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"Contribution to Studies of LCLUC in Northern Eurasia"

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ABSTRACT

Understanding the human impact on land cover is fundamental to informed decision-making to address global change and to ensure sustainable development. The science objective of the proposed project is to improve the understanding of broad continental-scale patterns of land-cover change and assess socio-economic drivers and environmental controls that have significant impacts at time-scales of interest for policy decisions (several years to several decades). An additional organizational and outreach objective is to engage a broader community of scientists in the development of methods and data sets for studies of land cover and land-use change and for validation of coarse-resolution land cover products. The proposed project builds on established professional connections and contributes to two ongoing studies of land cover and land-use change. The first study is based at the Geomatics Department of Humboldt-Universität zu Berlin (Prof. Dr. Patrick Hostert, PI) and the second one is at the Siberian Center for Environmental Research in Tomsk, Russia (Dr. Igor Okladnikov, PI). Combined with selected sites established as part of NELDA (Northern Eurasia Land Dynamics Analysis) project (OSU, Dr. Olga Krankina, PI), the resulting network of sites will span a wide gradient in environmental and social conditions enhancing greatly the capabilities of the NELDA network of sites. The focus of the proposed study is cross-site comparison and synthesis of results from individual sites and identification of mechanisms of land cover and land use change that can be generalized over large spatial domains. This research will inform the future development of global models of land cover change by assessing the predictive power of variables over wide environmental and social gradients. We will also investigate the potential of multi-date trajectory approach and integrated use of fine and coarse-resolution data to characterize important land-cover change processes at test sites.

STATEMENT OF PROGRESS

The major focus of research effort in Year 2 was on development and testing methods, compilation of data for analysis of land cover change at test sites and the visits to OSU of project collaborators based in Northern Eurasia:

1. OSU investigators have worked with Dr. Hostert's group at the Geomatics Department of Humboldt-Universität zu Berlin to test implementation of LandTrendr algorithms on a dense time-series of Landsat imagery for the previously established Carpathians-S site (Path 184 / Row 028). LandTrendr algorithms (http://landtrendr.forestry.oregonstate.edu/content/methods) use temporal segmentation at the pixel level to capture both abrupt events and slow processes, and had not been previously tested outside the archive of imagery for the continental U.S. The algorithm was implemented on the time series stack of 52 Landsat images ranging from 1984 to 2010 by Patrick Griffiths (PhD student at the Geomatics Department) in close collaboration with OSU team. Following Patrick's visit to OSU, the initial results showed success in detecting changes in timber harvest following reprivitization of forest lands in Romania (Griffiths et al. in prep). The annual temporal resolution of LandTrendr results also allowed to detect characteristic lags between the time legislations on forest land restitutions were passed by the Romanian Parliament (1991, 2000 and 2005) and an increase in annual disturbance rate. These new results provided a better understanding of the broad range of forest disturbance rates and their change over time across Northern Eurasia (Fig. 1).

2. The project at the Siberian Center for Environmental Research in Tomsk, Russia ("Human Impact on Land-cover Changes in the Heart of Asia"; Dr. Igor Okladnikov, PI) was completed and the final report submitted to APN. The results of land cover and change mapping at an additional site near Tomsk followed NELDA protocols and have good potential to expand the representation of West Siberia in the planned continental-scale analysis of land cover and land-use change. Results of forest disturbance mapping from both Tomsk sites are shown on Fig. 1. The APN project supported the development of land cover map and its accuracy assessment for NELDA site in Mongolia. The map and its accuracy assessment were refined during the visit to OSU of Tsolmon Renchin (collaborator from Mongolia) in May-June 2010 and this site is ready to be incorporated into the future cross-site analysis.

3. A section for a book chapter by Bergen et al. (in prep) was prepared by Krankina, Loboda and Sun. The *CASE STUDY: Land Change in the Amur Site on the Russia-China Border* is based on results from NELDA Amur site (see site report at http://www.fsl.orst.edu/nelda/sites/sd_amur.html). The new analysis contrasts the patterns of forest cover change and attributes them to differences in forest management in China and in Russia. The rates of forest disturbance at Amur site are several times greater than those reported on Fig. 1: in 2002-2006 the rate of forest disturbance averaged 6.7%/yr and 9.8%/yr in Chinese and in Russian parts or the image, respectively . While in Russia fires were the primary cause of forest disturbance (Fig. 2) timber harvest was widespread in China in spite of the well-publicized efforts of Chinese government to protect forests. Adding the Amur site

to planned NELDA-II synthesis will improve the understanding of broad continental-scale patterns of land-cover change and help assess its socio-economic drivers.

