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Simulated trends of extreme climate indices for the Carpathian basin using outputs of different regional climate models

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Regional climatological effects of global warming may be recognized not only in shifts of mean temperature and precipitation, but in the frequency or intensity changes of different climate extremes. Several climate extreme indices are analyzed and compared for the Carpathian basin (located in Central/Eastern Europe) following the guidelines suggested by the joint WMO-CCl/CLIVAR Working Group on climate change detection. Our statistical trend analysis includes the evaluation of several extreme temperature and precipitation indices, e.g., the numbers of severe cold days, winter days, frost days, cold days, warm days, summer days, hot days, extremely hot days, cold nights, warm nights, the intra-annual extreme temperature range, the heat wave duration, the growing season length, the number of wet days (using several threshold values defining extremes), the maximum number of consecutive dry days, the highest 1-day precipitation amount, the greatest 5-day rainfall total, the annual fraction due to extreme precipitation events, etc.
In order to evaluate the future trends (2071-2100) in the Carpathian basin, daily values of meteorological variables are obtained from the outputs of various regional climate model (RCM) experiments accomplished in the frame of the completed EU-project PRUDENCE (Prediction of Regional scenarios and Uncertainties for Defining EuropeaN Climate change risks and Effects). Horizontal resolution of the applied RCMs is 50 km. Both scenarios A2 and B2 are used to compare past and future trends of the extreme climate indices for the Carpathian basin. Furthermore, fine-resolution climate experiments of two additional RCMs adapted and run at the Department of Meteorology, Eotvos Lorand University are used to extend the trend analysis of climate extremes for the Carpathian basin. (1) Model PRECIS (run at 25 km horizontal resolution) was developed at the UK Met Office, Hadley Centre, and it uses the boundary conditions from the HadCM3 GCM. (2) Model RegCM3 (run at 10 km horizontal resolution) was developed by Giorgi et al. and it is available from the ICTP (International Centre for Theoretical Physics).
Analysis of the simulated daily temperature datasets suggests that the detected regional warming is expected to continue in the 21st century. Cold temperature extremes are projected to decrease while warm extremes tend to increase significantly. Expected changes of annual precipitation indices are small, but generally consistent with the detected trends of the 20th century. Based on the simulations, extreme precipitation events are expected to become more intense and more frequent in winter, while a general decrease of extreme precipitation indices is expected in summer.