THE 2014 TANANA INVENTORY PILOT: A USFS-NASA PARTNERSHIP TO LEVERAGE ADVANCED REMOTE SENSING TECHNOLOGIES FOR FOREST INVENTORY

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Abstract—Interior Alaska (approx. 112 million forested acres in size) is the last remaining forested area within the United States where the Forest Inventory and Analysis (FIA) program is not currently implemented. A joint NASA-FIA inventory pilot project was carried out in 2014 to increase familiarity with interior Alaska logistics and evaluate the utility of state-of-the-art high-resolution remote sensing (lidar+hyperspectral+thermal airborne imaging) to support an FIA inventory of interior Alaska.

DATA DESCRIPTION

In the 2014 Tanana inventory pilot project, FIA plots were established at a 1:4 intensity (or 1 plot per 24,000 acres) on a regular (i.e. systematic) hexagonal grid across both Tanana Valley State Forest and Tetlin National Wildlife Refuge, within the Tanana valley of interior Alaska. The relatively sparse FIA field plot sample described was augmented with sampled airborne remotely-sensed data acquired with the G-LiHT (Goddard-Lidar/Hyperspectral/Thermal) system to increase the precision of inventory parameter estimates. G-LiHT is a portable, airborne imaging system, developed at NASA-Goddard Space Flight Center, that simultaneously maps the composition, structure, and function of terrestrial ecosystems using lidar, imaging spectroscopy, and thermal imaging. G-LiHT provides high-resolution (~1 m) data that is well suited for studying tree-level ecosystem dynamics, including assessment of forest health and productivity of forest stands and individual trees. In addition G-LiHT data support local-scale mapping and regional-scale sampling of plant biomass, photosynthesis, and disturbance. The data is accurately georeferenced and can be matched very precisely with field plot data that are georeferenced using high-accuracy (dual-frequency, GLONASS-enabled) GPS. G-LiHT data was acquired in July-August, 2014 along single swaths (250 meters wide) spaced 9.3 km apart over the entire Tanana inventory unit (135,000 sq.km). Standard (design-unbiased, plot-based) FIA estimation approaches are compared with model-assisted (i.e. approximately design-unbiased) and model-based (spec. Bayesian hierarchical) approaches which utilize relationships between field measurements and G-LiHT-derived structural and spectral metrics.

Several modified FIA field measurement protocols were used to provide additional information on boreal forest conditions, including: 1) Ground cover measurements to quantify biomass/carbon of lichens and mosses, 2) Soil core sampling to quantify soil carbon content , 3) Two microplots to increase sample of small (1”-5”) diameter trees , and 4) High-precision GPS to enable accurate registration of field plots to airborne remote sensing data. Preliminary analyses indicate a strong relationship between

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lidar-derived variables and forest inventory metrics and also suggest that the addition of a second microplot at subplot locations further improves model fit for biomass prediction in the boreal forestes of interior Alaska.

ANALYSIS METHODS

In this study three different approaches were used to estimate forest inventory variables of interest; with particular emphasis on estimation and mapping of aboveground carbon. The three estimation procedures include 1) the standard, design-based approach currently used by the annual FIA inventory for estimation of inventory parameters within the contiguous US, 2) a model-assisted technique where sample collections of remote sensing data can be incorporated into the estimation procedure to potentially decrease uncertainty while still being approximately design-unbiased; and 3) a Bayesian multilevel hierarchical modeling approach. We plan to assess the accuracy and bias of the three approaches experimentally via simulation and application within the Tanana Valley State Forest and Tetlin National Wildlife Refuge, using the field and remote sensing data collected during the 2014 Tanana Inventory Pilot project.

CONCLUDING REMARKS

Given the remoteness (i.e. lack of transportation infrastructure) and size of interior Alaska, it is prohibitively expensive to implement a FIA inventory at the same sampling intensity as the lower 48 (1 plot per 6000 acres). It is also expected that remote sensing (both airborne and spaceborne) will be heavily relied-upon to achieve acceptable levels of precision for inventory estimates in interior Alaska (i.e. levels that will provide a clear picture of present status and important trends in forest resource conditions). By comparing design and modelbased approaches we will gain understanding about how model bias influences forest inventory estimates for interior Alaska and determine if it is possible to obtain approximately design-unbiased inventory estimates while leveraging the flexibility of model-based approaches.

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