

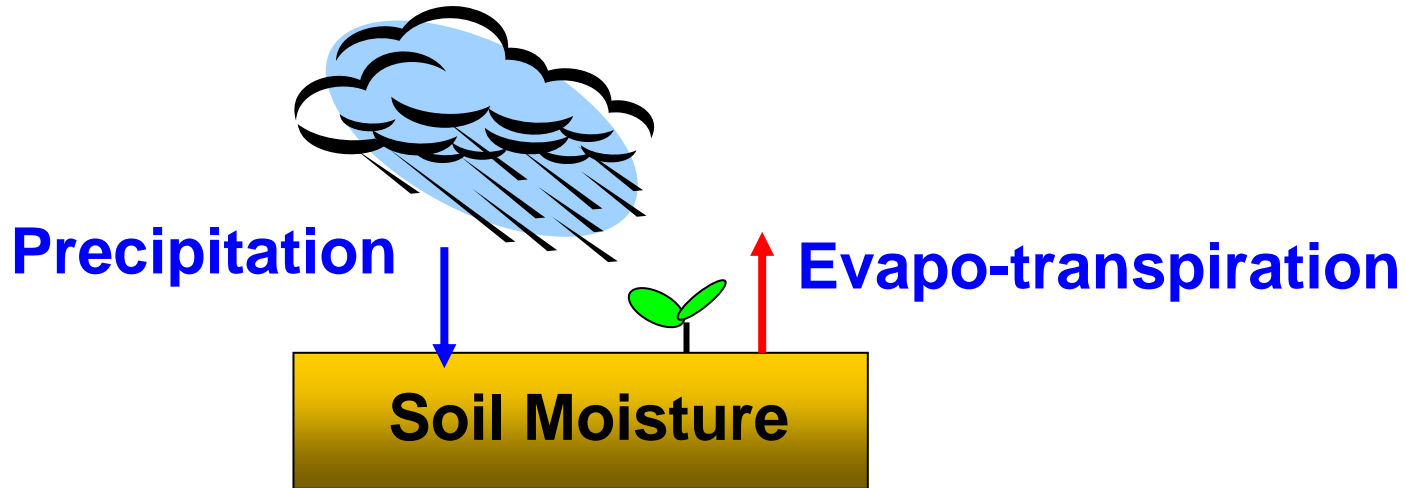
# **Relationship between Rainfall and Soil moisture based on AMSR-E Data**

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**Jet Propulsion Laboratory**  
California Institute of Technology



# Motivation

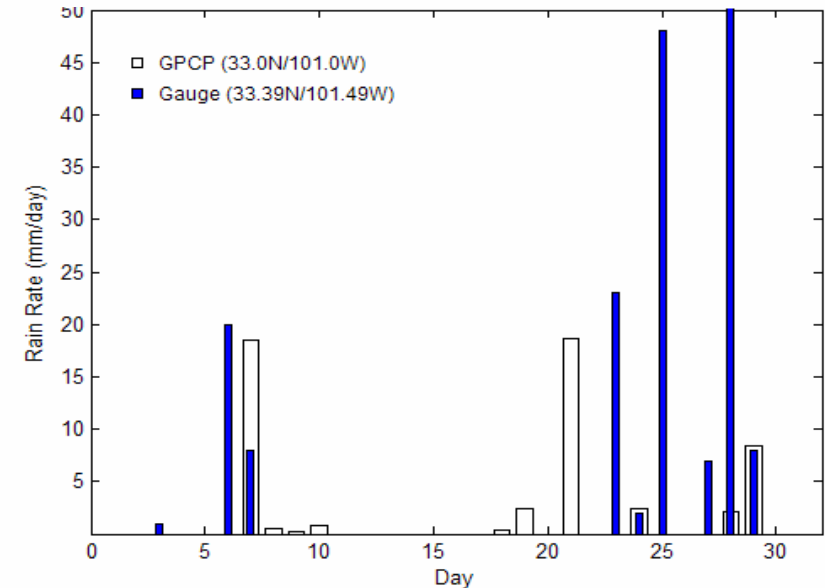
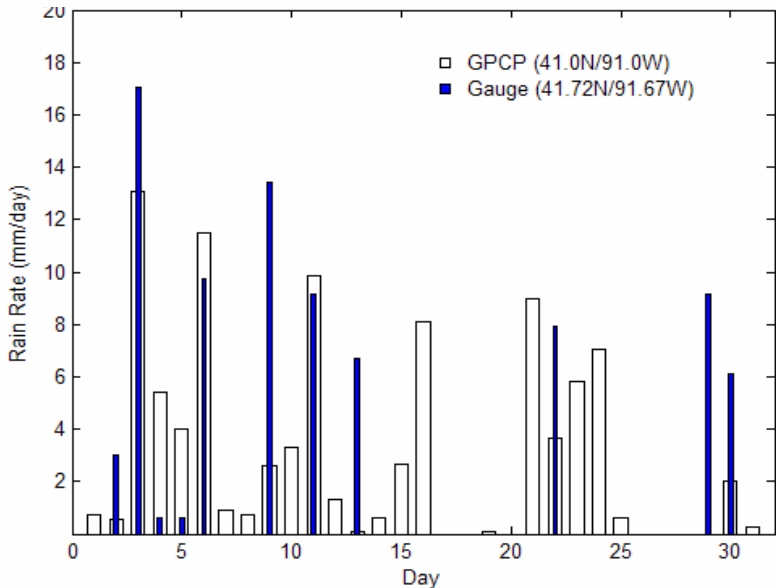
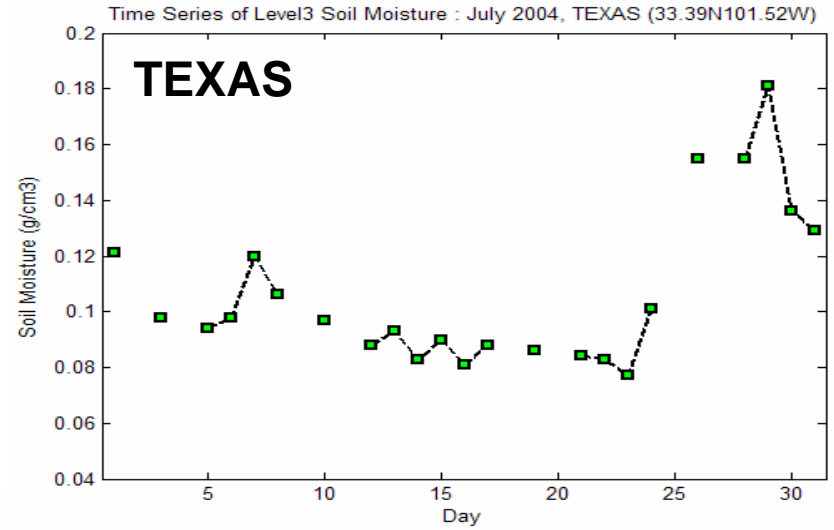
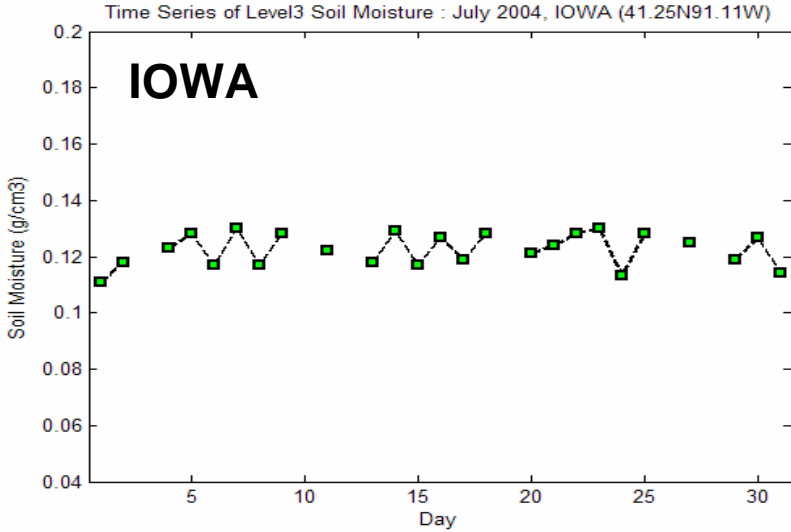


