



Correction of Real-Time Global Precipitation Measurements with multi-sensor satellite observations



Niko Wanders, Ming Pan, Eric F. Wood



Universiteit Utrecht



PRINCETON
UNIVERSITY

Introduction

- Real time precipitation important for drought monitoring and flood forecasting
- Available from satellite missions like the real-time TRMM Multi-satellite Precipitation Analysis product (TMPA-RT)
- However, errors do exist in the original TMPA-RT. How to improve...
- Precipitation leads to:
 - Increased soil moisture (SM)
 - Decreased land surface temperature (LST)



Overall objectives

- Potential of remotely sensed observations of land surface variables to correct for uncertainties in satellite derived precipitation
- The effect of the correction of precipitation with both soil moisture and land surface temperature changes and the potential gain obtained by either of these sources



Study area



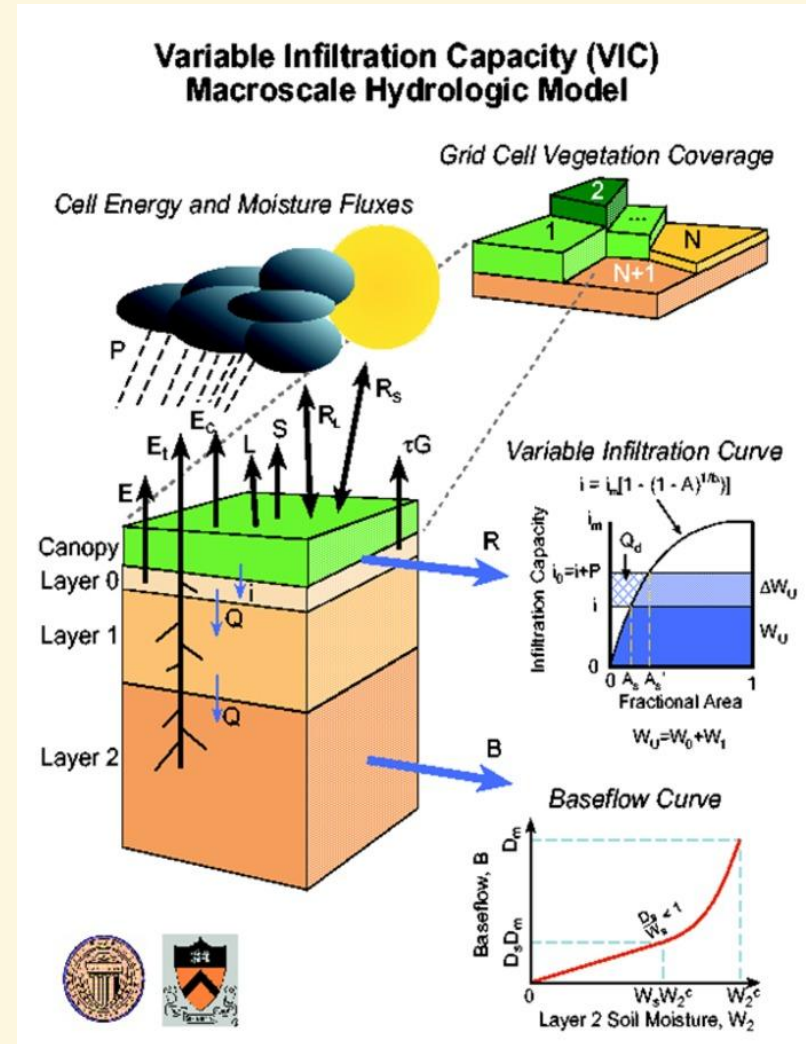
Universiteit Utrecht



PRINCETON
UNIVERSITY

Land Surface Model

- 3-hourly NLDAS meteorological forcing
- 3-hourly simulated SM and LST
- Simulations for 2010-2011



