

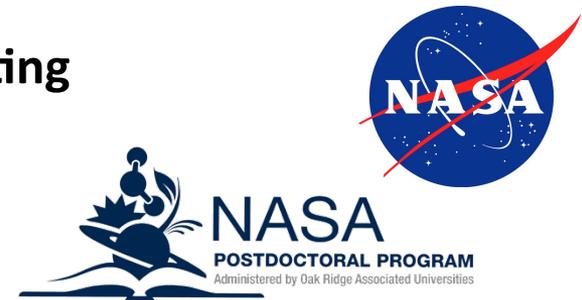
Satellite remote sensing observations of land-atmosphere interactions for monitoring and understanding drought mechanisms

Joshua K. Roundy and Joseph A. Santanello

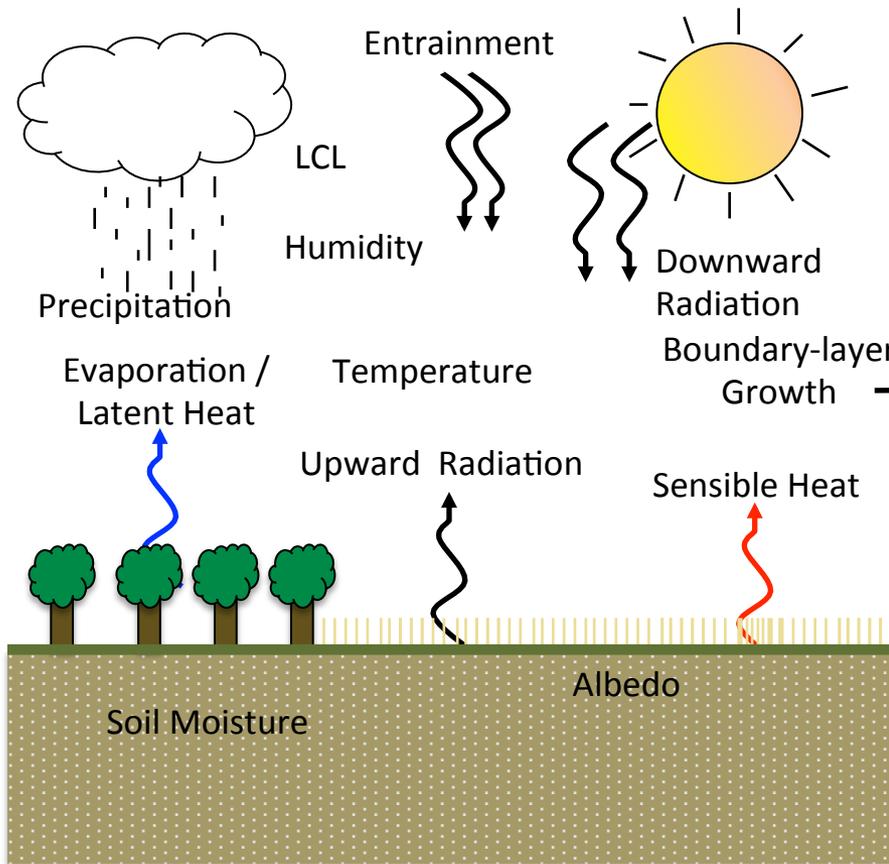


NASA Sounder Science Team Meeting

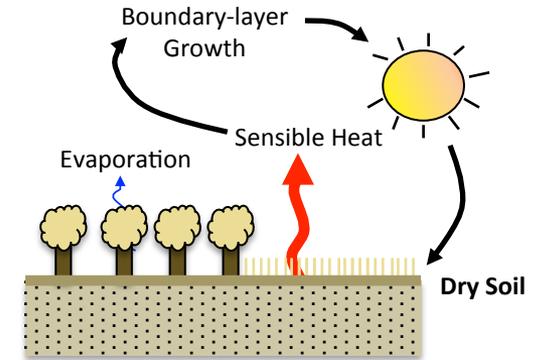
Tuesday October 13, 2015



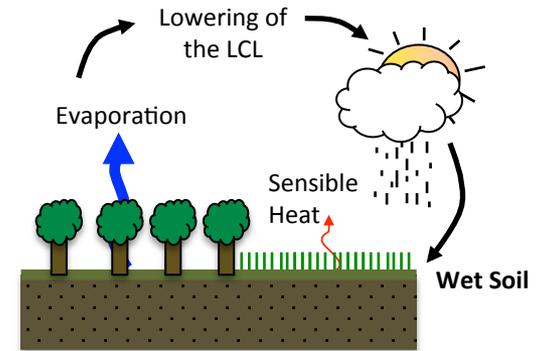
Persistent regimes influenced by land-atmosphere feedbacks impact drought



