

## **JULIA studies of post-midnight equatorial spread F events observed during the 2008/2009 solar minimum**

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Observations made by ionospheric plasma sensors on the Communications/Navigation Outage Forecasting System (C/NOFS) satellite indicated a surprisingly high occurrence of ionospheric F-region irregularities with occurrence rates peaking in the midnight/post-midnight sector during June and December solstices of the 2008/2009 deep solar minimum. Further studies suggested that the generation of these irregularities could be related to abnormal upward equatorial plasma drifts observed around midnight hours.

In order to better understand the morphology and source of the post-midnight irregularity events in the American/Peruvian sector we analyzed long-term (years 1996 to 2015) observations of F-region coherent scatter echoes made by the Jicamarca Unattended Long-term Investigations of the Ionosphere and Atmosphere (JULIA) system of the Jicamarca Radio Observatory in Peru. JULIA Range-Time-Intensity (RTI) maps provided insight on the vertical development, as a function of local time, of F-region irregularities associated with ESF. These observations were then used to better understand the local time origin of the ESF events observed by C/NOFS.

The radar observations show that ESF events during December solstice start during postsunset hours. These ESF events and the conditions for their development are shown to continue through midnight. The predominance of postmidnight irregularities on C/NOFS observations during December solstice is caused by a slow vertical development of the ESF structures, which only reach the topside near midnight in most cases. On June solstice, on the other hand, JULIA observations show that ESF started predominantly in the postmidnight sector. Collocated digisonde observations provide additional information on F-region conditions leading to these ESF events.