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Extremes of precipitation in the changing Central/Eastern European climate

Anna Kis, Rita Pongrácz, and Judit Bartholy

Dept. of Meteorology, Eötvös Loránd University, Budapest, Hungary (kisanna@nimbus.elte.hu, prita@nimbus.elte.hu, bartholy@caesar.elte.hu)

Hot weather and increasingly warm climatic conditions are quite straightforward consequences of global warming. Connection to precipitation is not so clear since precipitation is one of the most variable meteorological elements both in time and space. However, it has a huge effect both on vegetation and human activities. Intense precipitation events may result in severe environmental, agricultural and economical damages. In order to avoid them or at least decrease these potential damages, it is necessary to assess the possible changes, and build appropriate regional adaptation strategies.

To estimate the future trends, we used 11 regional climate model (RCM) simulations from the ENSEMBLES project. All the models used 25 km horizontal resolution and took into account the SRES A1B emission scenario. Three different global climate models provided the necessary initial and boundary conditions. Validation analyses for the Central/Eastern European region showed that simulated precipitation values usually significantly underestimate the observations in summer and overestimate in the rest of the year. Therefore, we applied bias correction in order to eliminate these systematic errors. We used a quantile matching technique for each RCM simulation: the monthly empirical distribution functions of each grid point were fitted to the observed distributions (reference: E-OBS database), then the calculated multiplicative bias correcting factors are applied to the raw outputs of RCM experiments. After the correction, we analyzed several precipitation-related indices (e.g., CDD, RR10, RR20, RX1, RX5, 90th pctl, 99th pctl) for 9 sub-regions as well as the 10 and 20 year return periods of the daily precipitation amount for the 1951–2100 time period on seasonal and annual scales.

According to our results climate change results in more intense and more frequent precipitation extremes in Central/Eastern Europe. The return period of the daily precipitation amount is estimated to increase in summer (by a factor of 1.2-2), but in winter a slight decrease is projected. In case of consecutive dry days $\sim$50% increase is estimated in summer, therefore substantially drier climatic conditions are projected for the future. In winter and in autumn more heavy precipitation days (RR20, 99th pctl) and more intense precipitation (RX1) are very likely to occur in the 21st century. Overall, in the future we should expect both floods and droughts, as in winter and in autumn more frequent and more intense precipitation are projected, while summer is tend to be drier, especially in the southern parts of the selected domain.