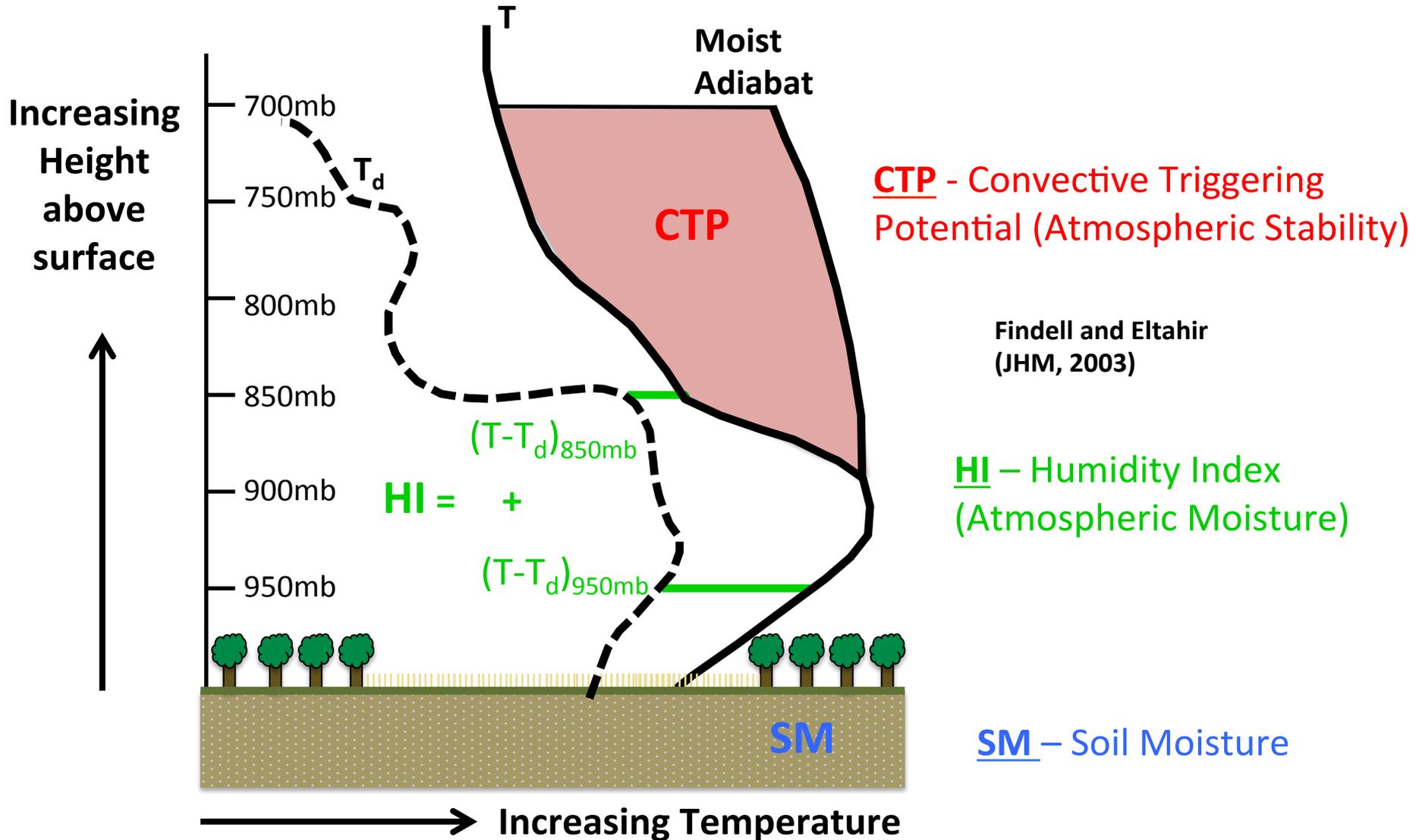
Drought Intensification Regime



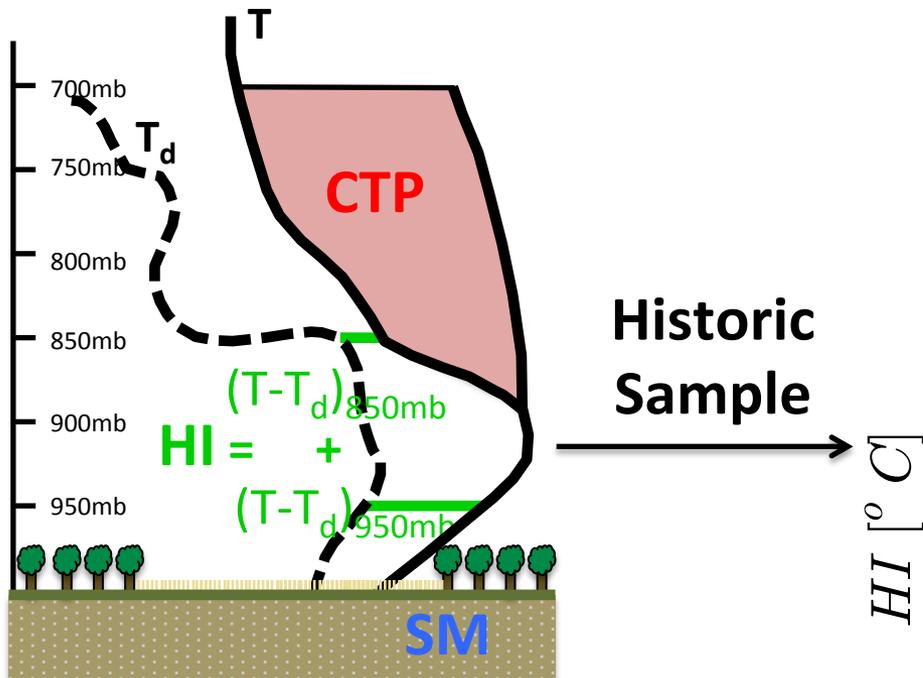
Drought Recovery Regime



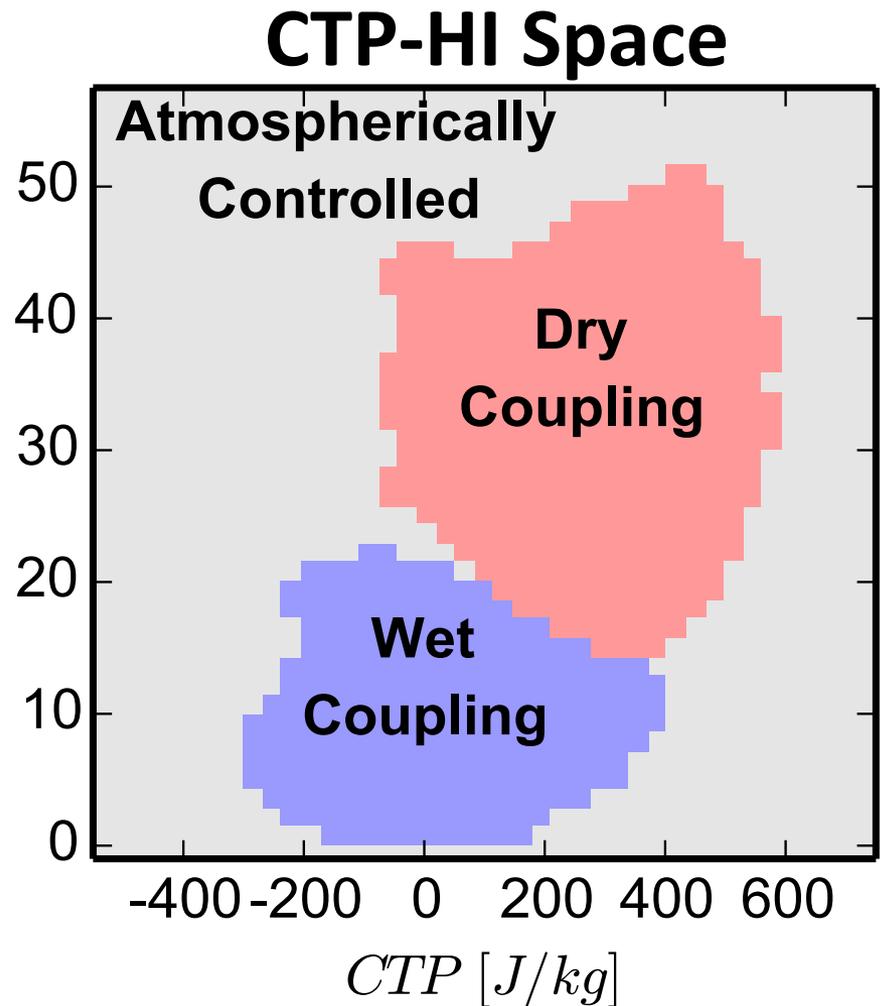
Three summary metrics of the land-atmosphere system are used to identify these regimes



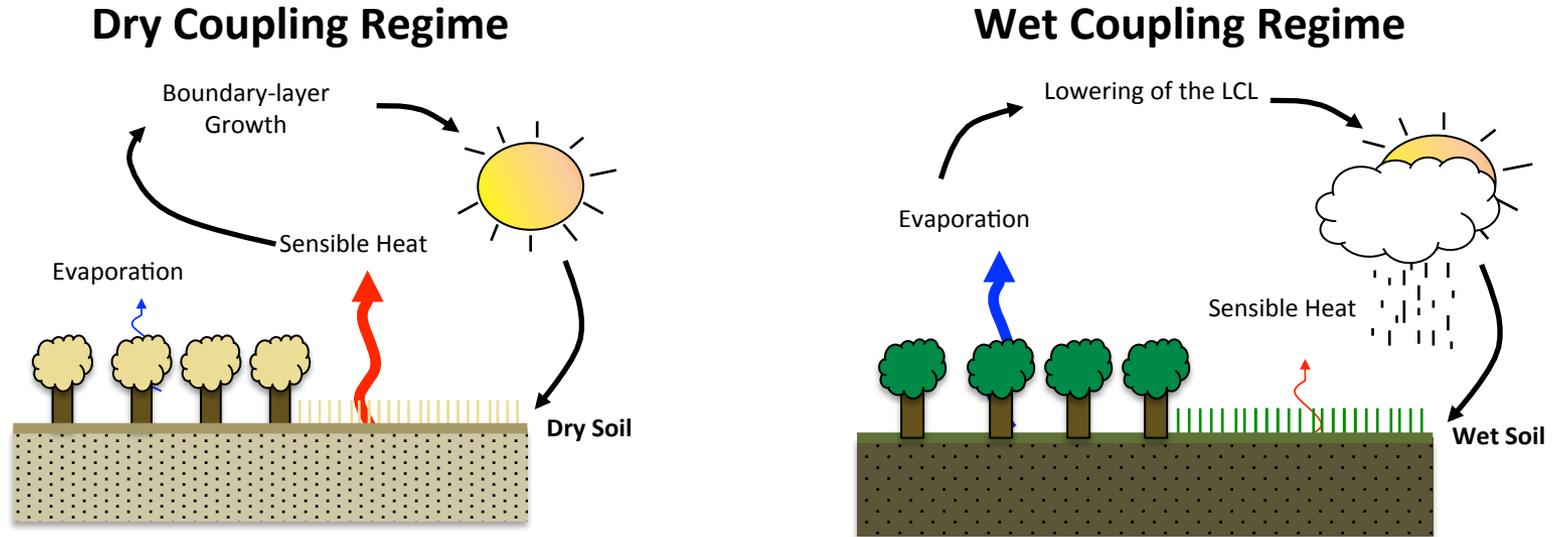
Regimes are based on classifying the CTP-HI space using SM



Once the CTP-HI space is classified, only CTP-HI is needed for daily classification



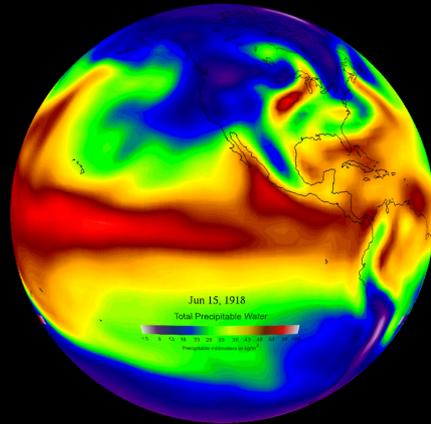
The impact of persistent coupling regimes can be quantified by the CDI



Coupling Drought Index (CDI) =
$$\frac{\text{Dry}_{\text{Coupling}} - \text{Wet}_{\text{Coupling}}}{\text{Total}_{\text{Days}}}$$

Roundy et al. (JHM, 2013)

