S9.P23: The Contributions of Precipitation and Soil Moisture Observations to the Skill of Soil Moisture Estimates in a Land Data Assimilation System

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Soil moisture data assimilation system

Surface meteorology, incl. **precipitation**

Satellite retrievals of **surface** soil moisture

Land model → ***Data Assimilation*** ← Satellite retrievals of **surface** soil moisture

Data Assimilation → **Data products**: Surface and root-zone soil moisture

Satellite soil moisture retrievals and modeled soil moisture suffer from key limitations. The data assimilation system can benefit from improved precipitation forcing and from model-data merging.

Objective: What are the relative contributions of precipitation observations and soil moisture retrievals to the skill of soil moisture estimates in a land data assimilation system?

1. Experiments

NASA/GMAO land data assimilation system, including the GEOS-5 Catchment model

At the pentad (daily) and 2.5 deg (0.25 deg) scale, the corrected re-analysis precipitation matches the correcting observations.

4 different **precipitation** forcing datasets:

- *MERRA*
  Reanalysis, 0.5 deg
- *MERRA+CMAP*
- *MERRA+GPCPv2.1*
  Pentad, 2.5 deg, global
  Satellite + gauges
- *MERRA+CPC*
  Daily, 0.25 deg, CONUS
  Gauges

Separately assimilate two different **AMSR-E soil moisture retrieval** datasets:

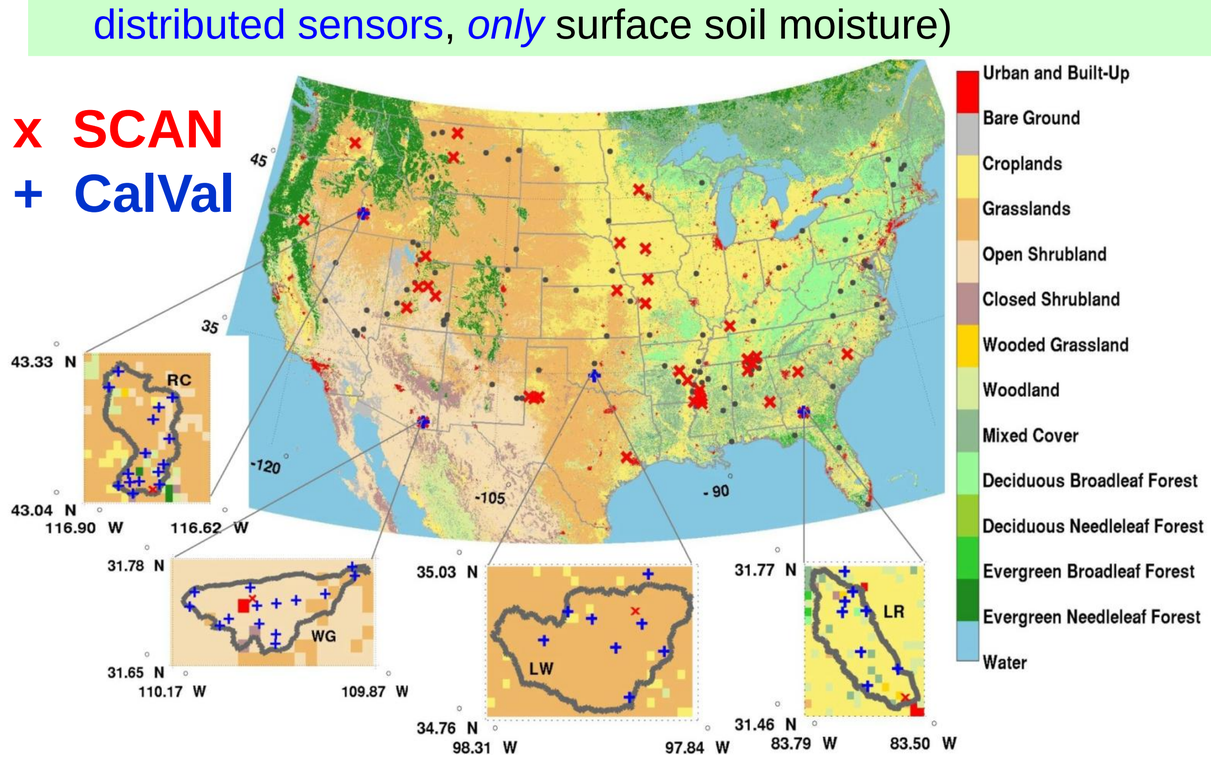
- NSIDC
- LPRM (X-band)

Combine into 12 experiments:

MERRA	MERRA +NSIDC	MERRA +LPRM
MERRA+GPCP	MERRA +GPCP +NSIDC	MERRA+GPCP +LPRM
MERRA+CMAP	MERRA +CMAP+NSIDC	MERRA+CMAP+LPRM
MERRA+CPC	MERRA +CPC +NSIDC	MERRA+CPC +LPRM

