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Analysis of ionospheric corrections for single-frequency GNSS spaceborne applications

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For ionospheric correction of single-frequency global navigation satellite system (GNSS) spaceborne applications, especially the low earth orbit (LEO) satellite, three-dimensional information of the electron density should be used to obtain the ionospheric path delay along the line of sight. Currently, only NeQuick-G model of Galileo provides the information of electron density vertical structure, which can be used to calculate the slant total electron content (STEC) through the integration of electron density along the signal path [1]. For other traditional ionospheric single-layer models (SLMs) of GNSS, how to obtain the STEC based on the ionospheric broadcast model parameters deserves further research. Extended slab mapping function [2] and an additional scaling dependent on the orbital height of the LEO [3] can be used to compute STEC from the vertical total electron content (VTEC) provided by broadcast or precise ionospheric information. This scale factor is related to the electron density profile function of altitude. This manuscript analyzes the scale factor based on the international reference ionosphere extended to plasmasphere (IRI-Plas) model [4] and the TEC product of the swarm mission [5] respectively. The topside STEC above the satellite is provided by the swarm TEC product, and the imaginary entire ground-to-GNSS STEC can be computed with global ionosphere maps (GIMs) products just as the ground users, then the scale factor can be obtained. It is found that for swarm-c satellite, the scale factor mostly varies between 25% and 50%, just as shown in the below figure. This result is smaller than the scale factor computed by extended slab density model and also the result from IRI-Plas model.

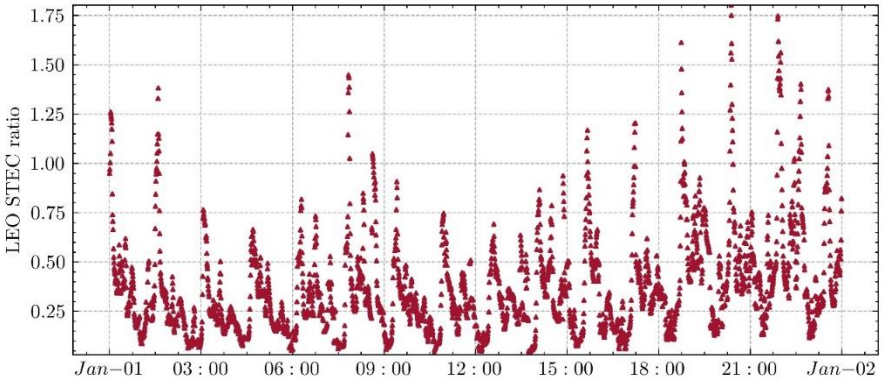

Figure 1. Analysis of scale factor for the topside electron content above swarm-c satellite on January 1, 2023.

References

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