range of characteristics were investigated from the ice-breaker CCGS Amundsen. Concentrations of DMS in the melt ponds during the two sampling programs varied from < 0.05 nmol l-1 (detection limit 0.03 nmol l-1) to 14 nmol l-1. Results from three incubation experiments conducted onboard the ship with melt pond water in 2014 suggests 1) a stimulation of DMS production following the addition of DMSP and DMSO, and 2) high DMS photochemical degradation rates. These results confirm the potential importance of melt ponds as a source of DMS for the atmosphere in the Arctic.

ON THE WAY TO IMPROVING MODERATE SPATIAL RESOLUTION OCEAN COLOR DATA NEARBY HIGHLY PRODUCTIVE ARCTIC ICE-EDGES

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Phytoplankton, which is responsible for approximately half of the planetary primary production and plays a key role in the world carbon cycle and marine food web, responds to variations in large scale factors controlled by climate, such as ocean circulation and water temperature. This is particularly expected in the Arctic Ocean and its marginal seas where global warming tends to be most pronounced. However, whether ongoing global warming, and subsequent ice melt, will increase or decrease primary production by phytoplankton remains uncertain and some studies disagree about the consequences of sea ice melt on the phytoplankton distribution and growth. The currently limited understanding in future Arctic phytoplankton dynamics largely results from a lack of accurate data at the edge of the ice-pack where spring-summer blooms take place. Ocean color sensors on-board satellites represent a valuable tool for providing a synoptic view of the Arctic Ocean systems. The quality of ocean color data in the icy Arctic waters may be seriously compromised due to, among others, contamination of the signal by sea ice. Two types of contamination, the adjacency effect of nearby ice-edges and sub-pixel contamination by sea-ice floes within an ocean pixel, are responsible for important biases in the interpretation of ocean color data (Belanger et al., 2007). To avoid this misinterpretation, methods have been suggested to mask ice-contaminated pixels (e.g., Belanger et al., 2007; Wang and Shi, 2009). However, the extent of the ice-contamination remains to be quantified. Moreover, since most of phytoplankton biomass develops along the receding ice-edges, masking ice contaminated pixels results in a significant loss of data and may lead to erroneous conclusions about Arctic phytoplankton dynamics. There is therefore a need to develop a reliable approach to correct the remotely-sensed ocean color signal from ice-related contamination. With the second generation of ocean color sensors (e.g., SeaWiFS, MODIS and MERIS) identification of ice-edges and ice floes remains very challenging, but the recent advances in satellite technology and the planned launch of multiple coincident high and medium spatial resolution sensors (e.g., the future Sentinel 2 and 3 missions) will make it possible to develop robust and accurate correction approaches. This it the main objective of the present study. Current methods to detect ice-contaminated pixels on medium spatial resolution images (i.e., Belanger et al., 2007; Wang and Shi, 2009) are evaluated and discussed. To further investigate ice contamination, a large set of in situ data collected during several Arctic sea campaigns in 2004, 2009, 2011, 2013 and 2014 is used. In situ water reflectance measurements taken nearby ice-edges and/or ice-floes are compared with spatial and temporal coincident satellite retrieved water reflectance data. Finally, an innovative approach is proposed to correct ocean color data retrievals from sea-ice contamination taking advantage of the synergy between high and medium spatial resolution ocean color images (i.e., from OLI on Landsat 8 and MODIS Aqua, respectively).

LANDSCAPE HAZARDS MAPPING FOR CLIMATE CHANGE ADAPTATION PLANNING IN YUKON: IMPACT OF LAND COVER DISTURBANCES ON PERMAFROST LANDSCAPES

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Climate changes represent a major challenge for northern regions underlain by permafrost and their impacts are already being observed in many communities. Environmental changes can be exacerbated by human intervention and in many cases these operations (e.g. road installation, building construction, logging, farming) can impact on the environment at a faster pace than those induced by climatic changes. When combined, climatic and anthropogenic changes can result in important hazards for community planning. To reduce and adapt to the risks associated with permafrost degradation and its impact on contemporary landscapes, the Northern Climate ExChange (Yukon College, Canada) has been developing adaptation strategies through hazards mapping in order to help guide the planning efforts of Yukon communities. Examples from Burwash Landing and Dawson City were selected to examine the impact of land cover changes and vegetation removal on permafrost landscapes following fire hazards management, mining operations and agriculture activities. Distinctive ground characteristics can be notable in areas presenting contrasting vegetation cover. Under a FireSmart zone where trees are still present in Burwash Landing, the stability of the permafrost has been maintained with an active layer depth of 0.65 m.

Illustrating how surface disturbance can greatly impact on the ground thermal regime, an adjacent fire cut area where all trees have been cleared, has developed a near-surface talik (unfrozen area in the permafrost) that reaches depths down to 8 m. Placer mining operations in Dawson City have disrupted the natural state of permafrost by stripping the first meters of soil and vegetation to access the rich gold bearing material beneath. The C3B subdivision (south-east of Dawson) shows early signs of permafrost degradation in a stripped-open area. By removing the insulating organic cover, the active layer has rapidly thickened to a depth greater than 1.6 meters in just under 10 years. In comparison, the adjacent, still forested zone, is showing a frozen table starting at 52 cm underlain by ice-rich permafrost. Removing vegetation and stripping the ground can also lead to an accelerated degradation of ice wedges, such as occurred at Henderson's corner, a small residential area where a forest was cleared in the 90's for agricultural purposes. In a little over 20 years, the polygonal network of ice wedges (5-10 m in diameter) appeared in the once level field and are now clearly visible. The degradation of the polygons formed deep linear depressions (down to 50 cm deep) in the landscape and water has been accumulating in the thaw-settlement troughs. These examples serve to show that atmospheric changes combined with a change in land use and vegetation cover can lead to important environmental disturbances. The resulting hazards maps created through this initiative are therefore highly valuable tools used to identify potential future trajectories of change, and serve to illustrate the impact of human intervention on the evolution of permafrost and environmental stability.

CHARACTERIZING RECEIVING WATER IMPACTS ASSOCIATED WITH MUNICIPAL WASTEWATER DISCHARGES IN NUNAVUT

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In cooperation with the Government of Nunavut, Dalhousie University is conducting research to assess and optimize effluent discharge systems to minimize environmental impacts in Arctic communities, with the end goal of ensuring compliance with new federal municipal wastewater discharge criteria. As part of this project, an understanding of the existing effects of effluent discharges on marine receiving water environments is required. This specific component of the research program focuses on characterizing the mixing processes and assimilative capacity within the arctic surface water systems receiving these municipal wastewater discharges. This research was undertaken in the Kugaaruk, Pangnirtung, and Pond Inlet communities in Nunavut. These study sites possess varying discharge configurations, allowing for receiving water characteristics to be examined for a broad range of different discharge and treatment scenarios typical within Nunavut communities. Field data collection programs were completed for each study site during the July – September 2013 treatment season, and involved the measurement of wastewater quality, quantity, and transport/dispersion parameters. These field programs included the injection of a tracer dye (Rhodamine WT) at the marine effluent discharge location, with subsequent tracking of the transport and dispersion of the dye within the receiving water environments. Water quality samples were taken throughout the moving dye plume and were analyzed for various water quality parameters, including total suspended solids, total nitrogen, total phosphorus, Escherichia Coli (E.Coli), Enterococci, metals, ammonia-nitrogen, and chlorophyll-a. Additional water quality data, including temperature, dissolved oxygen, pH, and electrical conductivity, were collected in-situ through the deployment of a water quality monitoring probe. Tracer studies were completed for various tidal regimes in each of the Kugaaruk, Pangnirtung, and Pond Inlet communities. Using this data, a definition of zones of potential environmental impact within the receiving waters of each site, including observed minimum dilution zones within these environments, has been completed. In addition, the analysis and characterization of the dominant mixing processes within the receiving waters of the three study sites has been undertaken in order to form a detailed understanding of these three typical discharge scenarios. Results show that the discharge regime of Kugaaruk has the most potential for localized receiving water impacts due to the buffering of the discharges through the multi-stage discharge system in place. Meanwhile, the significant variance in discharge scenarios observed at Pangnirtung due to the large tidal range observed at that location has been shown to present unique challenges in ensuring the potential for impacts remains on a small spatial scale. Finally, the increased flow rate associated with Pond Inlet's discharge, in combination with the strong ambient currents at this location, show the potential for longer-range transport of effluent constituents at this site. The data obtained from these studies has been used in the development, calibration, and validation of a receiving water mixing model for the Pond Inlet location, which has been used to conduct environmental risk assessments of typical effluent discharge scenarios, with the goal of establishing appropriate standards for municipal wastewater treatment in similar communities.

ARROW WORM ECOLOGY IN THE CANADIAN ARCTIC

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Organisms living in seasonal environments time 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 arrow worms (chaetognaths). These gelatinous zooplankters are numerous in high-latitude seas, and may be important prey for the early life stages of some fish. Authors debate over whether arrow worms themselves are strict predators or may feed primarily on other organic matter. This poster documents aspects of the life histories of two common Arctic species: Parasagitta elegans and Eukrohnia hamata, based on a year-round study in the Canadian Arctic. A focus is given here to their vertical distributions and timing of key life cycle events (e.g. reproduction and growth). Whilst E. hamata had a wide vertical distribution (spanning several hundreds of metres depth in the Amundsen Gulf), P. elegans was typically confined to the upper 200m throughout the year. Both P. elegans and E. hamata seemed to spawn one generation in spring-summer, but E. hamata spawned again in winter, when several possible food sources for omnivores decline. This, and other findings, suggest that E. hamata is capable of fuelling reproduction with endogenous oil reserves (capital breeding). Finally, in contrast to the accepted paradigm that arrow worms are exclusive carnivores, we discuss new evidence that some may also feed on algae and/or marine snow, at least on a seasonal basis.

REMOBILIZATION OF DISSOLVED ORGANIC CARBON IN A BOREAL FOREST-PEATLAND LANDSCAPE UNDER THE INFLUENCE OF RAPIDLY DEGRADING DISCONTINUOUS PERMAFROST

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Recent studies on global climate change have suggested that Arctic and Subarctic regions are likely to be affected the strongest by the ongoing climate change. About one third of Canada's northern peatlands is located in the Arctic or Subarctic and is affected by perennially frozen ground (permafrost). Our current understanding of peatland energy, water and carbon (C) cycles implies that northern peatlands might cause a strong positive or negative net feedback to the climate system should these cycles continue to be perturbed by the projected climate change. Ecosystems such as boreal forest-peatlands that are located in the discontinuous permafrost zone (50-90% of frozen ground) are especially vulnerable to rising temperatures as permafrost is already relatively warm and thin, has high ice content, and is thus susceptible to complete disappearance causing ground surface subsidence and a decrease in forest cover as a consequence water-logging. Subarctic boreal forest-peatland ecosystems can therefore serve as an indicator for future change in the continuous permafrost zone. Several recent studies have contributed to an improved understanding of northern peatland's role in the overall climate system by quantifying their net ecosystem C balance which includes atmospheric and aqueous C fluxes generally dominated by the export of dissolved organic C (DOC). We characterize seasonal and diurnal variations in DOC concentrations and export from five catchments (0.02-0.05 km2) at Scotty Creek, a 152 km2-watershed under the influence of rapidly degrading and disappearing discontinuous permafrost near Fort Simpson, Northwest Territories, Canada. The five catchments vary in size and areal permafrost cover as each of the five catchments is characterized by different fractions of forested peat plateaus with permafrost (38-73%) and permafrost-free collapse bogs (27-62%). Independent of the catchment size, dissolved organic carbon concentrations at Scotty Creek appear to be higher in catchments with a higher percentage of permafrost affected landscapes (peat plateaus) compared to permafrost free landscapes (bogs). Average DOC concentration for catchments with a lower percentage of peat plateaus is about one third lower (~43 mg/l) than for those with a higher percentage of plateaus (~60 mg/l). These preliminary results suggest that remobilization of C from this rapidly changing landscape is at least partly controlled by the peat plateau-bog ratio. Additionally the concentrations seem to be affected by the installation of weirs for runoff measurements as they differ depending on whether the sample is taken in front of the weir or behind the weir. Annual DOC export from the five catchments is limited by the observed dry conditions at Scotty Creek over the hot summer months in addition to a thin snow cover as a consequence of a dry winter with low precipitation: only one of the catchments produces continuous measurable surface runoff. Nevertheless

indicated by additional water level recordings subsurface flow occurs throughout the season which is an additional source for DOC export from the overall system.

BELUGA SPATIAL AND TEMPORAL OCCURRENCE AND HABITAT USE WITHIN KUGMALLIT BAY, NORTHWEST TERRITORIES, CANADA

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The eastern Beaufort Sea stock of beluga whales (Delphinapterus leucas) is one of Canada's largest beluga stocks. Every summer, beluga whales from this stock aggregate in the warm waters of the Mackenzie River estuary in the Western Canadian Arctic. Belugas are an important cultural and subsistence resource for the people of the Inuvialuit Settlement Region (ISR). Due to the importance of these whales to Inuvialuit, and an ongoing interest by the hydrocarbon industry in this region, the distribution, relative abundance was assessed in the four main bays of the Mackenzie Estuary, which included Kugmallit Bay, from 1977 to 1985 and in 1992. Results revealed recurrent areas of beluga use, 'hot spots', within the Kugmallit Bay area of the Tarium Niryutiat Marine Protected Area (TNMPA, Harwood et al., 2014). More recently, the temporal habitat use of beluga whales in the Kugmallit Bay was assessed using hydroacoustics. Findings from this study demonstrated two periodicities in beluga vocalization (Simard et al., 2014). The first was diurnal and correlated with the tides, where vocalizations were most prevalent at high tide and near absent at low tide. The second periodicity occurred over 2-5 day intervals, whereby an association with a physical driver has not been determined. Thus, the objective of this study was to investigate the spatial and temporal habitat use of beluga whales in Kugmallit Bay and whether beluga 'hot spots' were characterized by unique biophysical habitats over space and time. Current use of the bay was assessed through shore-based observations at two locations coupled with opportunistic boat-based observations, in 2013 and 2014. Beluga habitat use in Kugmallit Bay was characterized by combining historical data with traditional and local ecological knowledge and shore-based observations. The physical and chemical characteristics of Kugmallit Bay were studied over the same period. The survey was designed to identify any unique areas of Kugmallit Bay that may be associated with beluga usage. A comprehensive analysis of seabed characteristics was determined using a sidescan sonar system validated with sediment grab samples. In addition, four CTDs, one wave gauge and two turbidity sensors were placed on the seabed between mid-June to mid-August to determine the temporal variability of water salinity, turbidity and temperature in the study area. Preliminary results show the presence of defined seabed features (sandy shoals, ice scours, and the occurrence of pebble/cobble beds), changes in seabed bathymetry and temporal variation in the physical ocean chemistry (temperature oscillations, and various salinity turbidity peaks) during the study period. Shore-based and boat-based observations provide insight on the location, activity and group composition of beluga whales in the bay, which can then be related to oceanographic characteristics. Meanwhile, traditional ecological knowledge and historical aerial surveys provide a broader scale of beluga habitat use of Kugmallit Bay. The relationship between physical habitat characteristics and beluga presence may help to explain how beluga whales use the bay during their summer migration that will support decision making to ensure long term conservation of belugas and their supporting habitats.

INTERPRETING CARBON FLUXES FROM A SPATIALLY HETEROGENEOUS PEATLAND WITH THAWING PERMAFROST: SCALING FROM PLANT COMMUNITY SCALE TO ECOSYSTEM SCALE

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Various microforms, created by spatial differential thawing of permafrost, make up the subarctic heterogeneous Stordalen peatland complex (68°22'N, 19°03'E), near Abisko, Sweden. This results in significantly different peatland vegetation communities across short distances, as well as differences in wetness, temperature and peat substrates. We have been measuring the spatially integrated CO2, heat and water vapour fluxes from this peatland complex using eddy covariance and the CO2 exchange from specific plant communities within the EC tower footprint since spring 2008. With this data we are examining if it is possible to derive the spatially integrated ecosystem-wide fluxes from community-level simple light use

efficiency (LUE) and ecosystem respiration (ER) models. These models have been developed using several years of continuous autochamber flux measurements for the three major plant functional types (PFTs) as well as knowledge of the spatial variability of the vegetation, water table and active layer depths. LIDAR was used to produce a 1 m resolution digital evaluation model of the complex and the spatial distribution of PFTs was obtained from concurrent high-resolution digital colour air photography trained from vegetation surveys. Continuous water table depths have been measured for four years at over 40 locations in the complex, and peat temperatures and active layer depths are surveyed every 10 days at more than 100 locations. The EC footprint is calculated for every half-hour and the PFT based models are run with the corresponding environmental variables weighted for the PFTs within the EC footprint. Our results show that the Sphagnum, palsa, and sedge PFTs have distinctly different LUE models, and that the tower fluxes are dominated by a blend of the Sphagnum and palsa PFTs. We also see a distinctly different energy partitioning between the fetches containing intact palsa and those with thawed palsa: the evaporative efficiency is higher and the Bowen ration lower for the thawed palsa fetches.

ANISOTROPIC INTERNAL THERMAL STRESS IN LANDFAST SEA ICE FROM THE CANADIAN ARCTIC ARCHIPELAGO

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The sea-ice rheology, the relation between sea-ice dynamics and its internal stresses, is important in the current sea-ice dynamics models. Results from an internal Ice Stress Buoy deployed near the centre of a multiyear floe in the Viscount Melville Sound of the Canadian Arctic Archipelago between 10 October 2010 and 17 August 2011 is presented. The position record indicates that the landfast season was nearly 5-month long from 18 January to 22 June. Thermal stresses (ranging from -85 to 77 kPa) dominate the internal stress record, with a few dynamic stress events associated with floe interactions (~50 kPa). While there are tidal and inertial oscillations present in the floe drift, a wavelet analysis of stress time series shows no significant signal at 12 hours. Intriguingly, the thermal stresses, which are isotropic before the landfast ice onset, become anisotropic during the landfast ice season. Two possible causes are discussed to explain anisotropic thermal stresses: preferred c-axis alignment of the ice crystal, and land confinement associated with the nearby coastline. The orientation of the principal stresses with respect to the geographic North Pole indicates that land confinement is responsible for the anisotropy. The stress record also clearly shows the presence of residual compressive stresses at the end of the winter (melt onset) suggesting a viscous creep relaxation time constant that is significantly longer than previously reported in the literature.

NOVEL REQUIREMENTS AND SOLUTIONS FOR DIVERSE DATA MANAGEMENT IN THE ARCTIC

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Spatial integration of datasets offers a compelling way to connect knowledge that might otherwise lack the details necessary to link it. Standard formats and linking data to location is helping. But being able to throw it all on the same map is just a starting point. Numerous challenges lurk at all points along the winding path from designing research to delivering and archiving all the outcomes. Data collection from people and sensors necessitate very different processes and systems. Ideals for community stewardship of knowledge challenge the classic data centre model of putting it all in one spot to gain value, insights, and the ability to preserve it. New interfaces (both for humans and other computers to use) must provide the right tools and views to a variety of audiences. And these systems that are more than the sum of their data present real challenges to archival and preservation. The context, relationships, and interactions developed over time need to survive too. I'll talk about what we've learned from working with Elders, youth, teachers, scientists, bureaucrats, lawyers, average folk, and even robots. I'll give some examples of where we are going in our research and the progress on Nunaliit platform development to address these issues in a practical way.

HOW DO LAKE SYSTEMS DETERMINE LATERAL FLUXES OF CARBON IN TUNDRA PERMAFROST LANDSCAPES ?

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What is the influence of lake-rich tundra landscapes on lateral fluxes of carbon? We investigated the carbon storage and lateral fluxes of carbon in two tundra permafrost landscapes in Arctic Siberia: the central Lena Rive Delta (central Siberia) and in central Yamal (Western Siberia). In the central Lena River Delta, Siberia, there exist long-term Russian-German cooperations to investigate terrestrial and aquatic tundra ecosystems. In Yamal, Russian-Austrian and Russian-German cooperation projects have started since some years. In both lake-rich tundra permafrost landscapes, we sampled for coloured dissolved organic carbon (cDOM) and dissolved organic Carbon (DOC) across several lake types (deep tundra ponds, floodplain lakes, thaw lakes on Holocene terraces and Pleistocene-aged plateaus, in alas systems, in valleys) and channel and riverine systems. Sedimental facies is common for both investigated regions for all lake and river catchments. The Lena River Delta consists of the Lena River floodplain with swampy shallow floodplain lakes and three different geomorphological terraces with differing lake types. There are active lake-cliff coastlines on the Yedoma geomorphological terrace, and some parts of the thermo-erosional valleys are active. But in summary, the hydrographic system is not as erosive as in the central Yamal permafrost landscape dominated by thermo-erosional processes. The limnic aquatic systems show the low dissolved carbon concentrations as it is common for tundra landscapes. Drainage systems develop due to thermo-erosional degradation processes of the permafrost landscape. The analyses show low carbon concentrations also from the channel export from the lake systems. Therefore, a lake-rich tundra permafrost landscape seem to mainly export organic- and nutrient-low effluents. How will lake-rich tundra permafrost landscapes determine the fate of lateral carbon fluxes in future?

SEASONAL EVOLUTION OF ACTIVE LAYER FORMATION IN PEAT PLATEAUX AND IMPLICATIONS FOR SHALLOW GROUNDWATER CARBON CHEMISTRY

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Peat-accumulating wetlands are ecosystems whose rate of photosynthetic production of organic matter is greater than that of its decomposition, resulting in a build up of soil organic matter that may take centuries to fully decompose. Carbon (C) stocks within these ecosystems are a function of inputs from photosynthesis, and losses from heterotrophic decomposition. Due to the short growing season and overall cold climate of boreal and tundra regions, C has been accumulating within these landscapes, mostly in soil organic matter, since the last glaciation. Climate change, predicted to result in rising temperatures and increased precipitation, has begun to degrade the underlying permafrost of peat plateaux. Hydrologically, permafrost below the active layer acts as an impermeable layer, similar to bedrock, limiting the movement and storage of groundwater to the seasonally thawed active layer. The presence of seasonal ice in the active layer reduces the hydraulic conductivity and available storage capacity, significantly reducing water infiltration, and potentially increasing the occurrence of surface ponding. Accumulated water in surface pools maintains soil moisture levels for longer periods of time, and are often the locations of the deepest thaw depth due to the downward transfer of latent heat. Understanding the linkages between the hydrology, the energy balance, and chemical release into surface and groundwater is essential to predicting the response of these landscapes to future climate change. To examine how Northern peatlands are responding to recent warming, two study sites (62° 27' N, 114° 31' W; 62° 33' N, 114° 00' W) outside of Yellowknife, NT, were instrumented between October 2012-October 2013 to monitor groundwater carbon chemistry, ground thermal and moisture regimes, CO2 flux and energy partitioning, and active layer development over an entire summer period. Using a space-for-time approach, degraded and non-degraded areas of the peat plateau were identified. As warming commences over time, it is thought that the degraded portion of the plateau may act as a proxy for future landscape change. Results for groundwater chemistry at the Airport site will be presented, along with DOC results from a laboratory peat monolith experiment. Additionally, the active layer evolution between June 2013-October 2013 at both sites will be examined, along with supporting images derived from a ground penetrating radar (GPR) survey conducted in April and October 2013, allowing a subsurface view of the changes seen in active layer development between maximum freeze and maximum thaw. As analyses progress, differences seen between degraded and non-degraded areas of the study site will be interpreted as proxies for the future changes we can expect climate change to have on peat plateaux.

ENVIRONMENTAL CONTROLS ON WINTER DIEL VERTICAL MIGRATION BEHAVIOUR IN THE HIGH ARCTIC USING EIGHT YEARS OF ACOUSTIC DATA

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Diel vertical migration (DVM) is the classic paradigm of midnight surfacing to feed and midday sinking to avoid predation - this simple behaviour forms the biggest migration by biomass on the planet. DVM of zooplankton is classically assumed to cease during the polar night, with populations entering a state of diapause for the 24 hour darkness. This study, however, builds on recent suggestions that DVM continues well into the darkness - and outlines the processes that define it. The illumination levels of winter do not instantaneously switch from light to dark, they go through a process of transition. Zooplankton are seen to respond to this behaviour, with observations that their vertical migratory behaviour is not homogenous throughout winter. A long term series of acoustic data from a high Arctic location has been used to determine the general, repeated, robust patterns that occur during the winter, including the 24 hours of the polar night. These patterns are modified and masked by localised environmental factors including lunar illumination, cloud cover, current advection, and sea ice conditions. These parameters have been analysed in quantitative detail, and their effect on the prevalence and snycronicity of DVM is now well understood. If we are to remove these external, ephemeral parameters, DVM behaviour is a rigid, predictable paradigm linked primarily to solar illumination, even during the winter. However, the complex patterns and changes that we see from year to year do not reflect this - and are in fact a result of the interaction of these environmental changes. Using eight years of acoustic data, along with two short term high resolution winter campaigns - the various combinations of environmental factors are now understood in terms of their effect on the scattering layers in the fjord.

OCEAN NETWORKS CANADA'S ENGAGEMENT IN ARCTIC COMMUNITY OCEAN OBSERVATION

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Ocean Networks Canada is connecting with coastal communities to adapt ocean monitoring systems to address community priorities and concerns. Considerations such as the placement of ocean monitoring equipment, integration with existing science initiatives and traditional knowledge, and relevance and ease of use of collected data for community members are of particular importance. Coastal communities, most notably those in the Arctic, are facing a wide range of rapid changes due to evolving environmental conditions and increased human activity. To enhance local environmental monitoring and to support community involvement and scholastic outreach, Ocean Networks Canada has developed a community observatory program. A community observatory is a scaled-down version of the technologies developed for NEPTUNE and VENUS, the world-leading cabled ocean observatories operating off the coast of British Columbia. A community observatory includes a subsea platform which can host a variety of instruments such as temperature sensors and an ice profiler, and an above water component to enable atmospheric and ocean surface observations. In September 2012, the first Arctic community observatory was installed in Cambridge Bay, Nunavut. Today this community observatory offers year round, continuous monitoring with its data freely available through a web portal. In September 2014, an ONC expedition team completed the 3rd annual visit to Cambridge Bay to maintain and upgrade the observatory. A critical part of this expedition was to develop our relationships and collaborations in the community of Cambridge Bay. To complement the expanding community observatory network, Ocean Networks Canada is introducing an educational program, "Ocean Sense: local observations, global connections" that will be piloted at Kiilinik High School in Cambridge Bay, Nunavut and Brentwood College School in Mill Bay, British Columbia during the 2014-2015 school year. This novel educational program is based on analyzing, understanding and sharing ocean data collected by cabled observatories. The core of the program is "local observations, global connections." First, students develop an understanding of ocean conditions at their doorstep through the analysis of community-based observatory data. Then, they connect that knowledge with the health of the global ocean by engaging with students at other schools participating in the educational program. During the pilot year, teachers and students at Kiilinik High School will be using resources and data in classrooms and providing feedback and direction to Ocean Networks Canada in refining the program. An important collaborative development is the inclusion of relevant traditional knowledge in the resources. In parallel, other initiatives are being developed with government and community organizations including the Canadian High Arctic Research Station, the Nunavut Arctic College, the Kitikmeot Inuit Association and the regional and municipal governments of Cambridge Bay. This talk will outline Ocean Networks Canada's community

engagement, present and future, with the Cambridge Bay community.

QUANTIFYING EPISODIC SNOWMELT EVENTS IN ARCTIC ECOSYSTEMS

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Rapid and extensive snowmelt occurred during two days in March 2013 at a low-Arctic study site in the ice-free part of Southwest Greenland. Meteorology, snowmelt, and snow-property observations were used to identify the meteorological conditions associated with this episodic snowmelt event (ESE) occurring prior to the spring snowmelt season. In addition, outputs from the SnowModel snowpack-evolution tool were used to quantify the ecological relevant consequences of ESEs. From the snow observations and model outputs, we estimated a 50 %-80 % meltwater loss of the pre-melt snowpack water content, a 40 %-100 % loss of snow thermal resistance, and a 3-day earlier spring snowmelt snow-free date due to this one ESE in March 2013. Guided by the knowledge gained from this ESE, we investigated the origin, past occurrences, frequency, and abundance of ESEs at spatial scales ranging from local (using 2007 through 2013 meteorological station data) to regional represented by all of Greenland (using 1979 through 2013 atmospheric reanalysis data). Over the latter spatial and temporal domain, the annual frequency and extent of ESEs showed a statistically significant increase and a large interannual variation. The maximum number of ESEs was found in Southwest Greenland. Both the local- and regional-scale analyses in Greenland suggested that ESEs are driven by foehn winds that are typical of coastal regions near the Greenland Ice Sheet margin. Therefore, ESEs are a common part of snow-cover dynamics in West Greenland and, because of their substantial impact on ecosystem processes, ESE should be accounted for in snow-related ecosystem and climate-change studies.

MODELING LANDSCAPE SUSCEPTIBILITY TO PERMAFROST DISTURBANCES REVEALS DIFFERENTIAL PATTERNS RELATED TO SUBSURFACE WATER PRESSURIZATION

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Unusually warm conditions during some recent years in the Arctic have led to changes in the thermal, hydrological, and geotechnical properties of the seasonal active layer and the uppermost permafrost. These changes have led to an increased occurrence of various types of permafrost degradation and disturbance, including slope failures such as active layer detachments (ALDs), as well as ejections of pressurized slurries referred to as mudboils. While these phenomenon are morphologically different, the processes causing their formation are both related to high pore-water pressures as a result of deep active layer thaw and/or increased late season precipitation. While the formation of these features is well understood, little is known about their spatial relationship across the landscape. Recent work completed at the Cape Bounty Arctic Watershed Observatory (CBAWO) on Melville Island, Nunavut, has found that these two features occur in distinct landscape settings. ALDs are commonly found on vegetated slopes, whereas mudboils occur on flat, less vegetated terrain. This suggests that in less vegetated areas pressures are being released in the form of mudboils, whereas fluid pressures could continue to increase on sloped vegetated areas and result in larger slope failures. Therefore, mudboils may act as indicators of potentially hazardous subsurface fluid pressures that may lead to slope failure. We further investigated this spatial relationship using predictive modeling approaches to provide insight into landscape characteristics driving the formation of both types of features by identifying areas with high, moderate, and low susceptibility to future disturbance. Permafrost disturbance susceptibility models have been successfully applied at CBAWO and elsewhere in the High Arctic to identify areas prone to future disturbance. We used a generalized additive model (GAM) that was fit to disturbed and randomized undisturbed locations for both slope disturbances and mudboils using GIS-derived terrain predictor variables including: slope, potential incoming solar radiation, wetness index, curvature, geology, vegetation, and distance to water. Results suggest that the landscape at CBAWO can be broadly partitioned into largely mutually exclusive areas susceptible to mudboils and ALDs, supporting our hypothesis that excess soil water pressure responds differently depending on landscape conditions. Given that both ALDs and mudboils are driven by similar climatic and active layer processes, knowledge of the spatial patterns between them will improve our ability to recognize and predict permafrost degradation.

COMMUNITY ENGAGEMENT PRACTICES IN NUNAVUT: HOW TO SHARE CLIMATE CHANGE INFORMATION

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Changes in permafrost stability are greatly affecting Nunavut's communities and the need for adapting to these impacts is becoming more apparent at the community level. The Hamlet of Arviat, Nunavut is experiencing challenges in maintaining current infrastructure and planning for future development as a result of its wet landscape and poor drainage. Additionally, it is a community that is experiencing population increase; therefore, there is a high demand for new housing. The Government of Nunavut, Climate Change Section recently hosted community engagement activities in Arviat to gather and share information on how permafrost is shifting and to discuss measures for adapting to these impacts. It was particularly important to engage a variety of specific audiences and this was taken into account in the development of various community activities. These activities included a broad range of sessions that engaged community members through different approaches. A summary of lessons learned are outlined highlighting challenges that were overcome and best practices for community engagement in Nunavut and other northern regions.

SPRING HABITAT USE OF BELUGA WHALES IN THE SOUTHEAST BEAUFORT SEA

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Changes in climate and sea ice in the circumpolar Arctic are concerning for beluga whales (Delphinapterus leucas), that are a sea ice associated marine mammal. The eastern Beaufort Sea beluga whale migrates from the Bering Sea to the Beaufort Sea each spring, before arriving in the Mackenzie Estuary during ice break-up. The beluga summering aggregation in the Mackenzie River Estuary is one of the world's largest, allowing local communities to participate in the culturally significant beluga harvest. In anticipation of hydrocarbon development, increased shipping, and continued changes in climate and sea ice in the western Arctic, a comprehensive understanding of beluga habitat use is critical to identify environmental variables influencing their distribution. Despite the scope and history of beluga research in this region, much of our knowledge on movement and factors driving habitat use in the late spring remains unknown. This investigation of beluga habitat use in the Beaufort Sea and Mackenzie Estuary aims to enhance our knowledge of spring arrival and distribution with three main objectives: (1) Examine beluga habitat use of: sea ice, bathymetry and freshwater flow from the Mackenzie River; (2) Identify beluga preference of ice edge versus open water environments; and (3) Assess the selection of these features as it relates to the progression of sea ice break-up along the shelf. Here we assessed data collected from aerial surveys over two consecutive seasons (June 2012 and 2013). Surveys were flown seaward of the land fast ice edge, offshore of the Mackenzie River Estuary and Tuktoyaktuk Peninsula. Preliminary analysis revealed that in 2012 beluga selected open water environments and heavy sea ice concentration more than expected, with a preference for medium ice floes. Beluga were observed in depth ranges of 0-200 meters, but showed a preference for 0-50 m depth more than expected. In 2013, beluga selected open water and medium to heavy ice concentrations again with a preference for medium ice floes. Due to heavy ice conditions in the Beaufort in June 2013, whales were often restricted to the ice edge and depths of 0-50 m. These early findings suggest that ice conditions are closely linked to late spring distribution of beluga in the Beaufort Sea and this interaction will likely change from year to year with inter-annual variability in sea ice conditions. By closely examining local, finer-scale ecosystems, like that of the southeast Beaufort Sea, we can begin to recognize habitat features important to beluga and the processes influencing their distribution globally.

INFLUENCE OF NORTHERN HEMISPHERE SEA-ICE EXTENT VARIABILITY ON ATMOSPHERIC CIRCULATION

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Evidence from both observations and model results suggests a link between changes in the Arctic sea ice conditions and atmospheric circulation in the NH mid latitudes with its possible impacts on severe winters and extreme weather events. This study investigates underlying mechanisms for this Arctic-midlatitudes climate connection based on numerical experiments using a high-top AGCM. We compare and evaluate

results from two sets of perpetual simulations (60yrs run each), one with an annual cycle of sea ice conditions from the period of 1979-1983 and the other from the 2005-2009 period while other variables and parameters including SST and GHGs are fixed. Results from the numerical experiments show that the Arctic sea ice reduction leads to cold winters in the mid-latitude land areas centered in Siberia, Europe and the North America. The winter (DJF) mean temperature at 850 hPa averaged over the mid-latitude continents decreases by about 0.4 K associated due solely to sea ice reduction. The analysis based on a wave-activity flux indicates that this cooling is due to low-level cold advection. In early winter negative geopotential height anomalies over Siberia and the North America develop as a stationary Rossby wave response to anomalous turbulent surface heat fluxes associated with the sea-ice reduction in the Barents and Kala Seas. As winter progresses further wave propagation acts to intensify positive geopotential height anomalies over the high Arctic, which eventually leads to cold advections in the lower troposphere. In addition, we identify a pathway via the stratosphere which appears to aid this intensification of positive geopotential height anomalies. Observations in general support a similar relationship. For example, on interannual timescale there is a significant positive relationship between the September NH SIE time series and surface temperatures in continental regions. Our results have significant implications that sea ice can be used as a basis for mid-range prediction and that underlying mechanisms can be in part understood within the framework of the Rossby wave propagation and wave-mean interaction theory.

A RETROSPECTIVE ANALYSIS OF SNOW-COVER IMPACTS ON PERMAFROST THERMAL REGIMES

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Snow is an important factor influencing on the Arctic system. The snow cover/depth indicates overall the decreasing rates during the past few decades associated with climate warming, although the increase in the rates is found in some regions (i.e. eastern Siberia and northern Canada). To assess the insulation effect of the snow on soil thermal states, a land surface model (CHANGE) was applied to the period 1901–2009, with eight experiments treating precipitation differently. The increases (i.e. more 30% than the original) in precipitation during the winter season enhanced soil warming resulting in the decrease (i.e. 3–4 × 106 km2) in near-surface permafrost extent and vice versa. The increased/decreased snow depth caused soil temperature to change ±1.2°C in maximum, which was mostly significant in regions covered by continuous permafrost classified by International Permafrost Associate (IPA). Regionally, the significant increase in permafrost temperature was found in eastern Siberia, while the increase in North America was relatively weak. The experiments using CHANGE model addressed that the insulation of snow depth was more remarkable in continuous permafrost region, which was also identified by observations over Russia. These results suggest that snow cover could play a more important role under conditions of future Arctic warming.

DYNAMIC HYDROLOGICAL MODELING OF PERMAFROST WATERSHEDS USING PHM MODEL

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Climate change may have a significant impact on the hydrology of cold regions due to the dynamic of the permafrost layer that comes with these changes. Consequently, the hydrology of cold climate regions would be affected by this change. Indeed, permafrost degradation leads to an increase in the thickness of the active layer where major hydrological processes occur. Furthermore, the variation of active layer thickness through seasons may either increase or decrease the water flow rate at the outlet. In fact, the active layer acts as an impermeable layer during the winter season, but becomes a water storage tank in the summer. Nevertheless, usual hydrological models do not represent in detail the hydrological processes of a watershed located in a permafrost area. For example, the hydrological model GSSHA (Gridded Surface Subsurface Hydrologic Analysis) takes into account the presence of frozen soil, and not permafrost, by calculating a parameter which depends on the air temperature and indicates whether soil is in a state of freezing or thawing in order to properly estimate the infiltration. In addition, the importance of computational time consumed by numerical models for simulating active layer freezing / thawing and the large number of parameters used, complicate the permafrost model and make it difficult to use. Thus, the challenge of permafrost hydrological modeling is to develop a compromise between the accuracy of the simulation of the permafrost hydrological behavior and the time consumed by the model, so that it can be used on usual computational devices. In order to analyze the hydrological response of a watershed located in north Canada, during the thawing season, PHM (Permafrost Hydrological Model) was developed as part of the research project. PHM is based on a linking of GSSHA to the Stefan-algorithm which is able to assess the spatiotemporal

variation of active layer thickness. The Permafrost model calculates the active layer thickness and retention on a daily time step. The retention parameter is then integrated into GSSHA so that a daily variation of this parameter has been taken into account. The analysis and comparison between the use of GSSHA and the use of PHM during a hydrological simulation of a permafrost zone emphasizes the need to integrate a permafrost module in usual hydrological models to deal properly with the hydrological behavior of permafrost in a climate change context. Moreover, the examination of A2 climatic warming scenario to determine the global warming impact on the active layer and the hydrological behavior of the case study, using PHM, leads to a better understanding of the future hydrological regime of the study area.

AN INVESTIGATION OF HUMAN PATHOGEN REMOVAL IN A SINGLE CELL WASTEWATER STABILIZATION POND IN ARCTIC CANADA

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Use of waste stabilization ponds (WSPs) has been proposed as an appropriate biological wastewater treatment solution for remote communities in Arctic Canada. However, the biological treatment processes in WSPs are strongly influenced by climatic conditions. There is limited information about the removal of human pathogens in Arctic WSPs, which experience an extreme environment and short treatment seasons. The objective of this study was to asssess the current disinfection performance of Arctic WSPs in order to guide operation and/or future updates to the WSPs to protect human and environmental health. The presence of human pathogenic microorganisms was determined in the lagoon wastewater and the final effluent being discharged once annually into the environment in Pond Inlet (latitude 72°41'57" N, longitude 77° 57' 33" W), Nunavut during each of three treatment seasons (2012 -2014). Wastewater (WW) samples were collected from WW trucks, WSPs, and final effluent/decant events. Counts of Escherichia coli/coliform (fecal indicator bacteria) was obtained using the Colilert18 (Idexx) assay. Samples were stored in a cooler during transportation to the Iqaluit laboratory and analyzed immediately to minimize changes in the microbiology of the samples. For pathogenic tests, the samples were stored in a cooler for up to 48 hours during the transfer to our laboratory at Dalhousie University in Halifax, Nova Scotia. Upon arrival, samples were processed immediately. Following selective enrichments, the quantitative polymerase chain reaction (Q-PCR) methods using TaqMan probes were used to ensure the specificity of the signal from the pathogens (Listeria monocytogenes, Campylobacter spp., Salmonella spp. and E. coli O157:H7). The limit of detection (LOD) of the Q-PCR method for a 10 ml WW sample was 1 CFU/ml for Salmonella and Campylobacter spp., 10 CFU/ml for L. monocytogenes, and 10,000 CFU/ml for E. coli O157:H7. The WSPs in Pond Inlet were anaerobic throughout the three treatment seasons. There were no indications of algae blooms and pH remained consistently at levels between 7.4 to 7.8. The results showed the presence of the four bacterial pathogens in the WSPs throughout each of the three treatment seasons. Truck samples obtained during the 2013 and 2014 treatment seasons, all showed presence of the bacterial human pathogens. Although, there was an overall 100-fold reduction in the E. coli levels, which changed from 2.6 x 10^7 CFU/100 ml in the raw sewage to 4.6 x 10^5 CFU/100 ml in the final effluent, the human bacterial pathogens were consistently present in the final effluent being discharged to the receiving environment and ocean. In conclusion, the results showed that the current operation and/or design of the WSP in Pond Inlet resulted in insufficient disinfection and removal of human bacterial pathogens from the treated effluent. Future research should quantify the levels of human pathogens being released into the environment and perform an environmental and human health risk assessment.

INVESTIGATING THE CONTROLS ON SOIL MOISTURE SPATIAL VARIABILITY FOR ASSESSING THE EFFECTIVENESS OF MICROWAVE REMOTE SENSING OF ACTIVE LAYER SOIL MOISTURE DYNAMICS OVER THE CANADIAN ARCTIC TUNDRA

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Understanding the spatial and temporal variability of soil moisture over Artic regions is important as it influences several hydrological, climatic, and biogeochemical phenomena including permafrost degradation, vegetation growth, and nutrient cycling. However, the measurement of soil moisture over the arctic tundra is challenging due to its inaccessibility. Therefore the development of techniques to measure soil moisture accurately at large scales in this environment would be valuable. To develop appropriate techniques from various remote sensing platforms requires a firm understanding of the variability of soil moisture and the physical controls on this variability within this environment. Collection of this data is required to validate satellite information for large scale soil moisture measurement. For this research, 5 plots (42 m by 42 m) were

established at Trail Valley Creek, NT, where soil moisture in the top 5 cm and 20 cm were taken every 7 m on 3 separate dates coincident to RADARSAT-2 overpasses in July and August of 2014. To evaluate the controls on soil moisture variability, additional measurements at each point included depth to frost table, shrub presence, microtopography, and soil type. Statistical, geostatistical, and regression analyses were completed for each plot on each sampling date. A strong relationship between 5 cm and 20 cm soil moisture was observed. Generally, soil moisture was found to be highly variable and usually spatially independent. Patterns of variability were controlled by depth to frost table, elevation, microtopography, presence of shrubs, and soil type; however, the controls varied with depth and depended on the topography and mean soil moisture content of the plot. Shrub patches were found to have significantly drier soils and shallower frost table, which has implications on arctic hydrology given shrub proliferation of the Arctic. Following the investigation of soil moisture controls and variability, evaluation of the sensitivity of RADARSAT-2 data to measured soil moisture will be investigated. The findings of this research present a research opportunity to adapt models used to retrieve soil moisture measurements from satellite data for use in the arctic tundra. These models are currently only developed for mineral soils which are subject to different controls. It is anticipated that these results will facilitate retrieval of soil moisture measurements in the arctic tundra over large areas from remote satellites. These measurements will be useful for understanding and modelling hydrological, climatic, and biogeochemical phenomena, including permafrost thaw patterns and vegetation shifts, which is of utmost importance given the strong influence of climate change in the Arctic.

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.

UNDERSTANDING THE MOUNTAIN FOOD SECURITY IN THE FACE OF CLIMATIC AND SOCIOECONOMIC CHANGES IN THE HINDU-KUSH HIMALAYAN REGION

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The nature and causes of food and livelihood insecurity in mountain areas are quite different to those in the plains. Rapid socioeconomic and climatic changes have added to the food insecurity in the Hindu Kush-Himalayan (HKH) region where the people are already facing challenges of topographical constraints, inaccessibility, fragility and poor infrastructure. To further investigate the nature of and challenges to mountain food security in the HKH region, primary data of 1139, 2310 and 2647 households collected respectively from three sub-basins, i.e. Upper Indus (Pakistan), Koshi (Nepal) and Eastern Brahmaputra (India), were analyzed. More than 95% of surveyed households in all three sub-basins are directly indulged in agricultural activities. They perceive that climate is changing and inducing severe impacts on the agro-ecosystems. Over the last ten years (2002-2011), they have observed erratic patterns of precipitation, rise in average temperature and changes in time and duration and of summer, winter and rainy seasons. These climatic changes are resulting in frequent floods, low agriculture productivity, droughts, increased livestock diseases and heavy landslides. Due to decreasing agriculture productivity, limited access to markets and higher vulnerability to climatic

changes, the rate of outmigration from mountain areas has increased significantly. It has further deepened the problems of agriculture through inducing consistent labor shortages during critical periods. In Upper Indus (UI) sub-basin, agriculture is relatively more diverse where almost 30% cultivable land of farm households is under fruit orchards. Farmers perceive that fruit production has shown increasing trends over the last ten years. In Koshi and Eastern Brahmaputra (EB), farmers mainly cultivate agronomic crops which are more vulnerable to climate change. Farm households perceive that production of these crops have shown decreasing trends during the last decade (2002-2011). In UI and EB, nearly 67% households are mainly dependent on purchased food items for their consumption. However, in Koshi, majority of households rely on self-produced food items for their consumption. In all three sub-basins, agriculture and livestock contribute only 10-17% to household income. It implies that there is a vast scope to improve food security in the HKH region through divarication of food production systems and income sources. The potential of mountain niche products such as fruit, nuts, and livestock has remained underutilized, and the opportunities offered by globalization, market integration, remittances, and non-farm income have not been fully tapped. This paper suggests strategies which will be helpful in designing policies and programs to enhance food security in the mountains of HKH and elsewhere.

FISHERIES CO-MANAGEMENT IN THE INUVIALUIT SETTLEMENT REGION

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Fish stocks are co-managed within the Inuvialuit Settlement Region (ISR) by the Inuvialuit, Fisheries and Oceans Canada (DFO) and the Fisheries Joint Management Committee (FJMC), a co-management board established pursuant to the Inuvialuit Final Agreement (IFA) to ensure fish and marine mammal stocks are sustainably co-managed. The IFA was signed in 1984 and has ensured that the Inuvialuit are involved in decision-making and integrated approaches to resource management. The FJMC's approach to integrated fisheries management is adaptive and constantly evolving to meet the needs of the Inuvialuit for the management of their fisheries. An important tool in this approach is the creation of working groups that involve the Inuvialuit, DFO, FJMC and other relevant working partners and focus on adaptive management measures and the development of fish management plans. Each of the six ISR communities (Aklavik, Inuvik, Paulatuk, Sachs Harbour, Tuktoyaktuk, Ulukhaktok) is currently engaged in a working group dedicated to fisheries of local concern. This has proved a successful method of meeting management objectives and has improved the cooperation and communication among stakeholders.

STRONG COMMUNITY TURNOVER IN EPIBENTHOS COMPOSITION ALONG AND ACROSS THE SHELF AND SLOPE OF THE CENTRAL AND EASTERN BEAUFORT SEA

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As part of the Pacific Arctic region, the Alaska Beaufort Sea exhibits both along and across-shelf gradients in physical and zoogeographical conditions. The influence of Pacific waters and species pools diminishes in benthic communities from the west to the east and from the shelf towards the deep sea. One objective in our study within the US-Canadian Transboundary program is to explore how these gradients are expressed in epibenthic communities. Epibenthos was sampled at a total of 57 stations along 9 shelf-to-slope transects (20, 50, 100, 200, 350, 500, 750, 1000 m) in the Beaufort Sea from 137.8-151.1 °W and 69.6-71.5 °N in October 2012 and August 2013. Additional sampling from August 2014 is not yet included in this analysis. Fauna was collected using two types of staff beam trawls (plumb-staff beam trawl and Canadian bean trawl) and over 300 putative taxa were identified. As typical for Arctic epibenthos, the community was mostly dominated by echinoderms and crustaceans in abundance and biomass, and by arthropods, mollusks, and echinoderms in species numbers. Multivariate analysis documented that there was no significant difference in the two beam trawl types but that community structure changed significantly with water depth as well as with longitude. The community turnover with depth on the slope coincided with the transition from Pacific to Atlantic-origin water masses. The longitudinal effect is likely linked to the increasing influence of the Mackenzie River discharge in the eastern study region. The results of the gear comparison will allow future larger-scale comparisons with the complementary work being done through the Canadian BREA (Beaufort Regional Environmental Assessment) program.

BUILDING HOMES: DOMESTIC VIOLENCE AND HOUSING IN NUNAVUT

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A suitable housing design which is appropriate for the specific environmental and cultural context of Nunavut has not yet been developed. The logistical complications of building in the North have led to a housing stock which is inadequate and insufficient for the growing population of Nunavut. Existing housing conditions are a factor in a growing of a number of 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 in Canada experience a rate of victimization 2.5 times greater than non-aboriginal women. Factors which contribute to this are: a young population, higher levels of unemployment, loss of culture, and economic and social inequalities. One of the major contributing factors to domestic violence in Inuit communities are insufficient and inadequate housing conditions and limited shelter space. In the North it is exponentially more difficult for victims to leave a dangerous environment because of the limited housing availability and in some cases moving into a shelter would require leaving the support network of family and friends. The research explores the complex relationship between domestic violence and housing conditions in Nunavut by comparing housing statistics and crime rates at territorial and community scales along with other factors such as income, education rates, and loss of culture. Housing conditions in Nunavut are significantly lower than the national rate and the crime rate is significantly higher, 4.25 times the national rate, this would suggest a correlation between the two. However, this trend only occurs at the territorial scale not at the scale of individual communities. The two communities with the highest crime rate, Kimmirut and Iqaluit, are the two with the best housing conditions in the territory. Although it is clear from the territorial and national statistics that there is a relationship between crime and housing, the community statistics suggests that there are more underlying issues that extend beyond housing which effect crime and need to be accounted for. 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 which are more effective at addressing the unique cultural, social, and environmental context of Nunavut.

METHANE EXCHANGE IN A POORLY-DRAINED BLACK SPRUCE FOREST OVER PERMAFROST OBSERVED WITH THE EDDY COVARIANCE TECHNIQUE

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The ecosystem-scale methane (CH4) exchange was observed in a poorly-drained black spruce forest over permafrost in Interior Alaska for three snow-free seasons with the eddy covariance technique. The CH4 exchange did not show a clear diurnal variation, suggesting that most of CH4 is produced in a deeper soil where the diurnal variation of soil temperature is not significant, and the plant-mediated transport had a limited effect. Seasonally, the average CH4 exchange (average of three years ± standard error) increased from 1.5±0.2 nmol m-2 s-1 in May/June to 3.2±0.3 nmol m-2 s-1 in the rest of observation period. The magnitude of average CH4 emission differed depending on the wind direction, reflecting the spatial variation of soil moisture condition around the observation tower. The environmental variables controlling the seasonal variation in CH4 emission also varied from dryer to wetter areas. In the dryer area, the seasonal variation in the CH4 emission was explained by the variation of soil water content only. On the other hand, in the wetter area, in addition to soil temperature and soil water content, seasonal thaw depth of active layer was an important variable to explain the seasonal and interannual variations in CH4 exchange in this ecosystem. The season total (day of year 134–280) CH4 exchange was 11.96±1.00, 19.61±2.98, and 36.64±4.36 mmol m-2 for dryer, moderately wet, and wetter area, respectively. The observed season total CH4 emission was almost one order smaller than those reported in other northern wetland ecosystems, probably due to the relatively low ground water level as well as low soil temperature. The contribution of ebullition to the season total emission was estimated as a few per cents. Thus, diffusion, rather than ebullition and plant-mediated transport, was probably the dominant transport process between the soil and the atmosphere in this ecosystem.

THE FORMATION OF BEAUFORT SHELF WINTER WATER IN THE CANADIAN BEAUFORT SEA FROM 2009-2011

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Winter water that is dense enough to flow from the shelf to the slope forms during some years in the Canadian Beaufort Sea (Melling and Lewis, 1982) but mechanisms that control the properties of winter water have not yet been established. Using CT sensor and ADCP data collected at 6 moorings on the slope during the 2009-2011 industry-ArcticNet collaboration and data from 2 shelf and 1 slope mooring collected during the 2009-2011 Beaufort ice hazards study, we examine several mechanisms responsible for the formation of Beaufort Shelf Winter Water (BSWW). We find that while BSWW formed on the shelf in the winter of 2009-2010, it was too fresh to be the source of cold intrusions observed within the halocline over the slope. During the winter of 2010-2011, BSWW with a salinity of up to 34 was observed on the shelf and this was likely the source of cold intrusions within the halocline over the slope. Strong upwelling in the fall of 2010 brought Atlantic water onto the shelf where it was eventually modified to form BSWW. As BSWW formed, we estimate that heat lost from Atlantic water on the shelf could have melted 55 cm of sea ice. Thus, the continued monitoring of BSWW could help to understand shelf-slope interactions and sea ice variability in the Canadian Beaufort Sea.

