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

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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: $T_{b24v}-T_{b89v} > 8K$ and $T_{b89v} < 270K$
Sensitivity to Vegetation

Time Series of Level3 Soil Moisture: July 2004, IOWA (41.25N/91.11W)

Time Series of Level3 Soil Moisture: July 2004, TEXAS (33.39N/101.52W)
Physical Tools

• **Soil Moisture Algorithm**
  (Njoku et al., 2003; Njoku and Chan, 2006)

  \[ SM = 5.0 + 2.0wbar + 150.0 \times (Pr10 - Pr10_{\text{min}}) \times \exp(0.3wbar) \]
  \[ wbar = -3.5845 - 1.6605 \times \ln(Pr10_{\text{min}}) \]
  Where, \( Pr10 = \frac{(Tb10v - Tb10h)}{(Tb10v + Tb10h)} \)

• **Land Rainfall Algorithm**
  (McCollum and Ferraro, 2003)

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

  \[ SI = a - b \times Tb19 - c \times Tb22 + d \times (Tb22)^2 - Tb85 \]
Swath-basis analysis

AMSR-E Level 2 Rain Rate (mm/h) (July 2, 2004: 0753Z)

AMSR-E Soil Moisture (g/cm3) (July 2, 2004: 0753Z)
EOF Comparison

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

AMSR-E SM EOF1 (53% Var, 2004)
1DAY (July 1)  

3DAYS (July 1-3)  

5DAYS (July 1-5)
Daily Time Series Analysis

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

Normalized First Two PCs of RR (2003-2005)

Normalized First Three PCs of Pr10 (2003-2005, Ascending)