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Return period estimates for European windstorm clusters: a multi-model perspective

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Clusters of storms over Europe can lead to very large aggregated losses. Realistic return period estimates for such cluster are therefore of vital interest to the (re)insurance industry. Such return period estimates are usually derived from historical storm activity statistics of the last 30 to 40 years. However, climate models provide an alternative source, potentially representing thousands of simulated storm seasons.

In this study, we made use of decadal hindcast data from eight different climate models in the CMIP5 archive. We used an objective tracking algorithm to identify individual windstorms in the climate model data. The algorithm also computes a (population density weighted) Storm Severity Index (SSI) for each of the identified storms (both on a continental and more regional basis).

We derived return period estimates for the cluster seasons 1990, 1999, 2013/2014 and 1884 in the following way: For each climate model, we extracted two different exceedance frequency curves. The first describes the exceedance frequency (or the return period as the inverse of it) of a given SSI level due to an individual storm occurrence. The second describes the exceedance frequency of the seasonally aggregated SSI level (i.e. the sum of the SSI values of all storms in a given season). Starting from appropriate return period assumptions for each individual storm of a historical cluster (e.g. Anatol, Lothar and Martin in 1999) and using the first curve, we extracted the SSI levels at the corresponding return periods. Summing these SSI values results in the seasonally aggregated SSI value. Combining this with the second (aggregated) exceedance frequency curve results in return period estimate of the historical cluster season. Since we do this for each model separately, we obtain eight different return period estimates for each historical cluster.

In this way, we obtained the following return period estimates: 50 to 80 years for the 1990 season, 20 to 45 years for the 1999 season, 3 to 4 years for the 2013/2014 season, and 14 to 16 years for the 1884 season. More detailed results show substantial variation between five different regions (UK, France, Germany, Benelux and Scandinavia), as expected from the path and footprints of the different events. For example, the 1990 season is estimated to be well beyond a 100-year season for Germany and Benelux. 1999 clearly was an extreme season for France, whereas the1884 was very disruptive for the UK.

Such return period estimates can be used as an independent benchmark for other approaches quantifying clustering of European windstorms. The study might also serve as an example to derive similar risk measures also for other climate-related perils from a robust, publicly available data source.