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Ongoing strategies for assessing VTEC maps performance over a low latitude region

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Vertical total electron content (VTEC) is one of the main parameters used to describe the ionosphere. The VTEC values can be provided to correct ionospheric delay errors or to accelerate precise real-time determination for Global Navigation Satellite System (GNSS) positioning. Analysis and validation of such valuable information are subject of many investigations, and, in this contribution, the main findings on the research developed in our recent studies are summarized and discussed [1, 2, 3]. In this sense, we present ongoing strategies for assessing VTEC maps with methods using ionosonde data and GNSS positioning over a low latitude region. The first method, derived from ionosonde data, is based on the critical frequency of the F_2 layer to validate the VTEC values. The second assessment method, based on GNSS positioning, is analyzed by means of single-frequency kinematic precise point positioning (PPP). All analyses are performed over one of the most challenging scenarios, considering the ionospheric influence, the Brazilian region. Four ionosondes (combined in six pairs) and four GNSS stations are used to assess different ionospheric maps, considering approaches with global and regional products from different analysis centers. Analyses are performed taking into account daily, weekly, one-year and four-year time series. In general, the assessment results with ionosonde data have shown better performance with regional products. Among the global products, CODG (product from Center for Orbit Determination in Europe - CODE) and UQRG (product from Universitat Politècnica de Catalunya - UPC-IonSAT) have provided the best results. As for regional maps, OTHR (product from Deutsches Geodätisches Forschungsinstitut-Technische Universität München - DGFI-TUM) leads to the best results. Considering the GNSS positioning approach, some regional products presented expected large errors in stations at the edges of the coverage area. In these cases, the use of a hybrid product leads to significant improvements. Such a hybrid product uses data from global maps reprocessed with the same resolution of the regional product to extend the RIM covered region. The hybrid product leads to the best performance on the GNSS positioning. Additionally, the impact of the use of the VTEC uncertainties from GIMs on the VTEC interpolation and on the GNSS positioning is also assessed. For the VTEC interpolation, no clear influence is observed with the use of uncertainties. However, the use of such values has a clear impact on the positioning error, leading to smaller errors in different ionospheric scenarios and regions, especially in periods of high solar flux and stations in region under more intense ionospheric effect.

References

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