TEC and L-band scintillation studies over the Equatorial and low latitude regions using the data of Indian GPS network

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A total of 18 dual frequency GPS receivers are deployed at different locations in the Indian equatorial and low latitude regions under the ISRO/GAGAN programme with a view to carry out a detailed study on the spatial and temporal behaviour of the Total electron content and scintillations at the L-band frequency of 1.5GHz. The data collected at 1 minute interval are used to compute the vertical TEC and the amplitude scintillation index S4. The vertical TEC show diurnal, seasonal and latitudinal variations typical of equatorial and low latitude regions. The development and decay of the equatorial ionization anomaly in clearly seen with the anomaly peaks occurring in the latitude zones of 15 - 25^0 geographic latitudes (8 to 15^o geomagnetic) maximizing around 1600 to 1700 hrs IST. The anomaly peaks are found to be more prominent during the equinoxial months of March, April and September, October. The day maximum TEC varies from 55 TEC units at the equator to about 95 TEC units at the anomaly crest region, corresponding to a range delay variation of 1 to 10 meters and 1 to 15 meters (at L-band) at the two regions respectively.

A study of the temporal variation of the L-band (1.5 GHz) scintillation (S4 index) data of the low sunspot activity (LSSA) year of 2004 show that the occurrence of scintillations is mostly confined to the pre-midnight hours with maximum occurrence during the equinoxial months of March, April, September and October and practically no activity during the summer months in the Indian sector. The latitudinal variation shows that the scintillations occur all the way from the equator to the anomaly crest region and beyond but the maximum percentage of occurrence as well as strong scintillation activity is confined to 15 – 25^o geographic latitudes. The absence of strong (S4 > 0.4) scintillations at the equatorial regions is due to the low ambient electron densities (during LSSA) and lack of strong density gradients responsible for the generation of strong irregularities. At the anomaly crest regions and during the post sunset periods when strong (S4 > 0.4) scintillation activity is present, the TEC has shown presence of strong depletions (bubbles) with amplitudes varying from 10 to 30 TEC units corresponding to a range error of 2 to 6 meters. Further, it is observed that the GPS receiver looses its lock (on the amplitude channel) wherever the S4 index exceeds 0.45 ($\geq$ 10 dB). The statistics on the occurrence of strong scintillations associated with the plasma bubbles and loss of receiver locks will be presented and discussed in detail.

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