Geophysical Research Abstracts
Vol. 21, EGU2019-10674, 2019
EGU General Assembly 2019

Analysis of Single- and Double-Differenced SLR Observations at the Wettzell Observatory

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In GNSS processing forming single- and double-differences of observables has been a common approach to reduce or eliminate error sources and parameters. Within this contribution, the benefits and deficiencies of these differencing methods are investigated for Satellite Laser Ranging (SLR) observations. While the approach of SLR single-differences is not new, as it was already considered by Erricos Pavlis in 1985 and by Drazen Svehla in 2014, a novel feature of this study lies in the fact that it is based on the SLR data obtained from the very short baseline formed by the two co-located SLR telescopes at the Geodetic Observatory in Wettzell (Germany). These co-located instruments, connected by a local tie from terrestrial measurements and sharing a common timing system, provide the unique opportunity to quantify the magnitude and stability of instrumental biases, to evaluate the quality of the local ties and to test these observation and processing strategies in SLR.

The work presented here focuses on: (1) how to form quasi-simultaneous single- and double-difference observations from the ranges of two stations to two satellites, respectively, and what approximations are made thereby, (2) to what extent biases related to the satellite orbit and the retro-reflector on the satellite can be reduced or eliminated by forming single-differences, (3) to what extent station-dependent range biases and calibration issues can be reduced or eliminated by forming double-differences, and how accurately the local ties between the two stations can be estimated and assessed by these SLR single- and double-difference observations. The overarching goals of this study are the improvement of the understanding of the biases present in the SLR technique, and how can this knowledge contribute to an enhancement of the ITRF that suffers heavily from technique-dependent biases.