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Validation of the annual cycle of extreme precipitation events across the UK in 14 regional climate models

A. Schindler (1), D. Maraun (2), and J. Luterbacher (1)

(1) Justus-Liebig-Universität Giessen, Germany (anne.schindler@geogr.uni-giessen.de), (2) Leibnitz Institute of Marine Sciences at the University of Kiel, Germany

Precipitation in the UK shows a pronounced annual cycle. To study past, present and future impacts on agriculture, ecosystems, etc. it is important to analyse intensity and frequency of extreme events together with their spatial and temporal occurrence throughout the year.

We design a statistical model based on extreme value statistics (EVS) and fit the statistical model to the gauge-based, gridded UK Metoffice data set for the time period 1961-2000. We study spatial and temporal patterns of the annual cycle of the intensity of heavy precipitation in observations. We fit the statistical model as well to the ERA40 driven regional climate models (RCMs) for the same time period in order to validate the representation of the annual cycle.

Here we model extreme precipitation in the UK as a Poisson process with a non-stationary threshold. We determine the threshold by normalizing the data relative to the "day of the year" mean precipitation, then calculating a high quantile, e.g. 95% quantile, of the normalized data and by transforming these values back to the original scale we obtain the threshold values for each day of the year. We use a sinusoidal model for the location and scale parameter of the corresponding generalized extreme value (GEV) distribution and a constant shape parameter.

We validate spatial and temporal patterns of the representation of the annual cycle of extreme precipitation events simulated by 14 RCMs with a resolution of 25 km, used in the ENSEMBLES project. As a reference data set we use the gridded UK Metoffice data set to compare the annual cycle of intensity simulated by the RCMs to. We focus on the peak time of the annual cycle of heavy precipitation of the annual return levels conditioned on the month of their occurrence, the relative amplitude of their annual cycle and the relative bias of their absolute values. The performance of the RCMs to represent the annual cycle of heavy precipitation throughout the UK varies considerably. The greatest difficulties lie in the representation of heavy summer precipitation in central England. Northwest Scotland with its high absolute values and its strong annual cycle with peak values late in the year is well captured. The strong relative amplitude of the annual cycle in East Anglia on the other hand is not well captured if at all.