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Validation of GNSS signal slant total delays obtained from GNSS4SWEC WG1 benchmark campaign data

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Continuous observations from GNSS receivers provide excellent data to derive the state of neutral atmosphere. Currently, development of services for near real-time (NRT) and real-time (RT) troposphere parameter estimation from GNSS data are of utmost importance in severe weather events research. The GNSS&METEO research group at Wroclaw University of Environmental and Life Sciences (WUELS) participate in the COST ES1206 Action: GNSS4SWEC (Advanced Global Navigation Satellite Systems tropospheric products for monitoring severe weather events and climate) and EGVAP initiative as NRT/RT GNSS processing centre. Our interest is to provide the reliable GNSS products to weather prediction and climate studies. The knowledge of spatial and temporal variation of water content in the atmosphere cannot be obtained using the signal delays in zenith direction only. The possibility of slant wet delays estimation in directions to GNSS satellites makes possible the 4-dimensional modelling of troposphere precipitable water vapour content. Benchmark activity done according to the GNSS4SWEC action's WG1 objectives is an excellent reference for verification of the slant delays processing scenarios. Area of the benchmark contains the territories of Austria, Czech Republic, Germany and Poland and consists of total 430 GNSS stations, where 360 have GPS+GLONASS observations. Data in benchmark's repository is from the period covering May and June of 2013. The weather conditions during the selected period include quiet weather as well as heavy rainfall events. Benchmark data repository includes: GNSS data, GNSS troposphere products from near real-time solution, numerical weather model data, radiosonde data, radar images, meteorological data from synoptic stations and water vapour radiometer data.
The paper presents methodology of GNSS signal slant total delay estimation at WUELS using the Precise Point Positioning (PPP) approach. It presents also resultant slant delays obtained from benchmark's campaign GNSS data as well as their validation using the radiosonde, water vapour radiometer and numerical weather model data.