

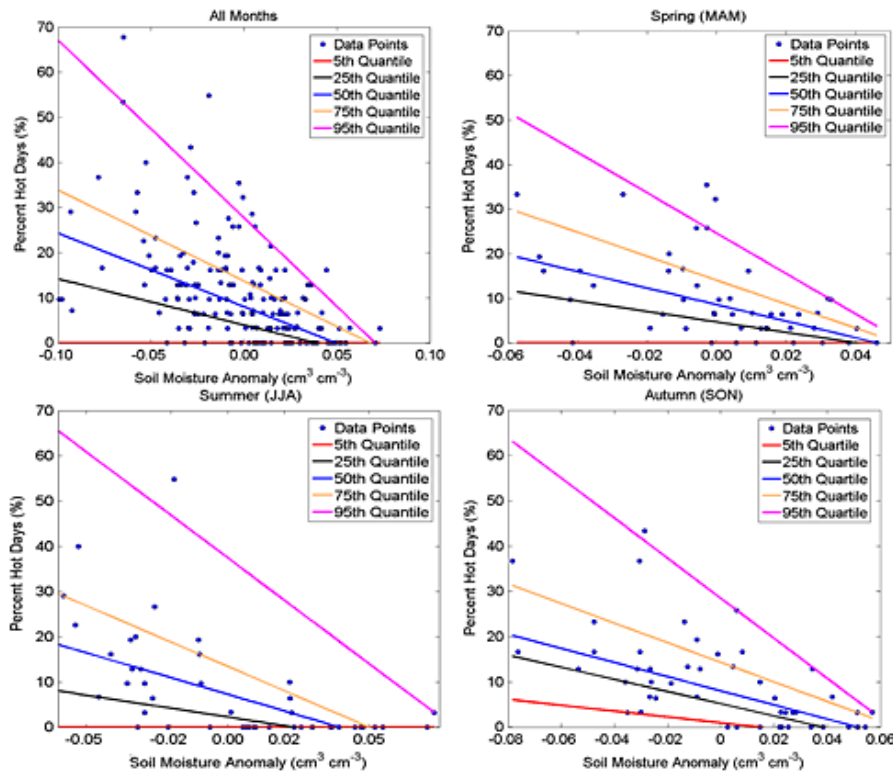
Soil Moisture – Maximum Temperature Coupling: Information Added From Satellite Remote Sensing



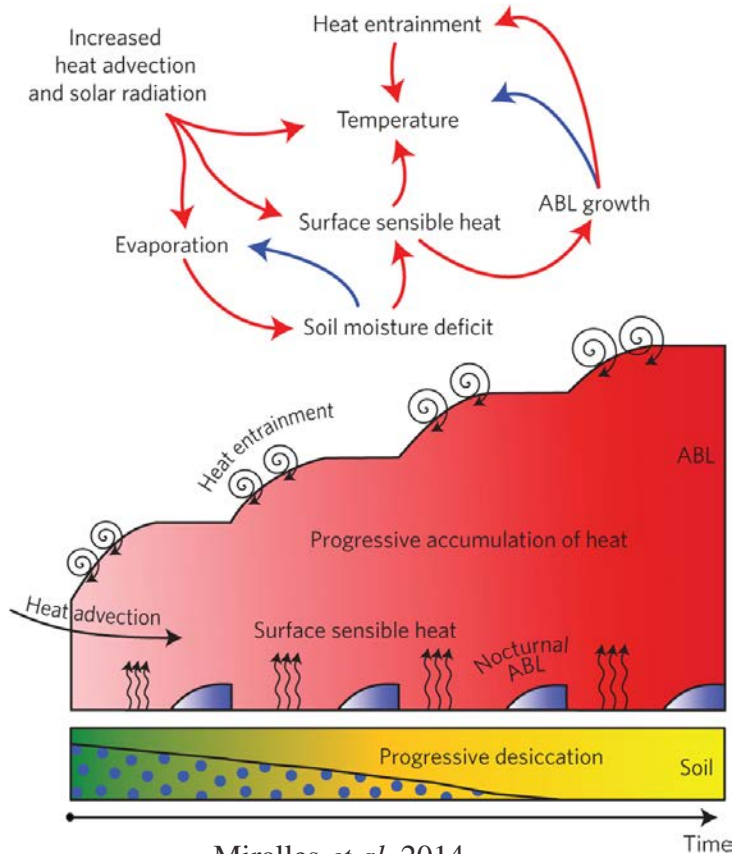
Trent Ford and Steven Quiring
Department of Geography, Texas A&M University
twford@tamu.edu



