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Local Modeling of VTEC Using GPS Observations and B-spline Expansions

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Observation files for the day 29.10.2005 of 16 permanent GPS sites from a continuous GPS network (MAGNET) located in the Marmara region were provided by TUBITAK-MAM (Marmara Research Center). Observation files were pre-processed with the GPS software Bernese v5.0 to produce phase-smoothed pseudo range values and differential code biases (DCB) for the corresponding receivers. Precise orbit files and DCB values for the GPS satellites were obtained from the web pages of international GPS organizations. Using phase-smoothed pseudo ranges, and DCB values for receivers and satellites, slant total electron content (STEC) values have been calculated for each observation. Then the STEC values were converted into vertical total electron content (VTEC) values with the single layer model for the ionosphere. The final output of our procedure includes besides the VTEC values also latitude and longitude of the ionospheric pierce points.

For the numerical evaluation of these data we apply a three-dimensional B-spline expansion of the VTEC consisting of a given reference part, computed from the International Reference Ionosphere (IRI), and an unknown correction term. The unknown series coefficients were calculated by parameter estimation procedures. Since the data are heterogeneously sampled in space and time, finer structures of the VTEC are modelable just in regions with a sufficient number of observation sites.