



Predictability of stratospheric sudden warming in the Northern Hemisphere: A case study for 2003/04 Winter

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Predictability of the major stratospheric sudden warming in early January 2004 is carefully compared with that in late December 2001 using the Japan Meteorological Agency (JMA) ensemble one-month forecast data and discuss important factors giving rise to the sudden warmings. The 2001 warming event was brought about by the amplification of zonal wavenumber (WN) 1 components without pre-conditioning following a cold and undisturbed early winter. On the other hand, the 2004 warming occurred shortly after a pronounced minor warming in late December 2003. In this case, the intensification of WN1 first caused the weakening of the polar vortex and brought about the minor warming. After incomplete reestablishment of the polar vortex, the second intensification of WN1 gave rise to a major WN1-type warming, under significant helping of the high pressure originated in mid-latitudes, which contributed to wave components smaller than WN1. Hence, the situation of the latter warming seems to be rather complicated.

Such a difference in time evolution of the warmings also affects their predictability as follows. Concerning the 2001 warming event, the stratospheric warming in the polar region is predictable at least from two weeks in advance; All ensemble members successfully predicted the temperature change in terms of timing as well as its magnitude. In case of the 2004 warming event, however, almost all ensemble members starting from two weeks in advance failed the temperature change accomplished with the warming event, suffering from the previous minor warming. Moreover, it is found that the minor warming itself was also imperfectly predicted from two weeks in advance. Such limited predictability could be related to more complicated stratosphere-troposphere dynamical interaction during the 2004 warming period.