- Key parameters on interaction between Atmosphere and Land
- The role of precipitation and soil moisture for hydrological cycle and energy budget of the earth

# Issue and Challenge

- Rainfall over land is a primary uncertainty source and limitation for the soil moisture retrieval.
- Discerning the signal emitted by the surface from emission of a raining atmosphere is **extremely complicated** -- Retrieval of soil moisture is not attempted in the presence of precipitation using a rain-screening method:  
**Tb24v-Tb89v > 8K and Tb89v < 270K**

# Sensitivity to Vegetation



# Physical Tools

- **Soil Moisture Algorithm**

(Njoku et al., 2003; Njoku and Chan, 2006)

$$\underline{SM=5.0+2.0wbar+150.0x(Pr10-Pr10_{min})\cdot EXP(0.3wbar)}$$

$$wbar= -3.5845 -1.6605xLn(Pr10_{min})$$

Where,  $Pr10=(Tb10v-Tb10h)/(Tb10v+Tb10h)$

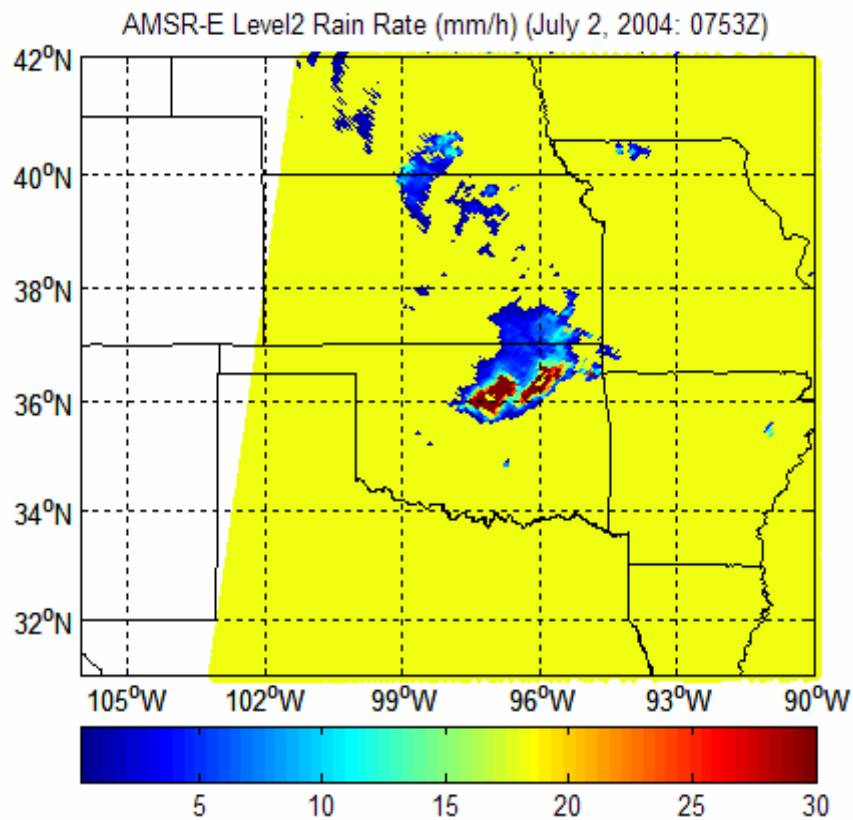
- **Land Rainfall Algorithm**

(McCollum and Ferraro, 2003)

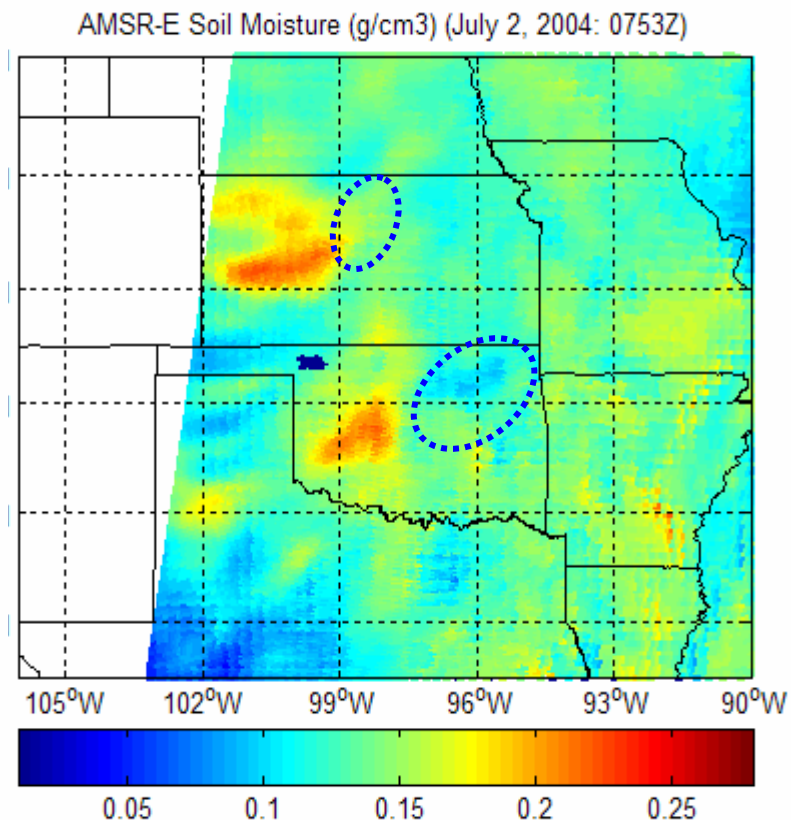
**Over Land (Warm Background)** - Brightness temperature depression signature from the scattering of ice particles.

