Comparative Studies on Carbon Dynamics in Disturbed Forest Ecosystems: Eastern Russia and Northeastern China

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I. INTRODUCTION

Due to differing management regimes, forests on both sides of the Amur River in Eastern Russia/Northeastern China have experienced very different trajectories of disturbance and recovery. Forests throughout the region are dominated by larch, and fire in early spring is a major factor in forest disturbance and development. A new forest policy implemented in 1999 - the Natural Forest Conservation Program (NFCP) - and the rapid economic development of China, have put heavy pressure on forest resources in the Russian Far East.

The proposed study will focus on the characterization of forest disturbances and recovery in response to differing management regimes in Russian Far East and Northeastern China, and the ultimate impact of these natural and anthropogenic disturbances on forest ecosystem dynamics, vegetation diversity, and carbon uptake and storage in the region.

II. RESEARCH OBJECTIVES

The major objectives of this proposed study are:

1. Identify the major disturbances and disturbance patterns in Russian Far East and Northeastern China;
2. Understand the impact of forest fire and human activities on forest structure, carbon stocks and uptakes;
3. Assess the current forest carbon stocks and productivity in Russian Far east and Northeastern China; and
4. Contrast the change patterns of forests during the last decade between Russian Far East and Northeastern China, and provide insight on future forest development and carbon dynamics in this region.

III. METHODOLOGY

Data

The NASA-held remote sensing data will be the major data source for the studies. Field data, local forest inventory maps, and statistical reports generated through cooperation with scientists in Russia and China will be the main source of the ground truth data.

Forest disturbance from Satellite data

a) MODIS products and MISR multi-angle data to stratify the region, mapping the forested area into categories of disturbance.

b) Orthorectified MSS (~1970), TM (~1990), and ETM+ (~2000) data for constructing a detailed temporal history of disturbance for the critical region around the Amur River from the 1970's to 2006.

c) AVHRR data from the 1980's, the ATSR World Fire Atlas (1995-2000), the 1km MODIS active fire product (2000 to the present) - will be compiled into a coded mask to help stratify forested area in the region.

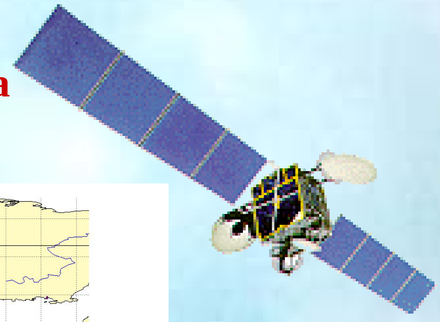
Analysis of Impact of disturbances

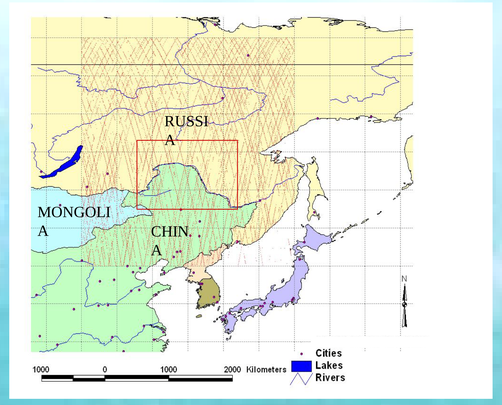
a) *Forest recovery from fire* from radiometrically calibrated historical Landsat (TM, ETM+) and SAR data (ENVISAT ASAR, ALOS PALSAR, ERS SAR)

b) *Timber harvesting* - the origin (agricultural conversion versus harvest) and the spatial patterns of clearing from satellite images and forestry statistics.

Quantifying carbon storage and dynamics

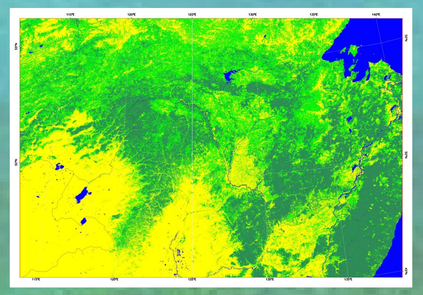
The MODIS land cover type and tree coverage maps, the disturbance and the forest change maps produced from this project, plus the tree height and possibly the biomass from GLAS samples and MISR data will be used to map total above ground biomass of this region and the changes in carbon stocks during last several decades.



