

Drivers and effects of long-term land use changes on climate, environment and socioeconomy in Central Europe

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Introduction

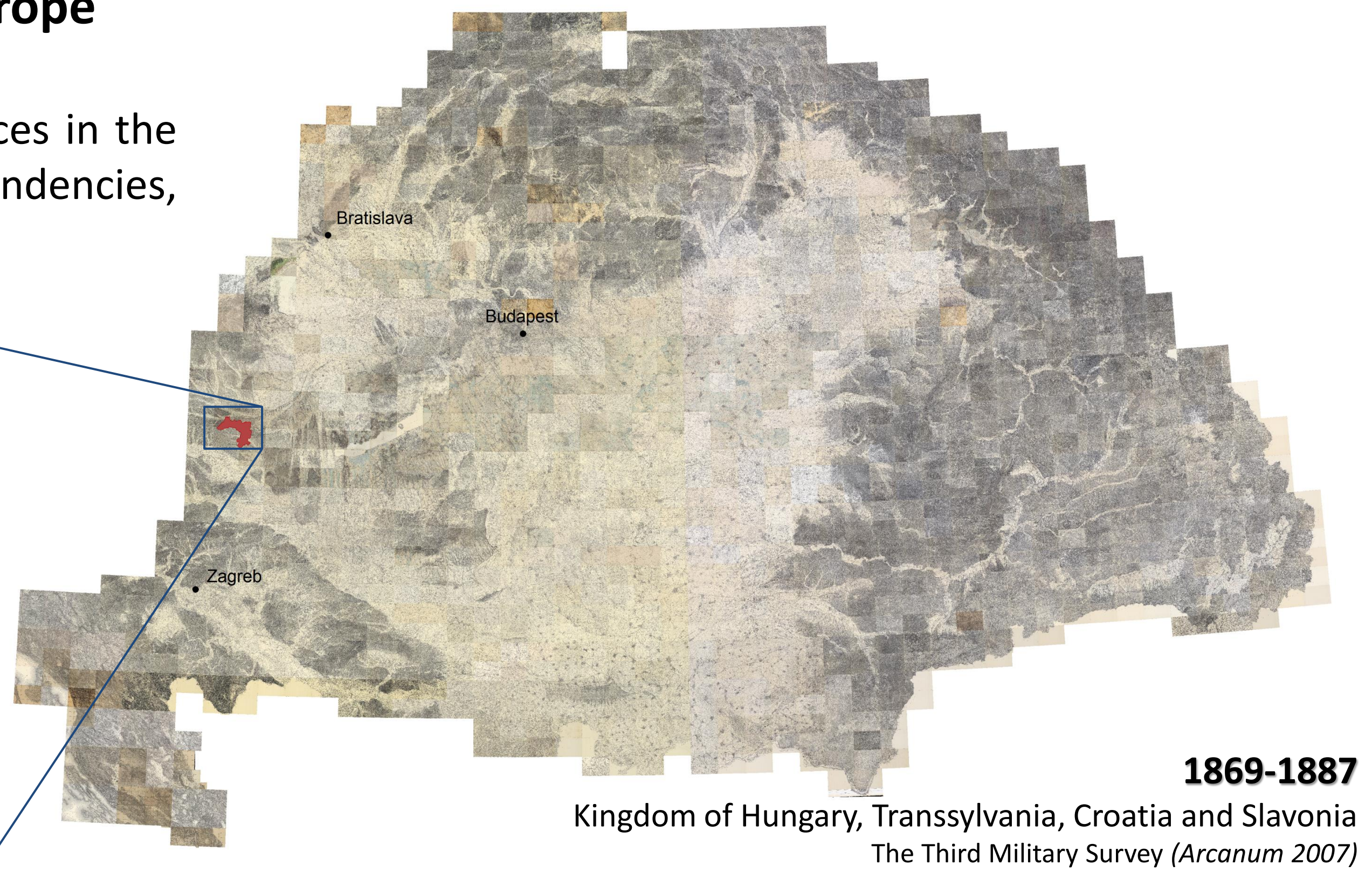
A unique opportunity to analyse long-term land use changes has opened by the analysis of digitalised and georeferenced historic maps. Military surveys depicting the land cover and land use types are available from the end of the 18th century, and give a comprehensive dataset for the whole territory of the Carpathian Basin. GIS processing of the map series provides an excellent basis for historical land cover reconstruction and for the analysis of long-term land cover and land use changes. Projects presented here help to understand the effects of land cover changes on regional and global environmental processes.

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

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This international project subsidied by NASA will start in 2011. It is focusing on agricultural land use change and its driving forces in the Carpathian Basin. Another important aim is to create regional and global spatial econometric models based on land cover tendencies, environmental, agricultural, socio-economic, population, and land use legacy variables.

