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Predictability of Stratosphere-Troposphere Dynamical Coupling Examined by Ensemble Forecast Datasets

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We have examined the dynamics and predictability of several aspects of the stratosphere-troposphere dynamical coupling based on ensemble forecasts datasets such as the Japan Meteorological Agency (JMA) operational 1-month ensemble forecast dataset and a series of ensemble reforecast experiments by using MRI (Meteorological Research Institute) AGCM.

First, we show prolonged predictability of a stratospheric sudden warming (SSW) event occurring in December 2001, which was a typical vortex displacement SSW. This warming is found to be predictable at least 2 weeks in advance due to persistence of a prominent blocking event over the Atlantic. We also find high sensitivity of the prediction skill of the SSW to the initial condition. The causal relationship between the Atlantic blocking and the succeeding SSW is dynamically confirmed by a series of reforecast experiments with the MRI AGCM. For the initial condition of the experiment, the regressed anomaly field with respect to the succeeding temperature increase in the polar stratospheric region computed from the JMA operational 1-month ensemble forecast is superposed on the ensemble-mean field. From this experiment, we find that the SSW will occur spontaneously when the specified amplitude of the regressed anomaly field resembling the Atlantic blocking exceeds a threshold value, otherwise the stratospheric polar vortex remains strong.

Second, we will also examine the predictability of the reflection of stratospheric planetary waves occurring just after a SSW of March 2007. Although the observed evidence of this reflection event was already reported in detail by Kodera, Mukougawa, and Itoh (2008), a precursory phenomenon and the necessary condition of the stratospheric circulation for the occurrence of the reflection of the stratospheric planetary waves have not been elucidated. A series of reforecast ensemble experiment using the MRI AGCM will unveil the detailed mechanism of the reflection of stratospheric planetary waves.