Motivation



Ford and Quiring, 2014

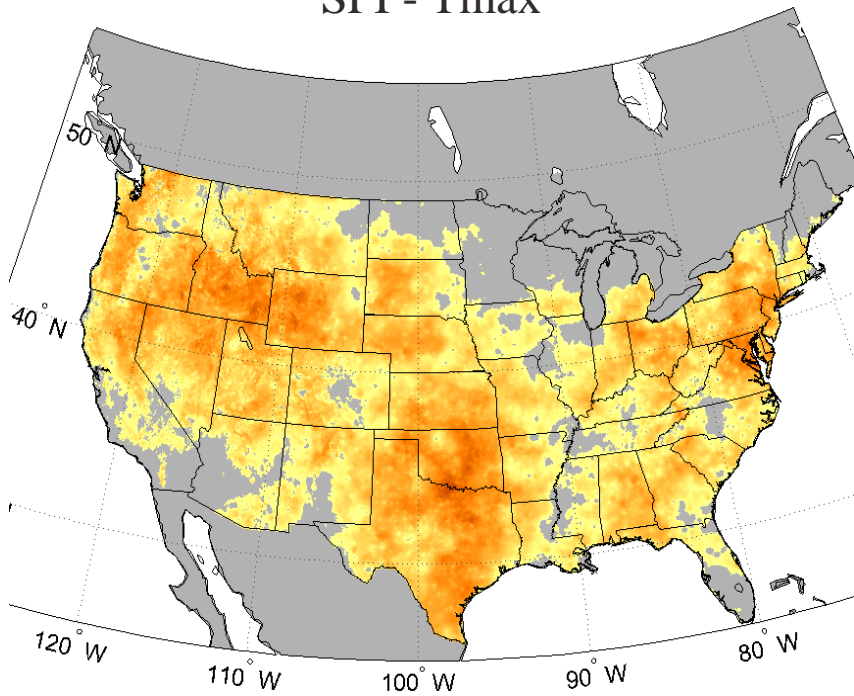


Miralles *et al.* 2014

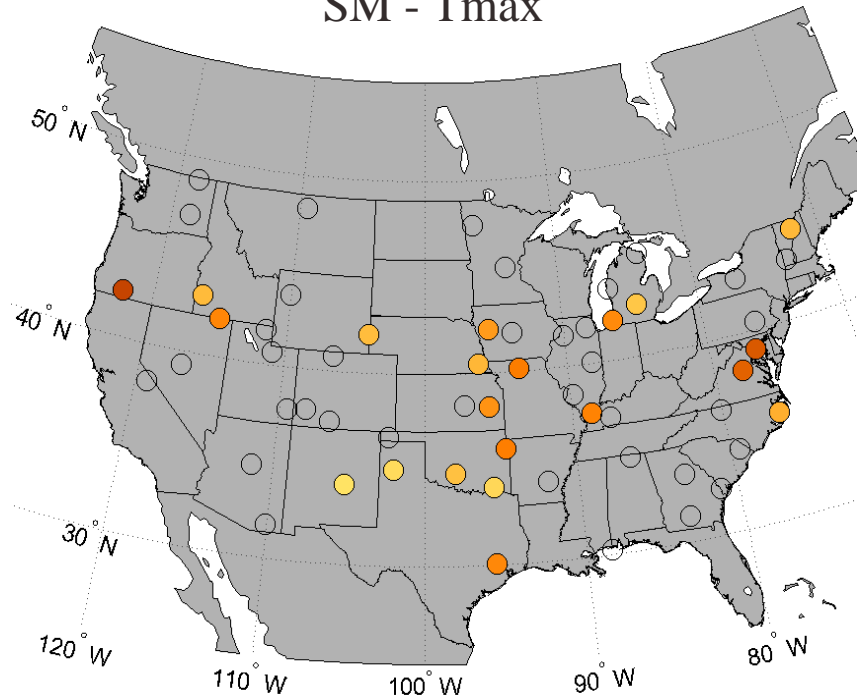


Motivation

SPI - Tmax



SM - Tmax



Ford *et al.* in preparation



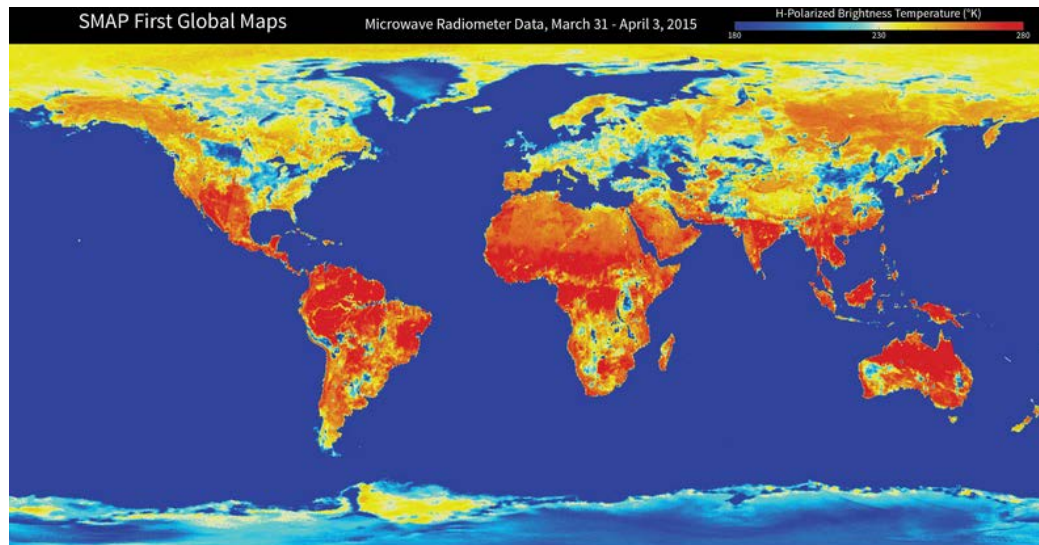
Motivation



Jet Propulsion Laboratory
California Institute of Technology

SMAP SOIL MOISTURE
ACTIVE PASSIVE

[Mission](#) [Observatory](#) [Science](#) [Data](#) [Multimedia](#) [Education](#) [News & Events](#)



Objectives

1. Quantify RS soil moisture – maximum temperature coupling over United States
2. Determine the importance of soil moisture “information added” for monthly maximum temperature forecasts



Data

Soil Moisture

- TRMM Microwave Imager (TMI) – 10.65 GHz, 0.25°
 - Level 3 (GES_DISC_LPRM_TMI_SOILM3_DY_V001) daily product
 - 1998 – present, south of 38°N

Maximum Temperature

- PRISM – Oregon State University
 - Thousands of stations across CONUS
 - 1895 – present, 4 km resolution
 - RegridDED to 0.25° to match TMI



