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

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Concentric gravity waves (CGWs) have been intensively studied in the past few years because of its unique characteristic that shows the direct coupling between lower and upper atmosphere. The past studies, both by using the ground-based and space-based observations, have revealed the general properties of these CGWs, such as; source and 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. To address this issue, a space-based observation is more preferable since it covers wider area. Until recently, IMAP/VISI is the only space-based instrument that capable of imaging gravity waves above in the MLT region in the nadir direction. 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 of OI (630 nm), OH Meinel (730 nm) and O_2 (762 nm) with the typical spatial resolution of 16 – 50 km in the nadir direction. 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 O_2(762nm) 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 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. In the northern hemisphere, the sources were mostly found to be convective activity (convective plum, tropical storm and typhoon), which was identified from the meteorological satellite data. 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. 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 will derive more data from the other months to see if there is any wave parameters distribution tendency globally. 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. The detailed analysis of the background wind condition based on the GAIA model will be used to conduct further analysis in this study. Data from 2014 will also be added and if possible will also be presented in this meeting.