Time-variable Earth's gravity field derived using SLR and GRACE data

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Observations of the time-variable Earth's gravity field describe the redistribution of environmental masses in the Earth system, including changes in land hydrology, ice, ocean, and atmosphere. These observations provide essential insights in to the global water cycle, changes in ocean surface currents, mountain, and polar ice mass loss, large-scale underground droughts, sea-level rise, surface load displacements, as well as many other environmental processes. The variations of the Earth's gravity field directly influence the Earth's rotation, in 18 particular, pole coordinates and length of the day variations from intra-annual to decadal and secular scales.

Currently, the observations of mass transport within the system Earth are mainly observed by two satellite missions, GRACE, and GRACE Follow-On. During these missions, there were problems with acquiring actual observations, especially at the end of the mission, and in some periods data gaps occurred. For the recovery of the mass redistribution processes on large scales, we may employ Satellite Laser Ranging (SLR) observations to spherical geodetic satellites, such as LAGEOS-1/2, Starlette, Stella, Ajisai, and LARES-1/2.

The primary goal of this study is an analysis of monthly temporary models from different available solutions. We compare solutions from GRACE and GRACE Follow-On missions with those from SLR missions. For this comparison, we use calculated trends and amplitudes in equivalent water high (EWH) in global and specific regions with prominent changes. Trends are derived for models using their entire period, but also for shorter periods. We also calculate global empirical orthogonal functions (EOFs) for GRACE and SLR models to compare the main EOF contributors. Finally, we analyze the time series of selected zonal, tesseral and sectorial spherical harmonics of significant interest.