

On the Existence of Dependence between Frequency and Intensity of North Atlantic Extra-Tropical Cyclones

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Key Questions:

- Are the frequency and intensity of wintertime extra-tropical cyclones in the North Atlantic truly independent?
- If contiguous regions of dependence exist, how are they related to other features of the storm track?

Motivation:

Mailier (2006) found significant evidence of clustering in time of extra-tropical cyclones in the exit region of the North Atlantic storm track over Northwest Europe and Vitolo (2009) found that this clustering increased for the most intense cyclones.

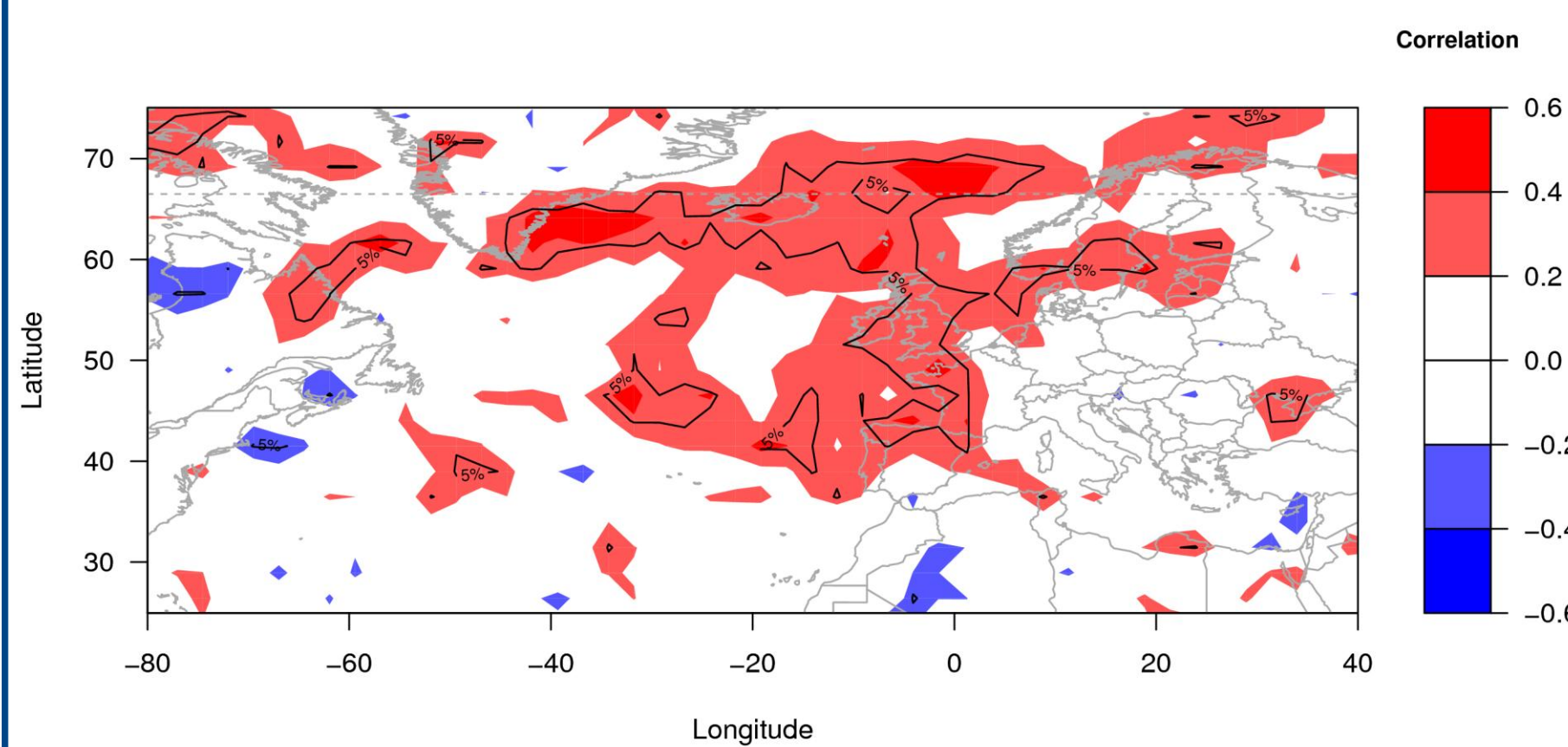
This suggests the existence of a region in which the frequency and intensity of cyclones may not be independent which could have important implications for the insurance industry.