$$SI=a-b\cdot Tb19-c\cdot Tb22+d\cdot (Tb22)^2-\underline{Tb85}$$

# Swath-basis analysis

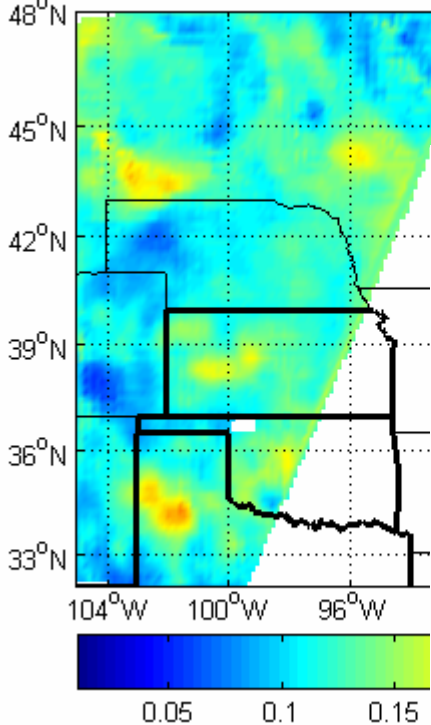


**Rain Rate (mm/h)**



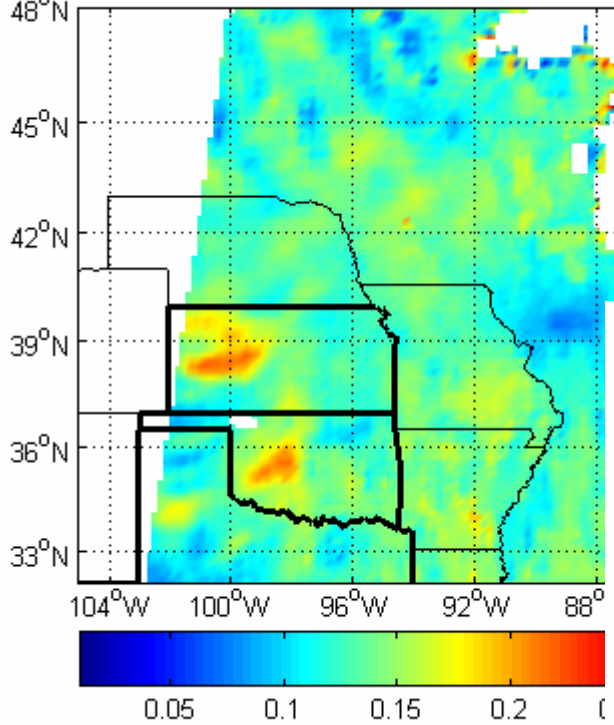
**Soil Moisture (g/cm<sup>3</sup>)**

AMSR-E Soil Moisture (g/cm<sup>3</sup>) (July 1, 2004: 0848Z)



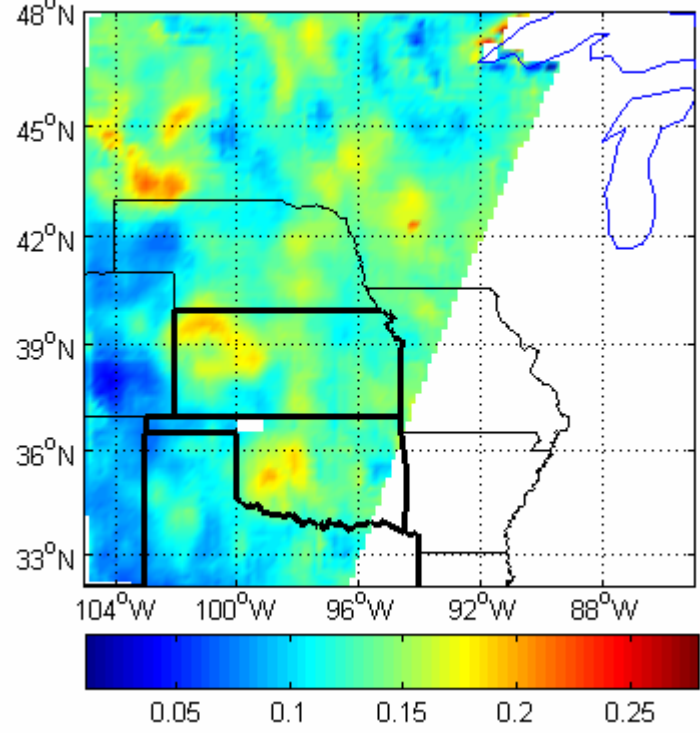
**JULY1**

AMSR-E Soil Moisture (g/cm<sup>3</sup>) (July 2, 2004: 0753Z)



**JULY2**

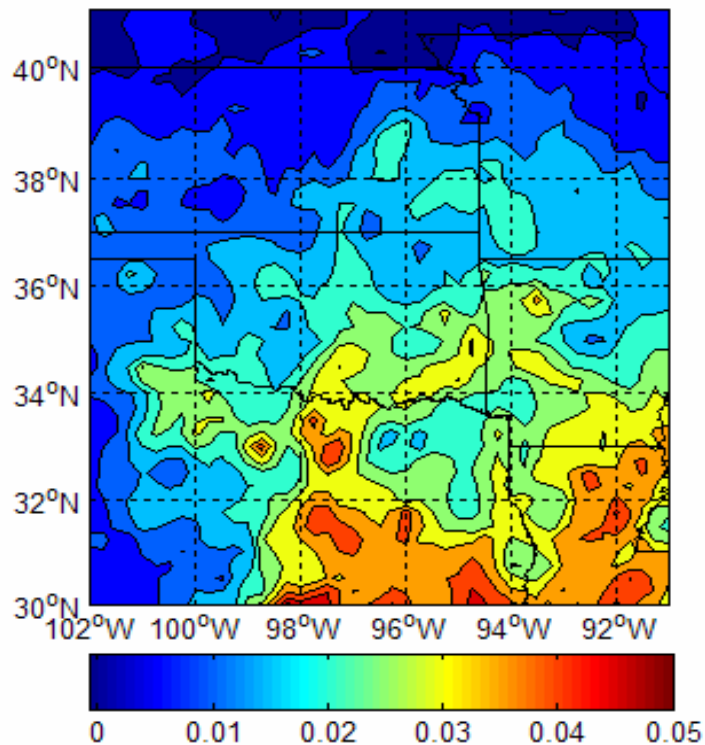
AMSR-E Soil Moisture (g/cm<sup>3</sup>) (July 3, 2004: 0836Z)



