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Slant Wet Delays from GNSS observations - Precise Point Positioning vs. Double Difference Approach

Gregor Moeller and Robert Weber

Vienna University of Technology, Department of Geodesy and Geoinformation, Vienna, Austria
(gregor.moeller@tuwien.ac.at)

The tropospheric parameter SWD (Slant Wet Delay) is the path delay caused by the highly variable amount of humidity in the atmosphere at altitudes below 12 km. It can be derived from Numerical Weather Predication data or even more precisely from dual- or multi-frequency observations of a regional GNSS reference network. In order to find the most adequate processing strategy dual GNSS observations of a small network of reference stations were simulated and tropospheric parameters were estimated in Precise Point Positioning (PPP) and in Double Difference (DD) mode.

In DD mode the integer character of the phase ambiguities remains which allows to fix them to their true values and to obtain the tropospheric zenith delay as well as north and east (N/E) gradients with highest precision over very short time periods. In PPP mode orbit and clock errors are not cancelled out which affects the quality of the tropospheric estimates. On the other hand it has the advantage that the GNSS observations are processed undifferenced. Latter is important because the Zero Difference Residuals (ZDR) contain the azimuthal-anisotropic part of the tropospheric delay which is not covered by the estimated parameters. From Double Difference Residuals (DDR) the ZDR can be recovered too but only conditionally since common tropospheric effects have been cancelled out in advance by differencing.

In this presentation we show how good the anisotropic slant path delays can be obtained from GNSS observations processed using both concepts - the PPP and the DD approach. Therefore tropospheric zenith delays and N/E gradients were estimated and Pseudo-ZDR were reconstructed from DDR and afterwards compared with ZDR derived from the PPP solution. In addition it is shown how good both concepts are applicable for observations at very low elevation angles and under extreme weather conditions. The IGS final and ultra-rapid service products were taken into account to define the best strategy not only for post-processing but also for near real-time applications.