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Ongoing terrestrial and groundwater resource depletion poses serious threats to socio-ecological systems. In-situ measurements remain largely unavailable, creating a significant knowledge gap, especially regarding how terrestrial and groundwater have changed over time across natural and working landscapes. The GRACE (Gravity Recovery and Climate Experiment) and its follow-on missions (GRACE-FO) offer insights into terrestrial and groundwater storage over time. However, the coarse resolution (~27 km to 111 km) of post-processed GRACE datasets remains inadequate for decision-relevant assessments and management of water resources. To address this challenge, we proposed a G-SMAT (Scalable Mapping & Assessment Tool), a GRACE and AI/ML-driven framework for mapping high-resolution estimates of terrestrial and groundwater changes for decision-relevant water management. G-SMAT is a web interface downscaling tool that streamlines planetary-scale data of GRACE products and remote sensing variables via Google Earth Engine. It utilizes scalable AI and machine learning models to perform cloud-based downscaling. It offers a variety of features, including selecting and optimizing machine learning models, evaluating performance, and user-defined downscaling (kilometers to meters). Additionally, it provides visualizations of high-resolution terrestrial and groundwater storage variations over time from 2002 to the present, focusing on specific areas of interest (AOI). G-SMAT lowers technical barriers and enables water managers, policymakers, and stakeholders to incorporate satellite-driven, decision-relevant insights into sustainable water resources planning and management. We introduced one of the first global-scale, multi-source mapping tools for terrestrial and groundwater storage, providing a practical approach to connect science, policy, and management for sustainable water resource planning across observationally constrained areas. We are enhancing the features of this tool to better align with community needs and plan to host it on the NSF NCAR webpage.

Meeting homepage

GRACE-FO 2025 Science Team Meeting

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