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Regional multi-resolution representation of the ionospheric electron density

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The knowledge of the electron density is the key point in correcting ionosphere delays of electromagnetic measurements and the study of ionosphere physics. During the last decade GPS has become a promising tool for monitoring the total electron content (TEC), i.e. the integral of the electron density along the ray-path between the transmitting satellites and the receivers, in the construction of so-called Global Ionospheric Models (GIMs). Hence, geometry free GPS measurements provide informations on the electron density, which is basically a four-dimensional function depending on spatial position and time. In addition, other available data including nadir, over-ocean TEC observations from dual-frequency radar altimetry (T/P, JASON, ENVISAT), and TECs from GPS-LEO occultation systems (e.g., CHAMP), with heterogeneous sampling and accuracy that complements the GIMs.

In our approach we decompose the electron density into a reference part, computed from an empirical model, the International Reference Ionosphere (IRI), and an unknown correction term expanded in a three-dimensional series in terms of localizing base functions. The corresponding time-dependent series coefficients are calculable from satellite measurements applying parameter estimation procedures. Since GPS receivers (and other data) are irregularly sampled, finer structures are modelable just in regions with a sufficient number of observation sites. Due to the localizing feature of B-spline functions we apply a tensor-product spline expansion to model the cor-

rection term regionally. Furthermore, the multi-resolution representation derived from wavelet analysis allows monitoring the ionosphere at different resolution levels. Here we present first results and demonstrate the advantages of this procedure by modeling the electron density regionally using simulated data and satellite measurements.