4. The new analysis of agricultural land abandonment at NELDA sites was initiated during the visit to OSU by Alexander Prishchepov (currently Post-Doctoral Research Associate at Leibniz Institute of Agricultural Development in Central and Eastern Europe, Halle (Saale), Germany). The classification was performed on multi-date image composite derived from layerstack of Landsat imagery. Supervised non-parametric support vector machines algorithm was used to classify the agricultural LULCC; this approach was shown to be superior to other classifiers used to map agricultural land abandonment (Prishchepov et al. *In review*). Preliminary results for the St. Petersburg site showed that by 2006/2007 about 20% (~77,100 hectares) of agricultural land actively managed in 1992 became abandoned. This was by far the lowest agricultural land abandonment rate observed in European Russia: for comparison, in Ryazan' oblast 28% (403,400 hectares) of agricultural land were abandoned from 1988 to 1999/2000, and additional 14% (~222,700 hectares) from 1999/2000 to 2007/2009 with only 1.7% of abandoned agricultural land brought back into the agricultural land use by 2007/2009 (Prishchepov et al. *In review*). The rates of agricultural land abandonment at the St. Petersburg site appear closer to those reported in Eastern Europe (Kuemmerle et al. 2008).
5. An additional NELDA site is being developed by collaborators from Mari-El State Technological University with support from Russian Federal government. In addition to land cover mapping in line with NELDA standard legend, the mapping of agricultural land abandonment and forest disturbance is planned.

In summary, the overall progress on the project is in line with plans.

References:

Prishchepov A.V., Radeloff V.C., Müller, D., Dubinin, M., Baumann M. "Determinants of agricultural land abandonment in post-Soviet European Russia". Agricultural Economics. In Review.

Kuemmerle, T., Hostert, P., Radeloff, V.C., Perzanowski, K, and Kruhlov, I. (2008): Postsocialist farmland abandonment in the Carpathians. Ecosystems, 11, 614-628.

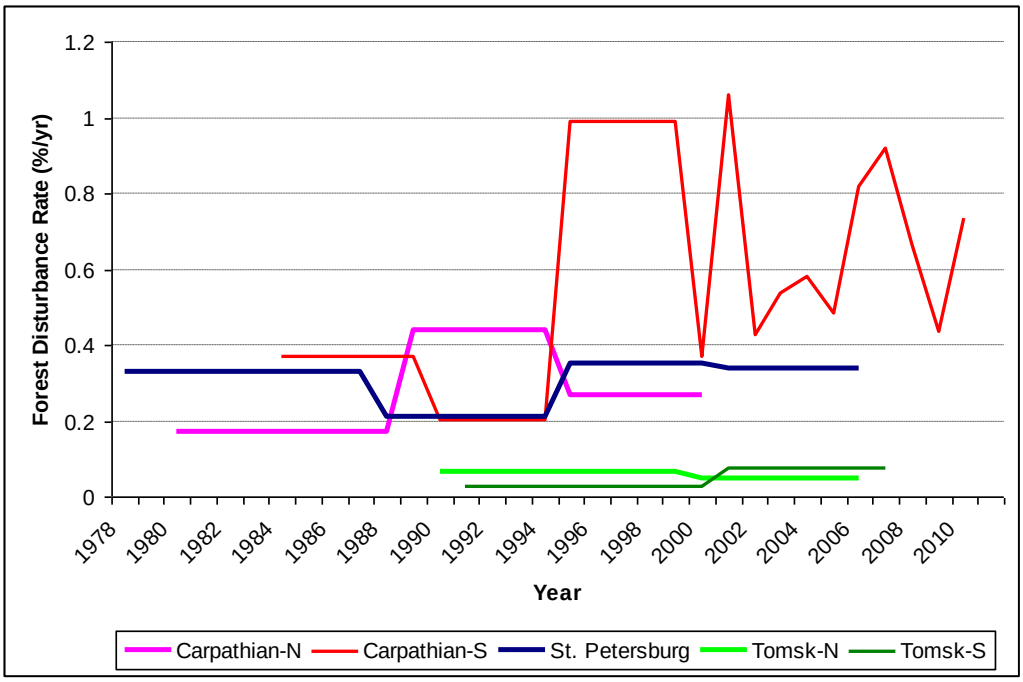

Fig. 1. Divergent patterns of change in forest disturbance at St. Petersburg, Carpathians, and Tomsk sites: results of change detection on time series of Landsat imagery.

