Mapping Post-Socialist Forest-Cover Change in Temperate Russia

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Introduction

Background

➢ **Introduction**

- The breakdown of the Soviet Union in 1991 weakened Russia's forest management agencies, rural population declined and agriculture was abandoned. As a result, the temperate forests of European Russia are changing rapidly.
- Yet, compared to well-studied boreal forests, only little is known about past and present dynamics of Russia's temperate forests.

➢ **Objective**

- **Detect forest cover changes in European Russia during the socio-economic transition period from the Soviet Union to present (1985 – 2005) using Landsat TM/ETM+ imagery.**

➢ **Study site and selection of Landsat footprints**

- Two-step selection of Landsat footprints: (1) Stratified random selection of regions, based on average MODIS forest cover. (2) Select Landsat footprint that covered most of the area of the regions.

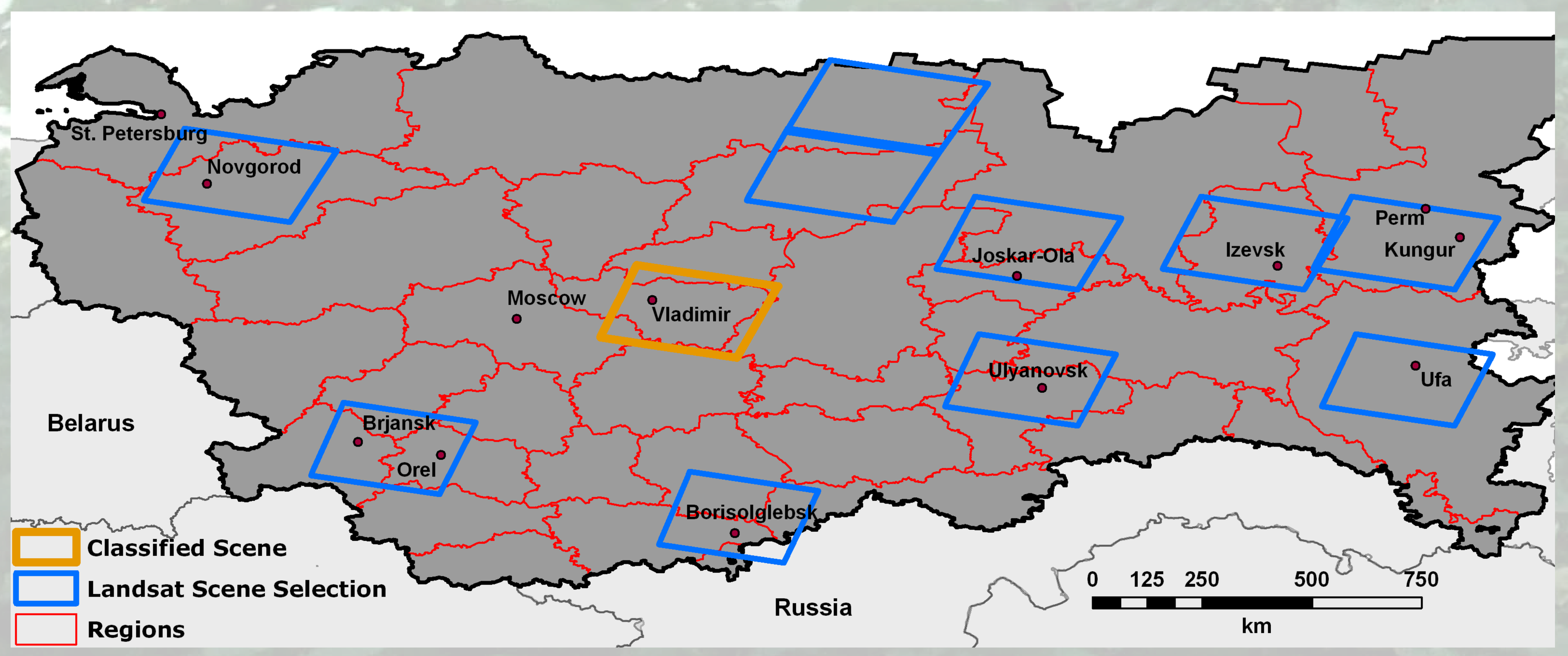

Figure 1: Study area and selected Landsat footprints.

