Comparison of gravity wave characteristics in the OH layer over Syowa and Davis, the Antarctic, using OH airglow imagers

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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]. To understand this role quantitatively will improve the modern general circulation models [Garcia et al., 2017].

The polar night jet region is known to have high gravity wave activity. However, their sources and propagation are only poorly understood because of the lack of observations. To understand those, our group has observed the gravity waves over Syowa (69°S, 40°E) using various instruments (e.g., lidar, OH imager, and MF radar). We recently compared the gravity waves over Syowa and Davis (69°S, 79°E), which have similar terrain and meteorological conditions, to show their horizontal variation over the East Antarctic. We found, from the lidar temperature observations, that 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 westward at three stations (Syowa, McMurdo, Halley), but at Davis GWs seems to propagate in all the directions, which is different from the other three. [Matsuda et al., 2017]. It seems like the GWs over Davis did not suffer wind filtering in the middle atmosphere.

The goal of this study is to reveal what causes the difference of the mesospheric gravity wave characteristic over Syowa and Davis. In this study, we will show the ground-based horizontal phase speed spectrum at ~87 km altitude over the two stations derived from OH imagers in more details. We analysed the OH airglow imager data obtained for eight months (from March to October in 2016) over the two stations with M-transform [Matsuda et al., 2014]. This included only 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. In 2016, clear sky and aurora free data were available at both stations on ten nights. Comparison of phase velocity spectrum obtained on the same night showed very similar characteristics on only one night out of ten. 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 investigated, using raytracing method, where the gravity waves with common spectrum and additional spectrum on one of the four nights (29th Aug.), propagated from. This investigation suggested the common waves could propagate from the troposphere right below. On the other hand, the additional waves could propagate from the stratosphere over the sea. This presentation will show the results of OH imager observations and of the raytracing results, and we will discuss what causes the difference of the gravity wave characteristic over both stations.