THE CHRONOLOGY OF CLASTIC SUPPLY TO THE CENTRAL BAFFIN BAY DURING THE LAST DEGLACIAL ICE SHEET MELTING

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The Baffin Bay is a key region for understanding the interaction between ocean circulation and the Greenland Ice Sheet. Oceanic conditions in the basin are affected by the extent of seasonal sea-ice and changes in the inflow of water from the Labrador Sea and North Atlantic. The input of freshwater from the Arctic Ocean and meltwater from both the Canadian Arctic Archipelago and the Greenland Ice sheet also plays an important role. All of these systems have been shown to vary on millennial and centennial timescales and their state is predicted to change in response to the ongoing Arctic warming trend. However, the complex feedbacks and phase relationships between these systems, as well as how they respond to shifts in climate in the wider region, remain unclear. During the last deglaciation, the region experienced large magnitude environmental change and we use this interval to investigate the phase relationship between regional warming, meltwater discharge and oceanic circulation. To reconstruct meltwater history and surface ocean conditions in the central Baffin Bay below the axis of the inflowing Atlantic water and the outflowing Baffin Current, we use sediment cores retrieved from the eastern and western continental slope. Planktic and benthic foraminiferal δ18O and δ13C values will be used to establish sea surface temperatures, salinity and ocean ventilation. This will be supported with information from dinoflagellate cyst assemblages, which also give information on sea-ice cover. Here we present XRF profiles for both cores, which provide a high-resolution record of terrigenous input. A novel preparation method allowing AMS 14-C dating of ultra-small samples (0.5 mg) has been used to generate a robust deglacial chronology in both cores. The results indicate enhanced melting and clastic supply into the deep Baffin Bay coinciding with the onset of the Bølling/Allerød warm period. A second pulse of detrital material into the Baffin Bay appears to have started at the end of Bølling/Allerød and lasted until the early Holocene. This pulse seems to be almost exactly out of phase with Greenland temperature, indicating a fundamentally different relationship between melting and temperature during the Younger Dryas.

SELENIUM UPTAKE IN THE BATHURST CARIBOU IN THE EKATI, NWT REGION & ITS IMPACTS.

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The Bathurst Caribou herd is currently at a depleted population size, approximatley 100,000 animmals by some reports from a number ten years ago, of over a million animals. A range on impacts may account for this including natural cycles, climate change impacts, disturbance from mining operations. The authour believes that there is a cumaltive effect from changing selenium concentrations in the area from antorpogenic sources that may add to selenium concentrations or in neighbouring regions may diminsh them (in the cases of high acidic levels).Selenium is critical to the health of caribou where concentrations that are too low or high (separated by the smallest range of any mineral). It also is known to be the key that drives anti-oxidant mechanisms (for caribou and most species). Brain function, skeletal and muscle development, de-

toxification of some heavy metals, are amongst the important health processes influenced by selenium concentrations. (ref: Markus Lenz, Piet Lens 2009).Atmospheric selenium is transported along with toxic emissions (heavy metals, organochlorides etc.) from Eurasia. It may either increase selenium concentrations in some regions through deposition, or decrease (deplete) selenium when acidic portions of atmospheric the emissions are high. 40% of atmospheric selenium emissions on a world average are said to be antropogenic. In the Bathurst region, these chemicals are deposited mainly in the Spring in sub-Arctic regions roughly parallel to the Arctic Circle. (ref: Fisher and Korernor 1985).Caribou in the Bathurst region (unlike the western regions) eat mainly lichen in the winter and large portions in the summer. Most of the caribou plant food sources in this region therefore, receive their nutrients directly from the air and not from soil. In the Ekati area this would be fine particulate from Arctic haze (the long range transport component), larger sized particulate from local windblown natural sources (such as eskers) and from ore crushing and other mining operations (also larger particulate). The Bathurst Herd passes Ekati in the Spring on the way to calving grounds, and again in the Fall when they are returning from calving. Recent observations of herds by biologists in the regions are 1) that the calving grounds in recent times are areas increasingly northward (but will be blocked from additional northerly migration by the Arctic ocean), and, 2) that Caribou appear to be avoiding dust from the mine. (ref: PLAIN LANGUAGE ANNUAL REPORT 2012-13). Research will include snow core sampling above frozen lakes to capture the Eurasian antropogenic sources, dustfall to determine local source contributions of selnium, and it will use comparative data from atmospheric monitoring, reported selenium blood concentrations in caribou, and sampling undertaken at nearby mine site.

INUIT WOMEN'S CONCEPTUALIZATIONS OF AND APPROACHES TO HEALTH IN A CHANGING CLIMATE

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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.

SEA ICE CONDITIONS DRIVE BREEDING PROPENSITY AND TIMING OF BREEDING IN ARCTIC NESTING COMMON EIDERS

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Variations in sea ice conditions near the nesting site can strongly affect breeding success of arctic seabirds. We investigated the impact of early season sea ice conditions on the reproduction of common eiders (Somateria mollissima) breeding at East Bay, Southampton Island, Nunavut, CA. East Bay is characterised by a thick annual ice cover which melts in summer. Female eiders nesting at this site partly rely on nutrients acquired locally during the pre-laying and laying period to produce their eggs. Also, individuals that time laying to match duckling hatching just prior to fully ice-free conditions obtain the highest duckling survival probability. Using Radarsat images acquired in June from 2002 to 2013, we measured the seasonal change in water concentration at river mouths at East Bay in order to track the availability of potential foraging areas for pre-breeding eiders. The timing of ice-breakup (i.e., date of 1% water concentration) varied greatly between years, ranging from June 10th to June 30th and was strongly correlated with the date of ice-free condition, which occurred in July. This indicates that such environmental cues could be used by eiders to adjust their timing of breeding. As expected, we found a strong correlation between the timing of ice-breakup in early summer and the timing of eider arrival date and laying date. Moreover, the timing of ice-breakup in early summer strongly affected female breeding propensity: much fewer individuals captured during the pre-laying period were resighted nesting in the colony when the ice-breakup was late. This strongly suggests that the timing of water accessibility in early summer is crucial for eiders reproductive decisions and success. A better understanding of the sea ducks flexibility in response to variations in sea ice conditions is important to understand the potential impacts of the rapid changes in arctic sea ice.

ISLAND CARIBOU: THE INFLUENCE OF A NATURALLY FRAGMENTED RANGE ON GENETIC CONNECTIVITY

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In Canada, the most northerly caribou herds occur on the remote islands of the Arctic Archipelago. During much of the year, sea ice provides a natural bridge between islands, potentially allowing movement of individuals and genes. However, this naturally fragmented range, spanning over 2 000 km, is ecologically heterogeneous with likely impacts on diversity below the species level. This diversity is important to management and conservation efforts, particularly with the rapid loss of biological diversity and global changes especially acute in the Arctic. Many island caribou are already of conservation concern. Peary caribou are endangered and some island populations likely extirpated. In addition, barrenground caribou on southern Baffin Island have potentially declined by 95% in just a few decades and the unique Dolphin and Union caribou are listed as Special Concern. The impacts of climate change and increased human activity including industrial exploration, development, and shipping place these ungulates at further risk. These concerns highlight the need to fully understand the spatial structure of arctic island caribou and potential barriers to movement and gene flow. Here we explore caribou diversity and structure and the influence of spatial heterogeneity by integrating landscape ecology and genetic characterization. Using a multi-scaled approach and 16 microsatellite loci, we quantified the genetic variation within and among groups across an immense spatial gradient and linked genetic diversity to the spatial structure of the Archipelago. Our results indicate differences in genetic diversity with spatial and genetic disjunction among some islands and between island and mainland herds. Given climate warming scenarios and caribou declines, such results provide a first step in understanding meaningful units for conservation and the implications of anthropogenic change on this unique, island-dwelling ungulate.

THE TREND OF CHANGES IN ARCTIC MARINE PRIMARY PRODUCTION IN RESPONSE TO DECLINING SEA ICE COVER

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The arctic ecosystem is experiencing dramatic changes in response to enhanced global warming. Declining sea ice cover and increasing light availability to the ocean are the major factors that can change the ocean and sea ice primary production in many ways and the behavior and production of higher trophic levels as well. A global coupled ice-ocean ecosystem model was developed in CESM's ocean and sea ice modules: POP and CICE. This coupled climate model runs with NCEP reanalysis data CORE II (1948-2009). The climatology and trend of changes during the modeling period were analyzed for following variables: the primary production (PP), the peak value of spring bloom and the timing of the bloom for both ice algae and phytoplankton. The climatology of each variable was compared with the ranges of limited observations. A trend of declining of PP in the subarctic (Bering Sea) but increasing of PP in the coastal Arctic Seas (e.g. Chukchi Sea) was found from the analysis, which agrees with the observed trend of northward movement of ecosystem in the Pacific Arctic Ocean.

ADDRESSING HISTORICAL LEGACIES IN THE CONTEXT OF MINING AND INDIGENOUS HEALTH: WHY IT MATTERS FOR INDIGENOUS WELL-BEING

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Environmental Assessment and related permitting processes have long struggled to identify and mitigate community and human health impacts associated with resource development, especially in northern, largely Indigenous, jurisdictions. This governance deficit has been addressed somewhat with routine use of mechanisms like Health Impact Assessments (HIA), and Impact and Benefit Agreements (IBAs) between Indigenous groups and mine developers. Coincident with this shift in practice has been a growth in research that recognizes diverse concepts and complex drivers of Indigenous well-being; it is increasingly common for researchers to speak of the 'good life' and to recognize health disparities that are based in experiences with poverty, stress, trauma, cultural erosion and environmental dispossession. Unfortunately, little of this research has come to influence contemporary assessment mechanisms. Missing is a recognition that resource development is complicated by legacies of colonialism and assimilation policies, which impact current Indigenous well-being. This poster highlights examples from recent research that demonstrates this omission and introduces new research that seeks to conceptualize pathways between historical legacies of colonialism and Indigenous concepts of well-being in the context of assessing resource development.

FOOD INSECURITY IN INUIT COMMUNITIES: SUPPORTING DECISION MAKING THROUGH BAYESIAN MODELING

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Today, evidence based policy making is common practice. Meanwhile, enlightened decision making processes still require access to the most appropriate knowledge. One of the most important and cited Canadian public health issues today is the level of food insecurity in Inuit communities. For obvious logistical (physical and financial constraints on sampling effort) and statistical reasons (large coefficient of variation), levels of household food insecurity indicators are often reported at a regional level only and based upon a limited number of samples. The rate reported for the region of Nunavik is no exception. The 2004 Qanuippitaa? How Are We? public health survey conducted in the 14 communities in that region gathered data from a total sample size of 2089 households, and reported an overall household food insecurity rate of 24% (i.e. observed proportion of total number of Nunavik households sampled reporting having lacked food at least once during the month preceding the survey). Because reported rates of food insecurity were not common at the time in Inuit regions, such a study provided an invaluable comparison point with other Canadian regions and supported public heath recommendations and initiatives. Nonetheless, one recurrent critique of the dataset is that this food insecurity knowledge does not account for potential community variability and socio-cultural and economic differences between communities. As a result, the dataset is not looked at as having value in considering action and responses at the community scale. In order to respond to this major limitation we have re-investigated the 2004 Qanuippitaa? How Are We? household public health data at a community level in order to provide appropriate knowledge to support public health policy making. We adopted a Bayesian statistical framework which permitted us to easily compute and present community specific household food insecurity probabilities along with the associated level of uncertainty. The uncertainty was represented by upper and lower boundaries providing the

range of 95% of the distribution of possible values for a given community while considering the random sampling process used in the survey. This preliminary descriptive statistical result identified the potential of the Qanuippitaa? How Are We? dataset to investigate the socio-cultural and economic determinants of household food insecurity at both regional and community levels. We are currently conducting Bayesian statistical analyses using a hierarchical generalized linear modeling approach (fixed and random effects to match the corresponding sampling design) coupled with a model selection approach (based upon information theory). The preliminary analyses discussed above help fill a knowledge gap to support policy making as they illustrate the variability and capacity to discriminate between food insecurity at the community level within a regional database. This information can be used to support and prioritize actions to be taken in terms of interventions and more comprehensive studies on the topic in the future.

CHANGES IN BACTERIAL COMMUNITY AND SOIL ORGANIC CARBON WITH INCREASING TEMPERATURE AND PRECIPITATION IN THE HIGH ARCTIC

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Climate models predict considerable changes in temperature and precipitation in the Northern Hemisphere. This change occurring in the Arctic might influence the microbial community and soil organic carbon (SOC) dynamics. Here, we aimed to investigate the effects of warming and increasing precipitation on microbial community structure and SOC in high Arctic. We established open top chambers (OTC) to increase temperatue and the amount of weekly added water to increase precipitation in Cambrige Bay, Canada in 2012. The experimental deign consisted of a completely randomized block with five replicates, and a 2 x 2 factorial arrangement of treatments; NWNP (non-warming and non-precipitation), NWP (no-warming and precipitation), WNP (warming and non-precipitation), and WP (warming and precipitation). Furthermore, we set up two types of plots for monitoring and destructive sampling. In the monitoring plots, we continuously surveyed plant species, vegetation coverage and measured the production rates of carbon dioxide, methane, and nitrous oxide. In the destructive sampling plots, we collected soil samples to measure the changes in the microbial community and SOC. In early July 2012, two depths of soil (0-5 and 5-10 cm) were sampled as baseline data before the initiation of climate manipulation. In August 2013, soil samples were collected to observe the changes in bacterial community structure and SOC after one year of treatment. The analyses for bacterial community and SOC concentrations in 2012 and 2013 are currently taking place.

DISTRIBUTION AND RANGE EXPANSION OF MUSKOX LUNGWORMS IN THE CANADIAN ARCTIC: IS CLIMATE WARMING A POTENTIAL DRIVER?

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Muskoxen (Ovibos moschatus) are keystone arctic species with social, economic and ecological value. Two pathogenic lungworms of muskoxen, Umingmakstrongylus pallikuukensis and Varestrongylus sp. nov. are endemic to the Canadian Arctic. These two protostrongylid nematodes, previously limited to Canadian mainland, appear to have invaded and substantially expanded their range on Victoria Island in the Arctic Archipelago during a relatively short time frame. The purpose of this study was to determine the current distribution and abundance of these lungworms and to understand if ongoing climate warming is driving the rapid range expansion in the Canadian Arctic. To do this, published and unpublished historical data on lungworm distribution was summarized, and targeted and opportunistic collections of fecal and lung samples from different areas of the Canadian Arctic (mainland, Victoria and Banks Islands) were done in spring 2013 and 2014. Fecal samples were analyzed for the presence of first stage larvae using the Baermann technique and lungs were dissected and examined for parasite cysts. Historical, current, and future distribution of lungworms was mapped using established empirically based degree–day models for development of U. pallikuukensis in gastropod intermediate hosts and satellite-based temperature data obtained from NCEP North American Regional Reanalysis database for a period of 1979 to 2013. We found that the U. pallikuukensis has substantially expanded its geographic range to the north and east since its discovery in 1988 on the western mainland of Nunavut. Prevalence and intensity of infection follows a southwest-northeast gradient. These observations

are consistent with predictions based on our degree-day maps. These predictions suggest that, given the presence of suitable intermediate hosts, under current and future conditions the distribution of U. pallikuukensis can continue to expand to new areas, invading new islands and new muskox populations. The abundance of Varestrongylus sp. nov. on south-east Victoria Island increased from 2009 to 2013, but historical data are insufficient to comment on its range expansion. We conclude that the ongoing climate change is facilitating range expansions by making higher latitudes more suitable for parasite development. This imposes the risk of lungworms colonizing the muskox population free of these lungworms in near future. Findings from this study benefit our ecological understanding of arctic parasitology and provide insights for wildlife management.

MONITORING THE SEASONAL SOIL FREEZING IN A CANADIAN SUB-ARCTIC REGION USING PASSIVE MICROWAVE DATA IN L-BAND (SMOS)

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Seasonal soil Freezing/Thaw (F/T) cycles play an important role in Boreal and Arctic regions, where structure, condition, and distribution of vegetation are strongly regulated by environmental factors such as soil moisture and nutrient availability, permafrost, growing season length, and disturbance. In these seasonally frozen environments, the growing season is determined primarily by the non-frozen period. The frozen soil mapping can be improved by using SMAP instrument that will be launched in early 2015, which includes both Radiometer and Synthetic Aperture Radar operating at the L-band. The radiometric accuracy, the spatial resolution (40 km passive and 3 km active), and the global coverage of SMAP will make possible a systematic updating of frozen ground maps and monitoring the seasonal F/T cycle at a regional scale. The main objective of this study is to develop and validate algorithms to monitor F/T over the Tundra and the Boreal Forest using available time series of passive L-band microwave. To reach the objective in the absence of SMAP, data from the SMOS (Soil Moisture and Ocean Salinity) mission launched in November 2nd 2009 was used. SMOS time series data was analyzed to examine seasonal variations of soil freezing and to assess the impact of snow and land cover on the freeze-thaw cycle. To classify daily F/T state dynamics (frozen or thawed) from SMOS brightness temperature (Tb), the Seasonal Threshold Approach (STA), applied by Kim et al. (2011) using Tb derived from Special Sensor Microwave Imager (SSM/I), was adapted for the study area which contains numerous lakes and rivers. Since the water presence causes a decrease in Tb, a weighting factor of the water percentage in a given SMOS pixel, determined from land cover maps, was introduced in the algorithm to obtain more realistic estimations. Soil freezing maps derived from SMOS observations were compared to microwave active images and field survey data in the region near Umiujaq. Field data shows that freezing and thawing dates vary spatially at the local scale. After introducing a weighting factor, no tendency in the daily F/T state dynamics was found. Also, results were not improved if we isolated the ascending and the descending passes. This could be related to adapting an algorithm using higher frequencies data to L-Band (lower frequency). Investigating the causes and improving the algorithm are still in.

EFFECTS OF SHRUBS ON MICROENVIRONMENTAL CONDITIONS NEAR SPRUCE SEEDLINGS AT TREELINE

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The alpine boreal-tundra ecotone, an area commonly referred to as 'treeline', has seen significant vegetative changes in the last few decades as a result of climate change. One unexplored aspect of these changes is the interaction between shrubs and trees. Shrubs can have both facilitative and competitive interactions with tree seedlings, which could significantly influence treeline movement. However the net-effect of these interactions is unknown, largely because of the scarcity of studies in the literature. To properly understand the effects of shrubs on tree seedlings, it is important to understand the underlying mechanisms by which shrubs can influence seedlings; that is, how do shrubs influence microsite conditions? For this poster we present a subset of results from a larger study being conducted in the mountainous Kluane region of southwest Yukon. In 2013, 80 Picea glauca (white spruce) seedlings were located in densely shrubed plots in the forest-tundra ecotone. Shrubs were removed from a 10m2 area surrounding half of the seedlings, such that the seedlings were divided into shrub-removed and shrub-intact plots. A variety of instruments were used to test for microsite differences between shrub removed and intact plots. iButton temperature sensors were placed in the soil downslope of the tree seedlings. In addition, 5 iButtons were fastened to a stake at various intervals for use in inferring snow depth. Plant Root Simulator (PRS) probes were installed into the soil. Time domain reflectrometry

(TDR) was used to measure soil moisture, and a pair of Smart-Wind sensors was used to measure wind differences between the shrub removed and intact plots. Preliminary results show that shrub removed plots had higher soil temperature range, increased soil nitrogen, and increased average wind speed and wind gusts. These results suggest that shrubs do influence microsite conditions, which may ultimately affect seedling growth and establishment, influencing treeline dynamics in alpine sites.

DYNAMICAL-CLIMATE MODELLING OF THE UPPER TROPOSPHERE AND LOWER STRATOSPHERE REGION OVER THE ARCTIC: GEM-AC SIMULATIONS FOR CURRENT CLIMATE WITH AND WITHOUT AVIATION EMISSIONS

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Upper troposphere and lower stratosphere (UTLS) region is a thin layer around the Tropopause. Perturbation of the chemical composition in the UTLS region can impact physical and dynamical processes which can lead to changes in cloudiness, precipitation, radiative forcing, stratosphere-troposphere exchange and zonal flow. The objective of this study is to investigate the potential impacts of aviation emissions on the upper troposphere and lower stratosphere (UTLS) in the Arctic. In order to assess the impact of the aviation emissions we focus on changes in chemical composition as well as on transport processes in the UTLS over the Arctic. Specifically, we will assess perturbations in ozone, halogens, reactive nitrogen species, and wind in the UTLS. Our study will based on high resolution dynamic-climate model simulations for two scenarios - with and without aircraft emissions. The tool that will be used in our study is the GEM-AC (Global Environmental Multiscale with Atmospheric Chemistry) chemical weather model where air quality, free tropospheric and stratospheric chemistry processes are on-line and interactive in a weather forecast model of Environment Canada. In vertical, the model domain is defined on 70 hybrid levels from the surface to ~60km. The gas-phase chemistry includes a comprehensive set of reactions for Ox, NOx, HOx, CO, CH4, NMVOCs, halocarbons, ClOx and BrO. Also, the model can address aerosol microphysics and gas–aerosol partitioning. Aaircraft emissions are provided by the AEDT 2006 database developed by the Federal Aviation Administration (USA). Results from model simulations on a global variable grid with 1 degree uniform resolution over the Arctic region will be presented.

TOWARDS SEDIMENT AND ORGANIC CARBON BUDGETS FOR LAKE MELVILLE, A SUBARCTIC FJORD-LIKE ESTUARY IN CENTRAL LABRADOR, CANADA

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Coastal environments, such as estuaries and fjords, are important regions for the transfer of sediment and nutrients between land and the open ocean. In estuaries, the combination of terrestrial organic matter and nutrients from rivers and the adjacent marine shelf generally create highly productive ecosystems. Hydroelectric damming and reservoir development of rivers upstream are known to have major implication for the flux of sediment, organic carbon, and nutrients, in addition to freshwater, reaching these coastal environments. Since the 1970's the Upper Churchill River in central Labrador has been controlled by the Churchill Falls power generating station while the head waters have been modified through a series of dykes put in place to redirect small rivers and hundreds of kilometers of bog and muskeg to create the Smallwood Reservoir. Following the Upper Churchill River development, local fisherman expressed concern over changes in the oceanography and fisheries in Lake Melville, a fjord type estuary that receives approximately 2000-3000 m3 yr-1of freshwater from the Churchill River before draining into the Labrador Sea. The downstream effects of the Upper Churchill development are still not well understood today yet a second hydroelectric project is underway on the Lower Churchill River, where construction is expected to begin holding back water as early as spring 2015. In the context of hydroelectric development and climate change, our research is investigating the rates of sedimentation and composition of organic matter through Lake Melville spatially and over time. Sediment core and water sampling throughout Lake Melville and the whole of Hamilton Inlet was conducted in June 2013 on board RV Nuliajuk and in October 2014 on board a local Inuit-owned fishing vessel What's Happening. Sediment cores collected in 2013 were interpreted using natural and anthropogenic derived tracers 210Pb and 137Cs and appropriate models, resulting in the first high resolution, modern sedimentation rate estimates for Lake Melville. Organic carbon (OC) content and stable carbon isotope (μ13C) values were measured downcore and will be used in combination with the sedimentation rates to quantify the accumulation of terrestrial and marine OC in the system. Sediment cores collected in 2014 will complement data obtained from cores collected in 2013. These data together with previously published

data will be used to develop preliminary contemporary sediment and organic carbon budgets of Lake Melville that may be used to quantify the major sources (i.e., river inputs, primary production, and import from the open ocean) and sinks (burial, outflow) to the system. These budgets will contribute to the overall understanding of the functioning of Lake Melville and adjacent water bodies while at the same time will provide insight into the components of the system that may be most sensitive to hydrological or climatic change in the future. This research is one component of the Avativut, Kanuittailinnivut (Our Environment, Our Health) community based research and monitoring program initiated by the Nunatsiavut Government to study the effects of modernization and climate change on Inuit health and well-being in Labrador.

DEGRADATION AND RECOVERY OF ICE WEDGES IN RELATION TO ROAD INFRASTRUCTURE IN THE PRUDHOE BAY OILFIELD, AK

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Widespread degradation of ice wedges has been observed in the Arctic Coastal Plain of Alaska during the last decades. It strongly affects environment and infrastructure of the Prudhoe Bay Oilfield (PBO). The upper permafrost of PBO contains significant amounts of excess ground ice, including segregated ice and large epigenetic ice wedges (width up to 4 m; vertical extent up to 3.5 m). High ice content makes the study area extremely vulnerable to thermokarst and thermal erosion. In most cases, these processes are triggered by climatic changes or human activities. Road infrastructure in PBO affects the ice-wedge degradation by an increase in the active-layer thickness (ALT) triggered by flooding of large areas due to construction of road embankments; accumulation of dust, which kills vegetation and changes thermal properties of soil; and additional snow accumulation near the embankment. Our studies show that degradation of ice wedges is a cyclic process, which includes five main stages: Undegraded wedges – Degradation-initial – Degradation-advanced – Stabilization-initial – Stabilization-advanced. The processes of ice-wedge degradation and recovery are determined by interactions between the active layer and the underlying transition zone of the upper permafrost, which includes transient layer (TL) and intermediate layer (IL). Accumulation of organic matter in the troughs developing on top of degrading wedges eventually leads to decrease in ALT and formation of the ice-rich IL, protecting ice wedges from further degradation. During 2-14 August 2014, 57 boreholes were drilled in ice-wedge polygon centers and troughs at 5, 10, 25, 100, and 200 m from the Spine Road in the Lake Colleen area along two transects established at the different sides of the road; 35 encountered ice wedges at various stages of degradation and recovery. At the time of drilling, a protective layer of frozen soil 1 to 27-cm thick (which includes frozen part of the active layer and in many cases TL and IL) was observed above the majority of ice wedges. The ice-rich IL up to 19-cm thick, which indicates relative stability of ice wedges, was encountered in 13 boreholes. Two ice wedges experienced thawing at the time of drilling, but calculations indicate that by the end of the thawing season several more wedges will be affected by thermokarst, and during exceptionally warm summers (the summer of 2014 was very cold) up to two thirds of wedges may experience thawing. Thaw subsidence above degrading ice wedges during such summers can reach 8 cm/year. Despite a strong influence of the road construction and heavy traffic on the upper permafrost stability, ice-wedge degradation is a reversible process. Its activation in most cases was triggered by increase in the ALT during exceptionally warm and wet summers. Initial degradation of ice wedges along Transect 2 was probably related to the flooding of the southwest side of the Spine Road triggered by the road construction, but at present time the wedges along this transect (even the wedges under the deep troughs filled with water) are more stable than the wedges along Transect 1, which have not been affected by flooding.

TOXIC LEGACIES: COMMUNITY PERSPECTIVES ON ARSENIC POLLUTION AT YELLOWKNIFE'S GIANT MINE

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This poster introduces a community-based research project exploring local perspectives on arsenic pollution and environmental remediation at Yellowknife's Giant Mine, NWT, Canada. For over six decades, environmental contamination has been a pressing environmental issue near Yellowknife as a result of the production of highly toxic arsenic trioxide, the byproduct of the roasting process that separated gold from ore.

In the 1950s and 1960s, pollution spread widely from Giant's roaster stack, causing severe health effects in Yellowknives Dene First Nation (YKDFN) communities due to the contamination of local food and water. The issue remains a concern today, as 237,000 tons of arsenic trioxide that was captured by pollution control equipment remains stored in chambers under the ground at the now-closed mine. The Canadian and NWT governments proposed to freeze this toxic liability in perpetuity, a solution that produced intense local controversy during an environmental assessment process in 2012. With the approval of the Giant Mine Remediation Project in 2014, community concern has shifted to focus on questions surrounding historical commemoration and long-term care of this toxic landscape. The poster features an ongoing, collaborative research project related to community responses and perspectives on arsenic pollution and its remediation, including: arsenic, toxicity, and environmental justice; reconstructing and mapping environmental change; communicating with future generations; and a documentary film, "Guardians of Eternity." These subprojects involve local community research participants and assistants, as well as students and the co-investigators. The results will not only document perspectives on the history of pollution at Giant Mine, but present lessons for the remediation of the environmental legacies of industrial development around the circumpolar North.

SEXUAL SEGREGATION IN TWO CLOSELY RELATED SPECIES: BELUGA WHALES (DELPHINAPTERUS LEUCAS) AND NARWHAL (MONODON MONOCEROS)

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Beluga whales and narwhals are important to the ecology of Arctic ecosystems, and the economy of Inuit. Despite being similarly-sized sister taxa ,they may exhibit different degrees of sexual segregation. Sexual segregation is the separation in social interactions, habitat use, or spatial use between sexes within a population. This may be a result of different energy requirements driven by sexual size dimorphism. Here stable isotopes and fatty acid analyses are used to determine if belugas harvested in Hudson Bay and narwhals harvested near Pond Inlet show different patterns of sexual segregation outside the mating season. Beluga samples were collected from Inuit subsistence hunts in Arviat and Sanikiluaq between 2003 and 2007. Narwhal samples were collected from subsistence hunts in Pond Inlet between 2004 and 2006. Muscle and liver samples were analysed for δ13C and δ15N stable isotopes, and blubber samples were analysed for fatty acids. Tests were used to compare dietary biomarkers between males, females, and immature whales from each harvest site. Tissues samples from belugas hunted in Sanikiluaq were sampled during the mating season and did not show sexual segregation in fatty acids or carbon isotopes, indicating that whales are feeding in the same location on similar prey species. Nitrogen isotope enrichment varied between sexes; this may be a result of larger males consuming larger prey items. Belugas from Arviat were harvested outside of the mating season and also showed no sexual segregation in diet. In contrast, significant differences in fatty acids between males and females and males and immature narwhal of both sexes harvested in Pond Inlet indicate that males, females and immature whales are consuming different prey items. There were also significant differences between male and female and immature narwhal in carbon isotope enrichment, indicating that they are feeding in different locations. Males may be feeding more benthically, while females and immature whales may be feeding more pelagically near sea-ice.

DYNAMICS OF VEGETATION ON LANDSLIDES OF DIFFERENT AGE IN CENTRAL YAMAL, WEST SIBERIAN ARCTIC, RUSSIA

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Active layer detachment slides are playing important role role in the formation of the local landscapes in Central Yamal. Different succession stages in recovery of cryogenic landslides are described. Four age categories of landslides were studied: 1) young landslides formed in 1989 with pioneer vegetation; 2) landslide formed (according to available air-photos) in the middle of 1970-es; 3) landslide formed (according to air-photos) in 1960-es; 4) ancient landslide cirque dated with radiocarbon method as ca 1000 year old. Study area is located within the bioclimatic subzone D, according to Circumpolar Arctic Vegetation Map 2003, which practically coincides with distinguished by Yurtsev (1994) northern hypoarctic tundra subzone. Plant communities on the shear surface, on displaced blocks with preserved but degrading initial tundra vegetation and on undisturbed surroundings were described. In 199, the first botanical survey was done and it was repeated in 2012. Both total projective cover of vegetation and cover of individual species/life forms as well as species composition

changed gradually on young and old landslides, though vegetation on the ancient ones is more stable. The total number of vascular plant species and green mosses slightly increased on all stages of recovery compare to the background. Several grass species are dominant on shear surface forming patches with different dominant (Deschampsia borealis, Puccinellia sibirica, Calamagrostis holmii and Poa alpigena ssp. colpodea, an in run-off troughs - Dupontia fisheri and Eriophorum scheuchzeri). Carex glareosa indicating saline deposits was recorded on all landslides. Mosses are playing important role both in recovery and in formation of organic horizon on the young landslides. Natural cryogenic disturbances determine structure and dynamics of vegetation on the marine terraces slopes in Central Yamal. Communities are closely correlated with the age of landslides and their morphological elements. An important reason underpinning these successional dynamics is the decrease of salt content in ground water, which changes from very high in the first years after detachment to slightly higher than background values on the more ancient surfaces. The recovery of bare shear surfaces takes dozens of years, during the first 10-15 years pioneer groupings dominated by grasses establish and they continue to develop for approximately the next 35-40 years, and afterwards are replaced by sedge-willow communities with relatively low (<50cm high) Salix glauca and developed cover of mosses typical for tundra shrub communities. The first willow seedlings appear already after 5 years but after 10-15 years they became abundant. In Central Yamal, the alliance Equiseto-Salicion glaucae indicates the presence of a landslide process, whereas its associations and sub-association indicate age, degree of mineralization of ground waters and morphological element of the landslide. Over the longer time frames, active layer detachment slides led to the formation of more productive derivative communities. In the severe climatic conditions of the Arctic, certain increases in mineral nutrition availability for plants due to exposure and thawing of ancient marine salts can be considered as a compensating ecological factor, allowing growth of higher willows normally not found in this subzone.

MOORING-BASED LONG-TERM OBSERVATION OF OCEANOGRAPHIC CONDITION IN THE CHUKCHI SEA AND CANADA BASIN OF THE ARCTIC OCEAN

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Changes of the Arctic Ocean environment are well known as one of the most remarkable evidences of global warming, attracting social and public attentions as well as scientists'. However, to illustrate on-going changes and predict future condition of the Arctic marine environment, we still do not have enough knowledge of Arctic sea ice and marine environment. In particular, lack of observation data in winter, e.g., under sea ice, still remains a key issue for precise understanding of seasonal cycle on oceanographic condition in the Arctic Ocean. Mooring-based observation is one of the most useful methods to collect year-long data in the Arctic Ocean. We have been conducting long-term monitoring using mooring system in the Pacific sector of the Arctic Ocean. Volume, heat, and freshwater fluxes through Barrow Canyon where is a major conduit of Pacific-origin water-masses into the Canada Basin have been observed since 2000. We show from an analysis of the mooring results that volume flux through Barrow Canyon was about 60 % of Bering Strait volume flux. Averaged heat flux ranges from 0.9 to 3.07 TW, which could melt 88,000 to 300,000 km^2 of 1m thick ice in the Canada Basin, which likely contributed to sea ice retreat in the Pacific sector of the Arctic Ocean. In winter, we found inter-annual variability in salinity related to coastal polynya activity in the Chukchi Sea. In collaboration with Distributed Biological Observatory (DBO) project, which is one of the tasks of Sustaining Arctic Observing Network (SAON), we also initiated year-long mooring observation in the Hope Valley of the southern Chukchi Sea since 2012. Interestingly, winter oceanographic conditions in the Hope Valley are greatly different between in 2012-2013 and in 2013-2014. We speculate that differences of sea ice freeze-up and coastal polynya activity in the southern Chukchi Sea cause significant difference of winter oceanographic condition. It suggests that recent sea ice reduction in the Pacific sector of the Arctic Ocean presumably influences marine environment not only in summer but also in winter.

RADIOGENIC ISOTOPE SIGNALS OF LATE PLEISTOCENE TO HOLOCENE MELTWATER EVENTS FROM SEDIMENT CORES OF THE BAFFIN BAY

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Large meltwater discharge is the principal carrier of detritus from the continent into the ocean and the dispersion of this detritus by ocean currents is a measure for the spatially focused addition of freshwater in the ocean. To trace Greenland ice sheet dynamics and freshwater routing during late Pleistocene to Holocene climate transition, we generate neodymium (Nd) and strontium (Sr) isotope records, used as proxies for continental detritus, seawater sources and changing weathering, on sediment cores from the Baffin Bay. Baffin Bay is situated between Greenland and Canadian islands and

connected to the North Atlantic through Davis Strait and the Labrador Sea and to the Arctic Ocean through Nares Strait. So far, two sediment cores from Baffin Bay, covering the last 20.000 years have been studied: GeoTU SL 174, 100 km east of the Coast of Baffin Island (Canada) and GeoTU SL 170, 250 km to the west of the Disko Bugt (west coast of Greenland). Sr and Nd analyses were performed for the first core on the water soluble fraction (only for Sr), the carbonates, Fe-Mn oxides formed on the surface of detrital grains the sediment, and the remaining detrital fraction. Detritus will receive our special attention since it mainly reflects the weathering regime of the nearby continental masses and should provide information about ice sheet shrinking and meltwater release to the ocean. The Sr isotope composition of the water soluble fraction is close to present day seawater (~0.70917) and shows a shift to more radiogenic values (0.70927 to 0.70944) with depth (i.e. age). Carbonates, which are supposed to reflect the Sr isotope composition of the seawater, range from 0.70958 to 0.7112. Fe-Mn oxides, representing bottom waters, even show a more pronounced variability (0.70995 - 0.71315) while the detrital fraction produces the biggest spread and the most radiogenic data (0.71963 - 0.73331). Nd isotope composition of Fe-Mn oxides shows variable εNd values from -25.1 to -35.0; the detrital fraction is slightly less radiogenic (-27.3 - 32.2). Ongoing research aims to decipher the potential influence of the different sources from the continent and the seawater and to evaluate the effect of the leaching procedure, which is obvious in the shift of the Sr isotope composition away from seawater values in authigenic Fe-Mn oxides and the carbonate fraction.

HOLOCENE CLIMATE VARIABILITY IN THE NORTH ATLANTIC: MODE TRANSITIONS AND DECADAL OSCILLATIONS IN A COMPREHENSIVE CLIMATE MODEL

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Variability of the North Atlantic climate during the Holocene and its potential link to the strength of the Atlantic meridional overturning circulation (AMOC) is studied in an experiment with the Community Climate System Model version 3 (CCSM3). The model has been forced with Holocene orbital forcing over 8760 years. Initially, the model is in a state characterized by a strong AMOC (13±1 Sv). After 7514±5 years the model switches within 117±8 years to a "weak" state with AMOC strength of 9±1.5 Sv. Over the North Atlantic region (50°-70° N), the state transition results in a cooling of 2.9°C at the sea surface (based on annual means) and an expansion of sea ice by 3.6*10^12 km^2 in the North Atlantic during March. Similar to an existing study with the same model, the weak state is dominated by AMOC oscillations (amplitude: 4.3 Sv) at a period of approximately 12 years. To understand the origin and behavior of these decadal oscillations we analyzed the temporal-spatial correlations of several variables (e.g. salinity, temperature and mixed-layer depth). In accordance with earlier results salinity, temperature and density in the upper 100 m in the Labrador Sea have their maximum approximately 4 years before the AMOC change. The correlation maps show a large positive density anomaly in the northern North Atlantic at lag of about -4 years which is reflected in a lowering of sea surface height and an increasing mixed-layer depth. The density anomaly becomes negative with a peak at lag +2 years and than positive again at lag +6 years. Further analyses will be presented on the mechanisms underlying the transition from the strong to the weak state.

USING POLAR BEAR WHISKER PRINT SOFTWARE TO NON-INVASIVELY COLLECT CENSUS AND BODY CONDITION DATA ON THE WESTERN HUDSON BAY POLAR BEAR POPULATION

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Polar bears (Ursus maritimus) may be particularly vulnerable to climate change because of their reliance on sea ice, and some studies have suggested polar bear populations in the Western Hudson Bay region are declining and that the bears are coming off the sea ice in poor body condition. Researchers have been assessing population sizes of U. maritimus for decades using a variety of techniques that have included everything from capturing individuals to helicopter surveys. Photo-identification of individual bears is a non-invasive means of collecting mark-and-recapture data on polar bear populations where bears are easily photographed. WhiskerPrint software is a facial recognition program that identifies polar bears using the patterns of whisker spots on each side of the snout as identifiers. This technique is based on the hypothesis that each polar bear has a unique whisker print, analogous to a human fingerprint. However, it is unknown if the whisker spots are symmetrical on each side of the face. It is thought that fluctuating asymmetry, where an organism deviates from bilateral symmetry either randomly or in a directional way, may be influenced by the body condition of an individual during development or early

maturity. If climate change leads to a decrease in body condition for polar bears coming off of the sea ice, it could also lead to increased asymmetry in the facial patterns of bears. The objective of this research was to test the reliability of using and implementing the facial recognition software as a means for reliably identifying individual bears and to examine how asymmetric whisker spot patterns are within individuals. To address this question, we used two methods of analysis to compare one side of the bears' face to the other. The results of a Spearman's test indicate that the whisker pattern from one side of the face shows no statistically significant concordance with the opposite side of its face ($\rho = -4.9$, $p < 0.001$). This new insight into the photo-identification process of whisker spot patterns can be used to quantify the fluctuating asymmetry in polar bears. Ongoing analysis will enable the verifiability of whisker printing as a reliable non-invasive, mark and recapture, technique. This study has effectively engaged, inspired, and trained over 100 citizen scientists in polar bear research design and data analysis.

UNDERSTANDING COMMUNITY-BASED MONITORING OF ARCTIC CHAR FROM THE COMMUNITY PERSPECTIVE

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Fish are an essential part of the diet and subsistence economy of the Inuvialuit. Although the wage-earning economy is now predominant, subsistence fishing remains a primary source of nutritious food. Fish meat is required when there is little meat in the store, the cost of store-bought meat has increased to unaffordable prices, or country food is desired for meals. The importance of fish, specifically Arctic Char (Salvelinus alpinus) and the effects of a changing environment on this subsistence resource, necessitates effective long-term community-based monitoring (CBM). CBM gathers systematic information in order to detect changes in, and make management decisions about, the resource. Arctic residents are often the first to observe local changes and are therefore best-suited to consistently monitor local resources over long time scales. CBM also supports opportunities for the collection of scientific data to inform how environmental stressors are affecting char. In light of this, the Sachs Harbour Hunters and Trappers Committee requested a community-collaborative research project to develop an effective Arctic Char CBM plan. This research is of great importance as the shift towards CBM as a model for environmental monitoring continues to grow. Arctic Char CBM programs exist for two of the three northernmost communities (Paulatuk and Ulukhaktok) in the Inuvialuit Settlement Region. However, Inuvialuit knowledge suggests the characteristics of Arctic Char and the local environment vary among communities. Therefore, an Arctic Char CBM plan unique to Sachs Harbour was required. A grounded theory approach was used to understand and document the Arctic Char knowledge and CBM needs of the Sachs Harbour fishers over the course of the seven year research collaboration. Local expert fishers were consistently involved in the research over this time. In addition to the understanding gained from the local fishers, semi-directed interviews were conducted with Arctic Char CBM experts working with communities in the Inuvialuit Settlement Region, Nunavut, Nunavik and Nunatsiavut. All resulting data and knowledge were analyzed for emergent themes using NVivo software. This research approach allowed the lead author to distill community concerns and needs for effective Arctic Char CBM. The results revealed well known themes identifying the needs for: local training; secure long-term funding; access to equipment; access to lab and data analyses from outside of the community with someone who understands the community's use of the data; and, on-going community engagement. These are operational issues that can be overcome to ensure an effective CBM program. Further, themes emerging from the data included: concerns about sharing fishing locations; concerns over not being able to carry out the CBM without outside oversight; changes to fishing practices that affect long-term monitoring; and, changing community concerns and needs. This research approach has not been used in this context before and the outcomes provide novel insights into needs and considerations for effective CBM from the community perspective. The results further demonstrate limitations to consider along with the concepts, methods, and protocols for effective Arctic Char community-based monitoring in Sachs Harbour, and for consideration across the North.

VARIABILITY IN ARCTIC COASTAL EROSION ALONG THE WESTERN YUKON COAST

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Arctic coastal erosion can have substantial impacts on coastal infrastructure, sometimes prompting the need for aggressive adaptation strategies. It can also induce the release of large quantities of organic carbon and nutrients directly into the nearshore with potential impacts on the ecosystem and/or transformation into greenhouse gases upon contact with sea water. The recent major changes in summer sea ice extent, as well as the warming of sea temperature could potentially lead to greater erosion rates and amplify these processes, yet few studies have quantified erosion in the Canadian Arctic over the period including the 2007 and 2012 minima in sea ice. In this study, we present erosion rates for the western Yukon coast, a 35 km long stretch between the Komakuk Beach Distant Early Warning Line station in the east and the Canada-USA border in the west. Shoreline position data from 44 aerial photographs as well as a SPOT image were analyzed to determine rates spanning 58 years (1951-2009). These remote sensing data were analyzed with the Digital Shoreline Analysis System (DSAS) extension for ESRI ArcGIS. Additionally, total station and real time kinematic global positioning system survey data from coastal monitoring sites maintained by the Geological Survey of Canada at Komakuk Beach and at the border were used to compute rates for the time period between 1991 and 2012. These two datasets together with LiDAR (Light Detection And Ranging) data collected in 2012 and 2013 allowed us to measure shoreline evolution and total volumetric land loss over the past 61 years. Mean annual volumetric land loss for the whole coastal stretch between 1951 and 2009 was calculated to be 250,000 m^3/a. DSAS results show rates of coastal erosion in the region have not changed significantly over time. A comparison of the mean annual erosion from 1951 to 1972 to the time period of 1972 to 2009 shows a slight deceleration from 1.4 m/a to 1.2 m/a. A clearer trend towards decreasing erosion was distinguished at the Komakuk Beach study site, where mean annual erosion decelerated from 1.92 m/a to 0.49 m/a during the time from 1951 to 2009. By contrast, coastal erosion at the Canada-USA border increased during the same time period from 1.3 m/a to 1.8 m/a. Work is under way to better understand these local differences and the overall nature of erosion along the Yukon coast.

BIOLOGICAL EFFECTS OF THE SKJERVOY DIESEL OIL SPILL: A SUB-ARCTIC CASE STUDY

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Anthropogenic activities are increasing in the Arctic and sub-Arctic environments along with an increasing risk for both accidental diesel oil spills and leakages. On December 14th 2013, 180,000 L of marine diesel was accidentally spilled into Skjervoy harbor, Troms county, Norway. In order to evaluate the impact and recovery capability of the local marine fauna, blue mussels (Mytilus edulis) were selected as indicator species, as they are known to filter large quantities of water and accumulate high levels of contaminants. Blue mussels from the spill area as well as a reference station were sampled 5 days, 1 and 5 months following the spill. Bioaccumulation of polycyclic aromatic hydrocarbons (PAHs) in blue mussel soft tissues was determined along biomarker responses for oxidative stress (lipid peroxidation) and neurotoxicity (acetylcholinesterase AChE). Water samples were taken to analyse the residual diesel concentrations of the PAHs in water column. Chemical analyses of the water samples showed that the diesel concentration in the seawater rapidly decreased after the diesel spill with 3.5 mg/L PAHs detected 5 days after the spill and levels below detection limit 1 month after the spill. Bioaccumulation of PAHs was shown in blue mussel soft tissues with concentrations reaching 4500 µg per kg of the wet weight 5 days after the spill. These accumulated levels decreased significantly over time, however they did not reach the levels of the reference blue mussels 5 months after the spill. Effect biomarkers showed that lipid peroxidation levels in digestive glands of the blue mussels collected at the diesel spill site were significantly higher than in the blue mussels collected from the reference site 1 month after the accident. Five months after the spill the lipid peroxidation levels in mussels from the contaminated site decreased, however, they still remained higher than in the reference blue mussels. These results indicated that the blue mussels were still experiencing high levels of the oxidative damage 5 months after the diesel spill. Ongoing analysis of AChE will also be presented. This study shows that Skjervoy blue mussel population had not been completely recovering 5 months following the spill. There is still a need for monitoring and evaluation of long-term effects of diesel on the ecosystem.

A TAPHONOMIC ANALYSIS OF BOWHEAD WHALE (BALAENA MYSTICETUS) REMAINS AT MCBEAN BAY, NUNAVUT

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The bowhead whale (Balaena mysticetus) is a highly-migratory planktivore of the baleen whale group adapted to feed in and around sea ice. As a result, its seasonal movements are associated with north polar floe edge, and bowhead fossils on raised beach sequences have been used as proxies of sea-ice history. However, mysticete remains are affected by an array of taphonomic processes – the activities which occur post-mortem, before and after deposition. A recognition of these mechanisms is important for the reconstruction of sea ice history, as such studies indicate population size and/or migratory patterns based on the abundance of remains. This study is a unique taphonomic analysis of bowheads from the Holocene beaches of McBean Bay, Nunavut. Of 37 Holocene bowheads recorded there by Savelle in 1990, 6 individual whales represented by 233 bones occur along roughly 850m of shoreline. The location of each skeletal component was recorded, mapped, and, whenever possible, it was identified to element. The proportion of bone types known in complete bowhead skeletons was compared to this assemblage, which revealed that over half the expected bones were lost between time of death and the 1990 observations. The degree of scattering and degradation as a result of fluvial action was primarily driven by the physical and morphometric characteristics of the remains. In particular, structural density (g/cm3), size, and shape strongly influenced the intensity of transportation by water. Taphonomic processes have clearly introduced biases into the sub-fossil assemblage. A more comprehensive understanding of their effects is necessary if we continue to use bowhead remains as proxies for sea-ice history.

ASSESSING SEASONAL BIASES IN PALEOCEANOGRAPHIC RECONSTRUCTIONS BY MODELING THE HABITAT OF PLANKTONIC FORAMINIFERA IN THE NORTH ATLANTIC OCEAN DURING THE LAST GLACIAL PERIOD

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Fossil shells of planktonic foraminifera serve as the prime source of information of surface water conditions in the Arctic and North Atlantic Ocean. For instance, by using oxygen isotopes on planktonic foraminiferal shells past large-scale meltwater events have been identified. In this study, the main focus is set on the left-coiling Arctic planktonic foraminifera species Neogloboquadrina pachyderma and its seasonality during a time period with large fluxes of icebergs and meltwater from the late glacial Laurentide ice sheet (so-called Heinrich Event 1, approx. 15-18 thousand years ago). For analyzing the seasonal variations of N. pachyderma during glacial-interglacial timescales a planktonic foraminifera model coupled to an ecosystem model is used. The model predicts that during Heinrich Event 1 the maximum seasonal production occurred later in the year compared to the preceding Last Glacial Maximum and present-day. Our model prediction suggests that not only the temperature sensitivity of N. pachyderma but rather the differences in the sea-ice cover have led to a shift in the maximum production from the Last Glacial Maximum to Heinrich Event 1 by up to six months. The change in the timing of the maximum production peak could lead to a bias in paleoceanographic reconstructions of sea surface properties. By using this ecosystem modeling approach the factors that may explain the seasonal variations during glacial-interglacial timescales can be investigated. Accordingly, by comparing the model output with existing paleoceanographic reconstructions it may be possible to correct the offset.

INDIGENOUS ENTREPRENEURS AND EAST ASIAN INVESTORS: PROSPECTS AND CHALLENGES IN COLLABORATIVE NATURAL RESOURCE DEVELOPMENT

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Natural resource extraction led by indigenous communities is an important avenue towards northern economic development. At the same time, a number of Asian countries, in particular China and South Korea, are becoming more interested in engaging on Arctic issues, especially natural resource extraction. This article evaluates the prospects for cooperation between indigenous entrepreneurs and East Asian investors in natural resource extraction, with some insights from existing partnerships. Through case studies and select stakeholder interview, this article aims to answer three questions: 1) What is the rationale for collaboration between indigenous peoples and East Asian investors, from the perspectives of Asian investors, indigenous peoples and the Canadian government? 2) What are some of the opportunities and challenges of

implementing collaborations between East Asian companies and indigenous communities? 3) What can stakeholders learn from existing collaborations in natural resource extraction in this respect? In sum, this paper seeks to underscore the importance and potential of the partnership between northern entrepreneurs and Asian investors; examine the prospect and obstacles for such collaboration; and provide policy recommendations for indigenous, federal, provincial and territorial governments on how to foster successful partnerships.

POLAR MICROALGAE ECOPHYSIOLOGY -- A NEW PARAMETERIZATION OF THEIR PHYSIOLOGY IN RELATION TO TEMPERATURE AND IRRADIANCE.

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Polar species evolve in extreme environments with very unique environmental conditions characterized by low temperatures (- 1.8 to 6°C) and by extreme variations in irradiance and day length. Sun elevations are generally low in polar areas but daily irradiance can be very high due to large daylength in summer. Light can be greatly attenuated by ice and snow. The specific conditions of polar seas may have conducted to various specific adaptations allowing arctic phytoplankton to be specialist of these conditions. Until now, ecophysiological characteristics of polar microalgae have not been described quantitatively in relation to growth conditions, although physiological parameters of microalgae are crucial variables in the ecological understanding of polar ecosystems and in model parameterization. The goal of the present paper is to provides an empirical account of the variability of various parameter of the growth of polar microalgae (μ, chla : C, PI curve parameters, N : C) as a function of temperature and light level in nutrient sufficient cultures. We showed that growth rates of polar microalgae (mean μ=0.43 d-1) are lower than temperate species but are in agreement with the Eppley relationship. Polar species that have been studied in laboratory do not seem to be particularly shade adapted as suggested by low initial slopes of the μ vs. I curves in comparison to temperate species and by the similar chl a to C ratio. The relationship between Chl a to C ratio and irradiance for polar species is very similar to the one found for temperate species, which is in contradiction to previous predictions (Geider 1987; Cloern, Grenz et al. 1995). We also described photosynthetic properties of polar microalgae and showed some interesting features that reflect the specificities of their environment.

A NEW COST-EFFECTIVE METHOD TO TRACK RAPID ARCTIC CHANGES

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Marine biodiversity monitoring typically requires heavy sampling tools (e.g., bottom trawl), multiple taxonomist experts and may cause significant negative impacts on the ecosystem. Despite the necessity to monitor and quantify diversity in the changing Arctic, the cost, logistics (e.g. inaccessibility) and potential negative impacts challenge large spatial and temporal biodiversity monitoring. The analysis of environmental DNA (eDNA) could be a revolutionary tool to overcome these challenges. The eDNA method, a novel sampling approach for macro-organisms, detects traces of DNA in water. The restricted spatial and temporal distribution of eDNA in natural ecosystems confirms that eDNA provides evidence of occurrences of local and recent species. In this presentation we show how next-generation eDNA sequencing increases biodiversity estimates from only few liters of water. By developing eDNA for Arctic ecosystems, we hope to accelerate the development of emerging genetic tools for species detection and community characterization to rapidly detect biodiversity shift in the Arctic ecosystems. Furthermore, the "eDNA meta-barcoding" method could also become a powerful tool to detect the introduction of exotic species or species extinction as climate, shipping routes, and other changes occur. Together, this could improve traditional approaches by offering the most advanced molecular approaches to standardize Arctic biodiversity databases. Regardless of the remaining challenges to eDNA methodology, analyses and interpretation, we believe that integrating the eDNA method for Arctic ecosystem is at a perfect conjunction of biotechnology accessibility, eDNA method advances, actual knowledge of marine biodiversity and the access to pristine environments.

UNDERSTANDING BALLAST WATER AS A PATHWAY FOR INTRODUCTION OF AQUATIC INVASIVE SPECIES IN THE ARCTIC.

