Investigating unseasonable equatorial plasma bubbles over South-East Asia

Julie Louise Currie[1], *Brett A Carter[1], John Retterer[2], Rezy Pradipta[2], Keith Groves[2], Ronald Caton[3], Sudarsanam Tulasi Ram[4], Tatsuhiro Yokoyama[5]

1. SPACE Research Centre, RMIT University, Melbourne, VIC Australia, 2. Institute for Scientific Research, Boston College, Boston, MA USA., 3. Space Vehicles Directorate, Air Force Research Laboratory, Kirtland AFB, NM USA, 4. Indian Institute of Geomagnetism, Mumbai India, 5. National Institute of Information and Communications Technology, Tokyo, Japan

In the post-sunset equatorial ionosphere the Generalised Rayleigh-Taylor (R-T) instability causes small-scale plasma irregularities to increase in size, generating large scale plasma depletions called Equatorial Plasma Bubbles (EPB). Diffractive scattering caused by these EPBs can cause scintillation of Global Navigation Satellite System (GNSS) signals. Space weather agencies around the world recognise the need for accurate forecasting of EPBs. However, there are currently no global scintillation forecasts freely available for GNSS users.

The climatology of EPBs is relatively well understood and has been shown to correlate well with the strength of the Pre-Reversal Enhancement (PRE) of the zonal electric field. Longitudinal gradients in the electron density across the day-night terminator control the strength of the PRE. These gradients are reduced when the ionospheric plasma can flow from the sunlit ionosphere into the post-sunset ionosphere, which requires a large angle between the magnetic field and the day-night terminator. The longitudinal and seasonal variations in the EPBs are relatively well explained in terms of this angle. However, the ability to provide accurate forecasts requires an understanding of the day-to-day variability of EPB occurrence.

It has been shown that the presence of post sunset EPBs depends on the amplitude of the initial ‘seed’ perturbations, the RT growth rate, and the number of e-folding periods over the RT growth time. Analysis of unseasonable EPB events provides insight into the ionospheric and space weather conditions that provide this daily variability. This work focusses on one of a number of unseasonable EPB events over South-East Asia that occurred in July 2014. This event was observed in the COSMIC S4 index and as Spread F in ionograms obtained from Sanya, China. Ionosonde data from Bac Lieu and Cebu show the upward plasma drift was small compared with typical values for EPB days. Solar wind data were obtained and used to categorise the geomagnetic environment during the event and showed no clear indication that EPBs were likely. The presence of low latitude sporadic E is observed using the ionograms from Sanya and its potential effects on EPB growth and plasma destabilisation are analysed.

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