Current topic for a Master's Thesis

Computation of realistic covariance information for estimated global Vertical Total Electron Content (VTEC) maps of the ionosphere

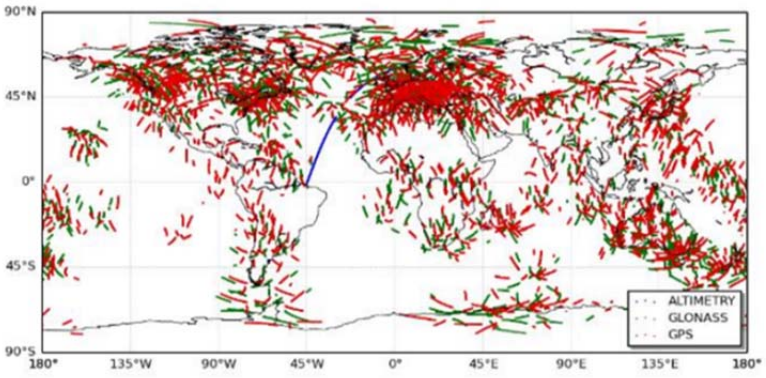

Figure 1: Global hourly ionospheric data distribution from GPS (red), GLONASS (green) and altimetry (blue) for the time interval of *07:30h - 08:30h on 05.03.2015*

At present, most geodetic ionosphere models describe the global VTEC, where the model parameters are derived from terrestrial measurements of the Global Positioning System (GPS). The most popular products are the Global Ionosphere Maps (GIMs) provided by the International GNSS Service (IGS) with a spatial resolution of 2.5° in latitude and 5° in longitude as well as a temporal resolution of 2 hours. Since spherical harmonics (SH) are global base functions they are widely used for global VTEC modelling. However, compared to SHs, localizing base functions such as B-splines are more suitable for modelling inhomogeneous distributed input data as shown in Fig. 1. The impact of data gaps can partly be reduced by introducing GLONASS, satellite altimetry, radio occultation and DORIS measurements into the estimation procedure.

Independent of the chosen approach, an up-to-date VTEC model must consist of both the estimated model parameters – such as SH or B-spline series coefficients – and the corresponding covariance matrix representing realistic standard deviations and correlation coefficients. To reach these goals a realistic stochastic model for the measurements of the chosen observation techniques must be set up before the parameter estimation procedure is started. Within the parameter estimation procedure the estimated covariance information has to be propagated appropriately, e.g. within the prediction step of a Kalman filter.

In this thesis the impact of simplifications on the estimated global VTEC maps including the covariance estimation shall be studied. Finally, a recipe shall be formulated how the covariance matrices have to be set up within the estimation procedure to obtain realistic standard deviations for the series coefficients and final VTEC maps.

Main tasks:

- Study current methods of global VTEC modelling based on SH and B-spline functions
- Set up an observation plan to estimate the unknown model parameters, e.g., the series coefficients, by least-squares estimation and/or Kalman filtering
- Set up both the full and simplified stochastic models for the chosen observation techniques
- Compare the different solutions and study the impact of the covariance information on the final VTEC and standard deviation maps

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