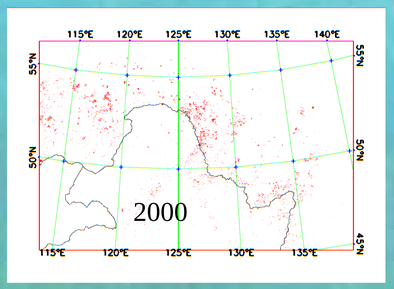


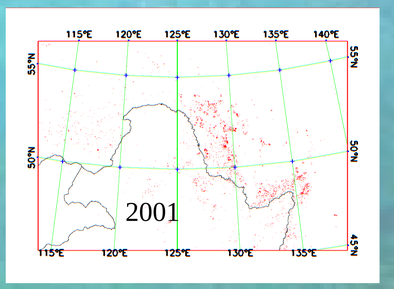
Study region overlain by the GLAS data acquired during the 33-day sub-cycle of the 91-day repeat orbits in Oct-Nov, 2003. Red box indicates the Intensive study area.

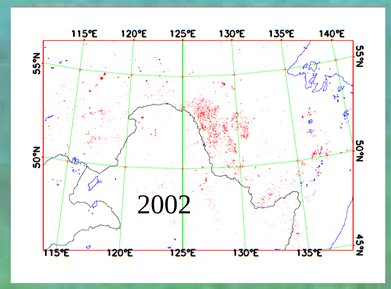
Raw logs export flows from Russia to China (http://www.forestsmonitor.org)

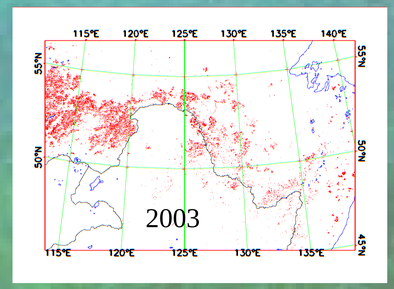


Tree coverage (MOD44B): yellow - <20%
Green – 20-50%, Sea Green > 50%









Forest fires edited from MOD14A2 (fire) and MOD44B (tree cover >=20%)

IV. WORK PLAN

First year

- Collect AVHRR, MODIS, GLAS, MISR data
- Investigate fire and other disturbance history from AVHRR and MODIS data
- Identify sites for detailed investigation
- Acquire Landsat, ENVISAT ASAR and other (JERS-1, ERS-1/2) data and collect large-scale forest maps and permanent sample data
- Investigate forest changes since 1970's using Landsat images at these sites.
- Develop forest classifications useful for carbon estimation based on AVHRR-MODIS classification and GLAS tree height sampling data
- Field trips
- Attend team meetings.

Second year

- Acquire ENVISAT ASAR, ALOS PALSAR, AVNIR-2, ASTER data in selected intensive study sites;
- Produce high-resolution biomass maps at intensive study sites
- Assess forest recovery process, and the consequences of forest management measures in these test sites
- Classify forest area into various categories reflecting the disturbance history, age, and current biomass level and spatial structure from MODIS, MISR and GLAS
- Produce regional biomass map from the forest classification and
- Analyze the effect of the spatial scale on forest biomass and productivity mapping
- Investigate the roles of the political, social and economical forces in LCLUC in the region
- Field trip to test sites, develop sampling data for map validation;
- Attend team meetings

Third year

- Investigate the impact of disturbances on forest ecosystem function, biodiversity, and carbon stock and uptake
- Contrast the disturbances, forest recovery, and change trends between Russian Far East and Northeastern China
- Understand the forest dynamics and study the future scenarios in this region
- Field trip to China for validating results
- Attend team meetings