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Statistical Study of Concentric Gravity Wave in the Mesopause by using the IMAP/VISI Data

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We report the first global study of concentric gravity waves (CGWs) in the mesopause region (~95 km) by using the IMAP/VISI data. CGWs have unique characteristic that shows a direct coupling between lower and upper atmosphere, makes it useful to study the role of gravity waves in atmospheric dynamic by transporting their energy and momentum from their sources in the tropopause to the mesopause region where the waves dissipate. The past studies have revealed the general properties of these CGWs such as: source, propagation mechanism and the effect of the background profile. However, they were mostly a single event studies and gave only limited information locally. Therefore, a statistical study on global distribution of the CGWs is needed to get more comprehensive understanding and the parameterization of gravity waves will also useful for the global circulation model. To address this issue, a space-based observation is more preferable since it covers a wider area. IMAP/VISI is the only space-based instrument that capable of imaging gravity waves in the MLT region in the nadir direction, makes it ideal for such a global study. The Visible and near-Infrared Spectral Imager (VISI) of the IMAP mission was launched successfully on July 21, 2012 with H-IIB/HTV-3 and installed onto the International Space Station (ISS). IMAP/VISI is now operated in the night side hemisphere with a range of +/- 51 deg. GLAT. IMAP/VISI is measuring three airglow emissions: OI (630 nm), OH Meinel (730 nm) and O2 (762 nm) with the typical spatial resolution of 16?50 km. Since the start of nominal operation in October 2012, IMAP/VISI has been operated with approximately 15 paths/day.

In this study, we analyze the CGWs events from IMAP/VISI data of 2013. We found total 172 CGWs events in the O2 (762 nm) airglow emissions out of 4853 data paths. The monthly distribution of the CGWs occurrence shows a clear seasonal dependence with the peak around March-April and August-September. The weak background winds (from GAIA model) in the middle atmosphere during the March and September equinox are likely responsible for the seasonal dependence. We determined the source of CGWs by estimating the center of the circular pattern and applying a ray-tracing method. We found that in the southern hemisphere, the high activity of CGWs can be found in a band-like area between 30-500 S while in the northern hemisphere the latitudinal variation is bigger, means that the activity can be found in the area ranging from 0-500 N. In the southern hemisphere, the high occurrence region is co-located with the jet streams flow region. Therefore, we suspect that the source in the southern hemisphere is likely related with the jet stream activity. In the northern hemisphere, the sources were mostly found to be convective activities (convective plum, tropical storm and typhoon), which were identified from the meteorological satellite data. We have calculated the wave parameters for two months (March and April) and found that the small-scale waves (horizontal wavelength $<$100km) expand from the center up to several hundred km (100-600 km), while the large scale can expand up to 2000 km. We are deriving more data from the other months to investigate any wave parameters distribution tendency globally. We also found that generally the concentric pattern appeared as arc like shape instead of full circle. It indicates that the background wind filter allows the wave to propagate in a particular direction and filter out the other directions. Data from 2014 will also be added and if possible will also be presented in this meeting.

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