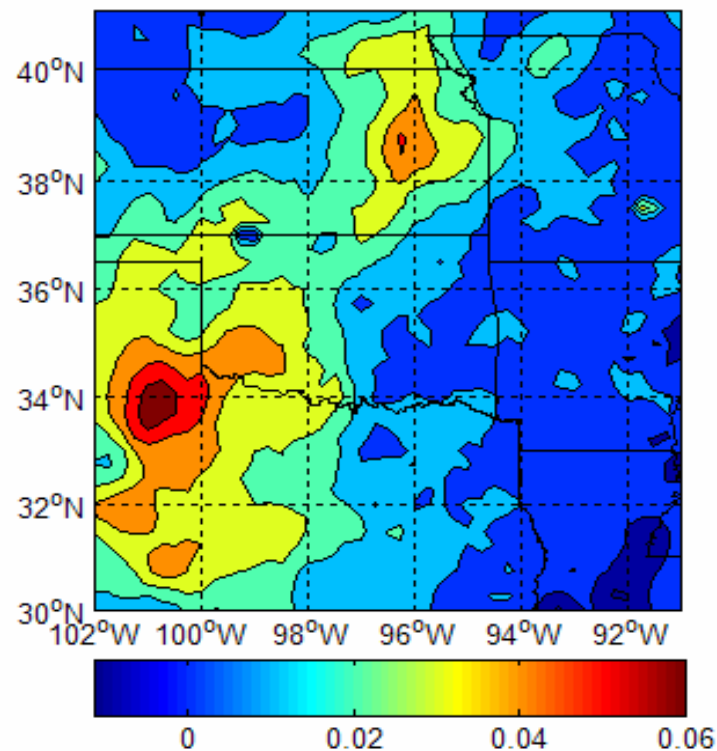
**JULY3**

# EOF Comparison

RR(CPC) EOF1 (48% Var, 2004)

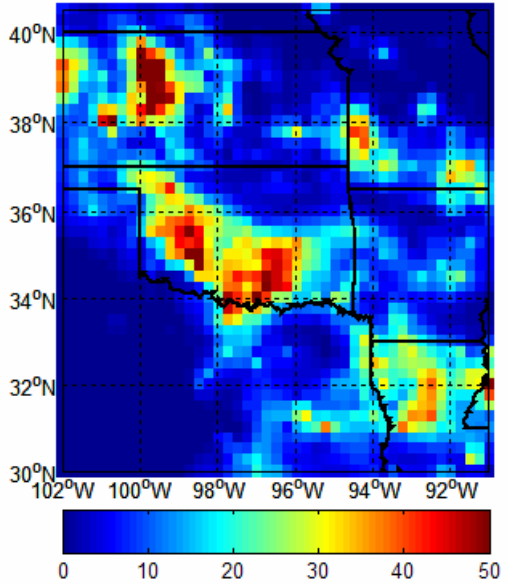


AMSR-E SM EOF1 (53% Var, 2004)

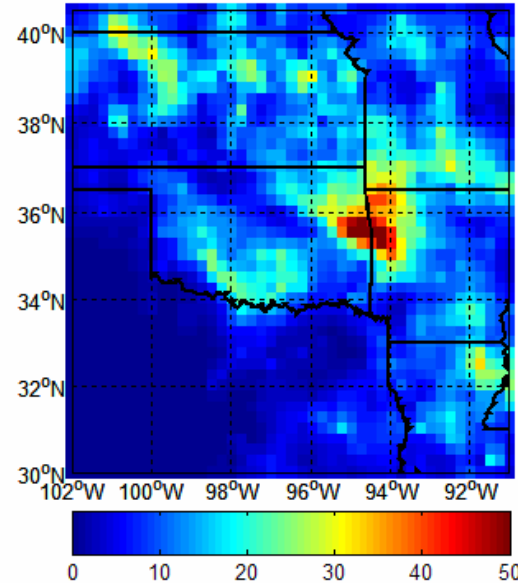




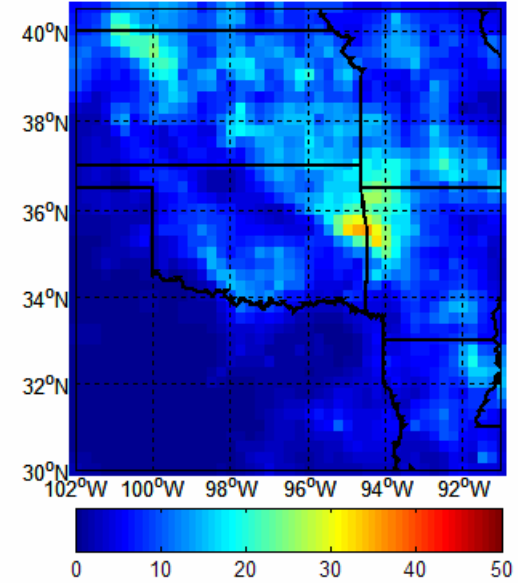
CPC Mean Rain (mm/day): (JULY 1, 2004)



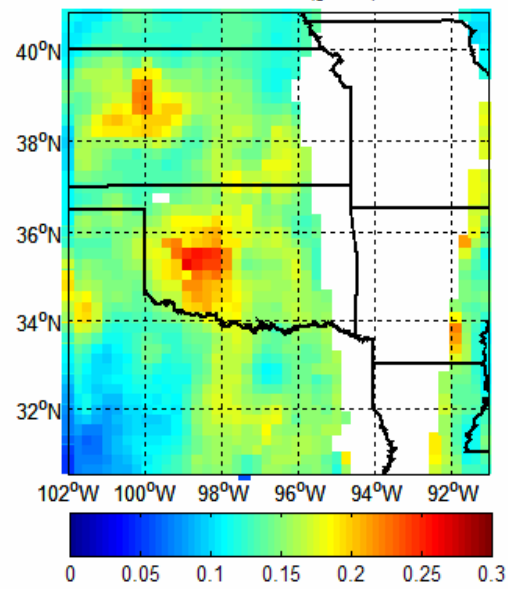
CPC Mean Rain (mm/day): 3days (1-3) (JULY 2004)



