Systematic errors in Satellite Laser Ranging validations of microwave-based low Earth orbiter solutions

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Satellite Laser Ranging (SLR) has become an invaluable core technique in numerous geodetic applications. For many applications a mm accuracy and 0.1 mm/year stability of reference frames is required or at least desired. Unavoidable SLR station biases and coordinate 24 uncertainties are a major error source and obstacle to reach these accuracy and stability goals when relying on SLR data. Among the stations of the International Laser Ranging Service (ILRS) there is a large diversity of biases and measurement qualities, and the calibration of these biases for all stations is key to further exploit SLR data for present and future geodetic applications.

We show that the analysis of SLR data to active Low Earth Orbit (LEO) satellites with fixed microwave-derived orbit solutions is a promising means to analyze SLR station biases and their stability. For this, a combined analysis of numerous different satellites and a high-quality modeling of gravitational and non-gravitational forces is a prerequisite. Nevertheless, different uncertainties in various dynamical models and offsets remain, potentially degrading the microwave-derived orbits and thus affecting also SLR station-related calibration parameters. In this presentation we address the question on how both station- and orbit-related correction parameters can be simultaneously derived from SLR analyses to active LEO satellites. Based on a consistently produced set of orbit solutions for 9 different LEO missions (Sentinel-3A/B, Sentinel-6A, Swarm-A/B/C, GRACE-FO C/D and Jason-3) we explore different possibilities to compute parameters that reflect corrections to individual orbit solutions, next to station calibration parameters. A special focus is on how to put constraints that are needed to decorrelate the different parameter sets, as well as their impact on the results. These investigations will help to disentangle station- from orbit-related systematic errors, allowing in particular for a better characterization of the former ones.