Post-Soviet land-use change and the effectiveness of protected areas in European Russia

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Background

- Declining global biodiversity
- Land-use change and overexploitation are two major drivers

- Protected areas are the cornerstone of global conservation efforts
- How effective are they in times of change?

- Protected areas are embedded in a 'zone of interaction'
- Here, land-use change affects related habitats and biodiversity

Post-Soviet land-use change

- Breakdown of the Soviet Union in 1991
- Widespread land-use change
  - Farmland abandonment
  - Illegal resource use (logging, poaching, etc.)

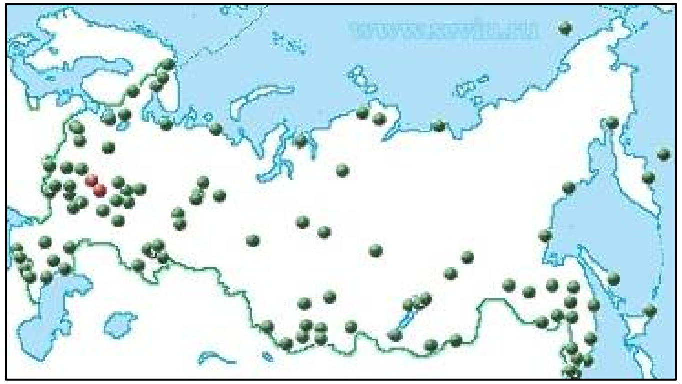
Abandoned farmland in Ryazan Oblast, Russia, in 2011

Russian protected areas

- Extensive network
  - 12,000 protected areas
  - Severe funding cutbacks after 1991
- Zapovedniks
  - Strictly protected, scientific nature reserves (IUCN cat. Ia)
  - 2010: 101 zapovedniks in Russia (34.5 mio ha)
  - Unique long-term time-series of environmental and biodiversity data

