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European Winter Storm Frequency in Relation to North Atlantic Sea Surface Temperature in the Previous Autumn

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Seasonal prediction systems have recently been shown to be able to successfully forecast windstorm frequency over parts of the North Atlantic and Europe. Reliable forecasts will certainly have great social and economical benefits as winter windstorms are the most costly peril in major European countries. The reason why the analysed seasonal models achieve skill remains however to be determined.

In this study we investigate the potential predictability of windstorm frequency in winter related to the so-called “Horseshoe Pattern” in sea surface temperatures (SST) of the North Atlantic in the previous summer and autumn. This Horseshoe Pattern can influence the North Atlantic Oscillation in the subsequent winter as previously shown. We will extent these studies by analysing the influence on windstorm-generating conditions and windstorm frequency in winter. For our analyses we use reanalyses, an AMIP-type sensitivity experiment and a state-of-the-art seasonal prediction model. We will thus be able to i) quantify the windstorm variability explained by that Horseshoe Pattern, ii) find physical mechanism linking SST and windstorm frequency, and iii) analyse whether such a relation is present in seasonal models.

We make use of the Horseshoe Index (HSI) as a measure for the strength of the SST anomaly. In both reanalyses ERA 40 and ERA Interim high HSI values in late summer and autumn (Aug-Oct) lead to more windstorms over large parts of Europe in winter (DJF). In early winter mid-tropospheric geopotential waves with wavelengths below 3000km show generally greater amplitudes in years with high HSI values. Composite analyses of the Maximum Eady Growth Rate confirm higher baroclinic wave activity in these years. The sensitivity experiments using the AGCM ECHAM5 support this hypothesis. First results using ECMWF – System 4 show a similar relation of the HSI to windstorm frequency albeit of smaller magnitude.