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Impact of different NWM-derived mapping functions on VLBI and GNSS analysis

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In this study, the issue of the tropospheric mapping functions (MF) employed for VLBI and GNSS data analysis is addressed. IERS Conventions (2010) recommend for standard operational solutions, the use of MF based on numerical weather models (NWM) to improve troposphere modeling. The Vienna Mapping Functions 1 (VMF1) map the atmospheric delay from zenith to the line of sight as an elevation dependent function and are capable of better accounting for real weather phenomena compared to MF without NWM input data.
However, the spatial resolution of the NWM itself, directly impacts the ability to model atmospheric conditions effectively. Therefore, we employ the UNB-VMF1 which utilize the high resolution model from the Canadian Meteorological Centre based on the Global Deterministic Prediction System (CMC GDPS). The latter, as a modern operational model, contains the latest application of atmospheric physics and parameterizations and is relieved from spatially based systematic effects.
For our investigations, we analyze all rapid turnaround VLBI experiments spanning a five year period using the VieVS@GFZ software, as well as the entire data set from IGS sites that observed at the same interval using GAPS: UNB Precise Point Positioning software. Using the independent UNB ray-tracing algorithm we derive hydrostatic and wet "a" coefficients of MF as well as zenith delays from ray-tracing in CMC NWM. The solutions we produced differ only in the choice of the MF. The VLBI and GNSS analysis are fully consistent. The comparison is conducted on both global and local parameters (station positions and velocities, Earth rotation parameters, zenith wet delays and first order tropospheric gradients) between VLBI and GNSS derived products as well as between employing VMF1 (ECMWF operational analysis) and UNB-VMF1 (CMC).