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Comparison of tropospheric estimates from DD and PPP processing approaches for climate monitoring

Katarzyna Stepniak (1) and Olivier Bock (2)

(1) University of Warmia and Mazury in Olsztyn, Institute of Geodesy, Olsztyn, Poland (k-stepniak@wp.pl), (2) IGN LAREG, University Paris Diderot, Sorbonne Paris Cité, 75013 Paris, France (Olivier.Bock@latmos.ipsl.fr)

The aim of this study is to test and compare of relative and precise point positioning (PPP) techniques to determine which processing is most suited for achieving high accuracy, stability, and homogeneity in the estimated tropospheric parameters. Relative processing mode uses double-difference (DD) observations from a network of stations while PPP uses zero-difference observations from single stations. Relative processing is usually thought as being more precise, but not necessarily more accurate and more stable. Indeed, the estimated tropospheric parameters (ZTD and gradients) are correlated and may include biases in their absolute values when too short baselines are used. Moreover, the network configuration (extend and geometry of the baselines) can have a significant impact on tropospheric parameters in double-difference processing. For example, gaps or increased noise in observations at one station can impact other stations because of the interconnections in the network. PPP is an absolute technique in the sense of no propagation of errors between stations. However, the accuracy of data processing in PPP mode depends strongly on the quality of external products, like satellite orbits and clocks. Data processing in PPP mode is also faster method than DD solution, because only observations for the stations of interest are processed while in relative processing additional stations are required to form long baselines and reduce the correlation between tropospheric parameters.
In order to compare PPP and DD solutions, the ZTD and gradient estimates were computed using both techniques and the same processing options were set. One year of GPS data from a network of more than 100 stations was used. In this study, a reference CODE solution was also used as a comparison for our processing strategies. Initial results show that ZTD outliers observed in DD solution are due to very few observations in common with other station in baseline and are not seen in PPP ZTD time series. It can be assumed that PPP might be an interesting alternative to double-difference processing for estimation of tropospheric parameters, especially in cases when outliers arising from defects in the baseline geometry in a double-difference processing. In addition, to validate GPS ZTD using an independent from GPS solution, ZTD computed based on ERA-Interim/ERA5 reanalysis was compared to PPP and DD estimates.