Multi-resolution remote sensing data for characterizing tundra vegetation communities on Boothia Peninsula, Nunavut

by

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Abstract

Arctic tundra environments are thought to be particularly sensitive and responsive to changes in climate, whereby alterations in ecosystem functioning are likely to be expressed through shifts in vegetation phenology and species composition. Due to the remoteness and climatic challenges of the Arctic, remote sensing may provide a viable means for estimating and monitoring these large-scale, potentially rapid changes. Therefore, the objectives of this study are to explore the relationships between conventional and soil-adjusted spectral vegetation indices (VIs), vascular plant biomass, percent vegetation cover, and moisture regimes in a tundra environment where exposed soil and gravel till have significant influence on the spectral response, and hence, the characterization of vegetation communities.

IKONOS multispectral data (4m resolution) were compared to Landsat 7 ETM+ data (30m resolution) for a study area in the Lord Lindsay River watershed on Boothia Peninsula, Nunavut. The former is thought to improve the delineation of tundra vegetation communities, and biophysical properties, characterized by small scale variations in moisture and topographic gradients. Coincident with image acquisition, extensive field data (e.g. percent cover, above-ground biomass, surface spectral characteristics) were collected for twelve 100m x 100m study plots to determine community composition. The normalized difference vegetation index (NDVI), the soil-adjusted vegetation index (SAVI) and the modified soil-adjusted vegetation index (MSAVI) were also investigated to evaluate the utility of soil-adjusted VIs that compensate for high degrees of soil reflectance.

Results suggest that vegetation community composition follows similar trends, but with somewhat lower productivity values, to previous Alaskan and Scandinavian biophysical remote sensing studies. Landsat 7 ETM+ data maintains superior spectral resolution, yet the spatial resolving power of IKONOS data proves useful in delineating within-plot microsite

variations. The utility of soil-adjusted VIs seems limited to moist communities, as there is no significant difference from NDVI over a range of cover types. Vascular plant biomass cannot be related to VIs, but moisture and percent cover are highly correlated with both types (i.e., NDVI and soil-adjusted VIs). Linear regression analysis provides a useful means of modeling percent cover variations over the entire study area. Improving estimates of vegetation community composition, distribution, and biomass are essential to determining a baseline for monitoring or modeling future changes that may follow trends of global climate change.

Dedicated to Joan Guy, and Claire Rondeau…

…in memory of their lifelong perseverance and positive outlook.

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