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Equinoctial asymmetry of GPS scintillation occurrence and drift velocities at post-sunset in Southeast Asia

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Since January 2003, three closely-spaced GPS receivers have been operated at Kototabang, West Sumatra, Indonesia (0.20ºS, 100.32ºE; geomagnetic latitude 10.6ºS) to observe scintillation and drift velocities. The GPS receivers sampled L1-GPS signal intensity at a rate of 20 Hz. Amplitude of radio waves passing through the electron density irregularities in the ionosphere fluctuates because the irregularities act as diffraction gratings. This phenomenon is called scintillation. At equatorial regions, scintillation is mainly caused by the electron density irregularities in equatorial plasma bubble, which is an electron density depletion in the ionosphere. Scintillation frequently occurs at equinox, whereas equinoctial asymmetry of scintillation occurrence exists [1]. We have analyzed amplitude scintillation and zonal drift velocity observed with closely-space GPS receivers at Kototabang, Indonesia between 2003 and 2016 [2]. It is found that the scintillation occurrence rate is higher in Mar. equinox than in Sep. equinox, and that the eastward drift velocity at post-sunset is higher in Mar. equinox than in Sep. equinox. This result suggests that the downward electric field at post-sunset, which cause the eastward drift velocity, may be related to the pre-reversal enhancement of eastward electric field. We also estimated vertical drift velocity from the virtual height obtained between 2003 and 2020 by the ionosodes installed at Chumphon in Thailand, Bac Lieu in Vietnam, and Cebu in Philippines, which are located near magnetic equator. The upward drift velocity at post-sunset is found to be larger in Mar. equinox than Sep. equinox. The ionosonde observations show that foF2 during high solar activity conditions is higher in Mar. equinox than in Sep. equinox. Based on these observations, we can speculate that in Mar. equinox, when the electron density is high, electric field could be more intense through the F-region dynamo so that plasma bubble likely occurs. Furthermore, MSIS-E-90 model shows that a ratio of [O]/[N2] is larger in Mar. equinox than Sep. equinox, suggesting that the high electron density in Mar. equinox could be caused by high [O]/[N2] in Mar. equinox.

References

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[2] Y. Otsuka, P. Abadi, K. Hozumi, and A. Almahi, Equinoctial asymmetry of plasma bubble occurrence and electric field at evening: GPS and ionosonde measurements in Southeast Asia, submitted to *Journal of Atmospheric and Solar-Terrestrial Physics.*