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Ionosphere modeling by means of electron density profiles based on the satellite missions COSMIC, CHAMP and GRACE.

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The Chapman function for the F2-layer of the ionsphere contains three physically defined key parameters, namely the maximum electron density NmF2, the corresponding peak height hmF2 and scale height HF2. Every quantity can be expressed as a series expansion in terms of the tensor product of three one-dimensional polynomial B-splines referring to longitude, latitude and time with unknown series coefficients. Polynomial B-splines are localizing base functions whose number depends on a level that is specified based on the density of given observations.

In order to determine the three key parameters, an iterative estimation procedure is required since the Chapman function is non-linear. Therefore, prior information for the series coefficients have to be determined from initial values which can be extracted from a given model such as the Neustrelitz TEC model (NTCM). Depending on the spatial and temporal resolution of this initial model, the B-spline level will be set to allow for the representation of the parameters on a desired scale. The availability of observations with comparable density cannot be guaranteed but even in scenarios of less observation density it is possible to improve the initial parameters at those locations where measurements are given. Otherwise, data gaps are bridged by prior information.

Global navigation satellite systems (GNSS) provide observations of the slant total electron content (STEC) with a high spatial and temporal resolution from a dense network of ground-based receivers. Nevertheless, the estimation of the key parameters suffers from an unfavorable geometry and the fact, that observations are given as integrated values of the electron density. The introduction of electron density profiles consisting of point wise measurements stabilizes the adjustment system. They can be derived for instance from radio occultation measurements between the Global Positioning System (GPS) and low earth orbiter (LEO) satellites. In the context of this contribution, the focus is on the consideration of electron density profiles to estimate the B-spline series coefficients which allow for the reconstruction of the key parameters and eventually improve the initial model. Data of three LEO satellite missions, in particular the „Constellation Observing System for Meterorology, Ionosphere and Climate“ (COSMIC), „CHAllenging Minisatellite Payload“ (CHAMP) and „Gravity Recovery And Climate Experiment“ (GRACE) are taken into account.

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