Evaluation of ionospheric and solar proxy indices for IRI-Plas 2017 model over the East African equatorial region during solar cycle 24,

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Abstract

This study evaluates the performance of Ionospheric and Solar proxy indices for the International Reference Ionosphere extended to the Plasmasphere (IRI-Plas 2017/SPIM) model in predicting the Total Electron Content (TEC) over the East African equatorial region during the high (2014) and low (2018) solar activity periods of solar cycle 24. TEC is derived from Global Positioning System (GPS) installed at Addis Ababa (adis, Geog: 9.04° N; 38.77° E and Geom: 5.28° N; 112.6° E) and Ambo (aboo, 8.99° N; 37.81° E and Geom: 5.43° N; 111.6° E). The results show that the SPIM model with all options of proxies overestimates the observed TEC for all seasons at both stations during the low solar activity year of 2018. However, in some cases, the SPIM model with IG index option showed a better agreement during the low solar activity period, while it displayed poor performance at both stations during the high solar activity period. The SPIM model with SSN proxy option was better in estimating seasonal and annual VTECs during the high solar activity period, while it was poor during low solar activity period over the study region. Results also showed that the SPIM model with Lyman-α proxy option performed poor for the seasonal and annual prediction of VTECs with maximum RMSE of 19 TECU during the high and low solar activity years. A good agreement is observed between the observed-VTEC and SPIM model with SSN proxy option. The correlation coefficients (r) between observed-VTEC and model output using SSN as proxy was good ($r = 0.9566$ at adis and 0.9494 at aboo stations) during the high solar activity year of 2014. Moreover, the model with all proxy options displayed a strong correlation ($r > 0.96$ at adis and $r > 0.95$ at aboo stations) during low solar activity year. Overall, the results in this study revealed that the SSN proxy option of the SPIM model was better in estimating VTEC during high solar activity period, while SPIM with the IG index was better during low solar activity period over the East African equatorial region. Such performance evaluation of a global model for different inputs/options is important for the space weather community at the study region where little or no ground based instruments are found.