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How well do the 25 km resolution regional climate models of the ENSEMBLES project represent the influence of the synoptic atmospheric circulation on UK local precipitation extremes?

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Extreme precipitation is a major natural hazard in the United Kingdom. Reliable high resolution estimates of future changes in the magnitude of precipitation extremes are required for local communities to adapt to potential impacts. In this context it is crucial how realisticly regional climate models (RCMs) simulate the spatial-temporal variability of extreme precipitation. Expected changes in precipitation patterns are mainly controlled by changes in the atmospheric circulation and by an intensification of the water cycle. For a reliable projection of extreme precipitation it is therefore not sufficient to validate the simulated climatology and variability over a control period. Moreover, it is important to validate the representation of the relationships between the controling large scale processes and the local precipitation extremes.

Here we present a UK case study to exemplify a new approach to validate the representation of physical processes in climate models. Based on a gridded precipitation data set provided by the UK Met Office we develop a statistical model that describes the influence of the atmospheric circulation on the generalised extreme value (GEV) distribution of local precipitation extremes. In a second step, the same statistical model is calibrated against 14 ERA40 driven 25 km resolution RCMs from the ENSEMBLES project. Subsequently, the parameters of the statistical models for observations on the one hand and RCMs on the other hand are compared with respect to a set of validation measures for spatial patterns. The results for the 14 different RCMs are compared using Taylor diagrams. Additionally, we use this approach to validate extreme precipitation in the E-OBS data set over the UK.

We show that the RCMs adequately simulate the influence of airflow strength and vorticity on precipitation extremes, but show deficits in representing the influence of airflow direction. E-OBS shows considerable biases in particular in regions of sparse data.