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Multi-observation integrated model of troposphere – current status

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The Global Navigation Satellite Systems (GNSS) and meteorological observation systems in the past decades were developed to address separate challenges and were used by different communities. Currently, the inter-dependence between meteorology and GNSS processing is growing up, providing both communities incentives, data and research challenges. The GNSS community uses meteorological observations as well as Numerical Weather Prediction (NWP) models to reduce the troposphere impact on the signal propagation (i.e. eliminate tropospheric delay). On the other hand, meteorology community is assimilating the GNSS observations into weather forecasting, nowcasting or climate studies.
To seamlessly use observations from both sides of the GNSS and meteorology spectra, the data have to be interoperable. In this study we present a current status of establishing an integrated model of troposphere. We investigated and compared a number of meteorological and GNSS data sources that are going to be integrated into the troposphere model with high temporal and spatial resolution. The integrated model will provide values of meteorological and GNSS parameters at any point and any time with known accuracy. First step in building this model is to inter-compare all available data sources and to establish the accuracy of parameters.
Three main data sources were compared: ground-based GNSS products on ASG-EUPOS stations, NWP model COAMPS (Coupled Ocean/ Atmosphere Mesoscale Prediction System) and meteorological parameters from three kinds of stations - EUREF Permanent Network (EPN) stations, meteorological sensors at airports and synoptic Institute of Meteorology and Water Management. Data was provided with different temporal and spatial resolution, so it had to be interpolated prior to inter-comparison. Afterwards, the quality of the data was established. The results show that NWP model data quality is: 4hPa in terms of air pressure, 2hPa in terms of water vapor partial pressure, and 6K in terms of temperature; the agreement between the GNSS phase delay and NWP phase delay is in the order of 20 mm. The meteorological stations quality differs from highly consistent observations to stations with corrupted temperature or pressure sensors.