Most of the analysis of CDI has focused on reanalysis and modeling data



- **Reanalysis:** Assimilates observations with models
 - Continuous earth system variables
 - 1979-Present
 - MERRA - NASA GMAO
 - CFSR – NOAA NCEP
 - CFSRR – NOAA NCEP Seasonal Forecasts
 - (Roundy et al. 2013, 2014, 2015)

Satellite Remote sensing provides all the need variables for the CDI



- **NASA EOS AQUA Satellite:**

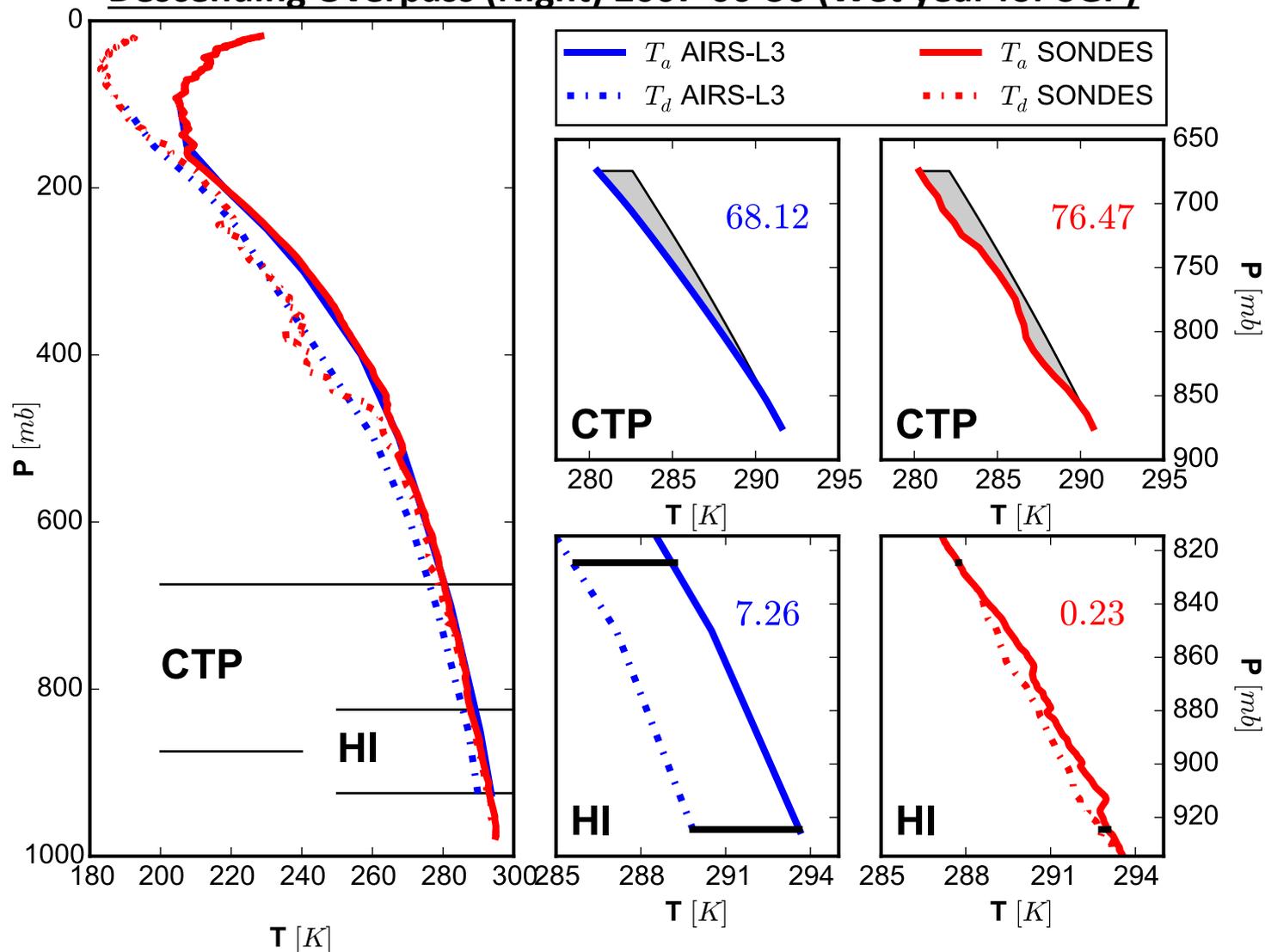
- Atmospheric Infrared Sounder (AIRS) V6 -L3
 - Atmospheric T, Q (12 levels)
 - **Provides CTP, HI**
 - 2003 - Present
 - Advanced Microwave Scanning Radiometer-Earth (AMSR-E)
 - **Provides Soil Moisture**
 - 2003-2011

How does the CTP-HI from satellite compare to radiosondes and reanalysis?

How does the CDI from satellite compare to reanalysis?

