Total electron content and scintillations over Maseno, Kenya, during high solar activity year

Abstract:

Proper characterization of total electron content (TEC) and scintillation is very important to global positioning system (GPS) users in communication, navigation, ionospheric or atmospheric studies. Quiet time variation of TEC is useful in the estimation and removal of ionospheric delay for global navigation satellite systems single-frequency positioning. During geomagnetic storms, the variations of ionosphere deviate from their quiet day pattern and can cause significant effects on short-term prediction of various ionospheric parameters. The dynamics of the ionosphere change from region to region; therefore, in order to evaluate and improve the performance of global models of the ionosphere, numerous studies of variations using measured ionospheric parameters from stations globally are useful. This paper presents for the first time variations in the TEC and scintillation at Maseno University (geomagnetic coordinates, 9.64°S, 108.59°E), Kenya, investigated using a NovAtelGSV400B GPS receiver for the high solar activity year 2014. The GPS-measured TEC values were compared with the modeled TEC values by the latest International Reference Ionosphere model (IRI-2016), with a view to evaluate the performance of this version of the model. The largest TEC values were observed from 1300 to 1500 h local time throughout the year with the largest diurnal values occurring in March equinox and smallest during June solstice. The largest TEC values are attributed to extreme ultraviolet radiation coupled with upward $\vec{E} \times \vec{B}$ �→×�→ plasma drift velocity. Nighttime enhancements in TEC attributed to the 'fountain' effect occurred during some months. Scintillation correlated with depletions in TEC occurred in the period between 1600 h local time to 1900 h local time (post-sunset) sector during some months, with the strongest value of – 0.91 being experienced in March equinox. Scintillation was absent during geomagnetic storms studied mainly as a result of the time of onset of the recovery phases of the storms. In addition, the geomagnetic storms were manifested in GPS-measured TEC as negative ionospheric storms. The IRI-2016 model gave a good prediction of measured values except for its overestimation of measured TEC in the months of May and June. Further, a new insight shown by the results is the ability of the IRI-2016 model to predict post-sunset TEC enhancements during some months contrary to previous versions reported by other researchers in East Africa. However, model is not quickly sensitive to transitions from one season to another. This result contributes to the improvement of the current IRI

model by recommending the introduction of an input into the model that is sensitive to transitions in seasons in future versions of the model.

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