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Evaluating the relative contribution of stratospheric and tropospheric drivers for the North Atlantic jet response after sudden stratospheric warmings

Hilla Gerstman[1], Bernat Jimenez-Esteve[1], and Daniela I.V. Domeisen[1,2]
[1]ETH Zurich, Institute for Atmospheric and Climate Science, Zurich, Switzerland (hilla.gerstman@env.ethz.ch)
[2]University of Lausanne, Lausanne, Switzerland

Sudden stratospheric warmings (SSWs) are extreme stratospheric events which can be followed by a significant impact on surface weather. Roughly two thirds of the observed SSW events are followed by an equatorward shift of the tropospheric midlatitude jet in the North Atlantic, while a third of the events generally show a poleward jet shift. However, it is not yet resolved which factors lead to the large inter-event variability in the surface impact.

Here, the sensitivity of the North Atlantic jet response to stratospheric forcing is investigated using an intermediate complexity atmospheric model. We analyze the contribution of different stratospheric and tropospheric drivers for determining the downward response, focusing on persistent anomalies in the lower stratosphere, downstream influence from the northeastern Pacific, and local tropospheric conditions in the North Atlantic at the time of the initial response. Both the model and reanalysis show that most of the variance in the tropospheric jet response after SSW events can be explained by the lower stratospheric geopotential height anomalies. To isolate the role of the stratosphere from tropospheric variability, we use model runs where the zonal mean stratospheric winds are nudged towards climatology. When stratospheric variability is suppressed, the coupling between the North Atlantic and the northeastern Pacific is found to be weaker.

These findings shed light on the relative contribution of the stratosphere and the troposphere to the diverse downward impacts of SSW events. The implications of these results for improved long-range prediction of tropospheric jet variability the North Atlantic will be discussed.