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The shipping season in the Canadian Arctic is predicted to increase in the next few years in response to global warming, with potential risks for aquatic invasive species (AIS) introductions. Ballast exchange regulations designed to limit introductions of non-indigenous coastal species under the "Canada Shipping Act" are restricted to international ships, whereas domestic vessels are currently unregulated, however some conduct voluntary exchange in coastal waters. Aquatic organisms entrained in ballast water may survive and be released in new environments during deballasting. Dinoflagellates are microalgae that thrive in coastal environments. They are among the organisms that can withstand the relatively long transit time in ballast tanks and studying their introduction pathways is of paramount importance in limiting aquatic invasions in new environments, such as the Canadian Arctic. Within this context, we are assessing the relative risks of dinoflagellate introduction into Canadian Arctic coastal waters by vessels entering the two main Arctic ports: Churchill (Manitoba) and Deception Bay (Nunavut). Transoceanic and domestic ships arriving in these ports transport ballast water from diverse marine and freshwater/estuarine areas. We will be testing 3 hypotheses: a) The dinoflagellate communities in ballast water from Transoceanic vessels that undergo mid-oceanic exchange will contain a lower proportion/abundance of coastal and freshwater non-indigenous species than domestic vessels that do not conduct exchange or undergo voluntary coastal exchange; b) Furthermore, species composition and associated level of risk, for ballast water from domestic vessels will vary with exchange practices and locations; c) The survival of some dinoflagellate species will be reduced seasonally during certain periods. We will characterize and compare dinoflagellate communities between pathways (international transoceanic and domestic) and evaluate seasonal changes in invasion risk associated with the transport and discharge of ballast water in both ports using samples collected from arriving vessels over the next two years (2014 and 2015). To determine the effectiveness and level of risk associated with current voluntary ballast water exchange methods for domestic vessels, we will evaluate ballast water samples from the Fednav vessel MV Arctic, which transits between Deception Bay (Nunavut) and Quebec City. During the transit to Deception Bay, the vessel conducts voluntary exchange in the Gulf of St. Lawrence or Belle Isle Strait. Paired pre- and post-exchange and control (non-exchanged) ballast water samples collected in both locations will be compared. In-transit sampling will also be performed along the ship's track for a subset of voyages during the ice free period. Sample will be collected: 1) in Quebec City after ballasting; 2) before voluntary exchange in the Gulf of St Lawrence or Belle Isle Strait; 3) after exchange in these locations; 4) in Deception Bay, before deballasting. Comparison of species composition and abundance between exchange sites and relative to control tanks will allow us to determine the relevance of current exchange locations and the effectiveness of voluntary exchange methods used by this vessel. This study will improve our ability to understand and limit dinoflagellate species introductions from ballast water discharge, and contribute to improving the implementation of ballast water regulations by Transport Canada.

EXPORT FLUX OF PARTICULATE ORGANIC CARBON IN THE PACIFIC ARCTIC REGION: REVIEW AND FUTURE PLANS

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Most of the primary production and particulate organic carbon (POC) export in the Arctic Ocean occur on the shallow, seasonally ice-covered continental shelves. In the Pacific Arctic Region, the northern Bering and Chukchi Sea shelves are among the most productive regions of the Arctic Ocean, supporting POC export fluxes ≥ 400 mg C m-2 d-1 in some areas. However, our knowledge on POC export over the Pacific Arctic shelves is limited primarily to results from a handful of ship-based studies conducted between May and August. Most of these studies used 234Th to derive POC export while one study used short-term sediment traps to investigate both the magnitude and composition of POC export fluxes on the northern Chukchi Sea shelf and slope. The use of sediment community oxygen consumption field experiments (SCOC) as an indirect indicator of export production indicates regions of enhanced export production to the benthos in various sub-regions on these shelves that support high benthic macroinfaunal biomass. As rapid seasonal sea ice retreat and seawater warming continue in the Pacific Arctic Region, long-term monitoring of export fluxes is urgently needed over the shelves of the Chukchi and northern Bering Seas to assess the biological response

to these physical changes. In addition of assessing temporal variations in the magnitude of POC exported to the seafloor, long-term measurements of the composition of export fluxes will indirectly allow the monitoring of shifts in phytoplankton and zooplankton communities. In this presentation, we review what is currently known on the spatial and temporal variability in the amount and composition of POC export in the Pacific Arctic in relation to associate benthic parameters (SCOC, benthic biomass), and we present our plan to deploy long-term sediment traps as part of the Distributed Biological Observatory mooring lines, starting with a deployment in the NE Chukchi Sea in September 2015.

THE CULTURAL NEGOTIATION OF INUIT EDUCATION

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There is a longstanding desire among Inuit and some northern educators to better integrate Inuit culture and modes of learning in education. At present, efforts to include Inuit culture in education can be described as ad hoc or add-ons to a Euro-North American schooling system, which puts many Inuit in internal conflict trying to live according to two value systems that in some ways contradict themselves. Stairs (1994) proposes the cultural negotiation of education as a viable and present alternative to assimilation. The proposed research seeks to contribute to the cultural negotiation of education among Inuit by examining adaptations which are currently in use, and those desired by Inuit and educators, to better represent Inuit culture and modes of learning in education. The aim will be accomplished through three objectives: (1) identify and describe what cultural values and knowledge Inuit desire to have represented in education; (2) identify and examine adaptations, which are currently in use and those desired, by Inuit and educators, to represent Inuit cultural values and knowledge in education; and (3) draw recommendations aimed at improving the relevance of education for Inuit students. The research will be conducted in partnership with community members in Ulukhaktok, NWT following recommendations for community-researcher relationships outlined by ITK and community protocols. It is anticipated that data will be collected using surveys, semi-structured interviews and focus groups with community members, educators and Inuit students at Helen Kalvak Elihakvik (school). 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.

RAPID NEST FAILURES CAUSED BY THE MASSIVE OUTBREAK OF AN ECTOPARASITE IN AN ARCTIC-NESTING BIRD

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Because the emergence of arthropods is closely linked to temperature, these taxa are expected to be among the first to respond to the warming of the Arctic. This response can be in the form of an earlier emergence, an increased abundance or a range shift. Since the emergence of arthropods can be episodic and detection usually requires intensive monitoring, the impacts of ectoparasites such as black flies (Diptera: Simuliidae) on wild animals are poorly documented in the literature. Nevertheless, some studies have demonstrated that harassment by black flies can reduce reproductive success in wild birds by affecting behaviour and survival of adults and nestlings. Here we document the first observations of partial and complete brood losses resulting from a massive outbreak of black flies in a population of Arctic-nesting peregrine falcons (Falco peregrinus tundrius) breeding on the west coast of the Hudson Bay near Rankin Inlet, Nunavut. During the 2013 breeding season, motion-sensitive cameras positioned at nest sites recorded the rapid death of four nestlings in a brood, likely as a result of a combination of body fluids lost and enhanced energetic expenditure attributable to harassment by black flies. Occurring only on July 20, the outbreak was sufficiently severe that within three hours the loss of large down patches and skin lesions appeared as a result of black fly bites on affected nestlings. About seven hours later, the carcasses were carried away from the nest by the resident female. In addition to this observation, a complete brood loss was confirmed at a second nest on the same day and partial brood loss was confirmed at four other nests, totaling 13 nestling mortalities attributable to black flies (14% of all nestlings in the study area). Moreover, nine additional nest sites without cameras but monitored on a weekly basis also experienced the loss of a least one young on or around July 20. This event may be the result of a range shift, local increase in the abundance of this ectoparasite due to improved environmental conditions or simply the result of a normal but rare outbreak

in our study area. In any case, to our knowledge this is the first documentation of infestation by black flies in birds nesting in the Canadian Arctic. The indirect effects of climate changes on arctic wildlife, through direct effects on terrestrial arthropods, deserve further investigation.

A MULTI-YEAR STUDY EXAMINING THE IMPACTS OF A PERMAFROST DISTURBANCE AND THERMAL PERTURBATION ON HIGH ARCTIC STREAM CHEMISTRY VARIABILITY, CAPE BOUNTY, MELVILLE ISLAND, NUNAVUT

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Ongoing research has shown that permafrost slope disturbances, particularly active layer detachments (ALDs), along with accelerated active layer deepening affects solute delivery and concentrations in hillslope runoff, which can have implications on downstream hydrochemistry and aquatic processes in rivers and lakes. This study investigates the variability of stream chemistry (major anions and cations) and stable isotope composition (δD and δ18O) in two High Arctic catchments from 2006 to 2012. At this location, 2007 was the warmest year on record and resulted in several ALDs in one of the study catchments. Here we track stream water quality of a recently disturbed catchment and an undisturbed control catchment throughout the study period to identify possible changes in water sources and/or pathways associated with disturbance. Cluster and principal component analysis (PCA) were performed to compare the hydrochemical and stable isotope record for the disturbed vs. undisturbed catchments over the 6-year sampling period, as well as for individual years. Viewed collectively, the first principal component (PC1) explains 46.5% of the variability in stream composition for both catchments from 2006 to 2012. PC1 is primarily controlled by the major ions Cl-, SO42-, Na+, Mg2+ and Ca2+. PC1 scores show that ion concentrations in the stream draining the disturbed catchment substantially increases post-disturbance while remaining relatively constant in the undisturbed catchment over the entire study period. In both cases, ion concentrations also shows a significant increase, and this is most notable in the disturbed catchment during 2012. The second principal component (PC2) explains 20% of the variability in both catchments and is controlled by δD and δ18O. PC2 scores are generally consistent in both catchments over the study period and do not show a high degree of variability. Hierarchal clustering further reveals a clear separation between the two catchments in terms of stream chemistry, with the major differences during the late summer period (mid- to end of July) when ion concentrations in the disturbed catchment are significantly higher than in the undisturbed catchment, particularly in 2012. Squared root distance analysis shows that stream water concentrations of individual ions between the undisturbed and disturbed catchments were statistically dissimilar in years following the ALD. However, δD and δ18O were statistically similar for both catchments in years following the ALD. Our results suggest that permafrost disturbances (e.g. ALDs) directly impact the variability and composition of ion concentrations in stream water, with variability appearing to increase over time from the onset of the disturbance. Thermal perturbation due to rapid active layer thaw also impacts the variability of stream water chemistry. Based on the consistent δD and δ18O values and variability between catchments, results suggest that differences in water pathways, as opposed to differences in water sources, may be the dominant control in ion strength for undisturbed vs. disturbed catchments. Work will continue to identify the physical mechanisms in the subsurface that drive increased solute levels observed in surface waters of catchments with ALDs.

NUNATARIUK: BUILDING AN INTEGRATED INTERNATIONAL PROJECT TO QUANTIFY AND UNDERSTAND LAND-OCEAN FLUXES OF SEDIMENT AND ORGANIC MATTER IN THE BEAUFORT SEA

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Climate change has drastic effects on the Arctic coastal environment, impacting both the lifestyle of northern residents and the Earth System Climate through the release of organic matter by the terrestrial environment. Decreasing sea ice extent and thickness, higher storm frequency and warmer sea surface temperature would all contribute to enhance coastal erosion and possibly of river discharge along ice-rich permafrost coasts of the Arctic. This erosion would result in larger quantities of sediment, and thus of organic carbon and nutrients being contributed to the nearshore zone. Once into the marine realm, the fate of sediment is controlled by a series of processes that drives its burial, its export or its conversion to greenhouse gases in the water column. The balance between these pathways is also likely to be altered by climatic change. In the Canadian Beaufort Sea, these issues have important impacts on the

coastal ecosystem and therefore on harvesting practices of the Inuvialuit. They also bear great relevance to the Earth Climate system in one of the biological hotspots of the Arctic, the Mackenzie Delta and the Beaufort Sea Shelf. Yet, an integrated understanding of the partitioning between Land-Sea, Land-Air and Sea-Air fluxes of organic matter and greenhouse gases is missing to accurately track and compare these fluxes and assess the impact of changing climate and weather conditions on their future trajectories. The objective of NUNATARYUK, a joint German-Canadian project proposal, is to fill this gap by building on already existing German projects such as COPER (Coastal permafrost erosion, organic carbon and nutrient release in the Arctic near shore zone) established on Herschel Island, or AIRMETH (Airborne studies of Methane emissions from Arctic wetlands) and to combine these with the annual ArcticNet expedition on board the CCGS Amundsen to extend land-based sampling to coast-shelf-slope transects into the Beaufort Sea to investigate the impact of coastal erosion on marine productivity and track organic carbon export in the coastal Arctic Ocean. In this presentation we present the objectives of Nunatariuk and the framework in which we plan to implement it over the next five years.

NEAR-SURFACE GROUND ICE CONDITIONS IN UNIVERSITY VALLEY, MCMURDO DRY VALLEYS OF ANTARCTICA

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The distribution and nature of ground ice is of importance to our understanding of polar environments. In the Arctic, the distribution and ground ice content of permafrost is fairly well characterized, as seen through the Circum-Arctic map of permafrost and ground ice conditions. In contrast, ground ice content and the distribution of permafrost in Antarctica is not as well understood. In the McMurdo Dry Valleys (MDVs) of Antarctica, three types of permafrost have been advanced: i) dry permafrost; ii) ice-cemented permafrost; and iii) ground ice or buried ice. The prevalence of dry permafrost in areas of the MDVs known to also contain ground ice has steered several studies related to subsurface ice conditions. However, only a limited number of studies determined the ground ice content in the MDVs' permafrost, most at a very coarse resolution, and none have described the soil's cryostructures. The objective of this research project is to describe the cryostructures in permafrost, quantify the ground ice content and determine the origin of ground ice in University Valley, McMurdo Dry Valleys of Antarctica. Relations between permafrost, ground ice and environmental factors (e.g., soil surface temperature, potential incoming solar radiation and soil texture) will also be investigated. This objective will be accomplished using the following methods: i) sampling of fifteen shallow permafrost cores (<1 m); ii) determining the ice content of the permafrost cores; and iii) using computed tomography scanning and imaging of the permafrost cores to determine cryostructures in permafrost. This contribution will help advance our current understanding of ground ice conditions in cold-dry environments and will evaluate the applicability of Arctic-centric cryostratigraphic classification schemes to Antarctic permafrost. Moreover, due to the similarity between the MDVs of Antarctica and the Martian landscape, results from this study may enable comparisons between Antarctic and Martian permafrost.

VULNERABILITY OF ARCTIC FOX (VULPES LAGOPUS) DENS TO CLIMATE CHANGE IN THE CANADIAN HIGH ARCTIC

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Climate change is affecting arctic ecosystems not only through biological means, but also physical processes. These effects are observable through the alterations of the physical structure of faunal habitats. Numerous climate models predict permafrost thawing which could lead to important geomorphological changes that may affect the ecology of various animal species. One species likely to be affected by these changes is the arctic fox (Vulpes lagopus). In the Canadian High Arctic, their dens are located in permafrost, which is difficult to dig so that the same dens are used year after year, sometimes over centuries. Foxes rely on the stability of these dens to raise their young, which is a crucial step of their life cycle. On Bylot Island, Nunavut, some dens that have been monitored for several years have now collapsed, which raises questions about the vulnerability of these structures to climate change. We used the arctic fox of Bylot Island as a study model to investigate the interaction between climate change and faunal ecology following three main objectives: (1) characterize permafrost in which arctic fox dens are situated, (2) estimate to what extent permafrost degradation could have caused the collapse of certain dens, and (3) assess the vulnerability of dens on Bylot Island regarding further climate change. An extensive survey in 2003 allowed us to locate most dens on the study site (n≈110) in order to monitor them annually. During the summer of 2014, numerous parameters such as slope, dominant vegetation, number of

collapsed burrows, active layer thickness, and drainage, were measured over 53 of these dens. We also took aerial photos and collected soil sample at each den. More dens will be sampled and characterized in 2015. Soils with a fine grain size composition promote ice segregation, a process that forms ice lenses when the volume of ground ice exceeds the total volume of water that can be held in the sediment. Thawing of these ice-rich zones promotes soil instability and mass movements causing landscape changes. Thus, we expect to observe a positive relationship between the number of collapsed burrows per den and the soil water content, which can be assessed from grain size. This study will provide insights into the geomorphological response to permafrost thawing affecting arctic fox ecology. Our data can eventually be used to predict short term effects of climate change on the interaction between physical and biological changes. This knowledge will help us intervene when facing major conservation issues resulting from global change.

PALEOENVIRONMENTAL RECORDS FROM A LATE PLEISTOCENE SYNGENETIC PERMAFROST (YEDOMA), ITKILLIK RIVER, ALASKA.

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The cold-arid climate associated to the late Pleistocene environment of unglaciated Beringia (northeastern Russia and Alaska-Yukon) was conducive to active sedimentation processes (eolian, alluvial, proluvial, colluvial, slope wash, solifluction, and permafrost creep) and accumulation of ground ice. These processes resulted in the formation of a relict form of ice-rich syngenetic permafrost, termed yedoma. Because yedoma accumulated during all Pleistocene, it contains paleoenvironmental archives that can be use as paleoecological and paleoclimatic proxies. This type of deposit offers an interesting opportunity to examine long term vegetation and climate dynamics of high latitude environments. Often fragmented, data obtained from yedoma can be linked to the framework established from continuous sequences (lake, pond, peatland) and provide interesting snapshots of a much older period. It also can potentially be linked to marine sequences and compared to northeastern Russia studies were the distribution of quality deposits are more widespread. Knowing that Beringia has acted as a refugium for plant species and the Pleistocene megafauna during the Pleistocene, many questions remain about the environmental history of northeastern Beringia, especially the extent and temporal dynamics of the now extinct tundra-steppe biome. The yedoma from Itkillik River (69°34' N, 150°52' W) is located at the boundary of the Arctic Coastal Plain and the Arctic Foothills. The site was formed over the late Pleistocene-early Holocene (48,000 to 5,000 14C yr BP). An exposure, about 400 m long, has been eroded by the meandering of the Itkillik River. The surface elevation of the bluff ranges between 30 to 35 m above the Itkillik River, and the whole stratigraphic exposures was analyzed for this study. Pollen analysis and reconstruction of paleoclimatic parameters such as temperature and precipitation (modem analogue technique) reveal a tundra-steppe environment dominated by herbaceous community. The preliminary results suggest a relative stable climate during the late Pleistocene, as species do not change much from the late Pleistocene through the Holocene transition. The warmer and more humid Holocene conditions were favorable to the establishment of a more diverse plant community and the emergence of shrub species (Picea, Alnus, Betula) which were absent in the Pleistocene Iktilik record. Overall, Cyperaceae and Gramineae are by far the dominant taxa in the sequence. The local conditions at the study site may have favored the presence and conservation of an herbaceous cover. Implications of our findings for vegetation and local climate reconstructions using pollen-climate transfer functions are discussed and linked to the sedimentology (C, C/N, OC, particle size distribution, gravimetric and volumetric water, sedimentation rate), and cryostratigraphy (cryostructure, ice content, ice wedge volume) of the site.

SNOWPACK MICROBIAL COMMUNITIES AS ACTORS IN A CHANGING ENVIRONMENT

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Despite a concerted effort over the last 10 years, relatively little is known about the biodiversity of the microbial communities and their biogeochemical processes which reside in the Arctic in comparison with the rest of the terrestrial biosphere. A thorough knowledge of the microbial biodiversity and their biogeochemical importance of an ecosystem is the fundamental first step toward understanding ecosystem

function. Mainly due to the recent developments in the field of microbiology and advanced logistic support, initial studies have characterized the microbial biota of sea ice, ice sheets, ice caps and glaciers showing that these regions are not sterile or abiotic reservoirs of dormant cells but are most active and sensitive to environmental changes. Among the most critical, yet under-studied components of the Arctic cyrosphere is seasonal snow, which extends over a third of the Earth's land surface, covering up to 47 million km2. Snow cover is a dynamic habitat with a limited lifetime that acts as a medium and a mediator transmitting and modifying interactions among microorganisms, plants, animals, nutrients, the atmosphere and soil. Within the snowpack, microbiological activities such as carbon fixation by algal communities may modify the nutrient cycle. Microorganisms may also be responsible for the metabolism and transformation of environmental contaminants such as mercury, a pollutant of arctic ecosystems. Through the use of a variety of metagenomic techniques (16S rRNA gene (rrs) clone libraries, phylochips, next generation sequencing) on snow and meltwater from Svalbard, we have explored questions related to microbial diversity, community structure, evolution, adaptation and function. We have observed high levels of microbial diversity (similar to certain soils) and the communities undergo dynamic shifts that are linked to changes in snowpack chemistry. Here, we will present the key aspects that impact snow ecosystem functioning including both chemical (e.g. nitrogen, mercury) and physical parameters (e.g. photochemistry, temperature). We will also focus on the role that these communities appear to play in how the snow functions, and how they may alter chemical cycling across Arctic environments. Based on our data, snow microbial communities have the potential to carry out several key pathways of the nitrogen and mercury cycle. The Arctic snow has among the highest amount of reads (microbial genomic sequences) associated to nitrate and nitrite ammonification pathways, which suggests that N may be limiting. It also appears that anthropogenic transport and deposition of bioavailable N species such as NH4+, NO3- and NO2- may contribute to altering N cycling in the snow. Photochemical reactions and oxidative stress also seem to be decisive parameters in structuring microbial communities inside Arctic snowpacks. These relationships play a critical role in the response of the Arctic ecosystem to anthropogenic perturbations. In order to predict how ecological processes will evolve as a function of global change, it is essential to identify which populations participate in each process, how they vary physiologically, and how the relative abundance, activity and community structure will change under altered environmental conditions.

THE ARCTIC BOREAL VULNERABILITY EXPERIMENT (ABOVE): INTERDISCIPLINARY RESEARCH ON COUPLED HUMAN-NATURAL SYSTEMS IN WESTERN NORTH AMERICA

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Climate change in high northern latitudes is unfolding faster than anywhere else on Earth, resulting in widespread changes in landscape structure and ecosystem function. The Arctic-Boreal Region (ABR) is vast and access to the region for in situ field studies can be challenging, thus remotely sensed data will be valuable for advancing our ability to observe, understand and model the complex, multi-scale processes of the coupled human-natural systems in the ABR. Building on prior and ongoing research conducted by a variety of agencies and individual researchers, the Terrestrial Ecology Program of the US National Aeronautics and Space Administration (NASA) is planning its next major field campaign for Alaska and Western Canada – the Arctic-Boreal Vulnerability Experiment (ABoVE). The ABoVE study will focus on 1) developing a fuller understanding of the vulnerability and resilience of social-ecological systems in the ABR to climate change, and 2) providing the scientific information required to develop options for societal responses to the impacts of these changes. The field campaign will emphasize research that integrates data collected by airborne and spaceborne sensors with information obtained from field studies and ground-based observations. NASA is especially interested in expanding our understanding of the human dimensions of climate change in the ABR. In this presentation, we will review the key components of the ABoVE Concise Experiment Plan, which includes the science questions to drive ABoVE research, the study design for the field campaign to address them, and the interagency and international collaborations desired for implementation.

INFRASTRUCTURE AND CLIMATE CHANGE IMPACTS ON GROUND THERMAL REGIME, IQALUIT INTERNATIONAL AIRPORT, NUNAVUT

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It is now common knowledge that climate change may threat the integrity of northern infrastructures and should

be considered in the design of infrastructures on permafrost. For transportation infrastructure, the structure itself, snow accumulation and water ponding along embankments will also influence the ground thermal regime. In the context of climate change, it is useful for planned or newly built infrastructure to differentiate between the effects of climate warming and anthropogenic factors on the permafrost thermal regime. In 2010, a joint study was initiated between the Canada-Nunavut Geoscience Office, Natural Resources Canada and Centre d'études nordiques of Université Laval to investigate permafrost sensitivity and terrain conditions within the Iqaluit International Airport area. The airport has a history of terrain stability problems and is now entering a major improvement phase. Ground surface temperature sensors have been used to monitor the surface microclimate on embankment slopes, undisturbed ground, stream channels or ditches, and areas with different thicknesses of snow cover. Combined with historical data since the construction of the airport and other geotechnical information, the ground surface temperatures were used to support numerical modeling. A two-dimensional cross-section between the runway and what is now the main apron of the new terminal building is used to show the separate and combined impacts of climate change, snow accumulation, and the infrastructure itself on the ground thermal regime. Initially, the past and current ground temperature distributions are simulated using the cooling (1946-1992) and the warming (1993-2014) trends in the air temperature record as well as the change in surface conditions that have occurred since 1946. Then different case scenarios over a 30 years period were simulated to assess the future ground temperature distribution: 1) new embankment material to extend the current apron, 2) use of insulation within the embankment, and 3) climate warming trends of 0.5°C and 1.0°C per decade. Results of past and current ground temperatures are in agreement with observed ground temperature changes. The impact on the ground thermal regime due to the new embankment material, without climate trends, depends on the ground temperature distribution and surface conditions prior to the embankment construction. The addition of Styrofoam insulation results in permafrost warming by a few tenths of degree Celsius at depth while the ground temperatures closer to the surface decreases and the permafrost table moves upward just underneath the insulation. In general, warming trends cause the permafrost to be warmer at depth while remaining colder close to the surface compared to the pre-construction condition. At a location where thick snow cover existed at the toe of the old apron embankment, the combined impact of new embankment (with or without insulation) and climate warming leads to a permafrost temperature similar to the pre-construction conditions at 15 m depth. Over years, the simulations indicate an increase in active layer thickness after an initial move upward within the new embankment. Results can be used by northern transportation infrastructure managers to better understand the causes behind the thermal changes of permafrost.

SYNTHESIS OF PERMAFROST RESEARCH ALONG THE EURASIA ARCTIC TRANSECT

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Permafrost research along the Eurasia Arctic Transect (EAT) included estimation of the thermal state of permafrost and activity of cryogenic processes through ground measurements and remote-sensing data analysis. The transect crosses the main bioclimatic subzones from south (E, Nadym) to north (A, Hayes Island). The transect length on the mainland Yamal is 635 km, and the Hayes Island site is located 900 km further north of Bely Island. Spatial distribution of permafrost parameters: ground temperature and active layer is highly variable. In Central Yamal measured ground temperature varies from -0.3°C up to -7°C, active layer depth varies from 40 to 240 cm. Temporal variations caused by climate fluctuations range at ±2°C for ground temperature, and ±5-10 cm for active layer depth. Thus, spatial factors, such as lithology and surface covers are of much higher importance compared to climatic factors. Yamal being an area of rapid natural and anthropogenic changes is an excellent object to calculate spatial distribution and temporal dynamics of ground temperature and active layer depth. Permafrost is affected by natural surface disturbances (cryogenic landslides, thermodenudation, thermoerosion, thermokarst), anthropogenic (structures, vehicle tracks, sandpits), and natural-anthropogenic (reindeer pasturing). Highly variable topography, deep dissection in the central part of Yamal compared to relatively flat southern and northern parts of EAT determine the role of precipitation, both winter and summer. Main forcing factor for ground temperature is snow cover thickness. It is the highest on slopes and in the narrow valleys. Snow insulates surface not only from winter cold, but also from summer warming, because snow patches survive at least till mid-July thus reducing active layer depth. At the same time, at the hilltops snow is blown away along with vegetation cover resulting in the lowest ground temperature, but at the same time, deepest summer thaw. Vegetation mat has less effect on ground temperature because in frozen state has higher thermal conductivity, but is the strongest factor of

thaw reduction through insulation from summer heat flux. Surface disturbances of all kind as a rule increase snow cover thus increasing ground temperature, and at the same time increase active layer depth because vegetation cover is reduced. Landslides and thermocirques specifically for Yamal expose saline permafrost with complicated phase transition process resulting in seasonal thaw different from the depth of zero temperature. In addition, forcing factors interact with each other. Spatial pattern of vegetation cover is mainly determined by landslide and thermodenudation activity the last several millennia thus affecting distribution of the active layer depth. Spatial distribution of permafrost parameters along the EAT involves latitudinal zonality based on directional lowering of air temperature northward from Nadym site in the south to Hayes site in the north. It is established that, on the whole, consistent trend of bioclimatic subzones northward determines the consecutive change of various parameters of permafrost. However, local factors connected to relief, drainage degree, location of plots on different landforms, which determine snow accumulation and vegetation mat thickness, distort zonal pattern.

A MILLENNIUM OF CHANGING ENVIRONMENT IN THE KANGERSUNEQ AND THE KAPISILLIT FJORD SYSTEM, WEST GREENLAND -INTERDISCIPLINARY ANALYSES OF CLIMATE VARIABILITY AND SETTLEMENT PATTERNS

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This PhD project is an interdisciplinary study drawing on both natural and social sciences to improve our understanding of long-term climate variability in Greenland. It explores the links between variations in past and present sea ice, climate conditions, changing environments and human societies. The Godthåbsfjord region has been the most densely populated part of Greenland, both in the past and present. Climatic and environmental variations in this area are significant, resulting in different patterns of human habitation and settlement (past and present Inuit cultures, or medieval Norse farmers). In the past, links between variations in sea ice, climate, and changing environments had significance for the dynamics of human societies. Each of these cultures were dependent on the natural setting in their own specific way and therefore likely responded to climatic and environmental change in equally particular ways. Their uniqueness was their adaptation to cold winters with snow and ice, but also summers with vegetation and a diversity of animals and plants gathered and hunted. Their cultural heritage and belief systems also influenced resource use, as well as flexibility and mobility in responding to changing environmental conditions. This project aims to understand the environments in change through the eyes of the cultural landscapes, local knowledge and memory of space and together with marine geological history depositions and data, reconstruct these lived environments with changing ice patterns, resources and changing human-environment relations in the Kangersuneq and Kapisillit fjord system. It wishes to link both natural and social science together with local knowledge and demonstrate how these different approaches and perspectives supplement each other in the understanding of environments in change. This project also has relevance for understanding climate and environments in change within the context of social and cultural change, changing settlement patterns and mobility, transformations in resource use, and local concerns over the development of large-scale industries.

WINTER SURFACE ENERGY BALANCE APPROACH TO VERY STABLE BOUNDARY LAYERS AT EUREKA

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The boundary layer during the High Arctic winter is commonly very stable and calm. The Richardson number, which is used to characterize turbulent heat fluxes, becomes so large that conventional mixing length theory breaks down. Other physical processes such as drainage flows and gravity waves need to be considered. The surface energy balance is used to demonstrate the role of high static stability in explaining much of the Arctic Amplification of the surface warming during the last several decades. This has important consequences in attributing the Amplification to the boundary layer static stability in addition to the normally considered positive feedbacks due to melting sea ice and enhanced meridional transport. Continued field work at Eureka is examining how gravity waves impact the vertical sensible heat flux and the surface temperature trend. This has important consequences when applied regionally for understanding the rate of sea ice thickness loss.

DEVELOPING A PREDICTIVE MODEL FOR PERMAFROST ACTIVE LAYER MONITORING BASED ON VEGETATIVE GROUND COVER IN THE THE HUDSON BAY LOWLANDS, MANITOBA, CANADA

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Global climate models indicate that temperatures are rising, and as a result, permafrost active layer thickness (ALT), the thickness of the sub-surface layer that thaws and refreezes annually, is expected to increase in arctic regions as the climate warms. Such changes have necessitated a more in-depth monitoring of ALT across the circumpolar arctic as a way of monitoring the permafrost in these regions. Developing a model that relates ALT to vegetation and other surface level indicators including water cover and soil moisture will contribute greatly to the feasibility of monitoring permafrost changes across the subarctic by relating them to more readily observable changes to the surface cover. Such a model will further our understanding of climate change impacts through the leadership of meaningfully-engaged citizen scientists. In this ongoing study, a selection of subarctic sites representing the seven most common fen and bog habitat types on the Hudson Bay coast of Manitoba were studied from 2006-2014. At each site, two parallel 50-m transects 10 meters apart were laid and flags were placed at 2-m intervals. At each flag, ALT was measured twice using a steel probe, and categorical ground cover percentage estimates within a square meter were recorded for all vegetation types. Additionally, at 2 randomly selected flags on each transect, more in-depth species-level percentages were recorded and soil moisture measured. Analyses of n=3172 ALT measurements determined that ALT for fen habitats (mean=96.6 cm; SE = 1.5) was consistently greater than ALT for bog habitats (mean=57.2 cm; SE = 1.2). Multiple-regression analysis of ALT as the dependent variable and vegetation cover types as independent variables to assess the relative importance of cover types determined that specific habitat type was the strongest predictor of ALT ($p<0.001$). Such a relationship is extremely promising in terms of the creation of an accurate predictive model. A model which takes into account only lichen cover, water cover, habitat type, and year can predict ALT very effectively ($R2=0.752$; $df=2755$; $p<0.001$), but will require additional parameters to account for the remaining variation in ALT. Future analysis will also incorporate data on water depth, soil moisture, and snowpack, as well as more specific and species-level vegetation variation that accounts for surface variation within a habitat type. Across the years of study, no notable overall positive or negative changes were recorded in ALT, but the values in each habitat type fluctuated year to year. Our analysis has shown that annual environmental factors, including precipitation and temperature recorded at Churchill weather stations, account for a portion of the year to year variation across habitat types, but further analysis is required to assess the specifics of such relationships. Ongoing analysis will refine this model and tailor it for use in more widespread permafrost monitoring research. This student-led approach has effectively engaged over 200 students in ecological research design and data analysis, while inspiring participants, raising awareness about arctic ecosystems, and effectively training future scientists.

NEWLY DISCOVERED PERSISTENT ORGANIC POLLUTANTS AND THE CHANGING EXPOSURE PROFILE IN POLAR BEARS FROM HUDSON BAY

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There is a growing array of chlorinated, brominated and fluorinated persistent organic pollutants (POPs) that have been shown to be transported to the (Canadian) Arctic and accumulate in biota. These recently emerged POPs include polybrominated diphenyl ethers (PBDEs) and other flame retardants (FRs) as well as perfluoroalkyl substances (PFASs) and their precursors. The polar bear (Ursus maritimus) is the apex predator of the arctic marine ecosystem and food web, and recently emerged POPs such as FRs and PFASs have been reported in the tissues of bears collected over the last decade or so from some circumpolar subpopulations. In this presentation, we report on targeted and newly detected POPs in the tissues of polar bears recently harvested from Hudson Bay. Fat and liver sample pairs from 2011-collected polar bears from the southern Hudson Bay were screened for a suite of 15 organophosphate FRs. Samples contained tris(2-chloroisopropyl)phosphate (TCIPP) and tris(2-butoxyethyl) phosphate (TBOEP) at mean levels at 7.2 +/- 8.2 and 4.8

+/- 5.1 ng/g wet weight (ww), respectively, in the fat, and 3.7 +/- 3.4 and 5.6 +/- 4.5 ng/g ww respectively, in the liver. These same fat samples were screened for several Dechlorane (DP) and DP-like, norbornene derivatives that are FRs. Syn- and anti-DP were not detectable, but DP-602 and DP-603 were quantifiable and at levels of 2.5 +/- 2.4 and 0.3 +/- 0.2 ng/g lipid weight (lw) respectively. Similarly in 2011-, 2012- and 2013-collected samples, of the 22 non-PBDE replacement FRs that were screened for in fat samples from all Hudson Bay bears, only 2 FRs were quantifiable (BB-153 and α-HBCDD). For southern Hudson Bay, bears had quantifiable α-HBCDD concentrations ranging from non-detectable to 37 ng/g lw. In recent 2013 liver samples, several previously undetected PFASs and precursors were found, e.g. perfluorobutane carboxylic acid and sulfonate and their sulfonamide percursors. In fat samples of 2012- and 2013-collected Hudson Bay bears, only 2 contained quantifiable but low ppb levels of hexachlorobutadiene, and β-endosulfan could be quantified at low ppb levels in 18 of the 20 fat samples, whereas both β-endosulfan and endosulfan sulfate were below detection. For fat samples from Hudson Bay bears harvested in 2012, the 24 short-chained chlorinated paraffins (SCCPs) screened for were of chain lengths of C10-C13, and for each chain length SCCPs containing 5 to 10 chlorines. The mean sum-SCCP concentration was very low and 493 +/- 343 pg/g lw. The C10, C11, C12 and C13 SCCPs were comprised of the Cl5-Cl8, Cl5-Cl9, Cl5-Cl9 and Cl5-Cl6 congeners respectively. We conclude that as of 2014, international regulations are showing effectiveness as legacy and emerged POPs over the last decade are generally not increasing and in some cases decreasing in polar bears from Hudson Bay. However, an increasing complexity of new targeted POPs are being found, and are presently unregulated (e.g. BDE-209 and SCCPs), and retrospectively may have been an exposure issue for some time and could be of future concern and exposure risk to Hudson Bay as well as circumpolar subpopulations of bears.

ICE ISLAND DETECTION AND IMAGE CLASSIFICATION USING RADARSAT-2 SAR IMAGERY AND SUPPORT VECTOR MACHINES

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Ice islands are large tabular icebergs calved from Arctic ice shelves that have increased in prevalence in Arctic waters over the last decade. Since these marine hazards drift south from their source areas, the Canadian Ice Service (CIS) detects and tracks them manually using the Synthetic Aperture RADAR (SAR) capabilities of RADARSAT-2 (RS2). This study examined 134 polarimetric variables to assess their utility in separating ice islands from various background ocean states (first and multiyear ice cover as well as open water that were obtained from ice charts). Analysis of Variance (ANOVA) with Tukey's Honest Significant Differences (THSD) was used to determine which of the available SAR variables in 70 fine-quad RS2 images were ideal for separability of ocean covers from other surfaces. For meteoric ice islands, the T22 SAR variable was found to be ideal while for marine ice islands, Krogager double-bounce decomposition offered the greatest separability. For multi-year ice and first-year ice, normalized shannon entropy demonstrated the best separability. Neumann tau was the most useful for open water. These four selected SAR variables were used along with segmented images and Support Vector Machines (SVM) to develop a classification model for ice islands. The classification separated ice islands from background ocean covers most of the time; however, there was a moderate degree of confusion between some ice islands and ice rubble/ridges. There was also confusion between other ice islands and first-year ice as well as water. We also evaluated the hypothesis that several factors such as air temperature, wind, SAR incidence angle, and look direction were confounding factors in the classification. Redundancy analysis (RDA) of image geometry, meteorological data and the four selected SAR variables identified incidence angle and air temperature as confounding factors and indicated that wind speed and look direction also influenced ice island classification. Once fully tested, these techniques could be developed into an automatic ice island detection algorithm which will be compatible with the Compact Polarimetry (CP) mode in the upcoming RADARSAT Constellation Mission (RCM), which would enhance ice hazard detection for the CIS and marine operators in the future.

MODELLING HIGH ARCTIC PERCENT VEGETATION COVER USING VERY HIGH SPATIAL RESOLUTION VEGETATION INDICES

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The objective of this research is to explore the relationship between seasonal vegetation indices (VIs) and percent vegetation cover (PVC) for a High Arctic environment using high spatial resolution field-level photographs. In this study, a Canon digital near-infrared camera (Maxmax Inc., Carlstadt, NJ) was used to collect quadrat-level (0.25 m x 0.5 m) image data for three arctic vegetation communities (i.e., wet sedge, mesic tundra and polar semi-desert) throughout the growing season (i.e., from late June to early August, 2014) at Cape Bounty, Melville Island, Nunavut. Vegetation indices, including the Ratio Vegetation Index (RVI), Normalized Difference Vegetation Index (NDVI)

and Soil Adjusted Vegetation Index (SAVI) will be derived from these digital near-infrared photographs for comparison to measures of PVC. Quadrat-level percent cover for 11 surface cover types (i.e., water, rock, mineral soil, organic soil, green moss, senescent moss, forbs, green graminoids, senescent graminoids, willow and plant litter) will be estimated from the classification results of field photographs using the K-means algorithm. Artificial grid points will be superimposed on field digital photographs to simulate the point-frame method which has traditionally been used to estimate PVC. The cover class for each artificial grid point will be visually identified and used to evaluate the K-means classification results in terms of assessing the accuracy of each classified image (and cover class) throughout the growing season. Linear regression analyses will be conducted to determine the relationships between the VIs and PVC for each of the vegetation community types. The purpose of this analysis is to determine the nature of the relationship of different VIs with different cover classes. Although it is anticipated that NDVI will demonstrate the strongest relationships with PVC, it is not clear how different cover types endemic to this environment may be better modelled using other indices. For instance, the VI-PVC relationship for wet sedge sites is anticipated to have stronger correlations with NDVI than mesic tundra and polar semi-desert. If so, this may indicate that other VIs (e.g., SAVI) are more suited to modelling PVC for areas with low vegetation cover and exposed soil (e.g., mesic tundra and polar semi-desert) by correcting for the influence of soil brightness. Hence, it may be better to partition the landscape into community types prior to modelling biophysical variables using different spectral indices.

SEX-DEPENDENT DIFFERENCES AND ENVIRONMENTAL INFLUENCES ON GROWTH AS LENGTH OF ARCTIC COD (BOREOGADUS SAIDA, LEPECHIN 1774) IN THE CANADIAN BEAUFORT SEA

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Arctic Cod are an important Arctic forage fish, as they are the most abundant fish in the Beaufort Sea and are energy-rich prey for larger predators. Arctic Cod are found throughout the water column, occupying different water masses at different stages of life. They act as an energetic link between lower trophic zooplankton and higher order marine mammals and seabirds, and likely other fishes. To understand the how regional differences may influence their role in the energy dynamics of the Canadian Beaufort Sea, energy allocation by Arctic Cod was investigated, taking into account the variation correlated with the environment, geography, and sex. Energy allocation typically follows a bioenergetics model, which indicates possible paths for energy consumed by an organism. A bioenergetics model is usually framed as Consumption = Metabolism + Wastes + Growth. After metabolic demands are satisfied, surplus energy may be allocated to growth, reproduction, or energy storage among other possibilities. In this study, Arctic Cod growth (fork length-at-age) differed among depth zones, arbitrarily organized by whether they were captured on the Beaufort Shelf, on the Shelf slope, or off the Shelf (differ by $L\infty$ parameter of fitted von Bertalanffy growth models, $p < 0.05$), as well as between sexes (by regression slopes, $p < 0.001$). Alternatively, growth did not differ among sampling transects, which were organized perpendicular to shore and spanned much of the Beaufort Shelf (by regression slopes, $p = 0.26$). As the environment was nearly uniform in the sampling area, differences in diet or daily energy intake may explain some of the variation in growth between sexes due to differences in gape size. Also, prey selectivity may explain some of the variation in growth observed among depth zones due to a difference in prey distribution among water masses. However, it should be noted that not all metabolic costs could be calculated and therefore may account for some of the variation in growth observed. This study is an important step toward understanding both the energetic differences within the population and the effect of the environment on Arctic Cod energy dynamics, and is part of a larger project on energy use and consumption in the Canadian Beaufort Sea.

EVIDENCE FOR GLACIAL ICE STREAMS IN EASTERN PARRY CHANNEL AND ADJOINING MARINE CHANNELS, CANADIAN ARCTIC ARCHIPELAGO.

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Multibeam imagery and 3.5 kHz sub-bottom profiles were acquired in eastern Parry Channel and adjoining channels from CCGS Amundsen by ArcticNet in collaboration with the Geological Survey of Canada and the Ocean Mapping

Group at the University of New Brunswick. These show the former presence of ice streams in those waterways. At the western margin of the study area, mega-scale ridge and groove lineations were formed in Peel Sound by an ice stream from the Laurentide Ice Sheet that flowed northward into Parry Channel. Farther east, seafloor lineations and terrestrial evidence indicate that glacial ice from an Innuitian ice centre to the north or northwest, and convergent ice flow from western Devon Island combined with probable ice flow from Cornwallis and Bathurst islands to sustain a southward flowing glacial ice stream in Wellington Channel. Likewise, linear glacial flutings in Prince Regent Inlet, Admiralty and Navy Board inlets were formed by glacial ice streams that flowed northeasterly into Lancaster Sound and eastward along the sound toward Baffin Bay. At the eastern end of Parry Channel, a moraine at an elevation of 500 – 600 m asl. on the north side of Bylot Island was formed by an ice stream grounded in Lancaster Sound that was buttressed against the north side of the island. An ice stream thickness of 1600 -1700 m is indicated. Investigations by other researchers of the trough mouth fan at the entrance to Lancaster Sound suggest the presence of ice streams in eastern Parry Channel during the Early, Middle and Late Pleistocene. Detrital carbonate sediments at the fan were correlated with Heinrich events H1, H2, H3, H4 recognized in the ODP 645 drill site in Baffin Bay, spanning a time period of 22,000 years. The apparent synchronicity of those correlations with Heinrich events in the northern Labrador Sea originating from ice streams in Hudson Strait demonstrates a pattern of region-wide ice sheet growth and retreat throughout the northeastern sector of the Laurentide Ice Sheet. High resolution Huntec, seismic reflection and 3.5 kHz sub-bottom profiles indicate that the seafloor in the eastern Parry Channel region contains variable amounts of ice-contact sediments that locally are overlain by glaciomarine and postglacial sediments. Chronological data from the sediments at the trough- mouth fan, and from sediment cores in Lancaster Sound and Barrow Strait together with terrestrial data indicate a systematic retreat of the last ice stream in eastern Parry Channel. Retreat was underway at the fan by ca. 16 cal ka yrs. BP and lift-off and decoupling of the ice from the seabed had reached eastern Lancaster Sound by ca. 15 cal ka yrs. BP, western Lancaster Sound by ca. 11.5 cal ka yrs. BP, and eastern Barrow Strait by ca. 10.8 cal ka yrs. BP. Terrestrial data indicate that the sea had reached the mouth of Wellington Channel by 10. 4 cal ka yrs. BP. These results extend the regional framework required for assessment of seafloor geohazards in the eastern Parry Channel sector of the Canadian Arctic Archipelago.

WILD REINDEER OF EAST TAYMYR: SPATIAL DISTRIBUTION DYNAMICS

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The modern development of Taimyr peninsula together with the "quick" changeable environmental conditions followed great anthropogenic pressing both on some arctic and subarctic tundra ecosystems and on the animal kingdom population level. By our observations and meteorological data climate, relief, vegetation, predators, anthropogenic pressing and other wild reindeer environmental conditions at East Taimyr have been described. Within last decades population needs the attention of some specialists and some management programs formation. Problem is to figure out the common natural phenomena of wild reindeer migration ways across East Taimyr. Within the period of 1984-1996 field work 500 hours of ground and 600 hours of air survey have been conducted. By our observations and meteorological data climate, relief, vegetation, predators, anthropogenic pressing and other wild reindeer environmental conditions at East Taimyr have been described. Wild reindeer seasonal migration is not fulfilled as an entire stream but by definite "migration branches". Terms and intensity of migration stream and groups number of each branch are differed in different years and in the same season even. For example, in spring 1984, 1988, 1990 the prevailed migration stream unit was east "branch". It is the portion where greatest number of animals went, and migration finished later than west. Spring migration 1986 is characterized by displace of west and east "branches" toward the centre and some junction partly. Migration is characterized by the following steps. Both in a spring and in a fall the migration beginning is appearance of the vanguard groups or reindeer movement traces, peak is massive groups movement, and finish is last groups had gone and no traces of reindeer movement. Some deviations have been figured out. For example, movement starts, than intensity of movement decreases and at last movement interrupts. In some time back migration starts and later an initial movement reinstitutes. Pulse migration beginning terms and occurrence of the back way has been influenced by climate factors.

ARCTIC-COLORS (COASTAL LAND OCEAN INTERACTIONS IN THE ARCTIC) – A NASA FIELD CAMPAIGN SCOPING STUDY TO EXAMINE LAND-OCEAN INTERACTIONS IN THE ARCTIC

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The overarching objective of our project is to design an integrative, interdisciplinary oceanographic field campaign to address high priority science questions related to land-ocean interactions in the Arctic, and assess the impacts of natural and anthropogenic changes on coastal ocean biology, biogeochemistry and biodiversity. A key component of the proposed field campaign will be the use of spatial-temporal information products derived from remotely-sensed data to extend observations to larger spatial and longer temporal scales, and the proposed integration of satellite and field observations with coupled physical-biogeochemical models for predicting impacts of future pressures on Arctic, coastal ocean, biological processes and biogeochemical cycles. Specific science objectives include: 1. Quantification of Arctic riverine fluxes of constituents with a significant impact on coastal biology, biodiversity, biogeochemistry (i.e. organic matter, nutrients, suspended sediment), and the processing rates of these constituents in coastal waters. 2. Evaluation of the impact of the thawing of Arctic permafrost within the river basins on coastal biology, biodiversity and biogeochemistry, including various rates of community production and the role these may play in regional economic well being. 3. Evaluation of the impact of changing Arctic land-fast ice and coastal sea ice dynamics on estuarine and coastal biology, biodiversity and biogeochemistry, including rates of community production. 4. Establishment of a baseline for comparison to future change, and utilizing models to assess the potential impacts of these future changes on coastal biology, biodiversity and biogeochemistry. Through organization of two dedicated workshops and presentations at NASA Ocean Biology and Biogeochemistry (OBB) science team meetings, the scoping study will engage the broader scientific community and invite participation of experts from a wide range of disciplines, to refine our research objectives and outline detailed research strategies needed to attain these objectives. The scoping study will also involve interagency and international collaborations. The deliverable will be a comprehensive report to NASA outlining the major scientific questions, and developing the initial study design and implementation concept.

FROM TRADITIONAL KNOWLEDGE TO SUSTAINABLE ENTERPRISE: BRIDGING LABRADOR INUIT USE OF RHODIOLA ROSEA TO FOSTER COMMUNITY CAPACITY

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Recent ethnobotanical studies in Arctic and Sub-Arctic communities have indicated a resurgence of interest in the traditional use of plants as medicine, as well as their potential as economic products. Rhodiola rosea is a plant native to Labrador with a history of traditional use among the Nunatsiavut Inuit. Rhodiola has also become significant in the global trade of natural health products, though most rhodiola in commercial trade is sourced in Eurasia. This creates an opportunity to cultivate a sustainable North American source of rhodiola in Labrador to produce a northern, fair trade product. Strong support from community Elders prompted research to investigate Labrador rhodiola for the development of a local enterprise with benefits for participating communities. To establish an evidence base for the commercial development of Labrador Rhodiola rosea as a locally cultivated natural health product, it was first determined whether the local plant populations exhibit suitable medicinal potency. Trial gardens were also established to determine appropriate cultivation sites and methods for the area. To ensure local objectives were addressed and integrated into the enterprise development, community goals and perspectives surrounding commercialization would need to be assessed, along with a preliminary business opportunity analysis. A business opportunity analysis was conducted which elucidated four product options and three potential target consumer groups. The scope of operations for the proposed enterprise comprises horticultural, processing, and manufacturing aspects of the business, with attention to Good Agricultural Collection Practices (GACP), Current Good Manufacturing Practice (CGMP), and regulatory frameworks relevant to the chosen target market. Market data shows a trend of consistent growth in the natural products industry over the last decade, and annual growth is predicted to continue, indicating robust economic potential in developing a natural health product. Rhodiola from Labrador would occupy a unique market niche as a sustainable, fair-trade product, based upon local Inuit traditional knowledge, in contrast to most rhodiola on the commercial market which is wild harvested in Eurasia. An enterprise based upon traditional knowledge and local resources presents the potential for a variety of tangible and intangible benefits to participating communities, including job creation, technical training, youth participation,

and economic gain. Consultation with community partners is integral to structuring a research framework with applied benefits. However, community members need a platform for expression before an enterprise with community benefits may be developed. Community round table sessions were held in several Northern Labrador communities to document existing knowledge and gauge community perspectives and goals. Elders were very surprised to learn that a local, traditionally used plant was valuable in the global commercial trade of natural health products. These discussions indicated unanimous support for the proposed enterprise, and also uncovered several previously undocumented traditional Inuit uses of rhodiola. By partnering with indigenous communities in the creation of entrepreneurship, this will stimulate the development of an enterprise culture that respects and integrates cultural traditions, leading to the empowerment of communities as economic agents.

LOCAL AND REGIONAL SCALE IMPACTS OF ARCTIC SHIPPING EMISSIONS OFF THE COAST OF NORTHERN NORWAY

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Decreased sea ice extent due to warming has already resulted in the use of new shipping routes through the Arctic. Marine traffic is a source of air pollutants, including NOx, SO2, and aerosols, and is predicted to be an increasingly significant source of Arctic pollution in the future. Currently there are large uncertainties in both global and Arctic shipping emissions, leading to uncertainties in diagnosing current and future impacts of marine traffic on Arctic air quality and climate. This study focuses on the local scale, examining chemical/aerosol transformations occurring in individual ship plumes. Measurements of ship pollution in the Arctic taken during the EU ACCESS aircraft campaign (Arctic Climate Change, Economy and Society) in July 2012 are used to quantify the amount of pollution emitted from different ship types. This is combined with regional model (WRF-Chem) simulations to evaluate the impacts of shipping in northern Norway in summer 2012. The model is run at high resolution (3x3 km) combined with STEAMv2 (Ship Traffic Emission Assessment Model version 2) emissions (1x1 km, 15 minute resolution) produced for shipping activity during the measurement period. WRF-Chem model results are compared with 3 ship plumes sampled during ACCESS. The model shows that both the location and total amount of pollution in individual ship plumes are correctly represented. Given this, the model is used to investigate the regional influence of ship pollution off the coast of Norway on a weekly time scale during July 2012, focusing on ozone photochemistry in ship plumes, the evolution of aerosols, and investigating the fate of black carbon emitted from ships. We compare regional modeling results obtained using 15 minute resolution STEAMv2 emissions with results using weekly averaged emissions, which are more representative of emissions typically used by global models to study the impacts of shipping on air quality and climate.

THE ARCTIC OBSERVING SUMMIT: HARNESSING KNOWLEDGE AND GUIDING THE FUTURE FOR DESIGNING, OPTIMISING, AND IMPLEMENTING AN ARCTIC OBSERVING NETWORK FOR ENVIRONMENTAL CHANGE ADAPTATION

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The International Study of Arctic Change (ISAC) is a long-term, international, Arctic environmental change research program. ISAC initiatives include engaging communities, stakeholders, researchers, managers and decision makers to collaboratively observe, understand and respond to Arctic change, from monitoring and research, to data-sharing and knowledge translation. The biannual Arctic Observing Summit (AOS) is a pillar activity led and co-organised by the ISAC International Program Office and partners. The goal of the Summit is to serve as a platform to provide community-driven, science-based guidance for the design, implementation, coordination and sustained operation of an international network of Arctic observing systems. The AOS functions as a forum for solutions-oriented discussion, planning and priority-setting to link stakeholder needs with Arctic observing systems planning, data collection and accessibility, and the creation of timely and relevant data products. The AOS is a SAON (Sustaining Arctic Observing Networks) task to identify and

pursue specific activities designed to improve Arctic observing for a full spectrum of applications, from climate research to the delivery of useful products for Arctic change monitoring and adaptation. AOS events facilitate collaboration, coordination, knowledge-sharing, and the identification of gaps, opportunities and novel challenges for sustained Arctic observing, from communities to biodiversity and ecosystems, for mitigation, forecasting, sustainability planning and conservation.

