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Projected changes of percentile-based precipitation indices for the 21st century in Central/Eastern Europe

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)

Observations of the last few decades suggest that extreme precipitation events became more intense and more frequent. Because of the important manyfold consequences (i.e. heavy precipitation may result in several environmental, economical, ecological, natural and health damages) this is a highly important issue to be addressed thoroughly. In order to appropriately adapt to the projected changes, an objective and quantitative analysis should be completed to estimate the future trends. For the investigation of extreme precipitation tendencies fine resolution multi-model approach has several advantages. (i) Global climate models (GCMs) are too coarse for such an analysis, therefore we applied regional climate model (RCM) simulations with 25 km horizontal resolution from the ENSEMBLES project. Three different GCMs – ECHAM, HadCM and ARPEGE – provided the necessary initial and boundary conditions for the RCM runs. (ii) In order to quantify the uncertainties of the projections, several models should be evaluated together.

Before starting the detailed statistical analysis, bias correction of simulated time series is necessary because simulations often under- or overestimate the observed data. In our studies, we use a quantile-matching technique and apply multiplicative factor sets to fit the empirical distributions for each RCM, for each month, and for each gridpoint, thus eliminating the systematic errors (compared to the reference E-OBS datasets). In the framework of this current analysis extreme events are defined by relative thresholds instead of the often used absolute threshold values. The projected changes of the 90th, the 95th and the 99th percentiles of seasonal daily precipitation amount (R90p, R95p, and R99p, respectively) and the total precipitation sum over the 90th, the 95th and the 99th percentile of daily precipitation amount of the reference period (R90pGT, R95pGT, and R99pGT, respectively) are calculated. The six percentile-based indices are determined for the 1951–2100 period, for nine subregions (SE-CZ, E-AT, SK, SW-UK, SI, HU, RO, CR, N-SR) within the selected domain (43.625°–50.625°N, 13.875°–26.375°E) using daily precipitation fields of the bias-corrected RCMs. In addition, the multivariate extremity is also analysed for the region.

According to our results, in winter, R90p, R95p and R99p will increase in the entire investigated domain. In summer, a decreasing trend is very likely to occur mainly in the southern parts of the region, however, in case of R99p increasing tendency is estimated in the southeastern part of the Czech Republic, in eastern Austria, in Slovakia and in southwestern Ukraine. Thus, we conclude that extreme precipitation is projected to increase especially in winter, and additionally in the northern parts of the selected domain in summer, too.