Methods

Soil Moisture – Tmax Coupling

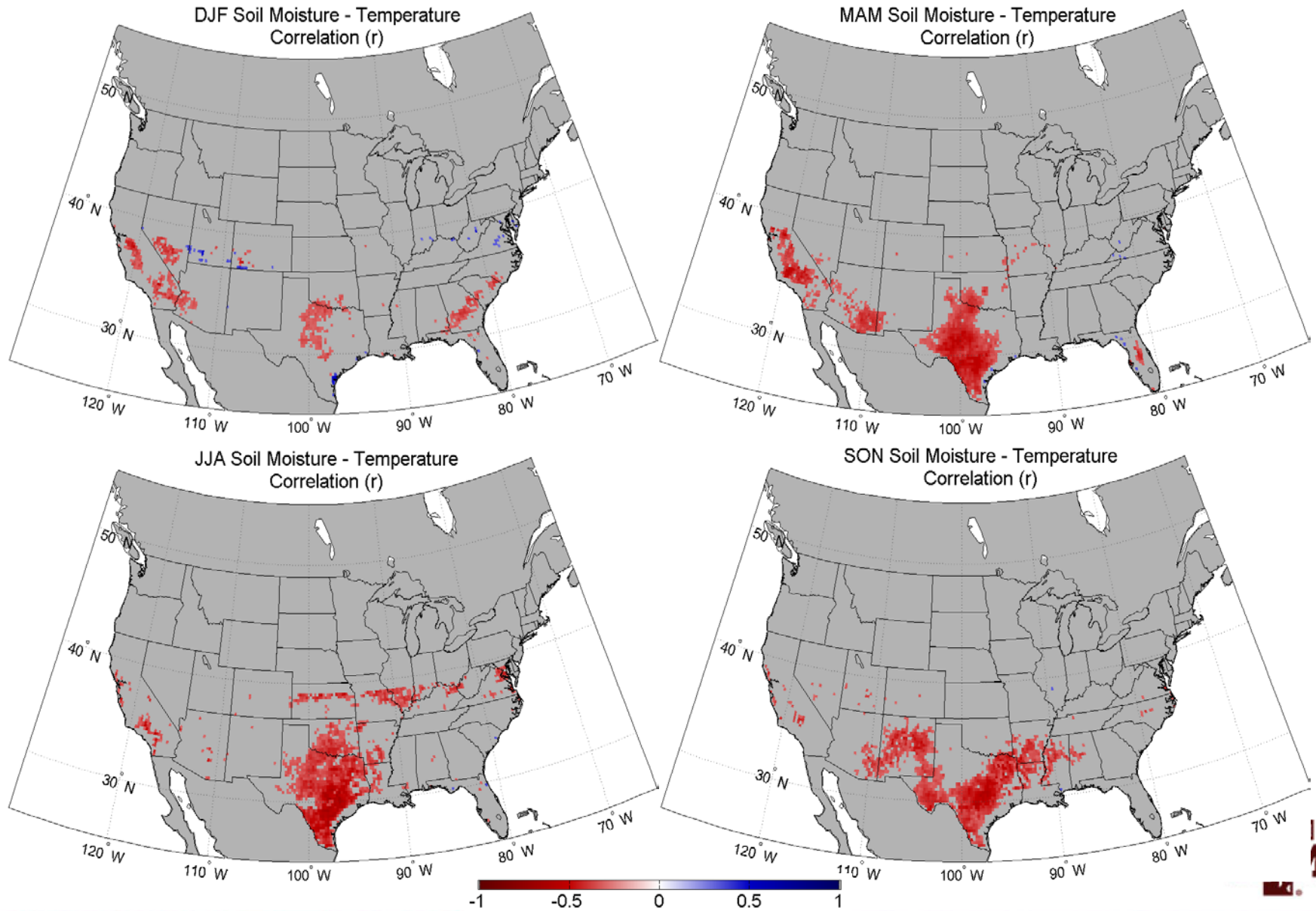
- Soil moisture anomalies in month n correlated with Tmax anomalies in month $n+1$