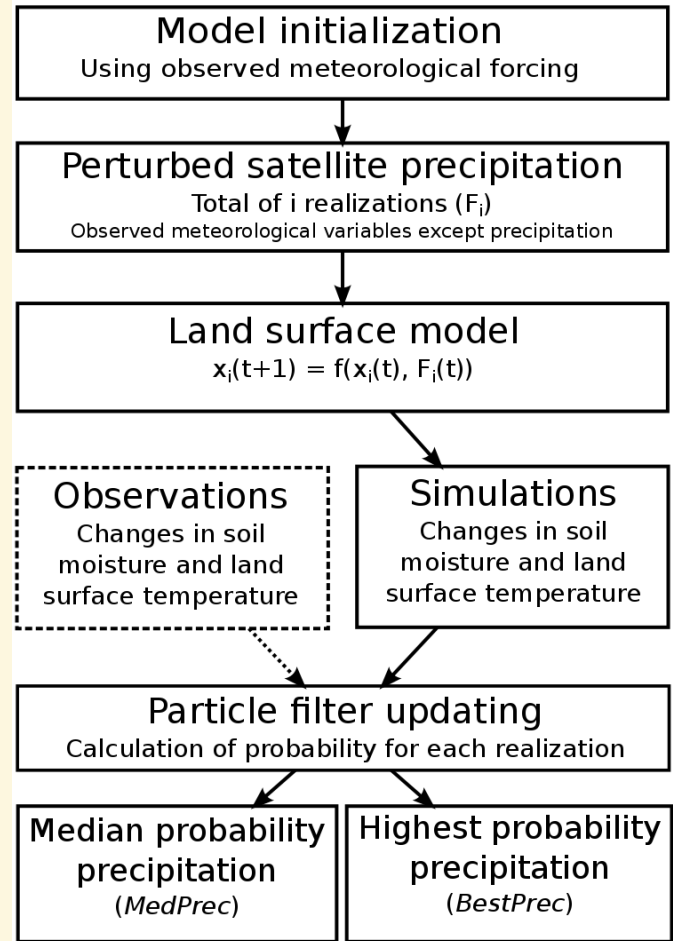
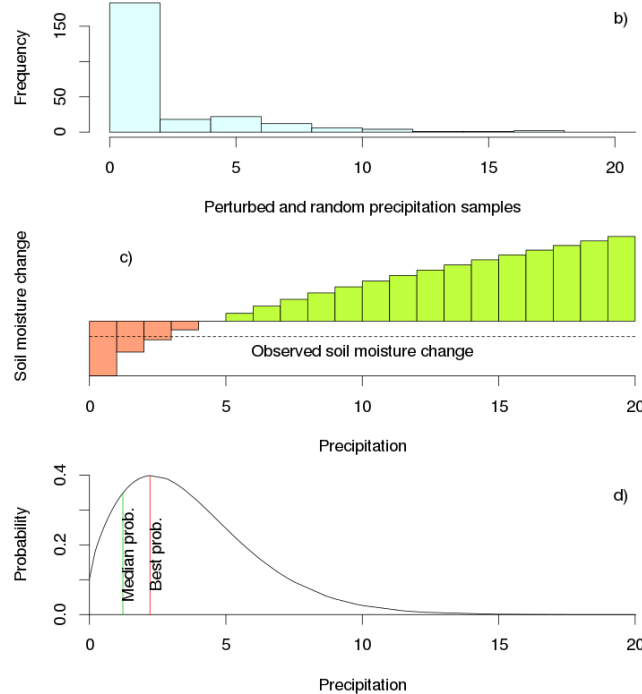
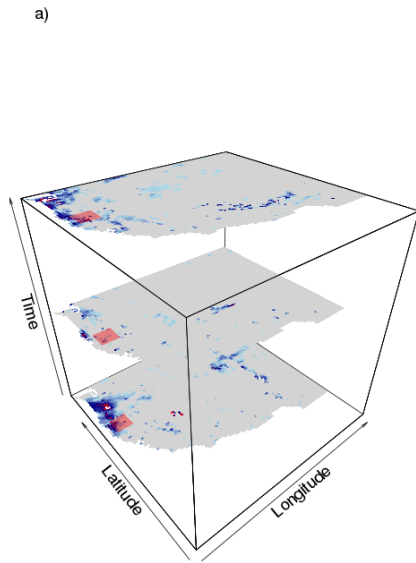
Observations

