Spatial and Temporal characteristics of L-band scintillations over the Indian low-latitude region and their possible impact on GPS navigation

P.V.S. Rama Rao, S. Gopi Krishna, K. Niranjan and D.S.V.V.D. Prasad
Space Physics Laboratories, Department of Physics, Andhra University, Visakhapatnam-530003, India.

ABSTRACT

The scintillation data (S4-index) at the L-band frequency of 1.575GHz, recorded from a total of 18 GPS receivers installed at different locations in India under the GAGAN project, have provided a unique opportunity, for the first time in the Indian region, to make a simultaneous study of spatio-temporal and intensity characteristics of the trans-ionospheric scintillations during the low sunspot activity (LSSA) period, 2004 - 2006. The studies reveal that the occurrence of scintillations is maximum around the pre-midnight hours of equinox months, with very little activity during the postmidnight hours. No significant scintillation activity is observed during the summer and winter months of the period of observation. The intensity (S4 index) of the scintillation activity is stronger around the equatorial ionization anomaly (EIA) region in the geographic latitude range of 15 to 25°N in the Indian region. These scintillations are often found to be accompanied by the TEC depletions with durations ranging from 5 to 25 min and magnitudes from 5 to 15 TEC units which affect the positional accuracy of the GPS by 1 to 3 meters. Further, during the intense scintillation events (S4>0.45 ≈ 10 dB), the GPS receiver is found to loose its lock for a short duration of 1 to 4 min, increasing the error bounds effecting the integrity of the SBAS operation. During the present period of study, a total of 395 loss of lock events are observed in the Indian EIA region; this number is likely to increase significantly during the high sunspot activity (HSSA) period, creating more adverse conditions for the trans-ionospheric communications and the GPS-based navigation systems.