Soil Moisture Information added

- Partial correlation
- Statistical models

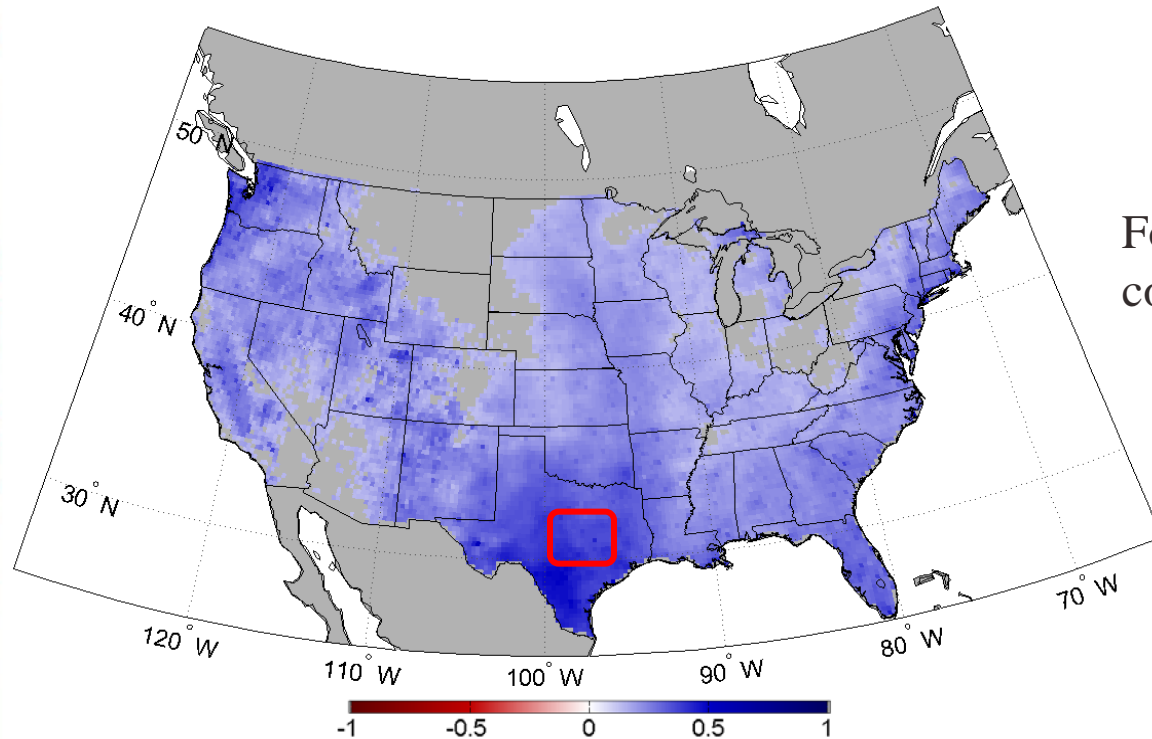


Soil Moisture – Tmax Coupling



Month-to-Month Temperature Persistence

PRISM Max Temperature
Lag 1 Autocorrelation (r)

