Estimation of gravity-wave momentum flux from mesospheric airglow images

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Gravity waves play important roles in both large- and small-scale dynamics of the atmosphere through their vertical transport of horizontal momentum fluxes. Wave dissipation causes divergence of momentum flux, which lead to local heating, turbulent diffusion, and accelerations of the local mean flow.

Radar observations of gravity –wave momentum flux have been performed for the last few decades. However, the estimation of momentum flux from airglow images has been reported only recently. Here we estimated short-period gravity-wave momentum fluxes quantitatively from all-sky airglow images using the method proposed by Swenson and Liu [GRL, p.477, 1998]. Wave parameters required for this estimation were obtained from airglow images and simultaneous wind data. We used OH airglow images observed on November 13, 1999 at the Shigaraki MU observatory (34.9S, 136.1E). The mesospheric wind data were obtained by the MU radar. The observed gravity waves had horizontal wavelengths of 15-40 km, horizontal phase velocities of 20-100 m/s, and amplitudes of airglow intensity variance of 0.5-4%, which is estimated by two-dimensional FFT analysis. We found that 52% of the observed gravity waves were non-propagating waves (m2 is negative), suggesting evanescent or ducted waves, and do not transport momentum flux. The momentum fluxes transported by the freely propagating waves were estimated to be 1-20 m2s-2 with a mean value of 4.6 m2s-2. This value is comparable to the results reported previously using different approach to the OH airglow images and radar observations. In the presentation, we will also discuss the ambiguity of the estimation due to mixing of different waves in the airglow image and due to uncertainty of the Brunt-vaisala frequency.