Effects of massive socio-economic changes on land-use: detecting agricultural land abandonment and its drivers in post-Soviet Eastern Europe

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Background

Land use decisions are made by local actors, but their actions are constrained by broad-scale factors (e.g., national policies and global markets). Increasingly, evidence suggests that these broad-scale factors are at the heart of many LULCC trends. The collapse of socialism in the Eastern Europe provides a 'natural experiment' to examine how broad-scale change affects LULCC.

Main Goals

• Develop methods to monitor post-socialist agricultural abandonment.
• Quantify agricultural land abandonment in several Eastern European countries.
• Identify drivers of agricultural land abandonment.

MAPPING LAND ABANDONMENT

Background

Multi-seasonal satellite imagery improves classifications, but Landsat image availability is often limited.

Objectives

• Assess the effects of image dates on the classification accuracy of land abandonment.
• Compare Support Vector Machines (SVM) and Maximum Likelihood Classifier (MLC).

Methods

• Classify all possible combinations of Spring, Summer, Fall images for pre- and post-abandonment (1989 and 1999, 49 combinations), using SVM and MLC, for one Landsat footprint (path 186, row 22).
• Assess key images dates and best classifiers to classify "abandoned arable land" and "abandoned managed grassland".
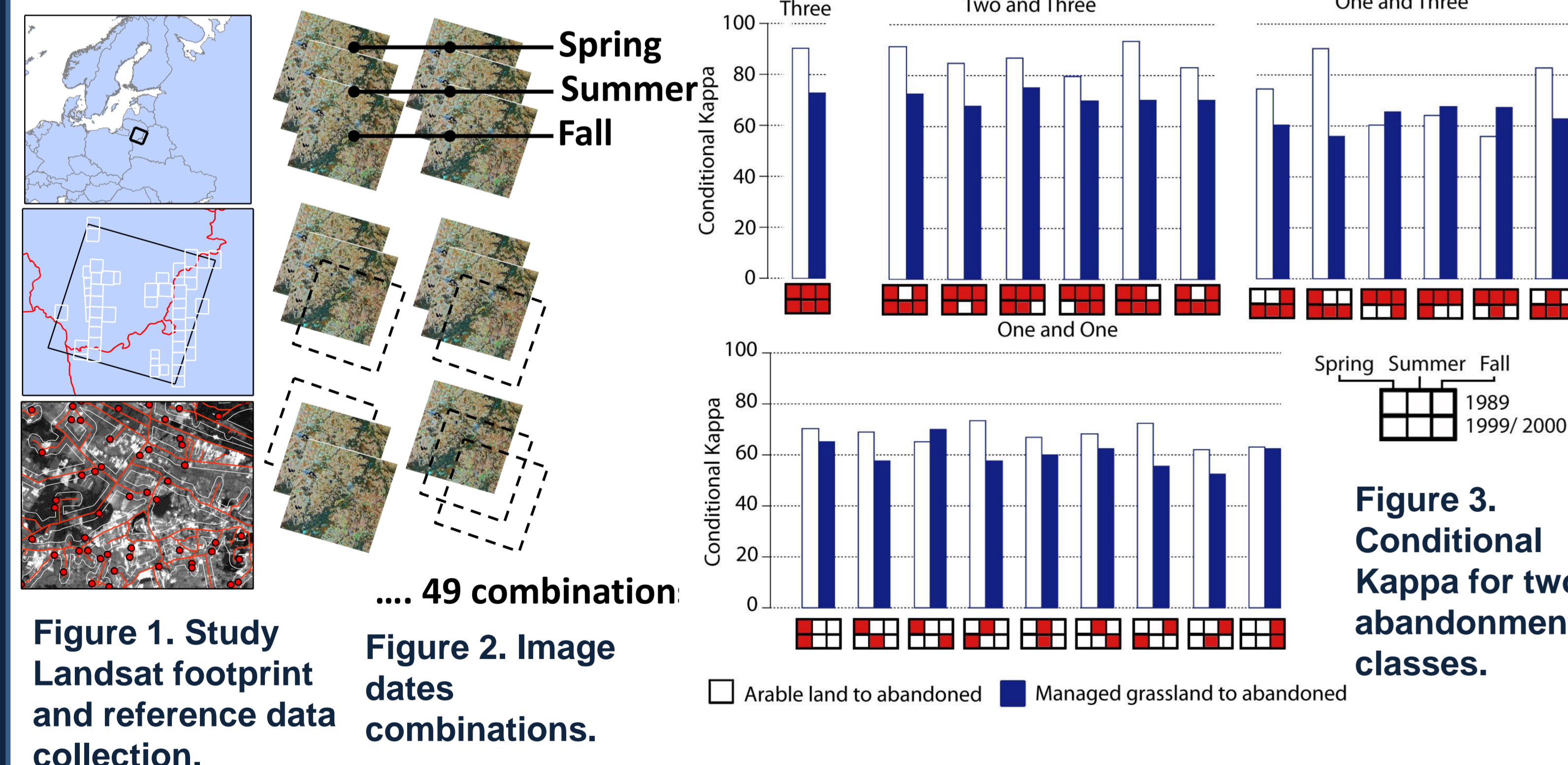

