Modelling of ionospheric irregularities during geomagnetic storms over African low latitude region

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Abstract

In this study, empirical models of occurrence of ionospheric irregularities over low latitude African region during geomagnetic storms have been developed. The geomagnetic storms considered consisted of Dst $\leq$ -50 nT. GNSS-derived ionospheric Total Electron Content (TEC) data over Libreville, Gabon (NKLG) (0.35° N, 9.68° E, geographic, 8.05° S, magnetic) and Malindi, Kenya (MAL2) (2.99° S, 40.19° E, geographic, 12.42° S, magnetic) during 2000 - 2014 were used. Ionospheric irregularities at scale-lengths of a few kilometers and ∼400 m were represented with the rate of change of TEC index (ROTI). The inputs for the models are the local time, solar flux index, Auroral Electrojet index, day of the year, and the Dst index, while the output is the median ROTI during these given conditions. To develop the models, the ROTI index values were binned based on the input parameters and cubic B splines were then fitted to the binned data. Developed models using data over NKLG and MAL2 were validated with independent data over stations within 510 km and 680 km radius, respectively. The models captured the enhancements and inhibitions of the occurrence of the ionospheric irregularities during the storm period. The models even emulated these patterns in the various seasons, during medium and high solar activity conditions. The correlation coefficients for the validations were statistically significant and ranged from 0.58 - 0.73, while the percentage of the variance in the observed data explained by the modelled data ranged from 34 - 53.

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