DEALING WITH LIMITATIONS AND BIASES WHEN DOCUMENTING INUIT KNOWLEDGE OF ARCTIC MARINE SPECIES: THE EXAMPLE OF WALRUS IN NUNAVIK (QUEBEC, CANADA)

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Combining the use of Traditional Ecological Knowledge (TEK) with science has recently increased in many fields of ecology. This is particularly true when working in remote locations where harvesters have a close relationship with wildlife, such as the Arctic. TEK is often gathered through interviews with elders and hunters and the resulting database provides valuable complementary information on aspects of wildlife ecology either overlooked or poorly understood by the scientific community. However, it is important to note that there are limitations and biases in the methods used to gather, analyze and represent TEK that can not only jeopardize the validity of the data, but potentially result in negative impacts for wildlife populations. To date, little attention has been given to the critical examination of TEK research methods and their impacts on the resulting data. Here, we discuss the limitations and biases involved in our documentation and analyses of TEK on walrus in Nunavik. Knowledge from 33 expert walrus hunters and elders was collected in Quaqtaq, Ivujivik, Inukjuak and Kangiqsualujjuaq. We used semi-directive interviews with a participant mapping process, to better understand the impacts of environmental changes on walrus distribution, behaviour and health, and incidentally on walrus hunting in Nunavik. Interviews were audio-recorded, transcribed and analysed using NVivo10. Maps were scanned, digitized and analysed using ArcGIS. To verify and validate our interpretation of the data, validation workshops were held with participants. Detailed attribute data were gathered for each participant (e.g. age group, gender, estimated number of hunting trips) and map feature drawn (e.g. source & estimated frequency of observation, year & month, number of animals). During the data collection and analyses, we faced the following challenges: 1) How to clearly define the limitations in space and time of the knowledge shared and how to represent this on maps? 2) How to identify the factors influencing the retelling of observations and knowledge and how to include them in analyses? 3) How to best consider and represent inter-individual variation in the data collected? This project tried several strategies, which attempt to address these limitations and biases in our methods. For example, by not initially documenting the geographic limits of participants' activities at sea (e.g. how far from the coast hunters generally travel), we potentially created a bias towards the coast of walrus observations mapped. Validation workshops not only allowed us to gather this geographic limit but also highlighted the desire of participants to include and consider this information in analysis and presentation of the dataset. By being critical of the methods we used and the biases they potentially introduced, we were more able to examine and implement strategies to address them. These strategies will help to create more reliable datasets that better reflect hunters' knowledge and observations of Arctic species in the future. We hope that this critical examination of methods will also help to increase widespread trust and confidence in these datasets as a valuable source of knowledge for wildlife management and decision making.

RESEARCH, MANAGEMENT, AND COMMUNITY PRIORITIES FOR RINGED SEALS IN NUNAVUT

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Ringed seals (Pusa hispida) are the most abundant Arctic pinniped, with a range that extends throughout the circumpolar marine region. They are specially adapted to habitats with periods of ice cover, and may be considered a keystone species. Ringed seals are vulnerable to changes in environmental conditions, such as ice extent and thickness, snowfall, and abundance of other marine species. All communities in Nunavut continue to hunt ringed seals, a practice they have done sustainably for generations. Ringed seals are an important food source for many Inuit throughout Nunavut, and seal skins are an important resource, fulfilling personal needs and providing economic opportunities. Therefore, changes in ringed seal health

will affect the health of Inuit communities. Multiple ringed seal research programs exist across the Canadian Arctic and involve the participation of local hunters in the collection of samples and data. However, while some research programs have data and sample sharing arrangements, there is a lack of a more formalized network connecting programs. There is growing interest among communities and researchers in expanding both the focus of research and the communities involved, and in developing stronger linkages between projects to create a more integrated approach to research. We report on a workshop held in Iqaluit, NU on March 6-7, 2014, that invited researchers, managers, community members, and students to discuss current knowledge and issues of ringed seal research in Nunavut. The purpose of the workshop was to provide an opportunity for knowledge exchange, identify information gaps and priorities, plan for future collaborative and community-based research, and identify community and management concerns regarding the species. The workshop highlighted important questions, potential misconceptions, and information needs related to ringed seal research in Nunavut. It also identified opportunities to improve relationships between researchers, managers, and community members. The workshop also provided the chance for community members and researchers to pose and answers questions to each other, offering an important opportunity to clarify aspects of their respective knowledge of and work with ringed seals. Main outcomes of the workshop were organized into four themes: 1) the need for effective reporting about the workshop, 2) the need for more effective and diverse methods to communicate research, 3) the identification of future ringed seal research priorities, and 4) the desire to increase student involvement in research. The workshop also highlighted key issues in methods and processes in attempting to bring together researchers and community members around wildlife issues in Nunavut. These lessons contribute to broader discussions around relationships between researchers and communities, and multiple knowledge systems in wildlife research and management in the Arctic.

CLOUDS IN THE CANADIAN ARCTIC TROPOSPHERE DURING POLAR NIGHT: A MULTI-YEAR DEPOLARIZATION LIDAR STUDY OF LIQUID, MIXED-PHASE, AND COLD ICE CLOUDS AT EUREKA, NUNAVUT

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Water vapour, being the most abundant greenhouse gas in the Earth's atmosphere, influences the radiative budget of the atmosphere, and thus the climate. Clouds, too, have a large influence which is less well understood [1]. The level of scientific understanding regarding cloud feedbacks, particularly in Arctic regions, and particularly during polar night, is low. The 2012, 2013 and 2014 Canadian Arctic ACE/OSIRIS Validation Campaigns in Eureka, Nunavut, Canada (80°N, 86°W) provided an opportunity to make extensive measurements of tropospheric clouds during polar night using the Canadian Network for the Detection of Atmospheric Change (CANDAC) Rayleigh-Mie-Raman Lidar (CRL). Water in tropospheric clouds affects the radiative budget in several ways, dependent on cloud particle phase (liquid droplets vs. frozen ice crystals), and incoming solar radiation. Water droplets can exist in temperatures well below 0° C for extended periods, so temperature measurements alone are not a definitive method of determining the radiative behaviour of the clouds. Lidar depolarization measurements allow liquid and solid states to be differentiated in individual clouds at high spatial-temporal resolution. The CRL lidar measures the extent to which the lidar's polarized green laser beam becomes unpolarized as it interacts with the clouds and is scattered back down toward the lidar. Depolarization parameter values d = 0.34 to 0.47 (equivalent to linear depolarization ratio values of δ = 0.2 to 0.3) are generally taken to be the cutoff between interpretations of ice (higher d) or water (lower d), and many CRL measurements from the 2012-2014 campaigns lie in this diagnostic range. Particular attention has been paid to the uncertainty analysis of these depolarization measurements, as this becomes important when extending the depolarization parameters to interpretation of the clouds and their effects on the atmosphere above Eureka. Integration of the depolarization measurements with other measurement products from the CRL lidar (e.g. water vapour mixing ratio) and other co-located instruments at Eureka is underway. CANDAC's network of university and government researchers operates a diverse suite of more than 25 instruments and provides access to complementary, and simultaneous, long-term datasets at Eureka. The ACE/OSIRIS campaign time-series of depolarization measurements from the CRL, and sample comparisons with twice-daily radiosonde temperature and water vapour profiles, is to be presented. [1] IPCC, 2013: Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Figure SPM.5 and pp. 13 - 16.

COMPARING OLD AND NEW BASELINE MEASUREMENTS FOR ASSESSING TEMPERATURE CHANGES IN A DEEP NORTHERN LAKE (KLUANE, YUKON) OVER THREE DECADES

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Freshwater-terrestrial systems in northern environments, especially large lakes and their broader catchments, are particularly sensitive to climate-related changes. Physical, chemical, and biological lake properties (including lake and stream temperatures, water distribution, transport and concentration of sediments) may respond rapidly to environmental changes such as temperature increases and changing precipitation patterns. Such lake property changes can have important ecological consequences for both aquatic and terrestrial biodiversity within a watershed, including nutrient cycling, terrestrial productivity, and evapotranspiration. Ecosystem services and human communities managing resources and development in northern watersheds will also be affected. In order to better understand the ecological, social, cultural, economic and political consequences of changing lake and watershed properties, it is essential to understand the basic processes and patterns of the changing properties themselves. Unfortunately, historical physical, chemical, and biological data is rarely continuous, if at all available, for many northern and alpine lakes and watersheds, primarily due to a lack of resources and consistent monitoring programs. Kluane Lake is the largest lake entirely within Yukon (~400km2). Its watershed extends from the central St. Elias Icefields, across the Front Ranges, and east into the Kluane Hills and Ruby Range. The Kluane Lake watershed drains into the greater Yukon River watershed, which eventually drains in the Bering Sea. Because of its size and latitude, its importance to tourism and fishing, its complex limnology, and its significance to First Nations, Kluane Lake is a model study lake to better understand how climate change may affect northern lakes and watersheds. Lake temperature data for Kluane Lake was collected during 1985 and 1986 by the National Water Research Institute (Environment Canada). An Anderaa thermistor string (with resolution of 0.015°C) was used to obtain temperature data at a range of depths and locations throughout the lake. In 2013 and 2014, a Castaway CTD (Conductivity, Temperature, Depth) device (with resolution of 0.01°C and accuracy of ±0.05°C) was deployed to replicate measurements taken in the 1980's. A mooring was also deployed in the deepest part of the lake (approximately 80m deep), equipped with 10 SBE56 temperature sensors (with resolution of 0.0001°C and accuracy of ±0.002°C) placed at regular depth intervals. The mooring has been collecting temperature data in the lake since August 2013. A comparative analysis of the 1985-86 and 2013-14 data sets allows for an initial investigation into the longer-term dynamics of Kluane Lake during a period of rapid warming and loss of winter snow. However, in order to address issues of seasonal and inter annual variability, more frequent and consistent measurements need to be collected, emphasizing the need for the implementation of a comprehensive and long-term monitoring program. Such a program would not only be beneficial for enhancing our knowledge of northern lake watershed processes in the face of climate change, but can also serve as a model monitoring system for other northern lakes and watersheds.

MARINE-BASED DEGLACIATION AT THE NE MARGIN OF THE LAURENTIDE ICE SHEET: A HIGH-RESOLUTION SNAPSHOT

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The Late Quaternary glaciation and subsequent deglaciation of the Canadian Arctic Archipelago (CAA) has seen considerable recent revisions, with major advances in understanding ice extent and interaction during and after the Last Glacial Maximum. As such, a revaluation of the understudied Late Quaternary marine deglacial history is essential to understanding the CAA's deglaciation as a whole. A sediment core (2011-804-010 piston and trigger weight components) collected by ArcticNet / Geological Survey of Canada from eastern Lancaster Sound off northwest Bylot Island provides important new insights into the deglacial dynamics of the Northeastern Laurentide Icesheet. A multiproxy analysis (ice rafted debris, biogenic silica, total organic carbon, foraminiferal assemblages), constrained by six AMS 14C dates, enables the high resolution palaeoceanographic reconstruction of deglacial conditions, spanning some 2,600 years from 10.5 to 13.1 cal ka BP. Biogeochemistry (biogenic silica, total organic carbon) results demonstrate very little bioproductivity throughout both cores components, indicative of harsh environmental conditions during deglaciation. While all classes of quartz (rounded, angular, clear, milky, iron-stained) remain broadly consistent throughout, limestone abundances vary while calcareous

sandstone decreases steadily up record. Notably, granite & gneiss (as well as unknown lithics) exhibit a pronounced peak at ~11.5 cal ka BP, also marked by the absence of mafic IRD clasts at this time. Foraminiferal faunas throughout the record are comprised of opportunistic species able to withstand adverse environmental conditions that characterise ice-proximal to distal glacimarine environments (e.g. Elphidium excavatum f. clavata). Radiocarbon dates provide a minimum date on inital deglaciation of 13.0 cal ka BP, with subsequent glaciomarine conditions persisting until ~10.6 cal ka BP. The post-deglacial Holocene record is missing from the core, either suggesting only limited Holocene marine sediment deposition since ~10.6 cal ka BP or, more likely, sediment removal due to significant current winnowing, or submarine slope failure. The absence of a winnowed lag at the core top is consistent with mass movement. The evidence for large slope failure and instability has profound geohazard implications in an area currently of interest for industrial development. Furthermore, the palaeoenvironmental changes observed through this deglacial record inform our understanding of the marine-based deglaciation of the Laurentide Icesheet and eastern Northwest Passage.

DIETARY CHARACTERISTICS OF CO-OCCURRING ARCTIC COD AND CAPELIN IN THE CANADIAN ARCTIC, DARNLEY BAY

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Reduction of sea ice combined with encroachment of habitats as Arctic marine conditions ameliorate due to climate change, is expected to affect the abundance of Arctic Cod Boreogadus saida (Lepechin, 1774) and perhaps also the relationships of these intermediate-level trophic taxa, particularly in more southerly fringing seas in the Arctic. Arctic Cod and Capelin, Mallotus villosus (Müller, 1776) are pelagic, planktivorous forage fishes, which occupy similar dietary niches. Moreover, these mid-level consumers are preyed upon higher trophic level predators including other fishes, marine mammals and sea-birds (e.g., Arctic char (Salvelinus alpinus), beluga, and Thick-billed Murres (Uria lomvia)). Co-occurring individuals of both species were collected in the Darnley Bay, NT during summer marine sampling from the F/V Frosti in August of 2013. Standard length used as a proxy suggests that observed Arctic cod were predominantly aged 1+ age and Capelin were mostly age 2+. Stomach-content analyses of co-occurring fishes indicate that both species feed extensively on calanoid copepods (Calanus hyperboreus, C. glacialis, Metridia longa) and amphipods (Themisto libellula) thus exhibit substantive overlap in the range of taxa consumed. This study describes the feeding characteristics of these sympatric forage fishes in an Arctic ecosystem and contributes to better understanding of feeding preferences, the potential for competition between these species, and the possible consequences of climate change to mid-level components of the ecosystem.

A CLIMATE CHANGE AND PUBLIC HEALTH NEEDS ASSESSMENT REPORT CARD FOR THE NORTH

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While Inuit have been adapting to changing climatic conditions in the Arctic for thousands of years, the rate of change and variability in conditions has significantly increased in recent decades. As a result, there is a need to understand the impacts these changes are having on public and environmental health, what knowledge and resources are required to effectively address them, and what responses are already taking place. Such an assessment is an essential step towards effective climate change health adaptation and management. It is also important that the information gathered through such a review is disseminated in a way that is easily comprehensible, effective, and readily applicable for use by decision makers in the public and environmental health community. A number of international environmental and health programs have started to use a "report card" process that presents information on a standard list of valuable metrics for their subject as a way of synthesizing extensive status information. The 'Climate Change and Public Health Needs Assessment in Inuit Regions' project seeks to identify the impacts of climate change on public and environmental health in the four Inuit regions of the Canadian Arctic, the actions already being taken at various levels and the further information and resource needs. Further, it aims to disseminate the findings of this review in a synthesized and easily accessible form to support decision making on this topic. A report card format was developed as a means of effective knowledge translation for communicating the results of this project in each Inuit region. The report card uses qualitative information in a standardized format to assess information needs, and strengths and gaps in actions and programs across different sectors. By using the report card the substantial amount of information gathered is synthesized and presented in a way

that is more easily accessed by policy makers and governments. Academic literature, including peer-reviewed journal articles from online databases was reviewed to identify the core themes used in the report card. In a 'snowball' approach, references of each relevant article were then reviewed for additional articles that were not identified in the initial search. The final list of scientific articles and books (n=54) were then reviewed. Grey literature sources (n=49) were reviewed to identify current climate change health response programs. Grey literature was sourced from the reviewed scientific literature, online lists of communities and regions participating in specific climate and health programs and initiatives (government and other). Key informant interviews (n=24) with environment, cultural, wildlife and health experts in each Inuit region, as well as community leaders and national representatives within Canada are also being conducted to include in the report card analysis. The report card developed through this project will provide a comprehensive overview of climate change and health related programming needs as reported in the literature and expressed by representatives in each region. It is hoped that this will assist decision makers at many scales in allocating resources for programming and enhancing general adaptive capacity for health-climate change issues in the future.

ARCTIC STATUS AND STATE IDENTITY IN NORWAY: BIG FISH IN A SMALL (ARCTIC) POND

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As the Arctic is undergoing rapid change, it has also become a locus of attention for politicians, pundits, and the public alike. Not least the question of governance has repeatedly been raised, with the popular press' affinity for hyperbolic headlines casting doubt on the strength of the current political regime. As has been argued by politicians and academics time and time again, however, the region's stability rests soundly on two self-reinforcing pillars: The interstate cooperation happening through the Arctic Council, and the principles of international law laid down in the United Nations Convention on the Law of the Sea (UNCLOS). Although the likelihood of adherence to this regime has been analysed from different angles, this paper aims to consider a hitherto under-explored aspect – namely that of state identity. Focusing on the case of Norway, it argues that central to the state's support of the present-day political configuration of the Arctic is its correlation with decision-makers' perceptions of the country's character and role in the world. For Norway, the reliance on UNCLOS, in particular, allows for framing Arctic activities as a natural extension of a long history of sea-faring, exploration, and identity as a coastal state. It also, conveniently, situates the Arctic at sea, thereby doing away with calls for exceptionality for mainland Northern Norway. Furthermore, the status as a so-called "Arctic state" granted by this regime is both instrumental and beneficial for the country, allowing the small state a role as a "big player" in the region; indeed, allowing Norway to be a big fish in a small (Arctic) pond. By connecting it to ideas of states' identities – making adherence thereto an inherent feature of what defines the state – the Arctic regime of governance comes to hold under-appreciated normative and discursive power

SPATIAL VARIATION OF PHYTOPLANKTON PIGMENTS AND DISSOLVED ORGANIC CARBON IN THE WESTERN ARCTIC SEA: ANOMALOUS SEA-ICE MELT DURING THE SUMMER OF 2012

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The spatial variation of phytoplankton pigments and Dissolved Organic Carbon (DOC) in the Chukchi Sea was investigated on the Western Arctic using the research vessel Araon from August 1st to September 10th in 2012. Phytoplankton pigments and DOC samples were collected at total 32 sampling stations, and contour distribution of photosynthetic epigmnts and DOC at East Siberian Sea (ESS) / Mendeleyev (MR) and Northwind Ridge (NWR) were sampled through the depths. Total chlorophyll a(Chl a + Divinyl Chl a) concentration ranged from 0.002 ~ 8.3μg L-1. Photosynthetic pigment assemblage at spatial were largely dominanted Fucoxanthin principally produced by diatoms(>60%). Other pigments such as 19-Hex-fucoxnathin(19`HF), 19-But-fucoxanthin(19`BF), Diadinoxanthin(Dino) and Prasinoxanthin(Pras) 0.8% to 49% of the total chlorophyll a. Sized - phytoplankton proportion were microplankton (Fuco+Peirid:12~67%), nanoplankton (ALL+19`BF+19`HF: 24 ~ 61%) and picoplankton (Zea+Tchl b:9 ~ 50%). Distribution of DOC concentration was shown an increase trend toward higher latitude stations rather than lower latitude ones. Higher latitude which were affected by Sea Ice, were represented the highest values of DOC concentration (200 ~ 278 μM L-1). Besides the DOC concentration obtained higher values (104 ~ 145 μM L-1) in the eastern part (75° 33 N, 173° 76 E ~ 78° 99 N, 174° 00 E) than those (50 ~ 90 μM L-1) in the western (74° 00 N, 163° 99 W ~ 76° 99 N, 153° 98 W) of Chukchi

sea. DOC concentration also showed higher values in ESS/MR areas than these in NWR area, relatively. High latitude areas were influenced by the sea ice melting and East Siberian current which had the high DOC concentration, however we need to interpret the current characteristics and source of organic carbon by further biogeochemical analysis.

MAPPING CLAM HABITAT IN THE ARCTIC: BASELINE DATA FOR FISHERIES ASSESSMENT AND MANAGEMENT

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A variety of natural clam resources exist in Nunavut (e.g. NCRI 2008). These clams are harvested for personal consumption by local gatherers and in some locations there have been small, seasonal, diver initiated harvests for commercial purposes for over a decade. Concerns about food safety, diver safety, and costs associated with diving have prevented commercial harvesting since the early 2000s. Siferd (2005) conducted a preliminary assessment of a designated clam fishing zone near Qikiqtarjuaq, and found potential commercial levels of various Mya spp. The clams are slow growing, however, and recruitment levels could not be adequately evaluated. The Government of Nunavut (GN) Fisheries and Sealing Division are therefore evaluating the clam resource base of the region, with the view to establishing sound estimates of the resource and potential exploitation levels. The Memorial University Marine Habitat Mapping Group (MhMg) is assisting the GN in preparing a benthic habitat map of the coastal area around Qikiqtarjuaq that was surveyed by Siferd (2005). By utilizing multi-beam sonar, ground-truthed with underwater camera and benthic grab samples, the benthic habitats surrounding the community are being classified with respect to Mya spp. GN and the community of Qikiqtarjuaq will use the map to help determine the viability of a community-driven commercial fishery.

Multi-beam sonar data have been collected by the GN vessel MV Nuliajuk in four regions of interest on the eastern side of Broughton Island: the Islands, Kingnelling Fjord, North Baffin, and South Broughton. The 2014 ground-truthing yielded 74 biological samples and 46 sediment samples. Substrates in the Islands region were primarily cobble/boulder with some sand in the northern portion, housing large populations of clams. Many of the Kingnelling Fjord sites were dominated by cobbles, but the eastern portion was sandy with cobble outcrop, with moderate to dense clam population. North Baffin was generally sandy with boulder outcrop and was relatively devoid of benthic macro organisms. South Broughton was highly variable with cobble/boulder areas and sand with moderate clam abundance. Once ground-truth data from these sites have been compiled, they will be cross-referenced with multibeam data to designate habitat classifications with respect to Mya spp. in the designated regions of interest. The resulting benthic habitat map of Qikiqtarjuaq represents a collaborative effort between the GN, MhMg and local harvesters.

BIOGEOCHEMISTRY OF THE INORGANIC CARBON CYCLE IN THE CANADIAN ARCTIC ARCHIPELAGO

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Water samples collected in August and September of 2013 and 2014 were analyzed for dissolved inorganic carbon (DIC) and total alkalinity (TA). Samples were also collected for 13C and 18O isotopes at some stations throughout these two time periods. In 2013, samples were taken from stations in Baffin Bay and Nares Strait. In 2014, stations were located in the Amundsen Gulf, on the Mackenzie Shelf and in the Canada Basin of the Beaufort Sea. These station locations allowed for analysis of water from many different oceanographic locations throughout the Arctic Ocean including shallow shelf waters, deep ocean environments and estuarine waters. A through examination of the complete carbonate system including pH and carbonate saturation states will take place. The relative contributions of water masses will be examined as well as the physical and biological factors leading to changes in the carbonate system. An analysis of the isotopic fractionation of carbon and oxygen will aid in the assessment of the importance of these different factors and how they are changing. The Arctic Ocean is particularly at risk of change as warming, sea-ice loss and a weak buffering capacity all influence this complicated system. Study of this area is essential to understand the impacts of rising carbon dioxide levels in the atmosphere and the resulting changes on ocean processes.

IMPACT OF EARLY FOOD INPUT ON THE ARCTIC BENTHOS ACTIVITIES DURING THE POLAR NIGHT

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In Arctic areas where benthic primary production does not occur or is not sufficient, the benthos depends on episodic events of food inputs from overlying waters, in particular spring ice algae and phytoplankton blooms. Climate change is expected to lead to earlier ice melts, and subsequently to earlier spring blooms and food inputs to the benthos. The goal of the present study was to characterize benthic communities structure and activities during the polar night in Rijpfjorden, a high Arctic fjord from Svalbard, and to assess experimentally how earlier climate-induced food inputs can impact these benthic activities. Two concentrations of freeze dried phytoplankton were added to intact sediment cores, while additional control cores did not receive food addition. SOD, nutrient fluxes, bioturbation coefficients (as indicator of benthic activities) and contents of organic matter and pigments in sediments were measured at the beginning of the experiment, and 9 days after the addition. In the initial polar night conditions, SOD was ~4.2 mmol O2 m^{-2} d-1, bioturbation coefficients were null for biodiffusion and 1.08 y-1 for bioadvection, and benthic biomass was 1.36 g 0.1 m-2. In the cores with food addition, the phytoplankton added was quickly consumed, and after 9 days, SOD and bioturbation were higher in the food treatments compared to the control cores, both being higher with higher food concentration. This study documented a clear and quick response in benthic activities following the food input, suggesting that in winter/early spring, Arctic benthos may depend on early food inputs for its activities. Climate-induced changes in food supply to the seafloor could have drastic consequences for the benthic ecosystem functioning. Keywords: Svalbard, pelagic-benthic coupling, bioturbation, biogeochemical fluxes, feeding experiment, ecosystem functioning

FACTORS INFLUENCING ARCTIC FOX (VULPES LAGOPUS) LITTER SIZE VARIABILITY ON BYLOT ISLAND, NUNAVUT.

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Spatio-temporal resource dynamics is a major driver of reproductive output for arctic predators. One widespread generalist predator, the arctic fox (Vulpes lagopus), occurs in various arctic ecosystems. The arctic fox has the largest litter of all carnivorous mammals; it can have up to 17 young per litter. It is found in two main habitat types with marked differences in diet and reproductive patterns. In coastal habitats free of ice, the arctic fox diet is dominated by marine resources (invertebrates, fish, seals, etc.) and colonial birds. These fox populations rely on relatively stable food supplies. Foxes in terrestrial habitats feed primarily on microtine mammals whose abundance varies significantly from one year to the next due to cyclical population fluctuations. Populations feeding on stable food resources such as those found in coastal habitats produce smaller litter sizes (mean 4.2 ± 1.5 / maximum 10), but reproduce consistently over the years. In comparison, those who depend on cyclical resources produce larger litters (6.3 ± 3.3 / maximum of 19), but reproduce only during periods of high abundance of prey. On Bylot Island (73 ° N, 80 ° W, Nunavut, Canada), foxes feed preferentially on lemmings (Lemmus trimucronatus and Dicrostonyx groenlandicus), whose abundance cycles over a 3-5 year period, and alternatively on colonial greater snow geese (Anser caerulescens atlanticus), who provide seasonal pulses of predictable and abundant food. The goose colony is also located in a restricted portion of the study area, whereas foxes breed in dens distributed across the entire study area. This is therefore an ideal setting to study how arctic fox litter size is influenced by variation in small mammal abundance in the presence of an abundant alternative seasonal food. We monitored fox litters using camera traps beginning with their date of emergence to their dispersal from 2008 to 2013. We analyzed pictures to accurately determine litter sizes, which has never been done for this species. As predicted, we found that arctic fox litter size is strongly correlated to lemming cyclic dynamics. Litter size was significantly higher during peak lemming phases. However, we also found that even in low lemming years foxes had medium litter sizes (5-6 young) when couples were established near the goose colony, though their litter survival was very low. This study will allow a better understanding of the reproductive ecology of a species that plays an important role in the arctic tundra.

SATELLITE-BASED MAPPING OF ICINGS IN THE GREAT SLAVE REGION AROUND YELLOWKNIFE: A CASE STUDY.

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Icings, sheet-like masses of layered ice that form over the winter by freezing of successive flows of water extruded to the surface, are poorly understood arctic and sub-arctic hydrological phenomena. For the first time, icings have been successfully mapped from a 30-year archive of satellite images, as a part of a case study undertaken to assess the utility of Landsat optical satellite imagery for mapping icings and to develop a methodology that may be applied to other regions. Remotely sensed data enable mapping of large areas, and Landsat data have the added benefits of being free and easily available, and having a relatively long historical archive. Both hydrologically and practically significant, icings indicate the location of springs, are important water storage components, can increase flooding potential by acting as major flow restrictions during spring freshet, and are a potential hazard to northern ice roads and all-weather roads, decreasing the number of days of operational use. Being controlled by local and regional factors, icings reoccur at the same location, but not each winter, nor to the same extent. Consequently, icing process studies and risk assessments require icing dynamics and distribution data from long-term datasets, but none have been compiled. Here we present the first semi-automated icing mapping approach, utilizing archival images acquired in late-spring when this region is largely snow-free, but icy bodies remain. All ice bodies are mapped, but a water mask is used to clip out frozen water bodies (lakes and rivers), and the remaining ice bodies are considered to be land-fast icings, having formed from winter overland flow of water. Maps from successive years are overlaid in a Geographic Information System to determine the total occurrence of icings and reoccurrence intervals. Nearly 5,500 icings were mapped in the Great Slave region around Yellowknife (21,886 km2) from 24 Landsat archival images (1985 to 2014). Icing size, which ranged by four orders of magnitude, was inversely related to return frequency, with 90 % of the total icing area returning 10 years or less. Substantial spatial variation occurred between ecoregions within the study area where geological setting affects icing dynamics. Interannual variation of total icing area was considerable, ranging from 1.3 to 29.4 km2, and was in general agreement amongst the ecoregions, but was not coincident, suggesting likely ecoregional climate variation. In addition, the groundwater source distances likely vary among the ecoregions according to geology and permafrost conditions. Consequently, icings in some regions may also be influenced by meteorological conditions outside of the study region. This case study successfully demonstrates a relatively uncomplicated methodological approach to icing mapping, which may be operationalized with modifications to map icings throughout the north. This approach takes advantage of Landsat archival data that allows for most icings to be mapped, and, being free, it is extremely cost effective. The data generated from this approach establish the baseline for winter hydrological variability in the region against which future icing conditions under a changing climate regime may be compared.

TEMPORAL TRENDS OF MERCURY AND PERSISTENT ORGANIC POLLUTANTS IN LANDLOCKED CHAR IN HIGH ARCTIC LAKES

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This long term study which is funded by the Northern Contaminants Program, is examining trends over time of mercury (Hg) and other trace elements, as well as legacy and new persistent organic pollutants (POPs) in landlocked Arctic char collected annually from lakes near the community of Resolute Bay on Cornwallis Island (Amituk, Char, North, Small, and Resolute) and in Lake Hazen in Quttinirpaaq National Park on Ellesmere Island. As the only top predators in most high latitude Arctic lakes, landlocked char are good indicators of changes in inputs of Hg and bioaccumulation of methyl Hg. Many POPs are known to undergo similar biomagnification as methyl Hg and also accumulate in Arctic lake food webs. Analysis of landlocked char can thus provide information on the range of chemical contaminants and time trends of these chemicals in Arctic freshwater systems which complements studies on marine mammals and birds from the same regions. Annual collections have been successfully carried out in Resolute Lake since 1997. Collections of char from the other lakes have not been as consistent, but all lakes have 9 or more years of data. Collection numbers have typically ranged from 7 to 25 adult fish (>200 g) per lake except in Char Lake where the range has been 3 to 10 fish annually. Char muscle samples are analysed for mercury by CVAAS after acid digestion or by a Direct Mercury Analyser. In addition the acid digest was analysed for 31 elements using ICP-MS. Char muscle (+ skin) samples were for analysis for POPs, including PCBs, legacy organochlorine pesticides, PBDEs and other flame retardants and perfluorinated alkyl substances such as PFOS. Statistically significant declines of Hg were found in Amituk, Char, Hazen, North, and Resolute lakes, ranging from -5.5 to -19% /yr for the period 2005 to 2014. Small Lake was the only lake with an increase in concentrations in more recent years (+2.3%/yr), however, the increase was not statistically significant. Alpha-HCH declined more rapidly than all other POPs with an annual decline of -6.5 to -12 %/yr. β-HCH actually increased in char from Hazen Lake, however, it makes up only 5 to 7% of ΣHCH; the other components α- and γ-HCH isomers are declining. ΣDDT and ΣPCBs declined significantly in Char, Amituk and Hazen lakes but not significantly in Resolute Lake.

Trends for ΣPBDEs (sum of 14 BDEs) in landlocked char vary widely among lakes. ΣPBDE concentrations increased overall in all lakes from the 1990s to late 2000s but are now declining in Amituk and Resolute lakes. ΣPBDE concentrations continue to increase in Lake Hazen char, although the trend from 2001 to 2012 is not statistically significant. There is considerable year to year and lake to lake variation, as well as fish to fish varation in contaminant concentrations which needs to be better understood. Work is ongoing to analyse the temporal trend results for effects of climate warming and to changes in global emissions of the contaminants.

BIOACCUMULATION OF MERCURY IN ARCTIC CHAR IN EAST AND WEST LAKE, CAPE BOUNTY ARCTIC WATERSHED OBSERVATORY, MELVILLE ISLAND, NUNAVUT

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The Cape Bounty Arctic Watershed Observatory (CBAWO) utilizes two adjacent, geologically similar watersheds, West and East, which are currently undergoing climate-driven changes. Climate over the period 2007-2012 was unusually warm during summer months and resulted in changing hydrology and permafrost degradation across the area. In addition, the West catchment experienced numerous large active layer detachments during the 2007-8 period while the East catchment has experienced relatively minor disturbances. These alterations to runoff patterns, erosion and permafrost degradation may also drive changes in the biogeochemical cycling of mercury (Hg). We are investigating whether these changes are also seen in mercury bioaccumulation in andlocked Arctic char (Salvelinus alpinus) and the food webs of West and East Lakes. We hypothesize that increased Hg inputs into West Lake will result in higher concentrations of Hg in char. To investigate this char were collected for analysis of total Hg (THg) and a suite of elements annually from 2008 to 2014 along with river and lake water samples. THg and multielement analysis were conducted on fish muscle and THg and methyl Hg were determined in water samples at Environment Canada labs in Burlington (ON). THg concentrations in West lake were >three times those in East (2.2±2.4 ng/L & 0.7±0.4 ng/L). These differences were due to high concentrations of particulate THg (7.1-9.4 ng/L) at the bottom of the water column in West Lake, which are indicative of sinking particles and/or resuspension. Methyl Hg concentrations were extremely low and almost identical in the two lakes (0.01±0.01 ng/L). Carbon (C) and nitrogen (N) stable isotope analysis showed that char have significantly more depleted δ13C in East vs West Lake (mean ± 95%CI; -27.22±0.16 ‰ (N=73) vs -24.97±0.31‰ (N=92)) indicative of greater terrestrial carbon inputs to West Lake. Also δ15N was significantly lower in West Lake char (10.03±0.18 ‰ vs 11.18±0.11‰) suggesting differences in food sources. The combined results from 2008 to 2014 collections show that the West Lake adult char have significantly higher Hg concentrations (0.159 ± 0.016 μg/g) compared to East Lake (0.097 ± 0.009 μg/g) and this difference is even greater if results are adjusted for δ15N using analysis of covariance. Condition factors (g*100/cm3) for char in West Lake have declined since 2008 and over the period 2011-2014 have been significantly lower than those in East Lake (0.62±0.02 versus 0.68±0.02) indicating they are thinner than fish of the same length in East Lake. This may be due to difficulty feeding in West Lake's turbid waters, particularly after 2008. However, no significant trends in Hg concentrations in the char were found over the period 2008 to 2014 in either lake. The higher mean Hg concentrations in West Lake char were consistent with higher unfiltered THg concentrations in the West River and in West Lake, extensive permafrost disturbance in the West watershed and seasonal anoxia in that lake. Our preliminary conclusion is that increased total Hg inputs into West Lake have resulted in higher concentrations of Hg in char in that lake.

SUMMARY OF THE ICE-CAMPS ANDR/V MARTIN BERGMANN MARINE SURVEYS IN THE CAMBRIDGE BAY AREA

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Climate change is being felt first and foremost in Arctic regions and is having a dramatic effect on the marine system. Unfortunately, the direction and extent of this change is not well understood due to the lack of baseline studies. New data to help fill knowledge gaps are urgently needed. This is particularly true for the Kitkmeot region, which includes Cambridge Bay, Nunavut, where only a few sea ice and oceanographic studies have taken place to date. Building upon the Arctic-ICE program out of Resolute Bay, the process-based and inter-annual aspects of the research undertaken during the Ice Covered Ecosystem-CAMbridge bay Process Study (ICE-CAMPS) and R/V Martin Bergmann marine surveys within Dease Strait and surrounding waters are critical for improving our understanding and predicting the impact the rapidly changing ice cover will have on the marine Arctic ecosystem and its associated climate feedbacks. To this end, the overarching objective of these programs is to investigate physical and biogeochemical processes operating across the ocean-ice-atmosphere interface during the winter-spring-summer transition. In this poster, we summarize the work that has been accomplished to date during these two field campaigns and discuss future plans.

CHANGES IN CARIBOU AND MUSKOX GENETIC VARIABILITY AND MOBILITY OVER THE LAST 4000 YEARS ON BANKS ISLAND, NWT, CANADA AS RECONSTRUCTED FROM ANCIENT DNA AND ISOTOPIC DATA

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Three quarters of the world's muskox population and a large percentage of the world's Peary caribou population live on Banks Island, NWT, Canada. Both species have played important roles in the diets, economies, and traditions of past peoples living on the island. Today, they are sources of food and revenue for residents of Banks Island's only community, Sachs Harbour. Both species live on the island throughout the year, though recent research suggests that at times, Peary caribou move off the island, and barren-ground caribou from the mainland visit the island. At present, there is a poor understanding of long-term linkages between muskox and caribou population dynamics and movement, broader environmental factors on the island, and exploitation by humans. The Ikaahuk Archaeology project is approaching this question through a synthesis of Inuvialuit knowledge and scientific analysis. This integrated approach can produce historical ecological baselines and document how environmental changes affect the abundances and spatial distributions of both species. Ancient muskox and caribou DNA data collected from well-dated archaeological sites are used to reconstruct the genetic diversity of both species over the past 4000 years on Banks Island. Because genetic diversity is known to be correlated with population size, these data can be used to infer fluctuations in both effective population size and the magnitude of genetic change over time. The comparison of mitochondrial and nuclear DNA from ancient populations with modern ones also enables a better understanding of historic inter-population relationships and levels of contemporary gene flow within each species. We use oxygen (δ18O) and hydrogen (δ2H) isotope analysis of water and animal tissues to explore relationships among environmental change, herd mobility and genetic change over the same time period. Meteoric water δ18O and δ2H values vary spatially and temporally by climatic variables. Water samples collected across the island provide detailed baselines of geographic isotopic variation for modern animals. Because tooth enamel carbonate reflects the isotopic composition (δ18O and δ2H) of water ingested during development, climate change over time is reconstructed from the isotopic compositions of caribou and muskox tooth enamel collected from important archaeological sites. Intra-individual variability in the isotopic composition of teeth formed at different life stages is used to indicate geographic movement. Collectively, these data reveal how both species responded to past environmental change, utilized space on the island, and whether observed variation in the genetic data relates to mobility beyond the island. Though analysis is ongoing, the use of aDNA and stable isotopes represents a novel approach to understanding long-term changes in the abundance, movement, and migration of these two important prey species. Combined with existing archaeological and environmental data, and Inuvialuit knowledge of landscape and animal behavior, these analyses will allow us understand how fluctuations in the availability of caribou and muskoxen affected human inhabitants of Banks Island in the past. They can also be used to better understand how both animal populations are likely to respond to climate change in the future.

NORTHERN SKIES: CONNECTING SCIENCE, EDUCATION, AND CULTURE IN THE NORTH, SOUTH AND AROUND THE WORLD

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Northern Skies is a developing national and international venue for learning about and participating in research on the Aurora Borealis. The Aurora is fundamental feature of the northern night sky, and figures prominently in northern art and the oral histories of northern peoples. The Aurora provides a window into the interactions between the Sun, the space surrounding the Earth, and the Earth's upper atmosphere - a focus for fundamental research in space physics. AINA has partnered with the University of Calgary's Space Physics program to develop an interactive, on-line citizen science program to study the Aurora using images from the Auroral Geospace Observatory (AGO) and the Institute for Space Imaging Science. Among other objectives one important one is to engage students, and northern students in particular in scientific research that enhances curriculum and brings the complexity of space physics "down to earth". In tandem we are developing an interactive, online museum of art, literature and legends to bring the science, culture and the Aurora together and accessible to any and all who are interested.Northern Skies will be an ongoing program that will engage a broad general public in the research activities of the Arctic Institute, and the University of Calgary.

SLIGHTLY OPEN SECRETS OF LIFE AND ADAPTATION OF THE ARCTIC FISH DAUBED SHANNY (LEPTOCLINUS MACULATUS) USING BIOCHEMICAL PARAMETERS OF LIPID METABOLISM

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The biochemical indexes of lipid metabolism are the most significant in terms of initial adaptive reactions that take place on the level of macromolecules and cells as an answer to specific conditions of habitation in the Arctic (specific temperature regime, special light regime, seasonal ice cover, starvation, short vegetation period in summer) as well as to the consequences of climate changes. The general and peculiar features of mechanisms of adaptation of the daubed shanny of different ecological groups and developmental stages (pelagic larvae and benthic adults) that inhabit the area of the north-western Spitsbergen under the influence of environment were studied. Pelagic-living postlarvae and bottom-living adults of the daubed shanny, in this research collected in summer and winter, play the key role in transfer and transformation of substance and energy via food chain. That is why they are important components in terms of maintaining of the unique structure and functioning of the Arctic ecosystem. The total lipid content, lipid classes and fatty acids of fish varying on ecological and physiological factors was studied: the connection between lipid content of gonads and maturity stage was determined; the features of accumulation of lipids in gonads of adults were examined; the connection between food and lipid content in larvae and adults of L. maculatus in summer and winter were studied; the features of fish life cycle in the Arctic summer and winter season in the north-western shores of Spitsbergen were examined. The fulfilled research enabled to get new information about lipid profile of larvae and adults of daubed shanny. It gives as opportunity to observe the ways of transformation and transfer of lipids through the links of food chain. Special attention was paid to research and assessment of biochemical status of the fish studied on the level of lipid and energetic metabolism, systems of maintenance of energetic and biosynthetic homeostasis under the conditions related to change of temperature and light regime in the Polar Regions. For the first time the results of the research enabled to determine specific and typical modifications of studied biochemical characteristics (lipids and fatty acids), to demonstrate differences of adaptive reorganizations of the larvae and adults of the daubed shanny, representatives of various ecological groups (pelagic and bottom). It is shown that the features of ecological and biochemical adaptations of the larvae and adults are connected, first of all, with full dependence on environment and assignment to the group of ectothermic animals as well as with the features of development cycle. The correlation between structural lipids and fatty acids in membranes corresponds to physical or chemical features of environment. 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.

THE MARINE ENVIRONMENT SURROUNDING A GROUNDED ICE ISLAND IN THE CANADIAN ARCTIC

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There is evidence that ice islands in the open ocean can be surrounded by an abundance of biological activity as the result of increased limiting nutrients in the photic zone of the water column. Ice island melt water can trigger two possible sources of nutrients: upwelling of marine deep waters adjacent to the ice island as the consequence of a buoyant convection cell or the ice island itself which serves as a source of limiting nutrients. Very few studies have been conducted in this area of research, all of which are focused on Antarctic icebergs, which differ greatly from Arctic ice islands. The objective of this study was to characterize the physical and biological oceanography of the water column surrounding a grounded ice island near Resolute Bay, Nunavut and to determine if ice island melt-water or upwelling of marine deep water are a source of nutrients. This study was conducted during peak melt conditions in the summer of 2014, which ensured the most extreme effects on the surrounding water column. Phytoplankton biomass adjacent to the ice island was measured every 2-3 days at five depths: the surface, 5, 10, 25, and 50 m. A general survey of the physico-chemical properties (salinity, temperature, δ18O, and nutrients) of the water column was conducted along two transects nominally named in terms of directions: East-West and South. In addition, the physico-chemical properties of the potential sources of nutrients, including the ice island and ocean bottom waters were also examined, which were used to determine what portion of the water sample originates from upwelling and melt-water. Preliminary results indicate that the water column adjacent to the ice island is stratified and a sharp pycnocline exists at 25 m depth. This depth corresponds to the maximum phytoplankton biomass observed, with values around 20 mg chl a m-3, which is indicative of phytoplankton bloom conditions.

ECOSYSTEMIC POSTGLACIAL SUCCESSION OF NETTILLING LAKE (BAFFIN ISLAND, CANADA) INFERRED BY THE OXYGEN ISOTOPE COMPOSITION AND THE ASSEMBLAGE OF LACUSTRINE DIATOMS

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In 2012, a 82 cm long sediment core (Ni2B) was drilled at Nettilling Lake. We use a multi-proxy paleolimnological approach to study the sedimentary records preserved in Nettilling Lake (Baffin Island, Canada) in order to reconstruct the postglacial environmental history of the lake watershed. 31 samples of biogenic silica were purified, their contamination assessed and corrected for and subsequently analysed for the oxygen isotope composition (δ18Odiatom). Additionally, the diatom assemblage from 35 samples was quantified under the light microscope with x 1000 magnification. Our chronology extends to ~ BC 1200 yrs based on radiometric dating 210Pd and 14C from bulk sediment. Downcore variations in δ18Odiatom values show a marine-lacustrine transition. The samples from the marine-brackish zone show a higher isotopic composition (27.5‰, 58.5cm depth, "middle Holocene") than the samples from the lacustrine section (21.7‰, 1.5cm, 2002 AD). The transition zone can be distinguished by values between these extremes, too (23.4‰, 33cm, ~1240 BC). This likely reflects changes in the water source, from more isotopically enriched marine water in the past to more depleted and cold lacustrine water. The diatom assemblage reflects the same transition. The marine-brackish zone contains polyhalobous-mesohalobous benthic species (e.g. Trachyneis aspera, Gomphonemopsis aestuarii, G. pseudexigua,Cocconeis scutellum) which have a salinity preference between 35‰ to 5‰, indicating a shallow, littoral environment. The transition zone is characterized by a sharp rise of alkaliphilous freshwater benthic taxa (e.g. Staurosirelle pinnata, Staurosira construens, Staurosira brevistriata). The diatom flora of the upper zone is characterized by halophobous planktonic and benthic species (e.g. Cylotella rossii, Cyclotella pseudostelligera, Tabelaria floculosa, Encyonema silesiacum, Nitzschia perminuta). The δ18Odiatom and the diatom assemblage record from Nettilling Lake register changes in the oxygen isotope composition of the lake water. This is the first δ18Odiatom record documenting a marine-lacustrine transition. Records from Nettilling Lake will provide further evidence for the usefulness of δ18Odiatom as an important parameter in multi-proxy paleoclimatic reconstruction.

OPTICAL DIFFERENTIATION OF ECOLOGICAL REGIMES IN THE ARCTIC OCEAN

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We develop an optical classification of assemblages of particles suspended in seawater which are representative of distinct ecological regimes from an extensive dataset collected in the Chukchi and Beaufort Seas. Measurements include the spectral coefficients of particulate backscattering and absorption,

phytoplankton pigments, and particle concentration, composition, and size characteristics. Hierarchical cluster analysis of the particulate backscattering-to-absorption ratio partitioned the dataset into seven optical clusters representing distinct particle assemblages, each characterized by a different set of indicators of particle concentration, composition, and phytoplankton taxonomic composition and size. Three phytoplankton-dominated clusters were identified. One cluster was dominated by small-sized phytoplankton and comprised samples from the subsurface chlorophyll-a maximum at the Beaufort Sea shelf break. The other two clusters were dominated by large diatoms but differed in terms of contributions of photoprotective pigments. Diatom communities with high photoprotection were predominantly found in surface waters, whereas communities with reduced photoprotection were found deeper in the water column on the Chukchi Sea shelf. Cluster samples representing clear waters dominated by detrital material with mainly small-sized phytoplankton were found off the shelf, whereas moderately turbid detrital-dominated waters containing diatoms with strong photoprotection were found in the surface waters of the Chukchi Sea shelf. Another distinct cluster represents mineral-dominated particle assemblages that were observed in the plumes of the Colville and Mackenzie Rivers and near the seafloor. Finally, samples representing a mixed particle composition cluster were scattered throughout all locations. These results demonstrate a capability to differentiate ecological regimes based on hyperspectral measurements of particle backscattering and absorption, which can be aquired from autonomous in situ platforms such as gliders and profilers.

ABUNDANCE AND SIZE DISTRIBUTION OF THE DEEP-WATER SEA PEN UMBELLULA CF. ENCRINUS (OCTOCORALLIA: PENNATULACEA) FROM ROV VIDEO TRANSECTS AND LONGLINE BYCATCH IN THE EASTERN ARCTIC

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Umbellula (family Umbellulidae) are elongated sea pens composed of a crown of feeding polyps restricted to the distal extremity, supported by a long stalk (rachis) and a basal muscular peduncle used for anchoring in the soft sediment. These deep-sea corals are commonly observed as fisheries bycatch in the Northwest (NW) Atlantic, especially Baffin Bay and northern Labrador Sea, where they can reach large sizes (> 2m). Their size-frequency distribution, combined with data on longevity and growth rates, can be used to assess population structure for the appropriate management of this species in response to fisheries bycatch. Using longline bycatch data and video-observations, here we report the size-structure of Umbellula cf. encrinus from three locations in the Eastern Arctic: Home Bay, Scott Inlet, and Jones Sound. Using a high definition camera on a remotely operated vehicle (ROV) onboard the CCGS Amundsen, colonies of U. encrinus were opportunistically video-recorded in situ in Home Bay (69.36 N, 64.85 W) and Scott Inlet (71.44 N, 70.17W), at depths ranging 482-744 m. At Jones Sound (76° N, 86° W) colonies were obtained as bycatch during an exploratory longline fishery for Greenland Halibut aboard the Kiviuq I. A total of 21 fishing sets were completed at depths between 80-840m, yielding Umbellula cf. encrinus colonies at depths between 579-840 m. From the videos, colony size was estimated using lasers 10 cm apart as a scale. The below-bottom portion of the sea pens observed in video was estimated by a regression equation between total rachis height and peduncle size measured on 33 previously collected colonies. In Home Bay, only six colonies were observed during 2.2 km of ROV transect; of these two were measured at 53 and 134 cm. In the Scott Inlet site 26 colonies were observed in 2.7 km of transect, from which only 13 could be measured, ranging from 34-116 cm. In Jones Sound a total of 98 colonies were caught on hooks of the longlines over ten sets, with colony heights ranging from 11-230 cm. The larger sizes observed for colonies in Jones Sound could be an artefact of sample size, due to the limited number of samples for the two other locations. These preliminary data show that U. encrinus was not largely abundant in Scott Inlet and Home Bay, with colonies showing a sparse distribution. The large number of colonies observed as bycatch in Jones Sound suggests high abundance of U. encrinus in Jones Sound, including very large and potentially old colonies.

THE IMPACT OF SURFACE WAVES ON THE WESTERN ARCTIC MARGINAL ICE ZONE

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The marginal ice zone (MIZ) is a very dynamic area where ocean waves and sea ice interact strongly. Sea ice scatters and dissipates the energy of the waves that can travel very long distances in the ice, while flexural stresses in the ice induced by waves break large floes into smaller ones. Recent theoretical and modelling efforts led to the development of

coupled wave-ice interaction models that predict what should be the floe size distribution as a function of the incident wave spectrum. However, this prediction is not easy to confirm and validate due to the scarcity of reliable measurements of the floe size distribution. Ice charts produced by National Ice Services represent a long-term and systematic evaluation of ice properties in most Arctic and sub-arctic ice-covered seas given in the form of the internationally recognized egg code standard. The egg code contains information about the predominant floe size of each ice type. Here we use digital ice charts from the Canadian Ice Service and the Danmarks Meteorologiske Institut to compute the extent of the MIZ in the western Arctic and correlate with wave conditions prevailing in the adjacent open water areas. Results reveal the importance of wave-ice interactions in shaping marginal ice zones and suggest that changes are to be expected as fetch distances increases and ice thickness decreases.

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.

BARE PEAT SPOTS: PHENOMENON OF FROZEN PEATLANDS OF THE NORTH-WEST SIBERIA.

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The considerable part of mire ecosystems of the Western Siberian plain develops in permafrost conditions. Such mire complexes as frozen peatlands are widespread in these locations. The purpose of this paper is to study a unique development path of frozen peatlands soils. The area of the research is located in the north of Western Siberia (65°18'.55"N, 72°52'.90"E) in a zone of discontinuous permafrost. There is a special formation - "peat spots" – they are diagnosed by extensive spots of bare peat surface, the vegetation on which is completely absent for decades. Usually peat spots are located at the tops of peatlands,

have an oval form, their diameter ranges from 0,5 to 5m, and their surface is covered with the overdried peat crust with a peculiar structure. During field works experimental sites were put on peat spots and on the background areas with a vegetative cover. The following features were noted for peat spots soil profile: it is thicker in contrast to typical soils, characterized by high degree of decomposition of organic matter. It was established that emission of CO2 is lower on sites with bare surface than on sites under vegetation (71,2 mgCO2*m-2*h-1, 155 mgCO2*m-2*h-1, respectively), at the same time concentration of CO2 at depths 10-60cm has inverse correlation and on average, it is higher for peat spots soil profile. The average annual temperature of peat spots soil profile is lower than that one under vegetated surface. The analysis of chemical properties has revealed an essential difference of peat spots soils to soils of surrounding areas. Peat horizons of peat spots have higher total contents of carbon (50,4% for bare peat soil profile and 45,0% for vegetated soil profile) and nitrogen (2,4% and 1,6%, respectively). The similar correlations have been found for Water Extractable Organic Matter (carbon (WEOC) and nitrogen (WEON)), its content is higher in soils of peat spots: WEOC-672,6 mg*kg-1 for peat spots soil and 491,0 mg*kg-1 for vegetated peat soil; WEON-131,5 mg*kg-1and 89 mg*kg-1, respectively. Peat spots have the lower content of such nutrients as potassium (46 mg*kg-1 for soils of peat spots and 257 mg*kg-1 for vegetated soils of frozen peatlands) and phosphorus (17,5 mg*kg-1 and 25 mg*kg-1, respectively). So, our results show that peat spots are specific landscape of frozen peatlands and they are diagnosed by the type of peat and by the absence of vegetation on soil surface. Soils of peat spots differ from typical frozen peatlands soils with their chemical properties, their microbiological and morphological characteristics. We suppose that genesis of peat spots relates to different causes. The first one is an impact of cryogenic processes such as frost heaving, turbations (impeding settlement of vegetation) and cycles of freeze-thaw (accelerating mineralization of peat). The second reason is the relict genesis of peat from peat spots and its high degree of decomposition. Thus, peat spots represent a kind of "hot centers" of transformation and conversion of peat soils in a zone of discontinuous permafrost of the North-West Siberia.

GEOPHYSICAL CHARACTERIZATION OF PERMAFROST AT IQALUIT INTERNATIONAL AIRPORT, NUNAVUT

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Iqaluit International Airport presently suffers from instabilities and subsidence along its runway, taxiways and apron. These instabilities may be related to permafrost, permafrost degradation and associated drainage conditions. In particular, asphalt surfaces are significantly impacted by permafrost degradation, thaw settlement and frost cracking. As part of a joint activity involving the Canada-Nunavut Geoscience Office, the Geological Survey of Canada and Université Laval, several types of electrical and electromagnetic geophysical data have been collected over and around airport infrastructure to characterize permafrost conditions and to investigate active permafrost processes including seasonal changes in unfrozen water content and the role of unfrozen water. Even with continuous permafrost and cold permafrost temperatures, the data often indicate material types with low electrical resistivity, suggesting fine-grained marine sediments and/or saline porewater with the potential for freezing point depression and significant unfrozen water content. In particular, electrical conductivity anomalies beneath taxiways and the runway are correlated with localized settlement problems and with downward multi-season displacement as derived from D-InSAR, and indicate potential zones of groundwater influence. We observe variable active layer thickness under infrastructure that is generally thicker than for undeveloped ground. The thawing front extends downward beneath the embankment material in the underlying glaciomarine sediments such that settlement due to melting of ice wedges or other ice rich materials is likely to continue. Observed seasonal changes in the data indicate that subsurface temperature fluctuations may result in significant ice formation near the thaw table and changes in unfrozen moisture content in the permafrost. Unfrozen water content is an important parameter in calculating the thermal properties of soil, which is used to predict the behaviour of the ground upon warming and thawing.