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Methods

Support Vector Machines

➢ **Concept**

- Separates two classes by fitting a linear hyperplane.
- Kernel functions project training data in higher dimensional space, fit separation hyperplane here and reproject training data and hyperplane into low-dimensional space.

➢ **Advantages**

- Handles complex classes.
- Often outperforms other classifiers while needing less training samples.
- Successful use in change detection and forest disturbance mapping (Kummerle et al. 2009, Baumann et al. *in prep.)*

Change Detection Approach

- Unsupervised classification (ISODATA) of year 2007 scene, classification into 'forest' and 'other land cover'.
- Random sample of ground truth points in 'forest' and 'other land cover' (500 each).
- Label each point, based on visual assessment of the Landsat images. Exclude points that are not constant in time.
- Use training data for each Landsat image.
- Automatic parameterization of SVM to classify the images.
- Automatic accuracy assessment based on cross-validation (Janz et al. 2007).
- Post-classification comparison and identification of change trajectories.

Table 1: Image acquisition dates and classification accuracies

Time Point	Acquisition date	Sensor	Accuracy	Kappa
1985	1986/08/09	TM 5	93.967	0.876
1990	1988/07/21	TM 4	93.558	0.868
1995	1994/09/16	ETM+	91.820	0.833
2000	2001/05/06	TM 5	94.581	0.889
2005	2007/05/15	TM 5	91.718	0.830
		Average	**93.129**	**0.859**

Results and Outlook

Results & Discussion

- Deforestation more than expected a-priori.
- Decrease in forest cover before 1990, since increase (Figure 3).
- Forest cover trajectories not uniform in the study region (Figure 2, upper left).
- Deforestation pattern varied, some areas without large changes.
- Year 1995 likely a little bit overestimated due to different month of image acquisition.
- Classification accuracies high (93.13%, Kappa 0.86; Table 1).

