

A study of the tidal periodicity of gravity wave energy in the mesosphere observed with MF radar at Poker Flat, Alaska

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The neutral wind velocity data from mesosphere to lower thermosphere observed by Poker Flat MF radar has been observed since October 1999. The National Institute of Information and Communications Technology (NICT) is developing science application software and database systems associated with remote sensing experiments, which include Poker Flat MF radar, and has been conducting scientific studies. A number of observational and theoretical studies have shown that a mesospheric meridional circulation which flows from the summer hemisphere to the winter hemisphere is mainly driven by gravity waves. On the other hand, the interaction between gravity waves and tidal waves has been studied by using observation and modeling data. However, the time and spatial variation of middle atmosphere general circulation has not been fully understood when the interaction processes are incorporated.

The purpose of this study is to improve the understanding of three dimensional (3D) structure of mesospheric circulation modified by gravity waves and tidal waves from observation and modeling data. First, we extracted tidal waves and gravity waves from the MF radar observation data. In this study, harmonic analysis was carried out for periods of 48, 24, 12, and 8 hours, which are extracted from the 5 day time series of wind velocity using. Gravity waves are defined as the 1 ~ 12 hour period component of difference between observed wind velocity and these harmonic components. The method is applied to 30-minute-average data to calculate the 5 day running mean amplitude and phase of tidal waves. We made 1-day composite plots of kinetic energy of gravity waves for periods of 1 ~ 4 hours and harmonic components. The results show that the kinetic energy of gravity waves has two peaks in 3 ~ 6 LT and 12 ~ 15 LT respectively, which tend to coincide with the time when easterly wind of the 12 hour component is switched westerly. This feature commonly recognized in April to August. We plan to discuss more detail of underlying physical processes, applying the three dimensional transformed Eulerian mean series formulated by Kinoshita and Sato (2013a, b) and Sato et al. (2013) to the output data of a gravity wave resolving general circulation model.

Keywords: gravity waves, tidal waves, mesosphere