KALAALIMERNIT: GREENLANDIC FOODS, CULTURAL IDENTITY AND CHANGES

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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.

FROM CONSULTATION TO COLLABORATION IN BELUGA WHALE RESEARCH IN THE INUVIALUIT SETTLEMENT REGION, NORTHWEST TERRITORIES, CANADA

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Beluga whales (Delphinapterus leucas) from the Eastern Beaufort Sea population are exposed to numerous stressors associated with anthropogenic activities, namely, contaminant exposure, reduced sea ice, shipping, and oil and gas development. The Hendrickson Island beluga whale-monitoring program is a flagship research program in the Inuvialuit Settlement Region (ISR), NT, Canada. Hendrickson Island is the site of a long-term sampling program, which provided the foundation for a range of interdisciplinary studies on beluga ecology, contaminants and health. Ecological monitoring and management relies heavily on community support and the development of research partnerships among knowledge-holders. We present the development of the beluga health research program that began on Hendrickson Island and expanded to additional communities in the ISR. We evaluate the communication strategies and training opportunities used within this program that contributed to its success. Community members played an integral role in this communication, not just at the end of the project but as working members and advisors throughout the process of developing the communication strategies for this study. Early communication efforts were focused on consultation with northern resource management boards (Fisheries Joint Management Committee and Inuvialuit Game Council) and community Hunters and Trappers Committees (HTC). Communication was coordinated among researchers, to increase the coherence of the program and foster collaboration. In response to feedback from harvesters and the Tuktoyaktuk HTC, we developed a youth mentoring program (2008 – 2014), organized a 'Sharing Knowledge' workshop and prepared a beluga report that responded to questions identified by harvesters. These efforts improved promoted dialogue among beluga knowledge-holders in the ISR, increased capacity for northern youth and promoted new research partnerships. Challenges included the timely dissemination of research updates/results to the community, creating a cohesive interdisciplinary research team from various institutions, and ensuring open dialogue between researchers and northern research partners. Overall, the collaborative approach to beluga research on Hendrickson Island facilitated present and future beluga whale monitoring programs.

ARE ARCTIC PLANTS FLOWERING AND FRUITING EARLIER IN RESPONSE TO CLIMATE CHANGE?

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In temperate regions there are clear indications that spring flowering plants are flowering earlier due, in part, to the rising temperatures of climate change. Temperatures in temperate regions 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. We might, therefore, expect to see a different pattern of flowering and fruiting time responses to climate change in the Arctic with summer flowering rather than spring flowering plants trending to earlier flowering and fruiting. As part of the International Tundra Experiment (ITEX), Parks Canada has been monitoring the timing of flowering and fruiting of purple saxifrage (Saxifraga oppositifolia) and mountain avens (Dryas integrifolia) for the past 20 years at Quttinirpaaq National Park on northern Ellesemere Island. Purple saxifrage and mountain avens are two common Arctic plant species with a wide distribution across the Canadian Arctic. Purple saxifrage is one of the first plants to flower in spring while mountain avens is a mid-summer flowering plant. Starting in 1994, Parks Canada staff have counted the number of open flowers and mature fruits every three days on 25 plants of each species near the Tanquary Fiord warden station. We used the flower and fruit counts to determine the peak flowering and peak fruiting times each year for each species. Our analysis indicates that mountain avens is trending towards earlier flowering and fruiting times but purple saxifrage has shown no significant change in its flowering and fruiting time over the 20 year period. We found no relationship between the last day of snow and time of flowering. The timing of flowering of both species is correlated to Tanquary Fiord mean monthly spring temperatures. Mountain avens showed a very strong correlation between number of flowers and number of fruits produced while the trend was less strong for purple saxifrage, suggesting that fruit of early flowering species are impacted by frost damage from possible extreme weather events that typify recent climate change. Studying climate change response trends of Arctic plants will provide a more comprehensive view of how plants may respond to different climate change scenarios.

THE GOVERNANCE OF SCIENCE AND TECHNOLOGY IN THE PERMITTING OF LARGE-SCALE MINES IN ALASKA

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Obtaining the permits and approvals needed to build a large mine is a process that is highly scientific, economic, political, legal and social. It is filled with debates and disputes on legal authority, rights of nature, risks and benefits, preservation of local economies, and environmental justice. This project explores the key science, policy, legal and ethical debates raised by the large mine permitting process in the State of Alaska. Based on a close analysis of current mines under exploration and permitting such as Pebble, Donlin, Chuitna, Wishbone Hill, Teller and Ambler and in-depth interviews with the key industrial, state, federal, civil, and the scientific community involved in these permitting debates, I evaluated 1) How is science shaped, discussed, debated, and disputed during the permitting processes of the large mines? 2) How permit processors balance risks and benefits? 3) How are the legal disputes related to permitting addressed and settled? And 4) How do democratic processes – social, ethical and political commitments, influence science, policymaking, and technology? Addressing these questions will inform insights into improving the permitting process in general, and will offer guidance for a better and cost effective governance of science and technology in large-mine permitting.

VULNERABILITY OF AN INUIT FOOD SYSTEM TO CLIMATE AND SOCIO-ECONOMIC CHANGE

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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 objectives of the research were to i) characterize elements of the community food system, ii) document the ways in which multiple stresses (climatic and non-climatic) affect food security, iii) document current adaptive strategies employed to manage or cope with stresses to food

security, and iv) identify opportunities and barriers to enhancing food security. 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 in Ulukhaktok over a period of three months between July and October 2014. Data were collected using 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 attributes of the dual country/store food system including costs, preparation, access and storage. Preliminary results are presented and discussed in the context of enhancing Inuit food security under a changing climate. 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).

GROWTH (LINEAR EXTENSION) OF RED CORALLINE ALGAE MORE SENSITIVE TO THERMAL STRESS, OVER OCEAN ACIDIFICATION

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It is well documented that both atmospheric temperature and carbon dioxide concentrations are expected to concurrently increase with the influence of anthopogenic climate change. In the ocean, enhanced carbon dioxide concentrations diminish the availability of carbonate ions required for the growth of many marine organisms and reduce water pH, a process known as ocean acidification. The inherent ability for cold water to uptake high quantities of CO2 means that the high latitude oceans will face the first impacts of such change. In addition, marine organisms currently experience thermal stress associated with increasing atmospheric temperatures. Here we investigate the influences of multiple stressors on the growth and structure of a marine biogenic carbonate at environmental conditions predicted to occur within this century. Red coralline algae (RCA) are important ecosystem service providers playing key roles in C cycling and nursery area provision. The RCA, Lithothamnion glaciale, was incubated in control (380ppm pCO2), moderate acidification (750ppm pCO2) and high acidification (1000ppm pCO2) at ambient and enhanced (+2°C) temperature conditions for 24 months. Coralline algae growth (linear extension) was highly dependent on temperature, with +2°C samples experiencing significantly reduced growth. No significant correlation was found between pCO2 concentrations and growth. These results indicate RCA may have the ability to acclimatize or cope with ocean acidification (possibly utilizing HCO3 for photosynthesis fertilization), but temperature stress may, over long term, have a strong impact on their growth. Significantly, this may have major knock on effects in the ability to provide ecosystem services.

NUNAMIN ILLIHAKVIA: LEARNING FROM THE LAND

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The Nunamin Illihakvia program, funded by Health Canada, aimed to support the transmission of Inuit traditional knowledge, skill sets and values that are important for a healthy lifestyle, physically, mentally, and culturally in a time of rapid environmental and societal change. The pilot project brought together younger generation Inuit with experienced hunters and sewers, and Elders in Ulukhaktok to learn how to travel on the sea ice and hunt seals in the winter, how to prepare seal skins for sewing, and how to sew traditional seal skin clothing. Having such knowledge and skills provides younger community members with the opportunity to engage in productive activities that continue to have value economically and socially. The program sought to revive participation in winter seal hunting and traditional sewing skills, to strengthen health and food security during a time of rapid climatic and societal change. Some project highlights include: 60+ participants took part in sealskin sewing classes, equipment making, and hunting trips with the guidance of Elders and experienced instructors; 6 equipment projects completed (naulaq – harpoon head, tuuq - ice chisel, haviq - snow knife, pilaun - butchering knife, oinikhiot - open water boat and paddles, and alliak - sled); 8 hunting trips on the sea ice conducted under the instruction of experienced hunters (seals harvested on these trips were shared with Elders and community members); 4 sewing projects completed (seal skin hat, kihimayok shoes - water-proof shoes made from bearded seal, puhitaq - sunburst for a parka, and sealskin parkas); and a youth-hosted weekly Inuinnaqtun radio

show. The program is continuing into 2015 with a new focus on tuktu – caribou under the name Tumivut: in the tracks of our ancestors.

POST-THAW CARBON STOCK VARIATION IN A PERMAFROST PEATLAND OF THE BOREAL ZONE.

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The current acceleration of permafrost thaw in the discontinuous permafrost of the boreal zone induces large uncertainties regarding the fate of soil carbon. Peatlands are believed to contain about 277 Pg of the total 1670 Pg stored in permafrost soils. In the discontinuous permafrost zone, the thawing of permafrost causes thermokarst features, leading to a succession from forested peat plateaus to non-forested sphagnum bogs. The changes in organic matter accumulation and deep carbon decomposition rates following thaw in permafrost peatlands could have an important impact on the climate system. We measured the total carbon content of peat cores along a thaw chronosequence from forested permafrost peat plateau to collapse-scar bogs. Four transect of four cores each were collected to expose the variations in carbon content at the collapse-scar feature scale as well as at the catchment scale. Loss on ignition, bulk density, carbon content of the organic matter and radiocarbon dating data reveal variability in the response of the total carbon content with time. Contrary to previous studies of this type, preliminary results do not seem to indicate an initial raise in carbon accumulation rate following thaw. The increase in surface peat accumulation of this peatland seems to be offset by an increase in deep carbon loss from anaerobic decomposition. We use paleoecological proxies such as vegetal macrofossils, testate amoebae and char layers to explain observed differences in total carbon content.

QUANTIFYING MERCURY EXPOSURE FOR MULTIPLE SHOREBIRD SPECIES ACROSS THE NORTH AMERICAN ARCTIC USING BLOOD AND FEATHER SAMPLES

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Many species of shorebirds are experiencing population declines, and the causes for these declines are unknown. Exposure to environmental contaminants, such as mercury, may be a key factor. Arctic-breeding shorebirds may be at particular risk of mercury contamination as recent studies indicate that the coincidence of long-range transport of atmospheric mercury and unique features of the Arctic environment result in increased mercury deposition. Shorebird may be further exposed to mercury as Arctic temperatures increase and the permafrost thaws, potentially releasing previously sequestered mercury into the environment. In addition, many of these shorebirds migrate through or over winter in countries with poor pollution control practices, potentially increasing their chronic exposure to mercury. Mercury exposure can cause sub-lethal effects in birds, including impaired physiology, behavior, and reproductive success, all of which may result in population declines. The ultimate objective of this study was to determine whether multiple species of shorebirds breeding across the North American Arctic are exposed to mercury at concentrations that may cause adverse effects. We analyzed a total of 2,478 blood and feather samples collected from 12 breeding shorebird species during 2012 and 2013 across nine field sites. Sampling locations included five sites in Alaska located near Nome, Cape Krusenstern, Barrow, and the Ikpikpuk and Colville river deltas; and four sites in Canada located on the Mackenzie River Delta, Bylot Island, Igloolik Island, and East Bay (Southampton Island). Blood mercury concentrations in individual shorebirds ranged widely from 0.014 – 3.53 μg/g, with an overall mean of 0.30 μg/g. Mean blood mercury concentrations differed significantly among species sampled at the same site; as did mean blood mercury concentrations of species sampled at different sites across the Arctic. Mean blood mercury

concentrations for most shorebirds species were significantly higher in 2013 than in 2012. Feather mercury concentrations were generally higher than blood concentrations, ranging from 0.067 – 12.14 µg/g in individual shorebirds, with an overall mean of 1.14 µg/g. Blood mercury concentrations of 0.7 µg/g have been associated with a 10% reduction in nest success for Carolina Wrens. In general, mean mercury concentrations in Arctic-breeding shorebirds were below this potential effect level. However, mercury concentrations were extremely variable among individuals, with 7.6% of shorebirds sampled having blood mercury concentrations high enough to potentially cause reduced reproductive success (blood concentration >0.7 µg/g). The majority of these individuals were sampled at Barrow, though a few individuals sampled at Nome, Colville, East Bay, and Igloolik Island had mercury concentrations exceeding 0.7 µg/g. Overall, this study indicates that mercury exposure in shorebirds varies by species and breeding location, and can vary between years. In addition, some shorebirds breeding across the North American Arctic may exceed levels that could reduce reproductive success.

MAINSTREAMING CLIMATE CHANGE IN YUKON: A PARTNERSHIP-BASED APPROACH TO BRIDGING THE GAP BETWEEN SCIENCE AND POLICY

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Climate change is a complex, crosscutting issue that requires a multi-sector response. Mainstreaming provides a more integrated, effective, sustainable way of addressing climate change. Mainstreaming is a long-term process aimed at transforming ideas, policies and practices to support integrated solutions. From the policy lens, it is based around the integration of a relevant value or concern into the decisions of institutions that drive policies, regulations, plans and actions that impact society. Mainstreaming builds on existing processes, and therefore promotes efficient use of resources, reduces duplication, and avoids over-consultation of stakeholders. In Yukon, the Climate Change Information and Mainstreaming Program was developed to fill the need to incorporate climate change into government decision-making without duplicating existing processes, and to ensure that decisions were based on current and relevant research and data. In existence for four years, the mainstreaming program has evolved into an effective model of how a local partnership-based approach can bridge the gap between science and policy. The goal of the mainstreaming program is the strategic integration of climate change considerations into institutional planning, projects, decision-making and operational processes. Putting mainstreaming into action involves eliminating existing or imagined barriers to considering climate change, leveraging existing planning processes, increasing awareness around climate change issues, and building on relationships and partnerships with other organizations. The mainstreaming program is housed at the Yukon Research Centre and is a partnership with the Government of Yukon. The goal of the mainstreaming program is to offer support and expertise on climate change considerations to government decision-makers, however the program has grown to include other organizations, agencies and local governments. The partnership between the Yukon Research Centre and Yukon government's Climate Change Secretariat was the basis for the inception of the program, and is also the essential ingredient to its current success. Built on a partnership between government and academia, the Yukon Climate Change Information and Mainstreaming program is an avenue to connect policy and decision-makers to current research and diverse expertise, both local and global. This presentation will explore examples of mainstreaming and discuss the challenges faced and strategies involved in building an effective mainstreaming program. It will include an in-depth study of the Yukon mainstreaming program and how it has influenced the science-policy interface in Yukon in respect to climate change.

ISOTOPE HYDROLOGY OF ARCTIC TUNDRA LAKES IN A REGION IMPACTED BY PERMAFROST DISTURBANCE

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A projected "hot spot" of climate warming and development is the Mackenzie River Delta region, Northwest Territories, Canada. The upland tundra areas within the Mackenzie Gas Project development area north of Inuvik contain thousands of small lakes and ponds with poorly defined ephemeral drainage that are underlain by thick permafrost and ice-rich sediments for which the basic water balance controls are not fully understood. Natural retrogressive thaw slumps are common along lakeshores and the rapid drainage of ice-rich permafrost-dammed lakes has been occurring. Ongoing oil and gas exploration activities and infrastructure construction may result in terrain disturbance and localized degradation of permafrost, while climate change may increase the magnitude

and frequency of thermokarst processes. These disturbed lakes are believed to act as historical analogues for the future effects of climate change on the hydrology, geochemistry, and aquatic ecology of small tundra lake catchments in the continuous permafrost zone of northwestern Canada. Environment Canada initiated an integrated research program in 2005 with the overall goal of improving our understanding of lake hydroecological impacts associated with shoreline slumping. Limited catchment studies have examined water-balance parameters (e.g., precipitation, evaporation, and surface flows) for tundra lakes in the development area. Comparisons of naturally-occurring water isotopes (δ18O and δ2H) are useful indicators of water balance variations among lakes in remote permafrost regions of Canada where hydroclimatic information is very limited. In particular, information on evaporation-to-inflow ratios and residence times would provide useful information for estimating appropriate water withdrawals from lakes within the proposed development area. Another key objective is identifying whether permafrost slumping impacts the hydrology of tundra lakes via catchment area enlargement and/or enhanced snow accumulation. Here, we present preliminary isotope hydrology findings from i) 7 years of seasonal surveys in a pair of representative lake catchments and ii) annual synoptic surveys in up to 60 lakes, including those with and without shoreline slumping, located along the proposed Mackenzie Valley Gas Pipeline.

CHARACTERIZING THE HYDROLOGICAL PROCESSES OF THE APEX RIVER REGION (NUNAVUT) USING WATER ISOTOPE TRACERS

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Freshwater and the services it provides are extremely important to both ecosystems and people in Arctic regions. Environmental change will strongly influence the hydrology of freshwater systems. One possible outcome is a longer ice-free season leading to increased evaporative stress on lakes. Consequently, northern regions may experience threats to water security. Surveys with residents from Iqaluit, Nunavut, indicate that the quantity of freshwater available to support their community is a concern. The municipal water source, Lake Geraldine, is expected to exceed its capacity to be the principle water supply due to increasing demands from urban development. The City of Iqaluit has recognized the Apex River as a supplementary source to Lake Geraldine once its capacity is exceeded. We are applying water isotope tracers to examine the hydrological processes that influence lakes and rivers in the Apex River region, and their relations with meteorological conditions. Samples for water isotope analysis were collected 4-6 times between early May and late August from different locations along the Apex River, and from ten lakes. Samples were also collected from remnant snowbanks and rainfall events for isotope analysis. In addition, an evaporation pan was deployed in July and August and sampled weekly to obtain the isotopic signature of a simulated terminal lake. An isotope mass balance model will be used to distinguish the relative roles of snowmelt and rainfall, and the importance of evaporation, on lake water balances. The use of deuterium excess will be explored to partition different sources of runoff (e.g., snowmelt, rainfall, lake outflow), and their temporal variability, that contribute to the Apex River. We anticipate that findings will contribute baseline hydrological knowledge, which will aid the municipal government in their use of the Apex River as a source of freshwater.

ARCTIC SEA-ICE PROXIES: A COMPARISON BETWEEN BIOMARKERS (PIP25), BIOGENIC SILICA, AND MICROPALAEONTOLOGICAL APPROACHES

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The recent decline in Arctic sea-ice extent and thickness has raised concerns due to its wide ranging implications for lower latitudes via climate inter-linkages and feedback mechanisms. Long term datasets of Arctic sea-ice variability are crucial in contextualising this relatively recent decline. Proxies, such as microfossils and biogeochemical compounds preserved in marine sediments, provide an archive of palaeoenvironmental information on which sea-ice reconstructions can be based. Nevertheless, the confident application of these approaches requires the critical appraisal of, and an assessment of the correspondence (or otherwise) between, different proxies and their direct relationship to physical oceanographic parameters. A high-resolution decadal-scale box core (99LSSL-001) from Coronation Gulf (Nunavut) represents an ideal archive by which to compare approaches to sea-ice reconstructions over the past 400 years. Previously published qualitative palynological (dinoflagellate cyst) and biogeochemical (total organic carbon) data from this core suggest marked episodes of very late Holocene sea-ice fluctuation. The construction of a new robust age model for this core, coupled with additional biogeochemistry (biogenic silica) and biomarker (PIP25)

data, permit an intercomparison between commonly applied palaeoenvironmental proxies. From 1630 to 1830 AD, decadal-scale high magnitude fluctuations in sea-ice conditions are suggested by PIP25, whereas dinocysts imply reduced sea-ice and longer open water season relative to modern. From 1830 to 1960 AD PIP25 ratios imply a longer annual sea-ice season, declining towards the mid 20th Century. Dinocysts from this period suggest an interval of increased annual sea-ice and cooler water conditions; assemblages being dominated by Islandinium? cezare s.l. Throughout the 1630 to 1960 AD interval, biogenic silica fluxes also remain low. From 1960 AD to the core top (1999 AD), PIP25 ratios increase, whilst biogenic silica and phototrophic dinocysts also show increases. This suggests extended seasonal sea-ice, but also enhanced primary productivity. While broadly in agreement for much of the core record, comparing biomarker, biogeochemical, and microfossil proxies for the late 20th Century period illustrates that complexities sea-ice reconstruction by multiproxy approaches.

NEAR REAL-TIME OBSERVATIONS AND DATA ACQUISITION IN THE ARCTIC

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In 2012, Ocean Networks Canada conceived, designed, installed and began to operate a community-based cabled underwater observatory in the Arctic based on the model of the NEPTUNE and VENUS systems. The system, designed to be inexpensive and maintained once a year, relies on available infrastructure in the northern community of Cambridge Bay, NU, where it is installed. The underwater instruments connected to this first system include a CTD equipped with extra oxygen, fluorometer and turbidity sensors; a pan-and-tilt HD colour camera, an ice thickness sensor, a hydrophone and a fish tag receiver. Four more instruments are installed on land: a weather station, a precision barometer, a camera to help observe the ice formation/breakup and an AIS receiver. The data are transmitted to the ONC data centre in Victoria, BC in near real time and are available to scientists and the public at large immediately. Other data collection projects, in support of currently on-going or new experiments are in the planning stages and will be mentioned in the presentation. They include citizen science support as well as more community-based observatories.

PROMOTING LEADERSHIP AMONGST ARCTIC YOUTH THROUGH AN ASSET-BASED APPROACH: THE CASE OF CANADA WORLD YOUTH PROGRAMS

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There is a strong case for building international collaboration to develop a youth leadership strategy in the Arctic and enhance support to youth leadership programs. Most of the population in the North is under 30 and most of their members are part of an indigenous community. In most circumpolar regions, Northern youth face disparities in terms of human development indicators in relation to national populations. These gaps need to be addressed concurrently with the fact that Arctic youth are playing and will play an active role in shaping their local societies, in a context of rapid environmental, societal, economic and political changes. Hence, a young population in the North can be transformed in a remarkable asset for development. They are part of transnational movements aiming at reasserting their identity and rights, including demands for self-determination and governance over their natural environment and resources. Investments to build their resiliency and leadership are sound investments. These include support mechanisms at multiple levels that contribute to the success of young people, including each individual personal assets, community structures, larger societies and their contact with global youth culture through social media and others. Northern youth's active participation in decision-making process, natural resources governance, strategies and policies is essential. CWY has advanced an asset-based approach in its work with youth and has been strengthening its collaboration with Northern communities to make its international education programs more accessible and more apt to offer a positive experience to Arctic youth. Accordingly, CWY has been engaging Arctic youth in international programs and developing new initiatives that are meaningful to their aspirations and are adapted to their life stage. Over 120 Inuit youth from the four Inuit regions of Canada have been part of CWY's programs over the last 5 years. The present paper presents CWY programs as a case study for initiatives that can have transformative impact on youth and build their leadership.

CYST-THECA RELATIONSHIP OF THE ARCTIC DINOFLAGELLATE CYST ISLANDINIUM MINUTUM (DINOPHYCEAE) AND PHYLOGENETIC POSITION BASED ON SSU RDNA AND LSU RDNA

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Round brown spiny cysts constitute a morphological group common in high latitude dinoflagellate cyst assemblages. The dinoflagellate cyst Islandinium minutum (Harland et Reid) Head, Harland et Matthiessen is the main paleoecological indicator of seasonal sea-ice cover in the Arctic. Despite the importance of this cyst in paleoceanographical studies, its biological affinity has so far been unknown. The biological affinity of the species I. minutum and its phylogenetic position based on the small subunit ribosomal RNA gene (SSU rDNA) and the large subunit ribosomal RNA gene (LSU rDNA) were established from cyst incubation experiments in controlled conditions, optical and scanning electron microscopy, and single-cell PCR. The thecal motile cell obtained was undescribed. Although the motile cell was similar to Archaeperidinium minutum (Kofoid) Jörgensen, the motile cell of I. minutum lacked a transitional plate in the cingular series, which is present in Archaeperidinium spp. Islandinium minutum and Archaeperidinium spp. were paraphyletic in all phylogenetic analyses. Furthermore, Protoperidinium tricingulatum, which also lacks a transitional plate, was closely related to I. minutum and transferred to the genus Islandinium. Based on available data, it is clear that Islandinium is distinct from Archaeperidinium. Therefore, we considered Islandinium Head, Harland et Matthiessen as a non-fossil genus and emend its description, as well as the species I. minutum. This is the first description of a cyst-theca relationship on a species assigned to the genus Islandinium.

COMMUNITY-DRIVEN RESEARCH ON HELICOBACTER PYLORI INFECTION IN ARCTIC CANADA: ASSOCIATION OF BACTERIAL GENOTYPES WITH DISEASE MANIFESTATIONS

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H. pylori is a bacterium that colonizes the human stomach lining and causes inflammation. While many people with chronic H. pylori infection do not develop serious disease, around 1% develop stomach cancer. Evidence suggests that specific H. pylori genes may determine disease outcomes: in particular, cytotoxin-associated gene A (cagA) and vacuolating cytotoxin gene (vacA). H. pylori strains can be cagA+ or cagA-, while all strains have a vacA gene consisting of 3 regions: signal (alleles s1 or s2); intermediate (alleles i1 or i2); mid (alleles m1 or m2). Genotypes reported to be associated with severe disease are cagA+ and vacA allelic combinations of s1/m1. Investigated Arctic communities have increased occurrence of H. pylori infection and associated disease relative to southern Canadian populations. The Canadian North Helicobacter pylori (CANHelp) Working Group conducts projects in Arctic Canada to address community concerns about health risks from H. pylori. In 2012-2013, residents of Old Crow YT, Tuktoyaktuk NT and Fort McPherson NT were invited to undergo endoscopy with gastric biopsies taken for histopathological examination and microbiological culture. This analysis describes the distribution of virulence genes in H. pylori isolates from CANHelp project participants and estimates their associations with histopathologic diagnoses that indicate increased gastric cancer risk (severe gastritis, atrophy, intestinal metaplasia). Of 129 participants with biopsies collected, 85 were H. pylori-positive with histopathology and genotype data: 59% were cagA positive; proportions with vacA s1, i1 and m1 alleles were 76%, 58% and 55%, respectively. Some genotypes were strongly associated with severe chronic gastritis, severe acute gastritis and intestinal metaplasia. Relative to participants with cagA- isolates, those with cagA+ isolates had 5.3 (95% CI: 1.7 to 17) times the odds of severe chronic gastritis and 7.7 (95% CI: 1.6 to 72) times the odds of severe acute gastritis. The strongest association observed for vacA variants was for the contrast of s1 and s2 alleles. For severe chronic gastritis, severe acute gastritis and intestinal metaplasia, odds ratios (95% CI) comparing vacA s1 to s2 alleles were 7.3 (2.0 to 33), 11 (1.5 to 481) and 9.1 (1.2 to 394), respectively, while odds ratios comparing vacA allelic combinations of s1/i1/m1 to other combinations were 3.7 (1.4 to 10), 3.1 (1.0 to 10) and 1.4 (0.47 to 4.3), respectively. We observed a strong association of cagA positivity with both chronic and acute gastritis in members of Arctic communities. Participants infected with H. pylori containing the vacA s1 allele had much higher odds of chronic gastritis, acute gastritis and intestinal metaplasia compared to those with isolates not containing the s1 allele. In contrast, results for other vacA allelic combinations suggest that the vacA s1 allele may be more important than vacA allelic combinations in determining disease outcomes in Canadian Arctic communities. Although limited by small numbers for some outcomes, this analysis adds to evidence that H. pylori genotypes influence disease outcomes and demonstrates that CANHelp community projects have the potential to identify bacterial risk factors for severe disease in the participating communities.

CHANGES IN COMMON EIDER BREEDING NUMBERS AT A HIGH ARCTIC COLONY: INTERACTIONS WITH SYMPATRICALLY-NESTING MARINE BIRDS

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Many high Arctic islands near polynyas are key breeding sites for multiple species of marine birds. Arctic terns (Sterna paradisaea) nest at some of these sites, and they aggressively defend their colonies against intruders by group mobbing perceived threats. Certain other marine bird species take advantage of this behaviour by nesting in close association with terns, which increases the nesting success of the other species nesting in the tern colony. At Nasaruvaalik Island in Queen's Channel, Nunavut (96° 18' W, 75° 49' N), all long-tailed ducks (Clangula hyemalis) and Sabine's gulls (Xema sabini) nest within the limits of tern colonies. However, common eiders (Somateria mollissima borealis) nest within and outside the boundary of the tern colonies at the site. Since 2007, the eider population on the island has been growing. These changes in numbers and density of eider nests have led to many questions regarding their interaction with sympatric terns. We monitored eiders nesting on the island to evaluate their distribution and/or nesting success between 2007 and 2014. The overall nesting success was 70% (n=1969 nests), and differed for eider nests inside (64%, n=469) and outside (71%, n=1500) of the tern colony. Thus, nest location was correlated with nesting success, but the relationship varied among years. However, an egg placement experiment showed the opposite pattern: eggs disappeared more quickly when left outside of the tern colony than inside the colony. Further findings lead us to believe that the density of eider nests can likewise positively influence their success. Since 2011, years during which the island has been systematically searched for eider nests throughout the breeding season, the maximum density increased from 50 up to 170 nests per hectare while the nest abundance increased from 573 to 990. Higher density, or the presence of terns, may reduce the chances of nest predation by avian predators, but these choices may be of little consequence when catastrophic, stochastic events occur, such as polar bear (Ursus maritimus) predation.

GREENHOUSE GAS EMISSIONS FROM ARCTIC LAKES AND PONDS AS INFLUENCED BY CARBON LABILITY

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The rapid climate warming in Arctic regions has induced extensive permafrost thawing and the consequent mobilization of a large reservoir of organic carbon that was frozen for millennia. Although the release of this old carbon into the atmosphere, either as carbon dioxide (CO2) or methane (CH4), acts as a positive feedback mechanism to global warming, very little is known about the extent and rate of the gas release and the biochemical processes involved as the different carbon pools are becoming available to ecosystems of Arctic lakes and ponds. As a part of an interdisciplinary project investigating the influence of geomorphological and limnological factors on GHG emissions from lakes and ponds on Bylot Island, Nunavut, the present study aims to determine the lability and accessibility of the different carbon pools to microorganisms. In 2014, lability experiments were performed on four sediment types found in organic-rich polygonal patterned ground landscape and possessing specific characteristics (e.g., annual thermal regime, C/N ratio): upper-half portion of the active layer, lower-half of the active layer, permafrost, and thermokarst lake sediment. The different soil samples were incubated in-situ in shaded conditions, in one of the shallow tundra ponds. These incubation tests were repeated in controlled and stable temperature conditions in laboratory. Leachates were also produced from the same soils and incubated similarly both in the field and in the laboratory. Dissolved oxygen (O2) and headspace CH4 and CO2 concentrations were measured regularly over a period of up to two weeks, and the rates of consumption or production were calculated. Preliminary results show that O2 consumption rates were higher in upper active layer samples, while it depleted more slowly in other incubations, suggesting the presence of active aerobic consumers of organic matter in active layer soils naturally exposed to O2. On the other hand, the production of CO2 was faster in lake sediments, whereas permafrost soils showed highest rates of CH4 production and lowest rates of CO2 production, possibly indicating a variable balance between different CH4 pathways in soils that are naturally anaerobic. Overall, the rates of CO2 production were not inversely correlated to O2 consumption rates, suggesting complex microbial communities inhabiting different niches in such Arctic landscapes, with a wide range of possible responses to the expected increase in carbon availability as permafrost thaws. These results also indicate the need to employ a wider array of indicators to assess C lability of Arctic soils.

ASSESSING HOW THE CUMULATIVE EFFECTS OF MERCURY AND PARASITES AFFECT EIDER DUCKS BREEDING IN NORTHERN CANADA

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Many wildlife species are currently experiencing changing environmental conditions at northern latitudes that may affect condition, reproduction, and survival of individuals. For example, rising temperatures in polar environments is known to have increased the release of mercury stored in glaciers and permafrost. Growing global industrialization has also generated higher atmospheric mercury emissions and subsequent mercury deposition in polar environments. These trends are disconcerting as mercury is a known toxin that can negatively affect both body condition and reproductive success of wildlife: traits which are themselves affected by the degree of parasitism experienced by individuals. We explore how factors such as mercury concentrations and degree of parasitism interact to affect breeding of a sea duck species, the northern common eider (Somateria mollissima). To do this, we manipulated the degree of parasitism of female eiders by administering them with either an anti-parasite treatment or a placebo treatment (distilled water), upon their arrival at a nesting colony in northern Hudson Bay, Nunavut (East Bay Island). The mercury concentration of the same females was assessed by analysis of a blood sample taken before they were released and subsequently observed on the breeding colony. Although we detected no difference in the timing of nest initiation between anti-parasite treatment and control groups among birds that arrived early, we found that anti-parasite treatment increased the likelihood that females arriving later would lay eggs. When mercury concentrations were also considered, nesting propensity was not influenced, but early data show that re-sight rates of females were. Collectively, our preliminary findings suggest both the degree of parasitism and mercury levels at arrival influence breeding decisions among female eiders in Arctic Canada, particularly among those arriving late and in poorer body condition.

A PROGRAM TO EVALUATE CHANGING NORTHERN LAKE ICE REGIMES

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A major research program operated out of the Water and Climate Impacts Research Centre (W-CIRC; a joint centre supported by Environment Canada and the University of Victoria) has been an evaluation of changing northern lake ice regimes and relate ecological effects. To examine the potential magnitude of climate-change-related impacts in ice-cover characteristics, particularly its formation, duration, breakup, thickness, and structural composition, the program has been employed a one-dimensional, process-based, lake simulation model, 'MyLake' (Multi-year simulation model for Lake thermo- and phytoplankton dynamics). Although the model has been validated at a limited number of northern lakes, this program is attempting to achieve validation across a wide spectrum of northern hydro-climatic conditions, specifically including broad ranges in air temperature/ice thickness and precipitation regimes. Since 2009, annual spring multi-point surveys of ice thickness and composition (white ice/black ice/snow cover) have been undertaken at a suite of lake sites in the northern hemisphere. Over the past 6 years, this network has grown to include 15 sites along a gradient extending over 44o of latitude. The success of the network represents the efforts of numerous individuals and organizations at both the national and international level to collect the field data. A special focus has also been placed on some key northern lakes where W-CIRC has deployed fully instrumented buoys, which monitor real time changes in meteorological conditions, ice conditions, water chemistry and biological productivity. Once advanced validation of the MyLake has been achieved, a longer term goal of the program is to evaluate whether the model could be used to provide seasonal predictions of ice conditions – information that would be invaluable to northern residents and companies for assessing ice trafficability from a hazards perspective. MyLake is also being used to evaluate how changes in ice cover can affect water quality and habitat conditions, and of recent special interest, in the near under-ice zone. A number of the lakes in the current network are being evaluated as sites where ice-cover modification experiments could be undertaken to evaluate the

direct effect of changes in ice-cover composition on under-ice ecological conditions.

THE DELIVERY OF CONTAMINANTS TO THE ARCTIC FOOD WEB: WHY SEA ICE MATTERS.

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For decades sea ice has been perceived as a physical barrier for the loading of contaminants to the Arctic Ocean. We show that sea ice, in fact, facilitates the delivery of organic contaminants to the Arctic marine food web through processes that: 1) are independent of contaminant physical-chemical properties (e.g. 2-3-fold increase in exposure to brine-associated biota), and 2) depend on physical-chemical properties and, therefore, differentiate between contaminants (e.g. atmospheric loading of contaminants to melt ponds over the summer, and their subsequent leakage to the ocean). We estimate the concentrations of legacy organochlorine pesticides (OCPs) and current-use pesticides (CUPs) in melt pond water in the Beaufort Sea, Canadian high Arctic, in 2008, at near-gas exchange equilibrium based on Henry's law constants (HLCs), air concentrations and exchange dynamics. CUPs currently present the highest risk of increased exposures through melt pond loading and drainage due to the high ratio of melt pond water to seawater concentration (melt pond enrichment factor, MEF), which ranges from 2 for dacthal to 10 for endosulfan I. Melt pond contaminant enrichment can be perceived as a hypothetical 'pump' delivering contaminants from the atmosphere to the ocean under ice-covered conditions, with 2 - 10% of CUPs annually entering the Beaufort Sea via this input route compared to the standing stock in the Polar Mixed Layer of the ocean. The above mentioned processes are strongly favoured in first-year ice compared to multi-year ice and, therefore, the dynamic balance between contaminant inventories and contaminant deposition to the surface ocean is being widely affected by the large-scale icescape transition taking place in the Arctic.

TREATMENT PERFORMANCE OF 4 MUNICIPAL WASTEWATER STABILIZATION PONDS IN NUNAVUT

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Single-cell Wastewater Stabilization Ponds are the most commonly used systems for municipal wastewater treatment in Nunavut, and 23 of 25 Nunavut communities utilize a single-cell Wastewater Stabilization Pond as their treatment system or a component of their treatment system. Wastewater Stabilization Ponds are natural or engineered containment reservoirs used to contain wastewater prior to discharge into receiving waters. Wastewater Stabilization Ponds are passive systems and are open to the influences of the local climate such as temperature, light and precipitation. Contaminants in the wastewater, such as carbonaceous biological oxygen demand (CBOD), total suspended solids (TSS), nutrients and pathogens are reduced though natural biogeochemical processes occurring in the Wastewater Stabilization Ponds, such as microbial decomposition and transformation, settling, and die-off. These systems are simple in design, maintenance, and operation, however their performance is difficult to predict due to the influence of the natural environment and the lack of operational control. Wastewater Stabilization Ponds performance is well documented in tropical and temperate climates, however there is limited records on the performance of these systems operating in the Arctic.Over the past 4 years, performance data has been collected from 4 systems located in different communities across Nunavut (Clyde River, Kugaaruk, Grise Fjord and Pond Inlet). This research was initiated in response to the Wastewater System Effluent Regulations (WSER) in which treatment standards of 25/25/1.25 mg/l CBOD5, Total Suspended Solids, and Un-ionized Ammonia respectively, are being proposed. These standards are far more stringent than those required by the Nunavut Water Board which are 180 mg/l TSS and 120 mg/l BOD5. None of the observed systems meet the Wastewater System Effluent Regulation with all systems exceeding the CBOD5 standard with a range of 65-160 mg/l CBOD5, most exceeding the TSS standard with a range of 20-440 mg/l TSS, and most being a concern for un-ionized ammonia with a range of 0.2-2 mg/l. The performance of the observed existing systems

will be put in the context of local climate, operation, design, and emerging regulation in order to identify what should be expected of these systems and potential areas for improvement.

INVESTIGATING BIOPHYSICAL VARIABLE INTERACTIONS WITHIN A WET SEDGE MEADOW BELOW A PERENNIAL SNOW PACK ON MELVILLE ISLAND, NUNAVUT.

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Vegetation communities in the Arctic are both integrators and indicators of underlying ecosystem functions and processes. Therefore, examining the spatial pattern between and within these communities can provide valuable information on biophysical processes. Perennial snow packs provide the hydrological input for many high Arctic wetlands, but with a decreasing snow mass as a result of changing climate, it is important to understand how they will respond. A wet sedge meadow located below a perennial snow pack at the Cape Bounty Arctic Watershed Observatory, on Melville Island, Nunavut, was examined through the 2014 summer season. Spatially and temporally intensive sampling of soil temperature (5cm and 10cm depth), active layer depth, and volumetric soil moisture provide a high resolution of detail to examine melt season patterns and relationships. Additionally, the changing extents of the adjacent snow pack were also mapped. The data was analyzed statistically and spatially. Spatial interpolations were performed on the point data to develop two and three-dimensional spatial models of the study site. Strong, clear relationships were found between increasing active layer depth and increasing soil temperatures. Soil moisture showed poorer relationships to an increasing active layer depth or fluctuating soil temperatures implying that generalizing relationships over an entire study site could be problematic.

INUIT PERCEPTION OF MARINE ORGANISMS: FROM FOLK CLASSIFICATION TO FOOD CONSUMPTION

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Although the nutritional benefits of many large marine animals from Inuit food systems are well known, other marine organisms, such as invertebrates from the intertidal region, are poorly studied. In order to highlight these components of the current and traditional food system in Nunavik, northern Québec, and elucidate their importance to health and wellbeing, interviews with Elders were held, in May 2014, in two Inuit communities, Ivujivik and Kangiqsujuaq. Altogether, 78 marine organisms were mentioned as part of the traditional or current food system, ranging from algae and small marine invertebrates to fish, birds and large mammals. Though most were common to both communities, some species, such as the atlantic puffin, or appakalak, Fratercula arctica Linneaus, and the bowhead whale, or arvik, Balaena mysticetus Linnaeus, were specific to one community or the other. In Ivujivik and Kangiqsujuaq respectively, 64 species and 53 species were mentioned. Slight variations in folk nomenclature between communities reflect local dialects and speak of the evolving local food system. While it is agreed that tallurunnaq, the term for scallops, a relatively new and regular addition to the local food systems of both communities, is a word borrowed from the community of Salluit, who actively fishes for the deep sea molluscs, elders in Ivujivik still remember the older name tallujaq, whose use has since become infrequent. Furthermore, folk taxonomy of marine organisms combines elements of morphological similarities with access to the sea, thus highlighting the intricate relationship in elements of the Inuit culinary, environmental and cultural heritage. Along with animal behaviour, the diversity of terms used to name animal skins bears witness to a classification that distinguishes cetacaeans from pinnipeds and walruses from other seals. Furthermore, marine mammals, imarmiutait uumajuit, refer literally to mammals, uumajuit, that come from imik, water, or imavik, deep water. One the other hand, tininnimiutait refer to organisms from the intertidal region, or tininniq, such as algae, crustaceans, echinoderms, molluscs and certain fish, and differ from itijumiutait, which come from a deeper region, itijuq. Not unlike other country foods, activities related to the harvest and consumption of crustaceans, molluscs, echinoderms and algae from the intertidal region are often associated with health and wellbeing. Furthermore, their abundance, proximity to the land, and year-round accessibility still make them an important food source. This highlights that past studies might have underestimated the importance of these country foods; hence, the content of such compounds such as omega-3 oils is poorly known. In light of growing concerns related to food security and climate change in the north, it is important to understand the importance of the role these organisms play in the Inuit cultural heritage.

MEASURING HERBIVORY IN NORTHERN AND ALPINE ENVIRONMENTS: TOWARDS A STANDARDIZED PROTOCOL

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Plant-herbivore interactions can be seen as a core in socio-ecological networks of northern and alpine ecosystems, where all parts are under the influence of climate change. Ongoing changes in the composition of plant and herbivore communities are likely to alter this biotic interaction and its outcomes, and ultimately the dynamics of these ecosystems. For example, recent studies have shown that mammalian herbivory may modulate the responses of tundra plant communities and buffer them against the destabilizing effects of climate change, and it has been suggested that grazing management could be used as a strategy to counteract the effects of warming on tundra vegetation. However, the impacts of herbivory have shown wide regional variability and many studies suggest that the role of herbivory depends on ecosystem-specific conditions. The causes of this context-dependency are unclear and partly relate to the diverging study approaches, accentuating the need for harmonizing data collection efforts and coordinated research in the circumpolar Arctic. At a global scale, tundra ecosystems share some commonalities, but also have some differences that affect the outcomes of plant-herbivore interactions. A common, standardized method to monitor herbivory and its impacts on tundra ecosystems should ideally include a well-replicated study design and variables that address prioritized questions selected for cross-site comparisons. Potential approaches include utilizing variation in herbivore and plant communities, as well as that of abiotic factors, as contrasting levels for monitoring designs, and the establishment of a coordinated experiment. Agreeing on which part of the landscape to actually include in the comparative studies can be challenging but, broadly, locations should cover contrasting sites (i.e. topographic entities, different habitats) to represent major variation in the landscape. This should allow for replication within and between landscapes that again will enable cross-region comparisons to quantify whether variation in the outcome of plant-herbivore interactions is larger within or between regions. Measurements of climatic variation in the same study design would allow disentangling the relative strength of the impacts that, for example, temperature and herbivory have on plants and herbivores. To date, coordinated monitoring or experimental approaches on biotic interactions, such as herbivory, are at their very beginning. However, recent efforts of several international initiatives give promise to exciting future work with plant-herbivore interactions to tease apart the seemingly notorious local context-dependencies often associated to this biotic interaction. In this sense, the Herbivory Network is a recently established network that aims at promoting collaboration among researchers working on herbivory in arctic and alpine environments. The success of this and other initiatives depends on adequate funding to planning and maintaining monitoring, as well as facilitating communication among researchers and other stakeholders involved.

VEGETATION CHANGES RELATED TO 45 YEARS OF HEAVY ROAD TRAFFIC ALONG THE SPINE ROAD AT PRUDHOE BAY, ALASKA

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Vegetation was sampled at different distances from the Spine Road at Prudhoe Bay, Alaska, as part of the NSF's Arctic Science, Engineering, and Education for Sustainability (ArcSEES) project. The Spine Road is a heavily-used gravel road built in 1969 during the initial development of the Prudhoe Bay Oilfield. The Colleen Study Area is on the northern side of Lake Colleen, in an area of ice-wedge polygonal tundra. Plots were set up at 5, 10, 25, 100 and 200 m from both sides of the road, in polygon centers and in the troughs above ice-wedges. Three additional plots were sampled adjacent to the road in dust-dominated communities, and two plots approximately 350 m from the road in relatively undisturbed tundra (even areas far from roads have had considerable winter traffic). Environmental data collected at each 1x1-m plot included latitude, longitude, elevation, aspect, slope, landform, surficial geology and geomorphology, disturbance, site moisture, snow duration, exposure, height of microrelief, and thaw depth. Plant cover data included lifeform cover estimates and height measurements, species cover from 100-points, LAI measured using an AccuPAR LP-80 PAR/LAI Ceptometer, and complete species list and cover category estimates for each species (Braun-Blanquet relevé data). Soil data included soil moisture category, measurements of live and dead moss thickness, and thickness of the dust,

organic layers and other layers visible in a 40-cm soil plug. Soil moisture, pH and organic matter were determined in the laboratory. Vegetation and environmental characteristics varied dramatically between the two sides of the road and with distance from road, as shown by the data summaries and ordination. Plant community descriptions were also compared with data collected from the same area in the early 1970s (Walker 1972). The SW side of the road is periodically flooded due to the road-blocked drainage. It is currently composed of relatively well-drained polygon centers and polygon troughs with lush aquatic sedge-moss communities. The NE side of the road is more similar to the original low-centered polygon vegetation complex, but there were large decreases in the larger mosses, forbs, and all lichens, and an increase in the abundance of dwarf erect shrubs, especially adjacent to the road (Salix lanata). The increase in shrubs is likely related to warmer soils and deeper snow adjacent to the road, as well as possibly to a warmer climate, whereas the declines in mosses, lichens and forbs are likely related to extremely heavy dust loads associated with the roads. All of these changes have an effect on the active layer and abundance of thermokarst in the region. The characteristics of vegetation and leaf area index of the two 200-m transects on either side of the Spine Road are further mapped and described in a poster by Buchhorn et al. Walker D.A. (1985). Vegetation and environmental gradients of the Prudhoe Bay region, Alaska. US Army Cold Regions Research and Engineering Laboratory, CRREL85-14, Hanover, NH.

TRENDS IN SEA ICE EXTENT AND POLAR BEAR (URSUS MARITIMUS) BODY SIZE IN WESTERN HUDSON BAY

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Polar bears (Ursus maritimus) are a sea ice obligate species that require sea ice as a platform from which to hunt their primary prey, ringed seals (Pusa hispida) and bearded seals (Erignathus barbatus). Consequently, significant change in the availability of sea ice has the potential to influence access to prey and therefore the energetic resources available to individuals. Herein, we investigate trends in sea ice conditions and body length of polar bears in western Hudson Bay to test the hypothesis that changes in sea ice availability during early development results in phenotypic variation in body size among polar bear cohorts. Temporal analysis of passive microwave sea ice data showed that the extent of sea ice declined significantly in western Hudson Bay from 1979-2012 resulting in earlier sea ice breakup, later sea ice freezeup, and an increased ice-free period. These results suggest that over the long-term, polar bears in western Hudson Bay have experienced reduced access to their primary prey during the critically important hyperphagic spring feeding period. From 1960-2006 the mean cohort body length of bears in western Hudson Bay ranged from 191.7 ± 2.2 cm to 206.3 ± 3.8 cm for females and from 224.2 ± 4.0 cm to 241.0 ± 8.1 cm for males. Temporal trends in adult body length showed declines for both males and females from 1960-2006. Subsequent cohort analysis revealed that sea ice conditions experienced during early development explained a significant proportion of the mean cohort body size in both sexes. We discuss our results in the context of polar bear life history, climate change, and the selective pressures that are likely to influence the fitness of the western Hudson Bay polar bear population.

CROSS-ECOSYSTEM COMPARISON OF MERCURY CONCENTRATIONS IN SURFACE WATERS OF THE EASTERN CANADIAN ARCTIC: INTERACTIONS BETWEEN LOCAL AND REGIONAL HYDROCLIMATIC DRIVERS

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A three-year cross-ecosystem study was initiated in 2012 to test a conceptual model of aquatic ecosystem sensitivity to atmospheric mercury (Hg) pollution along a climatic gradient spanning 20° of latitude, in eastern Subarctic and Arctic Canada. The overarching goal of this research is to quantify local (physiographic, hydrogeormorphic) and regional (hydroclimatic) factors that limit or enhance mercury bioaccumulation in aquatic foodwebs, including both biotic and abiotic pathways. This presentation will report on inter- and intra-regional differences in water-column concentrations of total mercury (THg), methyl-mercury (MeHg) and dissolved organic carbon (DOC) among 16 lakes from two of our three research locales: Kuujjuarapik-Whapmagoostui, QC (55.27° N, 77.76° W) and Iqaluit, NU (63.75° N, 68.52° W). Subsequent work will include observations from our third year of sampling at Resolute Bay, NU (74.70° N, 94.83° W). We analyzed statistical relations between THg, MeHg and DOC, and various physiographic (landcover), hydrogeomorphic

(watershed and lake morphometry) and climatic (mean annual temperature, precipitation and runoff) descriptors. Surface water concentrations of MeHg were strongly and positively correlated to THg concentrations, implying strong control of inorganic mercury supply on MeHg concentrations. THg was strongly correlated to DOC in surface waters when the lakes are pooled from both Kuujjuarapik and Iqaluit ($r2 = 0.67$, $p < 0.001$). When each locale was considered separately, however, this relationship between THg and DOC did not hold. Therefore, broad-scale, cross-ecosystem differences in DOC supply between sub-Arctic vs. Arctic lakes may influence THg mobility, but at the scale of individual lakes, other factors may also play an important role. In-lake processing (e.g. photoreduction of mercury) may be one such factor, contributing to the lack of intra-regional correlations between surface water THg and DOC concentrations. Surface water concentrations of both THg and MeHg decreased logarithmically ($r2 = 0.85$ and 0.84, for THg and MeHg, respectively, $p < 0.001$), as function of lake residence times (derived through watershed morphometry and available climate normal), suggesting that in-lake processing of THg and MeHg may reduce their concentrations within the water column. This effect was observed at both inter- and intra-regional scales of analysis. These results point to an interaction between watershed and lake morphometry (i.e. watershed area to lake-volume ratio) and regional climate (mean annual runoff) that can explain large variations in ambient THg and MeHg concentrations among subarctic and arctic freshwaters. Changing temperature and precipitation regimes will alter hydrologic residence times of subarctic and arctic lakes, with important implications for biogeochemical cycles affecting ambient surface water concentrations of THg and MeHg.

DISCRIMINATING DIFFERENT ICE TYPES WITH SYNTHETIC APERTURE RADAR (SAR) SATELLITE IMAGERY ALONG THE NORTHERN COAST OF ELLESMERE ISLAND, NUNAVUT, CANADA

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The ice shelves and other ice features along the northern coast of Ellesmere Island are a complex mixture of ice originating from marine and meteoric sources. This is reflected in the considerable variability in SAR backscatter, yet little is currently known about what controls these patterns. An understanding of ice properties (e.g., bulk salinity, grain size, presence of sediments and air inclusions) is central to the understanding of microwave scattering mechanisms and will aid in interpreting various ice types in SAR imagery. Fieldwork was undertaken in 2012-2013 on the Petersen (82°31'N, 81°45'W) and Milne (82°39'N, 81°26'W) ice shelves to sample the top 2 m of a variety of ice types, including meteoric ice (iced firn), marine ice (basement ice), and epishelf lake ice. Ice cores were examined in the field and then transported to Ottawa. A 1 cm piece of every second ice core segment was melted to measure the temperature and bulk salinity. Thin sections of the cores were created to view ice grain shape and measure their size under cross-polarized light. Backscatter in HH, VV and HV polarizations was extracted at each ice sample location from a fine-quad RADARSAT-2 image acquired on April 27, 2013. Our results indicate that each ice type has a unique texture and structure and that HV polarization had the greatest variability in backscatter between ice types. Our statistical analysis suggests that grain size and salinity have the greatest influence on backscatter values. These findings offer the potential to improve our ability to assess inter-annual and long-term changes (past and future) of the ice cover along the northern coast of Ellesmere Island.

SPATIAL TRENDS OF BENTHIC SECONDARY PRODUCTIVITY IN THE ARCTIC OCEAN

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Secondary production (i.e. the amount of organic material produced through time) has been recognized as a powerful tool in ecology to address questions of energy–biomass flow, trophic ecology, and management of biological resources. It is an integrative tool as it incorporates all of the information relative to the health status of a biological system (i.e., biomass, individual growth and community growth, reproduction, etc.). It consequently represents the cumulative responses of a population, community or ecosystem to its abiotic and biotic environment. In the context of global climate change, the Arctic system has experienced substantial and rapid changes with potential effects on marine ecosystem health. In that regard, secondary production may represent useful, quantitative tool for the assessment of ecosystem health and functioning, and may be

an indicator of ecosystem change. The purpose of this study is to describe the spatial pattern of benthic secondary productivity in the Arctic Ocean from retrospective large datasets and ongoing studies and from published and unpublished sources. We use geostatistical and multivariate approaches to assess benthic productivity distribution patterns, as well as their relation to environmental factors by correlating environmental variables with biological observations. The understanding of the spatial patterns in productivity in the Arctic Ocean will be helpful to 1) assess the large-scale spatial variability of benthic ecosystem functioning, and 2) develop a metric to quantitatively assess benthic ecosystem health. Results will also contribute to develop a better understanding of the ecosystem-wide impacts of global change on the Arctic system and may acquire an economic importance as secondary production provides a measure of food provision delivered by an ecosystem.

