

Role of the pre-reversal enhancement and medium-scale gravity waves on multiple plasma bubbles occurrence

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This study attempts to disclose statistically the role of pre-reversal enhancement (PRE) of the evening eastward electric field and medium-scale gravity wave (GW) on the multiple equatorial plasma bubbles (EPBs) occurrence in Southeast Asia in March-April from 2011 to 2013. The rate of change of bottomside F-region height at 1830-1900 LT derived from the equatorial ionosondes at Chumphon (99.3E, 10.7N, dip. Lat.: 3N), in Thailand and at Bac Lieu (105.7E, 9.3N, dip. Lat.: 1.5N) in Vietnam is used as a proxy of the PRE. Medium-scale GW in the equatorial bottomside F-region at dusk sector is extracted from in-situ measurements of thermospheric neutral wind and density by the GOCE satellite, which orbits at the inclination of $\sim 97^\circ$ and the altitude of ~ 250 km. We follow a technique done by Park et al. [2014] to extract medium-scale GW component from the GOCE wind and density data. Firstly, the Savitzky-Golay low-pass filter is applied to the GOCE neutral wind and density data to obtain the smooth backgrounds. Further, the GW component is obtained by subtracting the backgrounds from the data. Finally, we apply a simple FFT technique to obtain the amplitude spectrum of the GW component. The 3-meters ionospheric irregularities observed by the Equatorial Atmosphere Radar (EAR) at Kototabang (100.3 E, 0.2S, dip. Lat.: 10.1S) in Indonesia is used to observe the multiple EPB occurrence. Our findings can be summarized as follows. (1) The probability of the multiple EPBs occurrence enhances with the increase of PRE strength. (2) The distribution of zonal spacing between consecutive EPBs ranges 100-700 km with a maximum occurrence around 200-300 km, and this result is consistent with the previous study [e.g. Makela et al., 2010]. (3) Our spectral analysis shows that medium-scale GW with the horizontal wavelength of approximately 230-300 km is dominant. The dominant wavelength of the medium-scale GW is comparable with the peak occurrence of the zonal spacing between consecutive EPBs although the medium-scale GW wavelength is in the meridional direction because the GOCE satellite orbits in the meridional direction. Hence, our findings imply that the PRE strength controls the probability of multiple EPBs occurrence and medium-scale GW governs the zonal spacing of two consecutive EPBs.

Keywords: equatorial ionosphere, plasma bubble, gravity wave, pre-reversal enhancement