

Land use change after the collapse of the Soviet Union and its effects on protected areas and large mammal populations

Eugenia V. Bragina^{1,2}, A. Sieber³, T. Kuemmerle³, P. Potapov⁴, S. Turubanova⁴, A. Tyukavina⁴, M. Hansen⁴, M. Baumann¹, A.M. Pidgeon¹, K.J. Wendland⁵, A.V. Prishchepov⁶, A.R. Ives⁷, N. Keuler⁸, L.M. Baskin⁹, V.C. Radeloff¹

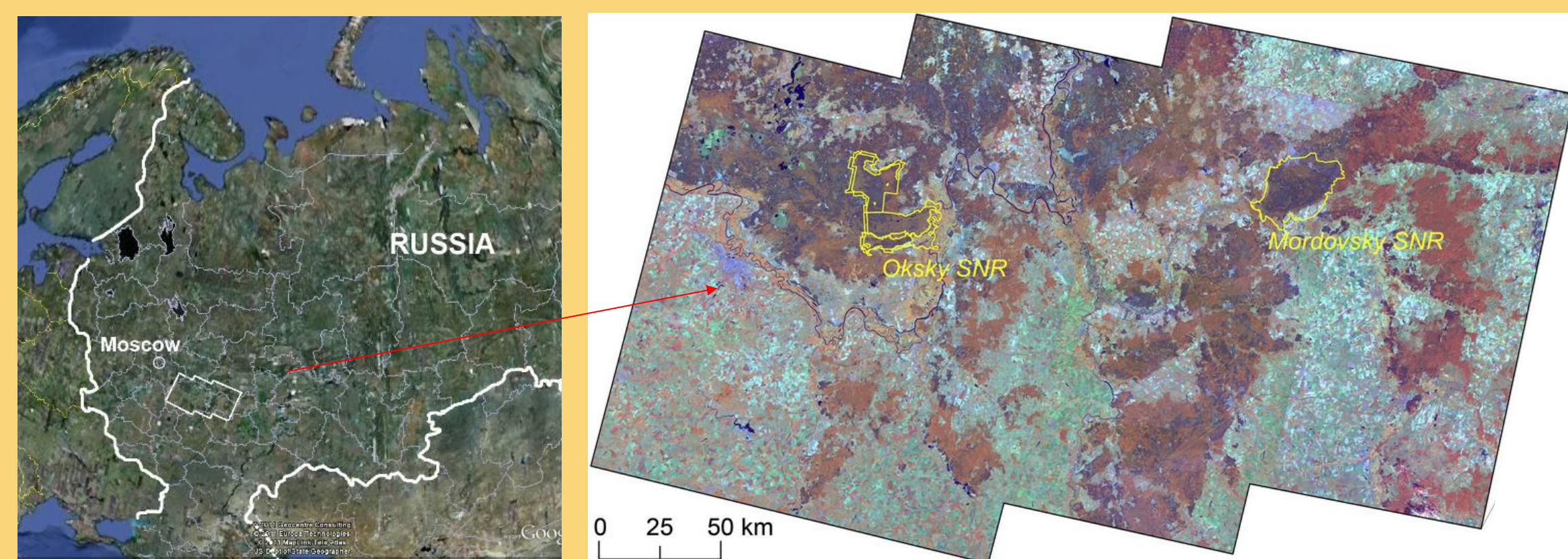
Protected area effectiveness

How effective were Russian protected areas during economic downturns given lack of funding and low enforcement levels?

Goal: Evaluation of the effectiveness of Russian protected areas before and after collapse of the socialism through changes in forest cover

Approach

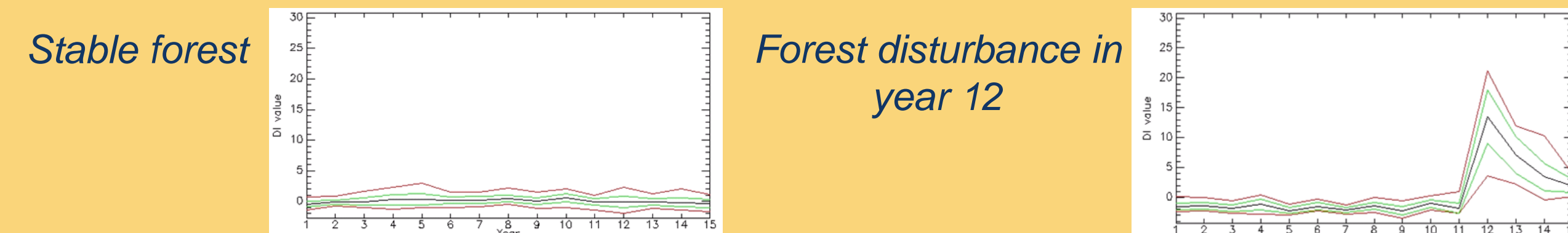
- Location: Oksky and Mordovsky strictly protected state nature reserves
- Data: Landsat footprints 174-175-176/22; 1985-2010



