

Observed and simulated precursors of stratospheric polar vortex anomalies in the Northern Hemisphere

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The Northern Hemisphere stratospheric polar vortex is linked to surface weather. After Stratospheric Sudden Warmings in winter, the tropospheric circulation is often nudged towards the negative phase of the Northern Annular Mode (NAM) and the North Atlantic Oscillation (NAO). A strong stratospheric vortex is often associated with subsequent positive NAM/NAO conditions. For stratosphere-troposphere associations to be useful for forecasting purposes it is crucial that changes to the stratospheric vortex can be understood and predicted. Recent studies have proposed that there exist tropospheric precursors to anomalous vortex events in the stratosphere and that these precursors may be understood by considering the relationship between stationary wave patterns and regional variability. Another important factor is the extent to which the inherent variability of the stratosphere in an atmospheric model influences its ability to simulate stratosphere-troposphere links. Here we examine the lower stratosphere variability in 300-year pre-industrial control integrations from 13 coupled climate models. We show that robust precursors to stratospheric polar vortex anomalies are evident across the multi-model ensemble. The most significant tropospheric component of these precursors consists of a height anomaly dipole across northern Eurasia and large anomalies in upward stationary wave fluxes in the lower stratosphere over the continent. The strength of the stratospheric variability in the models was found to depend on the variability of the upward stationary wave fluxes and the amplitude of the stationary waves.