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Statistical downscaling of precipitation using extreme value theory

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Present day weather forecast models cannot provide realistic descriptions of local weather variability due to the horizontally restricted resolution (50-100km at best for global, 2-7km for local models) and missing microphysical processes. However, they provide reliable forecasts of the atmospheric circulation that encompasses the sub-scale processes leading to precipitation. Hence, a description and forecast of extreme events can only be achieved through a combination of dynamical and statistical analysis methods, where a stable and significant statistical model based on a-priori physical reasoning establishes a-posterior a statistical-dynamical model between the local extremes and the large scale circulation.

We present a downscaling approach for daily precipitation extremes that employs extreme value statistics. The approach uses a Poisson point representation together with the generalized Pareto distribution (GPD) for the precipitation values above a high threshold. The parameters of the distribution are allowed to depend on the large scale circulation. They are estimated using the maximum likelihood method. The downscaling approach thus provides a distribution of the extreme precipitation events conditional on the large scale circulation for each day and station location.

The distributional forecast is validated using a quantile verification score. Furthermore, performance is compared to the censored quantile regression approach (Friederichs and Hense, 2007). Special emphasis is given to the role of the threshold magnitude and the sensitivity to variations in the GPD shape parameter. The approach will be demonstrated for daily precipitation totals at the station Dresden in August 2002 (Elbe flood).