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Oral
The excitation of polar motion (PM) caused by hydrospheric mass redistribution is represented by the hydrological angular momentum (HAM). It can be estimated from hydrological models, gravity field data, or climate model outputs. The Gravity Recovery and Climate Experiment (GRACE) and its successor GRACE Follow-On (GRACE-FO) have provided crucial data for HAM assessment, but their applicability is constrained by the mission gap and by the availability of observations only since 2002. Hybrid approaches that combine GRACE/GRACE-FO with Satellite Laser Ranging (SLR) observations have been proposed to overcome these limitations.
In this study, we re-evaluate HAM using the C21 and S21 coefficients of geopotential introducing a new class of hybrid solutions. In these solutions, empirical orthogonal functions (EOFs) derived from GRACE/GRACE-FO are fitted to SLR observations, replacing standard spherical harmonics (SHs). The method incorporates data from six SLR satellites and ten Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS) satellites, providing a longer and more consistent record of HAM variability.
Our results confirm the potential of hybrid solutions for analysing non-seasonal HAM variations. For HAM derived from hybrid solutions, strong correlations with hydrological signal in geodetic PM excitation (GAO) were found: 0.7 (in χ_1) and 0.8 (in χ_2) for non-seasonal short-term variations, and up to 0.9 for non-seasonal long-term changes (in both χ_1 and χ_2). Models with the highest correlation values also show the highest percent of variance explained (PVE) values.
Analysis of temporal changes in correlation and PVE indicates several periods of weaker agreement between HAM and GAO, such as around 2008 in the case of non-seasonal long-term variations in χ_1. The performance of hybrid solutions also

depends on the number of SHs expansions and EOFs included in the model. Overall, the best results, especially for short-term variability, are achieved with weighted SLR-only solutions, which outperform combined SLR+DORIS data.

Presentation file

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Meeting homepage

GRACE-FO 2025 Science Team Meeting

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