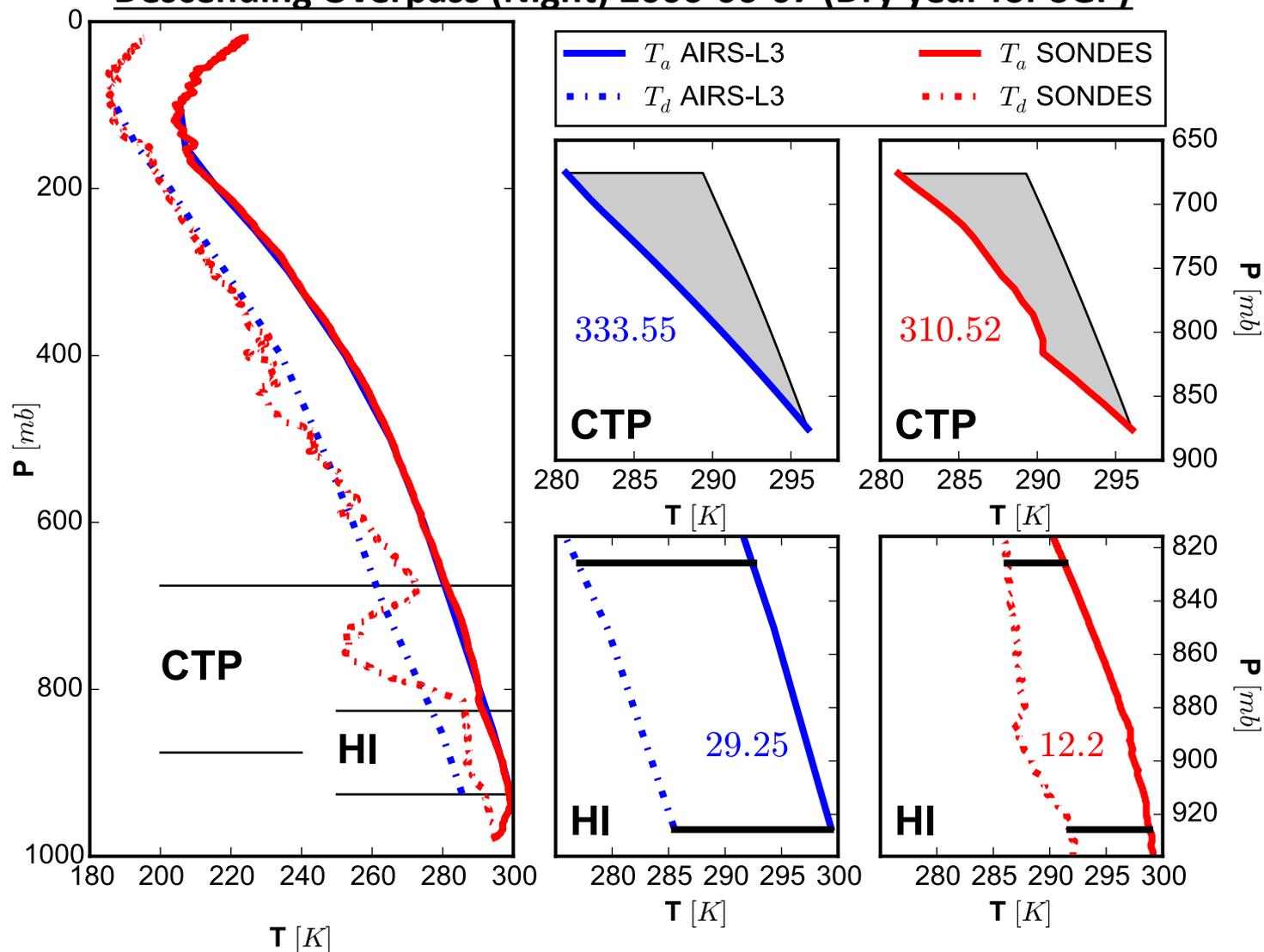
Comparison of AIRS CTP-HI with Sondes at the Southern Great Plains ARM site

Descending Overpass (Night) 2007-06-30 (Wet year for SGP)



Comparison of AIRS CTP-HI with Sondes at the Southern Great Plains ARM site

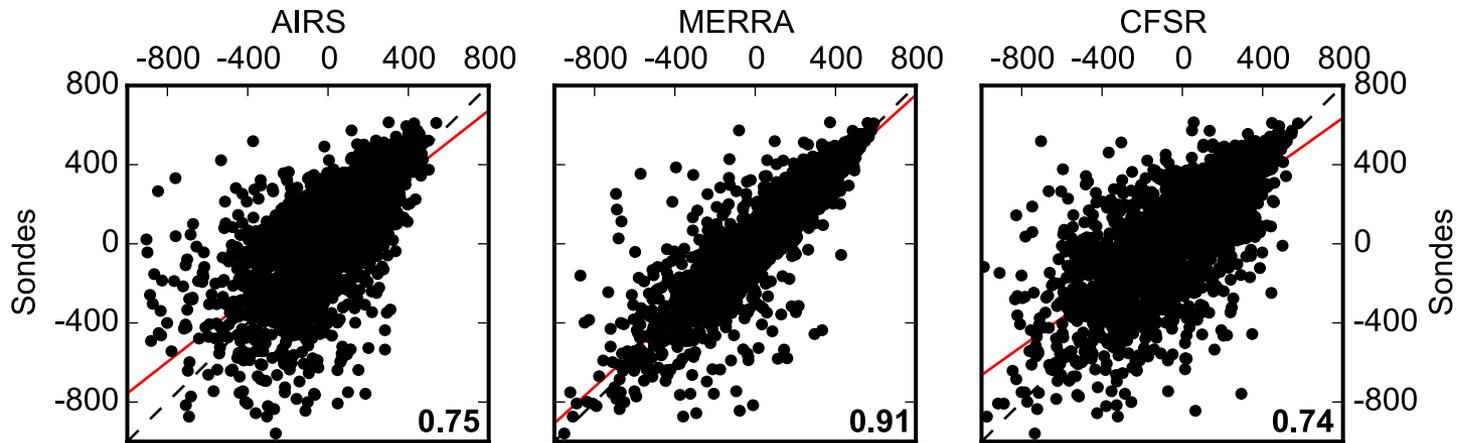
Descending Overpass (Night) 2006-06-07 (Dry year for SGP)



