

200 years of land use and land cover changes and their driving forces in the Carpathian Basin

Land use is a major aspect of global environmental change, but most land cover and land use change (LCLUC) research has examined deforestation, and assessments of agricultural LCLUC have focused on frontier conversions in the tropics. Less is known about agricultural change in regions with long land use histories. We propose to study long-term agricultural change in the Carpathian Basin (i.e., the Pannonian Plain and the Carpathian Mountains) in Central and Eastern Europe, a region that has experienced several major socio-economic transformations during the 19th and 20th centuries (i.e., WW I; the end of the Austro-Hungarian Monarchy; WW II; the rise and fall of socialism; and the eastward expansion of the European Union). These transformations have triggered drastic LCLUC, rendering the region a hotspot of agricultural land use change. Our proposal will contribute to both components of the NRA: we will detect patterns of agricultural LCLUC in a rapidly transforming region and we will provide novel insights into drivers of agricultural land use change in response to major institutional, economic and societal changes.

Our first goal is to improve knowledge about long-term agricultural land use change by reconstructing historic land use change since the mid 1800s for a comprehensive sample of case study regions across the Carpathian Basin. Our objectives are to:

- Map long-term land use change from historic military topographic maps from the 1840s, pre WW I (1890s), pre WW II (1930-40s), and the 1960-70s, for forty 100 km² case study regions, focusing on farmland expansion, agricultural abandonment and cropland-pasture transitions
- Quantify long-term agricultural LCLUC and analyze changes in the fragmentation of agricultural land.

Our second goal is to quantify the rates and patterns of recent agricultural change from satellite imagery. Our objectives are to:

- Map agricultural land and its changes in 1979, 1989, 2000, and 2010 for the entire Carpathian Basin (397,400 km²) using Landsat MSS/TM/ETM+ imagery
- Develop new approaches to quantify changes in agricultural intensity with dense Landsat image time stacks and map changes in the case study regions
- Map changes in agricultural fragmentation using image segmentation and image texture measures.

Our third goal is to understand the drivers of recent agricultural change. Our objectives are to:

- Use geographically weighted regression models to understand the drivers of recent agricultural change across the entire Carpathian Basin
- Build spatially explicit panel data models to analyze the drivers of long-term agricultural change such as the environmental conditions, agricultural production, socio-economics, population, and land use legacies
- Use propensity score matching to isolate the effects of different ownership regimes during socialism, land reform strategies, and EU accession on agricultural land use change.

Besides these scientific goals, our project will further strengthen collaborations among American, Hungarian, Polish, Slovak, Swiss, and German scientists, and ensure maximum synergy among our research activities.

Patterns and processes of agricultural LCLUC are poorly understood, especially in regions with long land use histories. Similarly, we know little about the effects of drastic socio-economic and institutional transformations in triggering non-linearity in land use transitions, and the role of land use legacies. Our proposed research thus will make a substantial contribution to the basic understanding of socio-ecological systems and its relevance will far exceed the geographic scope of our work. Our research will pertain to three of the major international programs supported by the LCLUC program, specifically GOF-C-GOLD, the IGBP-IHDP Global Land Project, and NEESPI. At the same time, this proposed work will contribute to the LCLUC program goals, NASA's mission, and support several GOESS societal benefits.