

Characterization of GPS L-band scintillations under different types of ESF irregularities using co-located ionosonde observations

S. Sripathi, S. Sreekumar, Ram Singh and S. Banola

Indian Institute of Geomagnetism, Navi Mumbai, India

Abstract:

In this paper, we present characteristics of Equatorial Spread F (ESF) irregularities/ ionospheric scintillations over Indian region during the years 2007-2015 covering solar cycles-23/24 to understand the different ambient conditions under which the ionospheric scintillations/ionospheric irregularities are observed. Here, we used (a) GPS TEC and L-band scintillations, (b) CADI ionosonde and (c) Equatorial Electrojet (EEJ) strength to study the unique electrodynamical characteristics of the ionosphere over Indian region. As the observations presented here are unique in the sense that they are observed not only during the ascending phase of the solar cycle 24 just after prolonged low solar activity period and but also they are observed at different scales, we shall be able to understand them better and also we shall be able to compare them to the previous solar cycle 23. It may be mentioned that as we are in the moderately high solar activity period, scintillation activity is picking up in the recent years and we are observing good no of scintillation events over Indian region. Scintillation levels recorded at L-band during recent years are relatively very high and are unacceptable for the navigation community. Our observations revealed that L-band scintillations of 0.5 or more are observed during equinoxes during the years 2011-2012 while weak scintillations are observed during 2009-2010. To understand the day-to-day variability of the ionospheric scintillations or ESF irregularities, the day-to-day variability in the altitude variation of F region height as measured by CADI ionosonde observations at Tirunelveli, an equatorial station in India prior to the scintillation event is examined. In addition, day-to-day variability in the satellite traces is examined. Similarly, the day-to-day variability of the EEJ strength is used to understand the day-to-day variabilities in the ionospheric scintillations or ESF irregularities. Temporal variation of GPS TEC over Tirunelveli, an equatorial station, suggests that there exists a distinguished mid-night TEC maximum during ESF events than during non ESF events. During ESF events, well developed mid-night TEC maximum is noticed. Earlier observations suggested that this could be linked to the enhanced equatorward meridional neutral wind circulation that is formed due to the enhanced ionization developed at equatorial ionization anomaly zone during ESF events. As majority of the observations presented here are collected or measured on a continuous basis, systematic attempts have been made to examine the different ambient conditions under which the day-to-day variabilities in the ionospheric scintillations or ESF irregularities are observed. Apart from this, we have also made an attempt to understand the role of geomagnetic storms on the ionospheric scintillations which will be presented.