- Support Vector Machine classifications
- Trajectory analysis of forest disturbance index (DI) (Healey et al. 2005)

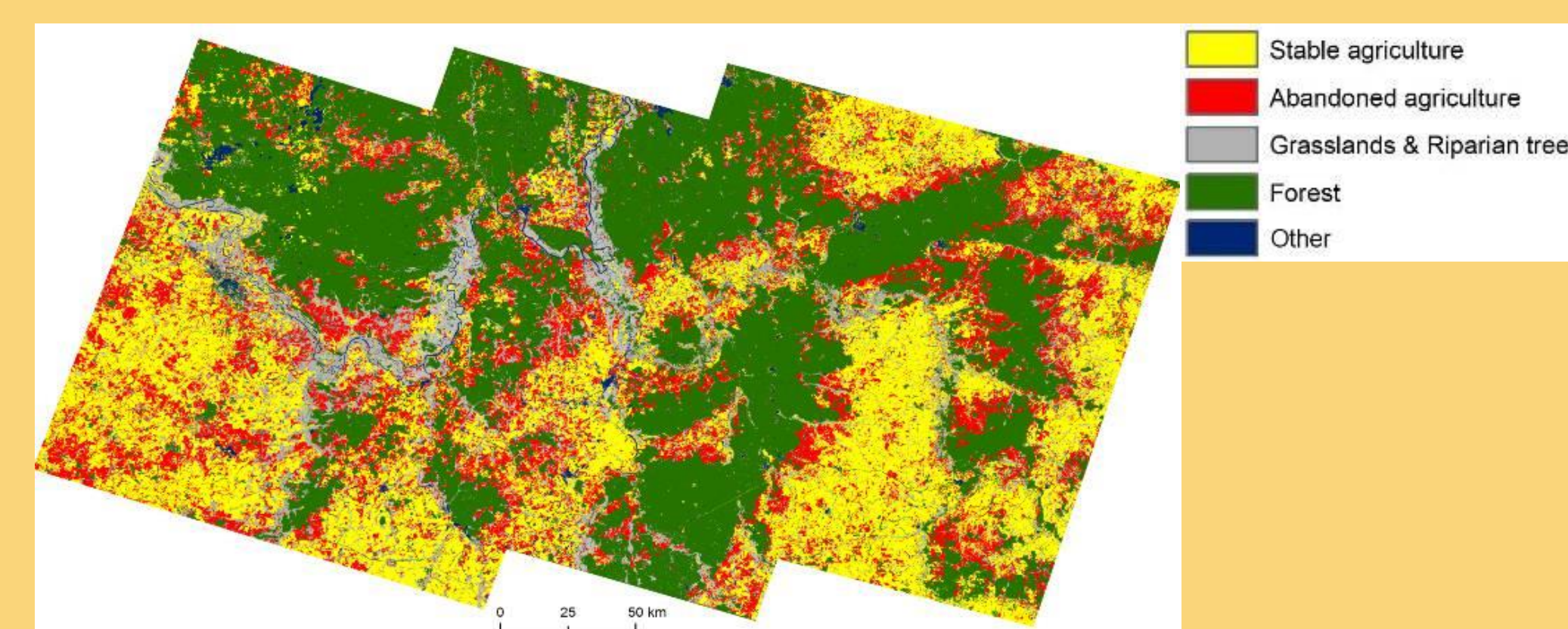
disturbance index < 2 → forest (undisturbed across time)

disturbance index ≥ specific threshold → non-forest (forest disturbance)