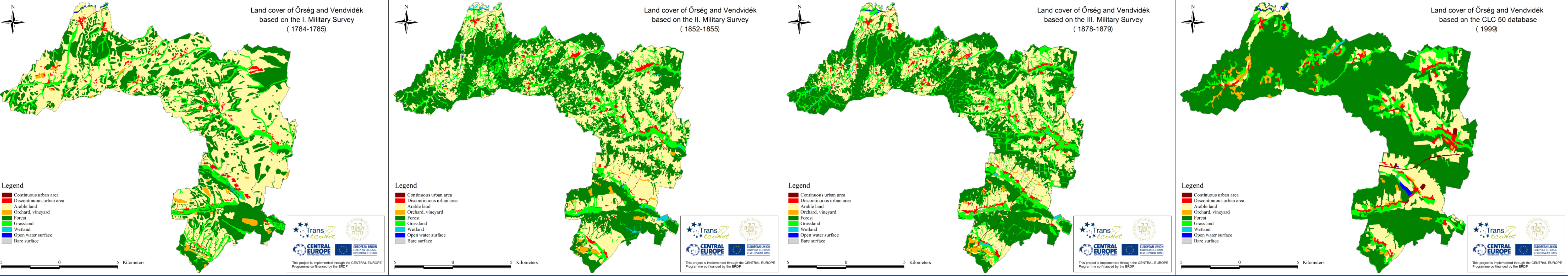
Samples of historical maps in South-western Hungary



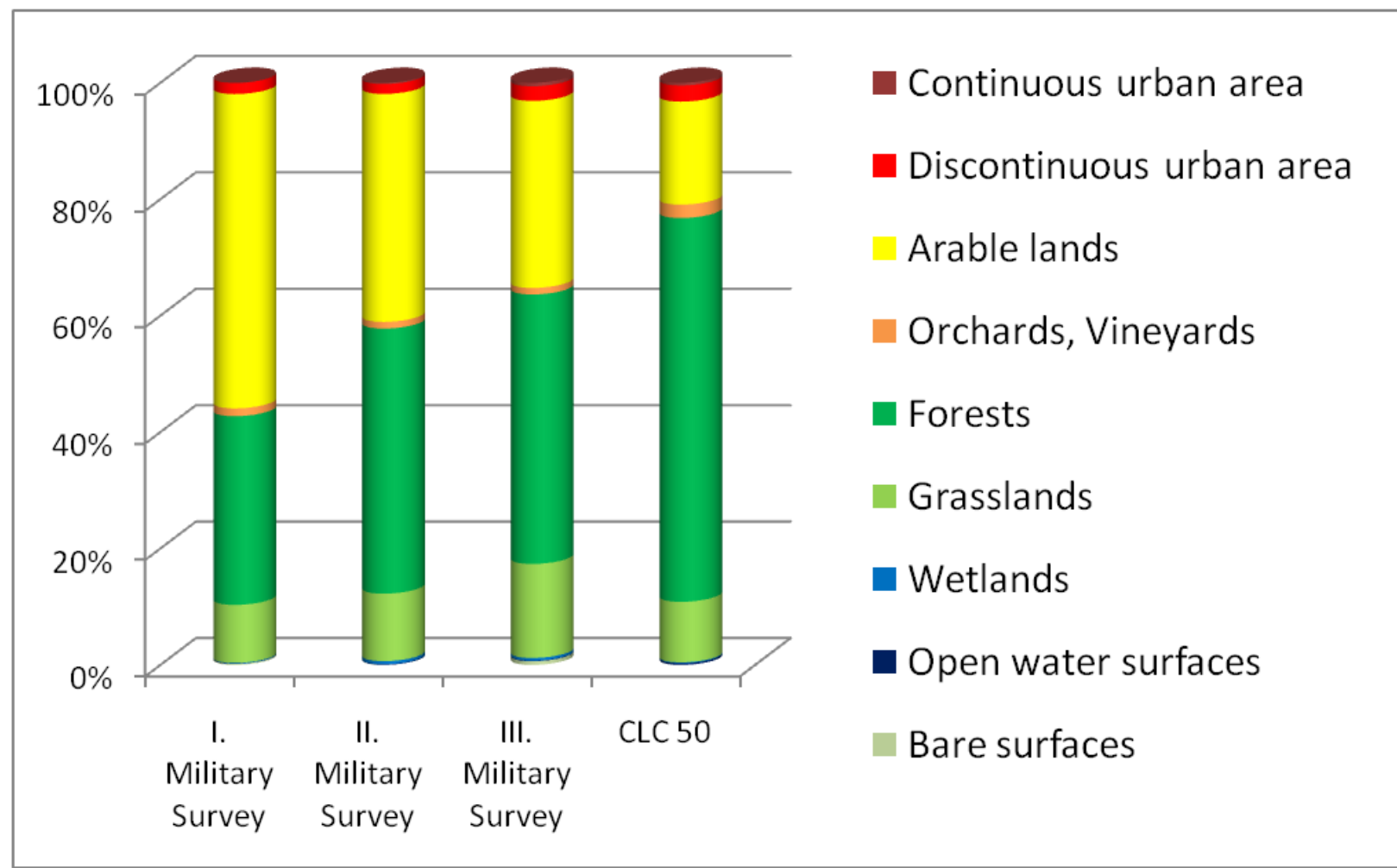
Transnational Ecological Network in Central Europe

