Potential of Lunar Laser Ranging for the determination of Earth orientation parameters

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Abstract. The distance between the observatories on the Earth and the retro-reflectors on the Moon has been regularly observed with Lunar Laser Ranging (LLR) since 1970. In recent years, LLR observations have been carried out with bigger telescopes (APOLLO) and at infrared wavelength (OCA, Wettzell), resulting in a better distribution of LLR normal points over the lunar orbit and retro-reflectors with a higher accuracy, also leading to a higher number of LLR observations in total. The analysis of LLR observations has also been improved through refined modeling (e.g., modeling of the lunar core) and changes in the analysis strategy (e.g., optimized calculation of ephemerides). These refinements/modifications enable the determination of various parameters with higher accuracy.By analysing LLR data, Earth Orientation Parameters (EOP) such as the Earth rotation phase ΔUT1, terrestrial pole coordinates, and nutation coefficients, as corrections to the MHB2000 model of the IERS Conventions 2010, can be determined along with other parameters of the Earth-Moon system. Focusing on ΔUT1 and terrestrial pole coordinates from different LLR constellations such as single or multi-station data and for different numbers of normal points per night, the accuracies of the estimated Earth rotation phase and pole coordinates from the new LLR data have improved significantly compared to previous results. We achieved an accuracy of about 20 µs for ΔUT1, about 2.5 mas for xp, and about 3 mas for yp from subsets of the LLR time series containing 10 and 15 normal points per night. Focusing on determining corrections to the nutation coefficients to the MHB2000 model, significantly smaller correction values and higher accuracies with one order of magnitude improvement, i.e., accuracies better than 0.01 mas, are obtained now. Recent results are presented and discussed.This research was funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under Germany's Excellence Strategy – EXC-2123 QuantumFrontiers – 390837967.