Mary Michael
O'Neill
NASA GSFC Hydrological Sciences Laboratory, University of Maryland ESSIC
Matt Rodell, NASA GSFC Earth Sciences Division
Bryant Loomis, NASA GSFC Geodesy and Geophysics Laboratory
Oral
Agriculture in the Sahara Desert depends almost entirely on fossil groundwater extraction, yet reliable estimates of aquifer depletion are hindered by scarce in situ observations and the coarse resolution of satellite gravity field products. Here we apply a recently developed regression approach that stacks GRACE and GRACE-FO Level-1B intersatellite range data to resolve long-term terrestrial water storage (TWS) trends at ~12,000 km2 resolution. Compared to conventional regression of Level-3 monthly mascons, which resolve detail at around 150,000 km2 at best, this method reduces signal attenuation and spatial smoothing, enabling clearer isolation of groundwater mining signals across the Sahara. Results indicate widespread and acute aquifer depletion from 2002 through 2020, with severe trends in Egypt’s East Oweinat agricultural outpost and in Libya’s Great Man-Made River extraction fields. TWS losses are significantly correlated with groundwater-irrigated cropland extent and withdrawal rates, while precipitation anomalies show little influence except in surface-water dominated systems. These relationships are unresolved or smoothed when using traditional regression approaches. Depletion rates for the primary Saharan aquifer systems exceed previous reports by a factor of two to three, suggesting unsustainable exploitation.
Meeting homepage
GRACE-FO 2025 Science Team Meeting
Download to PDF