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Advanced algorithms for ionosphere modelling in GNSS applications within AUDITOR project

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The H2020 project AUDITOR of the European Union started on January 1st 2016, with the participation of several European institutions and universities. The goal of the project is the implementation of a novel precise positioning technique, based on augmentation data in a customized GNSS receiver. Therefore more sophisticated ionospheric models have to be developed and implemented to increase the accuracy in real-time at the user side. Since the service should be available for the public, we use public data from GNSS networks (e.g. IGS, EUREF).
The contributions of DGFI-TUM and UPC are focusing on the development of high accuracy GNSS algorithms to provide enhanced ionospheric corrections. This includes two major issues:

1. The existing mapping function to convert the slant total electron content (STEC) measurable by GNSS into the vertical total electron content (VTEC) is based on a so called single layer model (SLM), where all electrons are concentrated on an infinitesimal thin layer with fixed height (between 350 and 450 kilometers). This quantity is called the effective ionospheric height (EIH). An improvement of the mapping function shall be achieved by estimating more realistic numerical values for the EIH by means of a voxel-based tomographic model (TOMION).

2. The ionospheric observations are distributed rather unevenly over the globe and within specific regions. This inhomogeneous distribution is handled by data adaptive B-Spline approaches, with polynomial and trigonometric functions used for the latitude and longitude representations to provide high resolution VTEC maps for global and regional purposes. A Kalman filter is used as sequential estimator. The unknown parameters of the filter state vector are composed of the B-spline coefficients as well as the satellite and receiver DCBs. The resulting high accuracy ionosphere products will be disseminated to the users via downlink from a dedicated server to a receiver site. In this context, an appropriate message (e.g. VTEC grid) has been defined by DGFI and UPC which can directly be used to provide ionospheric corrections for positioning and navigation.

In this contribution we present the total production chain from GNSS STEC observations to the dissemination of the ionospheric message to the user of the AUDITOR customized receiver.