Frontal structure and gravity waves observed during stratospheric sudden warming events

Yukari SUMI[1] and Kaoru SATO[1]

[1] *Department of Earth and Planetary Science, The University of Tokyo, Tokyo, Japan*

It is well known that the stratospheric sudden warming (SSW) is caused by an enhanced downwelling associated with the Lagrangian mean flow driven by strong planetary wave forcing (Matsuno 1971). Recent studies suggest that gravity waves (GWs) can also affect the evolution of the SSW, although their role and origin have not yet been fully understood (e.g., Tomikawa et al. 2012, Ern et al. 2016). We investigate the characteristics of GWs in the Arctic winter stratosphere during the SSW events in 2016 and 2017.

The synoptic-scale structure of the stratosphere is analyzed by using MERRA-2 reanalysis data. During the SSW in 2016, a front-like temperature structure is observed between anomalously warm and cold areas. In this study, the front is defined as a boundary where the horizontal gradient of temperature is significantly maximized. The temperature gradient reaches its maximum slightly prior to the SSW event in the pressure range between 40 hPa and 2 hPa, namely with a depth of about 10–20 km. It is also seen that the polar vortex area becomes small during the SSW and that the front is located near the vortex edge.

Temperature fluctuations associated with GWs are extracted by applying a highpass filter to individual vertical profiles of the temperature from COSMIC. A cutoff wavelength of 6 km is used for the highpass filter, which is shorter than used in previous studies. This is essential because longer cutoff wavelengths (> 10 km) may allow non-negligible contamination from the front-like structure. The GW amplitudes are larger near the front and smaller in the vortex core. As the front-like structure is located near the vortex edge, this result is roughly consistent with the previous studies (e.g., Wang and Alexander 2010).

Key words: stratospheric sudden warming, gravity wave

References

Matsuno, T, 1971: *J. Atmos. Sci.*, **28**, 1479-1494.

Tomikawa, Y., et al. 2012: *J. Geophys. Res.*,**117,** D16101

Ern, M., et al. 2016: *Atmos. Chem. Phys. Discuss.*, **16**, 9983-10019

Wang., L., and M. J. Alexander, 2010: *J. Geophys. Res.*, **115**, D21