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North Atlantic jet variability: bridging the weather and climate perspectives

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Jet streams exhibit large variability over a range of time scales, influencing both global climate and regional weather. They steer cyclones in the storm tracks, altering the exchange of heat with the underlying ocean as well as precipitation and evaporation patterns.
The North Atlantic jet is mainly eddy-driven, with characteristic north-south fluctuations on synoptic time scales as captured in part by the North Atlantic Oscillation (NAO) index.
However, during special periods, the dynamics of the North Atlantic jet can change - for example, during the 2009/2010 winter, it took on the attributes of a merged jet, which is both eddy-driven and thermally driven.
The merged North Atlantic jet is extremely zonal, shifted equatorward by about 8° latitude relative to its climatological mean position, and is linked to cold and dry conditions over Northern Europe.

In this study, we bridge the weather and climate perspectives and show that such altered dynamical behaviour of the North Atlantic jet occurs not only on longer (monthly or seasonal) time scales, but also on synoptic time scales.
We identify weaker eddy forcing and slightly increased persistence in the North Atlantic sector during merged jet periods, associated with changes in the storm track, cold air outbreaks, and atmosphere-ocean heat exchange. In addition, we find indications of enhanced heating over warmer sea surface temperatures in the tropical Pacific that may act as remote source of thermal driving.
These results help provide context for interpreting both observed North Atlantic variability from synoptic to seasonal time scales and simulated jet changes under global warming. Our findings also have potential implications for understanding biases in climate models, many of which simulate an overly zonal and extended North Atlantic jet.