

# New Findings of the Sporadic E (Es) Layer Development Around the Magnetic Equator During a High-Speed Solar (HSS) Wind Stream Event

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**Abstract:** The equatorial ( $Es_q$ ) and blanketing ( $Es_b$ ) sporadic (Es) layers occur due to the Equatorial Electrojet Current (EEJ) plasma instabilities and tidal wind components, respectively. Both  $Es_q$  and  $Es_b$  layers can appear concurrently over some Brazilian equatorial regions due to the peculiar geomagnetic field configuration in this sector. Previous works indicate that the inclination angle limit for the  $Es_q$  occurrence in ionograms is  $7^\circ$ . However, we found evidence that regions more distant can also experience such equatorial dynamics during disturbed periods. In this context, we deeply investigated this EEJ influence expansion effect by analyzing the  $Es_q$  layers in regions not so close to the magnetic equator during a high-speed solar wind stream event that occurred on May 05 and 06, 2018. To explain these atypical  $Es_q$  layer occurrences, we considered the Es layer parameters obtained from digital ionosondes over the Brazilian regions, São Luís, and Araguatins. We use magnetometer data and a model named MIRE (E Region Ionospheric Model) to validate this mechanism. The results show that the eastward electric field of the Gradient Drift instability in the EEJ is effective during the magnetic storm main phase in the boundary equatorial magnetic sites, creating the  $Es_q$  layers. Thus, the EEJ plasma irregularity superimposes the wind shear mechanism, changing the Es layer dynamics during disturbed periods over the magnetic equator boundary sites. Therefore, this work establishes new findings of the EEJ influence expansion dynamics in the Es layer formation over the Brazilian regions.

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