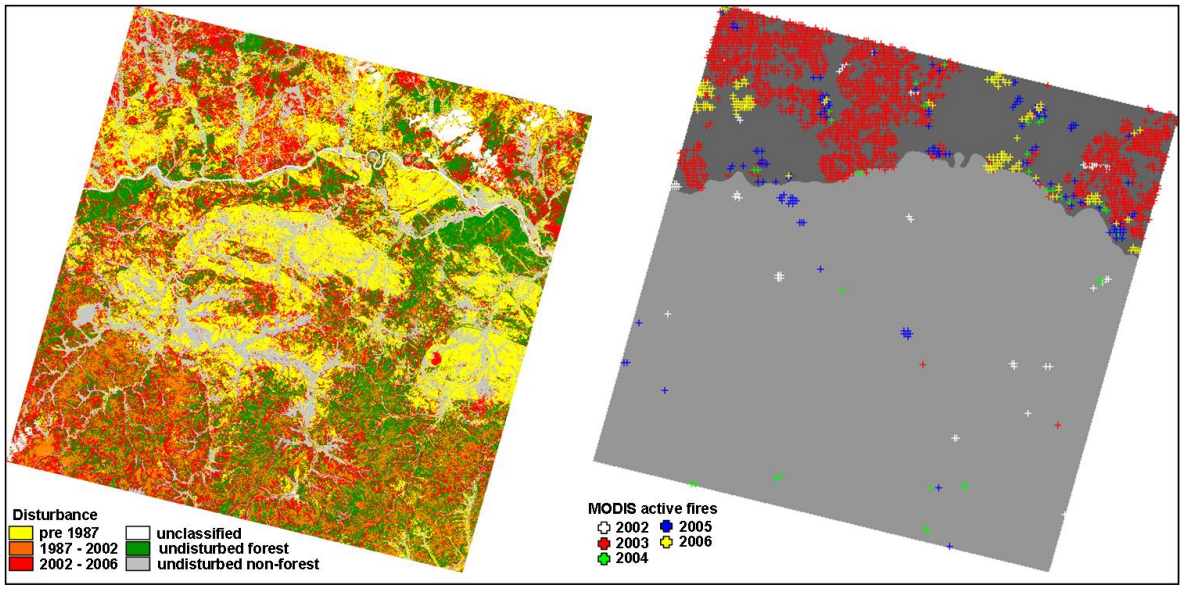

Fig. 2. Forest disturbance at Amur site: (left) Landsat-based disturbance pre-1987 (yellow, includes 1987 fire), 1987-2002 (orange), 2002-2006 (red); (right) MODIS active fire detections June 2002 – June 2006. Amur river separates Russian part (Northern ~1/4 of the Landsat scene) from Chinese part.

PUBLICATIONS

D. Sulla-Menashe; M.A. Friedl; O.N. Krankina; A. Baccini; C. E. Woodcock; A. Sibley; G. Sun; V. Kharuk; V. Elsakov. 2011. Hierarchical mapping of Northern Eurasian land cover using MODIS data, Remote Sensing of Environment, Volume 115, Issue 2, 15 February 2011, pp 392-403, ISSN 0034-4257, DOI: 10.1016/j.rse.2010.09.010 (http://www.sciencedirect.com/science/article/B6V6V-51D8956-1/2/54f39bb092c5036b9db55267ba67bd36)

Pflugmacher et al. (2011, in review) Comparison and Assessment of Coarse Resolution Land Cover Maps for Northern Eurasia Remote Sensing of Environment.

Griffiths, P., Kuemmerle, T., Knorn, J., Kennedy, R.E. and Hostert, P. Application of Landtrendr to map the outcome of the Romanian forest restitution (2011). Remote Sensing of Environment. In Preparation.

Bergen et al. In preparation CHAPTER 7. HUMAN DIMENSIONS OF ENVIRONMENTAL CHANGE IN SIBERIA.