Patrick Hostert

Zapovedniks in Russia


www.sevin.ru/natreserves

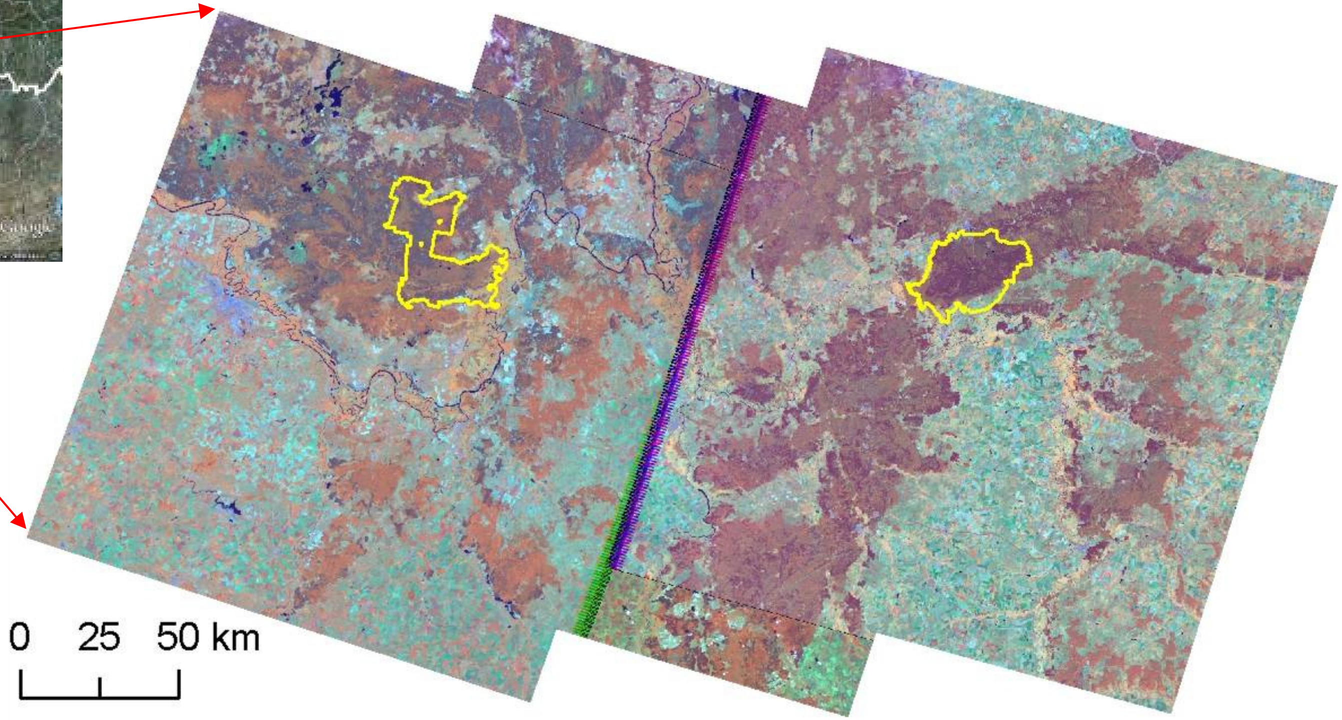
Objectives

- Assessing **rates and patterns of land-use and land-cover change** (LULCC) in European Russia (1984-2010), regarding
  - Farmland abandonment and subsequent forestation
  - Deforestation (wood extraction and natural disturbances)

- Evaluating the **effectiveness of** two strictly **protected areas** in the study region

Study area in European Russia

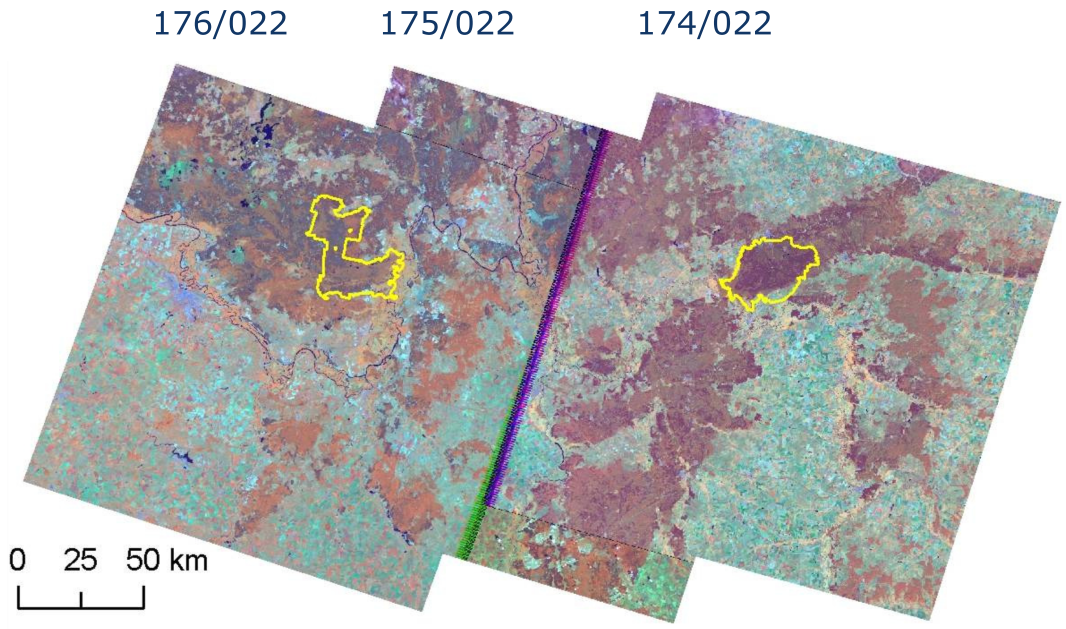
- 70,000 km² in Ryazan Oblast and Mordovia Republic
- Oksky (1935) and Mordovsky (1936) Nature Reserves



Landsat TM-5, false colors 453

Data used

- Landsat imagery



	176	175	174
1984		×	×
1986	×	×	
1987			×
1988	×		×
1989	×	×	
1991	×	×	
1992	×		
1993		×	
1994	×		
1995	×	×	×
1996		×	
1997	×		
1998	×		×
1999	×		
2000	×	×	
2002	×	×	×
2004			×
2006	×	×	×
2007	×	×	×
2009	×	×	
2010	×		×

- Topographic maps
- GIS data: Reserve boundaries, settlements, roads, elevation, etc.

