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Climatology and variability of cyclone clustering

Chris Weijenborg[1] and Thomas Spengler[2]
[1]Wageningen University and Research, Meteorology and Air Quality, Wageningen, Netherlands (chris.weijenborg@wur.nl)
[2]Geophysical Institute, University of Bergen, Bergen, Norway

The existence of cyclone clustering, the succession of multiple extratropical cyclones during a short period of time, indicates that the baroclinicity feeding these storms undergoes longer lasting episodic cycles supporting multiple cyclones. However, the generally accepted paradigm for baroclinic instability implies that individual cyclones reduce baroclinicity to support their growth. This apparent contradiction motivates our hypothesis that some cyclones within increase baroclinicity, yielding a pathway for cyclone clustering. A case study of the extreme storm Dagmar confirms that a particular sequence of storms culminating in a severe cyclone is due to the fact that the previous storms act to maintain or increase the background baroclinity along which the succeeding storms evolved.

Using a new cyclone clustering diagnostic based on spatio-temporal distance between cyclone tracks, we analyse cyclone clustering globally for the period 1979 until 2016. We complement this analysis with a baroclinicity diagnostic based on the slope of isentropic surfaces. With the isentropic slope and its tendencies, the relative roles of diabatic and adiabatic effects associated with extra-tropical cyclones in maintaining baroclinicity are assessed. We present a climatological analysis of where and when cyclone clustering occurs. We compare these findings to composites of clustered and non-clustered cyclones to quantify how consistent the proposed clustering mechanism is and its relation to changes in the frequency of atmospheric rivers. We complement this with an EOF analysis to investigate the variability of the clusters and how it covaries with the jet and diabatic heating.