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# Clustering of European winter storms: A multi-model perspective

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The storm series over Europe in 1990 (Daria, Vivian, Wiebke, Herta) and 1999 (Anatol, Lothar, Martin) are very well known. Such clusters of severe events strongly affect the seasonally accumulated damage statistics. The (re)insurance industry has quantified clustering by using distribution assumptions deduced from the historical storm activity of the last 30 to 40 years. The use of storm series simulated by climate models has only started recently. Climate model runs can potentially represent 100s to 1000s of years, allowing a more detailed quantification of clustering than the history of the last few decades. However, it is unknown how sensitive the representation of clustering is to systematic biases. Using a multi-model ensemble allows quantifying that uncertainty.

This work uses CMIP5 decadal ensemble hindcasts to study clustering of European winter storms from a multi-model perspective. An objective identification algorithm extracts winter storms (September to April) in the gridded 6-hourly wind data. Since the skill of European storm predictions is very limited on the decadal scale, the different hindcast runs are interpreted as independent realizations. As a consequence, the available hindcast ensemble represents several 1000 simulated storm seasons. The seasonal clustering of winter storms is quantified using the dispersion coefficient. The benchmark for the decadal prediction models is the 20th Century Reanalysis.

The decadal prediction models are able to reproduce typical features of the clustering characteristics observed in the reanalysis data. Clustering occurs in all analyzed models over the North Atlantic and European region, in particular over Great Britain and Scandinavia as well as over Iberia (i.e. the exit regions of the North Atlantic storm track). Clustering is generally weaker in the models compared to reanalysis, although the differences between different models are substantial. In contrast to existing studies, clustering is driven by weak and moderate events, and not by extreme storms. Thus, the decision which climate model to use to quantify clustering can have a substantial impact on the risk assessment in the (re)insurance business.