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Impact of different troposphere modelling methods on ZTD time series: case study of mountainous GPS stations

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GNSS Zenith Total Delay (ZTD) data is useful for numerical weather forecasting and climate analysis. Considering the fact that tropospheric delays over the mountainous areas are the most difficult to be modelled, we explored the influence of different troposphere models in Precise Point Positioning (PPP) mode. We used GPS data from 2008 to 2014 at 28 permanent EUPOS (European Position Determination System) stations, including 9 EPN (EUREF Permanent Network) ones, located in the Sudeten and Carpathians. The GPS data was processed in PPP mode using Bernese 5.2 GNSS software with the final IGS (International GNSS Service) orbits and clocks. Different processing variants were tested implying the newest mapping functions (Global Mapping Function – GMF, and Vienna Mapping Function – VMF1) as well as different time resolutions and constraints on estimated parameters (ZTD and gradients).
Median trends and amplitudes of annual/semi-annual oscillations for ZTD series were determined with Weighted Least Squares Estimation (WLSE) obtaining 0.1±0.5 mm/year and 44.7 / 7.2 ± 5 mm, respectively. Power Spectral Densities (PSDs) were estimated using Lomb-Scargle method for each of individual variants. PSDs showed, except oscillations of year and half a year, many other significant peaks in ZTD time series at higher frequencies, about 60, 30, 24, 20, 15, 12, 10, 8, 7, 6, 5, 4 and 3 cpy. The proper subtraction of the periodicities is crucial, because they will make stochastic part appear to be artificially autocorrelated. In order to recognized the periodicities in the ZTD signal, we analyzed the ZTD differences between GPS-derived delays and ERA-Interim reanalysis. The results of analysis showed the significant change from station to station and between variants. According to these results the authors will indicate an optimal processing strategy concerning troposphere modelling.