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An adapted multi-resolution representation of regional VTEC

Wenjing Liang, Denise Dettmering, and Michael Schmidt
Deutsches Geodätisches Forschungsinstitut (DGFI), München, Germany

The resolution of ionosphere models is mainly limited by inhomogenously distributed input data. The International GNSS Service (IGS) provides global ionosphere maps (GIMs) of vertical total electron content (VTEC) values with a spatial resolution of 2.5° in latitude and 5° in longitude. In order to provide local ionospheric structures and support high precise GPS positioning, different high-resolution regional ionosphere models have been developed by using dense observation networks. However, there is no model available with a spatial resolution adapted to the data distribution.

In this study we present a regional multi-resolution VTEC model which adapts the model resolution to the data distribution. In our approach, VTEC consists of a given background model such as the International Reference Ionosphere (IRI) and an unknown correction part modeled as a series expansion in terms of B-spline scaling functions. The resolution level of the B-spline functions has to be determined by the distribution of the input data. With a sufficient number of observations, a higher level can be chosen, i.e. finer structures of VTEC can be modeled. The input data are heterogeneously distributed; specifically, the observations are dense over the continent whereas large data gaps exist over the oceans. Furthermore, the GPS stations are unevenly distributed over the continent. A data adapted VTEC model is achieved by combining a regional VTEC part with some local densification areas, each represented by a B-spline expansion. The unknown scaling coefficients of all these parts are then estimated by parameter estimation.

In this contribution, our model approach is introduced, including the method of multi-resolution representation (MRR) and of combining the regional and local model parts. Furthermore, we show an example based on GNSS observations from selected permanent stations in South America.