Within the framework of the TransEcoNet project land cover and landscape change of two Hungarian focus areas have been assessed to evaluate the change of transboundary ecological networks on the Austrian and the Slovenian borderlands of Hungary. Both quantitative cartographic and qualitative sociological methods have been applied to compare the results drawn from the GIS analysis of historical maps with those of the public perception based on semi structures interviews.

Historical land cover maps of the South-western Hungarian study area called Őrség and Vendvidék



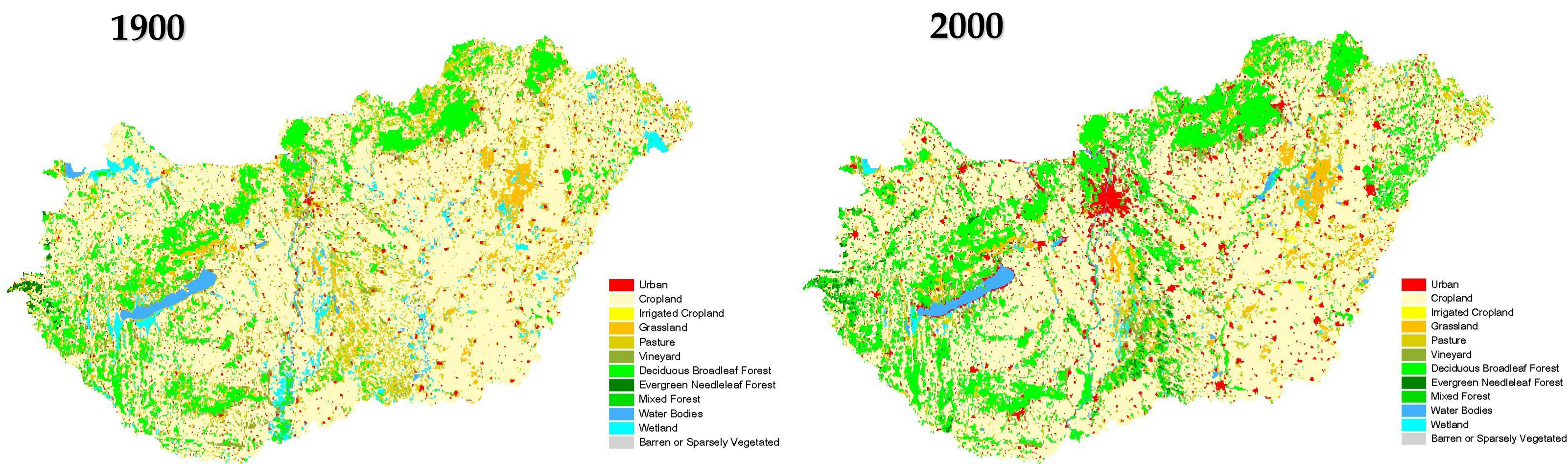
Land cover tendencies in Őrség and Vendvidék (1784-1999)



- The extent of arable lands and grasslands has significantly decreased, they have been replaced by forests.
- Forest areas have almost doubled. The mosaic-like landscape structure has been significantly diminishing and today large forest patches can be observed.
- Proportion of built-up areas have increased, the characteristic small villages have been growing.