Methods

1) Mapping of land-use and land-cover changes (LULCC)

2) Evaluating the protected area (PA) effectiveness

LULCC mapping - Methods

Landsat imagery
↓
LULCC detection
1) SVM classification
2) Disturbance index
↓
1986-2010:
Farmland abandonment
Deforestation
↓
Validation

- Support Vector Machines (SVM) classification

  5 LULCC classes:
  - Stable agriculture
  - **Abandoned agriculture**
  - Grasslands & Riparian trees
  - Forest
  - Other (Urban areas, water, etc.)

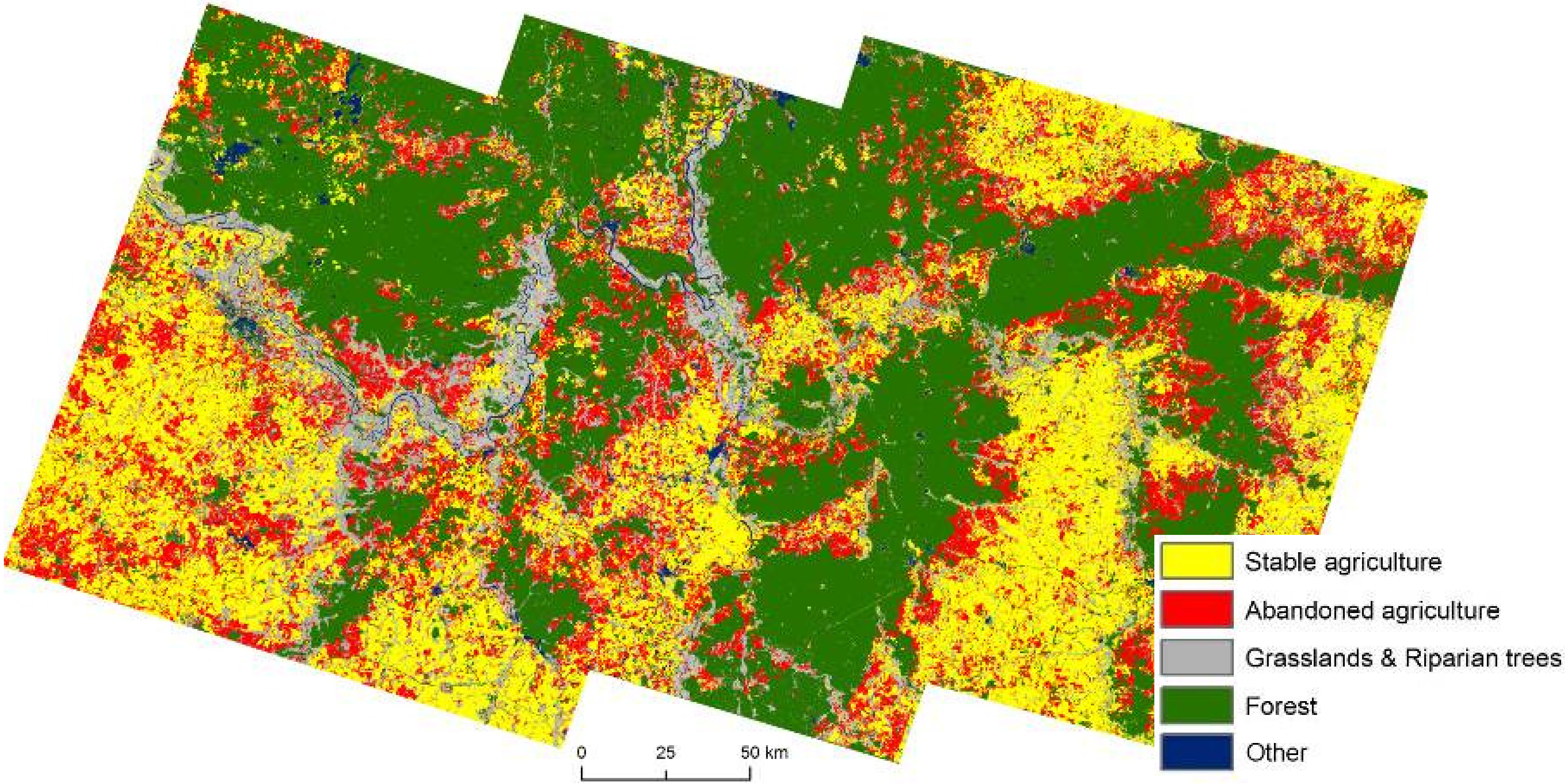
- Forest disturbance index (Healey et al. 2005)

