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# Multi-scale model of the ionosphere from the combination of modern space-geodetic satellite techniques

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Near real-time high resolution and high precision ionosphere models are used for a large number of applications e.g. in navigation, positioning, telecommunications or astronautics. Today, these ionosphere models are mostly empirical, relying on extensive pure mathematical approaches. However, the complex phenomena within the ionosphere can only be understood and modelled when taking into account the physics behind the phenomena. In this paper we present the basic structure of a model for the electron density of the ionosphere, which will be developed by a cooperation of DGFI Munich, the Institute of Astronomical and Physical Geodesy (IAPG) of the Technical University Munich (TUM) and the German Aerospace Center (DLR), Neustrelitz. This model will be based on series expansions in terms of physics-motivated mathematical functions such as the Chapman function.
Based on the expertise of the three project partners on effective modelling, the new ionosphere model will be characterized by a quality satisfying the high demands of the users. For testing the procedure, the model will be applied to an appropriate region in South America, which covers relevant ionospheric processes and phenomena such as the Equatorial Anomaly. The main features of the project are (1) the consideration of physics-motivated modelling approaches, which are introduced in the multi-dimensional ionosphere model by means of appropriate mathematical base functions, (2) the estimation of the model parameters from the combination of various space-geodetic techniques, such as terrestrial and space-based GPS observations, altimetry and/or VLBI as well as (3) the transformation of the results into a multi-scale representation. The latter step allows both an effective data compression necessary for handling the huge ionosphere data sets and near real-time applications as well as the identification of physical phenomena at different spatial and temporal scales.