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ESTIMATION OF FOREST BIOMASS WITH REMOTELY SENSED DATA

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ABSTRACT

Extensive research has recently been carried out at the Canada Centre for Remote Sensing to evaluate microwave, visible and infrared sensors for forest inventory and biomass energy estimation. In support of this project, airborne and satellite (LANDSAT) MSS imagery has been acquired over two 8x8 km mountainous sites, Anderson River and Gun Lake, British Columbia. Additional four--channel airborne and one-channel SEASAT SAR data were also available for the Anderson River area.

A first step in our analysis involved rectification of multisensor, multipass imagery to a common map (UTM projection) grid. This was accomplished using a fli flight modelling technique and digital terrain models to remove topographic related distortions. Because of overlaying errors, the resulting integrated data sets are suitable for digital analyses at resolutions coarser than 15 metres.

Accurate biomass estimation requires a sensor capable of discriminating forest species as well as forest from non-forest targets. Extensive analyses have therefore been undertaken to evaluate the effects of wavelength, sensor configuration and resolution on classification accuracy. The principal results are summarized below.

a) At 50 metre resolution, the performance of the airborne MSS is significantly better than the airborn SAR even if steep and shallow mode SAR data are combined. In addition, SAR imagery can suffer from extensive information loss due either to shadow or layover.

b) Spectral feature classification results indicate that the LANDSAT-D Thematic Mapper bands will provide improved forest species discriminability compared to the present LANDSAT MSS band selection. On the other hand, improved radiometric (8 bit vs. 6 bit) and spatial resolution has little or no effect. These results can be explained in part by the presence of significant image texture on spatial scales of less than 50 meters.

c) The utility of spatial features is presently being evaluated for high resolution (20 metres) MSS data. Results to date indicate that the information content in texture characteristics, such as variation and contrast, is comparable to that in the corresponding spectral feature domain. At 20 meters resolution, higher classification accuracies were achieved with combinations of texture features derived from various spectral channels than with combinations of texture and spectral features.

Finally, areal timber volume and biomass energy have been estimated with the aid of classified imagery, a digital terrain (slope) model, and volume estimates derived from a limited number of fixed-radius plots. The effects of classification accuracy and plot variances on large area energy estimations have been investigated and are presented in detail.