  Detection of:
  - Stable forest
  - **Deforestation**
  - **Forestation**

LULCC mapping - Results

- Farmland abandonment

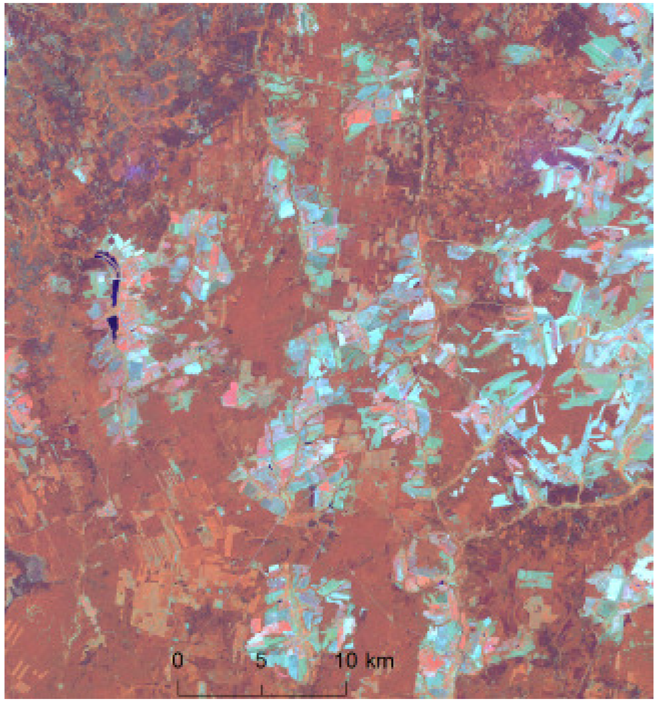
  At least 37% of the farmland in 1988 abandoned in 2010



