**Problem:** Can SMAP brightness temperature (Tb) observations improve estimates of near-surface atmospheric conditions in a global weather analysis system?

**Finding:** Assimilating SMAP Tb observations in the weakly-coupled GEOS land-atmosphere assimilation system during boreal summer 2017 improves the skill of soil moisture compared to a system without SMAP assimilation (not shown). Consequently, screen-level (2-m) air specific humidity (q2m) and daily maximum temperature (T2m_{max}) also improve, by up to 0.4 g/kg and 0.3 K, respectively, in some regions (Fig. 1). Improvement in specific humidity extends into the lower troposphere (not shown).

**Impact:** Results demonstrate the potential of SMAP Tb observations for improving global operational weather analysis and forecasting systems.

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*Fig. 1.* Difference in RMSE for simulated a) q2m and b) T2m_{max} with and without SMAP Tb assimilation. RMSE computed vs. in situ measurements for Jul-Aug 2017. Red colors indicate that SMAP Tb assimilation improves skill.

Reichle, R. H. et al. (2021), *IEEE JSTARS*, in press, doi:10.1109/JSTARS.2021.3118595.