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Empirical Study of Vertical ExB Drift Velocity for Post-Sunset Equatorial Plasma Bubble Forecast

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Equatorial plasma bubbles (EPBs) are a critical feature of space weather due to their significant impact on communication and navigation systems. Real-time monitoring of EPB occurrence is essential for mitigating radio signal degradation. To address this, we developed an automated EPB alert system based on spread-F detection from SEALION FMCW ionosondes. This study represents the next step toward EPB forecasting by establishing an empirical relationship between ionospheric parameters and the occurrence of Equatorial spread-F (ESF), without delving into the underlying physical mechanisms. For forecasting post-sunset EPBs, we utilize real-time h'F measurements to estimate the vertical ExB drift velocity. Using ionosonde data from Chiang Mai and Chumphon stations (2008 – 2014), we analyzed the probability of post-sunset (10 – 16 UT) ESF occurrence as a function of ExB drift velocity relative to its hourly median. To minimize geomagnetic influence, we selected March 2014, a period of extremely low geomagnetic activity (no magnetic storms; monthly mean K-index daily sum = 9.8). Our results indicate that the probability of ESF occurrence within the following hour increases with ExB drift velocity above the median. When the drift velocity is 0 – 10 m/s higher than the median, the probability is approximately 16.5%. This probability rises to about 52.6% when the velocity difference is 10 – 20 m/s and reaches 81.2% for a difference of 20 – 30 m/s. When the ExB drift velocity exceeds the median by more than 30 m/s, the occurrence probability reaches 100%. These findings provide a practical basis for real-time post-sunset EPB forecasting using ionosonde observations.