BASELINE ASSESSMENT OF HYDROCARBONS IN BENTHIC INVERTEBRATES IN BAFFIN BAY PRIOR TO OIL AND GAS EXPLORATION AND EXTRACTION AND INCREASED SHIPPING TRAFFIC

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Baffin Bay contains large estimated reserves of hydrocarbons (oil and gas) that have yet to be tapped due to economic and logistical considerations, the latter due to the presence of sea ice. However, with climate warming, sea ice extent is diminishing, and there is a greater push for exploration of these hydrocarbon reserves. There is, therefore, an urgent need to establish the background levels and composition of hydrocarbons in both abiotic and biotic compartments prior to further oil and gas development, and to develop our understanding of the factors controlling the transport, fate and biological effects of petroleum hydrocarbons spilled in the marine environment. This type of information contributes to hazard preparedness by providing the data, including chemical signatures, needed to distinguish between pre-existing (e.g. natural oil seeps) and potential offshore petroleum development sources in the event of an oil spill. Monitoring of Key Valued Ecosystem Components (VECs) such as bottom sediments and benthic invertebrates are essential if we are to properly estimate impacts and the recovery of an ecosystem should a spill ever occur. In this study, we have examined bottom sediment and three species of benthic invertebrates (Ophiopleura borealis, Bathyarcha glacialis and Ctenodiscus crispatus) in natural oil seep and reference sites for select hydrocarbon compounds (PAH, n-alkanes). Sediment data show significant enrichment of hydrocarbons at site 111. Biological samples are currently being analysed, with results forthcoming shortly. This study presents the first baseline study of hydrocarbons in biological tissues in Baffin Bay and a crucial basis for future comparisons of maritime shipping and oil and gas activity. We would like to thank the Nunavut General Monitoring Plan and ArcticNet for the funding of this study.

TREE SEED LIMITATION AT TREELINE IN THE SWISS ALPS

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The treeline is one of the most conspicuous vegetation boundaries in Arctic and alpine ecosystems. Understanding if and how the treeline is expanding or will expand with ongoing climate change is a key scientific challenge. The Global Treeline Expansion Experiment (G-TREE) uses a straightforward experimental design with seeding and substrate-altering treatments aiming to disentangle seed versus substrate limitations on treeline recruitment. At the Swiss G-TREE site (Stillberg, Davos), we studied germination of European larch (Larix decidua) and Norway spruce (Picea abies) with and without seeding, at three different elevations (forest zone, transition zone at the current treeline and alpine zone), in two consecutive years (2013 and 2014), with and without scarification of the soil surface, originating from high and low provenances, and with and without herbivore exclusion by above-ground cages. In both years, natural regeneration did not occur in any of the three zones and germination was almost zero in the forest zone, where competition with herbaceous plants strongly reduced light availability and soil temperatures. In 2013, germination was higher in the transition zone (larch 14 %, spruce 11 %) than in the alpine zone (larch 6%, spruce 2%). However, in 2014, with particularly high precipitation during the growing season, highest germination (larch 34 %, spruce 9 %) was found in the high-elevation alpine zone. Scarification of the soil surface and herbivore exclosures enhanced germination. Seeds from low-elevation provenances showed higher germination than those from high-elevation provenances. The experiment showed clear evidence for seed limitation and moderate evidence for substrate limitation. Our findings suggest that trees could establish c. 300 m above the current treeline, at

least in years with appropriate weather, if seeds were transported there. However, the continued experiment will have to show if the seedlings can survive or if high germination rates will be followed by high mortality rates. The study indicates that early establishment of seedlings is more limited by other factors than elevation and that treeline changes may be lagging behind ongoing climate change.

CHARACTERIZING RECENT ENVIRONMENTAL CHANGE WITH OTOLITH TRACE ELEMENT VARIABILITY IN TWO CANADIAN HIGH ARCTIC LAKE SYSTEMS

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Arctic charr (Salvelinus alpinus) are an important species for northern communities and ecosystems. The environmental stresses that they undergo due to climate and related permafrost change can be potentially recorded in the chemical composition of their otoliths. Otoliths are the inner ear bones of teleost fish and are composed of annually layered calcium carbonate (aragonite) and proteins. As the fish grows, the otolith incorporates trace elements from the aquatic environment during the 15-25 year typical lifespan for arctic charr. Recent environmental change has resulted in significant physical and chemical changes in Arctic lake systems and investigation of the otolith record offers the opportunity to determine how the fish have responded to these limnological changes. This research is part of a larger study investigating mercury cycling in freshwater ecosystems that have been affected by climate and permafrost changes and includes fish sampling from 2008-2014. The primary study sites are the two lakes of the Cape Bounty Arctic Watershed Observatory (CBAWO) located on south-central Melville Island, Nunavut. Landlocked arctic charr were sampled in both the East and West Lakes and the otoliths were embedded and polished using standard methods. Analysis was conducted using laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS) to investigate trace element concentrations. Two different locations were ablated on otoliths from both lakes: one along the outer edge and another from the interior, corresponding to the early and late stages in the fish's life, respectively. A transect analysis line was also taken from the outer to the inner edge of the otolith to provide a continuous time series of trace element data for the duration of the individuals lifespan. Results to date show that not only is the otolith chemistry notably different between the two lakes but also from the inner to outer zones (early to late life) of each fish. Cluster analysis indicates that charr in the East Lake record less variability among five individuals than differences between the earlier and later stages of the fish's life. By contrast, there are greater elemental differences between individuals compared to the early-late samples for a given individual for charr from the West Lake. These results suggest that the fish in the East Lake have responded relatively uniformly to changes to water chemistry over time, while fish in the West Lake have responded differently, and that these differences appear to be dominant compared to the temporal changes. Elements that show contrasts between the inner and outer portion of the otoliths include Sr and Zn as well as redox sensitive elements such as S, U and Tl. This research characterizes the temporal chemical variations in the otoliths and compares these results to observed chemical and physical changes in the lakes. Furthermore, this research investigates the driving factors behind this change and will seek to understand the impact of climate warming and the resulting permafrost disturbance in the surrounding watershed on aquatic ecosystems. This research will advance our understanding of how climate and landscape change alters downstream Arctic lake systems and impacts the aquatic food web.

FROM PARTICIPATORY MAPPING TO GIS: THE CHALLENGES OF USING TECHNOLOGY TO DEPICT TRADITIONAL KNOWLEDGE OF CARIBOU.

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Caribou are vital to social, cultural, economic and health dimensions of life in Inuit communities. Current caribou management processes are varied and an extensive literature review carried out between 2010 and 2013 revealed a gap in knowledge related to caribou research on or near King William Island (KWI), Nunavut. There is very little data collected on KWI and in surrounding areas, which leads to herd representations showing little to no caribou found on the island. Much of the research is reliant on biological research methods and few studies take traditional knowledge and the Inuit perspective into account. During research planning workshops, Elders from the Gjoa Haven, Nunavut (on KWI), previously identified four distinct types of caribou on and around the island year-round. This suggests that the inclusion of traditional ecological knowledge provides a broader perspective

of the status of caribou in the region, and provided the rationale for developing a collaborative community-based project in Gjoa Haven to learn about caribou from Inuit knowledge and experience. As part of a larger SSHRC-funded project entitled "Connecting Inuit Elders and Youth: Learning about caribou, community, and wellbeing" (2011 – 2014), 40 semi-directed interviews were conducted with Elders and hunters in Gjoa Haven. During interviews, participatory mapping was an important way that these local experts could document and share their knowledge of caribou on and around KWI. During the summers of 2012 and 2013, 32 maps representing personal biographies, caribou knowledge (i.e. herd ranges, calving grounds, migration routes), and areas of importance for hunting and travel were created during interviews. These were subsequently digitized and brought into a GIS using ArcMap. There are challenges in bringing participatory mapping data into a geo-spatial paradigm while maintaining the integrity, depth and richness of the information depicted by the Elders. The creation of compilation maps based on themes related to caribou knowledge and use is challenging due to the manner in which the contributors chose to depict relevant attributes. There are varied spatial representations for a single feature type. For example, in map drawings to indicate areas where caribou are known to be found, different contributors chose to represent these places as points, lines, and/or polygons. Therefore, this poster presentation will explore the challenges in representing traditional ecological knowledge as geographic information data (along with associated digitization and data manipulation processes) in order to minimize loss of meaning and context. We will feature maps of this traditional knowledge of caribou migration routes, calving grounds, hunting grounds as well as any distinctions made between the different types of caribou as explained during interviews. These maps, and the processes used in their creation, help to highlight important considerations and spatial representations of traditional knowledge that have potential to contribute to more inclusive decision making for caribou co-management.

POLYMORPHISM OF MAJOR HISTOCOMPATIBILITY CLASS I CLASSICAL AND NON-CLASSICAL GENES IN ARCTIC CHARR (SALVELINUS ALPINUS)

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Major Histocompatibility (MH) genes are involved in distinguishing between self and non-self molecules. Classical MH genes encode membrane receptors that present peptides to T-lymphocytes to initiate an immune response. The functions of non-classical genes are not completely understood, although they are likely involved in many physiological processes. We examined four class one genes UCA, UEA, UGA and UBA in Arctic charr (Salvelinus alpinus) to evaluate the potential use of each gene as a population marker. UBA is known to be a classical gene in several salmonid species and is the most frequently used class one gene to distinguish among populations. The combined use of genotyping and RT PCR suggests that UBA is also a classical gene in Arctic charr. Furthermore, Arctic charr appear to have a second classical gene, UGA, which is generally considered to be a non-classical gene in most other salmonid species. Our results further indicate that both UBA and UGA identify allelic lineages, but that UGA provides better resolution based on geographic origin. Arctic charr has an exceptional ability to adapt to varied environments and the use of two classical genes, both UBA and UGA in the defense against local pathogens might be one mechanism that facilitates their adaptability.

CHANGES IN PERMAFROST AND ACTIVE-LAYER THICKNESS DUE TO CLIMATE IN THE PRUDHOE BAY REGION AND NORTH SLOPE, AK

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Several permafrost observatories are situated in the immediate vicinity of the Prudhoe Bay Oilfield, Alaska and provide an important background reference for understanding the effects of oilfield infrastructure on permafrost conditions. Most of the permafrost observatories in the Northern Hemisphere show a substantial warming of permafrost since the 1980s. The magnitude of warming has varied with location, but was typically from 0.5 to 3°C. During the second half of the 20th century, permafrost has been already thawing within the southern part of the permafrost domain. However, recent observations documented propagation of this process northward into the continuous permafrost zone. Permafrost temperature at 20 m depth has been increasing between 0.28 and 0.47°C per decade since 2000 on the North Slope of Alaska. In 2013, new record high temperatures at 20 m depth were measured at some permafrost observatories on the North Slope of Alaska and in the Brooks Range, where measurements began in the late 1970s and early 1980s. Changes in permafrost temperatures

at 20 m depth typically lag about one year behind the changes in surface temperatures. The 20 m temperatures in 2013 were 0.03°C higher than in 2012 at West Dock and Deadhorse on the North Slope and 0.06°C higher at Coldfoot in the southern foothills of the Brooks Range. At the rest of the North Slope sites permafrost temperatures in 2013 were similar to those in 2012, except at Happy Valley where they were 0.06°C lower. Permafrost temperatures at 20 m depths were increasing steadily since the beginning of measurements in 2006 at the Imnavait Creek site near Toolik Lake reaching unprecedented for the North Slope value of -3.2°C in 2014. Long-term observations of the air temperature and snow depth available from our three North Slope sites (Franklin Bluffs, Deadhorse, and West Dock) provide undoubtable evidence that the changes in these parameters are the main driver of permafrost temperatures on the decadal time scale. In 2013, a majority of Alaskan regions reported higher active-layer thickness (ALT) values relative to the 1995-2012 average. On the North Slope of Alaska, for example, ALT was on average 11% higher than the 1995-2012 average of 0.47 m. This is 6% higher than in 2012 and on par with the 20 year maximum recorded in 1998. Changes in the active layer thickness, winter air temperatures and snow cover of the last decades substantially increased the time that is necessary for the complete re-freezing of the active layer during the winter. This time was steadily increasing at our northern-most observational sites, culminating during the 2013-2014 winter. The timing of freeze-up is extremely important for many biological and biogeochemical processes in these tundra environments as well as for the diverse human activities in this region.

MONITORING FREEZING AND BREAK-UP OF THE EAST-CHANNEL IN THE MACKENZIE-DELTA WITH HIGH RESOLUTION POLARIMETRIC SAR DATA

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The high-latitude regions of the earth are characterized by a vast number of water bodies, mostly lakes. Depending on the location the areal coverage of lakes in the arctic and sub-arctic regions ranges from 15 to 40% (Duguay, 2003). Water in general and lakes in particular have the ability to store heat. The monitoring of the ice-cover variability of lakes in high latitudes is therefore a good indicator for changes related to global warming and its effects on the polar regions. The monitoring of freeze-up and break-up of ice is important to help manage flow releases from hydroelectric generation facilities as they can influence the risk of ice jam related flooding, even up to several 100s of kms downstream of the dams. Furthermore frozen lakes and rivers are used as transportation routes for connecting local communities. Remote Sensing has the capacity to provide accurate high resolution information of the sea and land surface in an automated and standardized way. In particular satellites equipped with Synthetic Aperture Radars (SAR) enable regular mapping and monitoring. Their all-weather and day and night observation capability are important advantages in the Arctic due to high cloud coverage rates and low illumination during the winter period. In 2007 the German Earth Observation satellite TerraSAR-X was launched that provides high resolution SAR data. Since 2010 it is flying together with its twin satellite TanDEM-X in close formation enabling single pass interferometry. The primary mission goal is the generation of a global digital elevation model in outstanding quality and resolution that allows classifying the shoreline and land's topography at an unprecedented level of detail. Objective of the presented work is to test the applicability of higher level products of polarimetric SAR data. Based on these products an automized and transferable technique shall be developed for lake and river ice monitoring. In the current study a time series of dual polarimetric TerraSAR-X (HH/VV) data was processed and analysed. A Kennaugh decomposition was applied. The TerraSAR-X data were radiometrically and geometrically calibrated. A DEM provided by the TanDEM-X mission was used for ortho-rectification. The time series lasts from September 2012 to September 2014 and covers two entire freezing and thawing periods. Data were acquired from four different orbits (two ascending and two descending). Currently data from just one repeat orbit are considered.

LANDSCAPE HAZARDS MAPPING FOR CLIMATE CHANGE ADAPTATION PLANNING IN YUKON: APPROACH AND METHODS

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Since 2010, the Northern Climate ExChange (Yukon College, Canada) has been evaluating and mapping landscape

hazards related to surficial geology, permafrost and hydrology in eight different communities across the Yukon. The thawing of permafrost caused by rising temperatures is resulting in subsidence of the ground surface, increased landslide risks and reduced bearing capacity of the soil, which has important implications for infrastructure maintenance and future developments. Tools like landscape hazards maps help northern communities obtain clear and reliable information for adaptation planning, including identifying suitable locations for future development projects. As part of this project, the research team has been gathering and mapping geoscience data through sample collection, permafrost drilling and coring, geophysical surveys, topographical measurements and other types of field validation. By combining electrical resistivity tomography (ERT), ground penetrating radar (GPR), and coring, we were able to detect more accurately permafrost boundaries, identify the limits between soil types, and better select our sampling sites along geophysical transects. This approach allowed us to cover large areas with precision in a minimal time. To produce maps of landscape hazards, geoscience data were amalgamated and landscape polygons within our map area (identified via new fine-scale surficial geology maps) were ranked in intuitive categories (e.g., high risk, medium risk, no risk) based on the field data and the results of geotechnical analyses performed in the laboratory. We focused on characteristics related to the sensitivity of soil to permafrost thaw (e.g., excess ice content, thaw consolidation, grain-size distribution, etc.). Ranked polygons were then represented graphically (in stoplight colors) on maps covering the study area. By incorporating projections of future climate variability (e.g., temperature, precipitation, freeze and thaw dates), landscape hazards classification reflected both contemporary and potential future conditions. These hazards classification maps incorporated science into decision-making processes by combining and classifying geoscience data to create an easily interpretable ranked representation of current and future hazard potential. The maps were intended to be used as an adaptation planning tool by engineers, planners, consultants, and all levels of government and non-governmental decision-makers to assist with municipal planning activities.

DEVELOPING A HYDROECOLOGICAL MONITORING PROGRAM FOR LAKES IN WAPUSK NATIONAL PARK, NORTHERN MANITOBA

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Wapusk National Park (WNP), located on the southwest coast of Hudson Bay, contains over 10,000 shallow lakes which provide key habitat for many wildlife and waterfowl, but their hydroecological integrity is threatened by climate change and rapidly increasing Lesser Snow Goose (LSG) population. For example, lake desiccation has recently been observed and has been attributed to low snowmelt runoff (Bouchard et al. 2013; Geophysical Research Letters). And a study has shown that the carbon cycling of lakes may be strongly altered by catchment disturbance from LSG grubbing and vegetation loss (MacDonald et al. 2014; Arctic, Antarctic, and Alpine Research). To track the ongoing consequences of these stressors, we are developing the foundation of a hydroecological monitoring program for lakes in WNP in collaboration with Parks Canada. The framework for the monitoring program includes use of water isotope composition (d18O, d2H), measured at sixteen lakes located in the three main ecozones of WNP (coastal fen, interior peat plateau-palsa bog, and boreal spruce forest) during 2010-2014, which provide data to assess changes in lake hydrological conditions. Water isotope compositions span a large range, indicating that the study lakes appear to capture the diverse hydrological conditions throughout WNP. To monitor the consequences of LSG disturbance, our sampling design targeted fifteen other lakes in 2014. These include five highly-disturbed lakes, which have little to no vegetation in their catchments due to LSG grubbing, and five moderately-disturbed lakes, which were observed to have comparatively less evidence of LSG grubbing. Five non-disturbed lakes were also selected, which have healthy wet and grassy catchments, to serve as control sites. Lakes were visited in mid-June after ice-off, late-July and mid-September before ice-on and sampled for water chemistry (including nutrients, ions, carbon isotope composition of dissolved inorganic carbon and particulate organic carbon), water isotope composition and the upper 1 cm of sediment. Surface sediments will be analysed for organic and mineral matter content, organic carbon and nitrogen elemental and isotope composition, diatoms and pigments. Results will be used to determine analyses most sensitive to catchment-disturbance effects of LSG (e.g., d13CDIC; MacDonald et al. 2014), and which could be used for ongoing monitoring. Overall, the monitoring approaches will generate key metrics to assess aquatic ecosystem status and trends in response to ongoing changes in climate and LSG population.

THE SOCIAL DETERMINANTS OF HEALTH IN NUNAVIK: EXPLORING GENDER INEQUALITIES

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Background: In Canada, Inuit experience poorer health compared to the rest of the population. This large health gap is often explained by inequalities in the distribution of the social determinants of health. Yet, by solely focusing on reducing the health between the North and the South, social inequalities within Inuit Nunangat are masked. Over the years, Arctic communities have experienced rapid social, cultural, economic and political changes which have influenced men and women differently. This translates into gender inequalities in the distribution of the social determinants of health, and health status and outcomes. The aim of this study is to describe gender inequalities across a broad range of social determinants in Nunavik. Methods: Cross-sectional data from 860 Inuit adults were collected from the 2004 Qanuippitaa? How are we? Nunavik Inuit Health Survey. Information about socioeconomic status, lifestyle, perceived demands and social support was collected using questionnaires. Frequencies and means were used to describe the characteristics of the participants stratified by sex. Bivariate analyses were used to examine differences between men and women. Results: Results show that, overall, a higher proportion men report working compared to women. Among younger age group, 81% of men aged 18-24 years were employed compared to 63% of women of the same age. Higher income are reported by men, especially in older age groups where 26 % of men aged 55 years and over reported a yearly personal income above $40,000$ versus 8.5% of women of the same age. Regarding social demands, significant gender differences were observed: 22% of women reported frequently feeling that too much is asked from them, whereas 15% of men felt a similar pressure. Comparing to men, women less often got together socially to take part in recreational activities (33% vs 23%, respectively), but reported higher levels of social support. There were no significant gender differences on food insecurity, education and alcohol consumption. Conclusion: Results show important inequalities in the social determinants of health between men and women in Nunavik. There is a need to better understand the role of social determinants of health in the North, especially among Inuit woman. Results from this study provide information relevant to health policy decision-makers that held address inequalities on health reported between women and men.

CRITICALITY OF ENERGY SECURITY FOR REMOTE COMMUNITIES

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Every community needs to be part of drive to reduce GHGs • Vulnerable availability of non renewable energy supply: peak oil • Vulnerable supply routes: weather, terrorism • Potential instability of distant governments and agencies upon which a remote community (RC) may depend • Cyber attack or breakdown of remote systems upon which a RC may depend as a result of grid or other failure • RCs as havens, providing a degree of immunity from global catastrophes: pestilence, war, epidemics, starvation, effects of climate change, population exceeding necessary resources ECONOMICS • Increasingly beneficial financial and energy return on investment of emerging technologies conducive to lowering energy needs and increasing energy supply and storage. - Supply: wave, tidal, ocean current, micro- cogeneration from biomass, geothermal (many RCs are advantageously located to take advantage of renewable energy sources) - Storage: battery technology, compressed air, gravity - Demand: lighting, vacuum insulation, passive solar, HVAC - micro- grid management Growth of demand for most applicable technologies encourages further advancement in the technologies and economies of production scale to reduce costs EXEMPLARS Because of relatively small populations some RCs are potentially easier to grow into net-zero-energy communities, providing valuable lessons for non remote, grid connected communities.

THE ARCTIC FLORA OF CANADA AND ALASKA PROJECT

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The Arctic Flora of Canada and Alaska project aims to produce a new flora treating all vascular plants (ca. 800 species) in the Arctic ecozone in Canada and northern Alaska. Our research team includes botanists from Canada, Norway, and the United States, and is being led by researchers at the Canadian Museum of Nature. We are using a web platform to move the Flora beyond traditional standards, and to produce a treatment that is digital and interactive, taking full advantage of current web and database technologies. The flora will include parallel taxon descriptions, dichotomous keys, detailed nomenclatural data, common names, information on traditional uses, taxonomic comments, and will be richly illustrated with

photographs taken in the field and of herbarium specimens showing characters important for accurate identification. Tracking specimens examined will allow future verification of distributional and descriptive data, and will facilitate production of dynamic distribution maps. The Arctic Flora of Canada and Alaska website (http://arcticplants.myspecies.info) will be updated with content on an ongoing basis. The Flora will eventually serve as the key source of information for anybody who requires accurate and up-to-date information on the Arctic flora, including those involved in Arctic terrestrial monitoring, students in the north and elsewhere, and the international botanical community. It will also serve as an up-to-date source of baseline information on plant biodiversity in one of the worlds' most climate-threatened ecosystems.

POSTNATAL EXPOSURE TO PBDES AND VISUAL PROCESSING IN SCHOOL-AGED CHILDREN IN NUNAVIK

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Introduction: Polybrominated diphenyl ethers (PBDEs) have been detected worldwide in humans with levels substantially higher in North America, including in Inuit people living in Canada's Arctic Quebec (Nunavik). By contrast to several other contaminants, our knowledge of the toxicity of PBDEs on brain function development in humans is very poor. In line with previous works showing that environmental contaminants may alter the visual system, we examined whether visual processing is impaired as a function of PBDE exposure in the Nunavik Child Cohort. Method: Visual evoked potentials (VEPs) to motion-onset, achromatic and chromatic visual stimuli were recorded over the occipital central site (Oz) in 148 Inuit children (mean age ±standard deviation = 11.3 ±0.6). Blood concentrations of PBDE congeners 47, 99, 100 and 153 were measured at the time of VEP testing. Co-exposure to methylmercury, lead, PCB-153 and n-3 fatty acids, measured at the time of testing and at birth in cord blood, as well as other potential confounding variables were taking into account by multivariate regression analyses to assess the relationships between each PBDE congener, and their sum (ΣPBDEs), with VEP amplitudes and latencies. Results: The amplitude of the chromatic VEP (N1 response) was negatively and significantly associated with all PBDE congeners except PBDE 153 before and after adjustment for confounders (βs range = -0.21 to -0.24, ps = .007 to .029). PBDE 47 exposure was associated with a decrease of amplitude of the achromatic VEPs (rs range = -0.17 to -0.19, ps < 0.05), in particular at low contrast levels (4 and 12%) but, after adjustment for confounders, only the association with the VEP response at 4% of contrast remained significant (β = -0.17, p = 0.03). No significant association between PBDEs and motion VEPs was found, either for amplitude or latency. Conclusion: Our study shows clearly an adverse impact of postnatal exposure to PBDEs on color visual processing in school-age children. This result was not attributable to co-exposure to the other contaminants including PCBs, which shares physical and chemical properties with PBDEs. Considering that PBDEs are persistent and bioaccumulative, the alterations of visual processing reported here may result from cumulative exposure during prenatal period and after birth. Further prospective cohort studies are needed to address this issue.

VERTICAL CHANGE OF PASSIVELY SINKING COPEPODS FLUX UNDER THE PYCNOCLINE IN THE CANADIAN BEAUFORT SEA

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Passively sinking dead copepods (i.e. undecomposed copepod carcasses) is a grossly ignored component of vertical particulate organic carbon (POC) flux, resulting in the underestimation of the total POC flux. Recent studies pointed out the significant contribution of copepod carcasses to the annual export POC flux (up to 36%) from the surface mixed layer. Those studies suggested that the fresh copepod carcasses were likely to be very nutritive particles when compared to refractory and/or diluted detrital particles remaining.

Uncertainties, however, remain regarding the ultimate fate of these fresh POC under the pycnocline. In this study, we estimated the carcass flux at two depths (at 100 m and 200 m) under the pycnocline. Our result shows that up to 98% of the passively sinking dead copepods were retained in water column between 100 m and 200 m. Our study suggests that the exported carcasses from the surface layer were consumed rapidly in the water column within the twilight zone by heterotrophs such as zooplankton and bacteria.

SPATIAL DISTRIBUTION AND CONTRIBUTION OF SMALL PHYTOPLANKTON COMPOSITION IN THE CHUKCHI SEA

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Given a projection of thriving small phytoplankton in the Arctic Ocean under climate-induced environmental changes, it is important to estimate the contribution of small phytoplankton to the total phytoplankton community and primary production in the Chukchi Sea. Small phytoplankton productivity measurements were taken during two consecutive cruises in the Chukchi Sea in 2004, based on a 13C-15N dual isotope tracer technique. The average contributions of small phytoplankton (< 5 μm) to carbon and total nitrogen (nitrate + ammonium) uptake rates were 31.7 % (S.D. = ± 23.6 %) and 37.3 % (S.D. = ± 26.1 %), respectively. Given the higher nitrogen compared to carbon assimilation rate of small phytoplankton in this study, small phytoplankton might be contributing a relatively high quality, nitrogen–rich marine organic matter that could be supplied to upper trophic levels within the water column. Using flow cytometry, small size-fractions of the phytoplankton (< 20 μm) obtained during the cruise were analyzed for contributions of pico- and nano-eukaryotic phytoplankton and prokaryotic phytoplankton for the first time in the Chukchi Sea. The abundance of Prochlorococcus and Synechococcus represented about 30% of total small phytoplankton cells in the Chukchi Sea. We found that temperature and NH4 concentrations were significantly positive correlated with the abundance of total phytoplankton, pico- and nano-eukaryotes, Prochlorococcus and Synechococcus. Projected higher water temperature and increase of NH4 concentration condition in the Arctic Ocean as well as the Chukchi Sea could have fostered more small phytoplankton communities especially Prochlorococcus and Synechococcus.

THE ENVIRONMENTAL FACTORS AFFECTING THE SPATIAL VARIANCE OF ZOOPLANKTON AND FISH DENSITY IN THE CHUKCHI SEA

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Recent climate change and ice reduction are impacting on the physics, chemistry and biology of Arctic. Because zooplankton plays important roles in Arctic food-web as the links between phytoplankton and predators at higher trophic levels, the spatial-temporal changes in zooplankton distribution and abundance can influence on the distributions of commercially and ecologically important fish (i.e. Polar cod Boreogadus saida and capelin Mallotus villosus). Therefore, understanding the distribution and abundance changes in zooplankton with environmental change and the relationships between zooplankton and fishes distribution are important to predict the fishery responses to these caused by climate change. Zooplankton is sensitive to environment and their community and distributions are related to water mass. However, little is known about the environmental factors contributing to the spatial variance of zooplankton density. The objectives of this study are to develop the habitat models for zooplankton and fish, and examine the environmental factors affecting the spatial variance of zooplankton and fish density. Furthermore, we aim at investigating to the relationship between zooplankton and fish distributions. Zooplankton, fish and in situ environmental data in Chukchi Sea were collected from Arctic Cruise conducted by T/S Oshoro-Maru of Hokkaido University in summers of 1991, 1992, 2007, 2008 and 2013. Zooplankton and fish samples were collected by NORPAC net and trawl, respectively, and then were summarized by taxa. For oceanographic factors, we used temperature, stratification index (derived from density), salinity and chlorophyll-a concentration obtained from CTD and water samples; summarized by layers i.e. surface, vertically averaged and bottom. For geographical factors, distance from the land, distance from Bering Strait and water depth were included. We then applied Generalized Additive Model (GAM) with negative binomial distribution. We constructed 3 types of models: surface, vertically averaged and bottom oceanographic factors with geographical factors on each species. Based on R2

for Arctic copepods models, R2 values were derived in the order of bottom > vertically averaged > surface, and surface factors were also insignificant. Bottom environment likely reflects the conditions during the previous seasons. Hence, we suggest that the abundance of Arctic copepods could be affected by the previous environmental conditions. On the other hand, R2 for Pacific copepod models showed values following this order: vertically averaged > surface > bottom. Pacific copepods are known to be transported by the water masses from the Pacific and the Bering Sea. Our results indicated that the abundance of Pacific copepods was thus affected by water mass features in summer.

QUANTIFYING THE CONTRIBUTION OF VERTICAL VELOCITY TO TOTAL ELEVATION CHANGE FOR PENNY ICE CAP, BAFFIN ISLAND, NUNAVUT.

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Currently, no long-term surface mass balance records exist for Baffin Island glaciers. In the absence of such data, air- and space-borne measurements can be used to infer glacier mass change based on changes in surface elevation. However, this geodetic method is complicated by variations in vertical velocity, due to changes in densification rates and / or ice dynamics, which may result in elevation change of a glacier surface without an associated change in ice mass. Here, we quantify the net vertical velocity over Penny Ice Cap, Baffin Island, using in-situ differential GPS observations from 2011-2013 along three mass balance transects that range in elevation between 348 and 1882 m a.s.l. Vertical velocities are used to assist in interpreting mass changes derived from repeat airborne laser altimetry surveys conducted in 2005-2013 by NASA. Envisat imagery is used to delineate the area impacted by firn densification via identification of the firn line. In the accumulation area, dGPS-measured vertical motion (corrected for downslope motion) averages -0.8 ± 0.2 m per year. This is comparable to the elevation loss measured by airborne altimetry in this region, suggesting that true mass change at high elevations on the ice cap is negligible. In the ablation area, vertical velocities (corrected for downslope motion) increase the height of the glacier surface, suggesting that airborne derived elevation changes may underestimate mass loss in these regions.

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.

PHOSPHORUS REMOVAL IN ARCTIC WASTE STABILIZATION PONDS

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Passive wastewater systems are the most common form of wastewater treatment in the Canadian territory of Nunavut. Of the 25 wastewater treatment systems, 21 utilize waste stabilization ponds (WSPs) and/or wetlands. Little research has previously been conducted on the performance of passive

systems in Northern environments, and a comprehensive understanding of the treatment mechanisms occurring has not yet been obtained. Due to its role in eutrophication, phosphorus is a contaminant of particular concern. Phosphorus can be removed through both chemical and biological pathways. Chemical removal occurs through two pathways: the first is precipitation with iron, aluminum or calcium, and the second is adsorption to metal (primarily iron and aluminum) hydroxides. Biological removal occurs through the utilization of phosphate as a nutrient by phytoplankton or bacteria. Ultimately, both chemical and biological pathways rely on sedimentation for phosphorus removal. In response to the research gap, a comprehensive research plan was conducted at four sites over the course of four years. The communities of Grise Fiord, Kugaaruk, Pond Inlet and Clyde River were chosen as sites of interest. Grise Fiord, Kugaaruk and Pond Inlet each have single cell WSPs, while Clyde River has a two cell WSP. All four communities have an annual controlled decant though natural tundra wetlands. The primary focus of the research was to measure total phosphorus (TP) at various points in the each treatment process in order to determine system effectiveness. The research was expanded to look at other forms of phosphorus, particularly soluble reactive phosphorus (SRP) and the types of phosphorus compounds present in the WSP sludge layer. Levels of TP removal were not consistent amongst the systems. Effluent TP concentrations ranged from 3.5 mg P/L in Grise Fiord in 2011 to 12.3 mg P/L in Pond Inlet in 2014. Further analysis of water from Pond Inlet in 2014 showed that >80% of the total phosphorus was present as SRP. Therefore, while the amount of removal is low (24%), the amount of phosphorus available for biological utilization and/or chemical precipitation/adsorption is high. As a result, under optimized conditions there is a potential for much greater removal efficiencies. Using a method developed by Lukkari et. al. (2007), sediments from Kugaaruk (collected in 2013) and Pond Inlet (collected in 2014) were fractionated to determine the amount of phosphorus in the following pools: loosely bound, redox sensitive (bound to iron or manganese), bound to aluminum and non-reducible iron, calcium bound, mobile organic and immobile organic. The most common forms of sediment phosphorus were immobile organic, bound to aluminum and non-reducible iron, and redox sensitive. It is inferred that these fractions are most capable of remaining sequestered in the sludge layer under conditions (pH, redox) observed in Arctic WSPs. Therefore, these removal mechanisms will be the focus of further optimization. It is anticipated that this research will have relevance to government bodies charged with implementing and meeting future discharge regulations as well as for consulting firms tasked with designing and constructing new systems in the Arctic.

THE INTERNATIONAL PERMAFROST ASSOCIATION: CURRENT INITIATIVES FOR CRYOSPHERIC RESEARCH

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The International Permafrost Association (IPA), founded in 1983, has as its objectives to foster the dissemination of knowledge concerning permafrost and to promote cooperation among persons and national or international organizations engaged in scientific investigation and engineering work on permafrost. The IPA's primary responsibilities are convening International Permafrost Conferences, undertaking special projects such as preparing databases, maps, bibliographies, and glossaries, and coordinating international field programs and networks. Membership is through adhering national or multinational organizations or as individuals in countries where no Adhering Body exists. The IPA is governed by its Executive Committee and a Council consisting of representatives from 26 Adhering Bodies having interests in some aspect of theoretical, basic and applied frozen ground research, including permafrost, seasonal frost, artificial freezing and periglacial phenomena. This presentation details the IPA core products, achievements and activities as well as current projects in cryospheric research. One of the most important core products is the circumpolar permafrost map. The IPA also fosters and supports the activities of the Global Terrestrial Network on Permafrost (GTN-P) sponsored by the Global Terrestrial Observing System, GTOS, and the Global Climate Observing System, GCOS, whose long-term goal is to obtain a comprehensive view of the spatial structure, trends, and variability of changes in the active layer thickness and permafrost temperature. A further important initiative of the IPA are the biannually competitively-funded Action Groups which work towards the production of well-defined products over a period of two years. Current IPA Action

Groups are working on highly topical and interdisciplinary issues, such as the development of a regional Palaeo-map of Permafrost in Eurasia, the integration of multidisciplinary knowledge about the use of thermokarst and permafrost landscapes, and defining permafrost research priorities - a roadmap for the future. The latter project is a joint effort with the Climate and Cryosphere initiative (CliC) and a contribution to the upcoming International Conference on Arctic Research Planning III (ICARP III). The product stemming from the effort will consist of a journal publication listing permafrost research priorities and putting them into context. In all of these activities, the IPA emphasizes the involvement of young researchers (especially through the Permafrost Young Researchers Network and APECS) as well as its collaboration with international partner organizations such as IASC, SCAR, CliC, IACS, IUGS and WMO

MIGRATORY STRATEGIES AND REPRODUCTION OF THE LONG-TAILED JAEGER IN THE CANADIAN ARCTIC

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Carry-over effects, which occur when events or processes in one season influence the success of an individual in the following seasons, could strongly influence arctic wildlife. However, those effects are not easy to quantify, especially in migratory birds, because it is difficult to follow them during the non-breeding season. Among arctic-nesting seabirds, jaegers are unique as they spend most of the year in high seas but become entirely terrestrial during the summer when they come ashore in the tundra to breed. The Long-tailed Jaeger (Stercorarius longicaudus) probably accomplishes a trans-equatorial migration although its migratory routes and wintering areas are poorly known. Assessing potential carry-over effects on the reproduction of this species is thus difficult due to this lack of information. The aims of this study are to 1) characterize the migration routes and wintering areas of Long-tailed Jaegers breeding in the eastern Canadian Arctic, 2) determine annual reproductive success on an individual basis, and 3) identify potential carry-over effects by linking event occurring during the migration and on the wintering area with the subsequent reproductive success. We hypothesize that this population accomplishes a trans-equatorial migration of up to 10,000 kilometers to reach the southeastern part of the Atlantic Ocean. A potentially important wintering area could be the Benguela Upwelling, a food-rich area used by many seabirds. We further hypothesize that conditions encountered on the wintering area and during migration, including the migration phenology, could influence their reproduction due to carry-over effects. This study is conducted on Bylot Island (Nunavut). In 2008, 10 breeding adults were captured on the nest, marked with satellite transmitters and tracked for a few months during their fall migration. They left Bylot Island between mid to late August and flew over a narrow corridor in Davis Strait to reach the Flemish Cap in the North Atlantic, east of the Grand Banks of Newfoundland, in early September. From there, one bird crossed the Atlantic Ocean to reach the western coast of North Africa, after which we lost the signals. In 2014, we deployed 20 geolocators on breeding adults captured at the nest. Those devices track the migration trajectories by recording variations in day length (based on daylight). Because jaegers have a high survival rate and are faithful to their breeding site, we will recapture them on their nest in 2015 in order to recover the devices. We will also record their reproductive success in order to relate it to their past reproduction and their movements during the previous non-breeding period. Examining potential carry-over effects is important in this species because the two ecosystems used during their annual cycle, the Arctic tundra and the southern hemisphere ocean, are among the most affected by global warning. Moreover, because jaegers are top predators, they could be used as ecological indicators for all the changes going on in those ecosystems.

THE UKRAINE CRISIS AND THE ARCTIC: A ROLE FOR NATO IN THE HIGH NORTH?

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While the security environment in the Arctic has varied considerably over the years, the recent events unfolding in Ukraine illustrate how the High North has become firmly linked to the increasingly uncertain and complex international security framework. The neo-containment debate – in this case whether or not NATO's response to the crisis in Ukraine should be linked to the security environment in the Arctic – is a controversial one. This paper seeks to determine both the value and feasibility of a neo-containment strategy before arguing that the perceived benefits are uncertain at best. The underlying currents driving the push for neo-containment are first examined with an emphasis on the positions of individual Allies. Building upon this foundation, NATO's capacity to act in the Arctic is then analyzed in light of the political, military and economic constraints the alliance is currently facing. Two major research

strategies are employed to achieve these goals: a quantitative analysis of NATO's capabilities and several case studies. Data have been collected from archives, newspapers, interviews and published reports with the focus being on the immediate aftermath of Russia's annexation of Crimea. Although the collapse in relations between Russia and the West has yet to reach the gravity or scale of the Cold War, the consequences of a standoff in the Arctic are significant nonetheless. Ultimately neo-containment would only serve to antagonize Russia further and risks initiating a dangerous game of brinkmanship in the High North – a game for which NATO is woefully unprepared.

IMPROVED ACCESS, MANAGEMENT AND PRESERVATION OF TRADITIONAL KNOWLEDGE AND DATA THROUGH ONLINE TOOLS

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The Exchange for Local Observations and Knowledge of the Arctic (ELOKA) provides data management services and support to Arctic communities and others who are working with local and traditional knowledge (LTK) or who are gathering data from community-based monitoring systems. Housed at the National Snow and Ice Data Center (NSIDC), ELOKA continues a long tradition of data management at CIRES. ELOKA has partnered with several communities to provide distribution support for products based on their traditional knowledge, representing them online through robust web tools and interfaces. Three products recently developed by ELOKA illustrate the value of presenting data gathered by Indigenous people in the Arctic through such interfaces. The Clyde River Weather web site (http://www.clyderiverweather.org) displays data from weather stations on Baffin Island, Nunavut, Canada, in both English and the native Inuktitut. The Observations Interface of the Sea Ice Zone Observing Network (SIZONet, http://eloka-arctic.org/sizonet/) is a data entry and display tool of weather, wildlife, and sea ice conditions as observed by hunters from several Alaskan communities. The draft Yukon River web site is a prototype instance based on the Nunaliit system (https://github.com/GCRC/nunaliit/) that allows the display of site based data and information, in this case water quality information, and allows authorized users to contribute images, videos, audio files, and annotations of the information entered. Part of ELOKA's mission is to ensure the long-term preservation of the data from our partners. To this end they have collaborated with Johns Hopkins University and the Data Conservancy on the development of curation systems for science data. The instance of the Data Conservancy installed at NSIDC will initially be used to curate data as part of ELOKA's data management plan.

DEVELOPING WEATHER INDICATORS FOR ARCTIC SHIPPING SEASONAL OUTLOOKS

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Throughout the year, large scale storms (termed extratropical cyclones) generate high-impact weather for the North Pacific, Alaska, and the Arctic. Common definitions of storm activity in the marine context are based on examining some aspect of strong winds. For example, an activity assessment method developed by Atkinson (2005) allowed for the identification of different variations of "storms," primarily related to the speed, direction, and duration of high wind events. By definition, however, the preferred times to conduct shipping activity are periods of favourable weather, what can be termed as "lulls" between times of poor weather. A recent modification to the Atkinson algorithm allows for the assessment of the storminess of a given time period by explicitly accounting for pauses in storm activity that are useful for shipping. This talk will overview development of a lull indicator suitable for use in the shipping industry and will present a climatology of "lull events" for the circum-Arctic region. Arguably of greater utility to operational sectors, however, is the provisioning of information that can aid planning. Such information is provided by national weather agencies at horizons out to seven days. Beyond the seven day time frame, little guidance is available. Many other previous studies have examined various aspects of storm activity in the study area; however, there remain questions about storm activity and predictability in the region, especially when viewed from an operations standpoint. Work has been conducted on Arctic storminess with a particular focus on the Alaska region and has demonstrated some skill in predicting storminess at the one- to three-month time frame. This talk will also present initial efforts to determine the potential skill available in forecasts of lull events beyond the seven day period, out to the three month time frame. Where such methods show skill, planning capacity could be enhanced for northern tug-and-barge and shipping operators. This talk will show the products that can be generated by these methods to showcase their ability.

TAXONOMIC COMPOSITION OF PROTIST COMMUNITY IN FOUR SUBARCTIC FJORDS (LABRADOR, CANADA) DURING SUMMER AND FALL

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In subarctic fjord-type estuaries, the taxonomic composition of protists (> 2 μm) is highly variable, both in space and time, with respect to changing environmental forcing (i.e. temperature, salinity, irradiance, vertical stratification of the water column and nutrient availability). The objectives of this study were (1) to describe the taxonomic composition of protists in four different subarctic Nunatsiavut fjords (Nachvak, Saglek, Okak and Anaktalak) during summer 2007, summer 2013, early fall and late fall, and (2) to identify the environmental factors controlling its variability. Samples were collected at the surface (50 % incident irradiance) and deeper (15 % to 1% incident irradiance). Taxonomic composition was determined by inverted microscopy. A Bio-Env procedure was conducted to determine which environmental variables better explain the taxonomic composition of protists at the surface and deeper. This analysis was conducted using PRIMER v6 and PERMANOVA+ software. The taxonomic composition of protists showed significant seasonal differences. However, the spatial variations between fjords and sampling depths were less marked. During summer 2007, the community in the whole water column was numerically dominated by diatoms (24.8 %) and prymnesiophytes (19.8 %). In summer 2013, raphidophytes (30 %), prymnesiophytes (25.5 %) and diatoms (16.8 %) were the main taxonomic groups. During early fall and late fall, the community was characterized by higher abundances of unidentified flagellates (27.2 % and 33.5 %, respectively) and dinoflagellates (11.8 % and 12.8 %, respectively). At the surface, the abundance of protists ranged from 0.31 x 10^6 cells l^{-1} during late fall to 2.68 x 10^6 cells l^{-1} during summer 2007. At deeper, protist abundances ranged from 0.22 x 10^6 to 21.7 x 10^6 cells l^{-1} during late fall and summer 2013, respectively. At both depths, the minimum and maximum cell abundances were registered at Okak and Nachvak fjords, respectively. The average number of protists at the surface (1.26 x 10^6 cells l^{-1}) was low compared to deeper (2.06 x 10^6 cells l^{-1}). At the surface, salinity, vertical stratification, in situ irradiance and silicic acid concentrations explained 60 % of the variability in protist taxonomic composition. Many protists groups were also significantly correlated with these variables. At deeper, in situ irradiance alone explained 69 % of the taxonomic composition. These results clearly show the seasonal variability in the taxonomic composition of protists in Labrador fjords and the tight environmental control on this variability.

SPHEROIDAL CARBONACEOUS PARTICLES (SCPS): INDICATOR OF ATMOSPHERICALLY DEPOSITED POLLUTANTS IN KONGSFJORDEN, NY-ÅLESUND, ARCTIC

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Spheroidal carbonaceous particles (SCPs) are produced during the incomplete high temperature combustion of fossil fuels. Since these particles have no other known natural source, their presence in the snow and soil in such pristine areas as the Polar Regions can serve as proxy indicators for anthropogenic pollution. In this study we have carried out a morphological and chemical characterization of the SCPs extracted from the surface sediments of Kongsfjorden in Ny-Alesund, the Arctic. The characterization was carried out by scanning electron microscope coupled with X-ray spectrometer (SEM-EDX). The prevalent particle types in all the samples studied were granular-spherical, hollow- spherical and irregular shaped carbonaceous particles. Analysis of the elemental composition showed that the particles are mainly composed of C, O, NA, Si, Al, K, Cl, and Ti. Some particles contained heavy metals Fe, Al, Cu, Cr, Zn, Pb and Ni which indicate that the SCPs could have acted as the dominant carriers of the heavy metals deposited in the surface sediments.

DINOFLAGELLATE CYSTS FROM KONGSFJORDEN, NY-ÅLESUND, SVALBARD: PROXY TOOL FOR PALAEOCEANOGRAPHIC RECONSTRUCTIONS

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Dinoflagellate cysts are organic walled structures produced by planktonic protists, dinoflagellates. Their organic nature ensures good preservation in contrast to carbonate walled

organisms in the high Arctic regions. The composition of dinoflagellate cyst assemblage in modern sediments strongly reflects distribution along various environmental gradients, such as sea surface temperature, sea-ice cover, nutrients and oxygen content. This quality of dinoflagellate cysts makes them an important proxy tool in palaeoclimate, palaeoecological and palaeoceanographic reconstructions. The dinoflagellate cysts have been studied from the surface sediments of the Kongsfjorden, Ny-Ålesund, Svalbard. The surface sediments were collected from varied zones of the fjord including outer, middle and inner parts. The tidewater glaciers Kronebreen, Kongvegen, Kongsbreen, Conwaybreen and Blomstrandbreen drain into the fjord and account for a large amount of melt water discharge into the fjord during the short summer season. The outer fjord is connected to the sea. The cysts of Operculodinium centrocarpum have been recovered from the outer fjord, which is a key indicator of the influence of warm North Atlantic Current (NAC). The warm West Spitsbergen Current (WSC) which is considered to be an extension of NAC, flows along the western margin of Svalbard and has been reasoned to be responsible for the introduction of Operculodinium centrocarpum into the fjord. This study could be used as a modern analog for further research on the influence of warm North Atlantic water masses around Svalbard on glacial-interglacial scales.

PRESENTATION OF VILLUM RESEARCH STATION A NEW HIGH ARCTIC STATION

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The Arctic has heated twice as much as the rest of the world with large consequences for the wildlife, pollutants, the cryosphere and with possible large positive global feedback effects on climate. Though the knowledge about the Arctic has increased over the last years, Arctic is still one of the regions of which we know least. This is especially true for the High Arctic. One of the main reasons for this is the lack of infrastructure. In the present poster we present a newly build research Station, Villum Research Station, Station Nord located in North Greenland (81o 36'N 16o39' W). The aim of the station is to establish a unique state-of-the art research infrastructure in the High Arctic for investigating climate change and its effects on atmospheric, oceanographic, biological and geological conditions and processes in the Arctic. It will consist of three platforms with state-of-the-art laboratory facilities and equipment. The three platforms can be operated together or independently: 1. The Base Station located at Station Nord will consist of a series of buildings with living quarters, laboratories and storage rooms. It will provide a platform for joint studies of air pollution, climate, geology, and biological processes in ecosystems in the neighbourhood of Station Nord. The Base Station will have accommodation for 10 scientists at a time. 2. The Mobile Station includes mobile laboratories and living quarters consisting of tents and vehicles. The Mobile Station will make it possible to do atmospheric, terrestrial, sea-ice and marine research at long distances away from Station Nord. 3. The Air Station will consist of unmanned air vehicles and ground based remote sensors that will make it possible to study vertical profiles of the atmosphere to an altitude of a few kilometres, and to make aerial observations of snow, sea-ice and the terrestrial landscape by remote sensing. The Air Station can be moved and operated at different places, e.g. as part of the Mobile Station.

ATMOSPHERIC BLACK CARBON CONCENTRATIONS AT VILLUM RESEARCH STATION, STATION NORD

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The Arctic has heated twice as much as the rest of the world with large consequences for the wildlife, pollutants, the cryosphere and with possible large positive global feedback effects on climate. Traditionally focus has been on the long lived climate forcers like CO2 but lately shorter species like black carbon has also gained attention. At Villum Research Station, Station Nord in north Greenland (810 36´N, 160 40'W, and 24 m above mean sea level (msl)) a monitoring station for atmospheric measurements is located. The main sampling site is a house situated approximately 2 km southeast of the military camp. The hut is equipped with inlets for measuring gases and particles. In the period from May 2011 to August 2013, observations of the aerosol light absorption coefficient have been conducted using the Multi Angle Absorption Photometer (MAAP, Model 5012 Thermo Scientific). The instrument was operated with a sample flow of about 1 m3 h-1 and the aerosol light absorption coefficient was measured at a wavelength of λ = 670 nm. Aerosol light absorption coefficients were converted to BC concentrations using a specific absorption coefficient of 6.6 m2 g-1, which is a default setting for the MAAP. Model calculations of BC were made by the Danish Eulerian Hemispheric Model (DEHM). DEHM was set up

with a horizontal resolution of 150 km x 150 km south of 600 N and a nested grid of 50 km x 50 km north of 600 N, both model domains with the North Pole in the centre. The vertical resolution was defined on an irregular grid with 29 layers up to approximately 15 km reflecting the structure of the atmosphere. The current model describes concentration fields of 58 photo-chemical compounds (including NOx, SOx, VOC, NHx, CO, O3 etc.) and several classes of particulate matter, where one class is related to BC. This class comprises of two types of BC components: freshly emitted BC, which is treated as hydrophobic, and aged coated BC, which is treated as hygroscopic material. The model was compared to the measured values and was used to describe the effect of new point sources in the Arctic.

STRUCTURAL STUDY OF THE BEAVER CREEK (YUKON) RECESSION MORAINE: A CRYOSTRATIGRAPHIC APPROACH

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Permafrost terrains include significant ground ice to take into account in geotechnical assessments. It is climatically or ecologically driven, and is very sensitive to thermo-hydrological changes at the soil-atmosphere boundary. In order to assess ground stability, models need a certain range of physical parameters, including nature, structure and texture of sediment, water and ice content, thermal and hydraulic conductivity, shear strength, plastic index... etc. Geomorphic records can serve good engineering and modelling practices by documenting the local ground structure, which is fundamental to spatially represent the distribution of physical parameters. This approach was used at the Beaver Creek (Yukon) experimental road site (BC-RES). Being part of a wide geosystemic modelling project, this work aims to document permafrost structure. The site is located just at the margin of the Mirror Creek Glacial extension (antecedent to the last glacial maximum) and lays on the recession moraine. From the cryostratigraphic record of 22 boreholes ranging from 3 to 15m under the natural ground surface, a recent research (Stephani, 2013) has demonstrated a typical succession of 6 ground layers including the active layer, an ice-rich, poor and rich again fine grained deposit covering an interglacial peat layer and the original till. In order to spatially extend this sequence, a vegetation survey was made from aerial pictures, satellite photos and field surveys, a digital elevation model was created from a differential GPS survey, the cryostratigraphy of 22 new boreholes was described and the stratigraphy of the active layer was described in a hundred points. All the new data, including the prior cryostratigraphic record, were integrated in a GIS and led to propose a refinement of the surficial deposit local map and propose the following understanding. Positive topographic elements coalesce with forested areas and negative ones does with muskeg areas. While the climate and glacio-geological setting was the same for both, the hollows were moisture supercharged while the mounds were relatively drained. In the forested area, the shallow (1-3m) cryo-stratigraphic record (associated with holocene climate) shows that the organic layer is relatively thin, the active layer is thick and the quasi-syngenetic ice-rich permafrost table is thin. In the muskeg area, the opposite trend is observed: the organic cover is thick, the active layer is thin and the quasi-syngenetic layer is thick although both environments are based on a recent eolian silt and syngenetic permafrost aggradation. These results suggest that hollow permafrost could still be growing. The deeper (3-15m) cryostratigraphic record (associated with pleistocene climate) informed about a clear thaw unconformity between the recent eolian silt and a preserved syngenetic ice-wedge and eolian silt unit. The preserved pleistocene permafrost appears to result of a regular layered agradation and is relatively thin over the initial moraine under the forested areas while it is highly cryoturbated, thick and organic-rich under the muskeg areas. At the base of the boreholes, an organic-rich lacustrine-wetland deposit is found but the till foundation or the basal peat has never been reached.