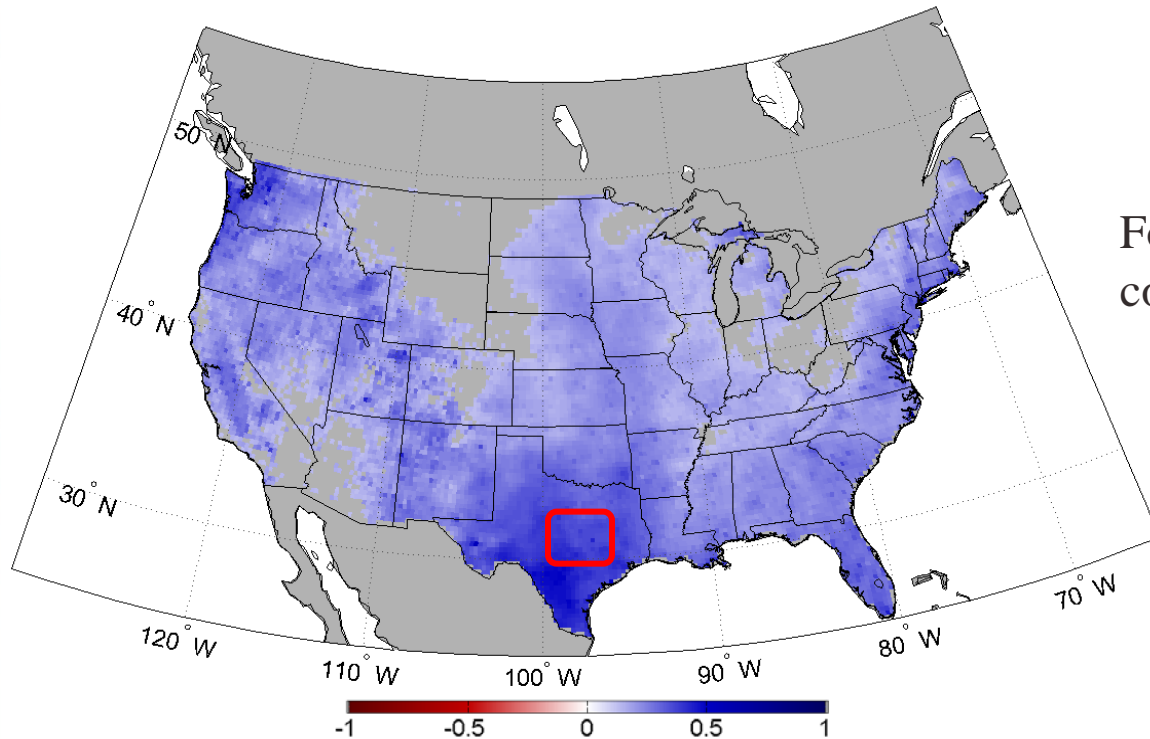


Focus on central Texas region,
consistently strongest coupling



Month-to-Month Temperature Persistence

PRISM Max Temperature
Lag 1 Autocorrelation (r)



Focus on central Texas region,
consistently strongest coupling

	Soil Moisture – Temperature (n)	Temperature (n) – Temperature (n+1)	Soil Moisture – Temperature (n+1)
Pearson Product-Moment Correlation	-0.78	0.33	-0.36
Partial Correlation			-0.16



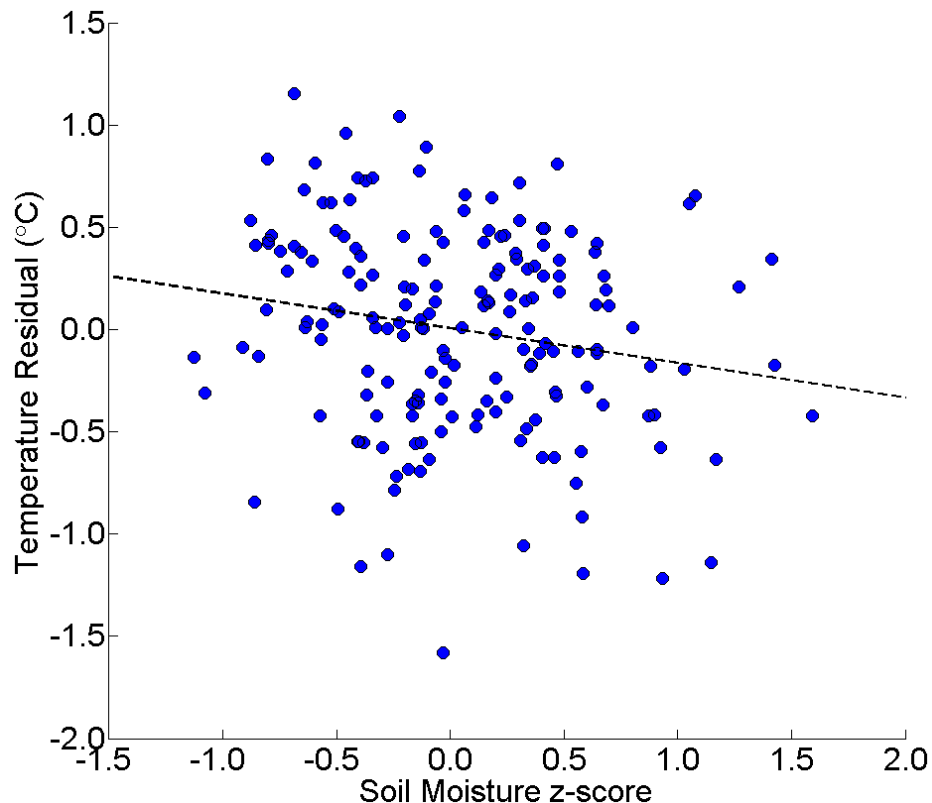
Separating Soil Moisture and Temperature Information

- Estimate AR1 for Tmax and remove residuals



Separating Soil Moisture and Temperature Signals

- Estimate AR1 for Tmax and remove residuals



Soil moisture anomalies are significantly correlated with AR1 residuals.

