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GNSS and VLBI integrated processing at the observation level

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The terrestrial and celestial reference frames, which serve as the basis for geodesy and astronomy, are mainly determined and maintained by space geodetic techniques such as Very Long Baseline Interferometry (VLBI), Satellite Laser Ranging (SLR), Global Navigation Satellite Systems (GNSS), and DORIS (Doppler Orbitography and Radiopositioning Integrated by Satellite). These techniques are also used together to determine the Earth Orientation Parameters (EOP), which are very important for precise positioning, navigation and timing. Currently, the combination of all these techniques is done on the parameter level (ITRF) or on the normal equation level (DTRF), which are well-known and convenient methods but may suffer from some inconsistency.

Unlike the combination on the parameter or normal equation levels, the integrated processing at the observation level exploits the lengths and unique features of different techniques, and is valuable in determining homogeneous reference frames and EOP, and to connect the terrestrial, celestial, and dynamic frames. We are applying the integrated GNSS, VLBI and SLR data processing in the current Positioning And Navigation Data Analyst (PANDA) software, which aims on processing multi-geodetic techniques on the observation level. We present the strategy and current status of the integrated GNSS and VLBI processing and demonstrate the benefit of integrating GNSS for VLBI using 14 years of VLBI intensive sessions (2001-2014) and five CONT campaigns (2005-2017). We discuss the impact of applying tropospheric tie and local tie in the integrated processing.