Mapping the global TEC by means of an adaptive B-spline parametrization and space-geodetic techniques

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Observation driven ionosphere models significantly benefit from the large amount of measurements that become available through the increasing number of space missions improving the spatial and temporal data distribution. In the global domain, the observations are available as regional aggregations and consequently the issue of bridging data gaps and at the same time adapting the model resolution to the data density remains.

In this contribution, we present a method to describe the vertical total electron content (TEC) from the combination of different sounding techniques. The general processing strategy includes a batch preprocessor that extracts the ionospheric delay from dual-frequency GNSS (GPS and GLONASS) carrier phase data and forwards the data arcs to a Kalman filter. The extent of the data basis by altimetry, DORIS and radio occultation measurements is already under progress.

Due to the heterogeneous distribution of measurement aggregations, data interpolation is an important issue where the influence of the measured signal should be restricted to its surrounding area. A global propagation of the information, as it can be the case when using for instance globally defined spherical harmonics, is on the contrary not desired. For this purpose, the TEC model parameters are expressed as tensor products of localizing quadratic polynomial and periodic trigonometric B-splines in latitude and longitude with knots adapted to the current distribution of measurements.

The Kalman filter implementation enables the sequential estimation of TEC and differential code biases. Through inclusion of external data, for instance from the International Reference Ionosphere (IRI), information about the dynamics of the TEC can be considered in the Kalman Filter prediction step. In the current setup, the filter incorporates hourly batch observations and processes the data depending on the data sampling whereas TEC maps are generated from the current Kalman Filter state and propagated by means of IRI TEC dynamics.