

# Detecting agricultural land abandonment and understanding its drivers in post-Soviet Eastern Europe

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## Background

Land use decisions are made at fine-scale (e.g., by local actors), but they are constrained by broad-scale factors (e.g., national policies and global markets). The collapse of socialism in the Eastern Europe provides a 'natural experiment' to examine how broad-scale change affects land use. *Controlling for agro-environmental differences, it is possible to assess the effect of socio-economic differences among the countries.*

## PATTERN OF LAND ABANDONMENT

### Background

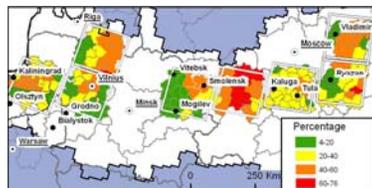
Many Eastern European countries had common starting point, but employed unique set of policies after the collapse of socialism. It is not clear how this affected agricultural land use.

### Objectives

- Map agricultural land abandonment from 1989 to 1999.
- Validate classification results using field and ancillary data (e.g., high resolution QuickBird and IKONOS images).
- Relate agricultural land abandonment rates to different transition models.

### Results

- Out of 9 million ha agricultural land in 1989, 2.5 million hectares (27% +/- 1%) were abandoned by 2000/2002.
- Statistically adjusted abandonment rates varied substantially among countries, and also among districts within countries.
- Cross-border footprints showed substantial differences exist between countries that implemented different transition approaches (e.g., Mogilev province of Belarus-10% +/- 1.2%, Smolensk province of Russia-46% +/- 1.4%).
- Abandonment rates were lowest in countries with strong institutions during the transition (e.g., Belarus and Poland).



Agricultural land abandonment rates summarized by district boundaries.



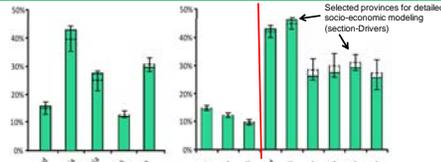
Study area and Selected Landsat TM/ETM+ footprints

### Methods

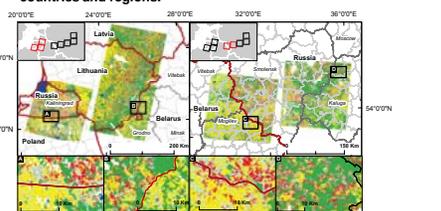
- Agro-climatic stratification using climate and soils data.
- Classification of multi-temporal Landsat TM/ ETM+ images using Support Vector Machines.
- Summaries of abandonment rates across and within countries.



Validating classification results in the field



Agricultural abandonment rates summarized by countries and regions.



Abandonment pattern.

## Goals

- Quantify agricultural land abandonment within one agro-climatic zone in Eastern Europe (Belarus, Latvia, Lithuania, Poland and Russia).
- At very broad scale (country level) relate the abandonment pattern with different transition approaches from state command to market-driven economies.
- Identify broad-scale (at district level) and fine-scale (at pixel-level) determinants of agricultural land abandonment in European Russia.

## DRIVERS OF LAND ABANDONMENT

### Background

Land use change is largely driven by economic decisions evolving from human behavior. Abandonment is common throughout the world and is affecting the environment. The determinants of abandonment are not well understood.

### Objectives

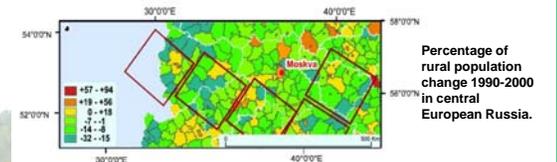
- Develop broad-scale (district level) statistical model for five Russian provinces (oblasts) to predict observed abandonment using socio-economic and biophysical variables
- Develop and compare fine-scale (pixel level) statistical models for two Russian provinces differing in agricultural land abandonment rates (Smolensk and Rjazan provinces) to examine socio-economic and biophysical variables at the hierarchical level.

### Results

- Results for broad-scale socio-economic modeling*
- Abandonment was higher where agricultural productivity was lower prior the transition (crop yields and milk yields per cow in the late 1980s).
  - Statistical models also showed that agricultural productivity was a function of environmental and socio-economic factors.
  - Rates of agricultural land abandonment was also higher for the districts with lower population densities in 1990 and higher forest percentage in 2000 (proxy for long-term marginal regions for agriculture).
- Results for fine-scale socio-economic modeling*
- At fine-scale agricultural land abandonment was determined by a combination of socio-economic and environmental factors in Rjazan province, but only socio-economic factors mattered in Smolensk province where abandonment was higher than in Rjazan province.

### 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*.



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

### Methods

- OLS linear regression modeling. Dependent variable: abandonment rates at the district level. Independent variables: 1) biophysical; 2) land cover; 3) socio-economic at the district-level.
- Logistic regression modeling. Dependent variable: binary variable, abandonment="1", non-abandoned agriculture="0". Independent variables: same as above, plus village level socio-economic statistics, pixel level socio-economic proximities and disaggregated biophysical variables.

Group	Smolensk	Rjazan
Interpolated population	(-)*	(-)'
Villages density	(-)'	(-)'***
Distance to municipality	(+)'***	(+)
Distance to district center	(+)'***	(+)
Distance to provincial capital	(+)	(+)
Distance to roads	(+)'***	(-)
Roads density	(-)'***	(-)
Elevation	(+)	(+)'**
Slope	(+)	(+)*
Aspect	(+)	(+)
Soil pH	(-)	(-)'***
Number of days with temperatures >10 C	(-)	(+)*
Forest percentage	(-)	(+)'***
Area Under Curve (AUC)	0.650	0.730

Relationship between selected covariates and land abandonment.

Significance is indicated with \*\*\*, \*\*, \* and ' for p<0.001, p<0.01, p<0.05 and p<0.1, respectively. "-"-negative relationship, "+"-positive relationship between dependent and independent variables.