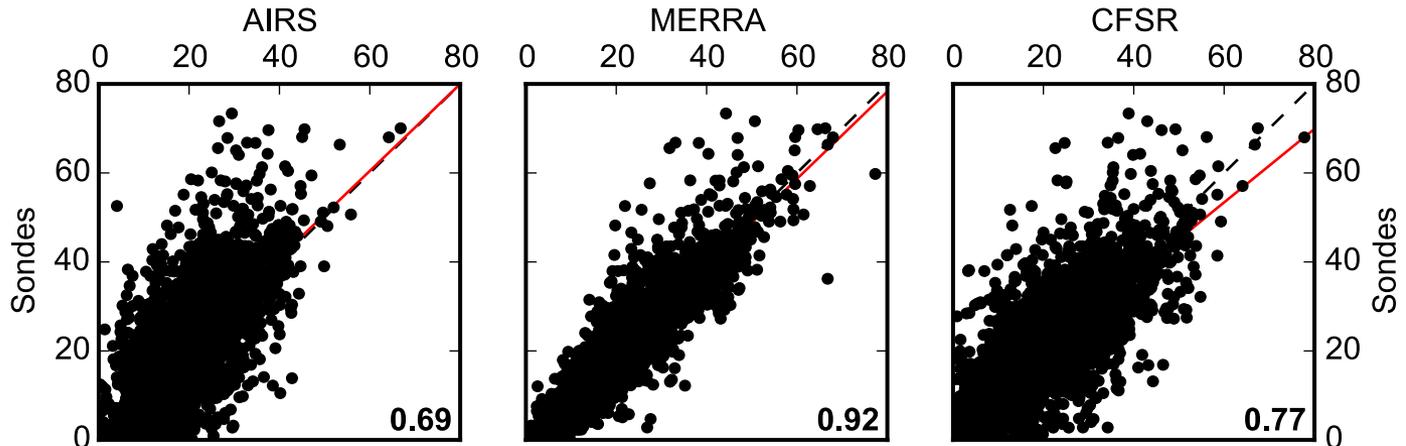
Comparison of Sondes CTP and HI with AIRS, MERRA and CFSR

Descending Overpass (Night) 2003-2013 (SGP)

CTP



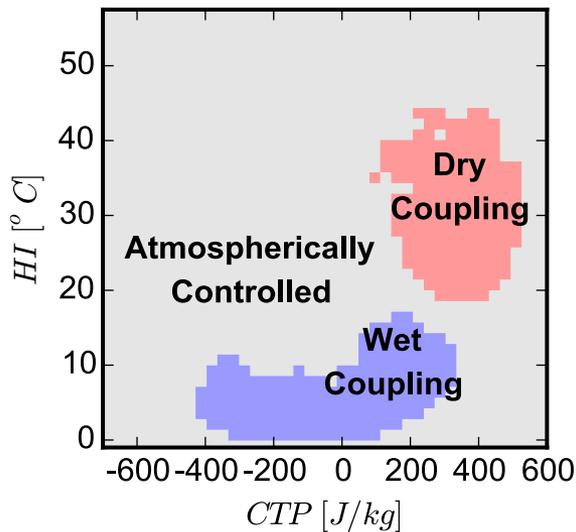
HI



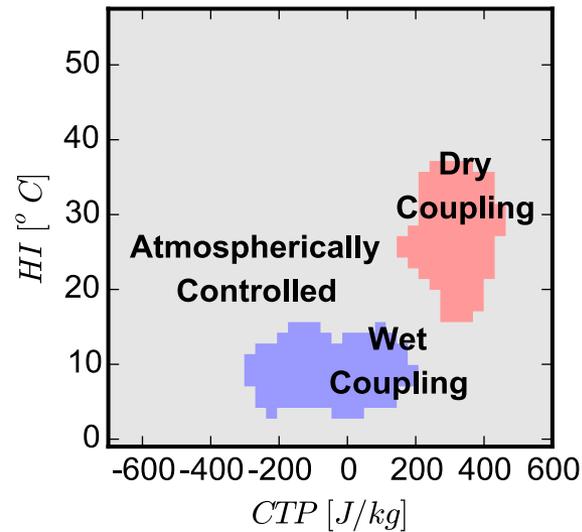
Comparison of CTP-HI classification from AIRS-AMSR-E, MERRA and CFSR

