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Seasonal Predictability over Europe arising from El Nino and Stratospheric Variability in the MPI-ESM Seasonal Prediction System

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Predictability on seasonal timescales over the North Atlantic / Europe region is assessed using a seasonal prediction system based on an initialized version of the Max Planck Institute Earth System Model. For this region, two of the dominant predictors on seasonal timescales are the El Niño Southern Oscillation (ENSO) and sudden stratospheric warming (SSW) events. Multiple studies have shown a potential for improved North Atlantic predictability for either predictor. Their respective influences are however difficult to disentangle, since the stratosphere is itself impacted by ENSO. Both El Niño and SSW events correspond to a negative signature of the North Atlantic Oscillation (NAO), which has a major influence on European weather.

This study explores the impact on Europe by separating the stratospheric pathway of the El Niño teleconnection. In the seasonal prediction system, the evolution of El Niño events is well captured for lead times of up to 6 months, and stratospheric variability is reproduced with a realistic frequency of SSW events. The model reproduces the El Niño teleconnection through the stratosphere, involving a deepened Aleutian Low connected to a warm anomaly in the Northern winter stratosphere. The stratospheric anomaly signal then propagates downward into the troposphere through the winter season. Predictability of 500hPa geopotential height over Europe at lead times of up to 4 months is shown to be increased only for El Niño events that exhibit SSW events, and it is shown that the characteristic negative NAO signal is only obtained for winters also containing major SSW events for both the model and the reanalysis data.