MDION (FWF P22203)

Project 'MDION' aims at the development of a multi-dimensional integrated model of the ionosphere, by using different space geodetic techniques and applying a combination procedure for computation of global ionosphere models. Geodetic techniques, such as the Global Navigation Satellite Systems (GNSS), satellite altimetry, or FORMOSAT-3/COSMIC allow the observation and modeling of the ionosphere, but each has its specific characteristics which affect the derived ionosphere parameters. The combined model makes best use of the advantages of every particular method, has a more homogeneous global coverage and is more accurate and reliable than the results of each single technique. In the first step models generated from the combination of GNSS and satellite altimetry within the Institute of Geodesy and Geophysics (IGG), Vienna, are integrated with occultation data from Low Earth Orbiter (LEO) satellites such as FORMOSAT-3/COSMIC in order to model ionospheric parameters in terms of the electron density as a function of latitude, longitude, time, and height. Since these LEO missions observe GPS occultation measurements, they have the capability of providing vertical profiles of ionospheric refractivity and would give the opportunity to develop 4D ionosphere models in form of Global Ionosphere Maps (GIM). For further improvement of the results, the models are integrated with external models and data such as the International Reference Ionosphere (IRI), the La Plata Ionospheric Model (LPIM), and the ionosphere data from integrated ionosonde profiles. The International Reference Ionosphere (IRI) has, for many years now, proven to be a valuable resource for modeling the average ionosphere; and as ionosondes are the most abundant and accurate sources of vertical profiles, using these models profiles in the assimilation procedure will be of great benefit for the models developed within project MDION. The integrated combined GIM will be useful for correcting single-frequency measurements carried out by many observation techniques using radio frequencies and for validation and improvement of ionosphere parameters derived by other individual techniques as well as theoretical models. They can also be utilized as information source for the technique-specific instrumental biases, like the GNSS Differential Code Biases (DCB) or satellite altimetry offsets, which are estimated as a by-product. Furthermore, the resolution of the models developed within the project will be increased, and the models will be densified by regional data. In order to accomplish this goal an observation-based variable degree Adjusted Spherical Harmonic (ASHA) model will be developed for near-real time regional ionospheric TEC mapping, primarily over the Austrian permanent GNSS network, and then over the European EUREF permanent network. Generally, the combined models will contribute to various studies of the physics of the upper Earth's atmosphere and solar terrestrial environment.