2003-2011 (SGP) Classification

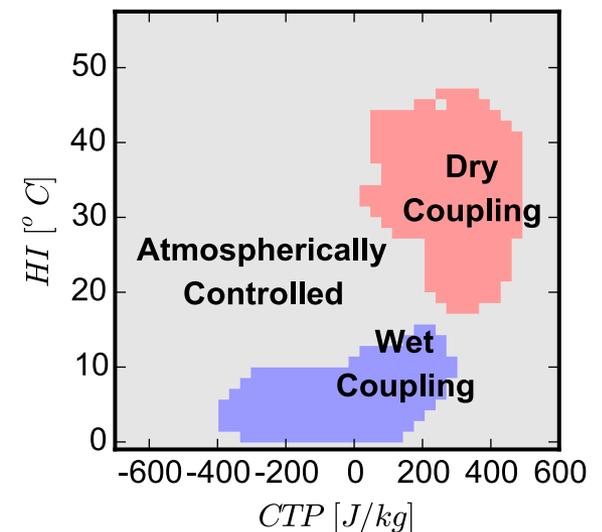
MERRA



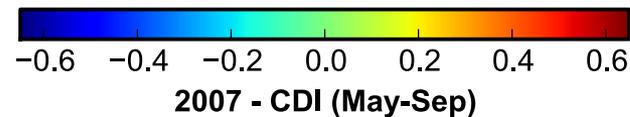
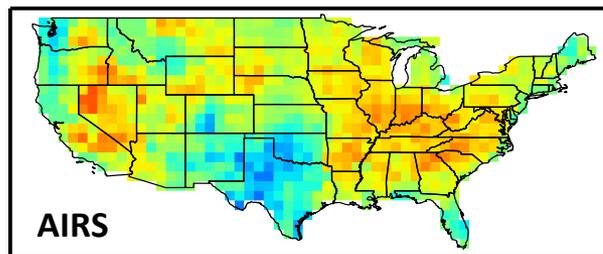
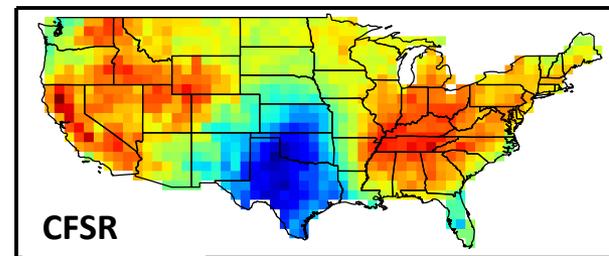
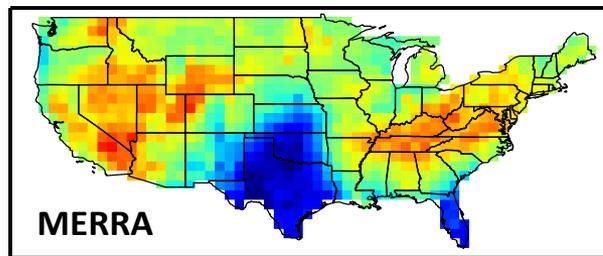
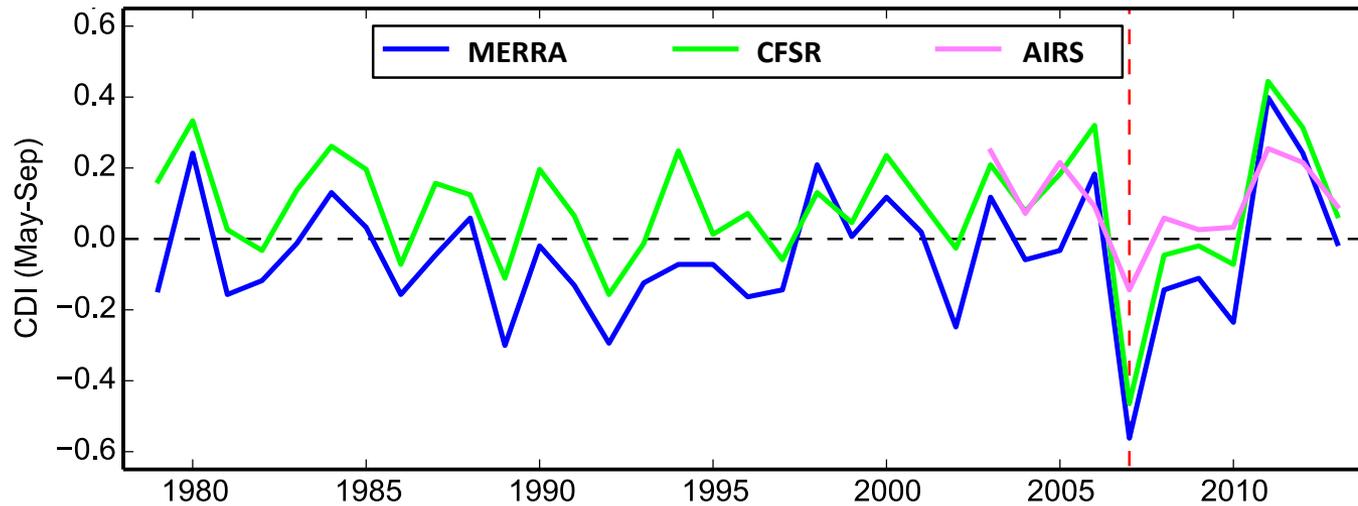
AIRS-AMSR-E



CFSR

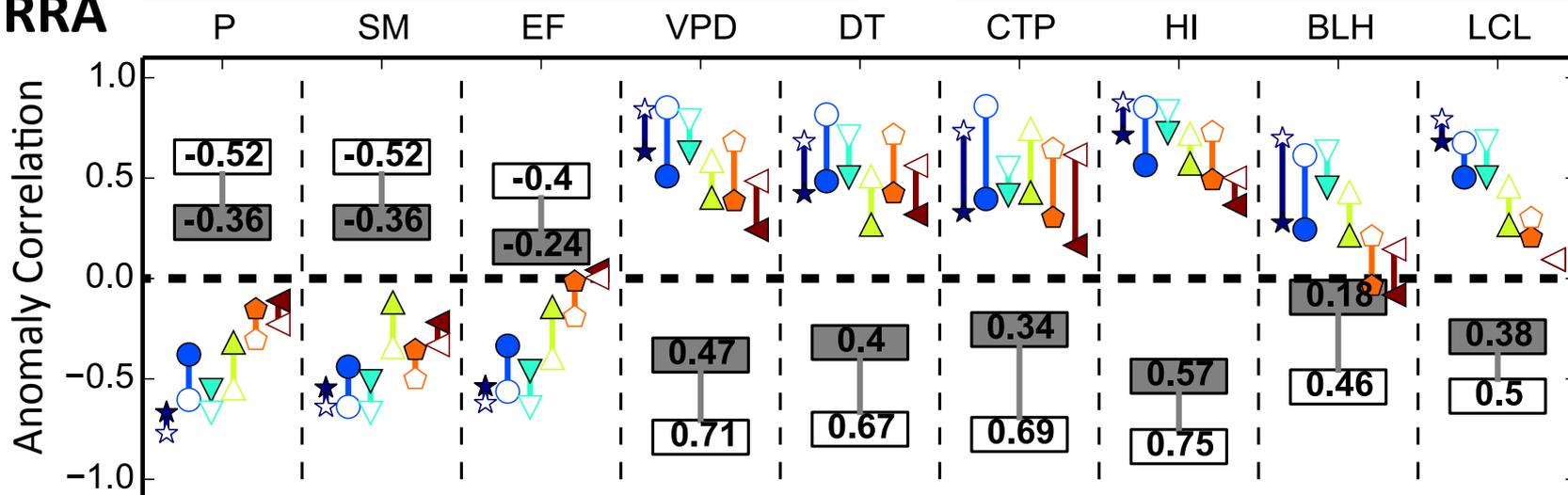
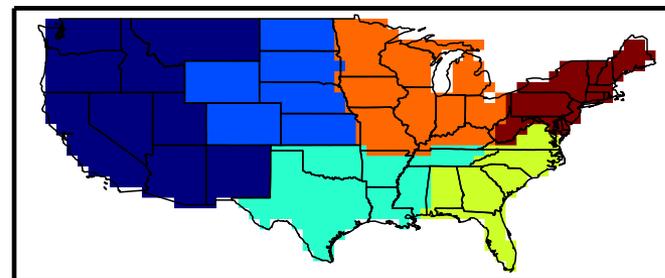
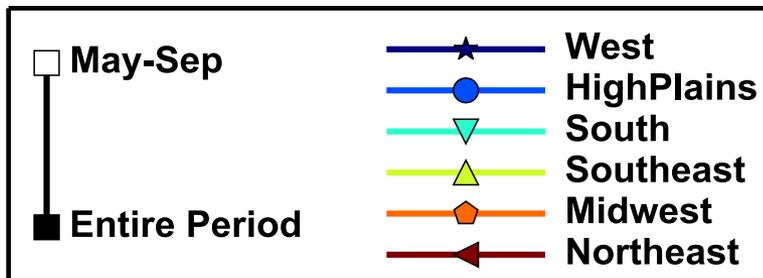


