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The Storm-time Assessment of GNSS-SBAS Performance within African Low Latitude Region

Abstract:
A Satellite Based Augmentation System (SBAS) is designed to improve Global Navigation Satellite Systems (GNSS) in terms of integrity, accuracy, availability and continuity. Its performance among other factors greatly depends on the condition of the ionosphere. The GNSS observables are usually degraded after the sunset hours even during magnetically quiet-time periods at low-latitude regions.

This study investigated the SBAS system performance during magnetically disturbed periods in African low-latitude region. The data used for this research were obtained from the ground-based GNSS receiver stations located within the Northern and Southern crest of the African Equatorial Ionization Anomaly (EIA) region, for the month of July and October 2013. The rate of change of total electron content (ROT) and rate of change of TEC index (ROTI) were estimated to examine the equatorial ionospheric gradient and irregularities. An index of ionospheric disturbance, the relative percentage of deviation of the vertical TEC from the quiet level at each station was evaluated to study positive and negative phases of the storms.

The study revealed that the effect of storm on SBAS system performance depends on the local time in which the storm occurs: the effect is positive when the relative percentage of TEC deviation increases after post-sunset, this enhances the SBAS performance; and negative when the relative percentage of TEC deviation is decreased, this degrades the SBAS performance. The study also showed that ROT and its index are a good proxy for the presence of ionospheric gradient and irregularities, and also a better parameter than geomagnetic indices for the assessment of the storm-time effect on GNSS-SBAS performance.

Keywords: GNSS, SBAS, Equatorial Ionosphere, ROTI, Geomagnetic indices, Performance