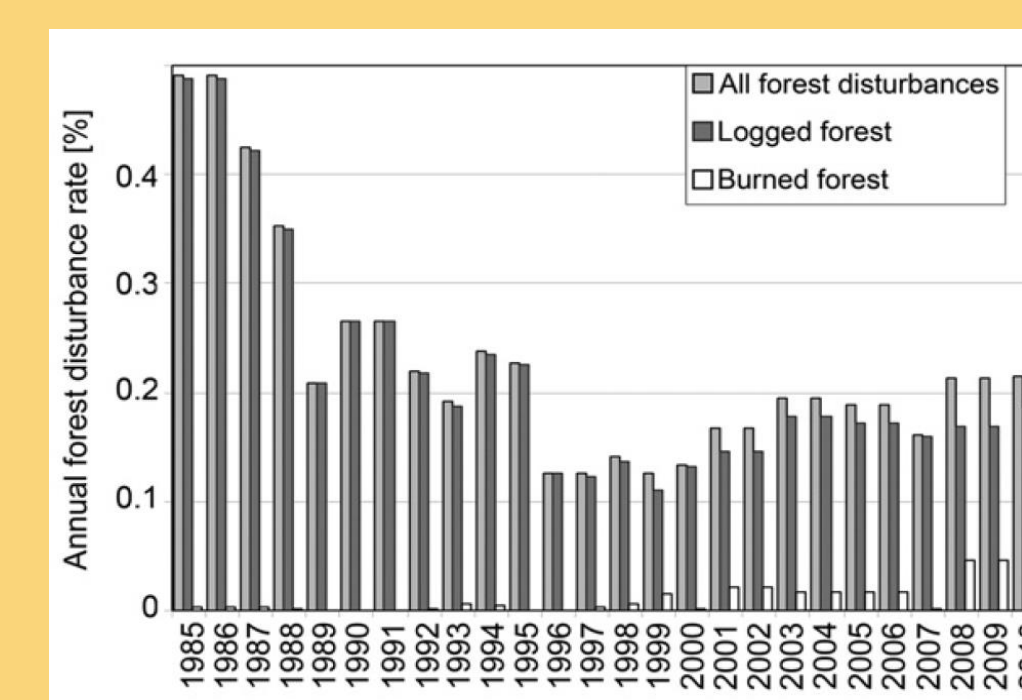


Results

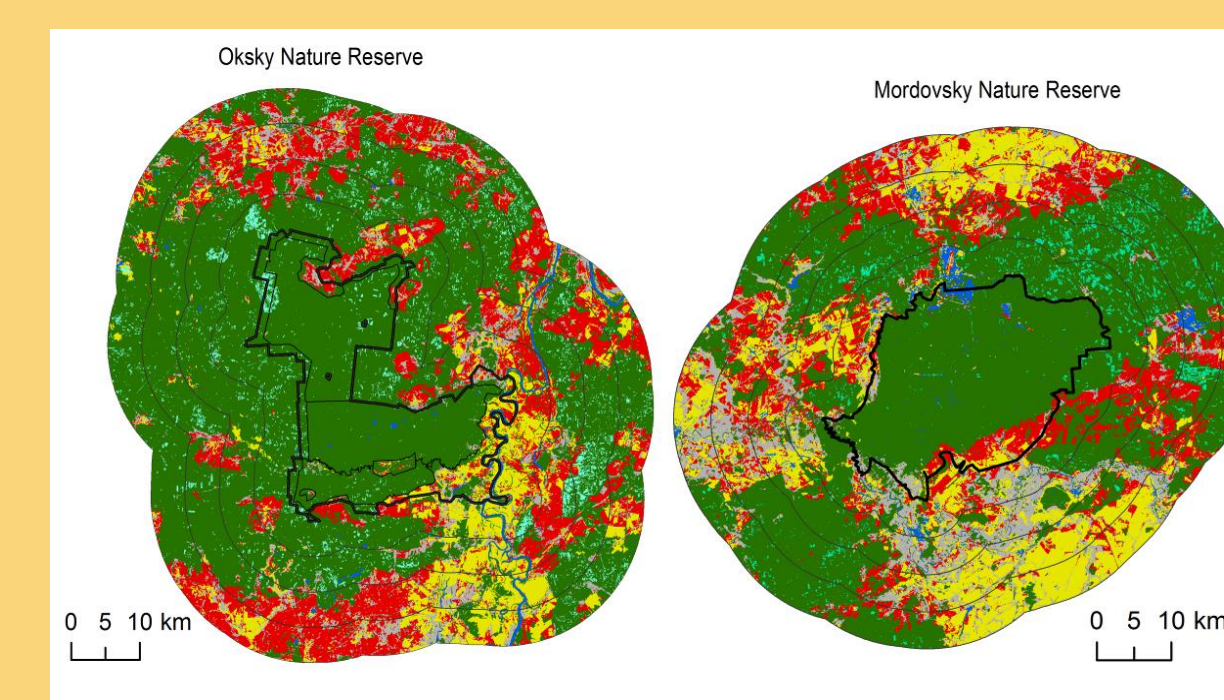
- About 40% of the 1988 farmland abandoned by 2010



