

## Effects of Pre-reversal Enhancement of $E \times B$ drift on the Latitudinal Extension of Plasma Bubble in Southeast Asia

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We investigated the effects of the F region bottomside altitude ( $h'F$ ), maximum eastward electric field ( $E$ ), duration of eastward  $E$ , and the integral of eastward  $E$  on the latitudinal extension of equatorial plasma bubbles in the Southeast Asian sector using the observations recorded by three GPS receivers and two ionosondes. The GPS receivers are installed at Kototabang (0.2 deg S, 100.3 deg E; 10.0 deg N magnetic latitude), Pontianak (0.02 deg S, 109.3 deg E; 8.9 deg S magnetic latitude), and Bandung (6.9 deg S, 107.6 deg E; 17.5 deg S magnetic latitude) in Indonesia. The ionosondes are installed at equatorial stations Chumphon (10.7 deg N, 99.4 deg E; 3.3 deg N magnetic latitude) in Thailand and Bac Lieu (9.3 deg N, 105.7 deg E; 1.7 deg N magnetic latitude) in Vietnam. We analysed those observations acquired in the equinoctial months (March, April, September, and October) in 2010-2012 when the solar activity index F10.7 was in the range from 75 to 150. Assuming that plasma bubbles are the major source of scintillations, the latitudinal extension of the bubbles was determined according to the S4 index. Our results show that the peak of  $h'F$ , maximum eastward  $E$  within the pre-reversal enhancement period, and the integral of eastward  $E$  are positively correlated with the maximum latitude extension of plasma bubbles. Our statistical and observational findings emphasise that plasma bubble extending more than 10-18 deg in latitude from the magnetic equator can be generated when the peak value of  $h'F$  is greater than 250-450 km, the maximum vertical upward  $E \times B$  drift is greater than 10-70 m/s, and the integral of vertical upward  $E \times B$  drift is greater than 50-250 m/s. In contrast, the duration of eastward  $E$  shows only weak correlation with the maximum latitude extension of plasma bubbles. These findings suggest that the latitudinal extension of plasma bubbles is controlled mainly by the magnitude of eastward  $E$  and the peak value of  $h'F$  at the initial phase of development of plasma bubbles (or equatorial spread F) rather than by the duration of eastward  $E$ .

Keywords: equatorial ionosphere, plasma bubble, pre-reversal enhancement, scintillation