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Oral
Groundwater resources are inherently challenging to assess due to their subsurface nature and the geological complexity of aquifers. Over the past few decades, remote sensing technologies have transformed our understanding of groundwater dynamics. Notably, the GRACE and GRACE Follow-On (GRACE/FO) satellite missions detect water mass variations over large aquifer systems, revealing widespread water scarcity in densely populated and agriculturally intensive regions such as the U.S. Southwest. Complementary observations of surface deformation, particularly vertical land motion (VLM), provide high-resolution insights into aquifer mechanics. Interferometric Synthetic Aperture Radar (InSAR) has enabled detailed VLM mapping, capturing groundwater-induced deformation at management-relevant spatial scales.
In this study, we extend the temporal capabilities of the multi-physics joint inversion framework of Carlson et al. (2024), which integrates high-resolution InSAR VLM maps with global GRACE total water storage (TWS) observations, while explicitly accounting for the physical processes driving each measurement. We adapt the framework to generate time-series groundwater storage (GWS) estimates for California’s Central Valley, spanning drought and post-drought periods and capturing variations in underlying deformation physics. The expanded framework provides a pathway to monitor GWS monitoring from regional to continental scales and from drought-specific events to long-term hydrological cycles.
Accurate, high-resolution GWS observations enhance the integration of geodetic data into hydrological models, improve our understanding of recharge processes, and support water management strategies.
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