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1 Application of space-based technologies and models to address land-cover/land-use change problems on the Yamal Peninsula, Russia

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The terrain and vegetation of the Yamal Peninsula in northern Russia has undergone extensive changes during the past 20 years due to gas and oil development, grazing and trampling by reindeer herds, and changes in climate. We are using a combination of ground-based studies, remote-sensing studies, and studies of land-use activities to help develop vegetation-change models that can be used to predict future states of the tundra. In 2007-2008 we are establishing a latitudinal transect of six locations in the Yamal Peninsula region, where we are conducting ground-based measurements of vegetation, soil, permafrost, active-layer, and spectral reflectance along the complete arctic climate gradient. We are comparing how vegetation changes in this heavily impacted region with nutrient-poor sandy soils with other areas in the Arctic, espe-

cially a similar transect on loess soils with less grazing impact in North America. We are especially interested in how the changes along these transects are influenced by recent changes in climate and sea-ice distribution. Nadym (northern boreal forest), Laborovaya (southern tundra, bioclimate subzone E), and Vaskiny Dachi (typical tundra, bioclimate subzone D) show clear trends in plant biomass related to the climate gradient in the southern part of the transect (varying from about 1800-2300 g m^{-2} for tundra and forest understory at Nadym to about 1000-1300 g m^{-2} at Vaskiny Dachi). Areas with sandy soils have 250-350 g m^{-2} less biomass than comparable clayey sites, with less mosses and graminoids, and much more lichen biomass than nearby areas with more clayey soils. Lichen biomass was especially large in the ungrazed areas near Nadym – over 1000 g m^{-2} in two areas studied at Nadym compared to less than 250 g m^{-2} in areas where reindeer grazing has occurred annually. Ground-based measurements of NDVI and optically-measured LAI showed little correspondence to the biomass data, demonstrating the difficulty of linking ground-based measurements of NDVI and LAI to biomass data at the plot level. However, space-based measurements of NDVI along the climate gradient in both North America and Eurasia show clear latitudinal trends that correspond to the biomass data. NDVI has increased in the last 20+ years along both the Yamal and North American transects and appears to correspond to decreases in near-shore sea-ice concentrations and increases in land-surface temperatures (LST). There are significant positive correlations between near-shore sea-ice concentrations and LST, but no significant year-to-year correlations between NDVI and sea-ice concentrations, suggesting that NDVI is not as sensitive to year-to-year variations in temperature as to long-term trends in temperature and could also be a reflection of long-term successional changes in tundra biomass that have been on-going for long periods of time. The baseline of information established along the Yamal transect could be extremely useful for monitoring long-term changes in plant biomass, permafrost temperatures, and active layer depths as temperatures warm in the region.