	AMSR-E LPRM	AMSR-E LSMEM	ASCAT	SMOS	AMSR-E LST
Frequency (GHz)	6.9	10.7	5.3	1.41	37
Microwave type	Passive	Passive	Active	Passive	Passive
Observation depth (cm)	2	2	2	5	1
Coverage	64%	62%	78%	45%	75%

- Ascending and descending separated
- CDF matching between VIC LSM and observations



Particle filter



Scenarios

Scenario	Description	Satellite observations
SM + LST	All data	LPRM, LSMEM, ASCAT, SMOS, AMSR-E LST
SM	Soil moisture data	LPRM, LSMEM, ASCAT, SMOS
LST	Land surface temperature	AMSR-E LST
SM_LPRM	LPRM soil moisture	LPRM
SM_LSMEM	LSMEM soil moisture	LSMEM
SM_ASCAT	ASCAT soil moisture	ASCAT
SM_SMOS	SMOS soil moisture	SMOS



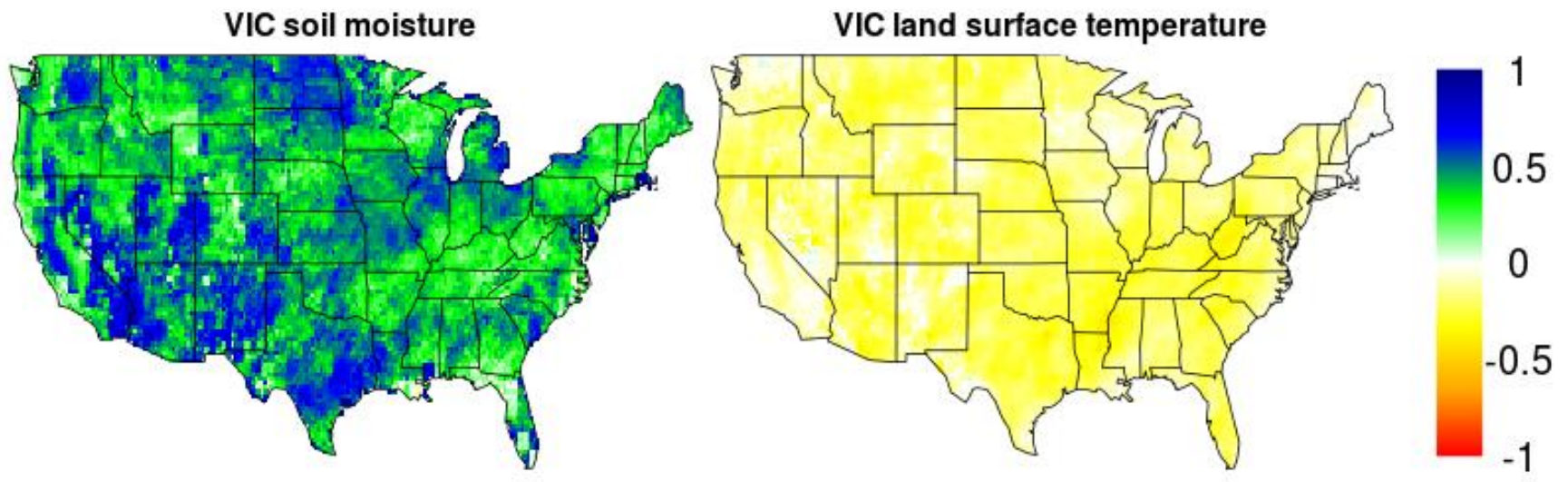
Validation

- Ground truth NLDAS-2 precipitation (Xia et al., 2012)
- Validation criteria:
 - Probability of detection (POD)
 - False Alarm Rate (FAR)
 - Relative Annual Precipitation (RAP)
 - Brier score (BS)



