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Multi-dimensional representations of VTEC from satellite data and IRI

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During the last decade various satellite missions have turned out to be promising tools for monitoring ionospheric parameters. Dual-frequency GNSS observations, e.g., can be used to determine the slant total electron content, i.e. the integral of the electron density along the ray-path of the signal between the transmitting satellite and a receiver. Today there is a variety of approaches to produce ionospheric maps of the vertical total electron content with a temporal resolution of two hours or less.

In this contribution we present a multi-dimensional ionospheric model calculated from (occultation) measurements of space-borne receivers flying on low-Earth-orbiting (LEO) satellites. To be more specific our model consists of a given reference part, computed from the International Reference Ionosphere (IRI), and an unknown correction term. Since the latter is represented as a series expansion in terms of multi-dimensional base functions constructed from polynomial B-splines, trigonometric B-splines or spherical harmonics, our approach can be applied to both global and regional data sets. The unknown series coefficients are calculable from LEO measurements by applying parameter estimation procedures. Since the input data are heterogeneously sampled in space and in time due to the specific orbit and instrumental characteristics, finer structures of the target function are modelable just in regions with a sufficient

number of observation sites.

We apply our method to data from the COSMIC/FORMOSAT-3 mission and validate the results by measurements from ionosondes. Furthermore, we address the combination of COSMIC data with other available data including GNSS observations and measurements from dual-frequency radar altimetry.