



Statistical Analysis of Equatorial Spread-F during Low and High Solar Activity of the 24th Solar Cycle over Chumphon and Tirunelveli Stations and Comparison with the IRI-2016 Model

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Abstract

The equatorial spread-F (ESF) irregularities can cause the degradations to the communication systems such as high frequency (HF) communications, satellite communications and satellite navigation systems. For example, the outage of HF communications after sunset may occur during spread-F phenomena, the scintillations of satellite navigation signals affected by the ESF and plasma bubbles (EPBs) may result in loss-of-lock events [1-2]. In this work, we present the statistical analysis of the equatorial spread-F (ESF) at the stations near the magnetic equator during low solar activity (LSA) and high solar activity (HSA) of the 24th solar cycle. The ionograms are scaled from two longitude regions, i.e., Chumphon or CPN (10.7°N, 99.4°E; geomagnetic latitude: 3.0°N) in Thailand and Tirunelveli or TIR (8.73°N, 77.70°E; geomagnetic latitude: 0.32°N) in India during 2008 (LSA) and 2014 (HAS). The parameters in the study include the ESF probability and ESF duration. From the results, we observe that, in 2008, the percentages of ESF occurrence are below 60% for both stations. In addition, the ESF percentages in September and October are higher than those in March and April. The ESF durations can be noticed at these stations as from 10 minutes to 8.50 hours in 2008. Long ESF durations are seen at TIR more frequently than at CPN. The high ESF percentages can be observed in both post-sunset and post-midnight in all months in 2014 for these stations. The post-sunset ESF is higher than post-midnight ESF observed in both stations. ESF durations are observed from 10 minutes to 11.3 hours in 2014. The trend of ESF percentages at CPN and TIR are similar in each month in 2014. Long durations of ESF occurrences are observed in TIR more often than at CPN. Finally, the comparison with the IRI-2016 performance is made. The comparison between the observations and the IRI-2016 model prediction shows that the IRI-2016 model overestimates the observed ESF probabilities up to 36.5% during LSA, but the underestimation is up to 36.8% during HSA at these stations.

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