1.9 Systematic effects in SLR measurements to GNSS satellites

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Satellite Laser Ranging (SLR) to GNSS satellites provides valuable information about the accuracy and quality of GNSS satellite orbits, e.g., by detecting degradations of the orbits due to deficiencies in the modeling of solar radiation pressure. However, SLR observations are biased by various systematic effects, such as the satellite signature effect, which is defined as a spread of optical pulse signals due to reflections from multiple reflectors. In case of multi-photon SLR stations observing GLONASS-M satellites the satellite signature effect causes variations of mean SLR residuals of up to 15 mm for observations between nadir angles of 0 degrees and 14 degrees. For single-photon SLR stations this effect does not exceed 1 mm. We study a dependency of the SLR residuals on the size, shape, and number of corner cubes in laser retroreflectors and various types of detectors used at SLR stations. Finally, we show that the coating of retroreflectors may also introduce some systematics in SLR observations to GNSS satellites and that thus a proper handling of all systematic effects in SLR observations to GNSS satellites is indispensable in order to achieve a high-quality co-location of satellite geodetic techniques in space.