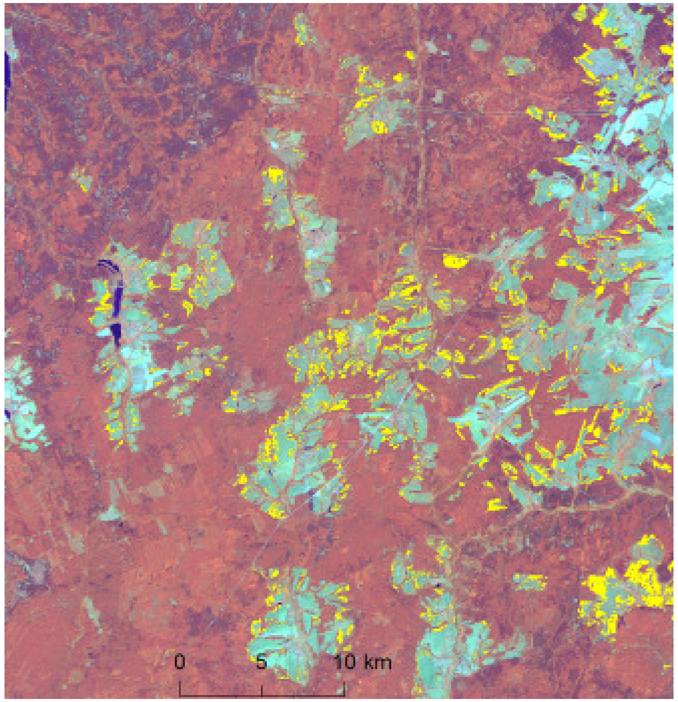
LULCC mapping - Results

- Forest expansion on abandoned farmland

  In 2007, forestation on 6% of the abandoned farmland



1988



2007

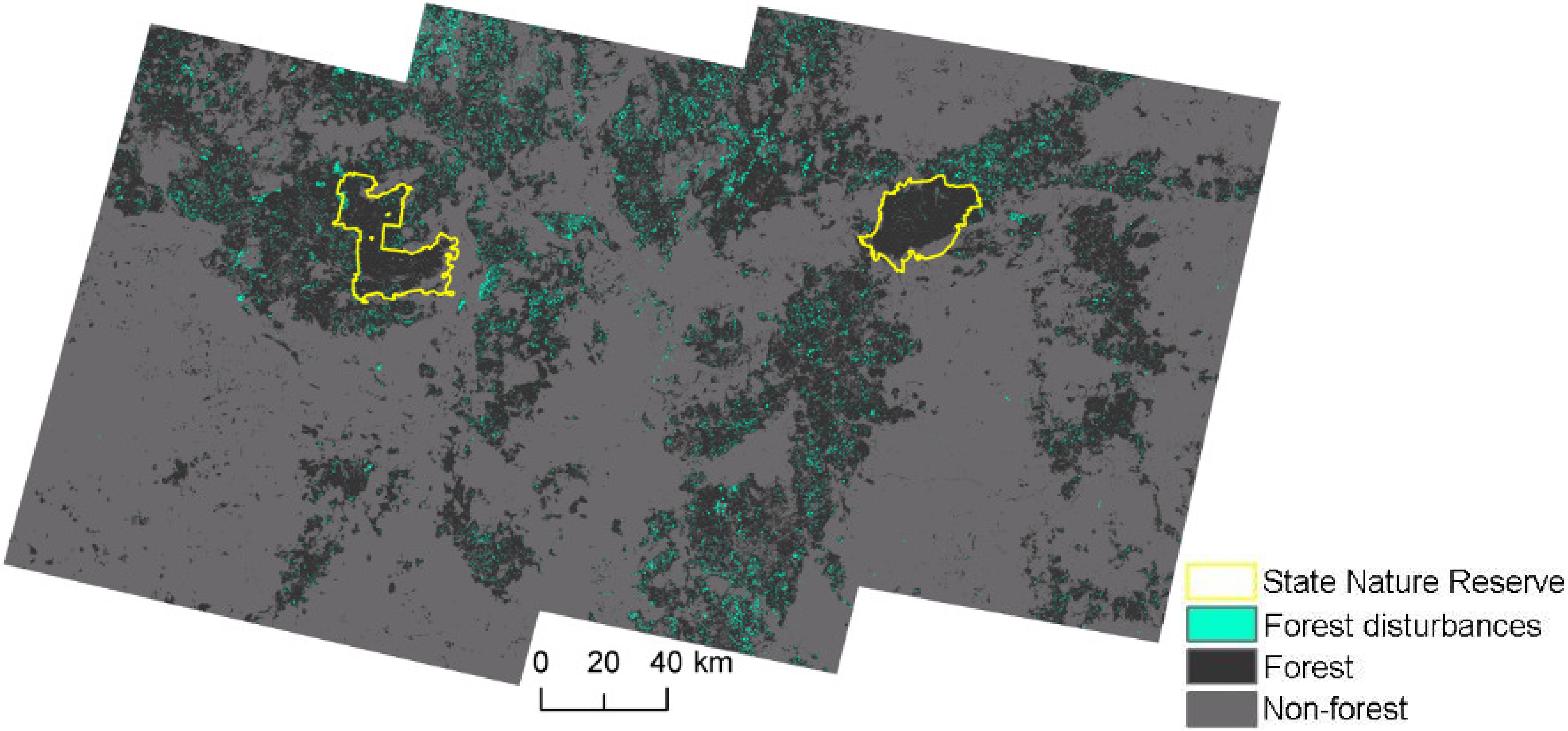
Forest succession in 2007

Landsat TM-5, false colors 453, (19880723 and 20070821)

LULCC mapping - Results

- Forest disturbances

  1984-2010: 7% of the forest area in 1984 (137.257 ha)



