Post-socialist land use and land cover change in the Carpathians

Assessing the importance of socio-economic and political factors on landscape dynamics and biodiversity

Patrick Hostert*, Tobias Kuzemerlija, Jan Knorn and Volker C. Radeloff

* Geomatics Department, Humboldt-Universität zu Berlin (Germany), 2 Department of Forest Ecology and Management, University of Wisconsin-Madison (USA)

The Carpathians are a hotspot of biodiversity, ecologically relatively homogeneous, yet heavily dissected by political borders.

Cross-border comparison of landscape dynamics and biodiversity in this mountain range.

Data

- Landsat TM and ETM+
- Preprocessing of Landsat data
- Semi-automatic geometric rectification based on correlation window
- Atmospheric correction and topographic normalization based on radiometric transfer modeling

Classification

- Multitemporal data
- Tasseled Cap Transformation + Principal Components
- Hybrid classification

Landscape pattern

- Landscape metrics
- Spatially explicit fragmentation measures

Results

- Our analyses revealed substantial differences in land cover and landscape pattern which we suggest can be attributed largely to differences in broad-scale socio-economic and political factors
- Forest cover and composition varied considerably. Forest cover is highest in Poland, likely due to afforestation and natural succession after the forced depopulation of some areas in 1947. In Ukraine, Soviet forest management resulted in widespread replacement of natural forest with coniferous species
- Concerning agriculture, land tenure in socialist times and post-socialist land reforms are important to explain land cover and to understand LUCC
- Land abandonment is common on formerly state owned land (virtually all land in Ukraine and some areas in Poland)
- Agricultural fragmentation is highest where private land ownership was allowed in socialist times (Poland) and where state farms were dissolved and the land was made available to the people (Ukraine)

Publications


Next steps

- Quantitative land cover change analysis
  Stage 1: Change detection
  Stage 2: Classification into change classes
- Spatially explicit assessment of changes in forest fragmentation based on Rüttiger’s fragmentation measures
- Quantification of changes in agricultural fragmentation using texture measures and image segmentation
- Cross-border comparison of landscape dynamics

Post-socialist land cover change

Widespread conversion of arable land to grassland and shrubland in Ukraine.

Extensive agricultural restructuring and fragmentation in the Ukrainian region of the study area. (principal components of three photographically different Landsat TM and ETM+ images for each time period: band combination B+3, B+5, B+2)

Land abandonment on former state farms in the Polish region of the study area.

Extensive clear cutting in the Ukrainian Carpathians.

Forest regrowth and small clear cuts in the Carpathians.

Cross-border studies

Land Cover Map for the Year 2000

Fragmentation Components

Total Forest

Available Land

Collaborators

- Dr. Kajetan Perzanowski
  Polish Academy of Sciences, Poland
- Dr. Daniel Mueller
  Humboldt-Universität zu Berlin, Germany
- Dr. Bogdan Zagajewicz
  Warsaw University, Poland

Background & Project Summary

- The economic and political transition has resulted in extensive land-use and land-cover changes (LUCC) in Central and Eastern Europe
- Main processes of LUCC include land abandonment and secondary succession, agricultural fragmentation, and forest cover changes
- The transition period since 1990 can be interpreted as a natural experiment that may help to assess the importance of socio-economic and political factors
- Comparative analyses in environmentally homogeneous border regions are particularly promising, because differences in land cover and landscape pattern are likely due to differences in policies and institutions

Objectives

- Cross-border comparison of contemporary land cover and landscape pattern using Landsat data
- Assessing post-socialist LUCC as well as changes in landscape pattern and fragmentation
- Relating possible differences in landscape dynamics between countries to dissimilarities in political and socio-economic boundary conditions
- Parameterizing a landscape model that considers political and socio-economic determinants and facilitates scenario generation
- Assessing consequences of landscape changes for biodiversity and ecological diversity using ecosystem indicators and habitat modeling of umbrella species

Further reading

- Geomatics Department - Humboldt-Universität zu Berlin
  Unter den Linden 6, 10099 Berlin, Germany  |  tel. +49 (30) 2093 6805 |  fax. +49 (30) 2093 6835  |  firstname.lastname@geo.hu-berlin.de |  web: www.hurs.de

- Geomatics Department, Humboldt-Universität zu Berlin (Germany)