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TEC MODELS AND THEIR USE IN IONOSPHERE MONITORING

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Abstract.

At L band frequencies used in Global Navigation Satellite Systems (GNSS), the ionosphere causes signal delays that correspond with link related range errors of up to about 100 meters. In a first order approximation the range error is proportional to the integral of the electron density along the ray path (Total Electron Content - TEC). Whereas this error can be corrected in dual frequency measurements by a simple linear combination of L1 and L2 phases, single frequency measurements need additional information for mitigating the ionospheric error. This information can be provided by TEC maps deduced from corresponding GNSS measurements or by model values. In this talk we discuss the development and use of background models for reconstructing reliable TEC maps distributed via an operational space weather and ionosphere data service (http://swaciweb.dlr.de) to the international community,. To reconstruct TEC over a selected region we assimilate the observation data into the specific background model of TEC. This approach has the advantage that in case of only a few measurements or even in case of total loss of input data, the operational data service is maintained by providing model values. Since ground based GNSS data are often uneven distributed, the inclusion of a background model in the TEC reconstruction helps to overcome such data gaps which naturally occur over the oceans. The Neustrelitz TEC Model (NTCM) is a basic approach for a family of regional and a global TEC models. The model approximates TEC variations depending on the input of location, local time and solar activity. The model coefficients are deduced from calibrated TEC measurements by least squares methods. The European TEC model NTCM-EU is a polynomial with 60 coefficients. Since the European monitoring and modelling activities started in 1995, the data cover more than a full solar cycle, thus forming a data set that is needed for developing a full solar cycle TEC model. Reported are also regional models from both polar areas as well as a global TEC model. All these models serve as background models in which observation data are assimilated. Operational TEC maps primarily deduced from European IGS and EUREF GNSS data area are available via the SWACI service at an update rate of 5 minutes. Accuracy of various background

models and corresponding TEC maps obtained after data assimilation are compared with other models and reconstructions such as the Klobuchar and NeQuick models and IGS TEC maps.