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Comparison of 21st century regional climate projections for the Carpathian Basin using ENSEMBLES outputs

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Global climate models (GCMs) provide a useful tool to describe and simulate large scale features of the changing climate. However, their spatial resolution is inappropriate to describe regional climate processes, especially, in case of precipitation, which is highly variable both in time and space. Therefore, GCM outputs may be misleading to compose regional climate change scenarios for the 21st century. In order to provide better estimations for regional climate parameters, fine resolution regional climate models (RCM) can be used. RCMs are limited area models nested in GCMs, i.e. the initial and the boundary conditions of RCMs are provided by the GCM outputs. In order to estimate the regional climate change projected for the Carpathian Basin, outputs from several RCMs (from the completed EU-project ENSEMBLES) with 25 km horizontal resolution are summarized and analyzed for 1951-2100 using the SRES A1B emission scenario, according to which CO_2 concentration by 2100 is estimated to exceed 700 ppm (more than twice of the preindustrial level).
In order to estimate the bias of the different RCM simulations, outputs from 1951-2000 are compared to the E-OBS datasets containing gridded daily temperature and precipitation values. The validation results suggest that the models are able to reconstruct the temperature sufficiently. In case of the precipitation, simulated values usually significantly overestimate the observations, except in summer when mostly underestimations are found. These biases of the raw RCM outputs are corrected using the monthly empirical distribution functions.
Then, for the evaluation of annual, seasonal, and monthly expected climatic changes, GCM-driven runs of the reference and the future periods are compared. For the selected target region, composite maps of projected change in temperature and precipitation are generated using the RCM simulations for the periods of 1961-1990 (as the reference period), 2021-2050, and 2071-2100. The results suggest that the temperature of the selected region is projected to increase significantly in all months and seasons. The projected annual warming is about 1-2.5 °C, and 2-5 °C for 2021-2050, and 2071-2100, respectively. In case of precipitation, the annual sum is not expected to change significantly in the Carpathian Basin. Most of the RCM simulations suggest that the winter and autumn precipitation is likely to increase, while summer precipitation is projected to decrease during the 21st century. The mean change by 2021-2050 is not likely to exceed 20% in any season. By 2071-2100 remarkable winter precipitation increase (by 10-30%) and significant summer precipitation decrease (by 15-40%) are projected for the region.