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Regime-dependent statistics of extremes

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This study searches for relations between large scale circulation patterns and extreme rainfall events. One of the major issues in hydrological impact investigations of climate change is the gap in spatial and temporal scale between the output of climate models (GCM and RCM) and the local scale at which input is needed for the hydrological impact models. Much work is put into creating downscaling techniques that bridges this gap.
Here severe rainfall events over Denmark are investigated using an objective clustering analysis. Combining ECMWF ERA-Interim reanalysis data with rain gauge data covering 96 stations Denmark from the Danish Meteorological Institute (DMI) outlines historical severe rainfall events in the years 1979-2010. The reanalysis data provides information about the large scale circulation pattern at the time of the local rainfall. In order to reduce the computational effort and bring out the most relevant information, a principal component analysis is performed on the large scale data. The resulting EOFs are clustered and the behavior of the extremes in each cluster is analyzed. Using a cluster-weighted approach the statistics encompassing all the extremes is found. The parameters of the cluster-weighted model are found using an Expectation-Maximization algorithm. From the statistics, valuable information like e.g. return periods can be drawn. Furthermore, the work can be used on data from GCM simulations, predicting the future extremes.