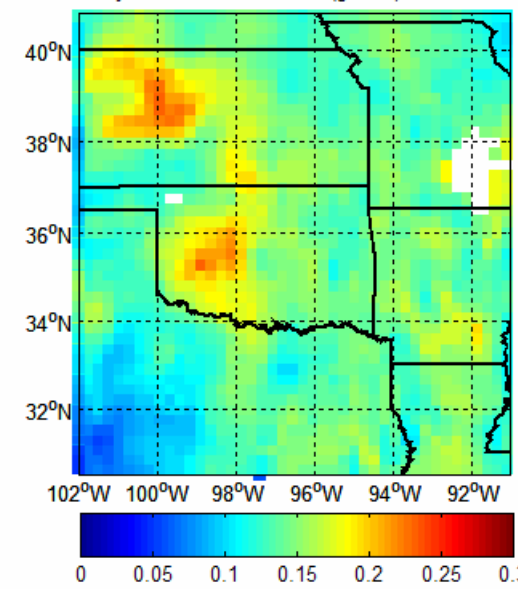
CPC Mean Rain (mm/day): 5days (1-5) (JULY 2004)



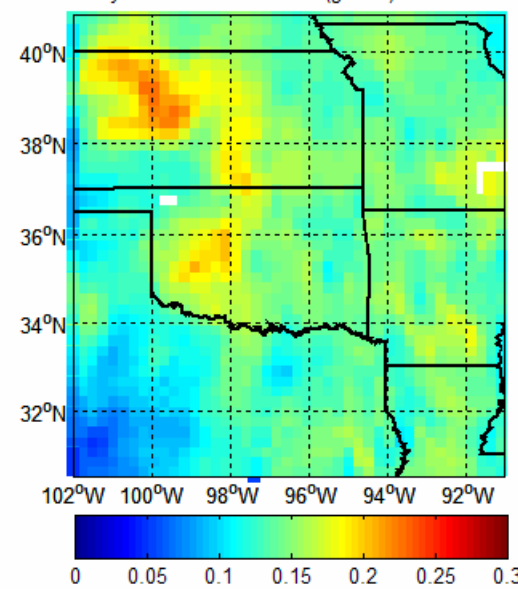
AMSR-E Mean Soil Moisture (g/cm3): JULY 1, 2004



