The Benefit of Brightness Temperature Assimilation for the SMAP Level-4 Soil Moisture Analysis Over Mainland China

Problem: SMAP L4 soil moisture estimates are based on the assimilation of SMAP brightness temperature (Tb) observations into a land model.

What factors control the skill gained through data assimilation?

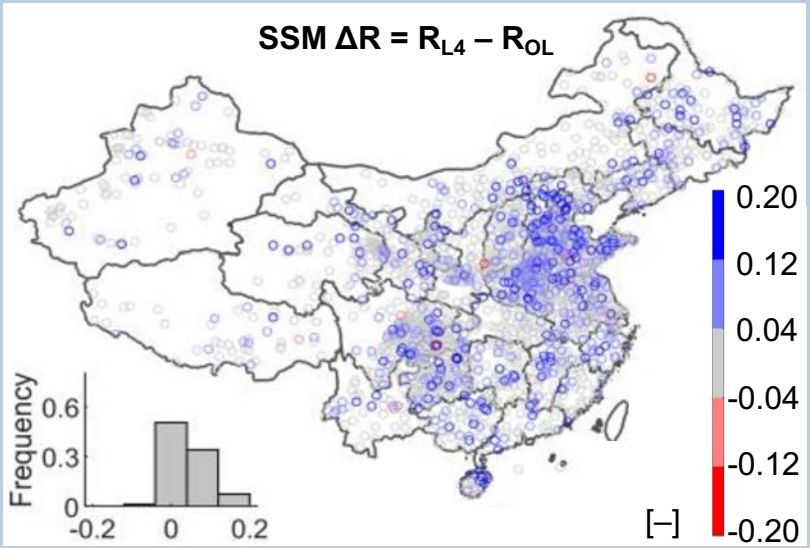

Fig. 1. Surface soil moisture (SSM) skill gain (ΔR) from assimilation. Blue colors indicate that L4 SSM is better than model-only (OL) SSM.

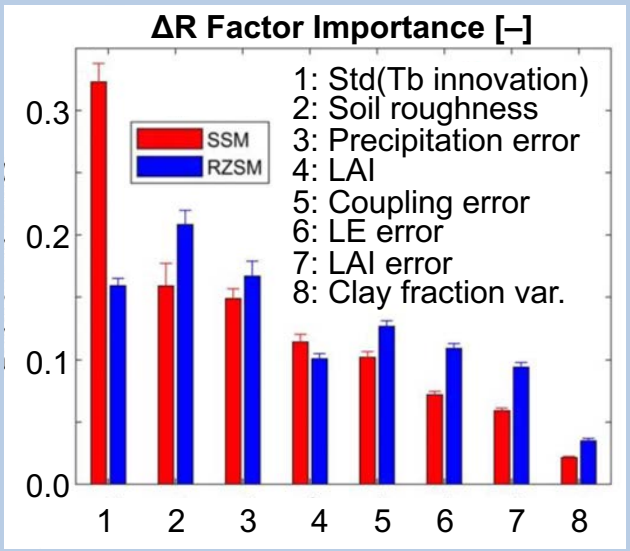

Fig. 2. Relative contributions of 8 factors to SSM and root-zone soil moisture (RZSM) skill gain.

Finding: Using in situ measurements from >2,400 sites, we find that SMAP Tb assimilation yields improved surface soil moisture anomaly correlation (R) skill across China w.r.t. a model-only simulation (Fig. 1).

Using a random forest method, we find that the top three factors that determine the skill gain from assimilation are the typical magnitude of Tb observation-minus-forecast residuals (Tb innovation), microwave soil roughness, and precipitation error (Fig. 2).

Impact: Knowledge of factors that dominate skill gain provides guidance for future algorithm development.

Qiu, Dong, Crow, Zhang, Reichle De Lannoy, 2021: The benefit of brightness temperature assimilation for the SMAP Level-4 surface and root-zone soil moisture analysis over mainland China, *Hydrology and Earth System Science*.