Quantifying carbon fluxes of forests in Russia through integration of eddy flux towers, remote sensing & biogeochemical models

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I. Introduction

A limited number of CO_2 eddy flux tower sites, distributed over the vast terrain of Northern Eurasia, provide valuable continuous observations of net ecosystem exchange (NEE) between forests and the atmosphere. It is a challenge to scale-up the *in-situ* flux data to a landscape or regional scale. In this three-year (2005-2008) project we proposed to combine a satellite-based Vegetation Photosynthesis Model (VPM) and a biogeochemical model (DNDC) for conducting diagnostic analysis of the spatial and temporal variation of CO_2 flux from forests in Russia. Major objectives include (1) improving quantification of CO_2 fluxes of forests in Northern Eurasia and (2) developing and evaluating a data-model assimilation system for biogeochemical analysis at large scales (Figure 1).

II. Temporal variability of CO_2 fluxes at individual flux tower sites

This project will conduct synthesis analyses of CO_2 flux data from several eddy flux tower sites in Russia in relation to vegetation indices (LSWI, EVI and NDVI), and will use CO_2 and H_2O flux data to evaluate both satellite-based VPM model and process-based DNDC model. Temporal sampling of leaf chlorophyll, nitrogen and water content over the plant growing season will also be conducted in an effort to improve algorithms that use satellite images for retrieval of both biophysical and biochemical parameters of the forest canopy. We will quantify relative contribution of individual driving factors to the temporal variability of gross primary production (GPP), ecosystem respiration and NEE (Figure 2).

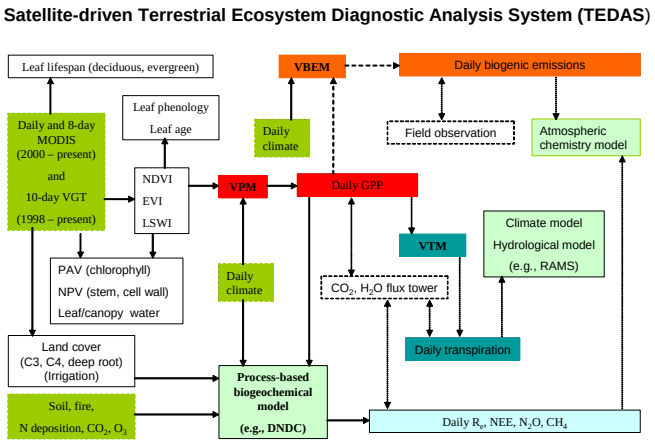

Figure 1. Framework of satellite-driven TEDAS

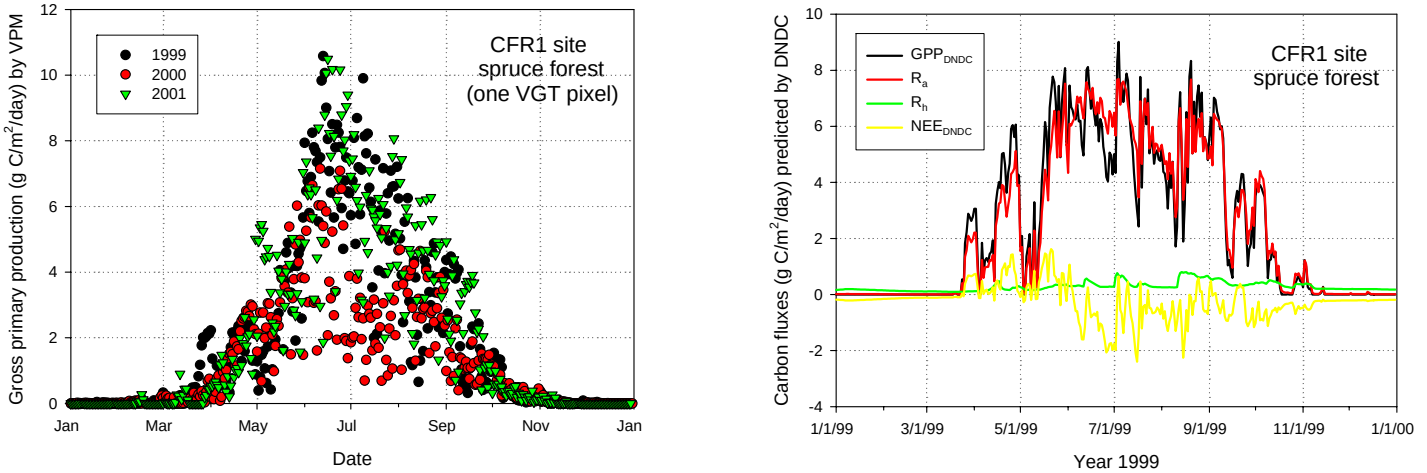

Figure 2. Preliminary simulation of VPM and DNDC models for a spruce forest tower site in western Russia.

III. Spatial and temporal variability of forests at landscape scale

The existing CO_2 eddy flux tower sites in Russia can be grouped into three clusters: western Russia, Central Siberia and Eastern Siberia. We plan to establish a multiple-scale, multi-temporal and multi-sensor image database (including Landsat, ASTER, MODIS and VGT sensors) for the three clusters, and land cover classifications at the landscape scale (~100 x 100 km^2) will be conducted to quantify spatial and temporal variability of vegetation. Simulations of coupled VPM and DNDC models will then be conducted to assess the variability of CO_2 fluxes across this complex landscape.

Relevant publication

Zhang *et al*., (2005), RSE, 99:357-371; Xiao (2006), IEEE GSRS (in press); Kurbatova *et al*., (in preparation)