

Day-to-day Variability of Field-Aligned Irregularities Occurrence in Nighttime F-region Ionosphere over Equatorial Atmosphere Radar : A Combinatorics Analysis

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This paper presents a statistical analysis to investigate day to day variability of field-aligned irregularities (FAI) occurrence in nighttime F-region ionosphere over the Equatorial Atmosphere Radar (EAR), West Sumatra, Indonesia. FAI echoes were identified based on signal intensity of backscatter radar observations. We analyzed nighttime F-region FAI during 3 years starting in January 2011 to December 2013. For the first time, a combinatoric analysis was applied to examine the statistical likelihood of various day-to-day FAI occurrence patterns. The empirical day-to-day combinatorics analysis was performed based on binary classification of EAR observation data into either FAI occurrence (+) or FAI absence (-) for each calendar data. We gathered all possible permutations of various day-to-day FAI occurrence patterns, from 1-day to 6-day patterns, and compile them into histogram. The combinatorics analysis was performed in 4 separate time intervals to account for seasonal variation: two equinoxes (March and September) and two solstices (June and December). EAR data show that FAI occurrence probability is maximum for the two equinoxes, and that it is minimum for the two solstices. The combinatorics analysis shows that certain day-to-day patterns are more likely to occur than others, and such “combinatorics fingerprints” also depend on season. During the solstices, persistent absence of FAI over several consecutive days far outweighed persistent FAI occurrence over an equivalent grouping of days with the same length. Meanwhile, during equinoxes, we found a generally more equitable distribution between persistent day-to-day FAI occurrence and persistent day-to-day FAI absence. These findings may open new ways to help forecast FAI occurrence on a regional basis.

Keywords: Combinatorics analysis, Ionosphere irregularities, Day to day variability