Equinoctial asymmetry in the east-west distribution of scintillation occurrence observed by GPS receivers in Indonesia

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We used GPS receivers installed in Pontianak (0.02°S, 109.3°E; 9.8°S mag. Lat.) and Bandung (6.9°S, 107.6°E; 16.7°S mag. Lat), Indonesia to observe azimuthal dependence of GPS-L1 scintillation occurrence rate. Crest of the equatorial anomaly region is located between both sites. We focus on analyzing east-west distribution of scintillation occurrences in equinox months. We collected scintillation data as indicated by S_4 index from those receivers for March and September from 2011 to 2015. Our findings statistically emphasized that scintillation occurrence rate is higher in the westward direction than that in eastward direction in March equinox. This east-west difference of scintillation occurrence is more distinct in March equinox than September equinox. In September equinox, the occurrence rate is almost comparable between westward and eastward direction. We can speculate that the equinoctial asymmetry in east-west distribution of scintillation occurrence could be likely caused by westward tilt of plasma bubble extending to higher altitudes/latitude, and that the plasma bubbles are more tilted westward in March equinox than in September equinox. We have analyzed zonal irregularity drift velocity observed by closely-spaced GPS receivers at Kototabang (0.2°S, 100.3°E; 9.9°S mag. Lat.), Indonesia for the same observation period. The results showed that eastward drift velocity decreases with increasing magnetic latitudes, and that the latitudinal gradient of eastward drift in March equinox is larger than in September equinox. Additionally, we used in-situ measurement of zonal wind velocity at ~400 km of altitude by CHAMP satellite in March and September from 2001 to 2005 for longitude 95-105°E. We found that latitudinal eastward wind velocity also show decrease of the magnitude with the increasing magnetic latitudes. The latitudinal gradient of eastward wind in March is larger than the latitudinal gradient in September. Thus, in March equinox, the large latitudinal gradient of irregularity drift and eastward wind velocity could be responsible for further westward tilt of plasma bubble extending to higher altitudes/latitudes. Consequently, the equinoctial asymmetry of east-west distribution of scintillation could be caused by the equinoctial asymmetry of tilted westward structure of plasma bubble.

Keywords: equatorial ionosphere, plasma bubble, irregularity, scintillation, equinoctial asymmetry, coupling neutral-plasma

