ABSTRACT 1

Stratospheric influence on the extratropical circulation response to surface forcing in high-top and low-top models

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Variability in the spatial extent of fall season Eurasian snow cover has been linked in observations to a teleconnection with the winter Northern Annular Mode pattern. Here, the dynamics of this teleconnection are investigated in 100-member ensembles of transient integrations using "high-top" and "low-top" versions of the GFDL AM2 general circulation model (i.e., with and without a well-resolved stratosphere). The models are perturbed with a simple persisted snow anomaly over Siberia and integrated from October through December. A planetary wave response to the surface forcing drives wave-mean flow interaction in the lower stratosphere and subsequent downward propagation of a negative phase Northern Annular Mode response back into the troposphere. The high-top model exhibits a faster and weaker response to the snow forcing than the low-top model. The difference between the models is tied to their representation of the seasonal cycle in lower-stratospheric zonal winds, which provide a waveguide for the response to snow forcing.

ABSTRACT 2

The influence of snow albedo feedback on the atmospheric circulation under climate change among IPCC AR4 models.

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Recent work has shown that climate change will cause reductions in the amount and spatial extent of snow cover on land, which will exert a local influence on the atmosphere and the hydrology of snow-margin areas. A significant fraction of variability among IPCC AR4 general circulation model (GCM) predictions for future climate change over these areas has been shown to be related to the models' representation of the snow-albedo feedback (SAF) mechanism. We present new work investigating the robustness of snow-atmosphere interaction among GCM simulations. Our results suggest that SAF also exerts a control over the nonlocal atmospheric response to climate change. Increased surface warming in models with higher SAF is associated with a characteristic Rossby wave response and a poleward intensified jet. A significant fraction of the spread in GCM predictions of changes in, for example, the position and strength of the zonal jets, may be controlled by SAF.