Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

AAS22-P13 会場:コンベンションホール 時間:5 月 21 日 17:00-18:30

成層圏-対流圏結合系における冬季極渦変動に伴う予測可能性変動について
Predictability variations in a stratosphere-troposphere coupled system associated with winter polar vortex conditions

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Predictabilities of sudden stratospheric warming (SSW) events have been examined by the use of operational ensemble one-month forecast data produced by the Japan Meteorological Agency (JMA) (e.g., Mukougawa et al. 2005; Hirooka et al. 2007). However, they are case studies limited to a few SSW events.

In this study, intraseasonal and interannual variations in predictability of temperature inside the polar vortex in the northern hemispheric winter are investigated for seven winters of 2001/02 to 2007/8 by the use of the JMA forecast data. The ensemble one-month forecast is performed every Wednesday and Thursday from a control initial condition and several couples of perturbed conditions with both signs. In total, 26 or 50 ensemble members are taken for a week with a time-lagged (one-day) ensemble technique. The seven-winter period includes four SSW events and some minor ones.

Several measures on the predictability of the ensemble forecasts are introduced to study the predictability variations associated with dynamical conditions of the polar vortex, which are related to SSW events or vortex intensification events. Predictability limit is defined using the root mean square error as the time when it first surpasses one half of the climatological standard deviation in winter for a statistical analysis of its seasonal variation. On average, the predictability limit in the stratosphere is longer (about 10 days) than that in the troposphere (about 5 days). Its seasonal variation is large in the middle stratosphere; relatively long in early and late winter, whereas relatively short in midwinter.

The occurrence of some SSW events is well predicted by a large part of the ensemble members with a lead time of one week or so, whereas that in some other cases is more difficult to predict. We also have some examples of the predictions of an SSW event but no realization in the real atmosphere: the real world is in the other tail of the probability distribution of the ensemble forecasts of an SSW event. The occurrence or non-occurrence of such extreme events is discussed with probability distribution functions that have large non-Gaussian nature.

キーワード: 成層圏循環, 予測可能性, 突然昇温, １ヶ月アンサンブル予報
Keywords: stratospheric circulation, predictability, sudden warming, ensemble one-month prediction