- Forest disturbance *inside* Oksky 1.81%, *outside* 6.15%; *inside* Mordovsky 0.5%, *outside* 5.21%
- Lower forest disturbance rate in the 1990s (Sieber et al. 2013)



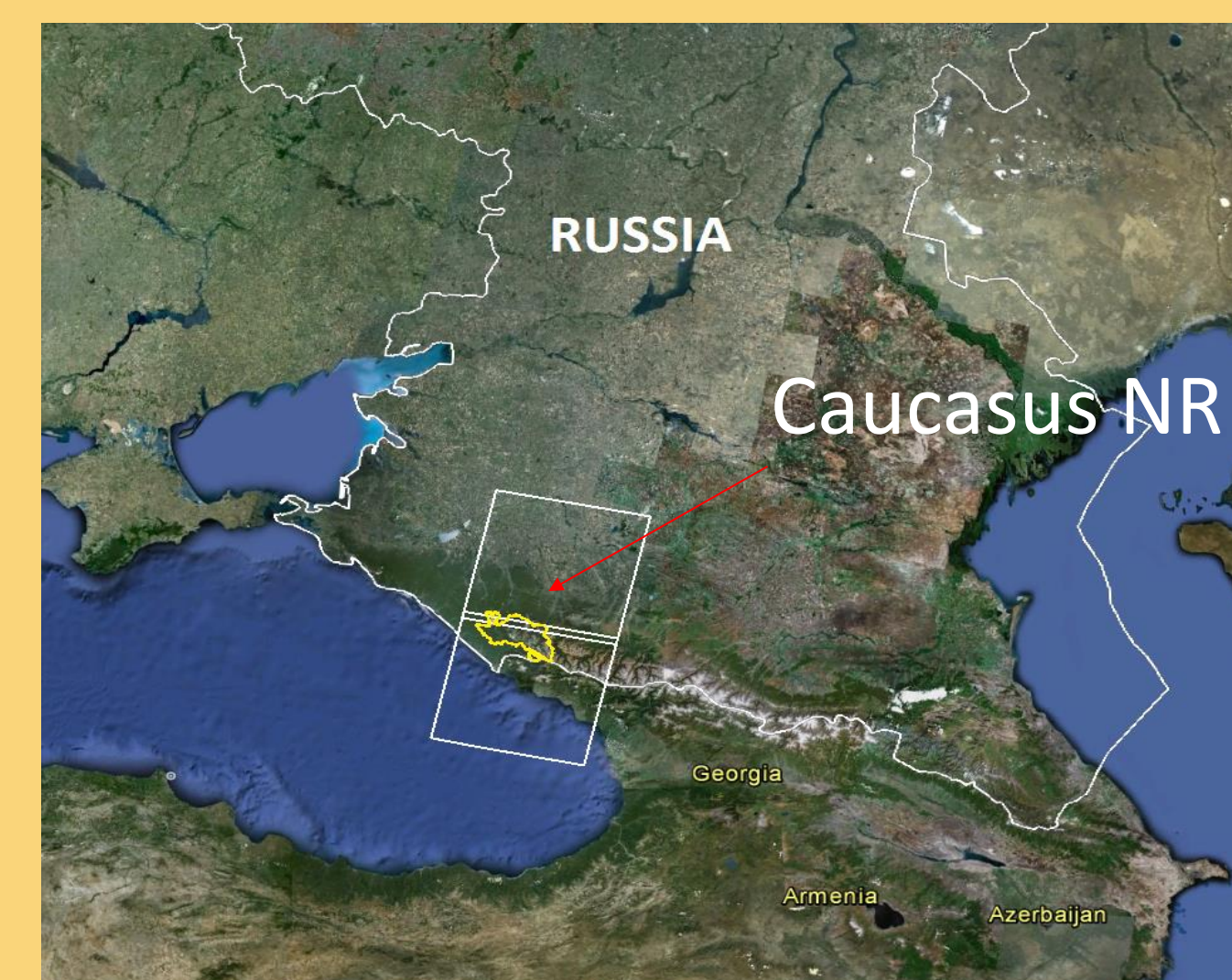
Annual forest disturbance rates (% of 1984 forest)



