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Validation of tropospheric ties at the test setup GNSS co-location site in Potsdam

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Atmospheric ties are induced by differences between the set-up of observing geodetic systems at co-location sites, are mainly attributed to frequency and position, and are usually quantified by zenith delay and gradient component offsets derived by weather models or in situ instuments.. Similar to local ties, they could be applied to combine datasets from several space geodetic techniques, thus contributing to the improvement of the realization of terrestrial reference frames (TRF). Theoretically, atmospheric ties are affected only by the height differences between antennas at the same site and meteorological conditions. Therefore, atmospheric ties could be determined analytically based on meteorological information from in situ measurements or weather models. However, there is often a discrepancy between the expected zenith delay differences and those estimated from geodetic analysis, potentially degrading a combined atmospheric ties solution should tight constraints be used. In this study, we set up a GNSS experiment campaign on the rooftop of a building in Telegrafernberg that offers unobscured data coverage for one month. We compared the estimated zenith delay and gradients from GNSS stations in this experiment, applying atmospheric ties from (1) meteorological data from the Global Pressure and Temperature model 3 (GPT3), (2) ERA5 reanalysis, and (3) in-situ measurements, as well as corrections derived from ray tracing (Potsdam Mapping Functions, PMF). The results show that atmospheric ties employing GPT3, ERA5, in-situ measurements, and ray tracing has an excellent and comparable performance in term of bias mitigation, but not in term of standard deviation, for zenith delay. Moreover, the unexpected bias in zenith delay was identified in the antenna with radome installation. A significantly large bias was identified in estimated gradients; the source of this discrepancy has been traced back to unmitigated multipath effects in this experiment.