- Tmax persistence alone underestimates (overestimates) next month's Tmax forecast when soils are very dry (wet)



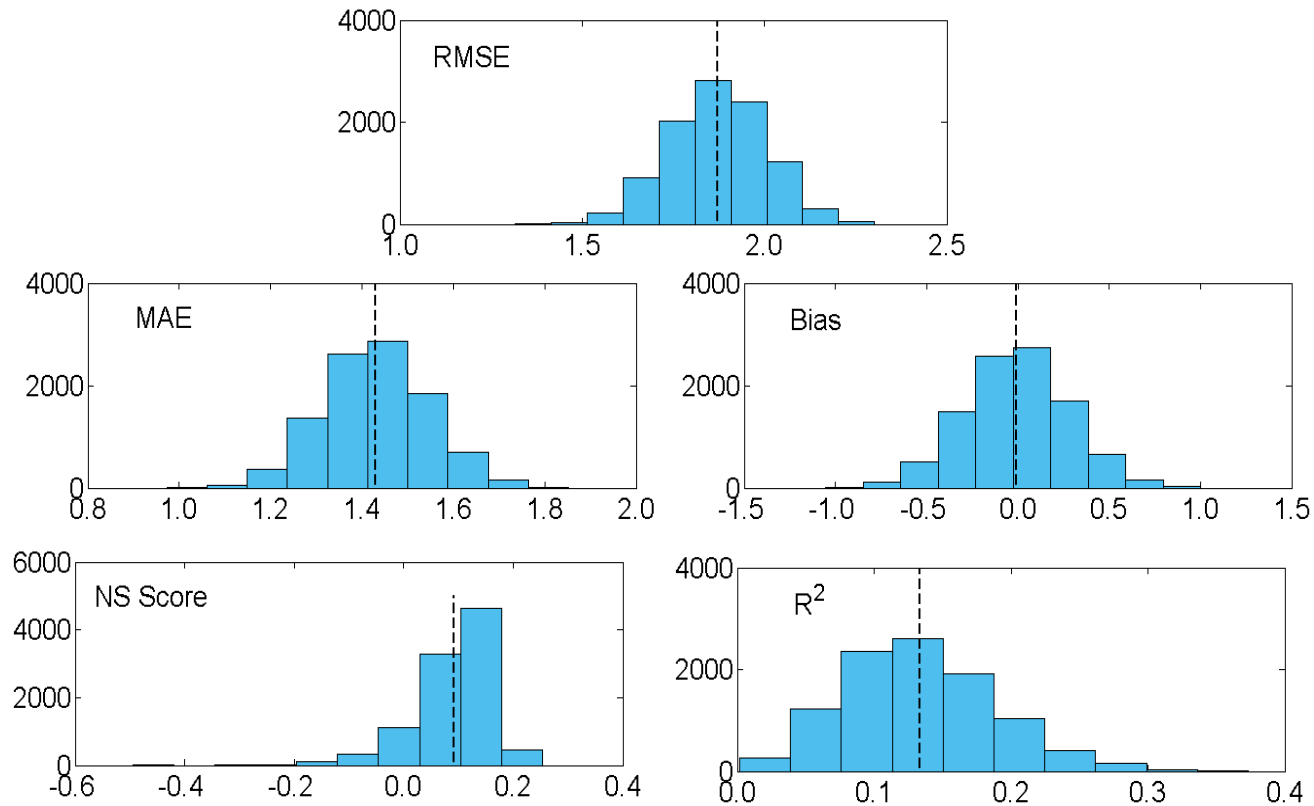
“Information added” from RS soil moisture seems to act as a supplement to monthly Tmax persistence

Does RS soil moisture inclusion in a statistical forecast model result in more accurate predictions at a 1-month lead?