AMSR-E 3days Mean Soil Moisture (g/cm3): JULY 2004 1-3 A



AMSR-E 5days Mean Soil Moisture (g/cm3): JULY 2004 1-5 A/D

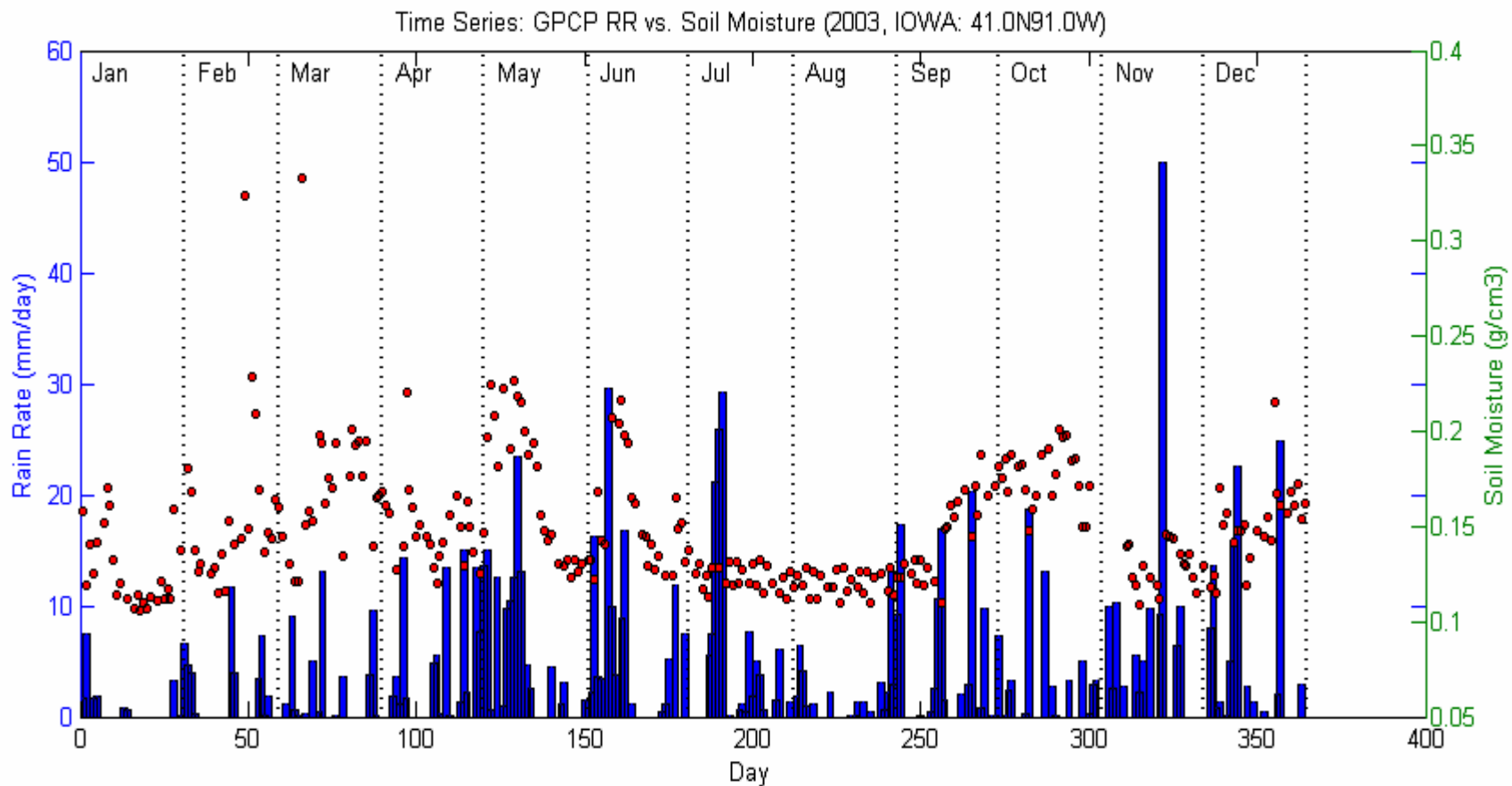


**1DAY (July 1)**

**3DAYS (July1-3)**

**5DAYS (July1-5)**

# Daily Time Series Analysis

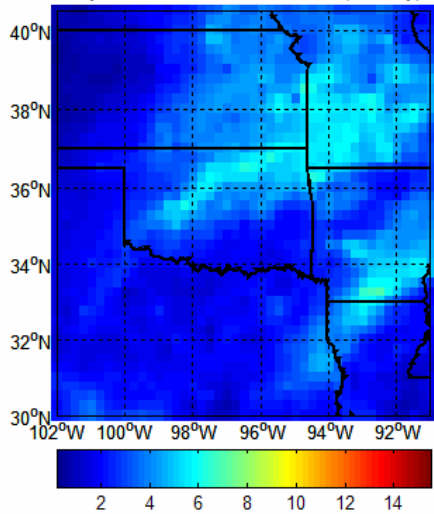


# Conclusion and Future Direction

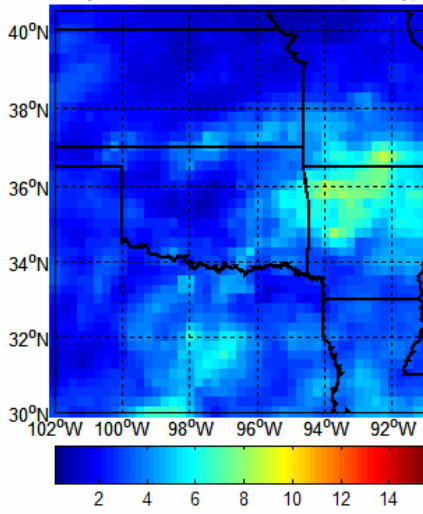
- Results show some insights of the relationship between precipitation and soil moisture **according to spatio-temporal scales**
- We are working on investigating **consistency between the retrieved soil moisture data and the model data (NARR)** to study how satellite-based soil moisture observations can contribute to simulate improved large-scale soil moisture estimation through data assimilation.

# Backup Slides

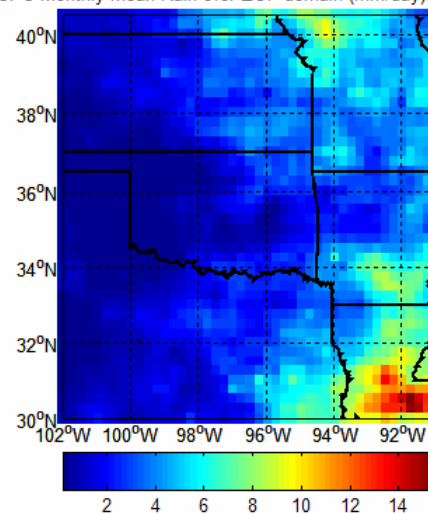
CPC Monthly Mean Rain over EOF domain (mm/day): 2004 3



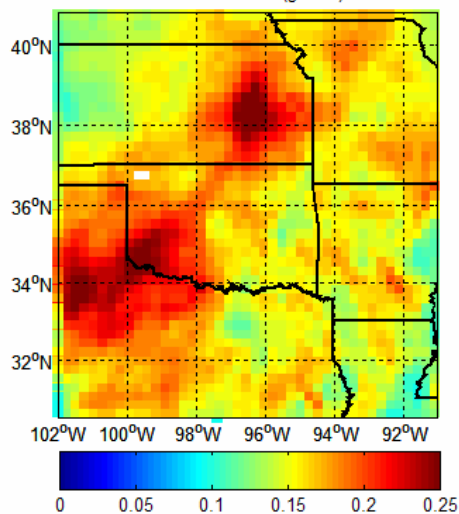
CPC Monthly Mean Rain over EOF domain (mm/day): 2004 4



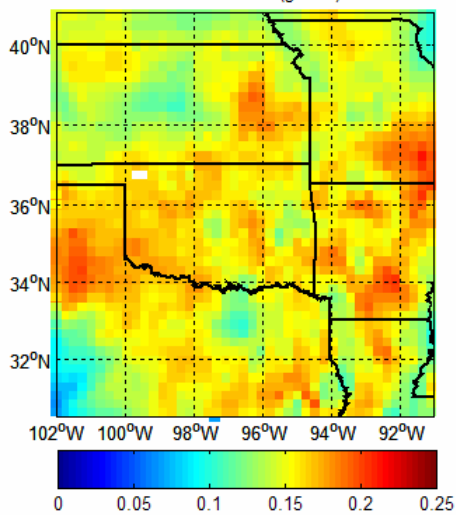
CPC Monthly Mean Rain over EOF domain (mm/day): 2004 5



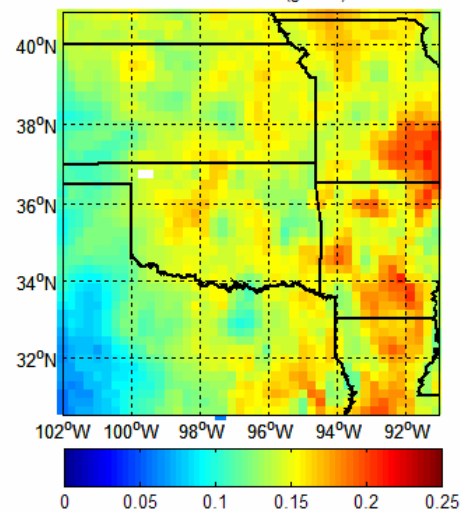
AMSR-E Mean Soil Moisture (g/cm3): 2004 3 A/D



