Substantial root-zone water storage capacity observed by GRACE and GRACE/FO

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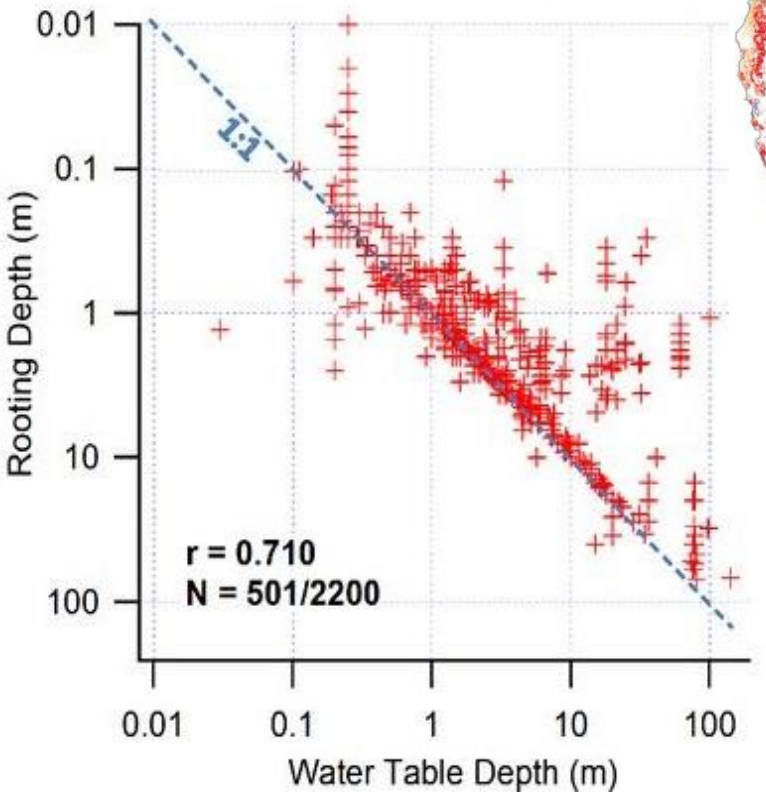
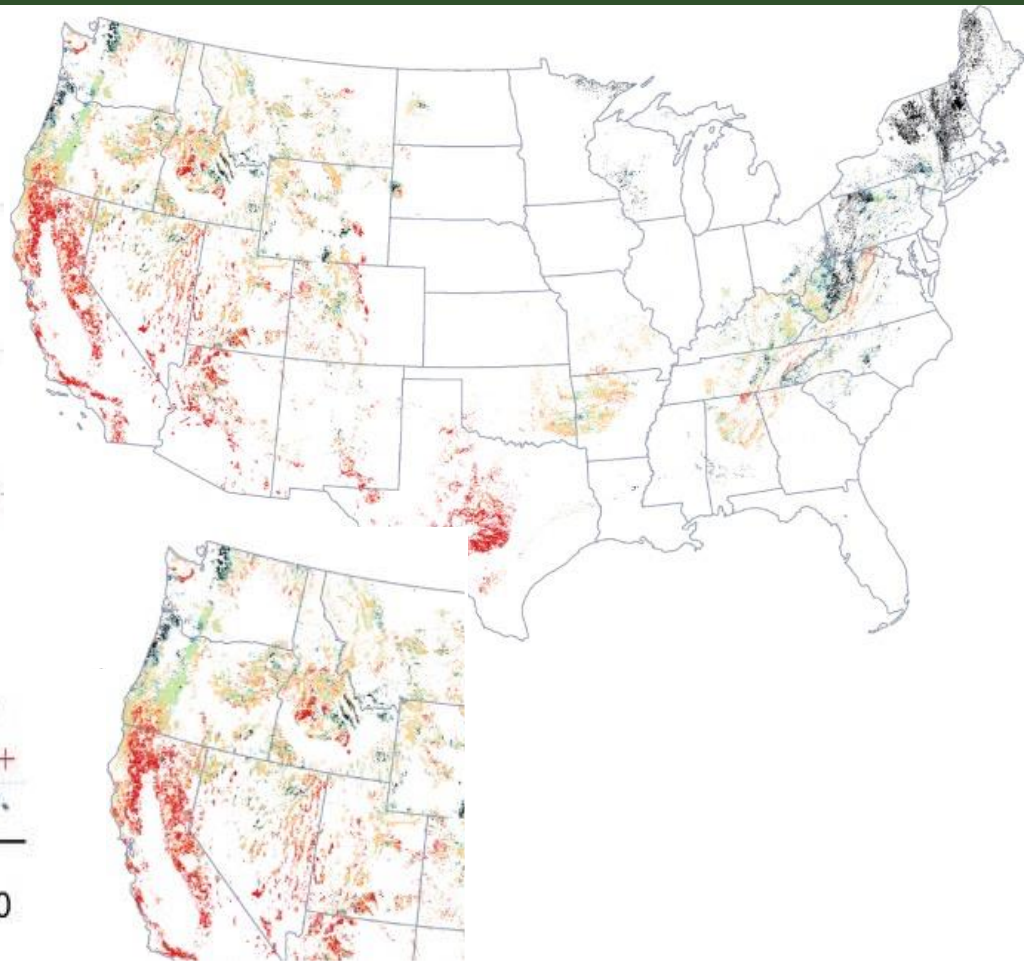
Plants can access much more diverse water resources than we previously thought

