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Effect of non-tidal station loading on Lunar Laser Ranging observatories and on the estimation of Earth orientation parameters

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The distance between the observatories on Earth and the retro-reflectors on the Moon has been regularly observed by the Lunar Laser Ranging (LLR) experiment since 1970. In the recent years, observations with bigger telescopes (APOLLO) and at infra-red wavelength (OCA) are carried out, resulting in a better distribution of precise LLR data over the lunar orbit and the observed retro-reflectors on the Moon, and a higher number of LLR observations in total. Providing the longest time series of any space geodetic technique for studying the Earth-Moon dynamics, LLR can also support the estimation of Earth orientation parameters (EOP), like UT1. The increased number of highly accurate LLR observations enables a more accurate estimation of the EOP. In this study, we add the effect of non-tidal station loading (NTSL) in the analysis of the LLR data, and determine post-fit residuals and EOP. The non-tidal loading datasets provided by the German Research Centre for Geosciences (GFZ), the International Mass Loading Service (IMLS), and the EOST loading service of University of Strasbourg in France are included as corrections to the coordinates of the LLR observatories, in addition to the standard corrections suggested by the International Earth Rotation and Reference Systems Service (IERS) 2010 conventions. The Earth surface deforms up to the centimetre level due to the effect of NTSL. By considering this effect in the Institute of Geodesy (IfE) LLR model (called 'LUNAR'), we obtain a change in the uncertainties of the estimated station coordinates resulting in an up to 1% improvement, an improvement in the post-fit LLR residuals of up to 9%, and a decrease in the power of the annual signal in the LLR post-fit residuals of up to 57%. In a second part of the study, we investigate whether the modelling of NTSL leads to an improvement in the determination of EOP from LLR data. Recent results will be presented.