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# PROBING THE IONOSPHERE BY MEANS OF SPACE GEODETIC TECHNIQUES

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**Abstract.**

In the last decade space geodetic techniques, such as Very Long Baseline Interferometry (VLBI), Global Navigation Satellite System (GNSS), satellite altimetry missions, and Low Earth Orbiting (LEO) satellites have contributed extensively to remote sensing and modeling of the ionosphere. The Institute of Geodesy and Geophysics (IGG) has also been involved in this pioneer research; several stand-alone and bi-lateral projects have been carried out within the institute since 2003. In the first project the aim was using VLBI measurements for investigations on the ionosphere and to obtain absolute quantities of TEC by help of GPS measurements. Within the project it was revealed that the absolute TEC quantities could be obtained with VLBI measurements by applying a special estimation method. Thus the project concentrated on evelopment of a sound and solid procedure which enabled obtaining VTEC values at each VLBI station without any exterior information. The next project focused on developing Global Ionosphere Maps (GIM) from combination of different space geodetic techniques. The classical input data for the development of GIMs are the dual-frequency GNSS observations. However GNSS stations are heterogeneously distributed around the world with large gaps particularly over the sea surface, which lowers the precision of the GIM over these areas. In contrary, dual-frequency satellite altimetry missions such as Jason-1 provide information about the ionosphere precisely above the sea surface. And furthermore LEO satellites, such as Formosat-3/COSMIC (F-3/C) provide well-distributed information of the ionosphere around the world. The combined GIMs developed within the project provide a

more homogeneous global coverage and higher precision and reliability than results of each individual technique. Finally, in our forthcoming project well aim 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. Since the 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 models of the ionosphere. This talk will give an overview of the ionosphere investigations accomplished within the IGG.