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Intensification of the regional scale variability of extreme precipitation derived from RCM simulations and observations

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Future climate change patterns are usually derived from ensembles of coarse global climate model simulations (GCMs), for instance within the Coupled Model Intercomparison Project (CMIP) or from regional climate projections at resolutions of some tens of km, for instance for Europe from the ENSEMBLES or PRUDENCE projects.
For regions with complex topography like Central Europe the horizontal resolution of these climate projections is still too coarse to resolve the typical topographical length scales, and therefore the impact of the large scale changes with the regional geography cannot be captured adequately. For this task high resolution ensemble simulations with regional climate models (RCMs) are needed. The generation of an ensemble of such high resolution simulations requires great computational efforts. With the RCM COSMO-CLM several simulations with resolutions down to 7 km have been performed, using different driving GCMs and GCM realisations. This ensemble approach is needed to estimate the robustness of the change signals and to account for the uncertainties introduced by differences in the large scale forcing due to the variability of the climate change signals caused by the different GCMs or the natural variability. The focus of the study is on the changes of extreme precipitation for the near future until the middle of the 21st century. An increase of the temporal and spatial variability is found for the precipitation extremes, especially for summer. The change patterns seem to be statistically robust. Based on long-term observation climatologies for the second half of the 20th century, similar structures where found with areas of decrease and increase only a few tens of kilometres apart from each other. The combination of the findings from the RCM projections and observations suggests a continuation of the trends from the recent past into the near future.
Possible causes for the horizontally heterogeneous change patterns are related to weather pattern changes. It is discussed to what extend changes in the frequencies of weather conditions, connected to the extremes, or changes in the meteorological characteristics during such conditions are responsible for changes of the extreme precipitation.