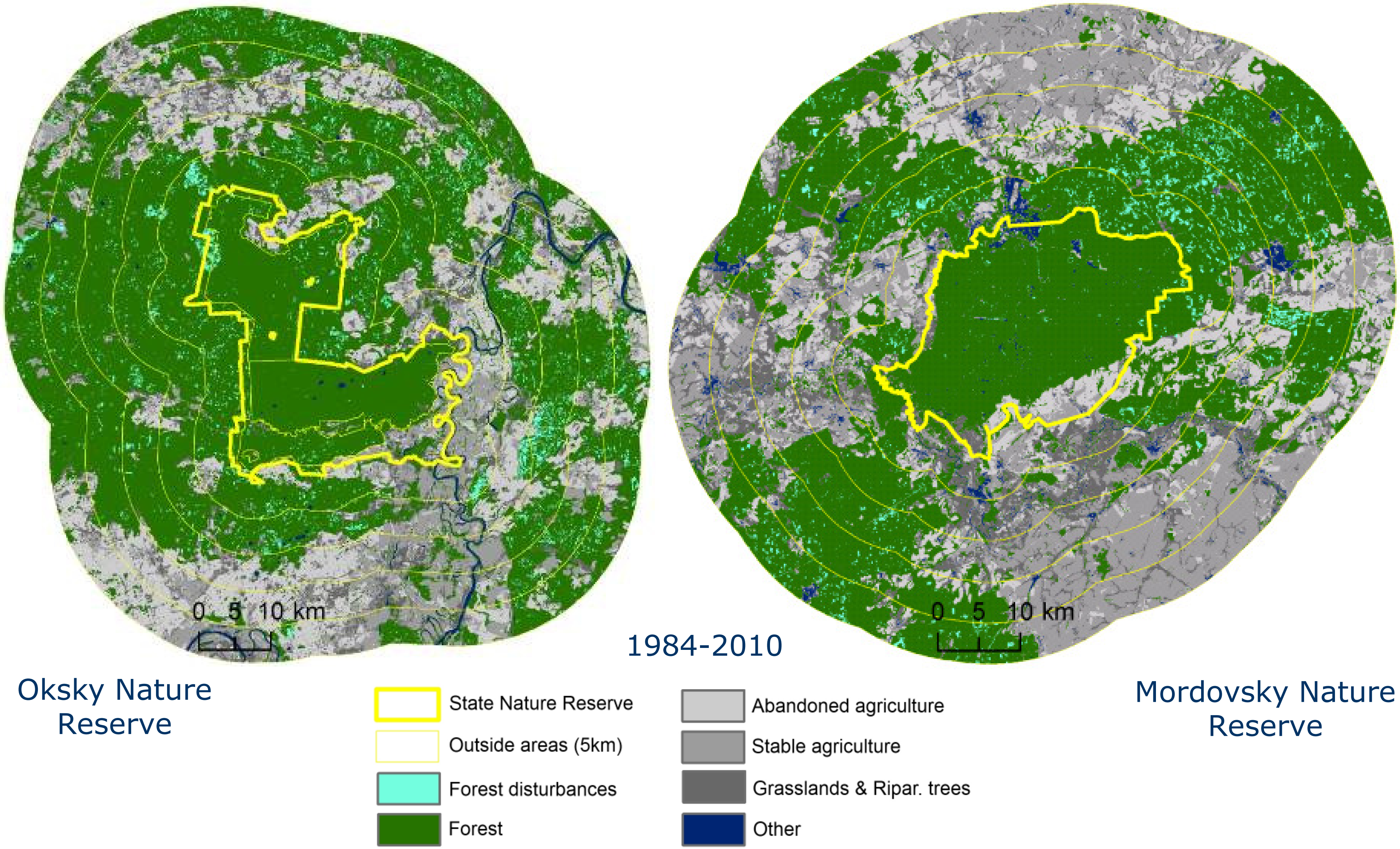
PA effectiveness - Methods

Landsat imagery
↓
LULCC detection
1) SVM classification
2) Disturbance index
↓
1986-2010:
Farmland abandonment
Deforestation
↓
Validation
↓
Protected area effectiveness