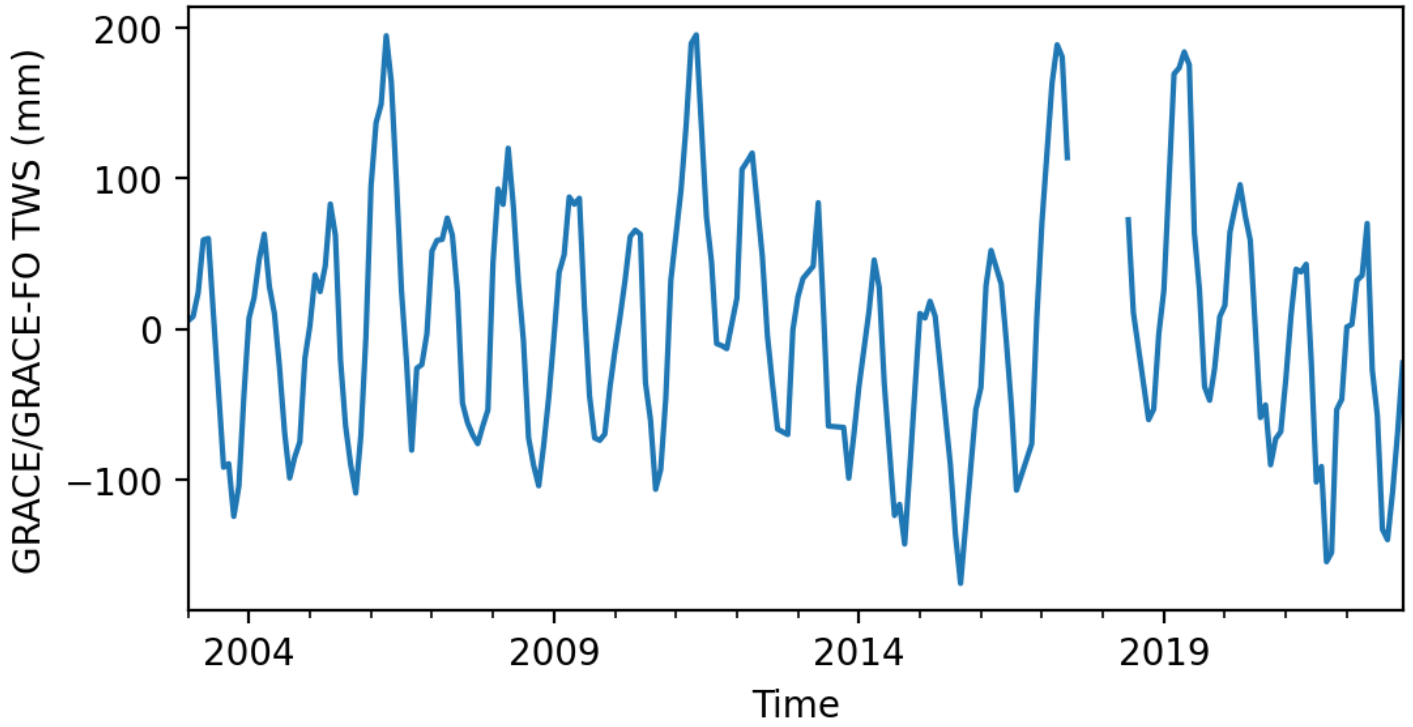


Fan et al. 2017 PNAS



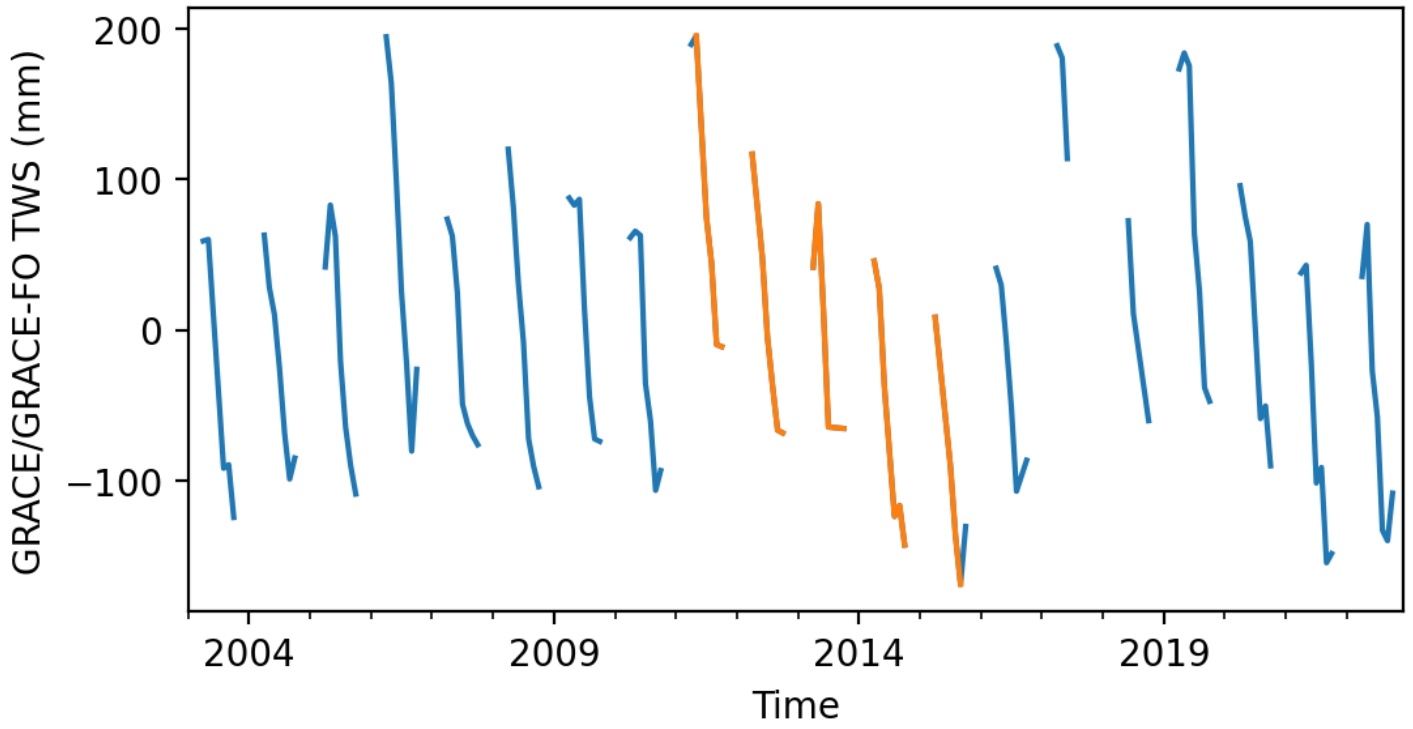