Forest disturbance detection

Approach

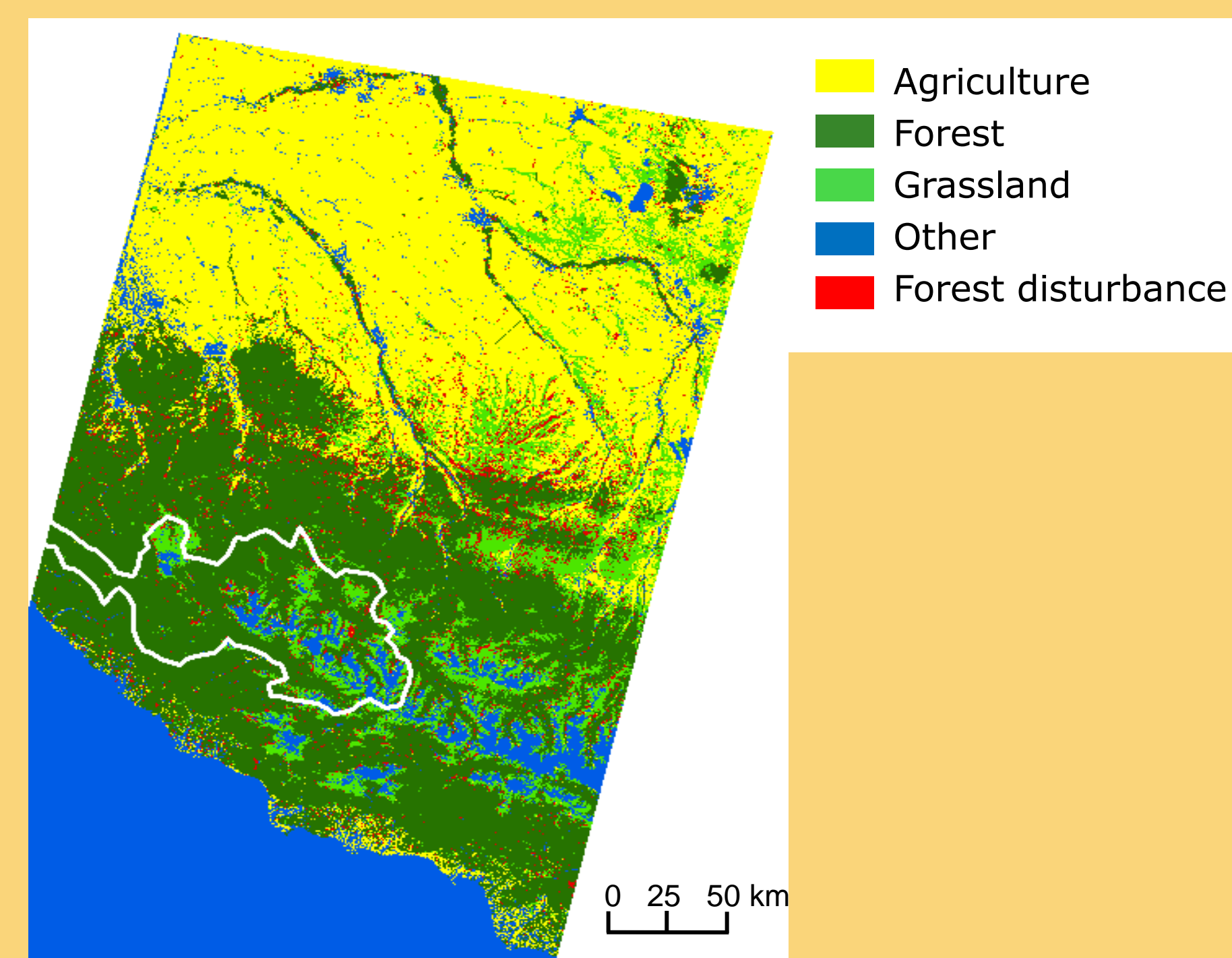
- Location: Caucasus strictly protected state nature reserve
- Data: Landsat footprints 173/29-30; 1985-2010



- Support Vector Machine classification
- Four classes: forest, agriculture, grassland, and meadows
- Post-classification comparison. Forest either converted to (1) agriculture, (2) grassland, or was (3) disturbed

Results

- Forest disturbances *inside* nature reserve was 7.03%
- Forest disturbances *outside* nature reserve was 12.3%



Forest disturbance in European Russia

Logging in boreal and temperate forests is a major source of carbon emissions, but region-wide forest disturbance information is lacking.

