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Stratospheric Warming Events Affect Winter North Atlantic Storm Tracks and European Hydrological Cycle

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Impact of stratospheric dynamics on the troposphere represents an important driver of climate variability near the surface with strong implications for extreme weather and climate events. In this respect, Sudden Stratospheric Warming (SSW) events provide one of the most critical impacts on the troposphere, specifically when the disruption of the Polar Vortex results in the equator-ward shift of the North Atlantic tropospheric storm track.
We analyze 21 SSWs (derived from ERA-interim dataset) identified during the winter months (NDJF) for the period from 1979 to 2016. Further, we consider the responses in the positioning of the North Atlantic storm track, Atlantic-to-Europe mid-latitude moisture transports, European precipitation and soil moisture to SSW events. Storm tracks were identified using numerical tracking algorithm applied to different reanalysis. Moisture transports were computed using 3D reanalysis output and precipitation analysis was based on the rain gauge station data from the ECA collection.
We demonstrate robust immediate responses of the storm tracks (southward shift) to the SSW events which are evident for 30-day periods prior and after the SSW episodes. The analysis shows that these responses cannot be attributed to the seasonal winter-to-summer migrations of the North Atlantic storm tracks and can be only explained by SSW. We show that these shifts are closely coordinated with the changes in the major pathways of the moisture transport from the North Atlantic to Europe and in the patterns of European precipitation (including extreme rainfalls) and soil moisture.
As the SSW events can be precisely detected, our results imply that European hydroclimate extremes can be predictable on time scales of several weeks, going far beyond the range of mid-latitude weather forecasts.
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