McCormick et al. 2021 Nature

Root-zone water storage capacity (S_r) from GRACE/GRACE-FO



Total Terrestrial Water Storage (TWS) for southern Idaho

Root-zone water storage capacity (S_r) from GRACE/GRACE-FO



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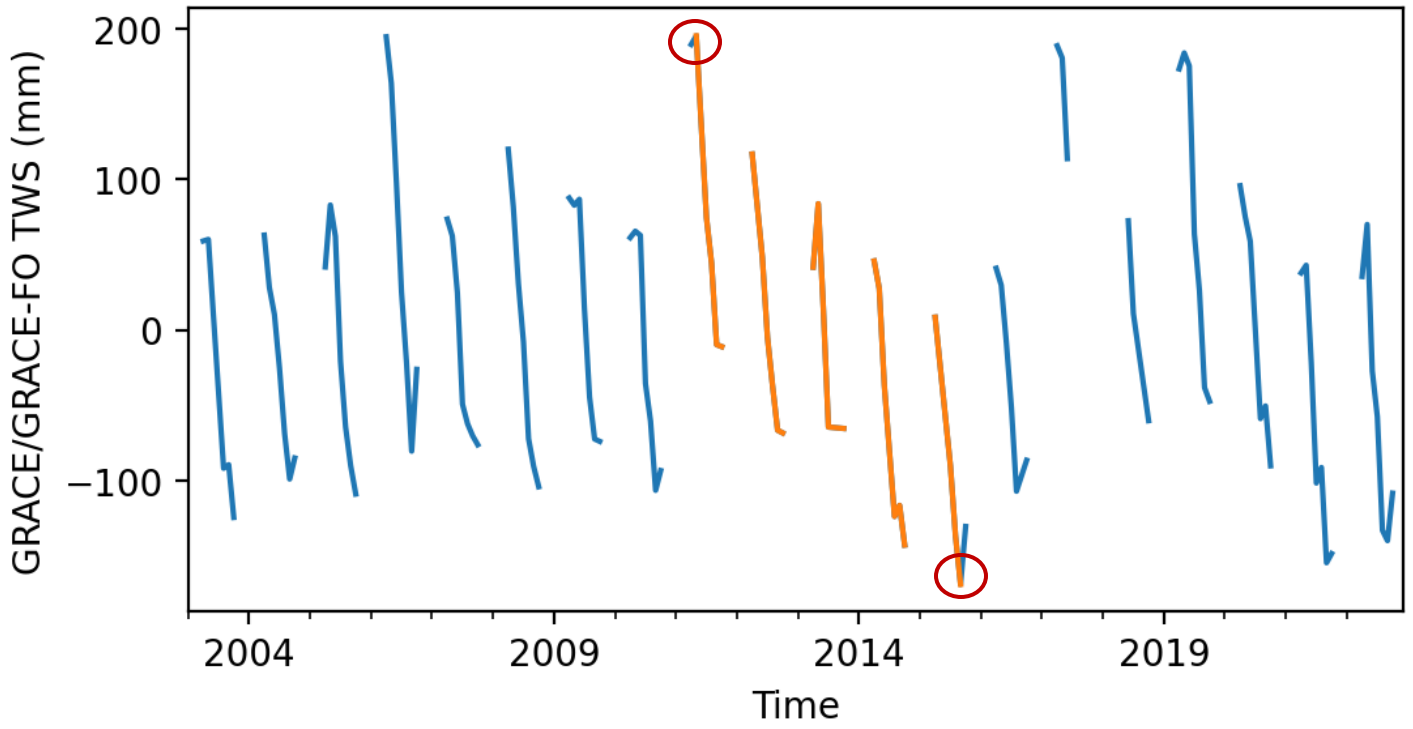
