Nocturnal equatorial zonal plasma drift over the Indian low latitude region: Estimation based on the L-band scintillation irregularities as tracer

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During postsunset hours, very often, the equatorial and low-latitude ionosphere behaves chaotically, by allowing the generation of multispectral plasma density irregularities, a phenomenon well known as equatorial spread F (ESF). The irregularity spectrum contains scale sizes of several orders of magnitude ranging from hundreds of kilometer to tens of centimeter. Among all these the intermediate structures of hundred of meters which cause the phase and amplitude scintillations of Global Navigation Satellite System (GNSS) satellite to ground signals have significant practical importance. In view of the increasing demand for continuous and precise GNSS based communication and navigation, 'forecasting' of these L-band scintillations becomes extremely important. In the past few years, significant efforts have been made to forecast the spatio-temporal evolution of L-band scintillation over the Indian low latitude region (Bagiya et al., 2014; Sridharan et al., 2012, 2014). Moreover, the dynamics of the ESF irregularities during the course of the night was observed to play an important role in improving the L-band scintillation forecast pattern (Bagiya et al., 2015). Thus, in order to learn more of the ESF dynamics on day to day and long term period an exclusive experiment to estimate the zonal drift of the nocturnal L-band scintillation irregularities has been commenced at Equatorial Geophysical Research Laboratory (EGRL), Tirunelveli, India.

This experiment uses the signals of Indian Satellite Based Augmentation System (SBAS) i.e. GPS-aided GEO augmented navigation (GAGAN). Two SBAS enabled GNSS receivers have been installed at EGRL which record the L-band signals transmitted by GAGAN geostationary satellites of GSAT-8 (PRN 127) and GSAT-10 (PRN 128). These signals are further processed to estimate the zonal drift of the L-band scintillation irregularities on equatorial spread-F days. During geomagnetically quiet period, the drift exhibited the eastward plasma flow with gradual decrease in amplitudes during the course of the night. In addition to the seasonal variability, this quiet time drift pattern could be understood through dynamo processes in the nighttime equatorial ionosphere. However, during geomagnetic storms the drift reverses to become westward on several occasions. The storm time westward drift is attributed to the disturbed time local electrodynamical changes. This talk will discuss the usual quite time and unusual geomagnetic storm time equatorial zonal plasma drift over the Indian region along with their plausible causative mechanism/s (Bagiya et al., 2018). Moreover, the analysis based on the estimated zonal drift is underway to improve the L-band scintillation forecast method for the low latitudes and efforts would also be made to present the improved forecast for the spatio-temporal occurrence pattern of L-band scintillation over the Indian region.

Reference:

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