Comparison of AVIRIS and AISA Airborne Hyperspectral Sensing for Above-Ground Forest Carbon Mapping

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Monitoring of the 418 million ha of forests in Canada is needed to ensure the sustainable development of these forests. Hyperspectral sensing can provide valuable information on forest species and forest health. Airborne hyperspectral sensing can also provide estimates of above-ground forest biomass [1].

On July 27, 2006, AISA hyperspectral data were acquired over the Greater Victoria Watershed District (GVWD) test site. The 499 spectral bands of the University of Victoria’s AISA sensor were geometrically corrected to 2m pixels with the aid of airborne navigation files and digital elevation models (DEM) and digital surface models (DSM) derived from LIDAR data. Summer NASA AVIRIS data had been earlier acquired in 2002 at 4m spatial resolution.

Working on our test site in Hoquiam, Washington that contained similar forest species to GVWD, we demonstrated that biomass obtained from AVIRIS hyperspectral data agreed with ground measurements of biomass with an r\textsuperscript{2} of 0.90. AISA with its higher spectral and spatial resolution offers the potential to separate ground cover (salal) from the forest overstory. Salal, a broad-leaved bush, is the dominant understory in the wetter portions of our GVWD test site. Salal can have high reflectance of 80% at 800 nm. In the drier portions of the site, the understory is dark soil and litter. To accurately map forest biomass, it is important to identify the understory and stratify the forests by understory type. This was done to create separate relationships for mapping biomass by sensor and by forest units. GVWD test site has extensive ground data plots. These plots were used to calibrate the biomass relationships. For the AISA and AVIRIS comparisons, spectral relationships were established between the AISA (adjusted to AVIRIS spectral and spatial resolution) and AVIRIS sensors for selected calibration targets. This between-sensor calibration placed the AISA data on the same calibration basis as the AVIRIS data. The calibrated reflectance data were used to generate forest species classifications, endmember fractions, and biomass estimates for the test site. Average classification accuracies exceeded 89% in mapping major forest species [2]. These products were used to create a map of above-ground carbon for the forested portion of the GVWD test site.

Earlier, above-ground carbon mapping was done with multi-temporal LANDSAT data for a test site in Alberta near the town of Hinton [3], [4]. Above-ground carbon mapping from remote sensing gave more accurate estimates than traditional estimates from inventory summaries for individual map sheets. Particularly critical was accurate determination of biomass. For the GVWD site, tree heights derived from LIDAR data, and allometric equations were used to provide independent ground estimates of biomass. These estimates were compared to the hyperspectral estimates of biomass. The resulting above-ground carbon maps were compared to estimates obtained from carbon budget models [5].

References