Figure 1. Study Landsat footprint and reference data collection.

Figure 2. Image dates combinations.

.... 49 combination

Figure 3. Conditional Kappa for two abandonment classes.

Results

• **Conditional Kappa was 90% for "abandoned arable land" with optimal image dates, but as low as 54% for sub-optimal dates (72% and 50% for "abandoned managed grassland").**
• "Abandoned arable land" accuracy depended greatly on spring images for both pre- and post-abandonment.
• "Abandoned managed grassland" required multiple image for pre-abandonment (preferably Spring plus either Summer or Fall) and at least spring for post-abandonment.
• SVM outperformed MLC only for "abandoned arable land" and only with many images dates.

PATTERN OF LAND ABANDONMENT

Background

Each Eastern European country employed unique policies after the collapse of socialism. It is not clear how this affected land abandonment.

Objectives

• Map land abandonment from 1989 to 1999 for several counties in one agro-climatic zone using SVM.
• Relate agricultural land abandonment rates to different transition models.

Methods

• Agro-climatic stratification using climate and soils data.
• Classification of multi-temporal Landsat TM/ ETM+ images using SVM.
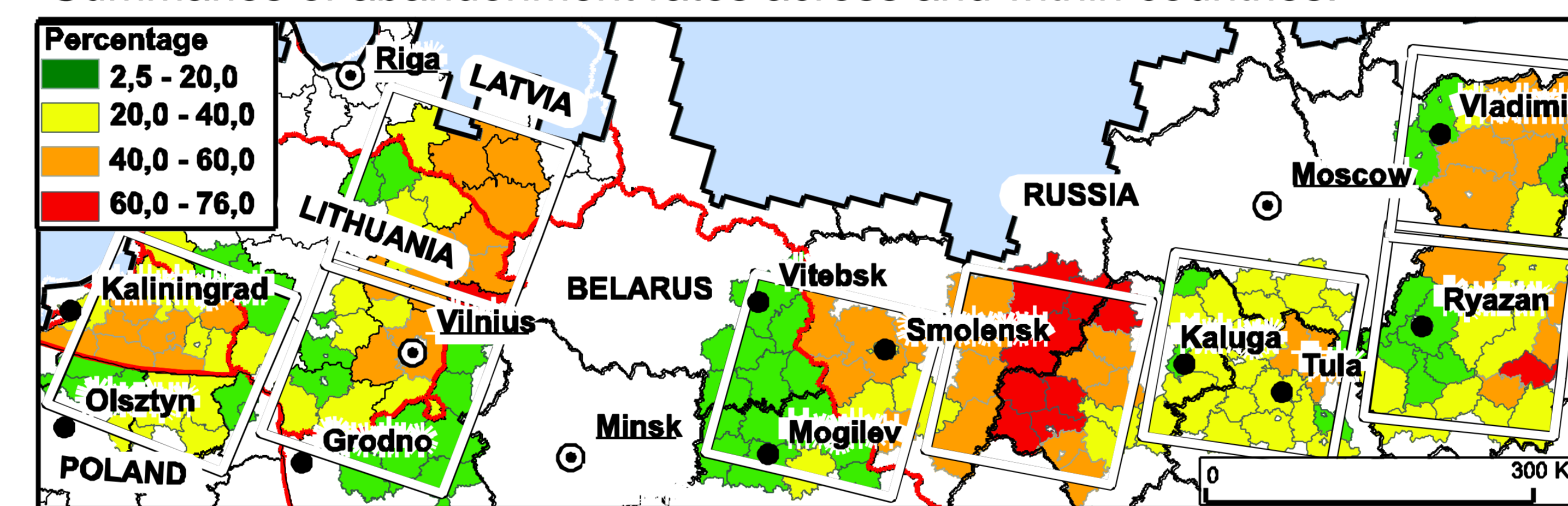• Summaries of abandonment rates across and within countries.