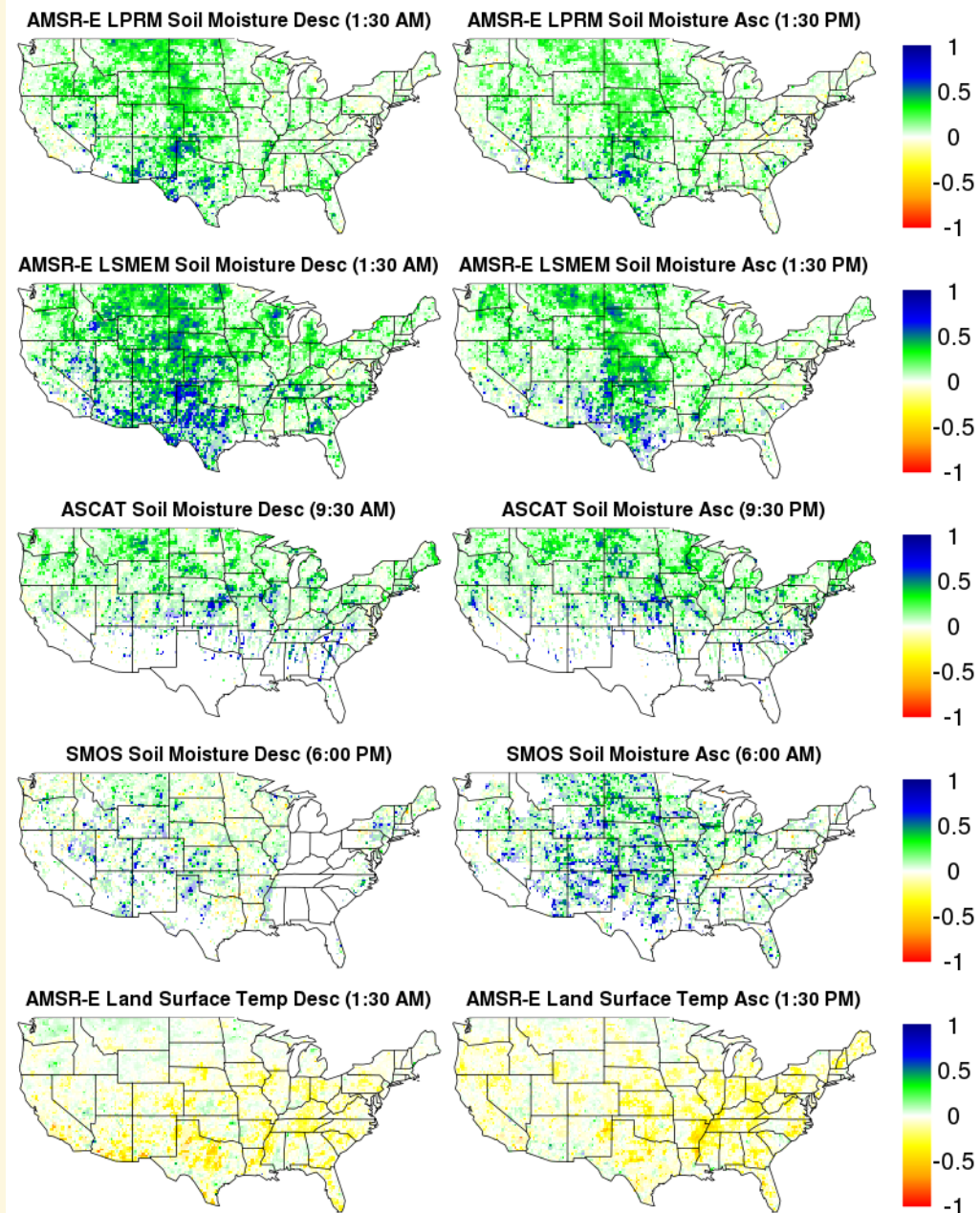
Sensitivity

- Good positive correlation between soil moisture and precipitation
- Good negative correlation between LST and precipitation