AMSR-E Mean Soil Moisture (g/cm3): 2004 4 A/D



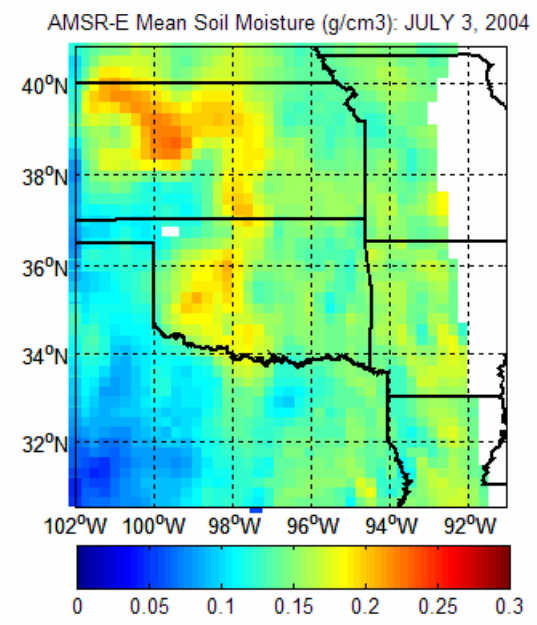
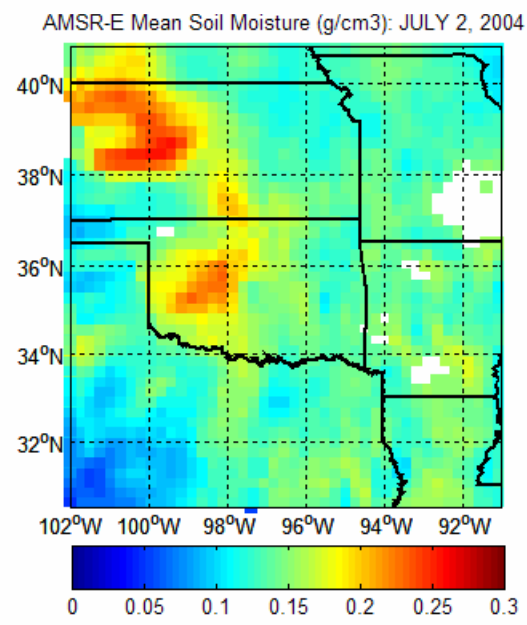
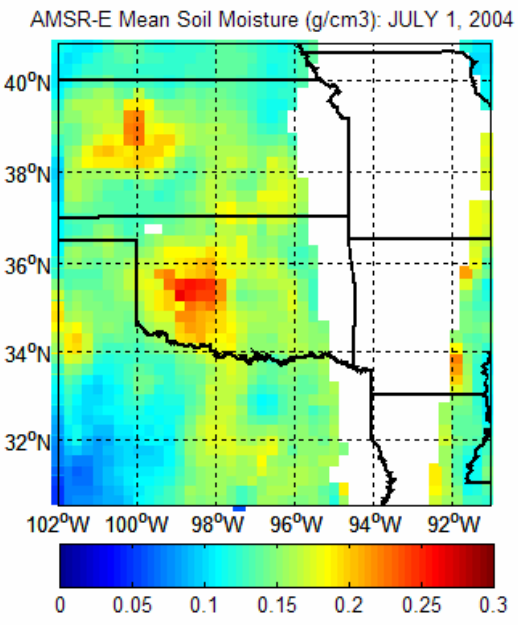
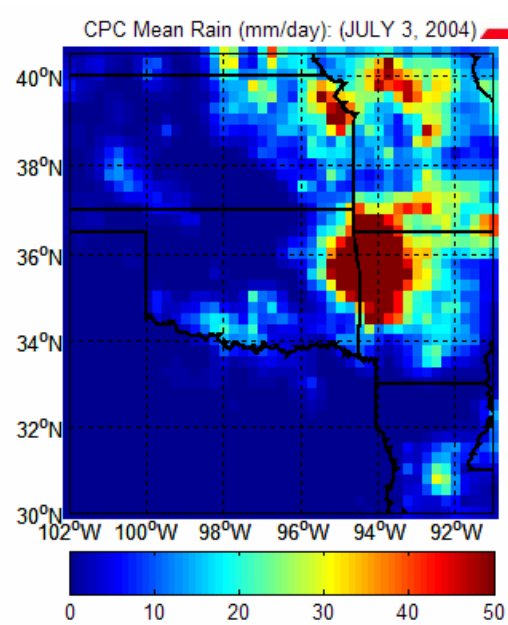
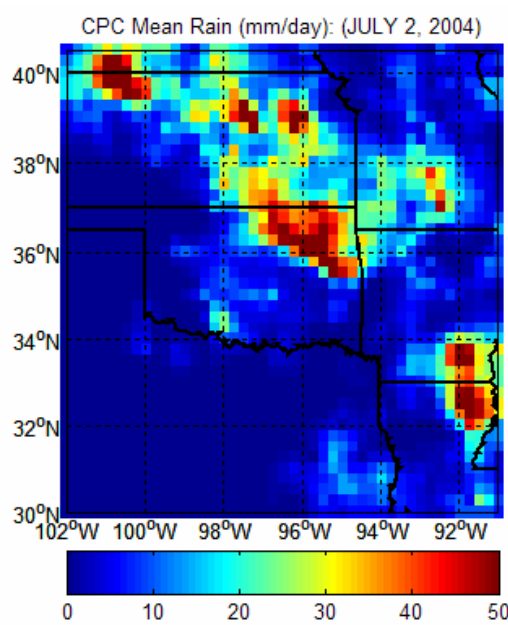
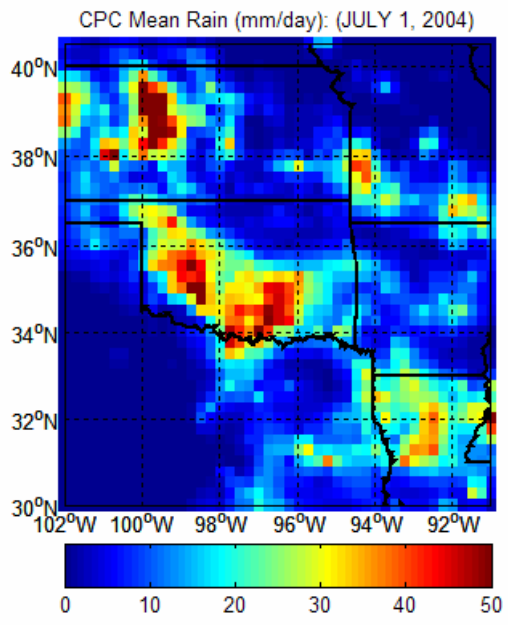
AMSR-E Mean Soil Moisture (g/cm3): 2004 5 A/D