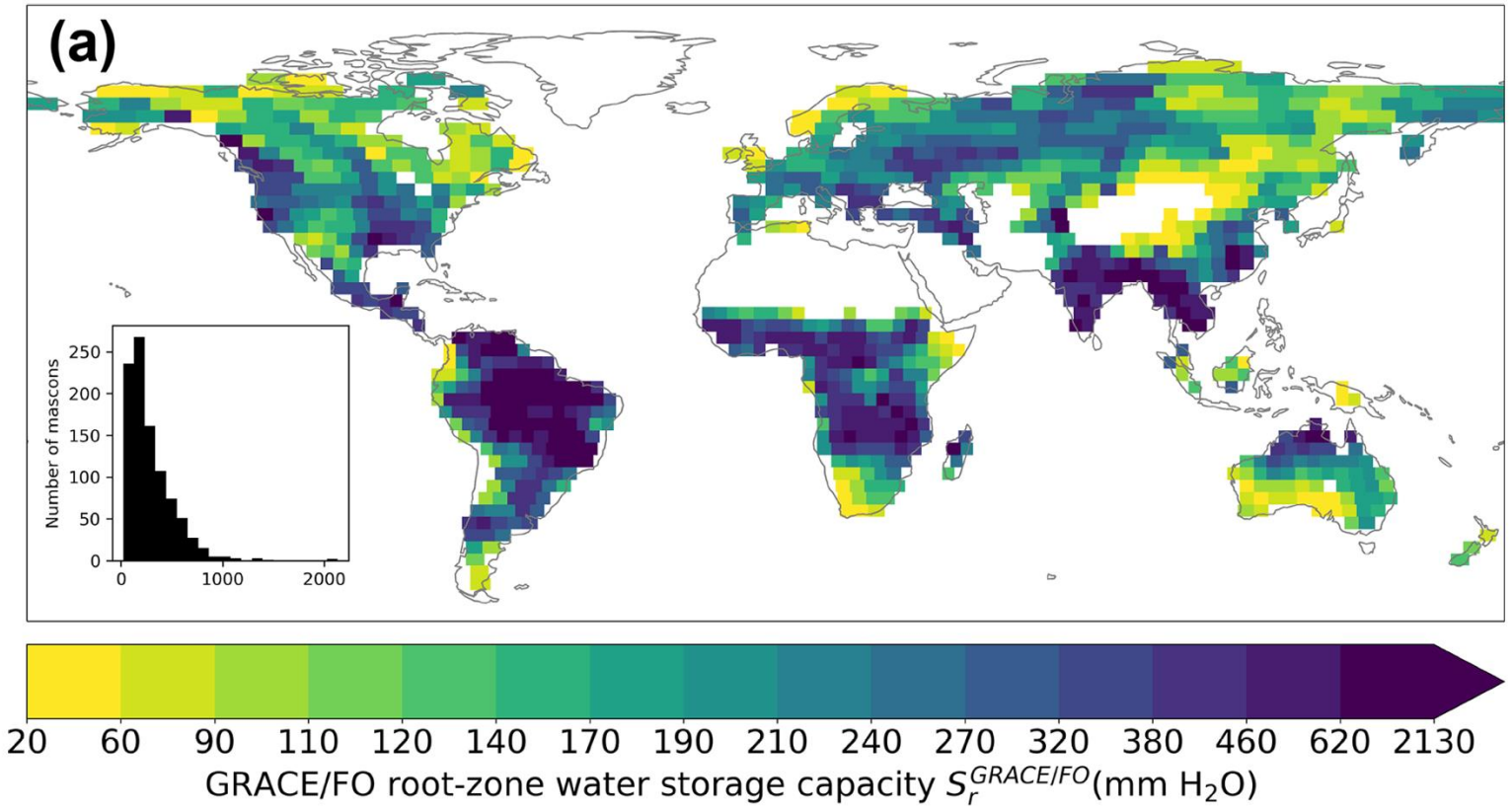
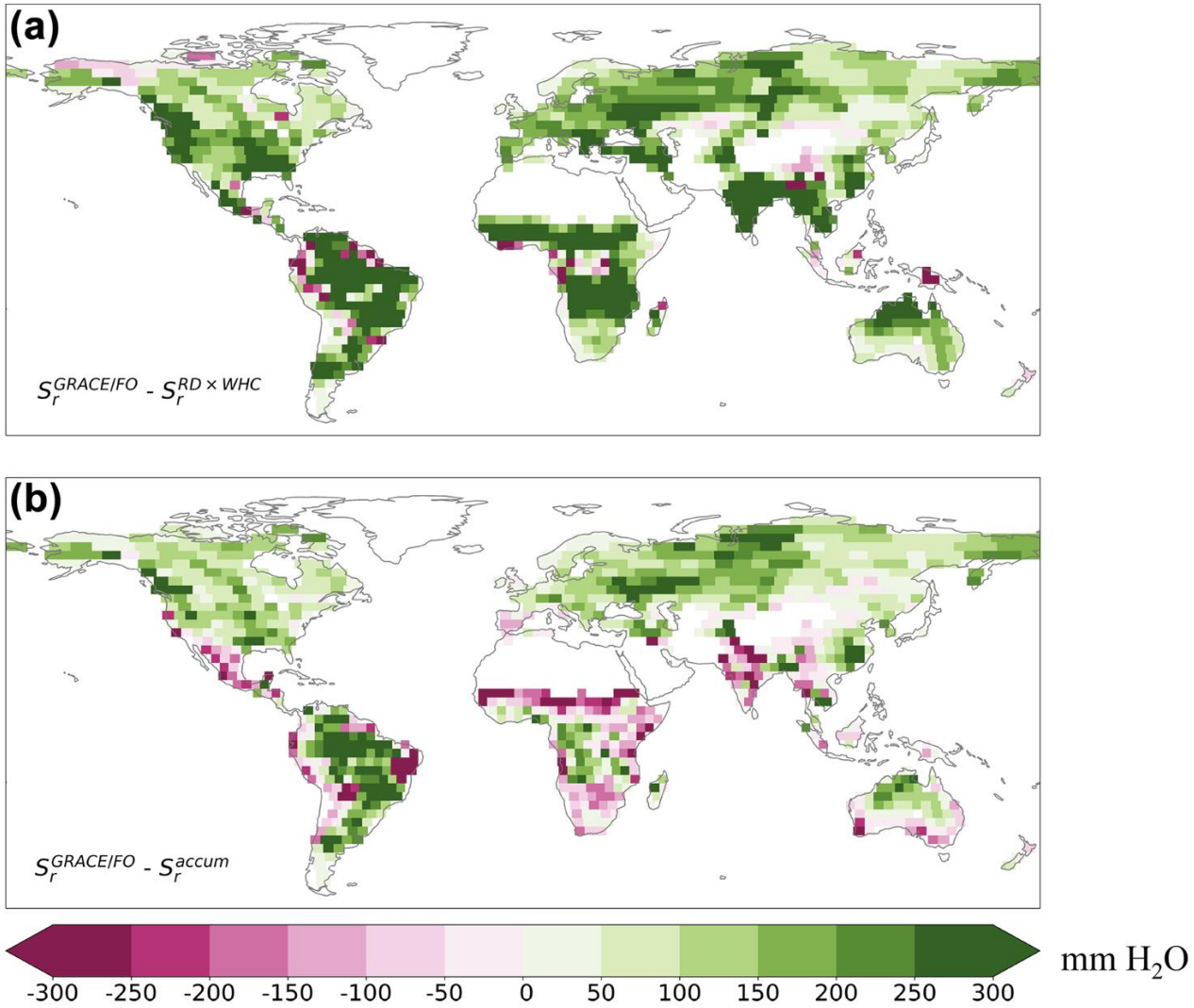