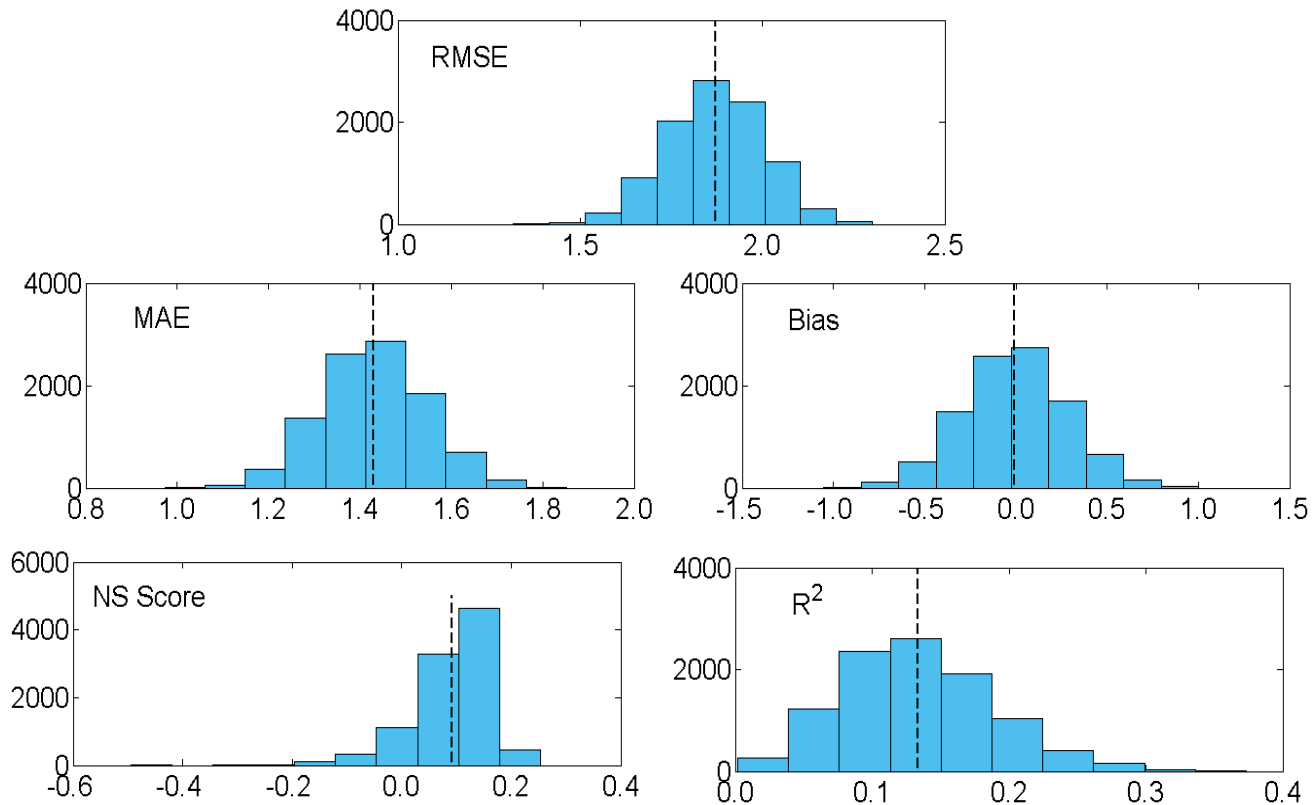
Regression Model Results

Tmax AR1



Regression Model Results

Tmax AR1 + Soil Moisture



Conclusions

- RS soil moisture strongly coupled with T_{max}...in Texas

Central Texas:

- Soil moisture acts as a supplement to monthly T_{max} persistence
- Forecast accuracy and consistency with and without soil moisture are not significantly different



Thanks, questions?



Just another day in the Climate Science Lab

Ford, T.W., and Quiring, S.M. 2014. In situ soil moisture coupled with extreme temperatures: A study based on the Oklahoma Mesonet. *Geophys. Res. Lett.*, **41**, 4727-4734

Hirschi, M., Mueller, B., Dorigo, W., and Seneviratne, S.I. 2014. Using remotely sensed soil moisture for land-atmosphere coupling diagnostics: The role of surface vs. root-zone soil moisture variability. *Rem. Sens. Env.*, **154**, 246-252.

Miralles, D., den Berg, M., Teuling, A., and de Jeu, R. 2012. Soil moisture-temperature coupling: A multi-scale observation analysis. *Geophys. Res. Lett.*, **39**.

