

Getting rid of ionospheric mapping function for improving STEC correction

Haixia Lyu^(1,2), Manuel Hernández-Pajares^(3,4)

(1) GNSS Research Center, Wuhan University, Wuhan, China. Email: hxlyu@whu.edu.cn

(2) Hubei LuoJia Laboratory, Wuhan, China.

(3) Universitat Politècnica de Catalunya (UPC-IonSAT), Barcelona, Spain. Email: manuel.hernandez@upc.edu

(4) IEEC-CTE, Barcelona, Spain.

The ionospheric mapping function defines the conversion between Vertical Total Electron Content (VTEC) and Slant Total Electron Content (STEC). Even under quiet ionospheric conditions, the slant ionospheric delay estimation error caused by the typically adopted thin-layer mapping function can reach as high as several meters, severely affecting the availability and integrity of high-precision GNSS services. The increasing number of single- and multi-frequency GNSS users, e.g., low-cost geodetic-grade receivers in applications like precise agriculture, and smart device users in mass markets, drives greater demands for high-precision location services. However, mitigating the ionospheric mapping function error remains a perennial challenge of GNSS positioning. To address this challenge, a new study group “Ionospheric Mapping Function” has been established in the frame of the IGS Ionosphere Working Group [1]. Attempts to improve the ionospheric mapping function by considering the realistic vertical structure of the ionosphere, and meanwhile the horizontal gradient to a certain extent, have demonstrated the benefit of applying the tomographic solutions derived from GNSS measurements to the ionospheric mapping function [2, 3]. In the same line, a more direct way of estimating STEC using accurate tomographic solutions is proposed, which depends neither on VTEC models nor on the ionospheric mapping function. Initial validation results for the 2024 Mother’s Day storm will be presented.s

References

- [1] Haixia Lyu, Andrzej Krankowski, Manuel Hernández-Pajares, Mainul Hoque, Adam Fron, Reza Ghoddousi-Fard, Claudio Cesaroni (2024). The new Study Group of IGS Iono WG “Ionospheric Mapping Function”. IGS 2024 Workshop, Bern, Switzerland, 1-5 July 2024.
- [2] Haixia Lyu, Manuel Hernández-Pajares, Metin Nohutcu, Alberto García-Rigo, Hongping Zhang, Jingnan Liu (2018). The Barcelona ionospheric mapping function (BIMF) and its application to northern mid-latitudes. *GPS Solutions*, 22(3), 67.
- [3] Hernández-Pajares, M., Juan, J. M., Sanz, J., & García-Fernández, M. (2005). Towards a more realistic ionospheric mapping function. XXVIII URSI General Assembly, New Delhi, India, 23-29 October 2005.