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Future changes in extreme summer precipitation over Europe in a convection-permitting model

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Extreme precipitation is increasing faster than mean precipitation with global warming and this has important implications for society. Global climate models (GCMs) have too coarse resolution to realistically represent extreme precipitation and its changes on local scales. However, scientific advances and increasing computer capacity have recently made regional climate modelling at convection-permitting scales (typically <4 km horizontal resolution) more feasible.

In this work we use the Weather Research and Forecasting (WRF) model at 3 km horizontal resolution over four selected regions in Europe, in both northern and southern Europe, for the summer months and early fall (June, July, August and September). Evaluation of mean and 1-day extreme precipitation (RX1day) of a historical simulation (1986-2005) have been made against meteorological station observations of daily precipitation from the European Climate Assessment & Dataset project. Modelled 1-hour extreme precipitation has been evaluated against other country-specific observation datasets. With some exceptions, the WRF model reproduces the observations very well, especially when considering that the WRF boundary conditions are from a free-running global climate model.

Future simulations for the 2081-2100 period assuming a high emission scenario (RCP8.5) show a decrease in mean summer precipitation in large parts of Europe, consistent with the results of the majority of GCMs in the Coupled Model Intercomparison Project Phase 5 (CMIP5) archive. Results also show an intensification of extremes compared to the mean precipitation change, and in most cases there is a further intensification of sub-daily extremes (1-hour and 10-minute precipitation extremes).