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Structural Variability of Tropospheric Growth Factors Transforming Mid-latitude Cyclones to Severe Storms over the North Atlantic

Simon Wild, Daniel J. Befort, and Gregor C. Leckebusch

University of Birmingham, School of Geography, Earth and Environmental Sciences, Birmingham, United Kingdom (sbw206@bham.ac.uk)

The development of European surface wind storms out of normal mid-latitude cyclones is substantially influenced by upstream tropospheric growth factors over the Northern Atlantic. The main factors include divergence and vorticity advection in the upper troposphere, latent heat release and the presence of instabilities of short baroclinic waves of suitable wave lengths.
In this study we examine a subset of these potential growth factors and their related influences on the transformation of extra-tropical cyclones into severe damage prone surface storm systems.

Previous studies have shown links between specific growth factors and surface wind storms related to extreme cyclones. In our study we investigate in further detail spatial and temporal variability patterns of these upstream processes at different vertical levels of the troposphere. The analyses will comprise of the three growth factors baroclinicity, latent heat release and upper tropospheric divergence.

Our definition of surface wind storms is based on the Storm Severity Index (SSI) alongside a wind tracking algorithm identifying areas of exceedances of the local 98th percentile of the 10m wind speed. We also make use of a well-established extra-tropical cyclone identification and tracking algorithm. These cyclone tracks form the base for a composite analysis of the aforementioned growth factors using ERA-Interim Reanalysis from 1979 – 2014 for the extended winter season (ONDJFM). Our composite analysis corroborates previous similar studies but extends them by using an impact based algorithm for the identification of strong wind systems.
Based on this composite analysis we further identify variability patterns for each growth factor most important for the transformation of a cyclone into a surface wind storm. We thus also address the question whether the link between storm intensity and related growth factor anomaly taking into account its spatial variability is stable and can be quantified.

While the robustness of our preliminary results is generally dependent on the growth factor investigated, some examples include i) the overall availability of latent heat seems to be less important than its spatial structure around the cyclone core and ii) the variability of upper-tropospheric baroclinicity appears to be highest north of the surface position of the cyclone, especially for those that transform into a surface storm.