Stratospheric front-like temperature structure and gravity wave activity during a stratospheric sudden warming event in 2016

*Yukari Sumi[1], Kaoru Sato[1]

1. University of Tokyo

A large-scale front-like temperature structure is observed in the Arctic stratosphere during a stratospheric sudden warming (SSW) event in 2016. As reported by previous studies, it is shown that a stratospheric front with a vertical scale of about 15 km is formed near the polar vortex edge and vertically tilts toward a colder region. Moreover, we found that the front is the strongest a few days prior to the major warming and that a local maximum of temperature appears in the exit region of a jet streak. These characteristics of the front are roughly common among other SSW events. However, it is not clear as to why the front-like structure is strengthened during the SSW event, which still needs more observational analysis. In the present study, the semi-geostrophic system is considered to better understand the frontogenesis in the stratosphere. Q-vector and frontogenesis function are computed by using MERRA-2 reanalysis data. Near the front region, the geostrophic and ageostrophic parts of the frontogenesis function have large negative and small positive values, respectively. Therefore, it is suggested that the weakening of the front due to geostrophic flow is dominant over the strengthening of the front due to ageostrophic flow. The ageostrophic part is further separated into horizontal and vertical components. The vertical component is positive and significantly larger than the horizontal component. This result implies that the frontogenetic effect of the ageostrophic motion mainly comes from the vertical motion, which seems to be different from the tropospheric front: convergence of the horizontal ageostrophic wind is dominant for the tropospheric front because the vertical motion is suppressed near the ground surface. In addition, gravity wave (GW) activity near the front is examined by using dry temperature data from FORMOSAT-3/COSMIC satellite. The vertical wavelength of the GW is estimated from 1D-Stockwell transform (S-transform) for the temperature data. The S-transform spectra have a peak around 4–7 km in the vertical range between 25 and 35 km where the stratospheric front is the strongest.

Keywords: stratosphere, stratospheric sudden warming

