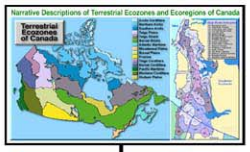
Methodology for deriving the spatial distribution of dominant tree species over Canada from remote sensing and ground data

*Goran Pavlic, **Wenjun Chen, **Richard Fernandes, **Josef Cihlar, ***David Price,
**Rasim Latifovic, **Robert Fraser, and **Sylvain G. Leblanc
*Noetix Research Inc., **Canada Centre for Remote Sensing, ***Canadian Forest Service

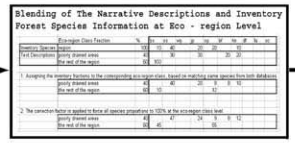
Reducing Canada's vulnerability to climate change

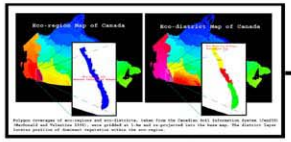
INTRODUCTION

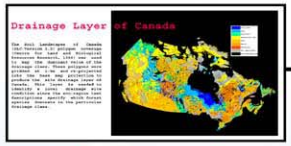
As globally important storehouses of carbon, forests play a critical role in influencing the Earth's climate. Forest plants and soils drive the global carbon cycle by sequestering carbon dioxide through photosynthesis and releasing it through respiration. Numerical simulation models are currently being used to produce estimates of Canadian terrestrial carbon budgets (Chen et al., 2000). This study describes the processing methodology and initial quality assessment of new 1-km resolution dataset giving the spatial distribution of the dominant forest species of Canada, required as one of the essential inputs to the models. The dataset is a raster coverage representing the fractional coverage of major Canadian forest species expected to be present in each 1-km grid cell based on publicly available survey information. The dataset is produced by blending, through decision rules, a large number of the existing independent datasets: a 1-km resolution land cover based on satellite remote sensing, an eco-region level of descriptions of forest species occurrences, Soil Landscapes of Canada information, a 1-km resolution digital elevation model, and a 10-km resolution Canadian Forest Inventory database (CanFI). The species mapped correspond to the 17 needleleaf and broadleaf overstory species groups reported in the Canadian National Forest Inventory (Gray et al, 1997). Several major objectives are set forth in this study: (a) a method for deriving the forest species fraction estimates from the given available inputs; (b) coverages of Canada wide estimates of the dominant forest species in both inventoried and non-inventoried regions, and, (c) a preliminary analysis of the uncertainty of these estimates.

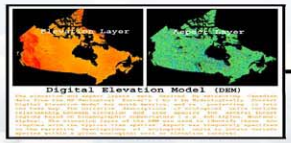


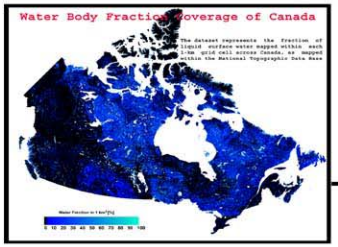
Canadian Forest Inventory (CanFI) at Eco-region level derived from the dataset (Siltanen and Price, 2000) which represents preliminary approximation of the 10-km gridded inventoried area estimates from the CanFI database (Gray and Power, 1997).



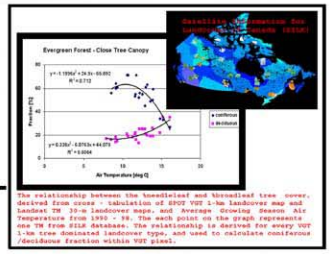




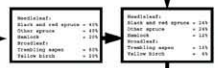




Needleleaf and broadleaf estimates were derived from the Land Cover of Canada 1998 in two steps. Firstly, by deriving the relationship between %needleleaf and %broadleaf tree cover and Average Growing Season Air Temperature, described within the flowchart's cell on the right. The relationship is derived for every VGT 1-km tree dominated landcover type, and used to estimate needleleaf and broadleaf fraction within every 1-km pixel. Secondly, the Waterbody Fraction Coverage of Canada (Pavlic, et. al., 2002) was used to constrain the fractional needleaf and broadleaf cover. In cases where the waterbody cover fraction exceeded the total mapped %needleleaf and %broadleaf cover, a reduction factor was equally applied to force the sum of %needleleaf, %broadleaf, and %water to equal 100%.

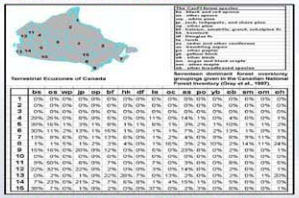


The relationship between the %needleleaf and %broadleaf tree cover, derived from cross - tabulation of SPOT VGT 1-km landcover map and Landsat TM 30-m landcover maps, and Average Growing Season Air Temperature from 1950 - 98. The each point on the graph represents one TM from SILC database. The relationship is derived for every VGT 1-km tree dominated landcover type, and used to calculate coniferous /deciduous fraction within VGT pixel.

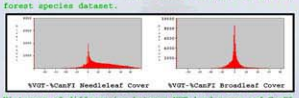


Results and discusion

Being aware of the mixed vintage and thematic accuracy in the source data, users of the product should factor in disturbance effects and the syngnetic nature of the eco-region text attributes. Also, the effective spatial resolution of the VGT data has to be mentioned. As the important source of errors, the effective spatial resolution leads to make confusion between different features within a pixel. Therefore, these maps are generally not precise on a single pixel basis, but they do give a representative picture of dominant forest species distribution over larger areas.



The figure demonstrates an analysis of forest species abundance by eco-zone over Canada derived from the new forest species dataset.



Histogram of differencies between VGT land cover and CanFI estimates of needleleaf and broadleaf forest cover over 10 -km grid cell.

Information about forest species identification and distribution at natioanl level is urgently needed by ecosystem modelers. Forest species coverage derived from forest inventories is not yet publicly available at national scale. In this respect, there is an essential to fill in the data gap at Canada level. This methodology through its initial results may possible be used for filling the gap. Additionally, the dataset may doublessly serve as a useful visualisation tool for educational purposes. The dataset is not intended to support biodiversity applications given that species cover is not derived from sample counts but from quantitative information generalized by local survay agencies to the level of eco-region. It does not aspire to replace actual forest species cover estimates derived from provincial or national forest inventories.