Title: Evaluating the Impacts of Eurasian Snow Cover Variability on Wintertime Stratosphere-Troposphere Coupling in the CFSv2 Model

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Abstract

The Arctic Oscillation (AO) is the leading mode of winter lower tropospheric climate variability in the Northern Hemisphere (NH). The AO is also the leading mode of variability in the stratospheric polar vortex, and changes in the polar vortex strength precede persistent changes in the NH surface climate. Among several hypotheses governing changes in the AO, recent evidence suggests that slowing-varying surface boundary conditions, particularly snow cover over Eurasia, strongly affects the evolution of the AO in the winter through the following steps: (a) enhancement of tropospheric vertically propagating waves induced by the snow cover; (b) weakening of the stratospheric polar vortex from anomalous wave-breaking; and (c) downward propagation of those stratospheric circulation anomalies into the troposphere.

We have been evaluating the Eurasian snow-AO relationship described by this framework in the CFSv2 model and comparing those results to the suite of models used for the Coupled Model Intercomparison Project Phase 5 (CMIP5). First, Eurasian autumn snow cover variability (i.e., the time of most rapid advance in areal snow cover on the continent) in the CFSv2 is compared to that in observations. Next, the atmospheric response to the snow cover changes are presented, particularly changes in the tropospheric jet stream and associated changes in Rossby wave generation that vertically propagate into the stratosphere. Then, relations between snow cover variability and the strength of the NH winter stratospheric polar vortex are diagnosed as a way of assessing the impact of the changes in the tropospheric circulation on the stratospheric circulation in the CFSv2 model. The evolution of the wintertime AO at the surface and its relation to the induced changes in vertically propagating waves and Eurasian snow cover are also evaluated. Collectively, the results presented will offer evidence of which parts of the proposed pathway are poorly captured in the model. Furthermore, the results can also be directly compared to similar analyses done with the CMIP5 suite of models.