

Predictability of the Stratospheric Polar Vortex Breakdown: An Ensemble Reforecast Experiment for the Splitting Event in January 2009

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A series of ensemble reforecast experiments is conducted to investigate the predictability and the occurrence mechanism of a stratospheric sudden warming occurred in late January 2009, which is a typical polar vortex splitting event. To fully examine the rapid vortex-splitting evolution and predictability variation, ensemble forecasts are carried out every day during January 2009.

The vortex-splitting event is reliably predicted by forecasts initialized after 6 days prior to the vortex break up. It is also found that the propagating property of planetary waves within the stratosphere is a key to the successful prediction for the vortex-splitting event. Planetary waves incoming from the troposphere are reflected back into the troposphere for failed forecasts, whereas they are absorbed within the stratosphere for succeeded forecasts. Composite analysis reveals the following reflection process of planetary waves for the failed forecast: Upward propagation of planetary wave activity from a tropospheric blocking over Alaska is weaker during initial prediction periods; then, the deceleration of the zonal wind in the upper stratosphere becomes weaker over Europe, which produces a preferable condition for the wave reflection; hence, subsequently incoming wave activity from the troposphere over Europe is reflected back over the Siberia inducing the eastward phase tilt of planetary waves, which shuts down the further upward propagation of planetary waves leading to the vortex splitting.

Thus, this study shows that the stratospheric condition would be another important control factor for the occurrence of the vortex splitting event, besides anomalous tropospheric circulations enforcing upward propagation of planetary waves.

Key words: predictability, stratospheric sudden warming, ensemble forecast

Reference

Noguchi, S., and Coauthors, 2016: *J. Geophys. Res. Atmos.*, **120**, 3388-3404.