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Tracing North Atlantic Oscillation Forecast Errors to Stratospheric Origins, with a new analysis of the 2021 winter

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The North Atlantic Oscillation (NAO) is the main driver of weather variability in parts of Eurasia, Greenland, North America, and North Africa on a range of time scales. Successful extended-range NAO predictions would equate to improved predictions of precipitation and temperature in these regions. It has become clear that the NAO is influenced by the stratosphere, but because this downward coupling is not fully reproduced by all forecast models the potential for improved NAO forecasts has not been fully realized. Here, an analysis of 21 winters of subseasonal forecast data from the European Centre for Medium-Range Weather Forecasts monthly forecasting system is presented. By dividing the forecasts into clusters according to their errors in North Atlantic Ocean sea level pressure 15-30 days into the forecasts, we identify relationships between these errors and the state of the stratospheric polar vortex when the forecasts were initialized. A key finding is that the model overestimates the persistence of both the negative NAO response following a weak polar vortex and the positive NAO response following a strong polar vortex. A case in point is the sudden stratospheric warming in early 2019, which was followed by five consecutive weeks of an overestimation of the negative NAO regime. A consequence on the ground was temperature predictions for northern Europe that were too cold. In this talk, we include a new analysis of the temperature prediction performance following the January 2021 sudden stratospheric warming. Another important finding is that the model appears to misrepresent the gradual downward impact of stratospheric vortex anomalies. This result suggests that an improved representation and prediction of stratosphere-troposphere coupling in models might yield substantial benefits for extended-range weather forecasting in the Northern Hemisphere midlatitudes.