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Why do some Recurving Tropical Cyclones Impact Europe as Post-Tropical Cyclones?

Elliott Sainsbury[1], Reinhard Schiemann[2], Kevin Hodges[2], Alexander Baker[2], Len Shaffrey[2], and Kieran Bhatia[3]

[1]University of Reading, Meteorology, United Kingdom of Great Britain – England, Scotland, Wales (e.sainsbury@pgr.reading.ac.uk)
[2]National Centre for Atmospheric Science, University of Reading, Reading, United Kingdom (alexander.baker@reading.ac.uk)
[3]Guy Carpenter, New York, USA (kieran.bhatia@gmail.com)

Post-tropical cyclones (PTCs) are often associated with high winds and extreme precipitation over Europe. For example, ex-hurricanes Debbie (1961) and Ophelia (2017) were both responsible for national wind speed records in Ireland, and further east across Europe, ex-hurricane Debby (1982) caused significant wind damage over Finland. In previous work, we show that despite comprising only 1% of European impacting cyclones during hurricane season, almost 10% of those cyclones with storm force (>25ms^{-1}) are PTCs, indicating that PTCs are disproportionately responsible for European windstorm risk.

By tracking and identifying observed TCs in two reanalyses, we explore the physical drivers for recurving TCs impacting Europe. Our methods of cyclone tracking and TC identification allow for a detailed analysis of the post-tropical stage of the TCs in the observational record, allowing us to separate the recurving TCs based on whether they impact Europe.

Using a composite analysis, we show that recurving TCs which impact Europe are significantly stronger at their lifetime maximum intensity, and for several days during and after extratropical transition. They are also 65% more likely to reintensify in the midlatitudes after completing extratropical transition. The Europe impacting recurving TCs interact more favourably with an upstream upper-level trough, which steers the TCs on a more poleward trajectory across a midlatitude jet streak. It is during the jet streak interaction that extratropical reintensification often occurs.

We show that TC lifetime maximum intensity and whether extratropical reintensification occurs both modulate the likelihood that a recurving TC will impact Europe as a PTC. Our results highlight the challenges of projecting PTC impacts over Europe in a future climate. Some climate model projections indicate a poleward shift in the jet, possibly indicating less opportunity for recurving TCs to interact with the jet and reintensify. However, sea surface temperatures are projected to warm, and lifetime maximum intensity may therefore increase. If the change in TC intensity outweighs any poleward shift in the jet, then a larger proportion of recurving TCs could reach

Europe in the future.