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The origin of the TRF from Satellite Laser Ranging (SLR)

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Satellite Laser Ranging (SLR) ranging data contribute to the realization of the Terrestrial Reference Frame (TRF), defining primarily its origin–geocenter, (realized through the estimated coordinates of its defining set of positions and velocities at epoch), and in equal parts with VLBI, the scale of the TRF. Both entities are fundamental in determining vital global change parameters, such as mean sea level changes, Earth rotation variations, etc. Driven by numerous geophysical processes, continuous mass redistribution within the Earth system causes concomitant changes in the Stokes coefficients of the terrestrial gravity field. The stability, integrity and applicability of the TRF are directly related to the accuracy and fidelity with which such motions can be observed or modeled during its development. Variations in the very low degree and order harmonics, produce geometric effects that are manifested as changes in the origin and orientation relationship between the instantaneous and the mean reference frame (multi-year average), as well as the axes of figure orientation. SLR has contributed the most accurate observations of these effects yet, demonstrating millimeter level accuracy for weekly averages over the past decade. Nevertheless, weather or failure-induced changes in the tracking routine of the sites, in the number and location of the sites comprising the SLR network over the decades, generate additional signals that can be aliased in the derived geocenter variations. “Secular trends” seen in the recovered series are far too large to be explained by any geophysical phenomena, and are primarily the result of these deficiencies of the SLR network (poor geometry, lack of redundancy, N-S hemisphere unbalanced distribution, etc.). We investigate here through a number of alternate solutions the robustness of our weekly geoceneter series, using our SLR analyses spanning the past thirteen years.