Modeling Carbon Dynamics and their Economic Implications in Two Forest Regions: Pacific Northwest and Northwestern Russia

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http://www.fsl.orst.edu/lter/research/intrnafr.htm

Introduction

•The goal of the project is to compare C dynamics in two major conifer forest regions Pacific Northwest and Northwestern Russia. The focus in the present report is on results from the Russian study area.

•The St. Petersburg region is located in NW Russia at about 60N. The mean annual temperature is about 4 degrees C, precipitation is 600-800 mm, total land area is 8.5 million ha, and forest area is 5.7 million ha.

•The mapping of C stores in forest ecosystems relies on Landsat imagery combined with stand-level forest inventory data, which is processed and supplemented with other ground data, including sample plots, timber harvest and economic data.

•Based on regional summaries of forest inventory data the Russian collaborators estimate that between 1973 and 1993 carbon stores in St. Petersburg region increased from 185 to 250 million tons (Kobak et al. 1999).

Results

•The analysis of the central Landsat TM scene started with unsupervised classification to identify the major landcover types: water, urban, agricultural lands, forests, and bogs. For forests we then used ground data in the framework of Canonical Correlation Analysis to derive a multispectral index for each of 4 forest variables: % hardwoods, % pine, age and biomass. Mean TM reflectance values were extracted from the image for 3200 forest stands, one half of them was used as a training set, the other half was reserved for testing.

•We tested three regression methods for projecting forest variables from multispectral indices. The final model used the reduced major axis method which provided a suitable compromise between reducing error and bias.

•The vegetation modeling will be extended from the central scene to the rest of the St. Petersburg region and changes will be detected between three different points in time: 1970's, 1980's and 1990's. The projected changes in C stores will be compared with estimates based on forest inventory data alone.

•The stores of coarse woody debris (CWD) were calculated from forest inventory database for 7 forests (1.1 million ha total area). Depending on forest category the amount of CWD ranged between 2 and 57 Mg/ha of organic matter. On average forests contain 5.2-7.4 Mg/ha of CWD.
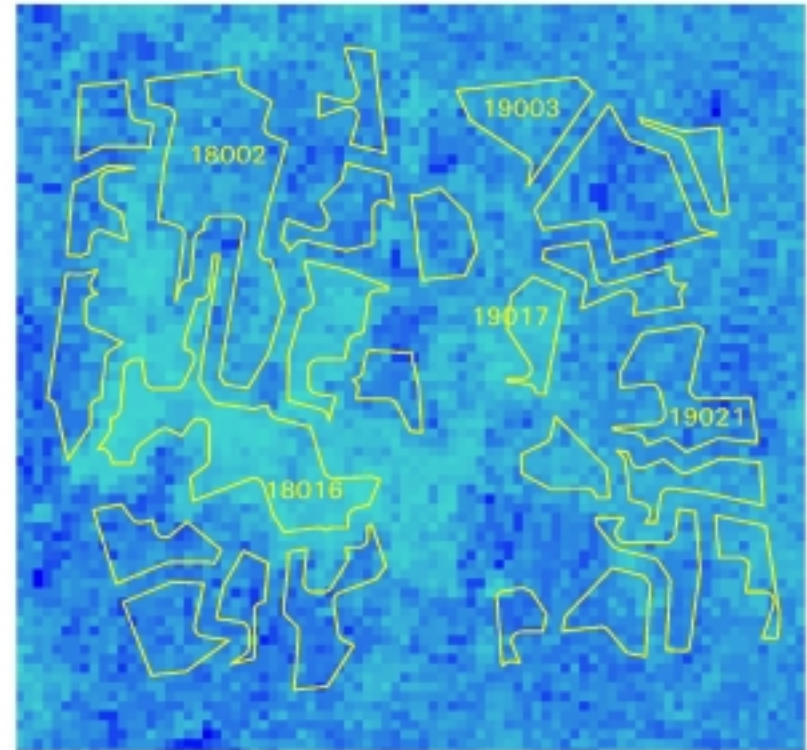
Plot	Observed Biomass	Predicted Biomass
18002	165.8	161.5
18016	31.0	65.2
19003	172.2	158.1
19017	92.4	85.1
19021	212.2	202.4

Conclusions

•Integration of Landsat imagery with ground data collected in Russia for purposes of forest inventory provides a basis for mapping forest attributes and modeling changes in regional C stores. This approach can be used in many regions of Russia for independent assessment of C stores in forest ecosystems.

•Preliminary analysis of forest inventory data for St. Petersburg region suggests significant net C sequestration in forest ecosystems between 1973 and 1993. Recent decline in timber harvest may have further increased C accumulation on forest lands. Landsat image analysis will test these preliminary results.

•Extensive forest management for timber production reduced the average stores of coarse woody debris on forest lands by 2.5-4.6 Mg/ha relative to pre-industrial level.

•Publications

- •O.N. Krankina, R.F. Treyfeld, M.E. Harmon, G. Spycher, and E.D. Povarov. Coarse woody debris in the forests of the St. Petersburg region, Russia. Ecological bulletins, in review.
- •Presentations for the upcoming conference: "The Role of Boreal Forests and Forestry in the Global Carbon Budget", May 8-12, 2000. Edmonton, Alberta, Canada
  - •*Coarse Woody Debris in Forest Regions of Russia: Estimation Methods and Role in Forest Management for Carbon Sequestration*
  - •*Integration of Satellite Imagery and Stand Inventory Data for Mapping Carbon Stocks in Forest Ecosystems of Northwestern Russia*
  - •*Effects of Silvicultural Treatments on Carbon Stores in Forest Stands*
- •Book summarizing the findings of this project and comparing controls of C cycling in two contrasting regions (planned)