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Geocenter coordinates from SLR and combined GNSS-SLR analysis

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Satellite techniques in general are sensitive to the geocenter, however, the quality of estimated geocenter coordinates depends on the type of solution. Many effects are influencing the geocenter, but not all of them are modeled perfectly yet in the analysis of space-geodetic data. We tested the impact of models related to the atmosphere and ocean masses (including their variations) on the geocenter estimates derived from SLR solutions. Models of interest in this context are ocean tidal loading, atmospheric tidal loading, atmospheric pressure loading and time-variable gravity changes due to atmospheric and oceanic mass variations.

Solutions using GNSS satellites suffer from insufficient modeling of solar radiation pressure (SRP) acting on the satellites. Thereby, it is independent whether microwave or SLR observations are used. Empirical orbit parameters are usually estimated in order to account for the SRP modeling deficiencies. Once-per-revolution (OPR) parameters, however, are correlated with the geocenter coordinates making it difficult to derive reasonable geocenter estimates together with freely estimated OPR parameters.

The modeling of SRP acting on spherical satellites (e.g. LAGEOS) is comparably simple. That's why geocenter estimates derived from solutions based on spherical satellites (using SLR data) are more reliable. This advantage is unfortunately slightly reduced by the small amount of SLR data compared to microwave GNSS data. Combined GNSS-SLR solutions thus have the potential to deliver better geocenter series than single-technique solutions. We combine GNSS microwave data and SLR data to GPS and GLONASS satellites as well as spherical satellites. The GNSS satellites are used as co-location platform allowing for a connection of both space geodetic techniques by common orbit parameters instead of applying local ties at the co-located sites. Including SLR data to spherical satellites provide information about the geocenter that is not contaminated by SRP modeling deficiencies, thus, OPR parameters for the GNSS satellites can be estimated without constraints in the combined solution. We analyse the geocenter estimates resulting from this type of combination and show their advantage compared to time series derived from single-technique solutions.