Geophysical Research Abstracts,
Vol. 10, EGU2008-A-04482, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-04482
EGU General Assembly 2008

Characteristics of mesospheric gravity waves in Korean Peninsula and the effects of the secondary waves

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The characteristics and origins of the observed mesospheric gravity waves in Korean Peninsula were investigated. From the airglow images, it was observed that the mesospheric gravity waves had characteristics of having short wavelengths and periods (λ_h = 10 $\sim$ 40 km, τ = 5 $\sim$ 35 min) and widely distributed phase speeds (0 $\sim$ 70 m s^{-1}). Based on the observed wave characteristics, ray-tracing was conducted to find the trajectories of gravity waves. In the ray-tracing calculations, 69% of the cases were terminated in the mesosphere, whereas 31% of the cases reached the troposphere. For the cases which reached the troposphere, convection was considered as the most probable source. The importance of the mesospheric sources was noted from the result of back-trajectory calculations.

Gravity waves forced by convection were simulated using the 2-D cloud-resolving model. The aspects of their breaking and secondary waves generated by the breaking were investigated for the background flows of four seasons. Although the structures of mesospheric gravity waves and the aspects of their breaking were different among four seasons, there were also some similarities as follows: The wave-breaking structure followed the phase of gravity waves propagating into the mesosphere and it became more complex as time passed. The secondary waves having broad spectra were observed outside the wave-breaking region and they propagated upward and/or downward. They cancelled more than $\sim$1/3 of the momentum flux and drag forcing by convective gravity waves in the middle atmosphere. The relation between the primary and secondary waves was investigated through some simple experiments. The results showed that the characteristics of the secondary waves in various basic states were different from each other, due mainly to the difference in wave propagation condition

rather than in wave sources.