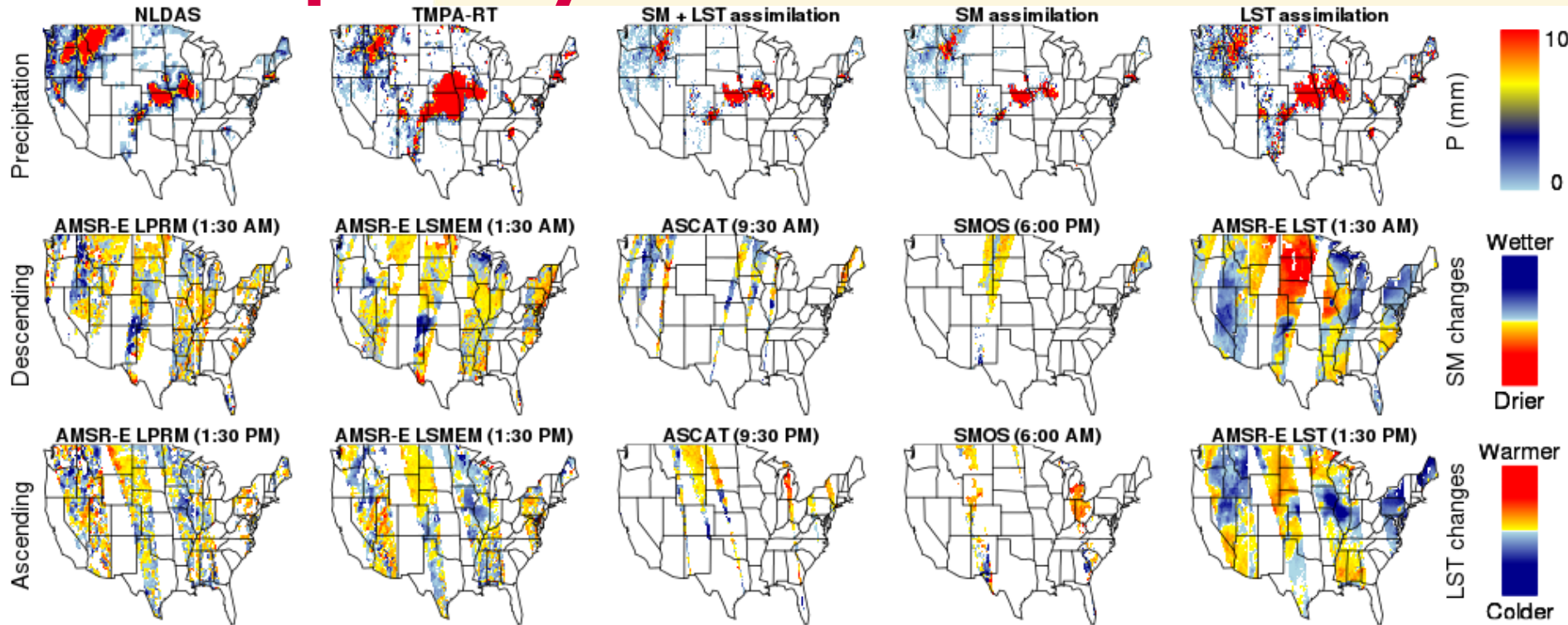


Sensitivity

- Decreased SM correlation
- Still information present
- ASCAT and SMOS suffer from low number of consecutive overpasses
- AMSR-E suffers from negative correlations
- LST good correlations