March

April

May

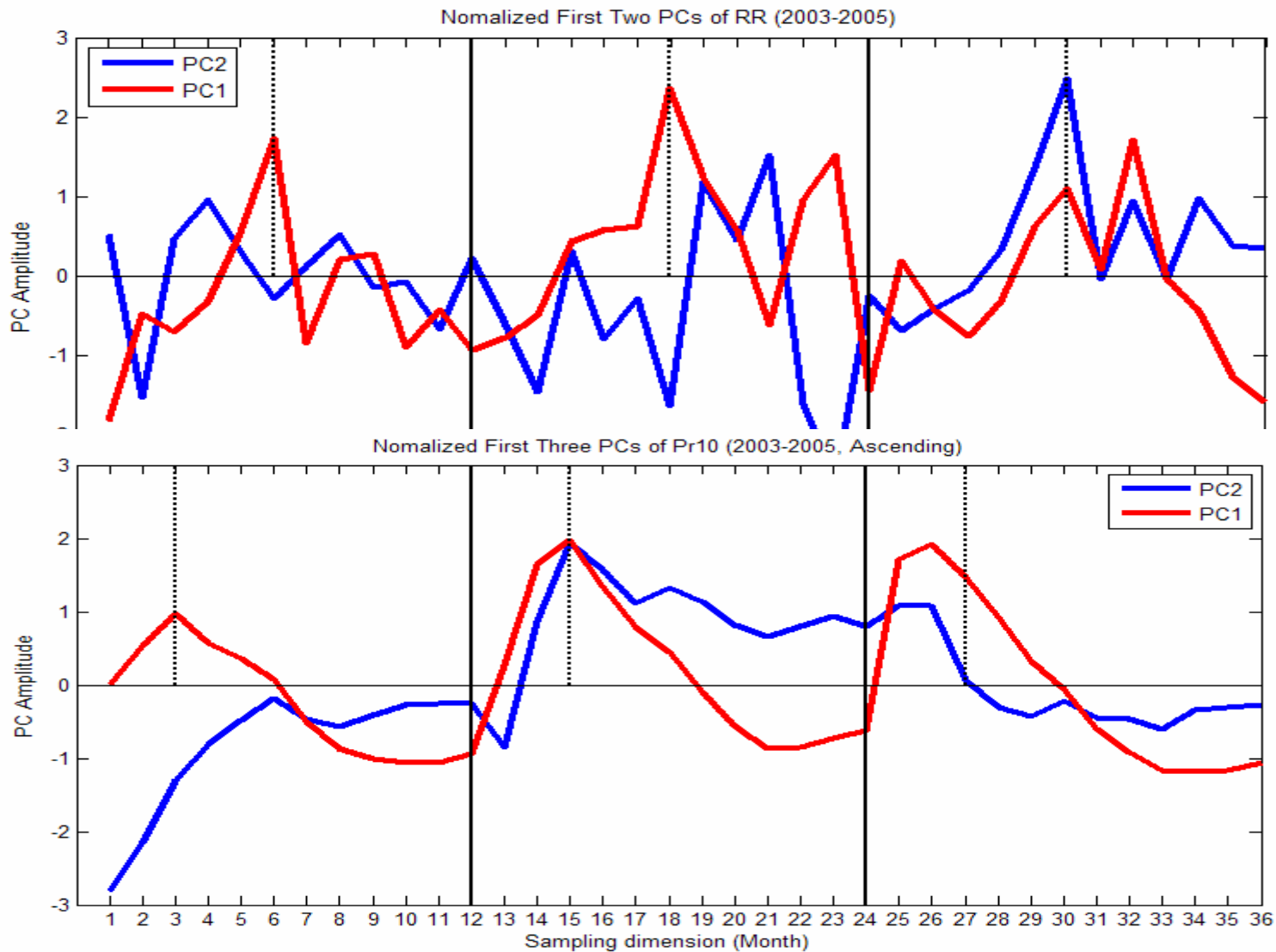


**JULY1**

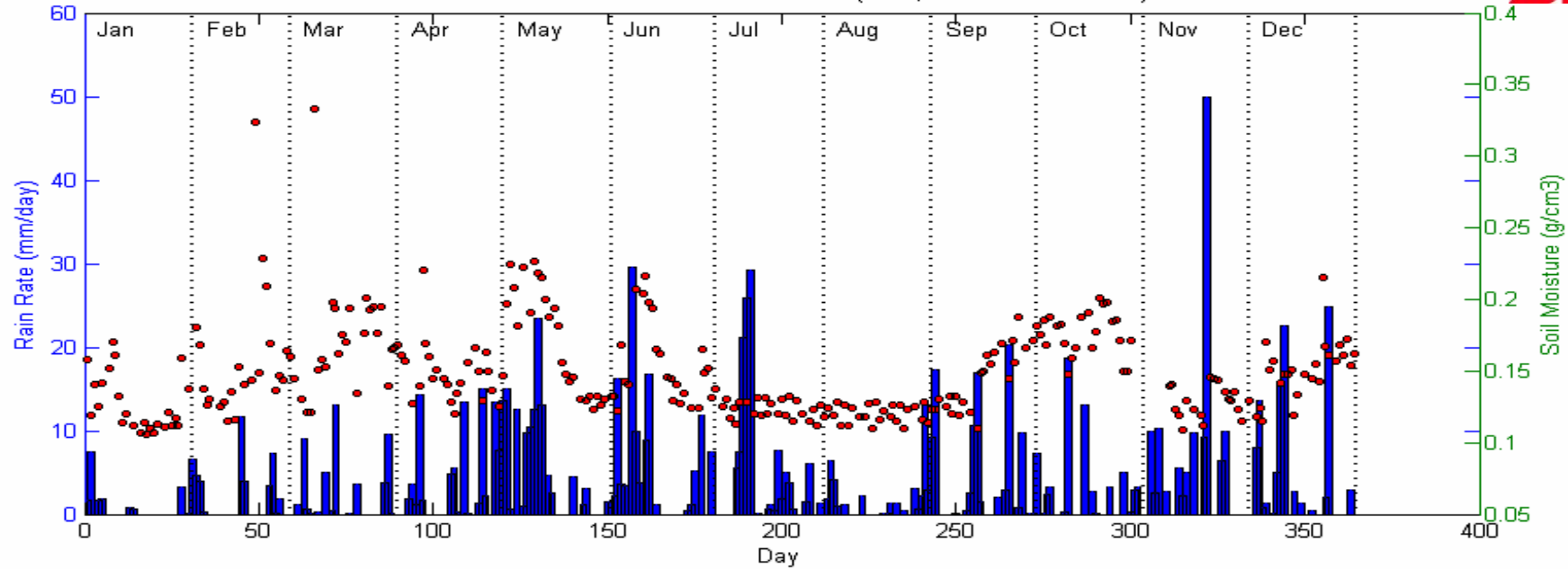
**JULY2**

**JULY3**

# PC Analysis



Time Series: GPCP RR vs. Soil Moisture (2003, IOWA: 41.0N91.0W)



Time Series: GPCP RR vs. Soil Moisture (2003, TEXAS: 33.0N101.0W)

