Geophysical Research Abstracts
Vol. 17, EGU2015-9070-1, 2015
EGU General Assembly 2015

Reconstruction of the ionospheric electron density by geostatistical inversion

David Minkwitz (1), Karl Gerald van den Boogaart (2,3), Mainul Hoque (1), and Tatjana Gerzen (1)

(1) German Aerospace Center (DLR), Institute of Communications and Navigation, Neustrelitz, Germany (david.minkwitz@dlr.de), (2) Helmholtz Institute Freiberg for Resource Technology, Division of Modelling and Evaluation, Freiberg, Germany, (3) TU Bergakademie Freiberg, Faculty of Mathematics and Computer Science, Freiberg, Germany

The ionosphere is the upper part of the atmosphere where sufficient free electrons exist to affect the propagation of radio waves. Typically, the ionosphere extends from about 50 - 1000 km and its morphology is mainly driven by solar radiation, particle precipitation and charge exchange. Due to the strong ionospheric impact on many applications dealing with trans-ionospheric signals such as Global Navigation Satellite Systems (GNSS) positioning, navigation and remote sensing, the demand for a highly accurate reconstruction of the electron density is ever increasing.

Within the Helmholtz Alliance project "Remote Sensing and Earth System Dynamics" (EDA) the utilization of the upcoming radar mission TanDEM-L and its related products are prepared. The TanDEM-L mission will operate in L-band with a wavelength of approximately 24 cm and aims at an improved understanding of environmental processes and ecosystem change, e.g. earthquakes, volcanos, glaciers, soil moisture and carbon cycle. Since its lower frequency compared to the X-band (3 cm) and C-band (5 cm) radar missions, the influence of the ionosphere will increase and might lead to a significant degradation of the radar image quality if no correction is applied.

Consequently, our interest is the reconstruction of the ionospheric electron density in order to mitigate the ionospheric delay. Following the ionosphere's behaviour we establish a non-stationary and anisotropic spatial covariance model of the electron density separated into a vertical and horizontal component. In order to estimate the model's parameters we chose a maximum likelihood approach. This approach incorporates GNSS total electron content measurements, representing integral measurements of the electron density between satellite to receiver ray paths, and the NeQuick model as a non-stationary trend. Based on a multivariate normal distribution the spatial covariance model parameters are optimized and afterwards the 3D electron density can be calculated by kriging for arbitrary points or grids of interest.