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Global climatology of cyclone clustering in present and future climates

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Cyclone clustering, the swift succession of multiple extratropical cyclones in a geographically confined region during a short period of time, constitutes a large fraction of European weather extremes. The idea that several cyclones follow a similar track dates back to the centennial concept of cyclone families of Bjerknes and Solberg. To investigate the dynamical causes of cyclone clustering, it is necessary to diagnose the occurrence of cyclone clustering and to determine their characteristics. So far, most diagnostics focused either on local impact or on a statistical analysis of storm recurrence. While the first cannot be applied globally, the latter is difficult to relate to individual events. We therefore use a novel method to globally detect cyclone clustering that is closer to the original concept of Bjerknes and Solberg, where extratropical cyclones follow similar tracks within a given time period.

Using this novel cyclone clustering diagnostic based on spatio-temporal distance between cyclone tracks, we analyse cyclone clustering globally in Era-Interim for the period 1979 until 2016 as well as for 10 CMIP6 models. We separate the cyclone clusters into two types: one representing the 'classical' bjerknes-type clusters, and one representing more stationary clusters. We find that cyclone clustering mainly occurs along the climatological storm tracks, with the bjerknes-type more common at the western side of the storm tracks, while the stationary-type of cyclone clusters occurs more downstream. In general, clustered cyclones are stronger than non-clustered cyclones. While CMIP6 models feature a slight bias towards an equatorward shift of the storm tracks, cyclone clustering in a future climate occurs more poleward. Furthermore, the average number of storms per cluster decreases in a future climate, though the mean intensity of the cyclones that are clustered increases slightly.