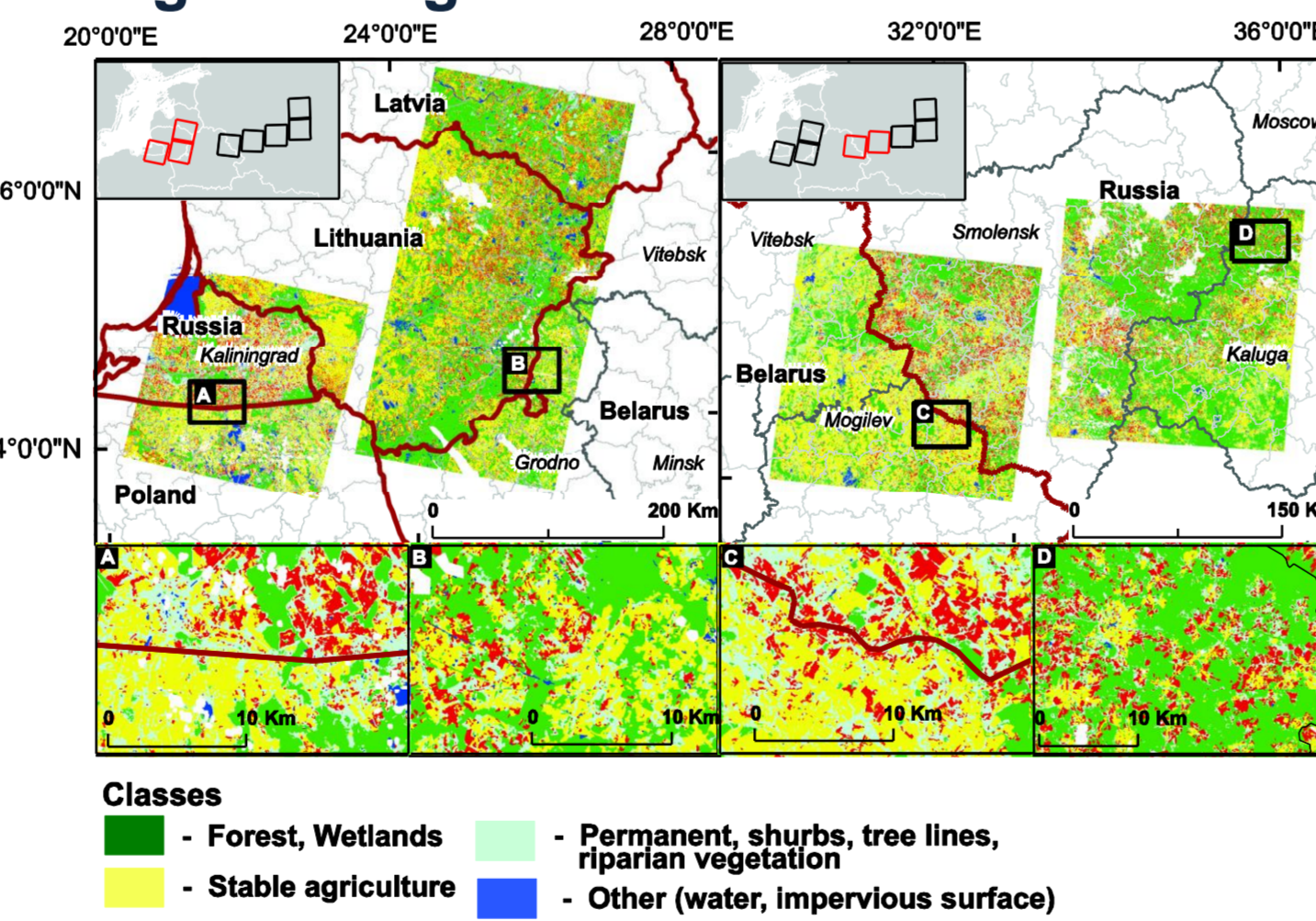Figure 4. Agricultural land abandonment