LAKE MELVILLE SEA ICE PROJECT: ANALYZING CHANGE AND MAPPING TRAILS TO INFORM MONITORING AND SAFER TRAVEL

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The Labrador Inuit communities of Rigolet and North West River are located on the shores of Lake Melville, a 140-km-long fiord-estuary in south-central Labrador, where sea ice forms an integral part of local Inuit culture and wellbeing. During the cold season it provides access to food and acts as critical travel infrastructure. Recently, local Inuit concern over sea-ice change in the communities has increased. In response, the Nunatsiavut Government and partners have initiated projects to understand potential drivers of change (Lake Melville: Avativut, Kanuittailinnivut [Our Environment, Our Health]) and develop technology to monitor change (SmartICE). The Lake Melville Sea Ice Project bridges these two initiatives. Recent changes in sea ice in Lake Melville are set against a backdrop of four decades of anthropocentric disturbance of the natural drainage, due to the construction of the Smallwood Reservoir and

operation of the hydroelectric developments on the Churchill River. The resulting alterations in seasonal discharge and water characteristics have changed Lake Melville hydrology and oceanography, potentially impacting ice formation. Over the same period, the region has experienced pronounced warming, further disturbing the baseline ice climatology. Although this warming was relatively weak through the 1980-90s, it has since accelerated. The relative impacts of climate and hydroelectric development on Lake Melville sea ice have not previously been quantified. The current project will fill this knowledge gap, providing context for predicting the impacts of the future hydroelectric development on the lower Churchill River (now underway). Local Inuit observations hold key information for understanding both cumulative sea ice changes resulting from both natural and industrial drivers, and event-specific disturbance (e.g. Upper Churchill project) that cannot be documented through other means. Knowledge of ice dynamics and trends that is acquired from continuous and extensive trail use and observation can provide key insights on what and where to monitor for change and to understand impacts of and adaptation responses to these changes on Inuit culture and wellbeing. The overall objective of this project is to investigate changing sea-ice conditions in Lake Melville. Specifically, this project will examine the Canadian Ice Service record of sea-ice coverage (1966-present) to determine spatial and temporal patterns in the estuary. Statistical analysis will be used to investigate the sensitivity of the ice coverage to various climate forcings, using the Goose Bay climate station as a reference source. Local knowledge of sea-ice change will be documented through interviews and a map biography approach to understand placed-based dynamics and trail use patterns in the context of the local ice climatology. Finally, local and scientific knowledge will be integrated to inform decisions around sea-ice monitoring for change detection and travel safety, using local workshops and consultations. The Lake Melville Sea Ice Project is an opportunity to provide the Nunatsiavut Government and Nunatsiavummiut with new knowledge on local sea-ice dynamics that will contribute towards a community-focused sea-ice monitoring program.

NEW INFORMATION ON PERMAFROST THERMAL STATE IN THE ALASKA HIGHWAY CORRIDOR, YUKON

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The Alaska Highway Corridor traverses the discontinuous permafrost zone of the southern Yukon. Permafrost characteristics were investigated in the corridor over 30 years ago to support a pipeline proposal but little information is available on current ground thermal conditions. Air temperatures in the region have increased 0.4-0.5°C per decade since the 1970s and recent studies in the corridor indicate that thawing of permafrost has occurred over the last four decades (e.g. James et al. 2013). Recent proposals for construction and operation of a natural gas pipeline and the need to develop climate change adaptation strategies for existing highway infrastructure has stimulated the acquisition of updated information on permafrost conditions. Between 2011 and 2013, nineteen boreholes up to 10 m deep were instrumented with temperature cables in the section of the corridor west of Whitehorse in order to characterize the ground thermal conditions. These boreholes complement those instrumented during the International Polar Year elsewhere in the central and southern Yukon. The ground thermal data collected indicates that permafrost is generally warm (above -1.5°C) in this section of the corridor. However, colder permafrost (-3°C) was found in the immediate vicinity of the Alaska border in an area predicted by Bonnaventure et al. (2012) to be continuous permafrost. Data records are too short to determine if there is any trend in permafrost temperatures. However, a comparison of recent ground temperatures with those collected by the Geological Survey of Canada in the late 1970s indicates that warming of permafrost (about 0.5°C increase) has occurred of a similar magnitude as that observed elsewhere in northwestern Canada (Duguay et al. in prep). The ground thermal data collected from these new monitoring sites have been compiled into a digital database along with data obtained from other instrumented boreholes in the central and southern Yukon. These data facilitate a better understanding of regional permafrost conditions and support improved assessments of terrain sensitivity including development of landslide susceptibiltiy models. The publicly available data can also be utilized for climate change adaptation planning and to support infrastructure design in the region. References Duguay, MA, Lewkowicz AG, Smith SL in prep. Permafrost changes along the Alaska Highway Corridor, southwest Yukon, from ground temperature measurements and DC Electrical Resistivity Tomography Bonnaventure PP, Lewkowicz AG, Kremer M, & Sawada M. 2012. A regional permafrost probability model for the southern Yukon and northern British Columbia, Canada. Permafrost and Periglacial Processes 23: 52-68. James M, Lewkowicz AG, Smith SL & Miceli CM. 2013. Multi-decadal degradation and persistence of permafrost in the Alaska Highway corridor, northwest Canada. Environ. Res. Lett. 8 045013, 10pp

PRIMARY PRODUCTIVITY AND MACROMOLECULAR COMPOSITIONS OF PHYTOPLANKTON IN MELT PONDS OF THE PACIFIC ARCTIC REGION

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The melt ponds are important feature of summer Arctic sea ice and their recent areal coverage in summer has been estimated to 80% of the Arctic sea ice. However, the biological impacts of melt ponds have rarely been studied. Using a 13C-15N dual stable isotope tracer technique, the carbon and nitrogen uptake rates of phytoplankton were measured at 36 different melt ponds between 74-84 °N from three different cruises in 2005 (74-76 °N), 2008 (82-84 °N), and 2011 (77-78 °N) in the Arctic Ocean. Additionally, the macromolecular compositions (proteins, lipids, and carbohydrates) of phytoplankton were measured at 10 different melt ponds during the 2011 cruise to understand their physiological. Extractions of different macromolecular compositions were performed using the methods of Lowry et al. (1951), Dubois et al. (1956), Blighr and Dyer (1959), and Marsh and Weinstein (1966). The average hourly carbon uptake rates of phytoplankton in melt ponds were 0.47 mg C m-3 h-1 (S.D. = ± 0.58 mg C m-3 h-1), 0.09 mg C m-3 h-1 (S.D. = ± 0.11 mg C m-3 h-1), and 0.18 mg C m-3 h-1 (S.D. = ± 0.31 mg C m-3 h-1) for 2005, 2008, and 2011, respectively. The average hourly nitrogen uptake rates was highest in 2005 (mean ± S.D. = 0.269 ± 0.338 mg N m-3 h-1) whereas lowest in 2008 (mean ± S.D. = 0.015 ± 0.018 mg N m-3 h-1). The carbon and nitrogen uptake rates in melt ponds decreased with increasing latitude. The contributions of proteins, lipids, and carbohydrates of phytoplankton in melt ponds ranged from 20 to 61% (mean ± S.D. = 40 ± 13%), from 25 to 46% (mean ± S.D. = 35 ± 8%), and from 11 to 49% (mean ± S.D. = 25 ± 12%), respectively. In comparison, the contributions of phytoplankton in the water column ranged from 6 to 31% (mean ± S.D. = 15 ± 9%), from 37 to 62% (mean ± S.D. = 49 ± 8%), and from 22 to 53% (mean ± S.D. = 36 ± 9%), for proteins, lipids, and carbohydrates, respectively. The protein contributions of phytoplankton in the melt ponds were higher than those in adjacent water column, which implies that melt ponds has a better nitrogen condition for phytoplankton growth.

NORTHERN EXPOSURE: A COMPARISON STUDY OF ALASKA AND YUKON MODELS OF MEASURING COMMUNITY WELLBEING

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Research suggests that developing a model of measuring community wellbeing in the Arctic is difficult because of the unique challenges in these communities. Two of the principle problems are that these communities often lack the resources to expand local research capacity; and models for measuring community wellbeing have predominantly been designed in southern more urban communities that do not account for unique aspects in the Arctic life. This presentation will outline the findings from my thesis project that examined different models of community wellbeing in resource dependent communities in the State of Alaska and Yukon Territory. Past research has only examined one or two models of wellbeing in one region; there has not been an analysis of multiple models across two regions. By using a case study approach and in-depth interviews with experts, this project compared the similarities and differences across models of measuring community wellbeing in Alaska and the Yukon. Furthermore, it provides a better understanding of best practices to engage community residents and builds local research capacity.

THE EVOLUTION OF A SUPRAGLACIAL STREAM

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The Evolution of a Supraglacial Stream St. Germain, Sarah L. and Moorman, Brian J., Department of Geography, Calgary University, Calgary A strong foundation in glacial hydrology is essential to further our understanding of glacial dynamics. With the global climate models predicting a rise in temperature, the effect of glacial melt on sea-level remains somewhat unknown, especially in the Canadian Arctic Archipelago. The global effects of climate change and sea level rise is expected to have enormous environmental, social, and economic implications on all of society. Therefore, developing a comprehensive understanding of the link between glacial hydrology, glacier dynamics, and climate change is imperative. Supraglacial streams are a significant part of the glacial hydrological regime. In order for a supraglacial stream to form the stream bed erosion must be greater than the rate of the surrounding glacier ablation. The difference between the stream bed erosion and glacier ablation will also dictate the amount the stream is able to incise. Typically, supraglacial streams vary in size from a few centimeters to several meters in depth and width. The research aim of this project is to understand the factors that influenced the evolution of a small supraglacial stream located on Fountain Glacier. Fountain Glacier, officially designed as Glacier B26, is located on Bylot Island in Nunavut. Just east of the northern point of Baffin Island, Bylot Island is at latitudes of 72.5° and

74°N, and longitudes 76° and 81°W. During the peak ablation period of the 2014 season, stream discharge, glacier ablation, and stream bed erosion surveys were conducted. Within the three week study period, the channel morphology and stream discharge altered drastically. The supraglacial stream, which fell off the glacier in the form of a waterfall, began to turn off and on (pulse) in irregular intervals anywhere from a few seconds to half a minute. Preliminary analysis suggests that the addition of both added heat and water in the form of precipitation caused the channel to form a step pool pattern. It is hypothesized that the formation of these step pools, in turn caused the distinctive character of the stream discharge. The study of the evolution of this small supraglacial stream has larger implications as two deeply incised canyons formed from supraglacial stream incision on the surface of Fountain Glacier. The goal is to interpolate the results from this study to understand the processes that have created these unique canyons. This will further our knowledge of the interactions that exist between glaciers and hydrology.

SOURCES OF TOTAL AND METHYLMERCURY TO HIGH ARCTIC LICHEN

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Consumption of caribou is the largest source of neurotoxic methylmercury (MeHg) for many northern residents. Although it is well known that lichens are critical forage for caribou throughout the year, little is understood about the sources of MeHg in lichens in the Canadian High Arctic. We quantified MeHg and total mercury (THg) concentrations, as well as other numerous chemical parameters (major cations, rare earth elements, δ13C, δ15N, organic carbon, carbonate), in lichen and soil samples collected along transects on Bathurst and Devon Islands, Nunavut, Canada to assess the relative importance of physical, chemical and biological factors on MeHg concentrations in lichens and soils. Lichen and soil THg concentrations ranged from 36 to 361 ng g-1 and 1 to 86 ng g-1, respectively. Lichen and soil MeHg concentrations ranged from 1.4 to 17.05 ng g-1 and 0.01 to 4.4 ng g-1, respectively. Although we initially hypothesized that the MeHg found in lichen was of marine origin, we found no evidence of MeHg enrichment in lichens relative to the underlying soils, rather suggesting that lichen and soils may be obtaining MeHg from a similar source. We will discuss potential sources of MeHg in terrestrial environments, highlighting a need for a better understanding of MeHg sources to northern caribou diets.

IDENTIFYING CHANGES IN THE FORMATION AND DISSOLUTION OF THE NORTH WATER POLYNYA ICE ARCH, 1979-2012: AN INDEX CLASSIFICATION APPROACH

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The North Water Polynya (NOW), one of the most biologically productive marine areas in the Arctic Ocean, typically forms early spring in northern Baffin Bay and dissolves early-to-mid summer. A key feature in its formation is the consolidation of ice to form an ice arch in Nares Strait, preventing the southerly movement of ice from the Lincoln Sea into Baffin Bay. With a changing icescape in the Arctic, the long-term impacts of variability in the ice arch formation are unknown. In this investigation we explored the trends of formation and dissolution of the ice arch at Smith Sound (1979-2012) using a sea ice concentration dataset derived from a Special Sensor Microwave Imager (SSM/I). The generated index of seasonality for NOW identified the formation and dissolution date of the ice arch, as well as the periodicity in which NOW remains open. The decadal trends show that NOW is forming earlier in the year (~20 days) and subsequently dissolving earlier (~30 days). These results show that with a thinning ice cover and less multi-year ice moving through Nares Strait, it is easier to advect ice from the region and open NOW. Additionally, when melt onset commences the thinner ice, which makes up the arch, melts quicker and thus dissolves the polynya earlier in the year. These findings illustrate that changes in the ice arch formation and dissolution are occurring, increasing the need to better understand the impact of the changing icescape on this biologically important region to the Arctic.

EVIDENCE FOR SIZE-STRUCTURED MARINE FOOD WEBS IN THE BEAUFORT SEA: COMPARISON BETWEEN DYNAMIC SHELF AND STABLE MESOPELAGIC BENTHIC HABITATS

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Marine food webs are often strongly size-structured, such that body size is a better predictor of trophic level than species identification. Within a size-structured community, it has been predicted that stable ecosystems will promote longer food chains with smaller predator-prey mass ratios (i.e., small size differences between organisms in successive trophic levels), resulting in lower energetic transfer efficiency between trophic steps and steeper negative slopes in abundance-body mass relationships. These theories have yet to be tested in an Arctic marine environment where resources at the bottom of the food web are limited, seasonal, and highly recycled. Here, we use stable nitrogen isotopes to test if (1) the size-structured hypothesis is applicable to demersal Arctic marine food webs in the Beaufort Sea, and (2) if relatively stable benthic habitats in the mesopelagic zone (750 to 1000 m) have longer food chains and steeper abundance-body mass scaling than dynamic habitats on the continental shelf (< 50 m), which are annually disturbed by ice scouring. Preliminary results using fish assemblages from shelf habitats suggest that size-based analyses explain a larger proportion of the variance in trophic level ($r^2 = 0.8$, $m = 0.38$, $p < 0.001$, $F = 38.1$) than species-based analyses ($r^2 = 0.24$, $m = 0.35$, $p = 0.07$, $F = 3.74$). Evidence for size-structured food webs in mesopelagic communities is weaker ($r^2 = 0.30$, $m = 0.08$, $p = 0.03$, $F = 5.7$), leading to estimates of larger predator-prey mass ratios in these stable habitats relative to dynamic shelf habitats. This contrasts with previous findings in the North Atlantic fish assemblage, where more stable habitats had lower predator-prey mass ratios. However, fish are only one component of complex demersal communities. Marcoinvertebrate epifauna may violate the size-structured hypothesis due to the presence of small-bodied predators (e.g., polychaetes and brittle stars), the consumption of detritus, and extensive nutrient recycling. The analysis presented will be extended to include both fish and invertebrate fauna. If marine food webs in the Beaufort Sea are size-structured in accordance with theory, changes in size spectra will be useful for tracking human and climate-mediated impacts on Arctic marine systems.

CRITICAL REFLECTIONS ON COMMUNITY-BASED ADAPTATION RESEARCH IN THE ARCTIC

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Community-based adaptation (CBA) has emerged over the last decade as an approach to empowering communities to plan for and cope with impacts of climate change at the local level. While such approaches have been widely advocated, few have critically examined the tensions and challenges that CBA brings. Responding to this gap, this paper reports on key themes emerging from a workshop examining the use of CBA approaches with Inuit communities in Northern Canada. We find that CBA holds significant promise to make adaptation research more democratic and responsive to local needs, providing a basis for developing locally appropriate adaptations based on Indigenous and Western Knowledge. Yet, CBA is not a panacea, and its portrayal as such in the literature obscures its limitations, nuances, and challenges. Uncritically adopted, CBA can potentially lead to maladaptation, is not appropriate in all instances, can legitimize outside intervention and control, and may further marginalize communities and Indigenous ways of knowing. We identify responsibilities for researchers engaging in CBA work to manage these challenges, emphasizing that how knowledge is generated is as important as the research outcomes in CBA, in which projects need to be flexible and open to change, with partnerships between researchers and communities open and transparent. Researchers also need to be realistic about what CBA can achieve, and should not assume that research has a positive role to play in community adaptation just because it utilizes participatory approaches.

CHARACTERIZATION OF THERMO-EROSIONAL VALLEYS IN SIBERIAN ICE-RICH PERMAFROST

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This study aims at understanding the patterns of thermo-erosional valleys and identifying the key drivers for their distribution in an ice-rich permafrost landscape in the central Lena Delta, Siberia. The spatial extent of thermo-erosional processes and related landforms (e.g. water tracks, gullies, valleys) and their impact on the degradation of permafrost is still not well quantified. Although degradation processes related to thermokarst and the resulting landscape features are

well studied in ice-rich permafrost regions, only a few studies with detailed investigations of thermo-erosional processes and resulting features and their relevance for permafrost degradation exist. These processes and features are important indicators of climate change in the Arctic. The Arctic is a substantial and very sensitive element in earth's climatic system that is undergoing extensive and rapid changes. Permafrost degradation affects the climatic system through carbon release and changes the living conditions for arctic communities. We use high resolution remote sensing data and digital elevation models (DEMs) to derive and analyse geomorphometric relief characteristics to understand periglacial landscape dynamics. However, geometric correction of remote sensing data, and generation of DEMs in arctic lowlands, is challenging due to low relief and surface contrast gradients and often scarce reference data. Therefore, high quality and high-resolution DEMs are rarely available, especially in Siberia. To address these difficulties, this study is using a multi-sensor and multi-temporal satellite data approach for a detailed inventory and 2D/3D morphometric analysis of thermo-erosional valleys on Kurungnakh Island. A high resolution DEM with 5m spatial resolution and a RMSE of 3.8 m was generated from ALOS PRISM stereo-datasets acquired in 2006 and 2009 and validated against extensive ground measurements taken during an expedition in July 2013. Mapping of 1214 stream segments related to thermo-erosional processes with a total length of 336 km was performed using a time-series of orthorectified GeoEye-1 and RapidEye datasets. We measured 32 longitudinal and transversal profiles of thermo-erosional valleys at three key sites, each representing different stages of valley evolution. We used additional profiles extracted from the DEM to characterize different valley types on Kurungnakh Island. We present a detailed inventory and characterization of thermo-erosional features on Kurungnakh Island. Our findings show a strong dependence of thermo-erosional processes to the prior degradation of ice-rich permafrost through thermokarst activity. Since the stream network of Kurungnakh Island is poorly developed, accelerated permafrost thawing due to an arctic warming could promote the degradation of ice-rich permafrost by thermo-erosional processes and alter the hydrologic regime as well as the sediment and carbon fluxes. Our dataset provides a new level of accuracy for the Lena Delta region.

MEASUREMENTS OF RADIOXENON IN YELLOWKNIFE, CANADA AS A POSSIBLE TRACER OF POLLUTION OF THE ARCTIC

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There is renewed interest in using radionuclides in the environment as tracers to help understand the transport and behaviour of contaminants in the Arctic. Both natural and anthropogenic radionuclides can be used for this purpose. The Radiation Protection Bureau (RPB) of Health Canada operates a number of radiological monitoring networks in order to detect routine emissions from nuclear facilities, provide early warnings of major nuclear events which may have an impact on Canada, and support obligations under the Comprehensive Nuclear-Test-Ban Treaty. The vast quantity of data collected from these networks can also contribute to a wide range of scientific studies on atmospheric transport processes and climate change effects. As part of one of these networks, Health Canada operates a SPALAX radioxenon monitoring station and a large-volume particulate air sampler in the Canadian Arctic at Yellowknife (62.5 N 114.5 W). The SPALAX (Système de Prélèvement d'air Automatique en Ligne avec l'Analyse des radioXénon) automatically extracts radioxenon from the atmosphere and measures the concentration activity of four radioxenon isotopes/isomers, namely 131m, 133m, 133, 135Xe by high purity Germanium gamma ray spectroscopy. The air sampler collects particulate matter on filters that are normally screened using gamma spectrometry, but they can also be analysed for stable chemicals using other techniques. This presentation describes a study in which it was demonstrated that specific observations of 131mXe and 133Xe in the north could be attributed to a localized source in the south (namely, medical isotope production at Chalk River Laboratories, ON), by atmospheric transport modelling. ICP-MS was used to measure cadmium from air filters collected at the same time as the radioxenon detections (cadmium was studied as its source tends to be near or from electrical power generation). This research is just one example of using anthropogenic radionuclides as tracers, and highlights the potential for using samples collected by radiation monitoring networks, correlations between radioactive and stable elements, and atmospheric transport modelling to infer source terms and pathways for contaminants in the Canadian Arctic.

ASSESSMENT OF IMPACT OF COASTAL HAZARDS ON SCIENTIFIC AND COMMUNITY INFRASTRUCTURE IN POLAR REGIONS USING REMOTE SENSING, GEOINFORMATION AND NEW GEOMORPHOLOGICAL MAPPING METHODS - PROJECT AIMS AND POTENTIAL IMPACTS

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Present-day Arctic coastal landscapes are modified by increased degradation of permafrost accelerated sediment supply from deglaciated catchments, and prolonged periods of open-water conditions and wave activity. Since the second half of 20th century there is also an observed increase in the number and intensity of storms entering the Arctic particularly in sum-mer months when coastlines are free of protective ice cover. Studies from Greenland on landslide-generated tsunamis, potentially a result of warmer air temperatures in the past century demonstrate that Arctic coasts are vulnerable to such extreme events. In addition, glacier calving and iceberg roll events provide potent tsunami sources, especially in confined fjord settings where constraining topography can amplify wave heights at the local scale. Despite the potential significance of these coastal hazards on the security of scientific (research bases and devices) and community (ports, airports, roads, buildings) infrastructure on Svalbard, relatively little is known on the present-day rate of Svalbard coastal zone changes and how they might impact the nearshore infrastructure in the future. Our HOMING PLUS project, recently funded by the Foundation for Polish Science, aims apply state-of-the-art geoinformation and remote sensing techniques together with new field-based geomorphological mapping methods to examine the impact of coastal hazards on scientific and community infrastructure along the coasts of Svalbard Archipelago, High Arctic. The research will also result in a risk assessment for development and protection of human infrastructure along the coasts of Svalbard under scenarios of climate change, sea level rise, changes to the frequency of storms entering the region and variations in sea ice extent. The project is also intended to promote ideas for Svalbard Integrated Arctic Earth Observing System through the development of the coastal hazard monitoring research group on Svalbard. In this paper we summarise the results of the first phase of the project that focused on the detection of coastal hazards in the surroundings of main towns on Svalbard: Longyearbyen and Piramiden as well as leading research facility in Horsnund. Study is a contribution to the FNP HOMING PLUS Project: 'Assessment of impact of coastal hazards on scientific and community infrastructure in polar regions using remote sensing, geoinformation and new geomorphological mapping methods'. Matt Strzelecki i salso supported by NCN FUGA Postdoctoral Fellowship (award 2013/08/S/ST10/00585) and Foundation for Polish Science START scholarship.

THE DEVELOPMENT OF HIGH ARCTIC COASTAL ZONE IN PERIGLACIAL AND PARAGLACIAL CONTEXT – ADVANCES FROM SVALBARD

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In-depth understanding of the mechanisms controlling the development of High Arctic coastal zone still remains an open question of periglacial geomorphology. This is an important area of research given the pace of recent climate change and future predictions. Svalbard Archipelago provides a superb location to quantify how High Arctic coasts are responding to climate warming and the associated permafrost thawing as well as sediment fluxes from rapidly transforming paraglacial landscapes. In this presentation, we summarize the results of several coastal studies (accumulative and rocky types) carried out by our research teams along paraglacial coast of Spitsbergen (main island of Svalbard) during the last two decades. We reconstruct the post-Little Ice Age evolution of coasts in western, central and southern Spitsbergen to illustrate high variability in coastal zone responses to the paraglacial and periglacial landscape transformation. Research was based on the combination of methods including aerial photogrammetric and GIS analyses, sedimentological tests of coastal deposits and field-based geomorphological mapping in Kongsfjorden, Billefjorden, Sassenfjorden, Van Mijenfjorden, Bellsund, Hornsund and Sørkappland. The presented results document dramatic changes in sediment flux and coastal response under intervals characterized by a warming climate, retreating local ice masses, a shortened winter sea-ice season and thawing permafrost. In case of rocky shorelines our observations emphasized the opulence of microrelief features and processes operating along Svalbard rocky cliffs and shore platforms. Study is a contribution to the National Science Foundation project 'Model of the interaction of paraglacial and periglacial processes in the coastal zone and their influence on the development of Arctic littoral relief' award no. 2013/08/S/ST10/00585). Matt Strzelecki is also supported by the Foundation for Polish Science HOMING PLUS (grant no. 2013-8/12) and START grants.

BIODIVERSITY, DISTRIBUTION AND ABUNDANCE OF GASTROPOD INTERMEDIATE HOSTS FOR TWO EMERGING LUNGWORMS IN THE ARCTIC.

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Terrestrial gastropods serve as obligate intermediate hosts for a variety of lungworms of arctic wildlife. Thus, establishing and monitoring the biodiversity, distribution, and abundance of gastropods is essential in order to understand the distribution and transmission dynamics of parasites in wildlife. Recently, two lungworms that use gastropods as intermediate hosts have emerged on Victoria Island, Nunavut. Umingmakstrongylus pallikuukensis and Varestrongylus sp. are common lungworms of mainland muskoxen and caribou. They have an indirect lifecycle and are transmitted when first-stage larvae, which are shed in the ungulate's feces, develop into infective third-stage larvae within gastropods and are unintentionally ingested by grazing ungulates. Muskoxen and caribou are keystone species in the Canadian Arctic and their sustainability is critical for the economic, physical, social and cultural health and welfare of northern communities. Thus, the recent emergence of these parasites has drawn considerable attention. Multiple factors may limit the range of protostrongylid parasites; the most critical of which is the availability of suitable gastropod intermediate hosts. Two previous, unpublished, gastropod surveys found gastropods on southwest Victoria Island, however, their broader geographical distribution and abundance on the island is poorly understood. Literature on terrestrial gastropod habitat use and activity in the Arctic is even more limited. The objectives of this study were to (1) characterize the habitat preferences of terrestrial gastropods in the Arctic and (2) determine the diversity, distribution and abundance of terrestrial gastropods on Victoria Island. During summer 2014 we did both island extensive surveys as well as intensive surveys near Cambridge Bay, Nunavut. To address objective (1) surveys were done near Cambridge Bay as part of a long-term monitoring study in collaboration with the Canadian High Arctic Research Station (CHARS). Fen, shrub-sedge and moist-upland habitats were sampled twice at each location every two weeks between late June and late August. Ground temperature and humidity were recorded to evaluate any association with capture success. The slug Deroceras laeve, a known intermediate host for these lungworms, was observed in varying abundance (0.06-0.23 gastropods per mat) among the wetter habitats and we observed that more gastropods were captured during cooler periods when humidity was high. To address objective (2) five sampling locations on Victoria Island, spanning a latitudinal gradient of 280 km, were chosen based on lungworm prevalence and average summer temperature and precipitation. We sampled two fen and two shrub-sedge habitats at each site using a modified cardboard technique to test for gastropod presence and a turf flooding technique to quantify abundance. Deroceras laeve was found only at two of the most southern sites; no other terrestrial gastropods were found. These data will help describe the habitat preferences, density, and activity of the intermediate hosts, and will contribute to the understanding of the transmission and epidemiology of the lungworm parasites. Knowledge of gastropod distribution and abundance will provide insight on regions of future parasite colonization and establishment. Further analyses of quantitative gastropod sampling methods for Arctic environments are underway and will serve to inform future study designs and methods in the Arctic.

THE PERMAFROST YOUNG RESEARCHERS NETWORK (PYRN): FROM EUCOP 2014 TO ICOP 2016

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The Permafrost Young Researchers Network (PYRN) is an international organization hosted by the International Permafrost Association (IPA) and technically supported by Arctic Portal. The network provides a platform for innovative collaboration between young permafrost researchers and aspires to recruit, maintain and promote future generations of permafrost researchers. PYRN strives to apply its multi-disciplinary talents toward global awareness, knowledge and response to permafrost-related challenges in a changing global climate. Officially founded at the 2nd International

Conference on Arctic Research Planning (ICARP II) in 2005, it will already celebrate its 10th birthday in the coming year. PYRN became increasingly popular after the International Polar Year that highlighted the importance of including young generations in polar research activities. Since then PYRN expanded constantly with more than 1000 permafrost young researchers from permafrost and non-permafrost countries today. PYRN built partnerships with large organizations such as the Climate and Cryosphere Project (CliC) and the International Permafrost Association (IPA). Under a joint Memorandum of Understanding, PYRN works closely together with the IPA and the Association of Polar Early Career Scientists (APECS) on a bi-polar and interdisciplinary perspective for a better understanding of cryospheric processes for society. PYRN is guided by an Executive Committee, consisting of 12 young researchers, but operates through its members that self-organize themselves. In the last years PYRN organized several workshops during regional and international conferences related to polar research and was active in education and outreach activities in schools and universities. To keep it members and partners updated the network regularly publishes a newsletter. The latest activities have been arranged at the European Conference on Permafrost (EUCOP4) in Portugal, to maintain an active, dynamic and growing early career scientific network on permafrost. Organized together with APECS, PAGE21, and ADAPT, this workshop was kindly sponsored by the IPA, CliC, the International Arctic Science Committee (IASC) and the Bolin Centre for Climate Research. The workshop included around 100 early career permafrost scientists from 20 countries that gathered interdisciplinary knowledge about permafrost and its key role in the Earth System in thematic break-out sessions and workshops. In coordination with the ICARP III activities, a major goal of the workshop was to frame the future avenues of permafrost research from a young researcher's perspective, contributing directly to IASC and the IPA strategy with Permafrost Priority Sheets for ICARP III. For the 11th International Conference on Permafrost 2016 (ICOP 2016) in Potsdam (Germany), PYRN has been involved in the conference planning from the very beginning to effectively integrate PYRN members in the process of organization as well as young researchers activities in the overall conference program (e.g. session co-chairs, workshop, PYRN awards, social program). On its way to Potsdam, you can approach PYRN on many upcoming conferences with permafrost-related topics. It will collect and trying to integrate ideas for a successful young researcher program during ICOP 2016 and is looking forward to discussions with its worldwide members. The Arctic Change conference 2014 in Canada will be the first stage on the road to ICOP 2016 in Germany.

EFFECT OF TEMPERATURE INCREASE ON FROZEN PEATLAND SOILS IN NORTH WEST SIBERIA, RUSSIA

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In this study some microbiological activity indexes of frozen peatlands in North-West Siberia were determined. The specific of these peatlands consists in the formation of peat soils developing under the permafrost influence (active layer 60-80 cm). In case of climate changes the response of peat ecosystems to temperature fluctuations seems to be an actual task to solve especially in the conditions of permafrost. The purpose of the study was to estimate the response of frozen peat soils microbiological activity indexes to temperature increase (5ºC, 15 ºC, 25 ºC). The study included field and laboratory parts. The field studies conducted in August 2014, on Nadym site, north West Siberia, Russia (65º18'.53"N, 72º52'.52"E). Two monitoring sites on frozen peatland were selected to CO2 efflux and temperature measurements: control and experimental site (a "Greenhouse" was built to simulate the effect of increasing temperature). Field measurements lasted for a week and were triplicated. As a result, we have determined the average daily temperature at the experimental site to be 2ºC higher than at the control site. The CO2 efflux at the experimental site also increased (88 mg m-2 h-1) in comparison with the control site (66 mg m-2h-1). Such soil microbiological activity indexes as basal respiration (BR) and substrat-induced respiration (SR) [1] were evaluated in the laboratory study. The medium decomposed moss peat from a depth of 20 cm was taken for BR and SR analysis. Our results showed that BR of peat soil samples subjected to 5ºC was significantly higher (6,9µg C g-1 soil) as compared with the samples, underwent to 15ºC (3,7µg C g-1 soil) and 25ºC (3,3µg C g-1 soil). The same effect was observed during SR analysis: the highest SR value was fixed in the sample subjected to 5ºC (19,9µg C g-1 soil) and then tended to decline from 15ºC (16,7 µg C g-1 soil) to 25ºC (16,1 µg C g-1 soil). Obviously, such temperature conditions (15 and 25ºC) are stressful for psychrotrophic microorganisms because the average annual temperature of these frozen peatland soils approximately equals to 0ºC and at the depth of 20 cm does not exceed 6ºC as a maximum. To summarize, the response of peat soils microbiological activity indexes to temperature increase may vary a lot and, consequently, further studies are required. The preview results indicated that microbiological activity of frozen peat soils tends to decline as a result of temperature increase to 10 and 20ºC. At the same time, the increase in the temperature of the peat soil surface to 2ºC causes the 30% increase in CO2 efflux from that soil surface. This fact shows a complex indirect mechanism of CO2 production by peatland ecosystems. Probably, there is a temperature optimum for soil

microorganisms of frozen peat lands: so beyond this optimum the activity of soil microorganisms becomes lower or there is an increase in the contribution of root respiration. Accounting for heterogeneity of response of the CO2 efflux and microbiological activity of frozen peat soils at elevated temperatures may be significant in balance estimations and also in models that calculate the contribution of soil microorganisms to the global balance of CO2. 1. Anderson J.P.E. Domsch K.H. A physiological method for quantative measurement of microbial biomass in soil // Soil Biology & Biochemistry. 1978. v.10. p.215-221.

CLIMATE CHANGE INTERACTIONS WITH HUMAN IDENTITY AND CULTURE IN THE ARCTIC

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Global climate change has observable impacts on the natural environment including changes to forest cover and diversity, glacial shrinkage, and changes in ocean and weather dynamics. In the Arctic, an area particularly vulnerable to climate change impacts, there are over forty different ethnic groups, making up approximately ten percent of the total population. While previous studies have focused on the climate change impacts to human culture and wellbeing due to migration and displacement further investigation on how these changes influence cultural and individual identity within populations is needed. In particularly many indigenous communities see their natural environments, such as forests, the ocean, and the ice, as spiritual and integral to identity and way of life. The objectives of this systematic review are to provide a deeper understanding of the interrelationships between climate change, culture, and identity in Arctic regions and offer recommendations for policy considerations and research in both the protection of cultural heritage and efforts to mitigate climate change.

BRIDGING THE GAP BETWEEN SCIENCE 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 STATE OF HEALTH OF NORTHEAST FEDERAL UNIVERSITY STUDENTS

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Health Research Institute of North - Eastern Federal University named by M. K. Ammosov

The aim of research: the assessment of an initial state of health and existence of risk factors of chronic diseases among first-year students of SVFU. Material and methods of research: 649 students aged from 15 to 30, on the average 18,8±1,5 years were surveyed. Results the analysis of the general incidence showed that 46,1% of students had chronic diseases. Prevalence of diseases of bone and muscular system is especially high among students. Data of anonymous questioning of behavioural risk factors revealed prevalence of smoking, alcohol intake, an inactive way of life. 25,3% of young men and 9,3% of girls smoked. 28,5% of young men and 12,5% of girls took alcoholic beverages. Physical activity of students was insufficient, only ⅓ part of respondents lead an active life. Conclusions The group of almost healthy students consisted of only 18,2%. Other 81,8% had various deviations, i.e. risk factors of development of chronic diseases.

NORTHERN CONTAMINANTS PROGRAM (III) PHASE 8 ASSESSMENT OF LABORATORY PERFORMANCE

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The Phase 8 interlaboratory study (ILS), as a part of the Northern Contaminants Program (NCP) Quality Assurance/Quality Control (QA/QC) Program, was conducted to assess the performance of laboratories providing data to NCP and the Arctic Monitoring and Assessment Programme (AMAP). The QA/QC studies focused on performance evaluation of analytical laboratories providing data on contaminants of concern, such as trace metals, persistent organic pollutants (POPs), and emerging contaminants, to the NCP managers. The number of participating laboratories increased to 46 from 42 in the previous study and has doubled since Phase 1 (19 laboratories in 2005/2006). Six natural matrix materials and eighteen injection-ready standards were provided to assess levels of organic and inorganic contaminants. Data quality assessments were conducted for dioxins, organochlorine pesticides (OCs), polychlorinated biphenyls (PCBs) and emerging contaminants (polybrominated diphenyl ethers (PBDEs), brominated and chlorinated flame retardants (BFRs/CFRs), perfluorinated chemicals (PFCs), organophosphorous flame retardants (OPFRs), polychlorinated naphthalenes (PCNs), chlorinated paraffins (CPs), trace metals, mercury, and methyl mercury. Results were evaluated using "Robust Statistics: a method of coping with outliers". The increasing number of participating laboratories helps to expand the database and data comparability of the results. This is critical for emerging contaminants due to limited availability of natural matrix reference materials. An overview of the program and results of laboratory analytical performance will be discussed.

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.

LIFE-HISTORY DIFFERENCES IN NORTHERN DOLLY VARDEN (SALVELINUS MALMA MALMA) TOTAL MERCURY CONCENTRATIONS

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The study examines life-history differences of total mercury (THg) concentrations in Northern Dolly Varden from the Babbage River, Yukon Territory, Canada. Northern Dolly Varden within the river exist as isolated headwater, adfluvial resident and anadromous forms that differ in age, size, and age-at-maturity. Using archival muscle tissues from 1988 and 1991, THg and carbon and nitrogen stable isotope measures were obtained for a representative sample of all forms. Differences in mean THg concentrations were found starting at 22 ng/g wet weight (ww) in isolate, increasing to 56 ng/g ww in resident, and 108 ng/g ww in anadromous fish. The pattern is markedly different than that observed in other migratory charr species, such as Arctic charr (Salvelinus alpinus), where anadromous fish typically have lower levels of THg. After adjusting THg to a standardized age and length, significant differences remained among the life-history types, with anadromous Northern Dolly Varden having the lowest THg concentrations. Trophic position was the most important factor in explaining observed differences among individuals regardless of life-history types, with growth rate also contributing to explaining the variation among individuals. The contrast of higher absolute, but lower age and size adjusted THg levels in anadromous fish was explained by a combination of two counter-acting mechanisms, including: 1) a switch to feeding at higher trophic levels and the use of prey with higher THg levels in the marine environment that raises THg levels, and 2) somatic growth dilution that decreases THg as fish age and increase in size.

CLIMATE-INDUCED CHANGES IN RELATIVE FISH ABUNDANCE AND CONDITION: IMPLICATIONS FOR FOODWEBS AND MERCURY TISSUE CONCENTRATIONS IN THE STEWART LAKE FISH COMMUNITY

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Combined analysis of nitrogen (δ15N) and carbon isotopes (δ13C) from fish species in Stewart Lake, Kuujjuaq, have demonstrated how ecological concepts (foodwebs) can be used to better understand patterns of mercury (Hg) bioaccumulation in fish, with both the vertical (trophic) and horizontal (habitat) position of an organism being important for determining Hg concentrations in fish tissue. Because foodweb position is ultimately determined by ecological processes (e.g., competition), environmental forcing (e.g., climate-change), will work to both directly and indirectly affect eventual mercury uptake by fish through changes in their feeding relationships within the foodweb and the methylation rates that control the bioavailability of mercury. Using fish data collected with standardized effort and gear type in Stewart Lake from two discrete periods (1999 versus 2014), between which significant local warming occurred, we examine the effects of climate

warming on the fish community (relative abundance), fish condition and species' foodweb position to draw inferences about [1] whether warming has been associated with significant structural ecological change, and, [2] what the consequences of such change may be for measured mercury concentrations in resident fish species.

SALTWATER INTRUSION IN THE BAIE DE RUPERT, JAMES BAY, CANADA

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Hydro-Québec commissioned the Rupert diversion, the Eastmain-1-A and Sarcelle powerhouses from 2009 to 2012. The purpose of this follow-up is to validate the changes anticipated during Environmental Impact Assessment (EIA) covering salinity in the Baie de Rupert and at the mouth of the Rivière Pontax and water levels in the bay and Rivière Rupert estuary. The follow-up of saltwater intrusion was carried out during winter and summer 2010 and 2013. Fixed instruments were put in place to continuously record salinity, current on the bottom and at the surface at four locations in the east and west channels, between Île Stag and Stag Rock. Vertical profiles were also taken in the water column to measure temperature, salinity and current. Traditional Cree knowledge was collected through interviews with users of the Rivière Pontax and through discussions with Cree members of the survey team. Our 2010 and 2013 results demonstrate that after diversion, limits of the freshwater-saltwater interface in open water moved about 3-5 km upstream, this change is estimated and predicted in the EIA. In the presence of ice cover, saltwater penetration is very limited and is similar to baseline conditions. At the mouth of the Rivière Pontax, saltwater intrusion events in open water were episodic and depended entirely on the interaction between spring tide and prevailing westerly winds. No saltwater was observed under the ice cover during baseline or post-diversion study years. In open water, levels in the Baie de Rupert were similar before and after diversion. The 2010 and 2013 follow-up studies found no evidence of the Rupert diversion having any effect on water levels in the bay, which is in keeping with the findings of the EIA. At Waskaganish, we observed a mean lower water level in the Rivière Rupert estuary of about 0.10 m to 0.15 m and about 0.30 m at low tide in comparison to the two baseline years. These results correspond to predictions made using the model developed for the EIA.

WHAT IS THE EFFECT OF THE ERECT SHRUB SALIX RICHARDSONII ON PLANT COMMUNITIES AT THE NORTHERN LIMIT OF ITS RANGE IN THE HIGH ARCTIC

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Increase in shrub abundance and associated impacts on ecosystem processes have been reported in the circumpolar Arctic, particularly in the Low Arctic. In the High Arctic, structural changes associated with a shift from prostrate to erect growth forms would also have profound impact on ecosystems, yet little is known about erect shrub ecology in this region. Our study focuses on the distribution of the erect shrub, Salix richardsonii, at the northern limit of its range in Qarlikturvik valley on Bylot Island, Nunavut (73°N). Here we present the first results focusing on the plant assemblages associated with the presence of S. richardsonii. We quantified the abundance of this shrub in relation to vegetation composition and diversity in 54 plots of 25 m2 along a glaciofluvial plain. The vascular plant diversity was assessed in each plot and the abundance measured by the presence of the species at 20 random points. Ordination analyses are used to investigate patterns in plant community assemblages in relation to S. richardsonii abundance. Comparisons will be made with available regional vegetation datasets representing the diversity of mesic habitats in the area. We predict that abundance of erect shrubs will be associated with low vascular plant diversity and minimal moss and lichen cover. This will be a first step in the evaluation of the parameters that support the growth of S. richardsonii and its impact on plant communities and ecosystem processes in this region. In the context of a potential recent increase of this shrub in the area, our results are essential to understand the dynamics and impacts of this phenomenon.

IS LANDSCAPE-SCALE HETEROGENEITY IN TUNDRA BIRCH SHRUB GROWTH RATES CORRELATED WITH VARIATION IN SOIL NUTRIENT AVAILABILITY?

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Shrub cover has increased in many sub-arctic areas underlain by discontinuous permafrost in Nunavik, as well as across much of the Low Arctic. However, the response in shrub growth is very heterogeneous at the landscape scale with some areas showing a great increase while others have hardly changed. Since nutrient availability is mainly controlled by micro-environmental conditions (e.g. soil temperature, litter quality, soil moisture) which influence the activity of soil microorganisms, it is important to understand how these conditions differ locally across a landscape. Our main objective was to evaluate the growth of Betula glandulosa Michx. in relation to the nutrient availability in areas near Umiujaq (Nunavik), a region highly affected by permafrost degradation. Sites were selected to reflect a gradient of moisture availability going from water-saturated to xeric sites. To assess how variations in soil conditions affect shrub growth, we evaluated the growth rates of Betula glandulosa in these sites using two complementary measurements: annual stem elongation per unit of ground area, and relative growth rate. To evaluate nutrient availability to those plants, we used ion exchange membranes that were buried in the soil under the plant canopy to estimate the quantities of soluble inorganic nitrogen and phosphorus supplied during four days incubation periods in the 2013 growing season. Furthermore, prior to senescence, Betula leaves were collected for chemical analyses to have another measure of nutrient availability (total C, N, P). Finally, soil moisture was measured using a hand-held probe and soil temperature was recorded hourly with dataloggers. Birch growth rate varied significantly among sites. Growth rate variation was positively correlated with the nutrient content of the foliar tissues (mainly nitrogen). Since the litter quality is a good indicator of soil nutrient availability, this result suggests that sites with greater growth rate have a higher soil nutrient availability because they are producing litter with relatively high nutrient concentrations.

SENSITIVITY OF ECOSYSTEM CARBON CYCLE TO CLIMATE CHANGE IN A NORWEGIAN HIGH ARCTIC

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Global circulation models predict warming and increased precipitation in Arctic regions throughout the 21st century. Since changes in carbon cycle would affect vegetation change, we need to know how carbon flows in the Arctic terrestrial ecosystem will respond to projected climate change. In this study, we construct a process-based model for simulating stand-level photosynthesis, root respiration and heterotrophic respiration at Svalbard in the High Arctic. Using this model, responses of net ecosystem production (NEP) to temperature and precipitation increases and to lengthening of growing season are examined. The study site was in the glacier foreland of Austre Brøggerbreen near Ny-Ålesund, Svalbard. A mixed community of Salix polaris and the moss Sanionia uncinata was selected for study, because it is the dominant vegetation of the late successional stage of the glacier foreland. The model was composed of six carbon pools: aboveground and belowground biomasses of vascular plants, biomass of cryptogams, organic layers of vascular plants and cryptogams, and mineral soil layer. Responses of each carbon flow to environmental factors were expressed by functions determined in previous studies. To evaluate model calculations and determine model coefficients, we selected three study plots (A, B, C) with different coverages of S. polaris in the glacier foreland. In the 2001 summer season, NEP was measured in these plots using a portable photosynthesis system with an assimilation chamber. Carbon pools in each plot were investigated after this measurement. In situ NEP values in the growing season varied widely among the three plots, ranging from 17 to 110 mg CO2-C m-2 h-1 (CO2 sink). Seasonal variation within a plot was also considerable, but there was close correlation between model-estimated values and those determined in the field. This shows that the model effectively simulates NEP in the growing season at the plot level. Model-estimated NEP values for the plots (A–C) were from 6.2–27.0 g C m-2 growing season-1. The NEP variations may be caused by a difference in Salix leaf biomass, because a significant correlation was observed between leaf biomass and NEP. We used the model to examine NEP response to temperature, precipitation and lengthening of the growing season. It was shown that NEP decreased rapidly with increasing temperature. All three plots became source of CO2 to the atmosphere with a 4°C increase. Precipitation is the major environmental factor to drive photosynthetic productivity of mosses, but was estimated to have minor influence of community-level NEP in a case the community is dominated by vascular plants. Lengthening the foliage period of S. polaris significantly increased NEP. In contrast, NEP was decreased by a maximum of 350% under a condition of prolonged foliage growing season (= snow free season) of 30-day, showing that growing season lengthening would produce a negative impact on the ecosystem carbon gain because of worse light conditions in autumn.

INVESTIGATING ARCTIC SEA ICE PROPERTIES WITH AN ADJOINT MODEL

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In spite of its comparatively small volume sea ice plays a major part in the Arctic climate system, because the interactions with the ocean and the atmosphere lead to many feedbacks in the coupled system. Unfortunately, these interesting properties are also one reason why modeling sea ice is still not mature. Many physical processes, most prominently maybe the formation and evolution of leads, are still only poorly represented in numerical models. The cause of those misrepresentations is often very hard to pinpoint because many factors play a role. One possibility to address this problem is an adjoint model. Such a numerical tool takes one objective function out of the huge output of a climate model and calculates the gradients and thereby the sensitivities to all variables that are modeled. In a first step one property of the sea ice model such as the ice transport through a strait in a certain time span or the minimal summer sea ice extent is defined. The result of the adjoint model then gives directly the influence of all modeled variables of the ocean, sea ice and the atmospheric forcing on this property, resolved in space and time. This level of detail is in no way feasible to arrive at via traditional sensitivity analysis by parameter perturbation. With this information we want to investigate the role of different components of current sea-ice-ocean-models in the simulation results. For this we will focus for one part on the sensitivities of modeled sea ice distribution to the boundary, initial and forcing conditions prescribed to the model. The results can be used to inform future choices for additional measurements to improve model output. The other focus will be on the modeling framework itself, and the influence the rheology and the different physical parameterisations used in the sea ice models have on those calculated sensitivities.

MASS MOVEMENT BY SOLIFLUCTION AND SYNGENETIC DYNAMIC OF PERMAFROST IN THE HIGH ARCTIC, WARD HUNT ISLAND, CANADIAN HIGH ARCTIC.

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The high Arctic is characterized by many extreme climatic and geomorphologic phenomena. According to recent climatic scenarios, climates changes will affect the Arctic more than any other region of the planet. The high Arctic, which is essentially bare of vegetation, will have a strong response to climates changes and will be characterized by an acceleration of periglacial processes associated with permafrost thawing. Mass movements on slopes will be favored by the deepening of the active layer increasing the creep and continuous sliding of the material over the ice-rich permafrost table. Our project focused on the influence of solifluction lobes movements on permafrost dynamics at Ward Hunt Island, Nunavut (Canada). The hydrologic budget of Ward Hunt Island lies essentially on the incoming water from snow melt and from active layer hydrogeology during the short annual thawing period. On the island, many solifluction lobes deform and entrain sediments downslope. Considering the recent deepening of the active layer, the increase of material downslope may modify permafrost dynamics, a question that hasn't been considered by permafrost model scenarios. We used 3D laser scanning techniques and total station surveys to reconstruct the microtopography and volume of solifluction lobes. Permafrost coring and ground penetrating radar surveys were used to characterize solifluction lobes cryostratigraphy. Permafrost cores were then analyzed using micro-computed tomography to quantify the different components of permafrost (sediments, ice, organic matter and gas). The geotechnical properties (grain size, Atterberg limit, thaw settlement, porosity, hydraulic conductivity and shear strength) of active layer and permafrost soils were measured in the laboratory. Our study demonstrated that solifluction lobes movements led to the development of syngenetic aggradation of ground ice downslope. These findings suggest that substantial accumulation of material downslope modifies permafrost dynamics and creates ice-rich zones which may contribute to slow down the degradation of permafrost, due to the important effect of latent heat represented by this new volume of ground ice.

THE ARCTIC SCIENCE AND TECHNOLOGY INFORMATION SYSTEM: CANADA'S NATIONAL NORTHERN DATABASE FOR PUBLICATIONS AND RESEARCH PROJECT METADATA

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The Arctic Science and Technology Information System (ASTIS) is Canada's national northern database for publications and research projects metadata. In operation since 1978, it

contains 80,000 records describing publications and research projects about northern Canada and the circumpolar Arctic. ASTIS covers all subjects including the earth sciences, the biological and health sciences, engineering and technology, the social sciences, traditional knowledge, history, and literature. The database includes both peer-reviewed and grey literature and covers the three territories, the northern parts of seven provinces, and the adjacent marine areas. ASTIS records contain abstracts, detailed subject and geographic indexing terms, and links to 22,000 online publications. ASTIS also maintains subset databases that provide selected records and background information for specific regions, subjects, or projects including the ArcticNet Publications Database. ASTIS has a mandate to make information about northern Canada more accessible to all and is available for FREE from a publicly accessible website. ASTIS is a project of the Arctic Institute of North America at the University of Calgary.

ELEVEN YEARS OF VALIDATING SATELLITE OBSERVATIONS OVER THE CANADIAN HIGH ARCTIC: THE CANADIAN ARCTIC ACE/OSIRIS VALIDATION PROJECT AT PEARL

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Ground-based measurements provide critical data for the validation of satellite retrievals of atmospheric trace gases and for the assessment of long-term stability of these measurements. As of November 2014, the Canadian-led Atmospheric Chemistry Experiment (ACE) satellite mission has been making measurements of the Earth's atmosphere for more than ten years and Canada's Optical Spectrograph and InfraRed Imager System (OSIRIS) instrument on the Odin satellite has been operating for thirteen years. As ACE and OSIRIS operations have extended beyond their initial two-year missions, there is a continuing need to validate the trace gas data profiles from the ACE-Fourier Transform Spectrometer (ACE-FTS), the Measurement of Aerosol Extinction in the Stratosphere and Troposphere Retrieved by Occultation (ACE-MAESTRO) and OSIRIS. In particular, validation comparisons are needed during Arctic springtime to understand better the measurements of species involved in stratospheric ozone chemistry. To this end, eleven Canadian Arctic ACE/OSIRIS Validation Campaigns have been conducted during the spring period (February - April in 2004 - 2014) at the Polar Environment Atmospheric Research Laboratory (PEARL) in Eureka, Nunavut (80N, 86W). This period coincides with the most chemically active time of year in the Arctic, as well as a significant number of satellite overpasses. A suite of as many as 12 ground-based instruments, as well as frequent balloon-borne ozonesonde and radiosonde launches, have been used in each campaign. These instruments include: a ground-based version of the ACE-FTS (PARIS - Portable Atmospheric Research Interferometric Spectrometer), a terrestrial version of the ACE-MAESTRO, a SunPhotoSpectrometer, two zenith-viewing UV-visible grating spectrometers, a Bomem DA8 Fourier transform spectrometer, a Bruker 125HR Fourier transform spectrometer, a Systeme d'Analyse par Observations Zenithales (SAOZ) instrument, and several Brewer spectrophotometers. In the past several years, these results have been used to validate the measurements by the ACE-FTS, ACE-MAESTRO, and OSIRIS instruments as well as the TANSO-FTS instrument on the Japanese Greenhouse Gases Observing Satellite (GOSAT). This presentation will focus on an overview of the measurements made by the ground-based, balloon-borne and satellite-borne instruments during the recent ACE/OSIRIS Arctic Validation campaigns and highlight how these have been used for satellite validation.

