EGU2020-9378
https://doi.org/10.5194/egusphere-egu2020-9378
EGU General Assembly 2020
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Recent studies on troposphere delay modeling for SLR

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Recent studies on troposphere delay in Satellite Laser Ranging (SLR) show that the compliance of horizontal gradients of troposphere delay reduces the observation residuals, as well as improves the consistency between SLR results and other space geodetic techniques, all of which are essential for the realization of the terrestrial reference frame. In this work, we examine 3 novel approaches of troposphere delay modeling in SLR, with respect to the standard Mendes-Pavlis approach. We test Potsdam Mapping Function (PMF) with mapping function coefficients and linear horizontal gradients which are based on ERA5 reanalysis provided by the European Centre for Medium-Range Weather Forecasts (ECMWF) model with improved time and spatial resolution in comparison to ERA-Interim reanalysis. We also test a solution based on Vienna Mapping Function 3 for optical observations (VMF3o) which considers the separation of the mapping functions for hydrostatic and non-hydrostatic delays and horizontal gradients. Eventually, we test a solution based on Mendes – Pavlis model with a parameterized model for horizontal gradients based on the 16-year time series of horizontal gradients from PMF. To conduct this experiment, we use SLR observations to passive geodetic satellites LAGEOS-1 and LAGEOS-2. From differences of residual standard deviations for all proposed solutions, we observe an improvement of the SLR observation residuals, for low elevation angles above 10% and improvement of the consistency between estimated pole coordinates and the combined solution IERS-14-C04 series with respect to the currently recommended solutions that neglect the horizontal gradients in SLR solutions.