



## **Serial clustering of winter storms over the North Atlantic and Europe under recent and future climate conditions**

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Under particular large-scale atmospheric conditions, several windstorms may affect Europe within a comparatively short period of time. The occurrence of such cyclone families leads to large socio-economic impacts. In this study, the dependence of serial clustering of winter storms on the intensity threshold is analysed. This is performed both based on cyclone statistics and a proxy for storm related losses. Clustering is quantified as the dispersion (ratio variance / mean) of cyclone passages/loss occurrences over a certain area. Dispersion statistics are derived for re-analysis datasets (NCEP/NCAR, ERA40 and ERA-Interim) and a large ensemble of ECHAM5 GCM simulations. Results show that serial clustering of cyclones is found primarily on the southern flank and downstream regions of the North Atlantic storm track. Here, serial clustering increases when extreme cyclones are considered. As expected, the clustering of storm based losses is predominantly found southward of the clustering of cyclones. The GCM is general able to reproduce the spatial patterns of clustering, but some biases are detected. Under future climate conditions, serial clustering over Western Europe is projected to decrease, particularly for more intense cyclones. The detected changes imply a change in the risk of occurrence of cumulative cyclones and storm based losses over Europe under future climate conditions.