Geophysical Research Abstracts
Vol. 16, EGU2014-5012, 2014
EGU General Assembly 2014

Using DORIS for modeling the Vertical Total Electron Content of the Earth's Ionosphere

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The ionosphere is a dispersive medium for microwaves. As a consequence, most space-geodetic observation techniques can be utilized to extract information on ionospheric parameters, e.g. the Vertical Total Electron Content (VTEC). By combining different techniques one can take advantage of their different spatial and temporal data distributions as well as their different observation characteristics and sensitivities concerning ionospheric parameter estimation. Nowadays, most geodetic VTEC models are based on observations from terrestrial permanent stations of the Global Navigation Satellite Systems (GNSS), especially of the Global Positioning System (GPS). In addition, a few groups compute models from a combination of different observations techniques, mostly combination of terrestrial GPS with satellite altimetry and/or GPS radio occultations (e.g. from the FORMOSAT-3/COSMIC mission). Today, DORIS (Doppler Orbitography and Radiopositioning Integrated by Satellite) is rarely used in ionospheric modeling although it provides valuable measurements on two frequencies.

Recently, we started to include DORIS measurements in our ionosphere modeling process and to test their capability and their potential to derive ionospheric parameters such as VTEC. Although DORIS was primarily designed for precise orbit computation of satellites, it can be used as a tool to study the Earth's ionosphere. The DORIS ground beacons are almost globally distributed and the system is on board of various Low Earth Orbiters (LEO) with different orbit heights, such as Jason-2, Cryosat-2, HY-2a, and Saral. The last generation of DORIS receivers directly provides phase measurements on two frequencies.

In this contribution, we show the capability of DORIS for ionosphere VTEC modeling. For this purpose, we compute DORIS VTEC values from the two-frequency measurements of different missions and include it in our ionosphere model approach where the unknown model parameters are estimated within an adjustment process. The weighting of the different observation groups is done by a Variance Component Estimation. By analyzing the estimated variance components we extract information on the quality of different DORIS missions for ionospheric modeling and on the consistency with other observation techniques.