Understanding the role of the troposphere in the surface impact of the 2018 sudden stratospheric warming event

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Sudden stratospheric warmings (SSWs) are impressive phenomena that consist of a rapid stratospheric polar vortex breakdown. SSWs can have a strong impact on the tropospheric weather and are mainly associated with the negative phases of the Arctic and North Atlantic Oscillations (AO, NAO), and with northern European cold outbreaks, thus causing high societal impact. However, the mechanisms behind the downward impact from the stratosphere are insufficiently understood, especially the role played by the troposphere. In this work, we investigate this coupling and its associated predictability limits by studying the 2018 SSW event.

By analyzing ECMWF 15-day ensemble forecasts and partitioning them into different weather regimes, we search for possible dynamical tropospheric events that may have favored the downward stratosphere-troposphere coupling during and after the SSW. It is found that two cyclogenesis events were the main drivers of the negative NAO pattern associated with a Greenland Blocking, causing a rapid change from prevailing westerlies into a blocked state in the North Atlantic region. Unless these cyclogenesis events are simulated in the forecasts, the prediction of a Greenland Blocking does not become highly prevalent. No important stratospheric differences between WRs were found. A possible oceanic contribution to this blocked state is also found. This work corroborates that individual synoptic events might constitute a “predictability barrier” for subsequent forecast lead times. It also sheds light, on the specific topic of troposphere-stratosphere coupling.