2. Validating in situ observations

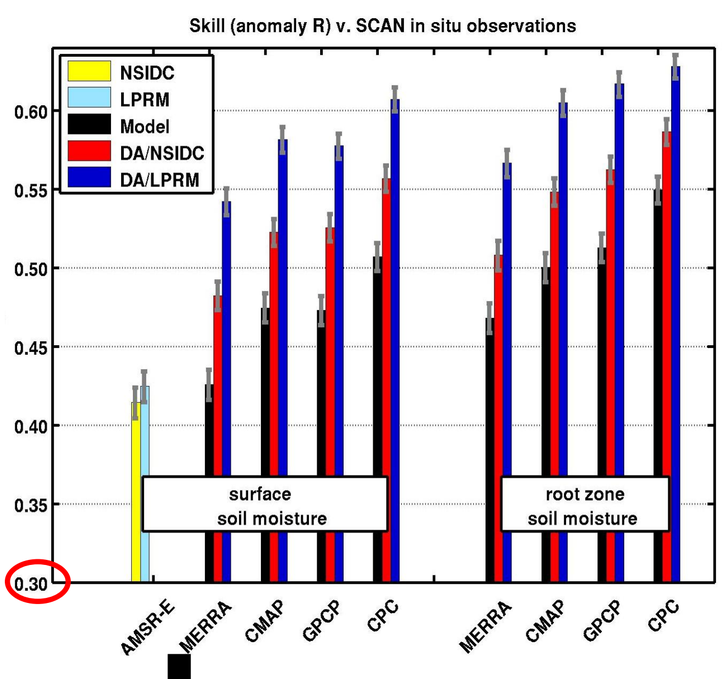
1) USDA **SCAN** stations (only 37 of 120 suitable, single profile sensor, surface *and* root zone soil moisture), and
2) four AMSR-E **CalVal** watershed sites (RC, WG, LW, LR; distributed sensors, *only* surface soil moisture)



3. Results

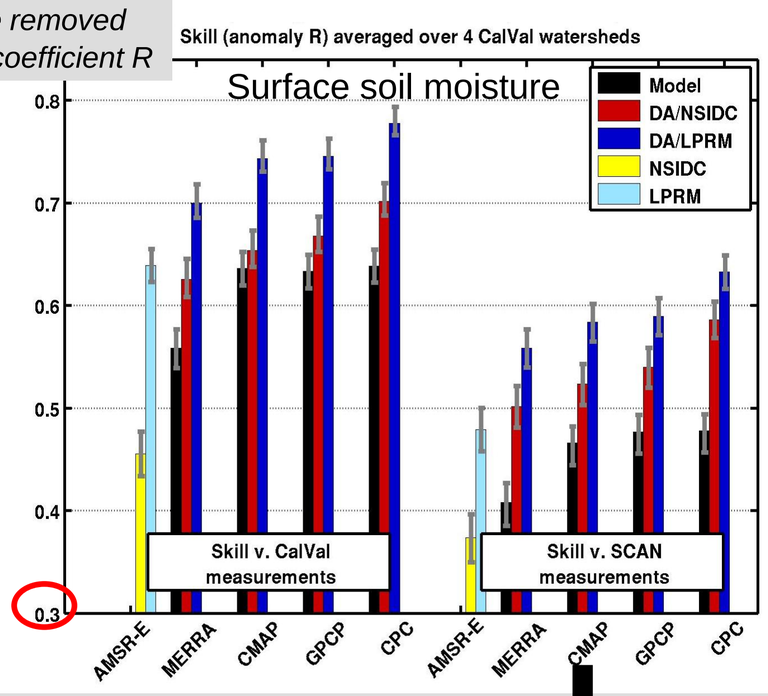
a) Skill (anomaly R) v. SCAN in situ observations b) Skill v. SCAN and v. CalVal (common space-time mask)

Anomalies *= mean seasonal cycle removed*
Skill metric*: Anomaly time series coefficient R*



Skill increases with
- precipitation corrections and
- retrieval assimilation.

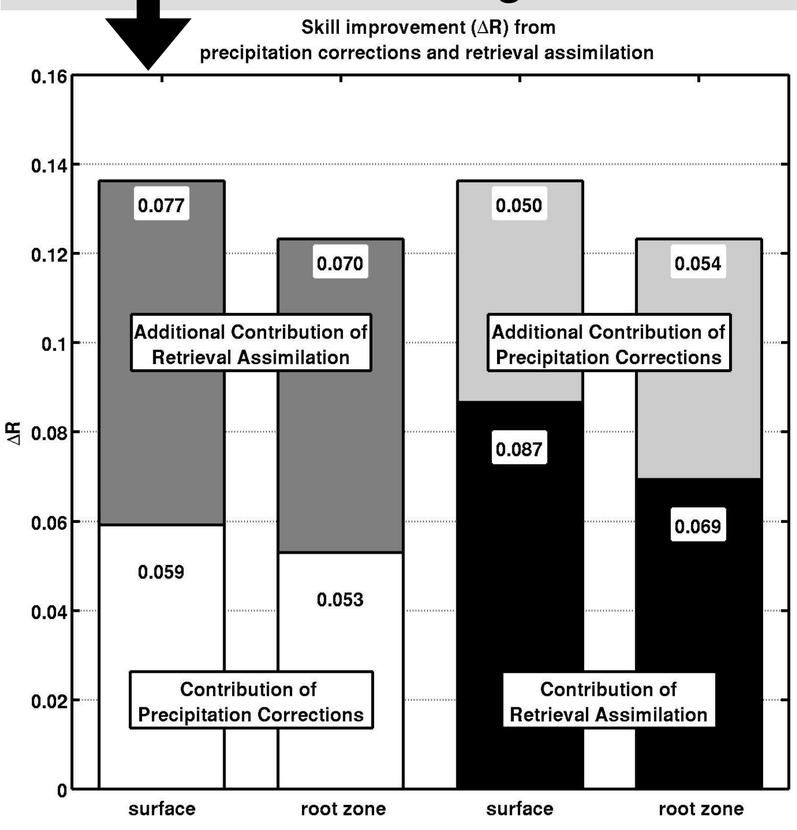
Improved root zone soil moisture.