Goal: Map region-wide Forest cover and disturbance with an automatic Landsat data processing, compositing and classification algorithm

Approach

- Location: Northern European Russia



- Data: USGS archive of Landsat TM/+ETM
- Forest disturbance detection in 1990-2000 (Yaroshenko et al., 2008):

Per-image change detection using SWIR band difference threshold and unsupervised clustering

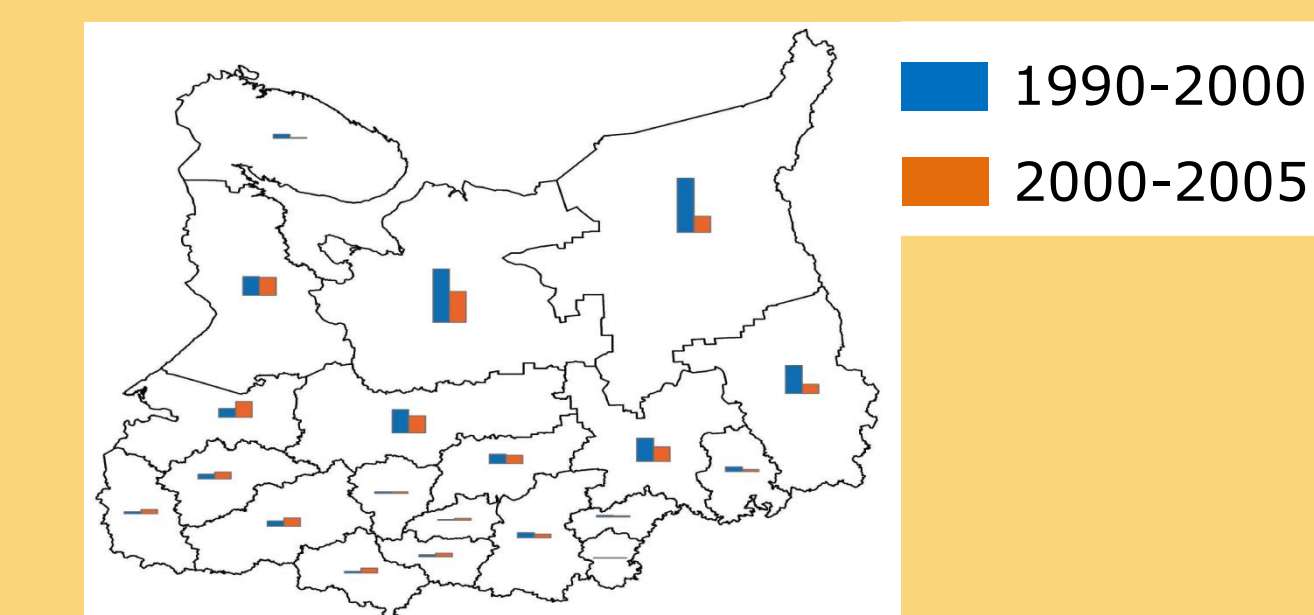
- Forest disturbance detection in 2000-2005 (Potapov et al., 2011):

Forest cover and change mapping using supervised classification tree algorithm and cloud-free image composites for 2000 and 2005