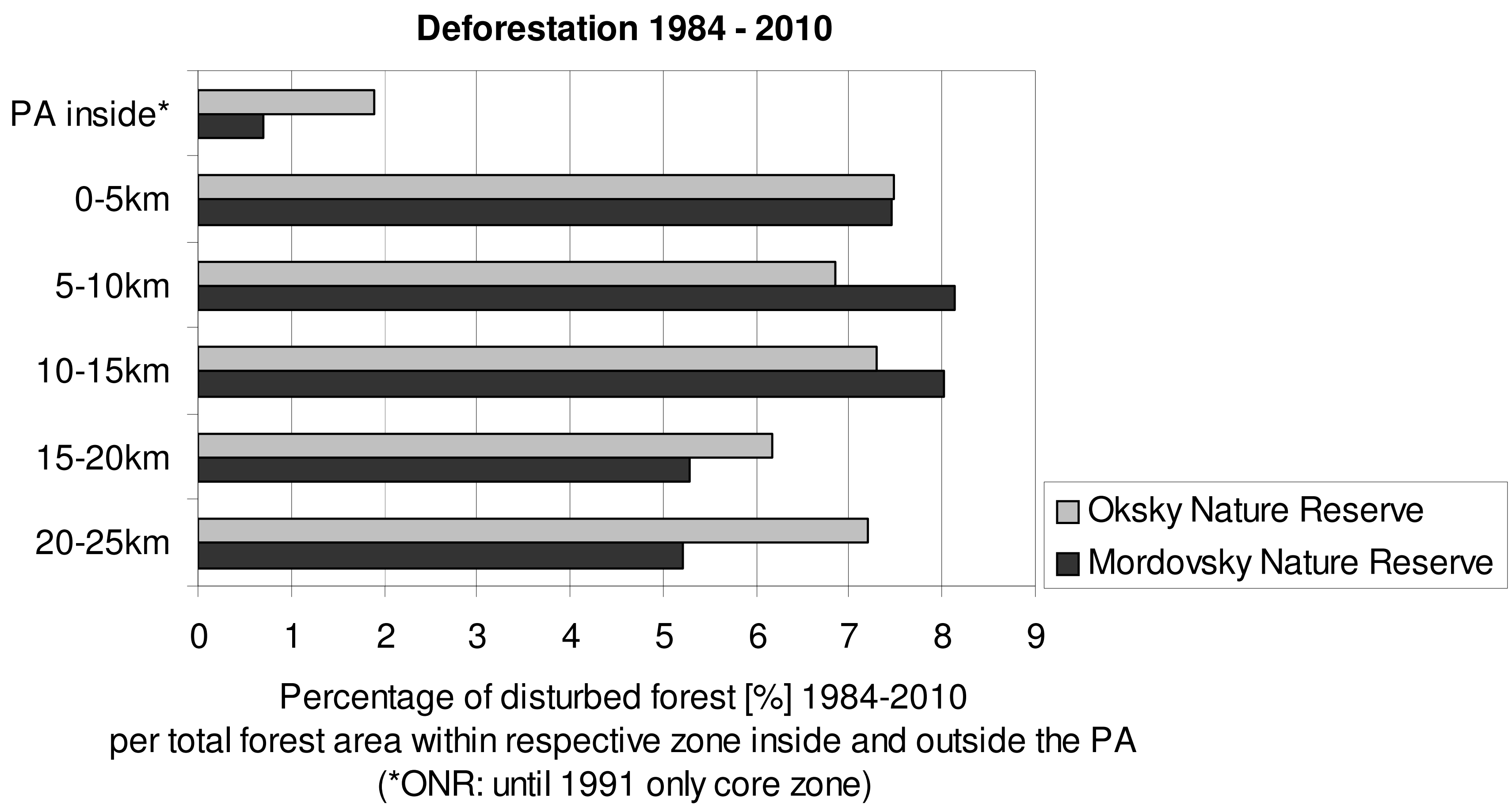
- Inside-outside comparison of deforestation
  - 5km buffer areas

- Matching comparison
  - Comparison of sites with similar characteristics (matching)
  - Post-matching regression
    - Distance to cities and roads
    - Slope and elevation
    - Nighttime lights

PA effectiveness - Results



PA effectiveness - Results



PA effectiveness - Results

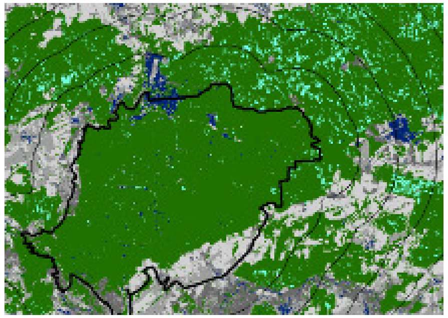
- Matching comparison
  - Mordovsky Nature Reserve (MNR) has a statistically significant effect on preventing forest conversion
  - The pixel inside the reserve have a 2% smaller chance of being converted

Time period	Chance of conversion to non-forest inside MNR in comparison to being outside of MNR		
1990-1995	lower	-3.5 - -1.5	%
1995-2000	lower	-1.0	%
2000-2005	lower	-2.0	%
2005-2010	lower	-1.0	%