RESEARCH HIGHLIGHTS FROM THE SEA-ICE ENVIRONMENTAL RESEARCH FACILITY (SERF)

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The Sea-ice Environmental Research Facility (SERF) is the first experimental sea-ice facility in Canada. Located in Winnipeg on the campus of the University of Manitoba, the main feature of SERF is an outdoor seawater pool with a movable roof, numerous in situ sensors and instruments, and an on site trailer laboratory. Sea ice can be created at the pool under various controlled conditions (e.g., seawater chemistry, snow cover, heating) with the additions of chemical, isotopic and/or microbiological tracers. During the first three years of operation (2011-2014), several types of sea ice including pancake ice and frost flowers were successfully created at the SERF pool. Real-time monitoring was carried out on surface and optical properties and on the evolution of temperature, salinity, dissolved oxygen, pH, alkalinity, pCO2, and mercury

in and across the sea ice environment. The results demonstrate that SERF could provide a unique research platform for hypothesis-driven, mesocosm-scale studies to examine geophysical properties and biogeochemical processes in the sea ice environment. Highlighted in this presentation will be case studies on remote sensing of frost flowers, pH evolution of sea ice, and the dynamics of ikaite and CO2 flux, as well as the development of a new oil-in-sea-ice mesocosm (OSIM) as part of the Churchill Marine Observatory (CMO) proposal.

FREQUENCY AND DISTRIBUTION OF WINTER THAW EVENTS FROM PASSIVE MICROWAVE SATELLITE DATA IN THE CIRCUM-ARCTIC

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Observed and projected warming and increased winter precipitation in the Arctic are likely to drive an increase in the frequency and duration of winter thaw events. These events can have important impacts on the soil thermal regime, climate, hydrology and ecology through changes in the physical properties of snow (albedo, density, thermal conductivity) and the generation of winter runoff. The refreezing of melt water can also create ice layers that adversely impact the ability of ungulate travel and foraging. Satellite passive microwave data are very sensitive to the appearance of liquid water in snow and have been used for snowmelt detection over various components of the Arctic cryosphere during the spring melt period. In this study, we developed an algorithm to detect thaw events during the winter period when there is continuous snow cover on the ground. The algorithm is based on temporal variations in the difference of the brightness temperature between 19 and 37 GHz from the Special Sensor Microwave/Imager (SSM/I). We define the winter period as days between the main snow onset in fall and the main melt onset in spring also determined using the SSM/I data at each grid cell. Evaluation using weather station data shows that the satellite-detected thaw events are mainly associated with above freezing air temperatures which are occasionally coincident to rain-on-snow events. We apply the algorithm to daily SSM/I data to derive thaw frequency over each winter from 1989 to 2013 across the subarctic and Arctic (land areas north of 50ºN). We present the spatial and temporal variability and examine the changes of winter thaw frequency over the 25 year period. Results are compared to winter thaw event statistics generated from ERA-interim reanalysis and simulations from the Canadian regional and global climate models. The synoptic events associated with winter thaw events are examined in the reanalysis and the climate models to determine how well winter thaws are represented in the climate models. Because subsequent refreezing following winter thaw events can lead to the formation of ice lens/crusts in snow, the number of winter thaw events should be an indicator of the number of ice layers in snow. Limited field measurements of snow stratigraphy in northern Canada support this assumption. Additional field observations from Alaska will be further evaluated to examine this assumption in more detail.

RECENT RETROGRESSIVE THAW SLUMP ACTIVITY IN THE EUREKA AREA, ELLESMERE ISLAND, NUNAVUT

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The Eureka Weather Station (80.05 ° N, 86.42 °W) is located on the Fosheim Peninsula of west central Ellesmere Island, in a region characterized by cold ice-rich permafrost, a thin active layer and patchy polar desert vegetation. As one of the warmest summers on record, 2012 also marked a 3 fold increase in thermokarst, including widespread new retrogressive thaw slump activity and accelerated collapse of ice wedge troughs. Environment Canada has expressed concern regarding potential infrastructure problems including fuel storage areas, runway and access roads. This presentation will show the evolution of thaw slumps around the Eureka Weather station between 2009 and 2014. Headwall positions were collected using a differential GPS and overlain on georeferenced WorldView 2 images (from 2009 and 2012) of the area. In addition to basic hazard analysis related to ground ice conditions fieldwork also includes close interval sampling for ice and sediment analyses. Preliminary results will be presented. The next step includes geophysical surveys and geochemical analyses related to potential thermokarst triggered contaminant remobilization (mainly linked to previous fuel spills). Future work will focus on a database /GIS for slumps in the area to include headwall positions, retreat rates, images of slumps and soil chemistry to monitor changes over time. With climate change already impacting the region, this database will be useful for future work.

HYPER-SALINE SPRING ACTIVITY ON AXEL HEIBERG ISLAND, NUNAVUT

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Researchers at McGill University have mapped and analysed several cold (QT=0° ± 5°C) mineralized perennial springs on Axel Heiberg Island in the Canadian High Arctic (Pollard, 2005). The presence of perennial springs in cold deep permafrost is highly unusual and provides a unique opportunity to study the limiting conditions for liquid water. On Axel Heiberg Island, a number surface features and geologic structures may suggest anomalous ground temperature conditions that are inconsistent with a mean annual air temperature of -18°C and extreme minimum temperatures below -50°C. Thermal patterns of permafrost are directly linked to climate but the depth of permafrost and the active layer are further influenced by ground materials (sediments, ice, and various rock types with differing thermal conductivities) and geothermal gradient. The interaction between mineralized groundwater with permafrost, geologic material, water and climate create surface expressions such as icings, frost mounds and ide wedges that shape the landscape they occur in. The Island`s geology is characterized by numerous piercement structures known as diapirs associated with thick evaporate deposits that are Carboniferous in age. This research hypothesizes the presence and deformation of salt deposits and saline groundwater contribute to elevated geothermal gradients that help sustain groundwater circulation. Perennial spring activity is also sustained because of depressed freezing temperatures. By analysing surficial hydrogeological processes this research attempts to link perennial springs to processes occurring within permafrost. This presentation will focus on two sets of perennial springs characterized by hyper-saline waters that reflect complex interactions between the evaporate deposits, permafrost and deep groundwater. The first spring is located at Wolf Diapir near Strand Fiord at 79°07'23"N; 90°14'39"W where discharge generates a large conical salt mound (2.5m tall and 3m diameter). The second spring is located at Stolz Diapir near the head of Whitsunday Bay at 79°04'30"N; 87°04'30"W. In this case a series of pool and barrage structures composed of salt minerals staircase down a narrow valley for approximately 300m (several pools are 10m wide and 3m deep). The formation of these landforms by freezing eutectic brines can only occur in Polar Regions where extremely cold ambient temperatures prevail for prolonged periods. Using a combination of time-lapse photography and air and ground temperature monitoring we propose a physical model that links groundwater circulation and surficial process. Many Polar Regions contain evaporate sequences as part of their geological foundation that could result in similar cryohydrologic processes. Understanding these interactions may provide insights into a number of natural systems and potential impacts of climate change.

VARIABILITY OF C-BAND BACKSCATTER SIGNATURES OF SEA ICE DURING SUMMER

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The recent changes of the icescape in the Beaufort Sea have caused a significant amount of attention on the effects of climate change in the Arctic. The combination of calving glaciers from Northern Ellesmere Island, the opening of the ice pack in the Beaufort Sea and the effects of the Beaufort Gyre create the risk of extreme ice features (ice islands) travelling into areas of potential oil and gas development. A majority of the oil and gas operations will be summer based, making satellite signatures of summer sea ice important to understand. The melt processes occurring at the surface of sea ice during the summer season impede the identification of different ice types using satellite synthetic aperture radars (SAR). This work has attempted to characterize signatures of different ice types [i.e. first year ice (FYI), multiyear ice (MYI) and extreme ice features] obtained from a C-Band Scatterometer and some Radarsat-2 imagery. With the increased global interest of marine shipping and oil and gas development in this area, it is extremely important for safe operations to have methods of detection and monitoring ice features that pose possible risks.

ANALYSIS OF THE SOIL WATER DYNAMICS OF A PERMAFROST PEAT PLATEAU

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The Canadian subarctic is experiencing one of the highest rates of climate change globally resulting in large-scale permafrost degradation. Subarctic peatlands are especially vulnerable as permafrost is responsible for controlling the

hydrological regime, carbon cycling, and the distribution of vegetation in these regions. Subarctic peatlands consist of peat plateaus, fens and bogs. A permafrost core supports peat plateaus 1 - 2 meters above the surrounding fens and bogs, which are permafrost free. Degrading permafrost due to climate change and anthropogenic development inevitably results in plateau collapse impacting basin hydrology. Motivated by the gap in knowledge regarding hydrological processes associated with organic soils in permafrost environments, this study aims to improve cold region hydrological modeling by advancing our understanding of soil water dynamics in the active layer of peat soils underlain by permafrost. Therefore, the temporal and spatial patterns of soil moisture in relation to changing frost table depth and transpiration rates are examined. Research was conducted at Scotty Creek, NWT (61°18'N 121°18'W) June to August 2014. Three Picea mariana (Black Spruce) were instrumented with five Heat Ratio Method sap flow sensors (SFS). Tensiometers were placed at 15 and 30 cm depths along the SFS monitored roots at 20 cm and 100 cm distance from the tree. Volumetric soil moisture over the top 5 cm and 20 cm of soil was measured every 10 cm along four transects that intersected the instrumented roots. Frost table depth, vegetation, and relative elevation were also measured along these transects. Two water table wells were installed near the bog and in the plateau interior. Diurnal patterns of soil tension were observed where tension decreased (decrease in soil moisture content) progressively through the day and increased (increase in soil moisture content) through the night. This is likely due to the formation of a vertical hydrological gradient where water moves from the deeper, wetter layers of peat to the drier, surface layers. The drying of the surface layers during the day is a result of evapotranspiration. The magnitude of the diurnal fluctuation appears to increase with time from last precipitation event. Soil tension rapidly increases during precipitation as expected, due to the high porosity of peat. These patterns existed within the overall drying trend as the summer progressed and the active layer thickened. Similar diurnal and temporal patterns were observed for sap flow rates and water table height respectively. Complex feedback processes were observed between soil moisture, frost table depth and sap flow. Increasing frost table depth resulted in decreased water table height as well as surface soil moisture, causing drought stress in P. Mariana and reducing transpiration. However, proximity to bogs or fens, or higher frost tables may induce root waterlogging and therefore also reduce transpiration. Large precipitation events may also temporally induce waterlogging. These feedback processes with be further investigated. As soil moisture increases the rate of permafrost thaw through heat conduction, it is important to further understand the controls on moisture variability and the broader implications of varying soil moisture on system processes.

ARCTIC SEA ICE ALGAE MODELING TO EXAMINE SUMMER BIOGENIC PARTICLE FLUX

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Seasonal and interannual variability in biogenic particle flux was captured by the multi-year bottom-tethered sediment trap measurements in the Northwind Abyssal Plain (Station NAP: 75°N, 162°W, 1975 m water depth) of Chukchi Borderland. The trapped sinking flux of biogenic particles had an obvious peak and the major component of diatom valve flux was sea ice-related species Fossula arctica in August 2011. On the other hand, the observed summer particle flux was considerably smaller in 2012 than those in 2011. The suppression of sinking materials would attribute to the extension of oligotrophic Beaufort Gyre water toward the Station NAP. In this study, to address an impact of water mass condition on biogenic particle flux during the summer season, sea ice algae component was newly incorporated into the lower-trophic marine ecosystem model NEMURO. The original NEMURO coupled to the pan-Arctic sea ice-ocean physical model COCO represented pelagic plankton species (i.e., diatom, flagellate, and copepod) and reproduced the early-winter peak of sinking flux of Particulate Organic Nitrogen (PON) [Watanabe et al., 2014, Nature Comm.]. Whereas the mesoscale shelf-break eddies played a great role in the early-winter peak, the simulated summertime peak was significantly delayed behind the trap data partly owing to lack of sea ice algae component in the previous experiment. In the developed model, the major habitat of sea ice algae was assumed to be a 2 cm-thick skeletal layer at sea ice-ocean boundary. Since sea ice bottom temperature was always kept at the freezing point of underlying sea water, the growth rate of sea ice algae was calculated following light availability and nutrient uptake terms. Light transmission through snow and sea ice column was given using empirical extinction rates. Sea ice-ocean nutrient exchange was formulated in the different manner for sea ice freezing and melting periods. We assume that sea ice algae can utilize nutrients (nitrate, ammonium, and silicate) both in the skeletal layer and in the ocean surface layer, according to nutrient availability in each layer. This "hybrid-type" nutrient uptake formulation is considered to represent more realistic characteristics of sea ice algae biology. In addition, the modeled PON was divided into two components with different sinking speeds so that sea ice

assemblage could sink faster than other particles derived from pelagic plankton. The one-year experiment from October 2010 to September 2011 demonstrated reasonable spatial distribution and seasonal transition in sea ice algae biomass and the related sinking particle flux during the summer season. The interannual variability and possible background mechanisms will also be discussed.

EVALUATING RECENT AIR TEMPERATURE VARIABILITY IN THE LABRADOR REGION OF NORTHEASTERN CANADA

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In the Labrador-Ungava region, rapid warming has been documented over the past 20 years by a variety sources including instrumental and satellite data. In coastal Labrador, recent warming has placed substantial strains on local ecosystems and on human adaptive capacity. This contribution extends upon a recent evaluation of Labrador air temperatures by Way and Viau (in press) showing multi-scale climate variability and strong linkages with ocean-atmospheric modes of variability and external forcings over the past century. Rapid regional warming over the past two decades is shown to be linked to both natural and anthropogenic factors with several anomalously warm years being linked to recent anomalies in the Arctic Oscillation and North Atlantic sea surface temperatures. Evidence is also presented that climate models underestimate the regional air temperature response to ocean salinity anomalies and volcanic eruptions. The suitability of several atmospheric reanalysis products for monitoring regional air temperature changes is also evaluated to compensate for the region's sparse population and lack of continuous climate records suitable for multidecadal change detection. ERA-interim and MERRA are both shown accurately model regional air temperatures over the past several decades while two widely-used NCEP products are shown to underestimate the air temperature response to the Pinatubo eruption. Several reanalysis datasets are shown to substantially underestimate changes in seasonal air temperatures suggesting that caution be taken when using these datasets in northeastern Canada. According to future climate scenarios from the CMIP5 generation of climate models, rapidly observed warming will continue throughout the next century albeit with considerable interannual-to-interdecadal variability. A comparison with future climate scenarios suggests that the anomalously warm conditions in 2006 and 2010 are similar in magnitude to climate conditions projected for the mid-21st century under RCP 8.5 emissions scenarios. The single largest source of uncertainty for understanding future climate conditions in the regions is the substantial differences projected under different emissions scenarios.

RESOURCE UTILIZATION FOR THE DIAGNOSIS AND TREATMENT OF H. PYLORI-RELATED DISEASE IN FT MCPHERSON, NWT

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Helicobacter pylori infection is a major cause of chronic gastritis, peptic ulcer disease, and gastric cancer. H. pylori-associated disease disproportionately affects Aboriginal peoples in northern Canada. Northern health officials lack information necessary to develop cost-effective H. pylori management strategies. The Canadian North Helicobacter pylori (CANHelp) Working Group formed to link northern communities and their health care providers with academic researchers in a collaboration aimed at reducing H. pylori-associated health risks. To support policy goals of the CANHelp Working Group research program, this analysis summarizes resource utilization information pertaining to health care for H. pylori infection and associated disease in Ft McPherson, NWT. In 2014, we conducted reviews of medical charts from the local health care centre for 190 participants in the Ft McPherson H. pylori Project, 177 of whom had data for each of 5 years before project enrollment, along with the year of and the year following enrollment. With this information, we estimated the average resource utilization associated with health care for H. pylori infection and related disease. Clinical assessments conducted for the Ft McPherson H. pylori Project were not carried out by the health care system and thus not counted as health care resources. For this analysis, we estimated the mean annual number and 95% confidence interval (CI) for total clinic visits and digestive health visits by sex, H. pylori status, treatment status and year within the study period. The annual mean among participants across the study period was 7.9 (CI: 6.8, 8.9) for total clinic visits and 0.68 (0.52, 0.84) for digestive health visits. Women had a higher annual mean for total visits at 9.2 (CI: 7.6, 10.7) compared to men at 6.3 (CI: 5.0, 7.6); the annual mean for digestive health visits was also higher for women at 0.85 (CI: 0.60, 1.1) compared to men at 0.47 (CI: 0.27, 0.68). For reasons that require further investigation, annual mean total clinic visits was higher for participants who tested H. pylori-negative on project enrollment at 9.9 (CI: 8.1, 11.7) than H. pylori–positive participants at 7.1 (CI: 5.7, 8.5);

the annual mean for digestive health visits was also higher for H. pylori-negative participants at 1.1 (CI: 0.64, 1.5) than H. pylori–positive participants at 0.53 (CI: 0.38, 0.67). Annual mean total clinic visits ranged from 7.3-9.2 across the 5 years preceding project enrollment, declining to 6.5 (CI: 5.5, 7.5) during the year of project enrollment and rising to 7.4 (CI: 6.2, 8.6) during the year after project enrollment. Annual mean digestive health visits ranged from 0.62-0.76 across the 5 years before project enrollment, declining to 0.56 (CI: 0.39-0.74) during the year of project enrollment and rising to 0.68 (CI: 0.47, 0.89) during the year after project enrollment. This is the first known study to estimate health care resource use associated with H. pylori in northern Canada. These data will be used to inform a cost-effectiveness model to aid territorial policy makers in developing cost-effective strategies for reducing H. pylori-related health risks.

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.

SURFACE-ATMOSPHERE EXCHANGE OF AMMONIA IN THE CANADIAN ARCTIC BOUNDARY LAYER

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The sea-air exchange of ammonia (NH3) is poorly characterized and large uncertainties exist for both its magnitude and direction. This sea-air flux will impact the transport and fate of NH3, which can affect climate and nutrient cycling. Data from a limited number of previous studies suggest that net emission occurs at lower latitudes whereas net deposition takes place at higher latitudes. In the Arctic marine boundary layer the surface is not exclusively open-ocean, but is partly covered by sea ice which may contain melt ponds. The net NH3 flux between the atmosphere and these surface pools (open-ocean and melt ponds) can be assessed by simultaneously measuring atmospheric NH3 as well as surface ammonium (NH4+) concentration, temperature, pH, and salinity. No prior studies have explored surface-atmosphere NH3 exchange in the Canadian Arctic. To address this, data were collected aboard the Canadian Coast Guard Ship Amundsen from July 10 to August 14, 2014 in the Eastern Canadian Arctic. Hourly measurements of NH3, as well as other water-soluble gases and constituents of fine particulate matter (PM2.5), were made using the Ambient Ion Monitor-Ion Chromatograph (AIM-IC) system. Fluorometry was employed to measure [NH4+] in both sea water (from 0 to 20 m) and the low-salinity melt ponds ubiquitous across the sea ice. Results show that there is significantly (up to 2 orders of magnitude) more NH3 in the atmosphere than is predicted by equilibrium calculations. This implies that there is either a substantial atmospheric NH3 source (possibly bird colonies) and/or a fast NH4+ consumption rate in surface waters. Although melt ponds had higher [NH4+], the lower water temperatures indicate they are still likely to be a sink for atmospheric NH3. The impacts of atmospheric NH3 on aerosol acidity and nutrient deposition are also discussed in the context of the summertime Canadian Arctic.

VESSELS OF OPPORTUNITY PROVIDE IMPORTANT RESEARCH PLATFORMS IN THE NORTH: AN ARCTIC FISHERY ALLIANCE-MARINE INSTITUTE PARTNERSHIP IN THE HIGH ARCTIC

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Changes in fish distributions and community dynamics are ongoing in the Arctic, and are expected to continue with warming temperatures and decreases in sea ice. With these changes comes the potential for emerging fisheries in the North, providing communities with the possibility for economic gain through the development of new commercial and subsistence fisheries. When developing any new fishery, a basic understanding of the ecosystem in which it operates is important for management and assessment of the resource and the fishery. However, many Arctic waterways are difficult to access, and both funding and platforms for research are limited leaving many areas understudied. The waters around Grise Fiord, Nunavut have been identified by high Arctic communities as a potential fishing ground for Greenland halibut (Reinhardtius hippoglossoides), prompting the development of an exploratory fishery in recent years. In September 2014, scientists from the Centre for Fisheries Ecosystems Research (CFER) of the Fisheries and Marine Institute of Memorial University partnered with the Arctic Fishery Alliance (AFA) to conduct an ecosystem survey in the waters of Jones Sound in conjunction with the ongoing exploratory fishery. This study demonstrates a range of biological and oceanographic data that can be collected aboard a fishing vessel, with members of the fishing crew trained to operate and deploy scientific sampling equipment. Thirty-four fishing sets were completed on board the AFA fishing vessel Kiviuq I over the course of the 14-day exploratory fishery: 14 strings of whelk pots and 20 longline sets, covering a depth range of 77m to 842m. In addition, 20 plankton samples were taken using a vertical tow ring-net to be analyzed for community composition, and 21 oceanographic stations (CTD, water samples) were completed collecting information on thermal profiles and water chemistry. Results will highlight the diversity and ecology of the Jones Sound region, and discuss temporal changes in oceanography and plankton assemblages. This study will emphasize the benefits of using vessels of opportunity in order to access currently understudied areas, and how community involvement and engagement are vital when completing research in the North. Partnerships with fishers and local Hunter and Trappers Organizations can provide both access and opportunity to gain important ecological data in areas currently looking to develop and expand their fisheries.

CONNECTIONS BETWEEN DESTABILIZATION OF GLACIER TONGUES AND PERENNIAL ICE COVER LOSSES IN YELVERTON INLET, ELLESMERE ISLAND, NUNAVUT, CANADA

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Glacier tongues comprise floating ice features that form where glacier ice flows across a grounding line and extends into the ocean (typically a fiord). If the glacier ice fills up an entire fiord they may ultimately form an ice shelf, and in Canada they are unique to northern Ellesmere Island. This study examines the behaviour of these glacier tongues since the 1950s, using a combination of aerial photography acquired in 1959 and optical satellite imagery (i.e. SPOT, ASTER, Landsat) available for most years since 1987. Analysis of the imagery from 1959 and 1987 reveals the presence of glacier tongues at the front of at least eight glaciers flowing into Yelverton Inlet and its neighbouring Kulutingwak Fiord. Partial losses occurred from most glacier tongues between 2003-2004 and again between 2005-2007. An open water event in summer 2008 led to the complete loss of glacier tongues (up to 4 km long) at the northern end of Yelverton Inlet, while an open water event in 2011 caused the complete loss of the remaining glacier tongues at the southern end of the inlet, including the entire glacier tongue (~15 km) at the front of Yelverton Glacier. The timing of these losses was associated with the removal of multi-year landfast sea ice (MLSI) from Yelverton Inlet in summer 2008 and 2010. This was preceded by the loss of >690 km2 of MLSI from Yelverton Bay in August 2005, which originally formed sometime between 1935 and 1947 (Polunin, 1955; Pope et al., 2012). The losses of glacier tongues in Yelverton Inlet underscore the importance of perennial sea ice as a stabilizer for these features; without sea ice they can rapidly retreat to their grounding lines.

CONTAMINANT BEHAVIOUR IN PERMAFROST-AFFECTED SOILS

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Contaminate Behaviour in Permafrost-Affected Soils
Dr. Les White Permafrost Environmental Consulting (Ottawa Canada) The fate, transport, and transformation of, a light

non-aqueous phase liquid (LNAPL), a dense non-aqueous phase liquid (DNAPL) chlorinated solvent and metalloids, all legacies of past resource development in the Arctic, is of much concern to agencies charged with safeguarding the health of northern residents. With increasing development in northern regions of the world, much of which is driven by petroleum and mining industry, there is an increasing level of interest in the behaviour of these contaminants in permafrost-affected soils "Cryosols". The release of a thirteen-volume Environmental Engineering Library titled "Contaminants in Freezing Ground Permafrost Terrain" and an accompanying "Contaminated Arctic Soils Database Library" provides the petroleum and mining industry and government agencies with the necessary tools to gain a better understanding of the mechanisms responsible for transformation and transport of contaminants in Cryosols founded in sporadic, discontinuous and continuous permafrost. The engineering library and databases provides an in-depth review of the physical chemical, biological and hydrologic properties of Cryosols that are responsible for positive or negative impacts of contaminants in northern soils. The engineering library underscores critical aspects of transformation and transport of these contaminants that should now reported when undertaking environmental assessment protocol and will further assist in policy development of guidelines for health and safety in the future development of natural resources in northern regions of the world. Les White, B.E.S Waterloo, MSc., PhD Carleton University, is a permafrost geoscientist who has worked for over thirty-five years as government researcher at the National Research Council of Canada, university professor and director of Geotechnical Science Laboratories, Carleton University and as a permafrost consultant to petroleum and mining industry and government agencies. Dr. White is currently Principal Permafrost Scientist, Permafrost Environmental Consulting a company that undertakes permafrost environmental and geotechnical projects and an assortment of initiatives associated with the challenges of cold regions development.

TURBULENT CO2 FLUX AND SURFACE ENERGY BALANCE OVER SPRING TIME FJORD ICE

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We present a springtime timeseries of the turbulent carbon dioxide (CO2) flux together with surface energy balance components over landfast sea ice in North East Greenland. The study took place between 29th May and 27th June 2014 in Young Sound fjord system. The timeseries captures the transition from a snow covered surface to a widely melt pond covered fjord. Relatively few studies on atmosphere-sea ice CO2 exchange has been reported to date. Recent studies show that the current understanding of this exchange is far from complete. The ongoing climate change drives rapid changes in the Arctic sea ice coverage and structure, toward thinner and younger ice. In order to understand the future role of the Arctic ocean as a carbon dioxide sink/source a deeper understanding of ice-atmosphere carbon dioxide exchange is required. We attempt to outline the relationship between the surface energy balance components and the ice-atmosphere CO2 exchange. An investigation of correlation patterns between the different atmospheric energy exchange components is presented and discussed. We focus especially on the basic mechanisms driving the atmospheric CO2 flux over melting spring sea ice.

CIRCUMPOLAR BIODIVERSITY MONITORING PROGRAM: TERRESTRIAL BIODIVERSITY MONITORING PLAN IMPLEMENTATION FEASIBILITY

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The Arctic Institute of North America (AINA, www.arctic.ucalgary.ca), University of Calgary is continuing to work with Environment Canada to implement CBMP Arctic Terrestrial Biodiversity Monitoring Plan through the Canadian Network of Northern Research Stations. This poster will highlight the recommendations in the recently available final report on Terrestrial Biodiversity Monitoring Plan Implementation Feasibility including: 1. A tiered set of priority parameters 2. Primary monitoring questions from 4 biotic groups 3. Value of utilizing citizen science programs in regards to monitoring 4. Increasing client based monitoring We appreciate the opportunity at the Arctic Change Poster sessions to continue raising awareness and strengthening connections between the diverse range of Canadian Research facilities through a common goal of monitoring biodiversity in the Arctic.

BIOGENIC CONTRIBUTIONS TO SUMMERTIME ARCTIC AEROSOL: OBSERVATIONS OF AEROSOL COMPOSITION FROM THE NETCARE 2014 AIRCRAFT CAMPAIGN

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The Arctic is a complex and poorly studied aerosol environment, impacted by strong anthropogenic contributions during winter months and by regional sources in cleaner summer months. In order to gain a predictive understanding of the changing climate in this region, it is necessary to understand the balance between these two aerosol sources to clarify how aerosol might be altered by or contribute to climate change. We present results of vertically resolved, submicron aerosol composition from an Aerodyne high-resolution aerosol mass spectrometer (AMS) during the NETCARE 2014 Polar6 aircraft campaign. The campaign was based in the high Arctic, at Resolute, NU (74°N), allowing measurements from 60 to 2900 meters over ice, open water and near the ice-edge. Concurrent measurements aboard the Polar6 included ultrafine and accumulation mode particle number and size, cloud condensation nuclei concentrations, trace gas concentrations and single particle composition. Aerosol vertical profiles measured by the AMS can be broadly characterized into two regimes corresponding to different meteorological conditions: the first with very low aerosol loading (<0.1 μg/m3) at low altitudes compared to that aloft and high numbers of nucleation mode particles, and the second with higher concentrations at lower levels. This second regime was associated with low concentrations of nucleation mode particles, and higher observable levels of methane sulphonic acid (MSA) from AMS measurements at low altitudes. MSA, produced during the oxidation of dimethyl sulphide, is a marker for the contribution of ocean-derived biogenic sulphur to particulate sulphur and could be identified and quantified using the high-resolution AMS. MSA to sulphate ratios were observed to increase towards lower altitudes, suggesting a contribution to aerosol loading from the ocean. In addition, we present measurements of aerosol neutralization and the characteristics of organic aerosol that relate to the growth of ultrafine particles to accumulation mode sizes

ADDRESSING THE 'NEED' FOR SUSTAINABLE FOOD SECURITY INITIATIVES: EXPLORING INUIT PERSPECTIVES OF FOOD NEEDS IN HOPEDALE, NUNATSIAVUT

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Rooted in Inuit culture is a connection to wild foods that come from the local environment. This relationship with the land provides Inuit with nutritious food, and the connection with their environment supports health and cultural identity. Changes in social and natural environments currently taking place in the North are challenging the availability, access to and use of these foods by Inuit communities, and are contributing to higher rates of food insecurity in regions such as Nunatsiavut (Labrador). Social and cultural elements of food are recognized needs in many conceptualizations of food security. In regards to wild food species, the 'need' for food is also a protected concept in some Land Claims agreements, such as the Labrador Inuit Land Claims Agreement. Objective measures of physiological needs (nutrient and caloric intake) for food are commonly recognized and understood, however, there is limited information regarding the concepts of and measurements for social and cultural food needs. Additionally, measures traditionally used to estimate the level of wild food need in Arctic communities, such as harvest studies, likely provide an underestimate of the true level of food needed at the household scale. This project follows a mixed methods design to explore the relationship between household food security status, the nature and diversity of food needs, and the use of food support programs in the Inuit community of Hopedale, Nunatsiavut. In Phase 1, 20 qualitative interviews were conducted with participants from different age and gender groups to examine the nature of personal food needs from an Inuit perspective. Beyond the basic need of an adequate amount of quality food to sustain life, participants discussed a perceived level of need for a variety of wild food species and identified a series of perceived

characteristics of their food that they need, "needs of food", and particular conditions that they need food for, "needs for food". These needs fall into the four categories of: physical needs (such as needing food that is perceived as healthy); personal needs (needing food that is versatile); social needs (needing food to participate in sharing networks); and cultural needs (needing food from the land that makes one feel part of a cultural group in which consumption of the item is a norm). Participants also identified a variety of potential barriers that impede the availability, accessibility and use of the foods for which they report a need. Results of Phase 1 informed the development of a community wide survey, that was implemented in Phase 2 and is currently being analysed. Overall, findings from this research will contribute to our understanding of the concept of food 'needs', potentially influence estimates of levels of different forms of 'need' that are protected in some Inuit land claim agreements, and inform the development or improvement of community level solutions for food insecurity.

INTER-ANNUAL VARIABILITY OF DISSOLVED CO2 CONCENTRATIONS AND FLUXES FOR PONDS IN CANADA'S LOW ARCTIC

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Carbon (C) is playing a large role in global climate change and a greater understanding of its cycling in the Arctic is important. The study of carbon dioxide (CO2) fluxes is important for understanding the current C sink or source status of the Arctic landscape, yet small water bodies, which have been known to be strong sources of C to the atmosphere, are typically excluded from CO2 flux monitoring studies. Additionally, most studies that have examined aquatic C fluxes obtained CO2 flux estimates from discrete sampling methods and often over one field season. Therefore the inter-annual variability of the CO2 dynamics of small Arctic aquatic systems remains largely unknown. The aim of this study was to examine the CO2 dynamics of four Low Arctic ponds over the snow free seasons of 2013 and 2014. This study was conducted near the Daring Lake Tundra Ecosystem Research Station (64052'N, 1110 35'W), Northwest Territories, Canada. Continuous CO2 concentrations were measured in the ponds using a NDIR sensor adapted for submersion in the ponds. Weekly headspace samples were also taken along with measurements of each pond's water chemistry and temperature. This study will examine the importance of atmospheric weather and pond conditions (including temperature, water depth, pH, and dissolved organic carbon) on the magnitude of inter-annual variability in CO2 emissions in both hydraulically connected and isolated ponds of varying sizes. These results reiterate the importance of including ponds in estimates of the C budgets of Arctic landscapes. These results reiterate the importance of including ponds in estimates of the C budgets of Arctic landscapes.

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

EVALUATION OF COSMOS (COSMIC-RAY SOIL MOISTURE OBSERVING SYSTEM) SOIL MOISTURE PRODUCT IN THE CANADIAN ARCTIC TUNDRA

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Permafrost is an integral part of environmental processes occurring in the Canadian Arctic; however, it is sensitive to disturbance. Warming of near surface ground temperatures associated with anthropogenic climate change has already been observed in the North and it is anticipated that this region will experience further changes to temperature and precipitation regimes. Soil moisture is a key variable in understanding Arctic hydrology due to the implications of these changes for Canada's climate. Consequently, establishing reliable in-situ and remote sensing methods to monitor active layer soil moisture are increasingly important. An emerging in-situ technology is the COsmic-ray Soil Moisture Observing System (COSMOS), which operates by measuring cosmic ray neutron intensity over an aerial footprint. These measurements are sensitive to soil water content, and calibration functions can be developed to observe absolute or relative changes of soil water content within a COSMOS footprint. These sensors have shown promise for use over agricultural mineral soils; however, few researchers have investigated the performance of this technology over porous organic peat found in the Arctic Tundra. Additionally, research is needed to establish the approximate COSMOS measurement footprint and contributing depth over unique application environments. This poster describes results of an on-going study to monitor soil moisture over Arctic Tundra using COSMOS, with implications for validating satellite remote sensing products. The objective of this research is to evaluate absolute and relative accuracy of soil moisture produced from a COSMOS (via existing calibrations) using co-located field measurements. Research was conducted at Trail Valley Creek, NWT (68°44'N 133°30'W), over July to August 2014. Six temporary soil moisture monitoring stations were installed at 5, 40, 75, 150, 175, and 200 m distances from the stationary COSMOS. Three Stevens Hydra Probe II Soil Moisture sensors were installed in a profile at each station to measure temperature and dielectric permittivity at 0-5.7cm, 3.5-6.5 cm, and 18.5-21.5 cm depths. These data were continuously recorded over the July to August study period at 4 hour intervals. Laboratory based dielectric to soil water content calibrations were developed for each Hydra Probe, resulting in an accuracy of approximately < 0.05 m3m-3 RMSE. Results of these soil moisture time series data show greater sensitivity to small scale precipitation events observed in the uppermost ~5 cm of the soil profile. Sensitivity of COSMOS measurements to changes in soil moisture content within the top ~20 cm of the soil profile will be investigated. These soil moisture data are used to evaluate the absolute and temporal agreement with the COSMOS soil moisture data.

DISTRIBUTIONS OF CHLORIDE AND BROMIDE IN SNOW, SEA ICE AND SEAWATER DURING SPRINGTIME IN THE ARCTIC

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Halogen chemistry in the polar oceans has received much scientific attention in recent years due to the springtime occurrence of bromine explosion events (BEEs) in the polar boundary layer. Reactive halogen atoms, which are produced during BEEs, react with ozone and elemental mercury, resulting in the occurrence of ozone depletion events (ODEs) and mercury depletion events (MDEs), respectively. Despite extensive studies in the past two decades, the source of bromine and the site for bromine activation remains poorly known. In this paper, vertical distribution profiles of chloride and bromide across the seawater-sea ice-snow interface were measured to study the cryospheric halide distribution and the potential difference between the behavior of chloride and bromide. The study was carried out at Cambridge Bay of the Canadian Arctic Ocean after polar sunrise. Bromide and chloride concentrations were analyzed using ion chromatography. Measurement results show that the Br- to Cl- molar ratio (Br-/Cl- ratio) in the bulk sea ice remains nearly constant (1/680) throughout the ice core and is close to the ratio in the underlying seawater (1/732). These results indicate that chloride and bromide ions in the ice originated from seawater and that the sea ice surface does not appear to be the site for bromine activation. Much higher Br-/Cl- ratios are, however, observed in the snow pack overlying the sea ice, suggesting the snow scavenges bromide from sources other than sea salt aerosols. Of particular importance is the depletion of Br-/Cl- ratio in surface snow: while the Br-/Cl- ratio in the mid-layer snow pack can be as high as 1/100,

it decreases to 1/326 in the surface layer. This surface depletion of the Br-/Cl- ratio is consistently observed over a 9-day period from March 9 to March 17. We believe the preferential loss of bromide over chloride in surface snow is due to photochemical conversion of bromide to gaseous atomic bromine and bromine oxide, resulting in BEEs. The occurrence of BEEs is indeed confirmed by the high mercury concentrations measured in the snow. Our results thus suggest that surface snow plays a more important role in the occurrence of BEEs, ODEs and MDEs in the springtime Arctic.

MICROZOOPLANKTON COMMUNITY STRUCTURE AND GRAZING IMPACT ON MAJOR PHYTOPLANKTON IN THE CHUKCHI SEA AND THE WESTERN CANADA BASIN, ARCTIC OCEAN

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We investigated the microzooplankton community and its grazing impact on major phytoplankton groups in the Chukchi Sea and in the western Canada Basin during the period July–August 2010. The study area was divided into three regions based on topography, hydrographic properties and trophic conditions: (1) a productive region over the Chukchi Sea shelf (CSS) with high phytoplankton biomass dominated by diatoms, (2) an oligotrophic region over the Northwind Abyssal Plain (NwAP) with low phytoplankton biomass dominated by picophytoplankton, and (3) the Northwind Ridge (NwR), over which waters were dominated by picophytoplankton and diatoms. The spatial distribution of microzooplankton biomass and its composition were related to differences in phytoplankton biomass and assemblage composition in the three water masses. Heterotrophic dinoflagellates (HDF) and ciliates were significant components of microzooplankton populations. Athecate HDF were the most important component in the CSS, where diatoms were dominant. Naked ciliates were dominant microzooplankton in the NwR. Microzooplankton grazing rate varied by the assemblage composition of both phytoplankton and microzooplankton. Microzooplankton was capable of consuming an average of 71.7 ± 17.2% of daily phytoplankton production. Growth rates of smaller phytoplankton (i.e., picophytoplankton and autotrophic nanoflagellates) and grazing rates on them were higher than rates for diatoms. Microzooplankton grazed more on picophytoplankton (PP grazed = 89.3 ± 20.5%) and autotrophic nanoflagellates (PP grazed = 82.3 ± 22.5%) than on diatoms (PP grazed = 62.5 ± 20.5%). The dynamics of predator and prey populations were almost balanced in waters in which smaller phytoplankton were dominant. Picophytoplankton production was consumed by microzooplankton allowing transfer to larger consumers. On average, microzooplankton grazed 62.5% of the diatom production in the waters we studied, indicating that the classical food chain (with carbon flux from diatoms to copepods) is likely operational and of significance in this region. Overall, microzooplankton grazing was an important process controlling phytoplankton biomass and composition in the Chukchi Sea and the western Canada Basin during early summer.

VARIATION IN INDICES OF RINGED SEAL DENSITY AND ABUNDANCE IN WESTERN HUDSON BAY DETERMINED FROM AERIAL SURVEYS, 1995 TO 2013

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We conducted systematic, strip transect, aerial surveys of ringed seals in western Hudson Bay (WHB), Canada, in late May to early June of 1995-1997, 1999, 2000, 2007-2010, and 2013. The density of ringed seals hauled out on ice over the entire study area ranged from 1.22 seals/km2 in 1995, to 0.20 seals/km2 in 2013. Density estimates varied significantly over the study period, and, with the exception of 2013, appeared to follow a cyclical pattern. Although density estimates also appear to follow a downward trend over time, results of multiple linear regression, weighted by survey effort, indicated no significant trend in ringed seal density as a function of year, survey date, and proportion of open water. In addition, no significant correlation was observed among any of the environmental variables and density estimates. As the proportion of seals hauled out at the time of the survey is unknown, the density estimates of WHB ringed seals presented in this study should be considered indices that might be useful to explore trends in abundance. Although our results do not indicate that a significant decline has occurred, the low density estimate in 2013 may be an indication that population changes, unrelated to a natural cycle, are taking place. Several mechanisms may contribute to an observed decline in ringed seal density. For example, changes in environmental conditions, leading to changes in snow and ice characteristics, can affect ringed seal fitness and reproductive success and can increase exposure to predators. It has also been suggested that climate related shifts in marine mammal prey communities could lead to nutritional

stress and a decrease in overall fitness. Nutritional stress and decreased levels of fitness can have significant effects on marine mammal health, and may promote the spread of disease, resulting in a large scale mortality event. Such an event appears to have occurred in Hudson Bay In late 2010 and early 2011, when there were numerous reports of sick and stranded ringed seals. It seems probable that a large die-off is at least partially responsible for the low seal density observed in 2013, though it is unlikely that such a causal link will ever be established. However, the effect of survey timing and environmental conditions on ringed seal haul out behaviour must also be considered as a possible explanation for the low density observed in 2013. In the absence of additional data to assess ringed seal haul out behaviour over the time period that surveys were conducted, it is difficult to determine how much of the variation in observed densities is a result of variation in timing of the peak haul out period, or by true changes in ringed seal abundance. Further monitoring and directed research are necessary to understand what mechanism may be responsible for variation in ringed seal density and potential demographic changes.

SPATIAL AND TEMPORAL DYNAMICS OF GROUNDWATER FLOW AT POLAR BEAR PASS: AN EXTENSIVE LOW-GRADIENT WETLAND, BATHURST ISLAND, NUNAVUT

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In large extensive wetlands, ponds generally are the most prevalent terrain type and at Polar Bear Pass (PBP), Bathurst Island, Nunavut they number about 4000. Their sustainability on a seasonal and long-term basis depends on a positive water storage where inputs of water (snowmelt, rainfall, surface/subsurface inputs) exceed losses (evaporation, outflow including groundwater). While we now have a good understanding of seasonal snowmelt and rainfall inputs and losses due to evaporation in these ponds, groundwater inflows remain elusive. To date, these waters have been lumped in with the pond storage term, which unfortunately also incorporates the measurement error. Besides water budget studies, reliable estimates of groundwater inflow are required to quantify nutrient and carbon fluxes being transferred from upslope regions into wet meadows and adjacent ponds The extensive, low-gradient wetland at PBP is bounded by hills rising up 100 to 200 m above the wetland. In the lee of these hills, deep snow often accumulates forming late-lying snowpacks. They serve to supply adjacent wet meadows and ponds with additional meltwater long after the seasonal snowmelt season has ended. However, due to recent warming in the Arctic (in the last decade) these late-lying snowpacks are now disappearing, and the impact that this has on groundwater supplies to both wet meadows and ponds at PBP remains unclear. The objectives of this study were: (1) to evaluate the seasonal and spatial pattern of groundwater flow in wet meadows located between upland regions characterized by late-lying snow beds and lower-lying tundra ponds at Polar Bear Pass, Bathurst Island (75.7°N 98.7°W); and (2) assess the importance of groundwater flow in pond water budgets across various seasons: e.g. 2007-warm/dry and 2009-cool/wet seasons. Groundwater flow moving from a late-lying snowbed across a wet meadow zone to a study pond was estimated using a modified Darcy's equation, which requires information on water tables, frost tables, and hydraulic conductivity. These data were obtained from 2007-2010 along a series of water wells (3 transects, 5 water wells per transect) which extended from a late-lying snowbed, across a wet meadow to a nearby study pond. Water tables were measured daily or every other day with water sensors and frost tables were probed at the same time. All groundwater well locations, including the study pond were surveyed with a total survey station. This allowed elevations water tables, frost table and the thickness of the water aquifer to be determined. Frequent hydraulic conductivity measurements (rate of water flow) were also obtained by pumping tests. This study will document the degree of intra and inter-seasonal variability across well transects illustrating (1) the impact of varying terrain conditions (gravelly vs. tundra soils) on groundwater flow inputs, and (2) the critical importance of late-lying snowbeds in keeping ponds recharged, especially in warm/dry years. The study will also detail the importance of reversal of flows in the wet meadows, especially during the freeze-back period, 2008 and 2009.

ATMOSPHERIC CONCENTRATIONS OF ORGANOCHLORINE PESTICIDES AND FLAME RETARDANTS IN THE YUKON TERRITORY, CANADA

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Twenty-five organochlorine pesticides (OCPs), 14 polybrominated diphenyl ethers (PBDEs) and 14 non-BDE flame retardants (FRs) were analyzed in month-long air samples collected at Little Fox Lake (LFL) in Canada's Yukon Territory from August 2011 to July 2014. The highest concentrations of OCPs were observed for hexachlorobenzene (HCB), with a median concentration of 60.2 pg/m3, followed by

α-hexachlorocyclohexane (α-HCH) and α-endosulfan. BDE-47 was the most abundant compound among the 14 PBDEs with the median concentration of 0.87 pg/m3, followed by BDE-99 at 0.44 pg/m3. Non-BDE FRs pentabromotoluene (PBT) and dechlorane plus (DP) were detected in all the samples. The total concentrations of syn- and anti-DP ranged from 0.01 to 1.76 pg/m3. Dechlorane 602, 2,3-dibromopropyl-2,4,6-tribromophenyl ether (DPTE), and hexabromobenzene (HBB) were also detected in > 75% samples. Ally-2,4,6-tribromophenyl ether (ATE), 2-bromoallyl-2,4,6-tribromophenyl ether (BATE) and dechlorane 604 were detected in <20% samples but frequently detected since 2014. Dechlorane 602 and 604, ATE and BATE are reported for the first time in Arctic air here. PBDEs has shown decreasing tendency as of 2013, indicating that the phase out of penta-BDE and octa-BDE has led to significant decline in the atmosphere. Seasonal variations did not show clear trends except for HCB, α-HCH, and α-endosulfan, indicating that LFL is well positioned to act as a background monitoring site. Back trajectory analysis showed that air mass during the sampling period often originated from Russia and the Pacific-rim, passing over the Pacific Ocean prior to arriving at LFL.

PHYTOPLANKTON PRODUCTION RESPONSE TO ENVIRONMENTAL CHANGES IN THE CHUKCHI SEA AND THE WESTERN CANADA BASIN

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Based on a 13C–15N dual tracer technique, primary production measurements were conducted in the Chukchi Sea and the western Canada Basin in 2009 and 2010. Primary productions from in situ measurements were considerably decreased compared to those previously reported from the regions. Low carbon production rates in the Chukchi Sea, 2009 were induced by high amount of fresh water accumulated from the Siberian Coastal Current and the Alaskan Coastal Water. Under these environmental conditions, small phytoplankton were more abundant than those reported previously in the Chukchi Sea shelf. In 2010, the exceptionally high nitrate production rates were regionally found in the western Canada Basin. Warm-core eddies could play an important role in the supply of nitrate to the euphotic zone and hence induce a high phytoplankton biomass and production rate in the Canada Basin. Therefore, the effects of physical forcing events on the primary production need to be more examined to better understand changes of primary production under ongoing environmental changes in the Arctic Ocean.

ESTIMATION OF THE ARCTIC AEROSOL TRANSPORT TIME SCALE AND RESIDENCE TIME USING RELATIONSHIPS BETWEEN 210PB AND 212PB ATMOSPHERIC ACTIVITY CONCENTRATIONS OBSERVED BY CANADIAN MONITORING STATIONS

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210Pb and 212Pb widely exist in the earth's crust as naturally occurring radionuclides. Their presence in the atmosphere is due to the decay of 222Rn and 220Rn gases which diffuse from the ground. Airborne 210Pb and 212Pb are frequently used as tracers in different studies concerning atmospheric transport. The elevated activity level of long-lived radionuclide 210Pb (T1/2 = 22.3 years) in the Arctic during winter months is believed to result from sources from outside of the Arctic region via a long range atmospheric transport processes, e.g. the Arctic haze originated from anthropogenic sources outside the Arctic. 212Pb (T1/2 = 10.6 hours), a short-lived radionuclide in the decay of 220Rn, can be used as a tracer for atmospheric transport in the sub-regional scale. Although airborne concentration of 210Pb has been routinely measured in most of aerosol monitoring stations, simultaneous detection with 212Pb is much less common. This is attributable to the time required for the sample to be shipped to the analysis site if the station has no on-site measurement capability. By assuming almost all of the 210Pb and its progenies (210Bi and 210Po) in the Arctic aerosols would be produced from the decay of 222Rn, the activity ratios of 210Pb and its progenies could be used to investigate residence times and removal rate constants of aerosols. However, there is disagreement between the reported values of the residence times due to extraneous sources of 210Po to the atmosphere, such as volcanic eruption, dust, particulate re-suspension from forest fires, and other anthropogenic activities. In addition, light scattering can impact the balance of each species in the atmosphere changing the apparent residence time of aerosols. The Radiation Protection Bureau of Health Canada, as part of its routine operations, monitors the radiation levels across Canada through networks of stations which measure radioactivity in air, water and other environmental samples. The Canadian Radiological Monitoring Network (CRMN) was initiated in 1959 to monitor environmental releases of radioactivity from atmospheric nuclear weapons

testing and accidental releases from nuclear facilities. Among a total of 30 stations, 4 stations are Comprehensive Nuclear Test-Ban Treaty (CTBT) radionuclide monitoring stations. Each one is equipped with a high-volume sampler for airborne particulate monitoring and a field laboratory for on-site sample measurements which allows for the measurement of 212Pb. These stations operate in a "short cycle" mode. This mode includes approximately 24-h air sampling by filtering air with a flow rate of 1000 m3/h, followed by a 24-h decay period, and a 24-h gamma spectrum acquisition in a compact geometry close to an HPGe detector. The CTBT stations are very sensitive systems and can give clear signals for natural radioactivity, including 220Rn and 222Rn progeny. The primary objectives of this study were to analyse existing long-term atmospheric 210Pb and 212Pb monitoring data collected from the CRMN that at locations between 42.10 and 82.50 north latitudes, to identify an indicator that can reflect the source tracking of air mass flow to the Arctic from mid- and low-latitudes of continents, and to estimate Arctic aerosol transport time scale and residence time. This study also provides a discussion on the research needed to determine how heavily the Arctic has been impacted by the accumulation of naturally occurring radionuclides.

SPECTRAL ANALYSES OF SHIP-BASED EDDY COVARIANCE DATA

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High frequency measurements (10 Hz) were made of three dimensional wind velocity, temperature and humidity during the 2011 and 2013 cruises from the Arctic research vessel CCGS Amundsen in order to measure surface fluxes using the eddy covariance (EC) technique. Ship-based application of the EC technique is complicated because of ship motion and flow distortion. A motion correction routine (Miller et al. 2008) was adopted to remove the ship motion contribution to the fluxes. The Eddy Covariance method was employed to calculate the fluxes. The resulting high frequency dataset were subject to spectral analysis and grouped based on ranges in atmospheric stability, wind speed and wind direction criteria. Compared against the ideal spectra and co-spectra curves (J.C. Kaimal and J.J. Finnigan, 1989), a good portion of the spectra plots for wind speeds, temperature and CO2 show that fluxes are overestimated because of advection and flow distortion artifacts at low and high frequencies. Signal processing techniques were applied to the data to mitigate observed bias, and to facilitate the calculation of surface fluxes. Here we present our methodology and preliminary results.

ASSOCIATION BETWEEN SERUM CONCENTRATIONS OF PERSISTENT ORGANIC POLLUTANTS AND MARKERS OF TYPE 2 DIABETES RISK AMONG NON-DIABETIC INUIT ADULTS IN THE CANADIAN ARCTIC

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Background: Persistent organic pollutants (POPs) have been identified as potential risk factors for the development of obesity-associated metabolic diseases such as Type 2 Diabetes Objectives: We studied the association between body burden of POPs and markers of diabetes risk among non-diabetic Inuit adults in northern Canada in a cross-sectional study. Methods: Data were obtained from the Inuit Health Survey included 36 communities in three Inuit jurisdictions in 2007-8. Out of a total of 2595 participants, 834 non-diabetic participants who completed the Oral Glucose Tolerance Test were included in this study. Logistic regression analyses were performed to evaluate the association between lipid-standardized serum concentrations of POPs and glucose intolerance. Linear regression was used to determine the association between serum POPs and adiponectin. All models were adjusted for age, sex, waist circumference, and smoking status. Analyses were conducted using STATA version 11.0 and a P-value <0.05 was considered statistically significant. Results: Mean concentrations of all POPs included in the analyses were 2-fold higher in glucose intolerant versus normoglycemic participants. Increased odds for glucose intolerance was observed among participants in the highest, versus lowest, quartile of trans-nonachlor (OR=2.23; 95%CI=1.09,4.56), toxaphene Parlar50 (OR=2.03 95%CI=1.01, 4.06), PCB118 (OR=2.75; 95%CI=1.27; 5.98), and PCB138 (OR=2.14; 95%CI=1.00; 4.55). All POPs concentrations were significantly and negatively associated with adiponectin. Conclusions: These results indicated that elevated exposure to POPs can be a risk factor in the development of metabolic disorders such as Type-II diabetes among Inuit adults in the Canadian Arctic.

THE INFLUENCE OF MASSIVE PERMAFROST THAW SLUMPS ON THE CARBON BALANCE OF STREAMS IN THE WESTERN CANADIAN ARCTIC.

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Massive permafrost thaw slumps associated with warming air temperatures contribute significantly to fluxes of terrestrial organic and inorganic constituents from land to river to ocean. Arctic streams contribute substantially to carbon balance in the aquatic conduit (e.g. via CO2 efflux), yet the influence of retrogressive thaw slump (RTS) activity on the source and fate of dissolved organic and inorganic carbon (DOC, DIC) in streams is poorly constrained. We investigate summertime DIC trends in RTS-impacted streams at eight sites across the Peel Plateau, NWT. Permafrost in this region is characterized by higher levels of inorganic substrate, largely derived from ice-rich deposits of unweathered glacial sediments, relative to organic-rich substrate (e.g. yedoma) in other RTS-impacted regions. Specific conductivity, bicarbonate, and pCO2 were variable by thaw slump yet consistently highest in RTS runoff (i.e. streams within slumps). Bicarbonate and pCO2 concentrations downstream of RTS activity were elevated with respect to upstream sites (pristine streams), suggesting that thawing permafrost could significantly increase horizontal and vertical carbon fluxes from streams. The potential for carbon efflux as CO2 versus fixation as bicarbonate was strongly related to pH, suggesting that variation within the DIC continuum is partly responsible for elevated pCO2 concentrations. Ongoing research exploring the sources and fate of DIC in RTS-impacted streams will more thoroughly constrain the contribution of biogenic relative to geogenic processes (e.g. microbial respiration of DOC and chemical weathering of mineral soils), thus improving our understanding of carbon cycling in the rapidly changing arctic.