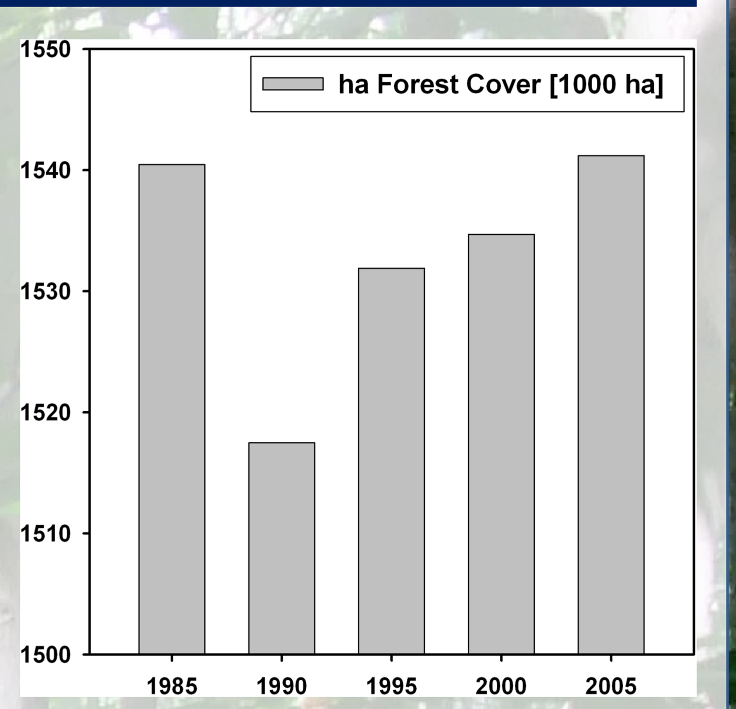

Figure 3: Forest cover change in the Landsat Scene 1985-2005

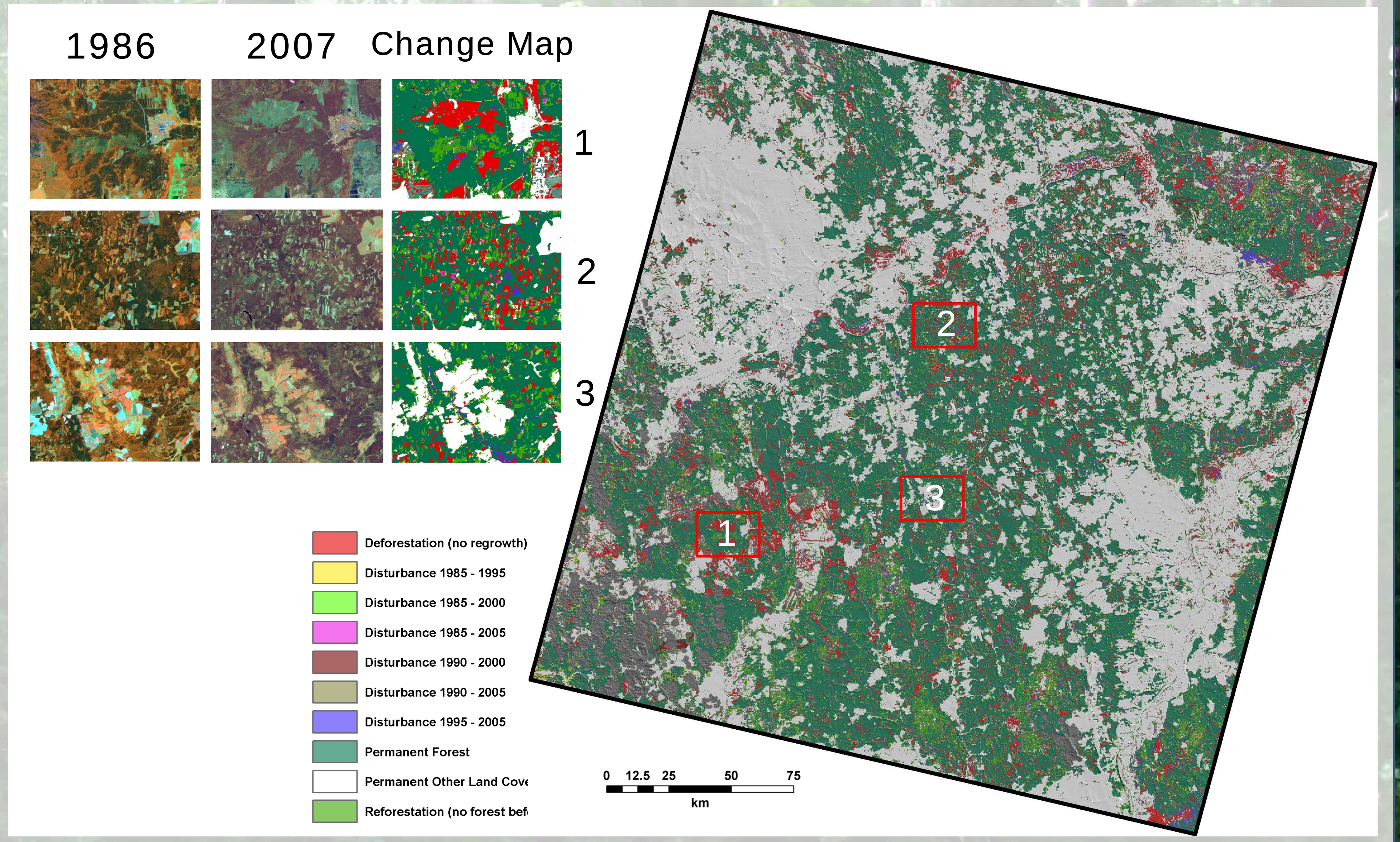

Figure 2: Change map 1986-2007 (right) and selected areas detailed (upper left)

Outlook

- 1st year of a 3-year-project.
- Selective logging might be a problem. Can we detect selective logging in the region using temporally dense Landsat time series stacks?
- What is the ability of other sensors to analyze the same question in comparison to Landsat satellites?

References:

Baumann, M., Kuemmerle, T., Elbakidze, M., Ozdogan, M., Radeloff, V.C., Keuler, N.S., Prishchepov, A., Kruhlov, I., and Hostert, P.: Post-socialist farmland abandonment in Western Ukraine. *In prep.*

Kuemmerle T., Chaskovskyy O., Knorn J., Radeloff V. C., Kruhlov I., Keeton W. S. & Hostert P. (2009): Forest cover change and illegal logging in the Ukrainian Carpathians in the transition period from 1988 to 2007. *Remote Sensing of Environment* **113**:1194-207.

Janz A., van der Linden S., Waske B. & Hostert P. (2007): imageSVM - A User-Orientated Tool for Advanced Classification of Hyperspectral Data using Support Vector Machines. In: Proceding of the 5th ERARSeL workshop on Imaging Spectroscopy, Bruges, Belgium.