Comparison of CDI from AIRS-AMSR-E, MERRA and CFSR

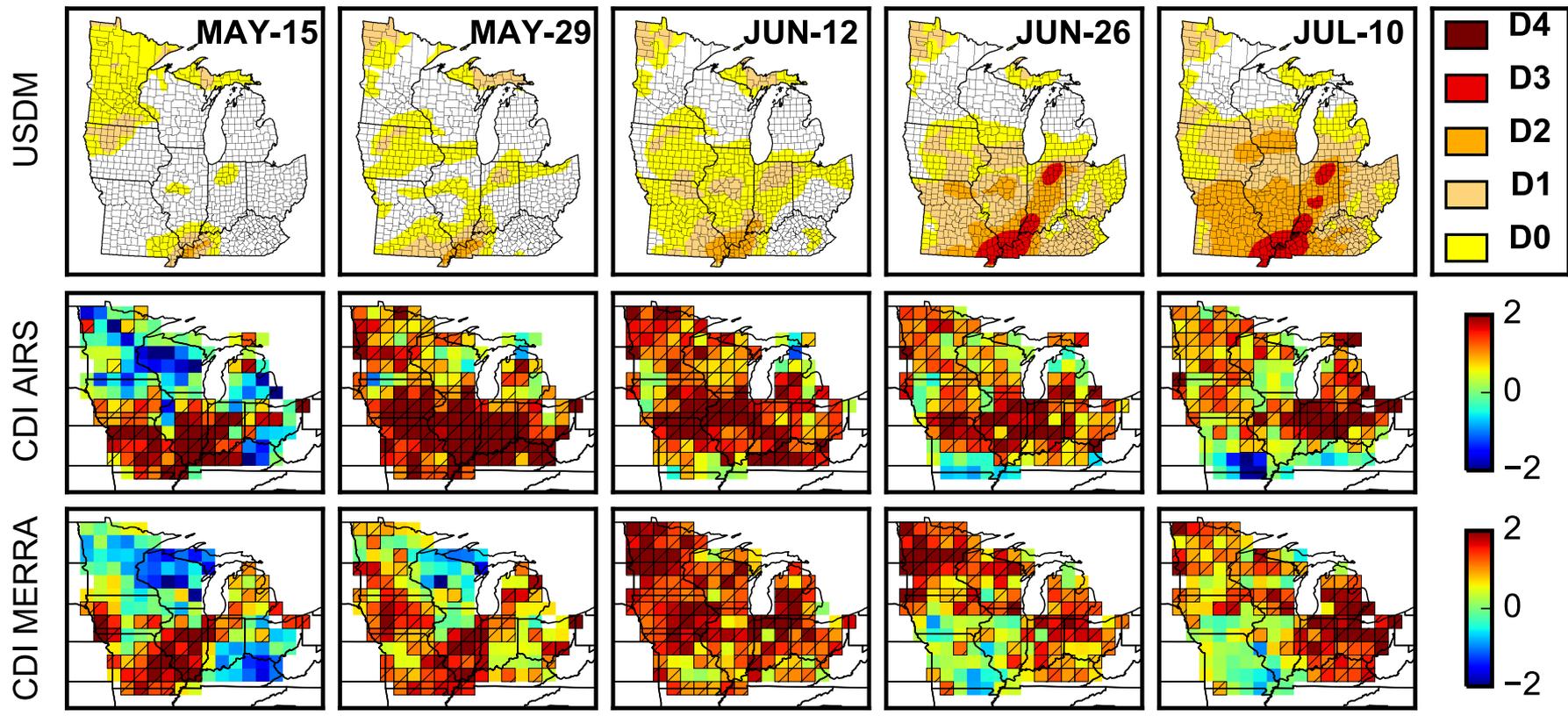


Comparison of AIRS CDI to other reanalysis variables

AIRS CDI
with
MERRA



The AIRS CDI provides an early warning of the Midwest 2012 drought



The CDI provides an early warning of drought development, but lacks the persistence of the USDM

Summary and Conclusions:



- The AIRS profiles capture the main changes in the observations but miss the details.
- There are biases in the CTP and HI from AIRS, but the classification methodology accounts for these biases.
- The CDI from AIRS shows good consistency with reanalysis, but has smaller magnitudes in space and time.
 - This is partially due to missing data
- The CDI from AIRS provided early warning of the 2012 Midwest drought, but lacks the persistence of the USDM.