Assessment of first Real-Time IGS global VTEC maps

M. Hernández-Pajares1, J.M. Juan1, J. Sanz1, A. García-Rigo1, N. Jakowski2, V. Wilken3, H. Barkmann4, M. tegler5, M. Caissy5, L. Agrotis1 and A. Krankowski5

Abstract

The assessment of the first Real-Time (RT) IGS global VTEC maps computed by DLR and UPC, against JASON-1 (during 2011) and JASON-2 altimeter VTEC measurements (2012), is presented in this work. Indeed, within the International GNSS Service (IGS), Associate Analysis Centres (ACC) produce specialized or derived products. Two examples of Real-time ACCs are the Universitat Politècnica de Catalunya (UPC) and the German Aerospace Center (DLR). They have participated in the IGS Real Time Pilot Project (RTPPP) and continue to collaborate on the development of a combined global IGS RT-VTEC product. This collaboration is occurring under the umbrella of the IGS Ionosphere Working group (IGS Ion-WG) currently led by the University of Warmia and Mazury in Olsztyn, Poland. RT-VTEC information is used to support earth observation missions and space weather monitoring and forecast. RT-VTEC information can improve single-frequency positioning on a global scale and in smaller regions where the ionosphere may be well sounded. RT-VTEC information is known to improve RTPPP accuracy results for single-frequency users. Through the use of iono-geometric techniques, phase quality dual-frequency RTPPP results are being improved by reducing the convergence time for phase ambiguity fixing. The JASON comparisons are considered pessimistic for the overall global VTEC product accuracy because the land-based tracking stations are generally located quite far from the location of the JASON measurements. The importance of a reliable globally distributed and sufficiently dense real-time GNSS tracking network will be shown. Moreover the RT-VTEC results are quite compatible with the rapid and final IGS VTEC maps for a significant fraction of time. These results suggest that it may be feasible to combine real-time VTEC products from several centres into a robust IGS real-time IONO product. Additional work to compare both solutions is underway with the goal of finding optimal ways to assess and combine these products into an IGS RT- VTEC product. Future efforts will include working with RTCM to ensure that the IGS RT-VTEC product is compatible with ionosphere correction information proposed for the RTCM-SSR standard.

Introduction

- The generation of real-time global IGS ionosphere VTEC maps is a new challenge within RTIGS project (Caisy et al. 2012).
- So far: final, rapid and predicted global VTEC maps are generated with latencies of about 12, 1, -1 and -2 days (Hernández-Pajares et al. 2009).
- Applications at short and long terms: Space Weather (see http://swacweb.dlr.de), GNSS navigation (single freq., PPP-RTK or Fast PPP Juan et al. 2012).
- Performance of first global RT-VTEC maps of UPC and DLR is summarized.

Models

- UPC RT-TOMION software directly fed by the RTIGS datastreams, estimates the TEC with two layers of voxels (Juan et al. 1997), with Kalman filtering and further Kriging interpolation (Orús et al. 2005) of the residuals regarding to predicted VTEC maps (García-Rigo et al. 2011).
- DLR VTEC maps are generated by assimilating GNSS data into a global TEC model (Jakowski et al. 2011a). The model is used to forecast TEC 1 hour ahead (Jakowski et al. 2011b).

Conclusions

- The importance of a reliable globally distributed and sufficiently dense real-time GNSS tracking network is shown. These results suggest that it may be feasible to combine RT VTEC products from several centres into a robust IGS RT IONO product, when a high enough number of worldwide distributed RT stations is available.
- The real-time results are sufficiently close, for a significant number of days, to those of the rapid and final IGS VTEC.
- Work to compare DLR and UPC RT solutions is underway with the goal of finding optimal ways to assess and combine these products into an IGS RT-VTEC product.
- Future efforts will be focused on an improvements to the apriori background VTEC model (UPC), and on working with the RTCM community to ensure that the IGS RT-VTEC product is compatible with the ionosphere correction information proposed for the RTCM-SSR standard.

References