Remote sensing and field-based mapping of permafrost distribution along the Alaska Highway corridor, Interior Alaska

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ABSTRACT

We employed an integrated approach that combined remote sensing techniques with field measurements to predict the presence/absence of near-surface permafrost in a section of the Alaska Highway corridor. We investigated the correlative relationships among vegetation type, topography, moss thickness, tussock condition and near-surface permafrost in the study area. Analysis of moss thickness and active-layer depth in low-lying plains (slope <8°) showed an inverse relationship in different vegetation classes. The maximum likelihood classification of remotely sensed data mapped 80% of the study area as covered with vegetation. We developed an empirical-statistical (Binary Logistic Regression) model to establish the statistical relationship between surface variables and permafrost. The statistical relationships between the surface variables (vegetation, aspect and elevation classes) and permafrost were used within a spatial model to estimate the probability of permafrost presence at any given location (or pixel) in the study area. The statistical model yielded an overall classification accuracy of 80%. The spatial model mapped 62% of the total vegetated area as underlain by permafrost, including 99.5% of the scattered short spruce, 92.5% of the dense tall spruce, and 35.8% of the mixed spruce and deciduous vegetation classes. Comparison of our probabilistic permafrost map with an independently produced photo-interpreted permafrost map showed 75% agreement for continuously frozen class and very close agreement for the discontinuously frozen class.

KEY WORDS: Permafrost; Remote Sensing; GIS; Mapping; Statistical Modeling; Interior Alaska