Different propagation characteristics of gravity waves in the mesosphere and lower thermosphere over Syowa and Davis, the Antarctic, using OH airglow imagers and MF radars

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Gravity waves transport momentum and energy from the lower atmosphere to the upper atmosphere, and drive the general circulation, which significantly change the temperature in the middle atmosphere [Fritts and Alexander, 2003]. Understanding this role quantitatively will improve the modern general circulation models.

The polar night jet region is known to contain regions of the high gravity wave activity. However, their source, propagation and intermittency are only poorly understood because of a lack of observations. To understand their source and propagation, our group has observed the gravity waves over Syowa (69˚S, 40˚E) using some instruments (e.g., lidar, OH imager and MF radar). We also compared the gravity waves over Syowa and Davis (69˚S, 79˚E), at which terrain and meteorological conditions are similar, to investigate their horizontal variation over the east Antarctic. We found, from the lidar temperature observations, that the vertical profile of gravity wave potential energy is similar between Syowa and Davis, except for a clear enhancement around 30-40 km over Davis [Kogure et al., 2017]. Horizontal propagation characteristics are more clearly observed by airglow imaging measurements of ~90 km altitude. The comparison of four imagers' results between April-May 2013 have indicated that the major propagation directions were west ward at three station (Syowa, McMurdo, Halley), but at Davis GWs seems to propagate all the directions, which is totaly different from the other three. [Matsuda et al., 2017]. It seems like the GWs over Davis did not experience the same wind filtering in the middle atmosphere.

The goal of this study is to compare the gravity waves over Syowa and Davis in many different ways and with more observational data. In this presentation, we will show the ground-based horizontal phase speed spectrum over the two stations derived from OH imagers in more details. We analyzed the OH airglow imager data obtaind for eight months (from March to October in 2016) over the two stations with M-transform [Matsuda et al., 2014]. We analyzed the data without clouds and aurora contaminations continuously for at least one hour. The numbers of nights with such data sets are 40 at Syowa and 55 at Davis. The seasonal variations of the nightly mean variance were very similar with winter maximum, but the variance over Syowa was significantly larger than that over Davis in September. The reason for a larger variance over Syowa in September was the existence of southward propagating gravity waves with the phase speed of ~10 - 80 m/s. In 2016, clear sky and aurora free data were available at both station on ten nights. Comparison of phase velocity spectra obtained on the same night showed similarity on at only one night out of ten nights. On five nights, the spectra were quite different. On the other four nights, the spectral peaks with slow westward phase velocity (> 50 m/s) were commonly observed but additional spectral peaks were found over Davis and not over Syowa. We will present comparisons of kinetic energy and propagation direction of gravity waves derived from MF radars, and compare with the results from OH imagers.

Keywords: MLT, Imager, Rader, Gravity wave, Spectral analysis, The Antarctic