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Winter storm identification by means of a cluster analysis

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Boreal winter wind storm situations over Central Europe are investigated by means of an objective cluster analysis. Surface data from the NCEP-Reanalysis and ECHAM4/OPYC3-climate change GHG simulation (IS92a) are considered. To achieve an optimum separation of clusters of extreme storm conditions, 55 clusters of weather patterns are differentiated. To reduce the computational effort, a PCA is initially performed, leading to a data reduction of about 98%. The clustering itself was computed on 3-day periods constructed with the first six PCs using“k-mean” clustering algorithm. The applied method enables an evaluation of the time evolution of the synoptic developments.

The climate change signal is constructed by a projection of the GCM simulation on the EOFs attained from the NCEP-Reanalysis. Consequently, the same clusters are obtained and frequency distributions can be compared. For Central Europe, four primary storm clusters are identified. These clusters feature almost 72% of the historical extreme storms events and add only to 5% of the total relative frequency. Moreover, they show a statistically significant signature in the associated wind fields over Europe.

An increased frequency of Central European storm clusters is detected with enhanced GHG conditions, associated with an enhancement of the pressure gradient over Central Europe. Consequently, more intense wind events over Central Europe are expected. The presented algorithm will be highly valuable for the analysis of huge data amounts as is required for e.g. multi-model ensemble analysis, particularly because of the enor-

mous data reduction.