EGU2020-7818
https://doi.org/10.5194/egusphere-egu2020-7818
EGU General Assembly 2020

On the multi-technique combination with atmospheric ties

Kyriakos Balidakis[1], Susanne Glaser[1], Florian Zus[1], Tobias Nilsson[2], Harald Schuh[1,3], and Richard Gross[4]

[1]GFZ German Research Centre for Geosciences, Space Geodetic Techniques, Potsdam, Germany
[2]Lantma teriet, Swedish Mapping, Cadastral and Land Registration Authority, Ga vle, Sweden
[3]Technische Universität Berlin, Chair of Satellite Geodesy, Berlin, Germany
[4]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, USA

We explore a new strategy to combine geodetic observations employing the existing and future systems. Imposing atmospheric ties on the combination at either the observation or normal equation level introduces a physical interpretation to the estimated atmospheric delay parameters, that is, zenith delays and gradients. In essence, besides combining station coordinates via local ties, we combine atmospheric delays via atmospheric ties. The purpose of this work is to assess the advantages and caveats of such a combination approach, on legacy, state-of-the-art, and next generation geodetic systems. We simulate 10 years of observations of all space geodetic techniques that currently contribute to the realization of the international terrestrial reference system; that is, very long baseline interferometry (VLBI), satellite laser ranging (SLR), global navigation satellite systems (GNSS), and Doppler orbitography and radiopositioning integrated by satellite (DORIS). The noise we inject in the simulated observations is technique-specific and - besides a thermal contribution - stems from three-state clock models and ray-traced delays from the latest ECMWF reanalysis, ERA5. To make the simulations more realistic, we estimate the probability of potential observations being successful by utilizing ERA5 fields, for example cloud fields for SLR. To avoid overoptimistic uncertainty estimates, we have accounted for the correlation between observations based on ERA5 fields. In a bias-free setup, we find that the improvement of employing atmospheric ties in addition to local ties to fuse multi-sensor observations, on the combined station coordinates and atmospheric delays is statistically significant for all techniques except for GNSS. We attribute the latter to the relatively good observing geometry. We also find that employing atmospheric ties reveals unaccounted systematic errors stemming from erroneous auxiliary data that are necessary for the reduction of geodetic observations, such as pressure measurements, cable calibrations, and range biases. Performing the observation combination with atmospheric ties improves the combined solution, especially for sparse observing geometry, and facilitates the detection of unaccounted systematic errors.