Statistical Study of Concentric Gravity Wave in the Lower Thermosphere by using the ISS-IMAP/VISI data of 2013

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Concentric gravity waves have been intensively studied in the past few years because of its unique characteristic that shows the direct coupling between lower and upper atmosphere [e.g. *Taylor and Hapgood,* 1998*; Sentman et al.,* 2003*; Suzuki et al.,* 2007*; Yue et al.,* 2013]. The past studies, both by using the ground-based and space-based observations, have been revealed the general properties of these concentric gravity waves, such as, source, propagation mode and effect of the background profile. However, these studies were mostly based on a single event and gave only limited information. Therefore, a statistical study on global distribution of the concentric gravity waves is needed to get further comprehensive understanding on the generation mechanism, propagation and the dissipation of the concentric gravity waves. 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 the troposphere 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 different airglow emissions of OI at 630 nm, the OH Meinel band at 730 nm and the O_2 (762 nm) atmospheric band at 762 nm at an altitude of ~400 km with the typical spatial resolution of 16 – 50 km. Since the start of nominal operation in October 2012, VISI has been operated approximately 15 paths a day.

In this study, we analyzed the concentric gravity wave events from IMAP/VISI data of 2013. We found total 172 concentric gravity wave events in the O_2 (762 nm) airglow emissions at ~95km altitudes, out of 4853 data paths. The monthly occurrence probability of the concentric gravity wave shows a clear seasonal dependence with the peaks around March-April and August-September. The weak background winds in the middle atmosphere during the March and September equinox are likely responsible for interpreting the seasonal dependence. We also determined the source of concentric gravity waves by estimating the center of the circular pattern. In most events, the sources were found to be convective activity (convective plum, tropical storm and typhoon), which was identified by using the TRMM data. We found that the convective plum usually generates small-scale concentric gravity waves with the horizontal wavelength (λ_h) generally less than 100 km. In the other hand, more intense convective activity such as typhoon can generate small-scale as well as large-scale (several hundred km in horizontal wavelength) gravity waves. We also found that the small-scale waves expand from the center up to several hundred km (200-300 km) while the large scale can expand up to thousands of km from the center (we found it in more than 3 events). Generally, the concentric pattern appears 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 data from March to December 2013 show that in Japan and central Asia sector, the circular arc appeared mostly in the northeastward direction while in Australia and south pacific sector dominated with the southeastward direction. The other sectors are still under the investigation. The detailed analysis of the background wind condition based on the GAIA model will be used to conduct further analysis in this study and will be discussed in the presentation.

References

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