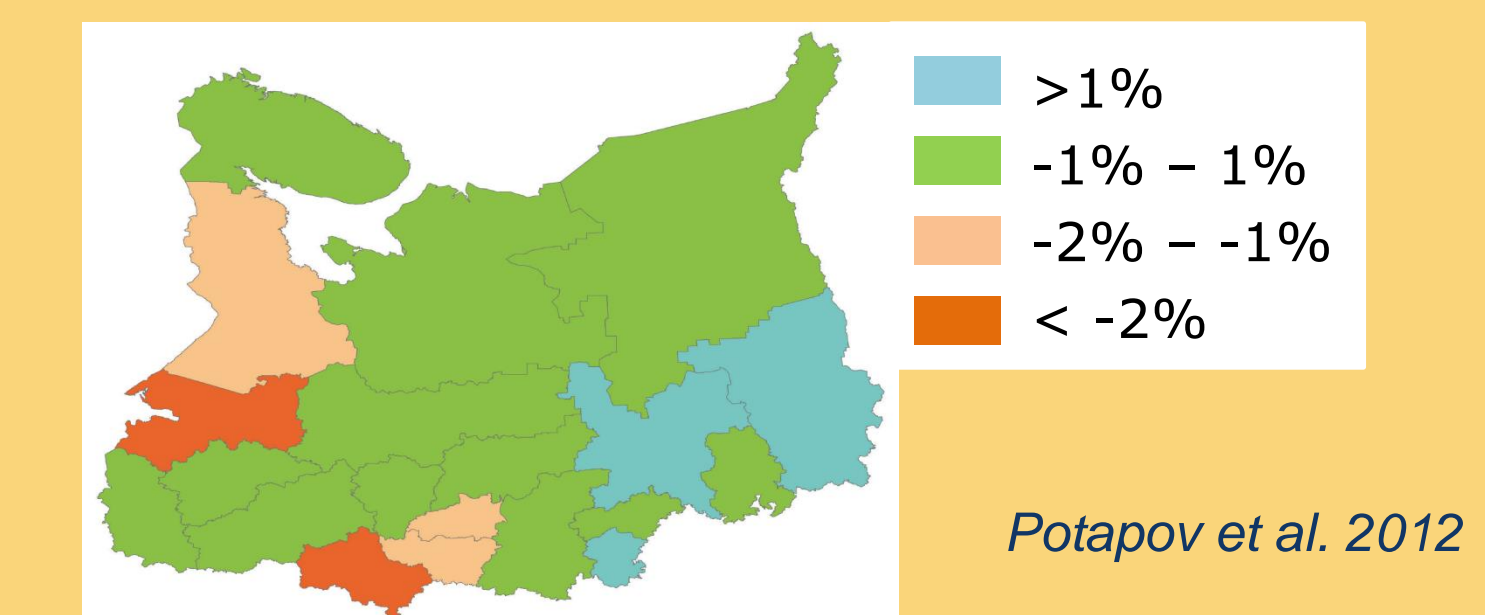
- Forest disturbance detection in 2000-2012: Annual forest cover change mapping using multi-temporal spectral metrics and annual cloud-free image composites

Results

- Logging contributes 89% of total forest cover loss
- The most populated regions had the highest rates of forest loss
- Between 1990-2000 and 2000-2005: Annual gross forest cover loss decreased from 528 to 402 ha*1000/yr
Annual logging area decreased by 33%
Logging increased within the Central and Western parts
Annual burned forest area increased more than 50%

