Comparison with horizontal characteristics of gravity waves observed by airglow imaging of different sampling periods

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Atmospheric gravity waves (AGWs), which are generated in the lower atmosphere, transport significant amount of energy and momentum into the mesosphere and lower thermosphere. Among many parameters to characterize AGWs, horizontal phase velocity is very important to discuss the vertical propagation. Airglow imaging is a useful technique for investigating the horizontal structures of AGWs around mesopause. There are many airglow imagers operated all over the world, and a large amount of data which could improve our understanding of AGWs propagation direction and source distribution in the MLT region.

We have developed a new statistical analysis method for obtaining the power spectrum in the horizontal phase velocity domain (phase velocity spectrum), from airglow image data, in order to deal with huge amounts of imaging data obtained on different years and at various observation sites, without bias caused by different event extraction criteria for the observer. From a series of images projected onto the geographic coordinates, 3-D power spectrum in horizontal wavenumber and frequency domain is obtained by applying the 3-D Fourier transform. Then, it is converted into phase velocity and frequency domain. Finally, the 3-D spectrum is integrated along the frequency for the range of interest and 2-D spectrum in horizontal phase velocity is calculated. This method was applied to the data obtained at Syowa Station (69ºS, 40ºE), Antarctica, in 2011 and compared with a conventional event analysis in which the phase fronts were traced manually in order to estimate horizontal propagation characteristics. This comparison shows that our new method is adequate to deriving the horizontal phase velocity characteristics of AGWs observed by airglow imaging technique.

Airglow imaging observation has been operated with various sampling intervals. We also present how the images with different sample interval should be treated.