Total Terrestrial Water Storage (TWS) for southern Idaho

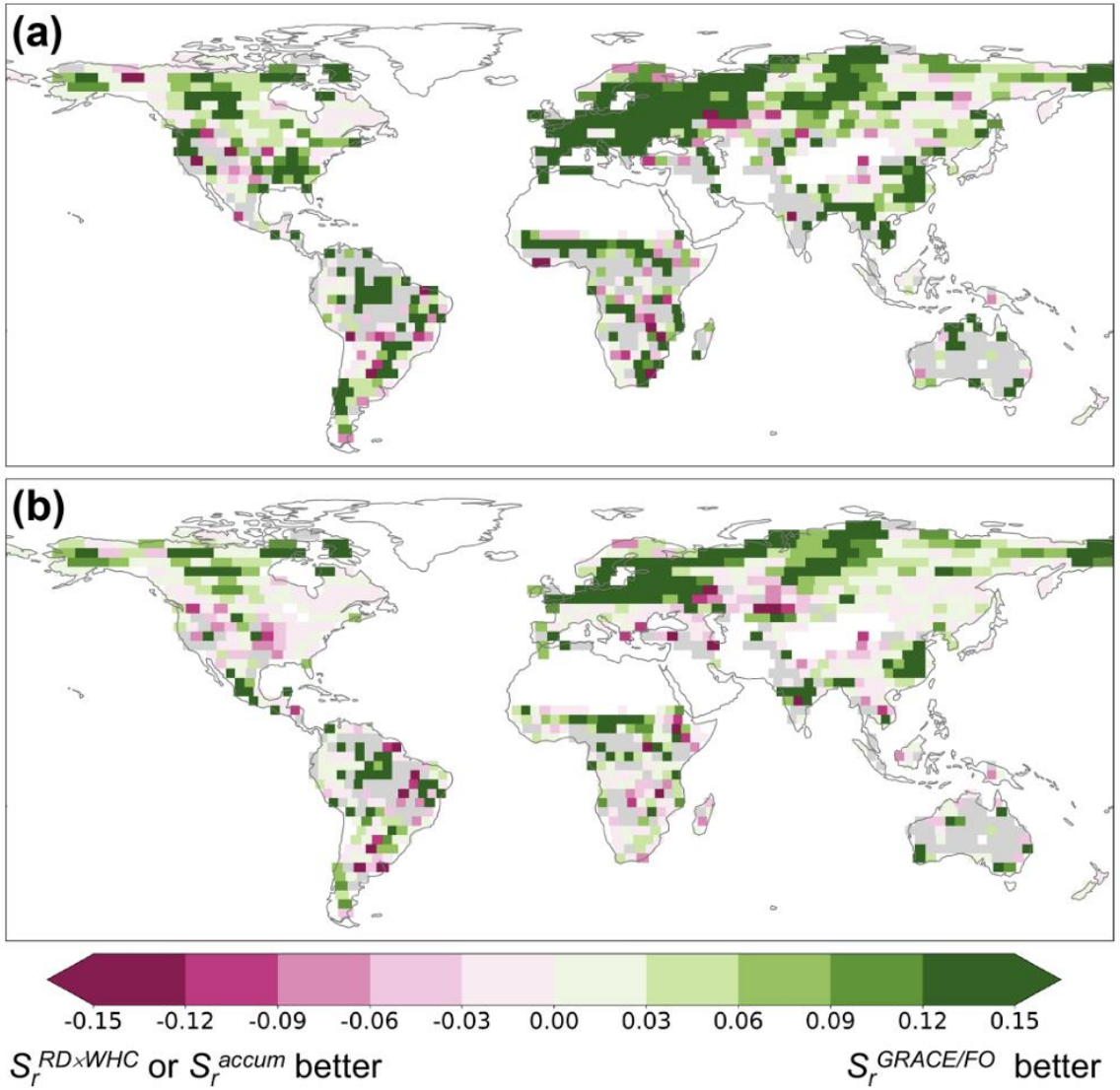
Global S_r pattern from GRACE/GRACE-FO



Did previous research underestimate S_r?



Which S_r is closer to reality?



Take aways

- **Global Sr is much larger than thought.** Using GRACE/GRACE-FO TWS, median Sr ≈ **220 ± 40 mm**, >50% above flux-tracking estimates and ~**3.8×** typical soil/rooting-depth values. In **nearly half** of vegetated areas, plant-available water exceeds the 2 m soil capacity.
- **Better drought physics in models.** Inserting these Sr values into a global hydrological model **improves ET simulations**, especially during droughts.
- The TWS-based method offers an **observational path** forward and merits continued refinement and validation.

Reference

Zhao, M., McCormick, E. L., A, G., Konings, A. G., and Li, B.: Substantial root-zone water storage capacity observed by GRACE and GRACE/FO, Hydrol. Earth Syst. Sci., 29, 2293–2307, https://doi.org/10.5194/hess-29-2293-2025, 2025.