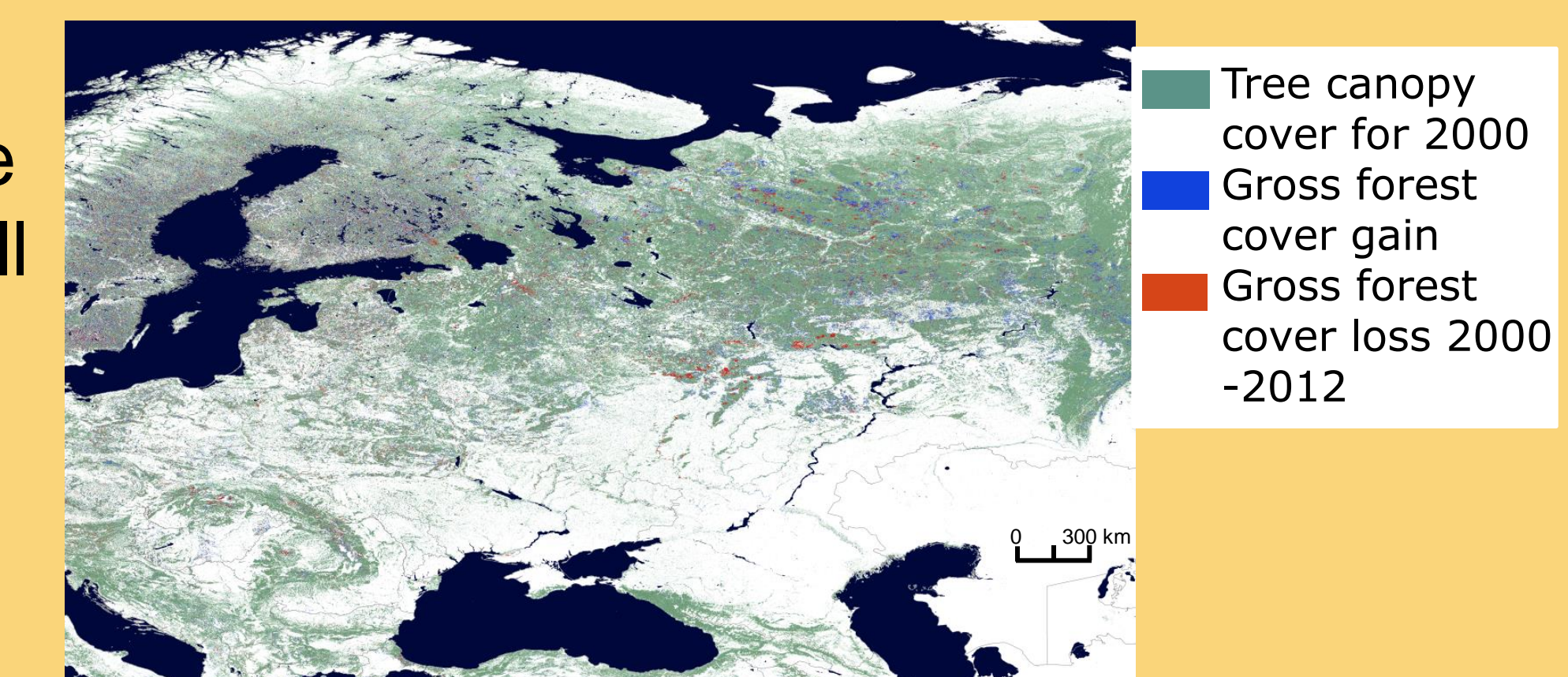


Annual gross forest cover loss attributed to logging



Net forest cover change 2000-2005, as % of forest cover for 2000

- Work in progress: forest cover change for 2000-2012 for all of Eastern Europe



Large mammals population trends after the collapse of the Soviet Union

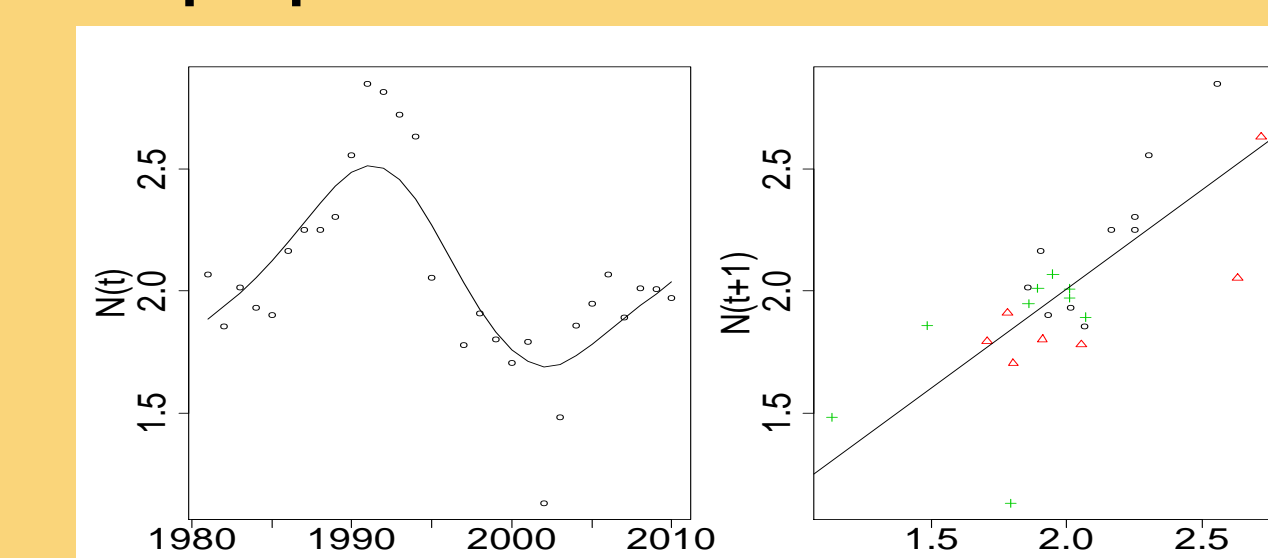
How do socioeconomic shocks affect wildlife? Quantitative evidence is sparse.

Goal: Examination of population trends of large mammal species in Russia before and after the collapse of socialism

Approach

- Winter Track Count data: annual survey of animal tracks since 1964 on up to 50,000 transects per year
- We analyzed wildlife population densities for all of Russia and for each administrative regions
- Models $N(t+1) = a + b \cdot N(t)$ for each region
- Positive residuals indicate population increases
- Negative residuals indicate population declines

Wild boar populations in Pskov region (left), and fitted model with residuals for 1980s (black), '90s (red) and '00s (green)



Results

- Most large mammal populations declined very rapidly after the collapse of socialism in 1991
- Only wolf increased after 1991
- After 2000 most species rebounded

Wildlife populations trends in Russia relative to 1991 populations