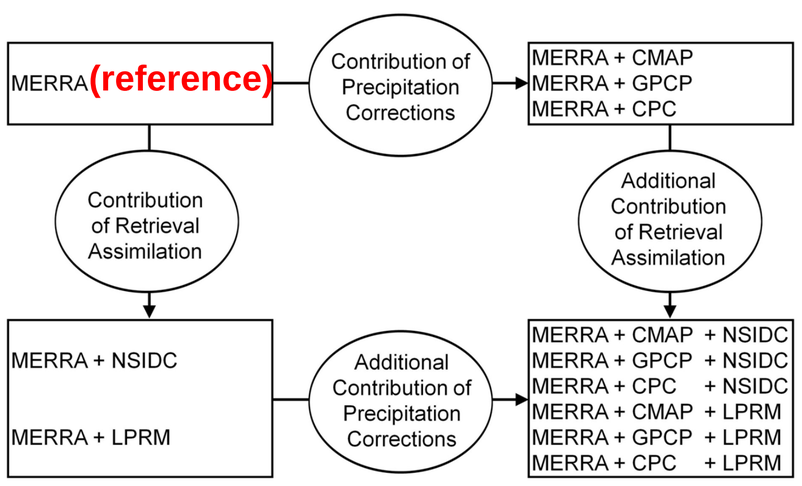


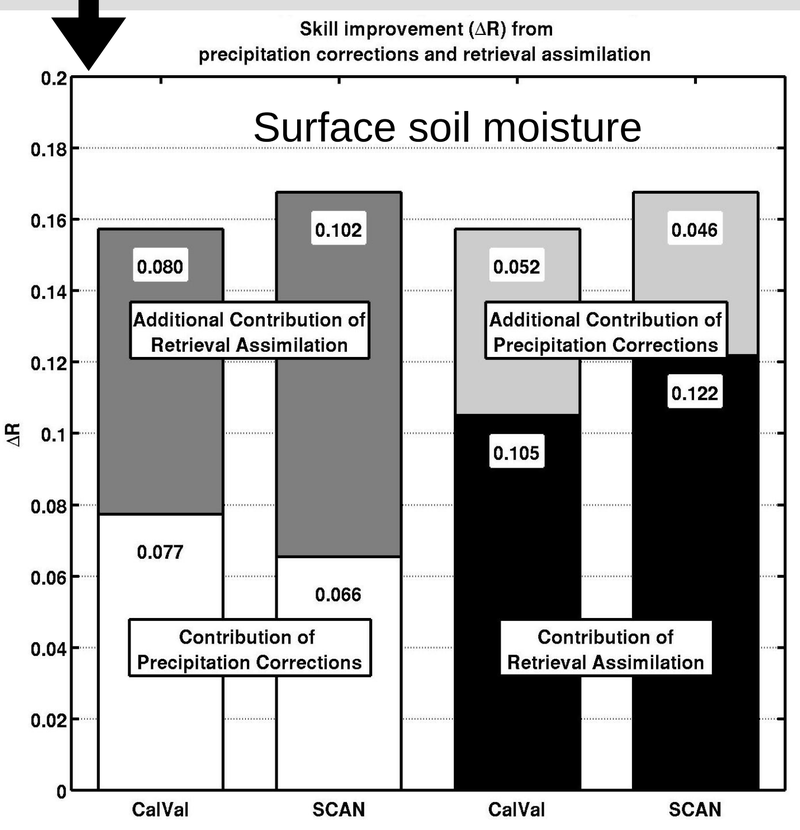
Skill v. SCAN is worse than skill v. CalVal, reflecting single-sensor in situ measurements.

Relative improvements similar for CalVal and SCAN validation – corroborates use of SCAN for assessing skill improvement.

Extract average skill contributions of precipitation corrections and retrieval assimilation:







ΔR = skill improvement over reference model integration

4. Conclusions

Precip. corrections & retrieval assimilation contribute:
- roughly evenly and
- largely independently to skill improvement.

Results from single sensor per watershed (SCAN data) are consistent with those from distributed CalVal sensors.

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