# Abstract

Earth's ionosphere is an important medium of radio wave propagation in modern times. However, the effective use of ionosphere depends on the understanding of its spatio-temporal variability. Towards this end, a number of ground and space-based monitoring facilities have been set up over the years. This is also complemented by model-based studies. However, assessment of the performance of the ionospheric models in capturing observations needs to be conducted. In this work, the performance of IRI-2016 model in simulating total electron content (TEC) observed by network of global position System (GPS) is evaluated based on RMSE, bias, correlation and categorical metrics such as Quantile Probability of Detection (QPOD), Quantile False Alarm Ratio (QFAR), Quantile Categorical Miss (QCM), and Quantile Critical Success Index (QCSI). IRI-2016 model simulations are evaluated against GPS-TEC observations during the solar minima 2008 and maxima 2013. Higher correlation, low RMSE and bias between the modeled and measured TEC values are observed during solar minima than solar maxima. The IRI-2016 model TEC agrees with GPS-TEC strongly over higher latitudes than over tropics in general and EIA crest regions in particular as demonstrated by low RMSE and bias. However, the phases of modeled and simulated TEC agree strongly over the rest of the globe with the exception of the polar regions as indicated by high correlation during all solar activities. Moreover, the performance of the model in capturing extreme values over magnetic equator, mid- and high-latitudes is poor. This has been noted from a decrease in QPOD, QCSI and an increase in QCM and QFAR over most of the globe with an increase in the threshold percentile values of TEC to be simulated from 10% to 90% during both solar minimum and maximum periods. The performance of IRI-2016 in correctly simulating observed low (as low as $10^{th}$ percentile) and high (high than $90^{th}$ percentile) TEC over EIA crest regions is reasonably good given that IRI-2016 is a climatological model despite large RMSE and positive model bias. Therefore, this study reveals the strength of the IRI-2016 model, which was concealed due to large RMSE and positive bias, in correctly simulating the observed TEC distribution during all seasons and solar activities for the first time. However, it is also worth noting that the performance of IRI-2016 model is relatively poor in 2013 compared to that of 2008 at the higher ends of the TEC distribution.

**Keywords: TEC (Total Electron content); IRI-2016 model; Ionosphere; GPS.**