Assessment of Regional and Global Ionospheric Models for GNSS users

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Abstract:
The ionosphere plays an important role in satellite-based navigation. In single frequency positioning the user has to correct its measurements with the predictions provided by an ionospheric model. Thence, the error in the ionospheric corrections is directly translated to the measurements modelling and, consequently, to the user solution. Once satellite orbits and clocks precise to few centimetres are granted to users in real time, positioning can be enhanced by means of an accurate modelling of the ionosphere.
In this work, a methodology is introduced to compare the accuracies of different Global and Regional Ionospheric model predictions with actual unambiguous, undifferenced, geometry-free combination of carrier-phase measurements.
Following this methodology, we have conducted an assessment of different Global and Regional Ionospheric models during the entire 2014, i.e., near to the last Solar Maximum. They involve: the operational models broadcast in the Global Positioning System (GPS) and Galileo, their correspondent satellite-based augmentation system (SBAS), i.e., European Geostationary Navigation Overlay System (EGNOS) and Wide Area Augmentation System (WAAS), a number of post-process Global Ionospheric Maps (GIMs) from different analysis centres belonging to the International GNSS Service (IGS) and, finally, a new GIM computed by the research group of Astronomy and GEomatics (gAGE/UPC). The result analysis is divided in time and latitude. The assessment also distinguishes Regional from Global coverage of the different models. In this sense, the performance of EGNOS is assessed in the area defined by the European Civil Aviation Conference (ECAC) while WAAS, within the Contiguous United States (CONUS).
The obtained results show that NeQuick (Galileo) model is about 5% more accurate than or Klobuchar (GPS), with errors are around 30-35% of the total slant delay. The errors of Rapid GIMs from IGS are 15%. SBAS models present a 10% error of the total delay, but are limited to mid-latitude regions. Finally, the error of our new global determinations is shown to be 5%.

Keywords: GNSS, Ionosphere, Global Ionospheric Maps

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