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Extreme Precipitation Events and Large Scale Circulation

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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 reanalysis data with rain gauge data covering 96 stations in Denmark from the Danish Meteorological Institute (DMI) outlines historical severe rainfall events in the years 1960-2010. The reanalysis data of the mean sea level pressure provides information about the large-scale circulation pattern at the time of the local rainfall. In order to reduce the computational effort, a principal component analysis is performed on the large-scale data. The resulting EOFs are clustered by the k-means and the behavior of the extremes in each cluster is analyzed. The weather regimes are found to have very different precipitation distributions. Return periods dependent on future regime frequencies are found and the method's skill at predicting extreme precipitation is evaluated by separating the time period into smaller slices. The clusters are also compared to GCM runs of the present and future.