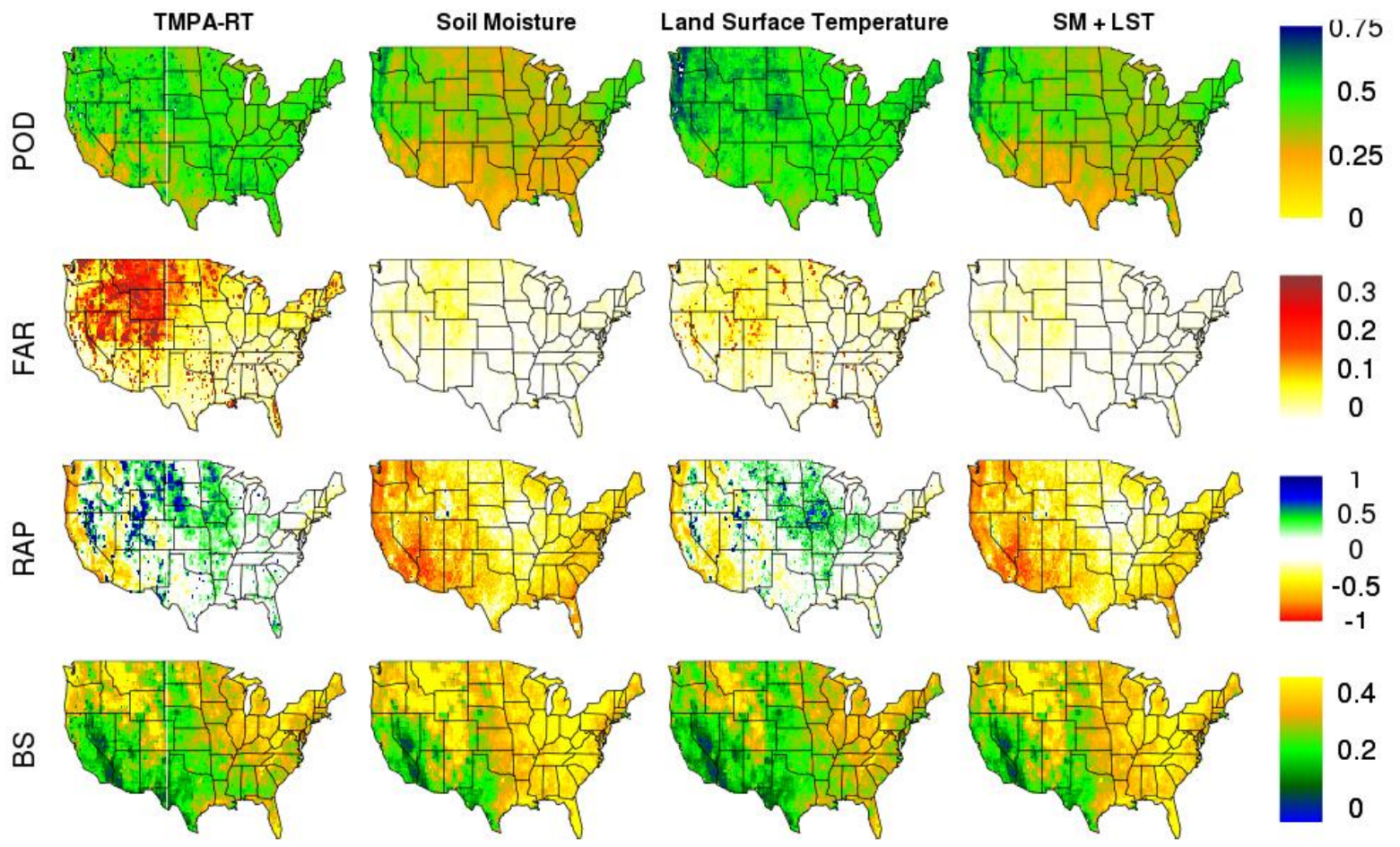
Example day



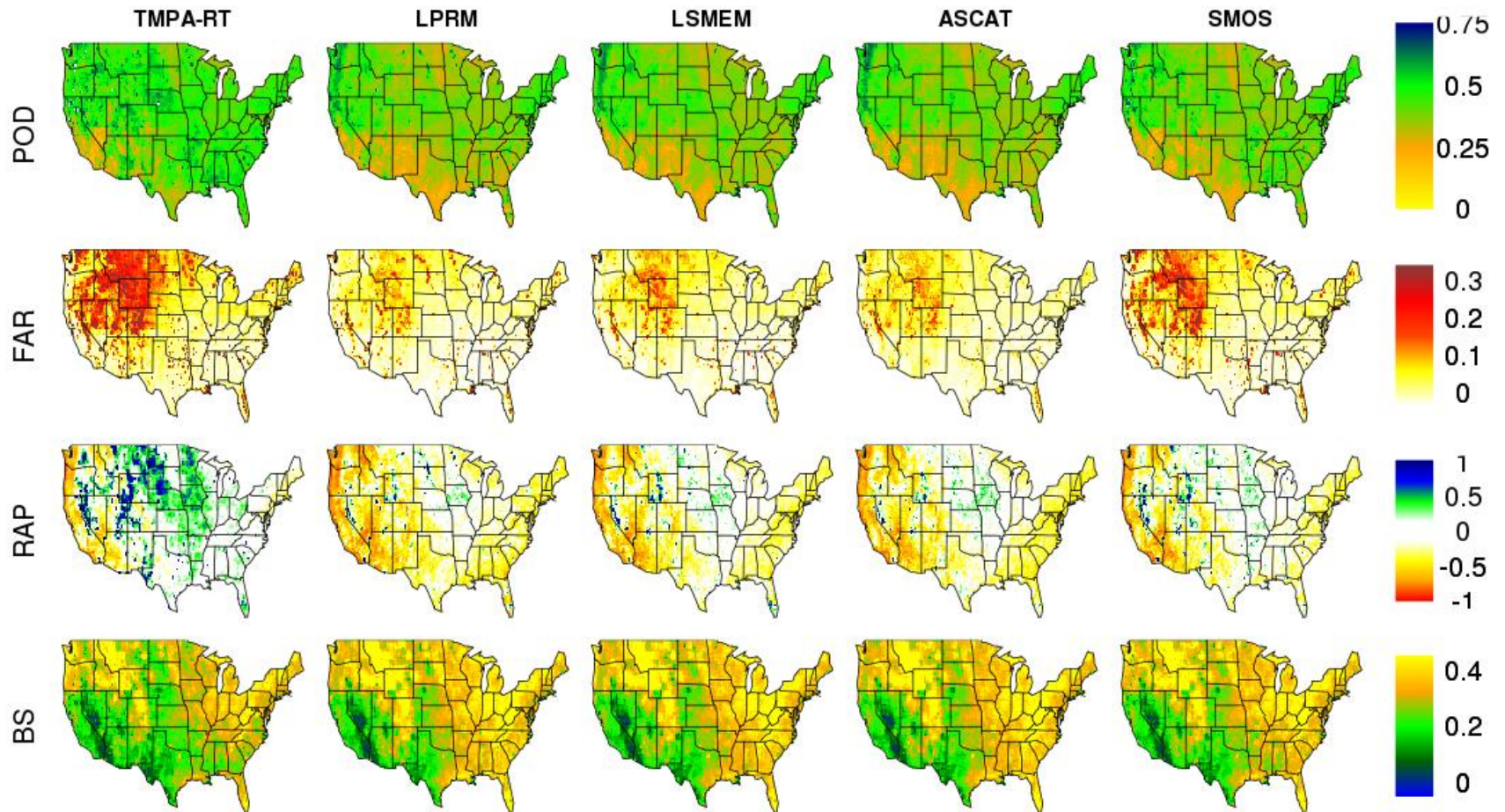
- Soil moisture correct for incorrect rain in TMPA-RT
- Soil moisture does not correct for missing rain
- LST corrects for missing and incorrect rain in TMPA-RT



Results (overall)

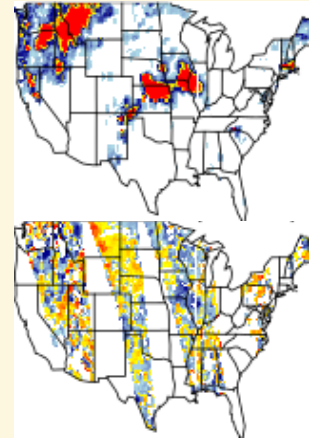


Results (Soil moisture)



Discussion

- Why is the impact of soil moisture limited
 - The soil moisture changes signal is noisy
 - Low correlation with precipitation events
 - Often increased soil moisture with dry conditions
- Synthetic experiment showed that the potential impact of SM is equally to the impact of LST assimilation
- Highest impact for most scenarios in summer



Conclusions

- Near real-time satellite precipitation can be improved with assimilation of remotely sensed soil moisture and land surface temperature observations
- Large potential for regions with poor ground-based precipitation measurement
- Important for real-time flood and drought monitoring and forecasting

