



## **Serial clustering of extratropical cyclones 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 short time period. The occurrence of such cyclone families leads to large socioeconomic impacts and cumulative losses. The serial clustering of windstorms is analyzed for the North Atlantic/western Europe. Clustering is quantified as the dispersion (ratio variance/mean) of cyclone passages over a certain area. Dispersion statistics are derived for three reanalysis data sets and a 20-run European Centre Hamburg Version 5 /Max Planck Institute Version–Ocean Model Version 1 global climate model (ECHAM5/MPI-OM1 GCM) ensemble. The dependence of the seriality on cyclone intensity is analyzed. Confirming previous studies, serial clustering is identified in reanalysis data sets primarily on both flanks and downstream regions of the North Atlantic storm track. This pattern is a robust feature in the reanalysis data sets. For the whole area, extreme cyclones cluster more than nonextreme cyclones. The ECHAM5/MPI-OM1 GCM is generally able to reproduce the spatial patterns of clustering under recent climate conditions, but some biases are identified. Under future climate conditions (A1B scenario), the GCM ensemble indicates that serial clustering may decrease over the North Atlantic storm track area and parts of western Europe. This decrease is associated with an extension of the polar jet toward Europe, which implies a tendency to a more regular occurrence of cyclones over parts of the North Atlantic Basin poleward of 50°N and western Europe. An increase of clustering of cyclones is projected south of Newfoundland. The detected shifts imply a change in the risk of occurrence of cumulative events over Europe under future climate conditions.