Conclusion

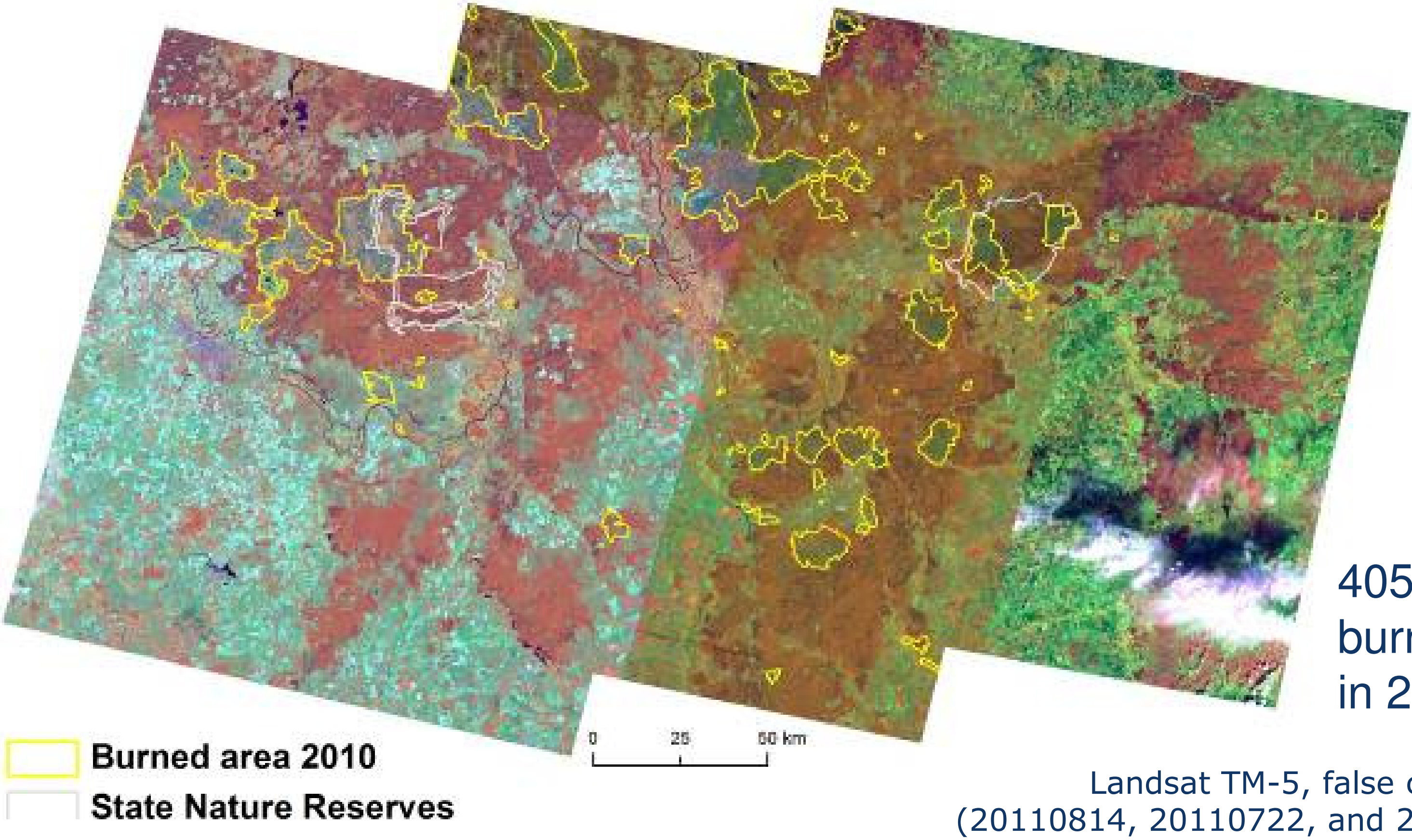
- Extensive LULCC in the study area 1984-2010
  - Widespread farmland abandonment
  - Often conversion to forest
  - High percentage of deforestation

- Protected area effectiveness
  - Oksky and Mordovsky Nature Reserve are effective in preventing changes to forest habitats
  - High percentage of human-induced deforestation in surrounding areas
  - Zone of interaction is strongly affected



Conclusion

- But: Natural disturbances can also have an enormous impact on habitats



405,298 ha burned area in 2010

Landsat TM-5, false colors 453
(20110814, 20110722, and 20100930)

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