Data:

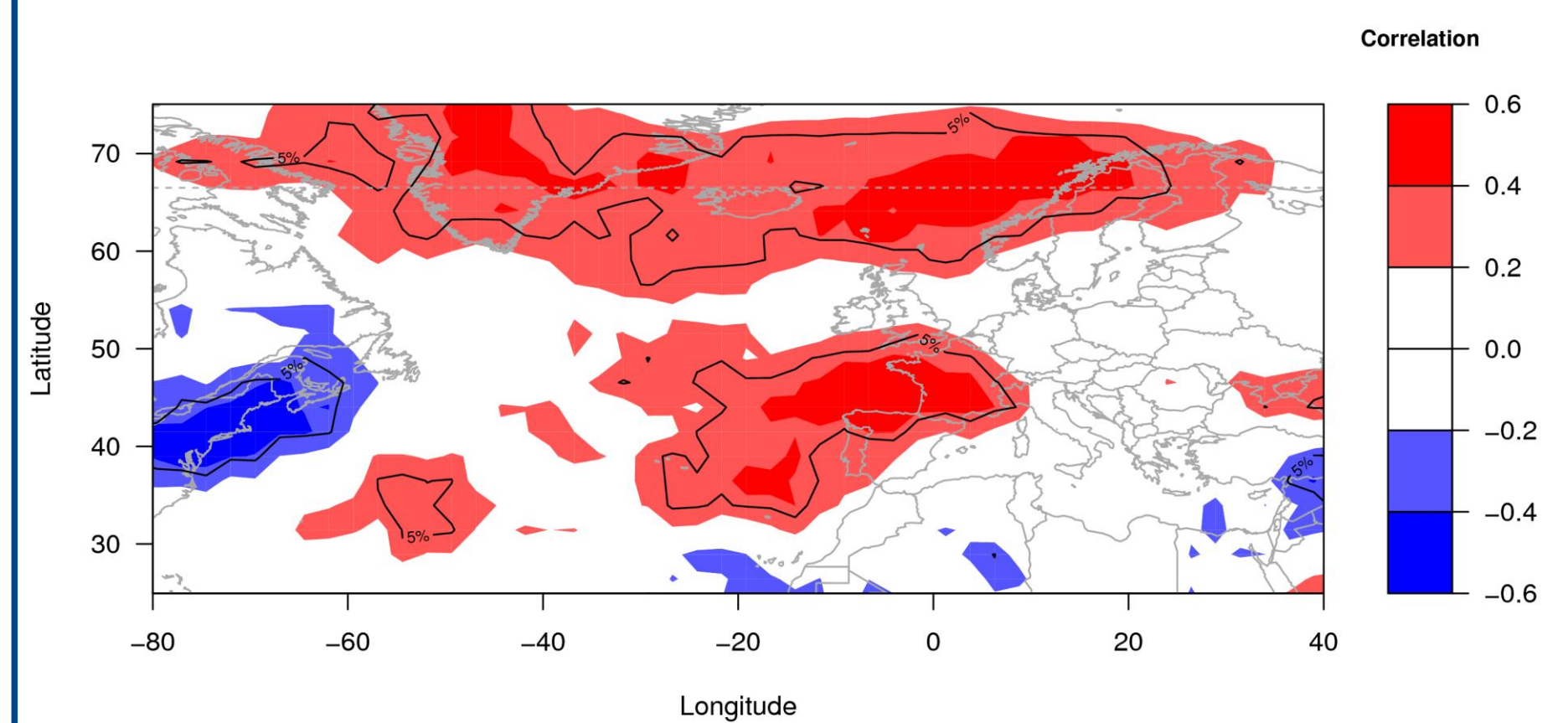
ERA-40 reanalysis data is used for this analysis giving a time series of 43 DJF winters.

