

Extra-tropical cyclone intensity: comparing different measures and different regions

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Text Abstract

Extra-tropical cyclones commonly occur in the mid-latitudes and can cause heavy precipitation and strong winds. In current climate model predictions it is unclear how the strength and number of these storms will change. One challenge is how to quantify the “strength” of an extra-tropical cyclone. Typically very dynamical measures are used, for example, the maximum vorticity or minimum mean sea level pressure, however these diagnostics may not always provide useful information about the impacts of extra-tropical cyclones.

The aim of this study is to compare different measures of extra-tropical cyclone intensity to each other in different regions (western Atlantic, eastern Atlantic, Europe) and to investigate if there are any trends in any measures of extra-tropical cyclone intensity. This aim is addressed using ERA5 reanalysis data from 1979 – 2020. All extra-tropical cyclones are identified and tracked based on the smoothed 850-hPa relative vorticity using the objective tracking software TRACK. Weak and stationary systems are removed from the analysis. For each identified extra-tropical cyclone, the high resolution maximum vorticity, minimum mean sea level pressure and maximum wind gusts within 3 and 6 degrees of the cyclone centre are computed. First, the distributions of these variables in different regions are analysed and compared to each other. Second, the linear relationships between these different measures of intensity are computed and bootstrapping is used to determine if the correlations differ between different geographic regions. Lastly, the time periods 1979 – 2000 and 2001 – 2020 are compared.

The results show that in terms of both maximum vorticity and minimum mean sea level pressure, cyclones in Europe are weaker than those in either the eastern Atlantic or western Atlantic. Stronger cyclones are found in the eastern than western Atlantic, but this result is only statistically significant when minimum MSLP is considered – not when maximum vorticity is. Since 1979, parameters such as wind speed, minimum MSLP and maximum vorticity, seem to indicate a trend of stronger cyclones in the western Atlantic and weaker cyclones in Europe, although the correlation is only weak to moderate. Regressions between variables are different in all the regions all regions and all time-periods. These results and others will be discussed in this presentation.