On the contribution of global, local, and tropospheric ties to TRF and CRF in GNSS and VLBI integrated solution

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The international celestial and terrestrial reference frames (ICRF and ITRF) are two important realizations of the global geodetic reference frame (GGRF). As the basis for high-accuracy astrometry and space exploration, ICRF is currently determined by the Very Long Baseline Interferometry (VLBI) technique solely and independently from the ITRF, whereas a consistent determination of TRF and CRF by a combination of different techniques is highly desirable. We conduct the Global Navigation Satellite Systems (GNSS) and VLBI integrated processing on the observation level and investigate the impact of applying global ties (that is, Earth Orientation Parameters, EOP), local ties, and tropospheric ties on the precision of both TRF and CRF. The GNSS and VLBI observations in VLBI continuous campaigns from CONT05 to CONT17 are processed simultaneously in the common least-squares estimator using the Positioning And Navigation Data Analyst (PANDA) software. We present that the precision of the VLBI station coordinates is significantly improved in the integrated solution, such as the horizontal components by global ties and the vertical components by local and tropospheric ties. Focusing on the precision of active galactic nuclei (AGN) coordinates, we demonstrate that the global ties can slightly reduce the AGN coordinate formal errors by up to 4%, and the local ties mainly improve the declination precision by about 10%. As for the tropospheric ties, the formal error of AGN coordinate can be reduced by 10% on average, and the repeatability can also be improved, especially the declination (10%). Moreover, the southern AGN are more improved than the northern ones, due to the observation geometry of the VLBI ground station distribution.