Method:

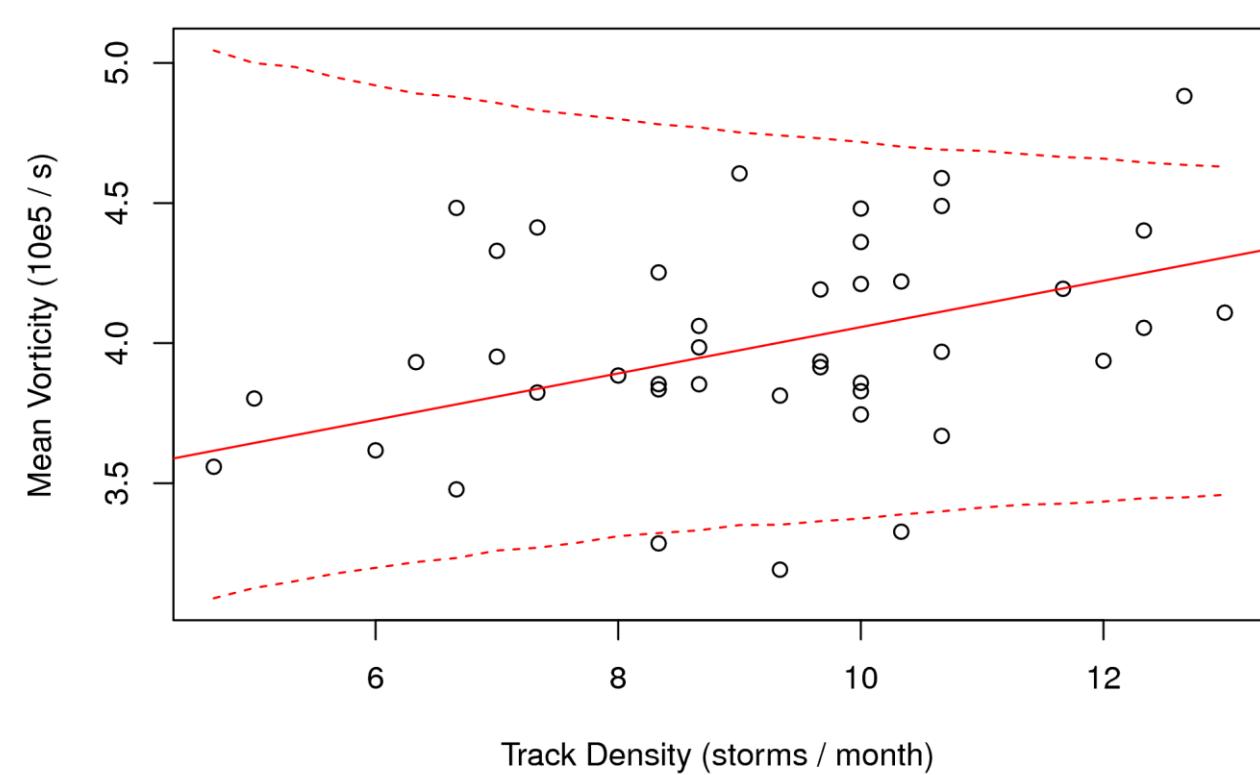
- Hodges' TRACK algorithm is used to identify individual storms in the T42 ξ_{850} field with a 6 hour time step.
- Track density is estimated by counting the number of unique storms with a feature point within 9° of each estimation point.
- Mean intensity is estimated as the mean value of the T42 ξ_{850} of all feature points within 9° of each estimation point.
- Track density & mean intensity are calculated for each DJF winter and then Pearson's correlation coefficient is calculated at each estimation point over all winters.



