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Classifying extreme precipitation events and their associated synoptic patterns

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Estimation of extreme precipitation design values often requires estimation of return periods exceeding the estimates that confidently could be derived from observations series. MET Norway is therefore developing a method applying physical atmospheric models for estimation of extreme precipitation. In order to find the most representative atmospheric conditions leading to extreme precipitation an analysis of observed precipitation events and their associated synoptic circulation pattern is performed.

It is well known that the occurrence and magnitude of precipitation is highly related to the large scale circulation but also orography and other regional and local physiographical parameters. We have studied precipitation events exceeding the 99, 99.5 and 99.9 percentile in the period 1971-2018. Precipitation values are selected from the NGCD gridded dataset, initially providing daily precipitation values on a 1 x1 km2 resolution. In this analysis we have aggregated the dataset to 10x10 km where each pixel represents the maximum value of all the 1x1 pixel values within the 10x10 km domain. For each pixel time series indicating exceedance of the different extreme precipitation thresholds are established. These series are classified into precipitation classes having similar temporal response in the occurrence of extreme precipitation by applying the k-mean clustering method, . The classification resulted in continuous geographic regions.

The extreme precipitation events are related to atmospheric circulation types. In the classification of circulation patterns pressure fields from ERA-40 and ERA-interim are merged into a data set covering the period 1971-2018 with a 1 degree horizontal resolution. The analysis domain is large, covering the area 60W - 60 E and 20N - 90N. The reason for initially selecting such a large domain is to identify patterns producing large moisture flows across the North Atlantic.

The relation between circulation patterns and frequency of extreme precipitation occurrence in the different precipitation regions is analysed, identifying which circulation pattern(s) that lead to extreme precipitation in the regions. Classification of the atmospheric circulation conditioned by days where extreme precipitation occurs somewhere in Norway seems to provide classes that are more relevant for extreme precipitation than the classification based on every day in the analysis period. Applying the cost733class software circulations classes from several classification methods are tested and compared.