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GPS Tomography: Water Vapour Monitoring for Germany

Michael Bender (1), Galina Dick (1), Jens Wickert (1), and Armin Raabe (2)

(1) Helmholtz-Zentrum Potsdam, Deutsches GeoForschungszentrum (GFZ), Department 1.1, Potsdam, Germany (bender@gfz-potsdam.de), (2) Universität Leipzig, Institut für Meteorologie (LIM), Leipzig, Germany (raabe@uni-leipzig.de)

Ground based GPS atmosphere sounding provides numerous atmospheric quantities with a high temporal resolution for all weather conditions. The spatial resolution of the GPS observations is mainly given by the number of GNSS satellites and GPS ground stations. The latter could considerably be increased in the last few years leading to more reliable and better resolved GPS products. New techniques such as the GPS water vapour tomography gain increased significance as data from large and dense GPS networks become available. The GPS tomography has the potential to provide spatially resolved fields of different quantities operationally, i. e. the humidity or wet refractivity as required for meteorological applications or the refraction index which is important for several space based observations or for precise positioning.

The number of German GPS stations operationally processed by the GFZ in Potsdam was recently enlarged to more than 300. About 28000 IWV observations and more than 1.4 millions of slant total delay data are now available per day with a temporal resolution of 15 min and 2.5 min, respectively. The extended network leads not only to a higher spatial resolution of the tomographically reconstructed 3D fields but also to a much higher stability of the inversion process and with that to an increased quality of the results. Under these improved conditions the GPS tomography can operate continuously over several days or weeks without applying too tight constraints.

Time series of tomographically reconstructed humidity fields will be shown and different initialisation strategies will be discussed: Initialisation with a simple exponential profile, with a 3D humidity field extrapolated from synoptic observations and with the result of the preceeding reconstruction. The results are compared to tomographic reconstructions initialised with COSMO-DE analyses and to the corresponding model fields.

The inversion can be further stabilised by making use of independent adequately weighted observations, such as synoptic observations or IWV data. The impact of such observations on the quality of the tomographic reconstruction will be discussed together with different alternatives for weighting different types of observations.