An unseasonal equatorial plasma bubble event observed over Southeast Asia

*Brett A Carter[1], S. Tulasi Ram[2], E. Yizengaw[3], R. Pradipta[3], J. Retterer[3], R. Norman[1], K. Groves[3], R. Caton[4], M. Terkildsen[5], T. Yokoyama[6], K. Zhang[1]

1. RMIT University, 2. Indian Institute of Geomagnetism, 3. Boston College, 4. Air Force Research Laboratory, 5. Bureau of Meteorology, 6. National Institute of Information and Communications Technology

Recent progress has been made in describing the daily variability of Equatorial Plasma Bubble (EPB) occurrence using global physics-based thermosphere-ionosphere modeling, particularly during “peak” EPB seasons. Presented in this study is an analysis of an “off-peak” EPB event over the Southeast Asian region on the evening of 28 July 2014 that was not captured by the modeling performed in previous work.

Ground-based GPS scintillation, ionosonde and space-based GPS Radio Occultation (RO) data show the existence of Equatorial F-region Irregularities (EFIs) shortly after sunset over a region spanning 30˚ in longitude and 40˚ in latitude, centered on the geomagnetic equator. This EFI event was observed during a season when EPBs are expected to be rare/infrequent in the Southeast Asian longitude sector. Interestingly, GPS RO data indicates that this EFI event over Southeast Asia coincided with a suppression of EPBs in the African and Pacific longitude sectors, which were both experiencing a “peak” EPB season. Supporting ionosonde data reveals the presence of a strong pre-reversal enhancement (PRE) in the upward plasma drift over Southeast Asia on this day after sunset, and that this PRE was significantly stronger than on any other day of July 2014. An analysis of the geophysical conditions during this event reveals that this enhanced PRE was not caused by geomagnetic activity, and therefore was not due to storm-time penetration electric fields. Instead, it is suggested that forcing from lower altitudes, perhaps from tidal/planetary waves, could have caused this strong PRE. This strong PRE subsequently created favorable EPB growth conditions during an off-peak EPB season in the Southeast Asian sector, which manifested as unseasonal ionospheric scintillation activity across the region. The present inability to forecast such events is a significant and continuing challenge for ionospheric physics and space weather prediction.

Keywords: Equatorial Plasma Bubbles, Ionospheric Scintillation, Space Weather Forecasting, Thermosphere-ionosphere coupling

