Horizontal phase velocity distributions of Antarctic mesospheric gravity waves observed by airglow imager network (ANGWIN)

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Gravity waves, generated in the lower atmosphere, can propagate to the mesosphere and the lower thermosphere, and transport great amount of energy and momentum, and release them at various altitude regions. Among many parameters to characterize gravity waves, horizontal phase velocity is very important to discuss vertical propagation and where the momentum is released. Near the mesopause region, OH and other airglow imaging has been used for investigating the horizontal structures of gravity waves for more than two decades. Although the huge amount of the image data has been observed at various observation sites distributed globally, a time consuming manual procedure has been used for detailed data analyses of horizontal propagation characteristics. This causes difficulty in obtaining a global map of gravity wave characteristics in the mesopause region. Another important fact on the mesospheric gravity wave studies is that observations over the Antarctic region were quite rare despites a significant amount of gravity waves generated in this region.

ANGWIN (Antarctic Gravity Wave Imaging/Instrument Network) is an international airglow imager (and other instruments) network in the Antarctic, started in 2011. It seeks to reveal characteristics of mesospheric gravity waves, and to study sources, propagation, breaking of the gravity waves over the Antarctic and the effects on general circulation and upper atmosphere. In this study, we obtained horizontal phase velocity distributions of the gravity waves at around 90 km altitude over different locations using our new statistical analysis method using 3-D Fourier transform, developed by Matsuda et al. (2014). Results from the airglow imagers at four stations: Syowa (69S, 40E), Halley (76S, 27W), Davis (69S, 78E) and McMurdo (78S, 156E) out of the ANGWIN imagers have been compared, for the observation period between April 6 and May 21 in 2013. We have also compared the results at Syowa and Davis with blocking diagram using wind profiles from re-analysis data and MF radar data, and found that effect of wind filtering by critical level could only explain the directionality over Syowa. It suggests that gravity waves observed at Davis could be secondary waves generated above the polar night jet.