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Observed and simulated precursors of Northern Hemisphere stratospheric vortex anomalies

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The strength and location of the Northern Hemisphere (NH) stratospheric polar vortex are linked to weather developments in the troposphere. Previous studies have shown that during the first 60 days after the onset of anomalous weak stratospheric vortex regimes in winter, the large-scale tropospheric circulation is nudged towards the negative phase of the Northern Annular Mode (NAM) and the North Atlantic Oscillation (NAO). A strong stratospheric vortex is associated with subsequent positive NAM/NAO conditions. The degree of usefulness of stratosphere–troposphere associations for predictive purposes depends on whether or not changes to the stratospheric vortex can be understood and predicted in advance. Recently, Garfinkel et al. proposed a new framework for identifying precursor patterns to major disturbances to the wintertime polar vortex. They suggested that these precursors could be understood by considering the relationship between the stationary wave pattern and the anomalous regional variability in the NH. Another important factor in understanding the stratosphere-troposphere links is the extent to which the inherent variability of the stratosphere in an atmospheric model influences its ability to simulate these links. Models differ greatly in their abilities to reproduce observed stratospheric variability, and these abilities appear not to depend simply upon the models' upper lid height or their stratospheric resolution. In this study, we examine the variability of the lower stratosphere in 300-year pre-industrial control integrations, with no volcanic or greenhouse gas forcing, from 13 CMIP3 coupled climate models. We show that: 1) Robust precursors to stratospheric variability events are evident across the multi-model ensemble, and 2) Comparisons of stratospheric variability across the ensemble enable us to develop tentative hypotheses about the role of the troposphere in determining the stratospheric vortex variability.