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Multi-model analysis of precipitation-related climatological extremes for the Carpathian Region

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As a consequence of global climate change, both frequency and intensity of climatological and meteorological extremes are likely to change. These will certainly further induce various effects on hydrological extremes. Although more frequent hot weather in summer and overall warmer climatic conditions compared to the past decades are quite straightforward direct consequences of global warming, the effects on precipitation might be less clear because the higher spatial and temporal variabilities might hide robust changing signals. Nevertheless, precipitation is one of the most important meteorological variables since it considerably affects natural ecosystems and cultivated vegetation as well, as most of human activities. Extreme precipitation events – both excessive, intense rainfalls and severe droughts – may result in severe environmental, agricultural, and economical disasters. For instance, excessive precipitation may induce floods, flash-floods, landslides, traffic accidents. On the other hand, the lack of precipitation for extended period and coincidental intense heat wave often lead to severe drought events, which certainly affect agricultural production negatively, and hence, food safety might also be threatened. In order to avoid or at least reduce the effects of these precipitation-related hazards, national and local communities need to develop regional adaptation strategies, and then, act according to them. For this purpose, climatological projections are needed as a scientific basis. Coarse resolution results of global climate model (GCM) simulations must be downscaled to regional and local scales, hence better serving decision-makers' and end-users' needs. Dynamical downscaling technique applies regional climate model (RCM) to provide fine resolution climatological estimations for the future. Thus, in this study 11 completed RCM simulations with 25 km horizontal resolution are used from the ENSEMBLES database taking into account SRES A1B scenario for the 21st century. Before the thorough analysis of several drought- and precipitation-related climate indices (i.e. describing drought events, or intensity of precipitation exceeding different percentile-based or absolute threshold values, respectively), a percentile-based bias correction method was applied to the raw RCM output data, for which the homogenized daily gridded Carpat-Clim database (1961–2010) served as a reference. Absolute and relative seasonal mean changes of the climate indices are calculated for two future time periods (2021–2050 and 2071–2100) and for three subregions (i.e. Slovakia, Hungary, and Romania) within the entire Carpathian Region. According to our results, longer dry periods are estimated for the summer season, mainly in the southern parts of the domain, while precipitation intensity is likely to increase. Heavy precipitation days and high percentile values are projected to increase in the Carpathian Region, especially, in winter and autumn.