rates summarized by district boundaries.
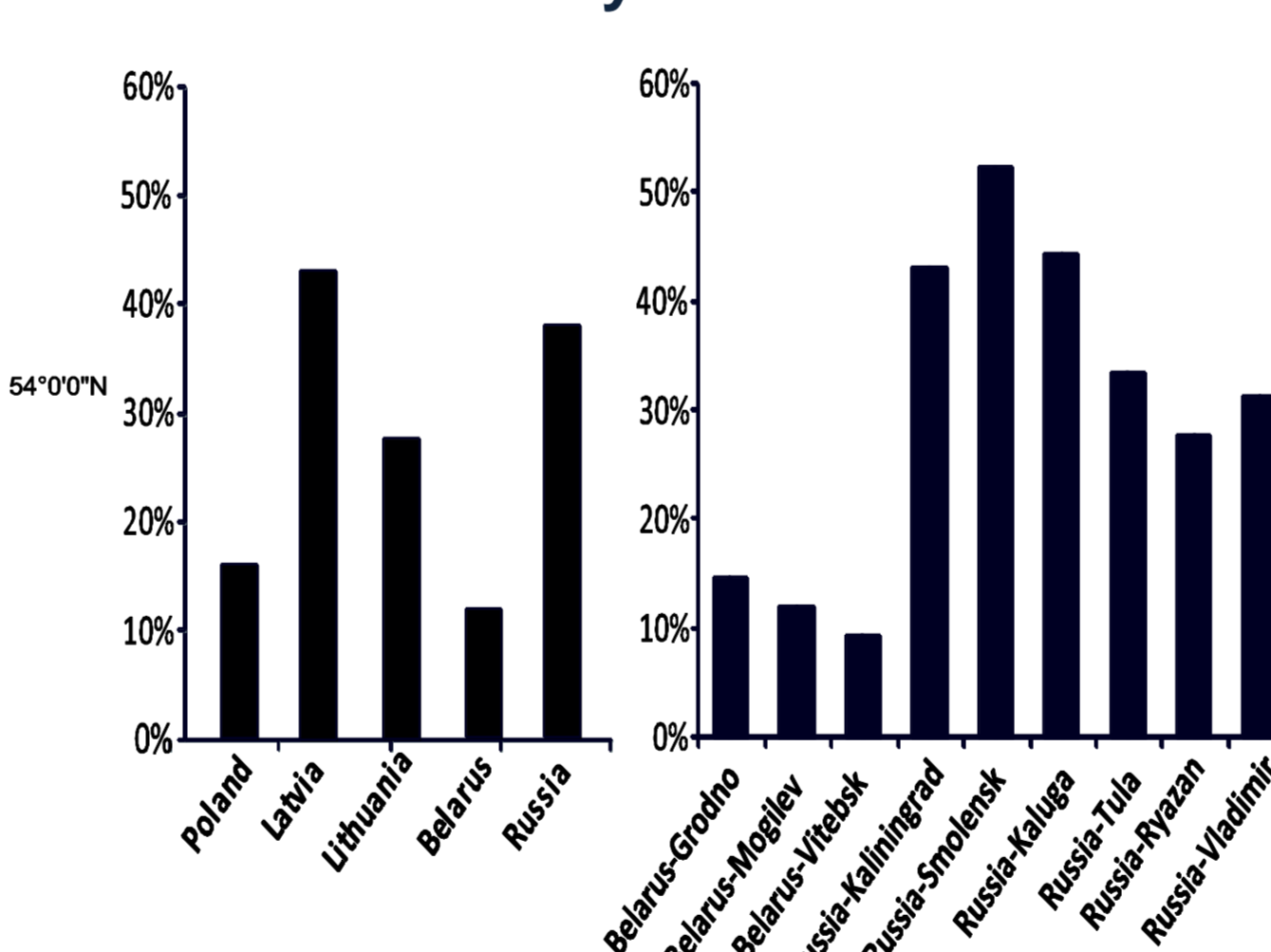

