



The combination of satellite observation techniques for sequential ionosphere VTEC modeling

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The project OPTIMAP is a joint initiative by the Bundeswehr GeoInformation Centre (BGIC), the German Space Situational Awareness Centre (GSSAC), the German Geodetic Research Institute of the Technical University of Munich (DGFI-TUM) and the Institute for Astrophysics at the University of Göttingen (IAG). The main goal is to develop an operational tool for ionospheric mapping and prediction (OPTIMAP). A key feature of the project is the combination of different satellite observation techniques to improve the spatio-temporal data coverage and the sensitivity for selected target parameters. In the current status, information about the vertical total electron content (VTEC) is derived from the dual frequency signal processing of four techniques: (1) Terrestrial observations of GPS and GLONASS ensure the high-resolution coverage of continental regions, (2) the satellite altimetry mission Jason-2 is taken into account to provide VTEC in nadir direction along the satellite tracks over the oceans, (3) GPS radio occultations to Formosat-3/COSMIC are exploited for the retrieval of electron density profiles that are integrated to obtain VTEC and (4) Jason-2 carrier-phase observations tracked by the on-board DORIS receiver are processed to determine the relative VTEC.

All measurements are sequentially pre-processed in hourly batches serving as input data of a Kalman filter (KF) for modeling the global VTEC distribution. The KF runs in a predictor-corrector mode allowing for the sequential processing of the measurements where update steps are performed with one-minute sampling in the current configuration. The spatial VTEC distribution is represented by B-spline series expansions, i.e. the corresponding B-spline series coefficients together with additional technique-dependent unknowns such as Differential Code Biases and Intersystem Biases are estimated by the KF. As a preliminary solution, the prediction model to propagate the filter state through time is defined by a random walk.