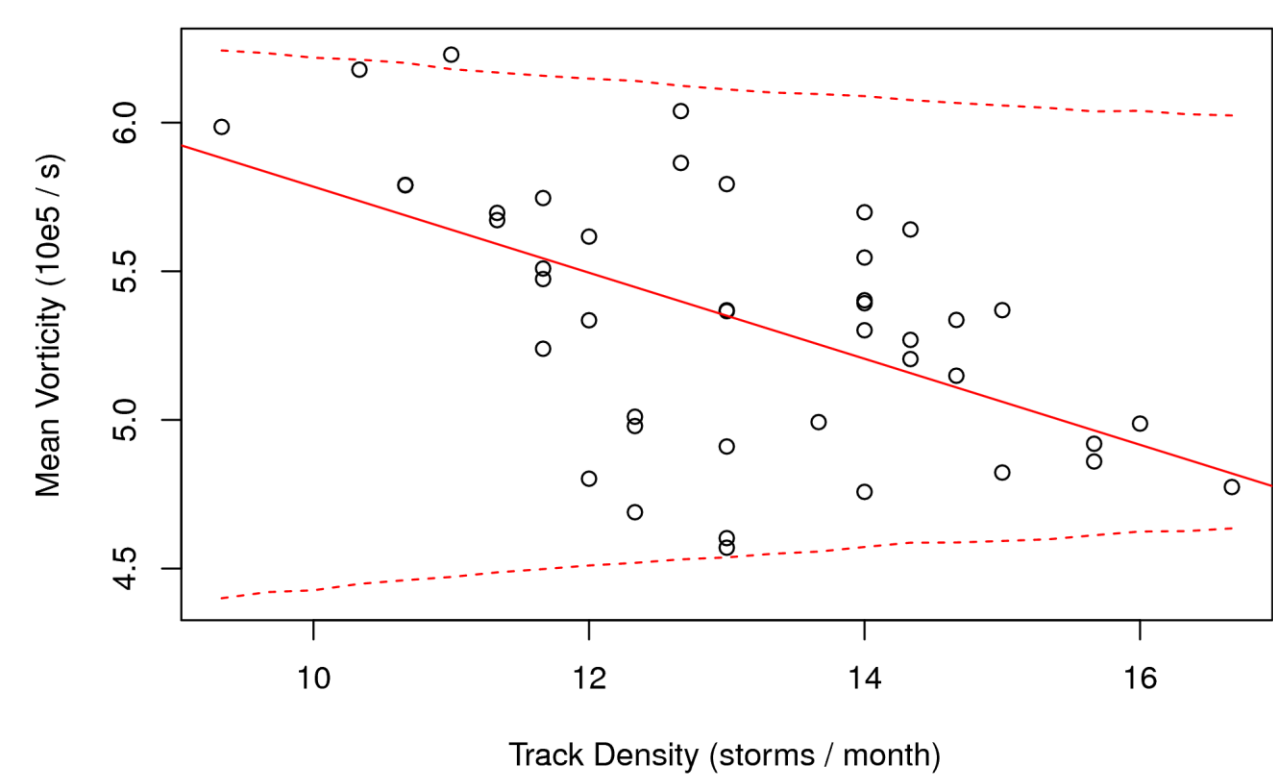
A contiguous region of positive correlation coalesces at a bandwidth of $\sim 4^\circ$, it stretches from Greenland to Scandinavia and South across the UK, France and Northern Spain. Contour indicates significant correlation at the 5% level.



If a wider bandwidth of 9° is used the two bands separate resembling the preferred jet positions of Woolings (2010). The region of negative correlation also increases over the genesis region off the eastern seaboard of the United States.



A clear positive relationship is visible in the winters of an estimation point between La Rochelle and Nantes. Confidence intervals are estimated under an assumption of independence by resampling entire tracks as in Hodges (2008).



A clear negative relationship is also visible in the winters of an estimation point between New York and Boston.