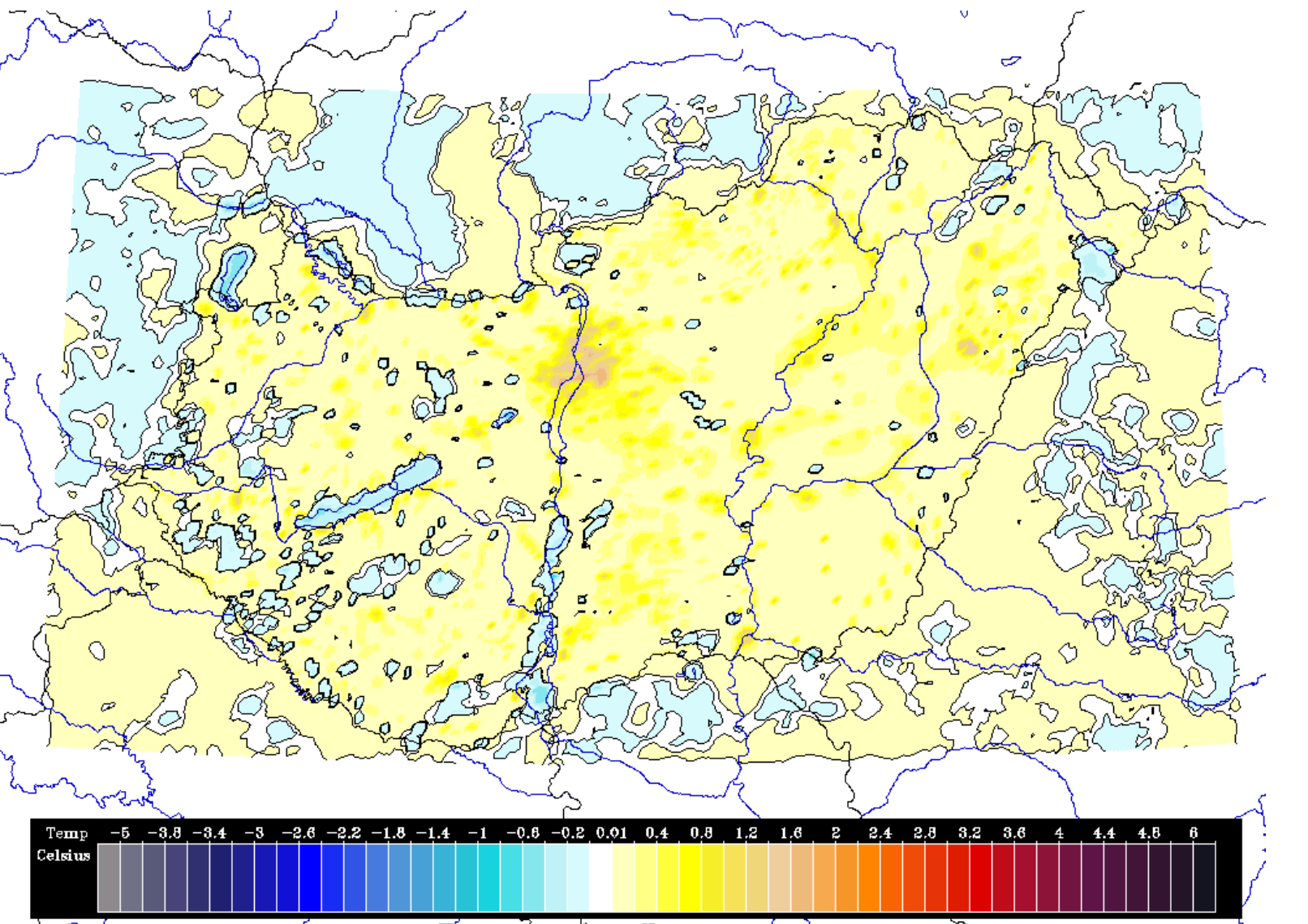
Effects of land cover changes on climate in Hungary

Climatic effects of the land cover changes are further evaluated using the MM5 non-hydrostatic dynamical model. The lower boundary conditions for the model have been generated for two selected time periods (1900 and 2000) based on historical and current land cover maps. According to the comparisons, the climatic effects of land cover changes on the near-surface meteorological variables have been significant. Changes in land use caused in nation-wide average +0.15 °C mean temperature rise and 0.18 °C increase in the dew point depression during the vegetation period. In selected vertically unstable weather cases, the land cover differences could significantly perturb the convective precipitation patterns and the regional mean as well.



Land use in Hungary at the beginning (left) and at the end (right) of the 20th century

| Land use type | 1900 | 2000 | Direction of the changes |
|---------------|---------|---------|--------------------------|
| Forest | 12.50 % | 21.07 % | ↑ |
| Urban | 2.43 % | 5.69 % | ↑ |
| Grassland | 15.99 % | 9.53 % | ↓ |
| Cropland | 61.0 % | 56.8 % | ↓ |
| Vineyard | 2.49 % | 1.51 % | ↓ |
| Water | 2.26 % | 1.86 % | ↓ |
| Wetland | 3.22 % | 1.12 % | ↓ |



Temperature changes due to the Hungarian land use changes during the 20th century

Sources:

Arcanum (2006) ¹: The First Military Survey: Kingdom of Hungary (1763-1787) 1:28.800, Arcanum Database Ltd., Budapest
 Arcanum (2006) ²: The Second Military Survey: Kingdom of Hungary (1806-1869) 1:28 800, Arcanum Database Ltd., Budapest
 Arcanum (2007): The Third Military Survey (1869-1887) Kingdom of Hungary 1:25.000, Arcanum Database Ltd., Budapest

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