Figure 5. Abandonment pattern.

Figure 6. Agricultural abandonment rates summarized by countries and regions.

Results

• Out of 9,5 million ha agricultural land in 1989, 3 million hectares (31%) were abandoned by 2000/2002.
• Abandonment rates varied substantially among countries, and also among districts within countries.
• Latvia (42%), Russia (37%), Lithuania (28%), Poland (15%), and Belarus (12%).
• Cross-border scenes exhibited striking differences between countries that implemented different transition approaches (e.g., Mogilev region of Belrus-10%, Smolensk region of Russia-56%).
• **Abandonment rates were lowest in countries with strong institutions during the transition (e.g., Belarus and Poland).**

DRIVERS OF LAND ABANDONMENT

Background

• Agricultural land use is largely driven by economic decisions evolving from human behavior. Abandonment is common throughout the world, but drivers may differ among and within countries as suggested by strong intra- and inter-country variability in abandonment rates.

Objectives

• Develop one spatially explicit, multilevel model for five Russian regions (oblasts) to predict observed abandonment based on socio-economic and biophysical variables
• Develop fine-scale models for two Russian regions to examine socio-economic variables at the municipality and village level.

Methods

• Objective 1: spatially explicit logistic model ("abandoned" pixels-1;"stable agriculture"-0). Variables: 1) biophysical; 2) land cover; 3) socio-economic, district-level; 4) socio-economic proximities; 5) regional level macro-economic variables.
• Objective 2: same as above, plus village level socio-economic statistics.
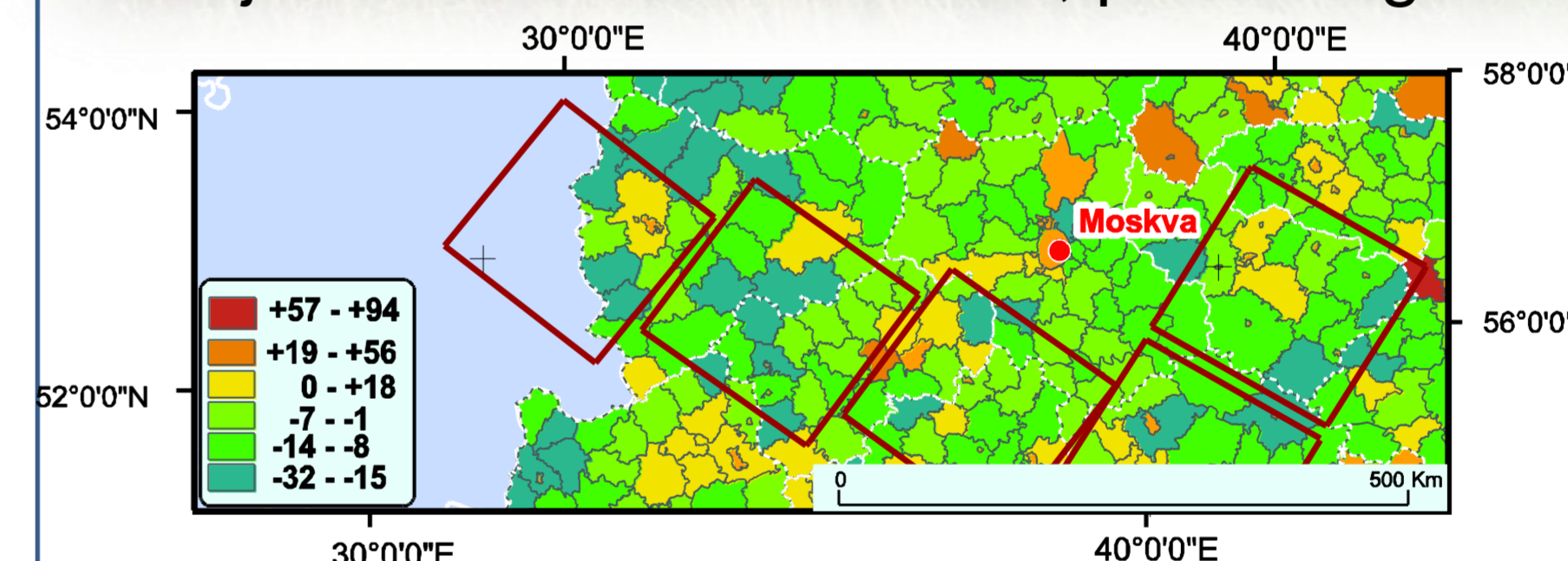

Figure 6. Percentage of rural population change 1990-2000 in central European Russia.

Expected results

• Testing the hypothesized relationship between covariates and land abandonment (Table 1).

Group	Driver
Land cover – proximities	Distance to 1989 shrubs (-)
Socio-economic – village level	Rural population (-)
Socio-economic – enterprise level	Public land ownership (-), dairy and milk production & livestock specialization (+)
Socio-economic – district level	Weighted number of registered land titles (-)
Socio-economic – regional level	Governmental investments in agriculture (-)
Socio-economic – proximities	Distance to roads (+), distance to administrative centers (+)

Table 1. Hypothesized relationship between selected covariates and land abandonment.

References

Prishchepov,A. V., Radeloff,V. C., Dubinin,M. & Alcantara,C. (2010) Effect of satellite image dates acquisition on land cover change detection and the mapping of agricultural land abandonment in Eastern Europe. Remote Sensing of Environment , In review .

Prishchepov,A. V., Radeloff,V. C., Baumann,M. & Kuemmerle,T. (2010). Massive socio-economic changes on land use change: agricultural abandonment during socio-economic transition in post-Soviet Eastern Europe. In preparation.

Acknowledgments