Role of gravity waves in the upper atmospheric temperature changes in association with sudden stratospheric warming

*Changsup Lee[1], In-Sun Song[1], Hwajin Choi[1], Jeong-Han Kim[1], Geonhwa Jee[1]

1. Korea Polar Research Institute

Fourier Transform Spectrometers (FTSs) at the Esrange space center (67°53′N, 21°04′E), Kiruna, Sweden and at the Dasan Korean Arctic station (78°55′N, 11°56′E), Svalbard, Norway have observed mesospheric air temperature from OH airglow emissions near 87 km height since November 2002. The FTS observations have provided simultaneous mesospheric temperature at the two different latitudes in association with elevated stratopause (ES) after major stratospheric sudden warming (SSW) events. ES-like phenomena and relevant warming have been simulated using global circulation models such as the whole-atmosphere community climate model (WACCM), but the model prediction is found to be much weaker mesospheric warming compared with the FTS and satellite observations especially in polar region such as the Dasan station. Considering that gravity waves (GWs) may have substantial impacts on the temperature and wind in the upper atmosphere, the discrepancy between observation and model may be attributed to common issues in GW parameterizations: Uncertainty in GW spectra and unrealism in GW propagation (i.e., columnar propagation). In this study, we investigate effects of the horizontal propagation and refraction of GWs on mesospheric warming associated with the ES after major SSW events using a ray-tracing model with specified GW spectra. Preliminary results for steady background flows show that the horizontal propagation and refraction increase westward GW momentum forcing near z = 100 km in the NH high latitudes that can induce downward motions and adiabatic warming in the NH polar regions below z = 100 km. Results are extended for time-varying background flows and different GW spectra to consider tidal effects and improve robustness of results, respectively.

Keywords: sudden stratospheric warming, gravity wave, ray tracing

