

Current topic for a Master's Thesis

Transformation of B-spline models of the global Vertical Total Electron Content of the ionosphere into spherical harmonic representations for data dissemination

At present, the Vertical Total Electron Content (VTEC) of the ionosphere is usually modelled by series expansions, mostly in terms of spherical harmonics (SH). At DGFI-TUM the global VTEC is represented by an expansion in localizing B-spline functions. The reason for this procedure is the rather inhomogeneous distribution of terrestrial GPS measurements (see Fig. 1 for a one-hour data set). The spectral content of a B-spline VTEC model can be controlled by the so-called resolution levels chosen with respect to geomagnetic longitude and latitude.

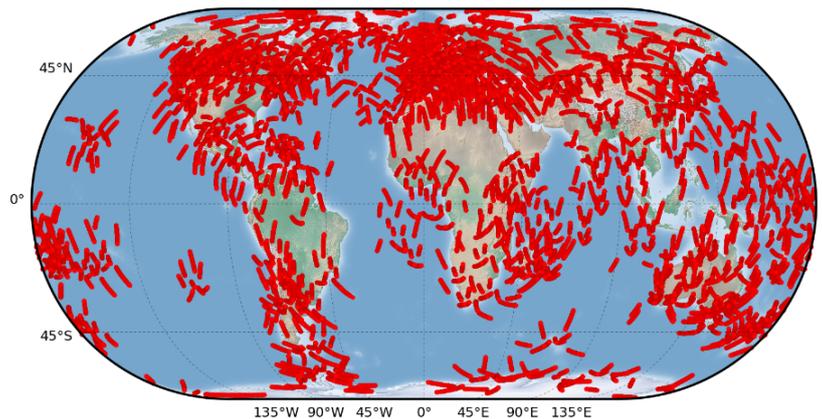


Figure 1: Distribution of ionospheric pierce points (IPP = intersection point of a signal ray path with the single-layer model in a certain altitude) based on GPS observation to IGS stations of February 11, 2016, 12:00 UT - 13:00 UT.

The dissemination of the VTEC information to a user, e.g. in precise agriculture, is usually executed by means of the RTCM (Radio Technical Commission for Maritime services) message format which is defined on the basis of a series expansion in terms of SHs up to a given maximum degree; currently this value is by default fixed to 16. Consequently, to apply the RTCM message format to the B-Spline VTEC model, it has to be transformed into a SH VTEC model.

In this thesis this transformation shall be developed and applied to B-spline models of various resolution levels. In particular, the loss of information for the end user shall be investigated by using SHs instead of the B-splines, i.e. by using VTEC values.

Main tasks:

- Study of the current methods of global VTEC modelling based on SH- and B-spline functions.
- Develop a procedure to transform B-spline VTEC models into SH VTEC models by including the full covariance information.
- Investigate the loss of information between the B-spline and the transformed SH VTEC models by modifying the B-spline levels and the highest degree value of the SH model.