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Meteorological Effects of Land Cover Changes in Hungary during the 20th Century

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Geological, paleontological and geomorphologic studies show that the Earth's climate has always been changing since it came into existence. The climate change itself is self-evident. Therefore the far more serious question is how much does mankind strengthen or weaken these changes beyond the natural fluctuation and changes of climate.

The aim of the present study was to restore the historical land cover changes and to simulate the meteorological consequences of these changes. Two different land cover maps for Hungary were created in vector data format using GIS technology. The land cover map for 1900 was reconstructed based on statistical data and two different historical maps: the derived map of the 3rd Military Mapping Survey of the Austro-Hungarian Empire and the Synoptic Forestry Map of the Kingdom of Hungary. The land cover map for 2000 was derived from the CORINE land cover database.

Significant land cover changes were found in Hungary during the 20th century according to the examinations of these maps and statistical databases.

The MM5 non-hydrostatic dynamic model was used to further evaluate the meteorological effects of these changes. The lower boundary conditions for this mesoscale model were generated for two selected time periods (for 1900 and 2000) based on the reconstructed maps. The dynamic model has been run with the same detailed meteorological conditions of selected days from 2006 and 2007, but with modified lower boundary conditions. The set of the 26 selected initial conditions represents the whole set of the macrosynoptic situations for Hungary.

In this way, 2×26 "forecasts" were made with 48 hours of integration. The effects of land cover changes under different weather situations were further weighted by the long-term (1961-1990) mean frequency of the corresponding macrosynoptic types, to assume the climatic effects from these stratified averages. The detailed evaluation of the model results were made for three different meteorological variables (temperature, dew point and precipitation).