On the variability of EIA characteristics using GPS TEC, IRI-2012 and NeQuick2 models and possible effects on GNSS applications over the Brazilian equatorial and low latitude sectors

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It is known that the equatorial and low latitude ionosphere is characterized with typical dynamical phenomena namely, the Equatorial Ionization Anomaly (EIA). Accurate modeling of characteristic variations of EIA is more important to arrive at the correct estimation of range delays required for the communication and navigation applications. The Total Electron Content (TEC) data from a chain of Global Positioning System (GPS) receivers at seven identified locations from equator to the anomaly crest and beyond along 3150E geographic longitude in the Brazilian sector is considered. The performances of the latest available IRI-2012 and NeQuick2 models have been investigated during 2010-2013 in the increasing phase of the 24th solar cycle. A comparative study on the morphological variations of the GPS measured and modeled TEC revealed that the performances of the models are improved during low solar activity periods compared to that during the increased solar activity years. The strength and the locations of the EIA crest are nearly well represented by both the models during the low solar activity while the models underestimate the peak TEC at the EIA during the increased solar activity conditions. The deviations between the GPS measured and model derived TEC are more during equinoctial and summer months at and around the anomaly crest locations. Significant differences have also been observed in between the TEC values derived from both the models. The causes for the discrepancies in the modeled TEC values are discussed based on the model derived and ionosonde measured vertical electron density profiles variations. Further, under the presence of aforementioned electron density variabilities, the possible difficulties in the accurate estimation of range delays for GNSS applications in the low latitude sectors have been discussed.