



# AIRS Drought Application

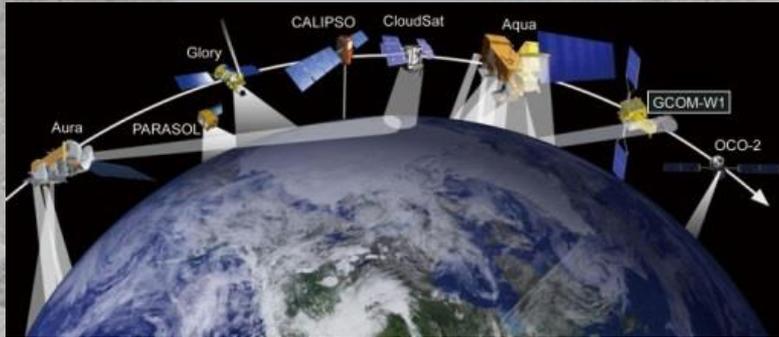
Stephanie Granger

Ali Behrangi

Alireza Farahmand

Steve Licata

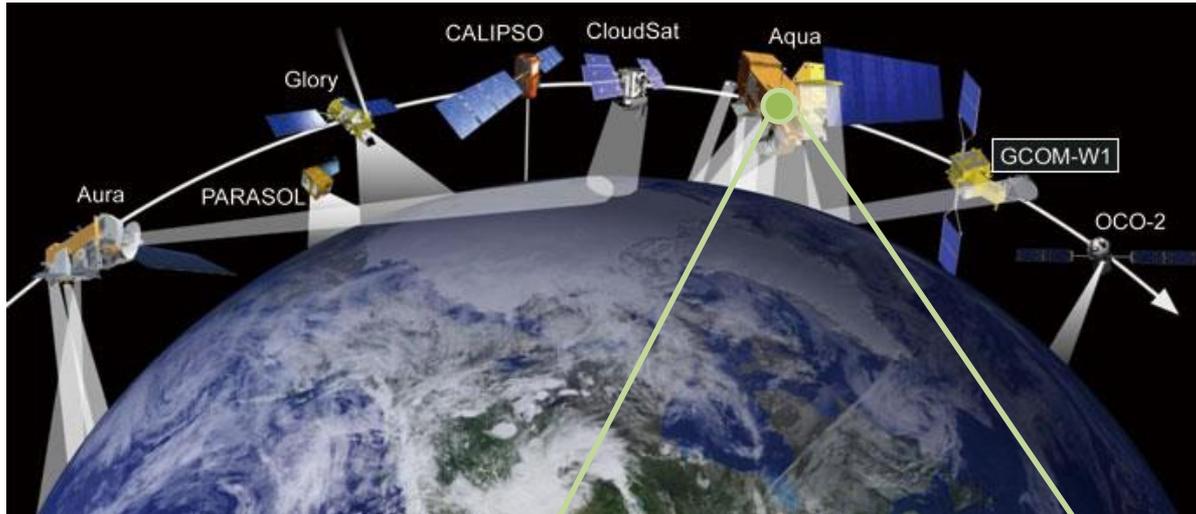
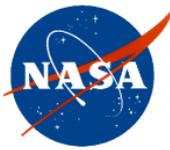
NASA Jet Propulsion Laboratory,  
California Institute of Technology



10th Biennial US Drought Monitor Forum  
Rapid City, South Dakota  
April 3 – 5, 2017

# Atmospheric Infrared Sounder (AIRS)

Aboard the NASA Aqua Spacecraft



**NASA Aqua Spacecraft**  
Launched May 4, 2002  
Equatorial crossing time  
**1:30/13:30**

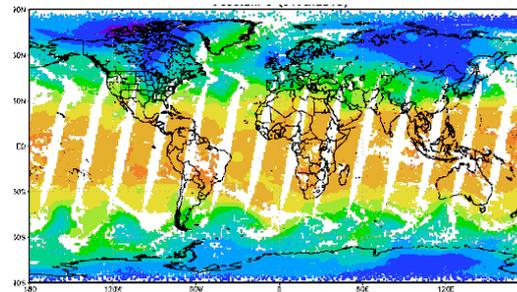
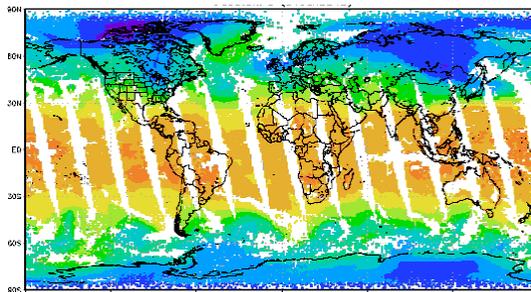
**AIRS Temperature and humidity products are at ~45km resolution.**



## Mission Objectives

1. Improve Weather Forecast
2. Reduce Climate Uncertainty
3. Observe Greenhouse Gases
4. Technology Risk Reduction

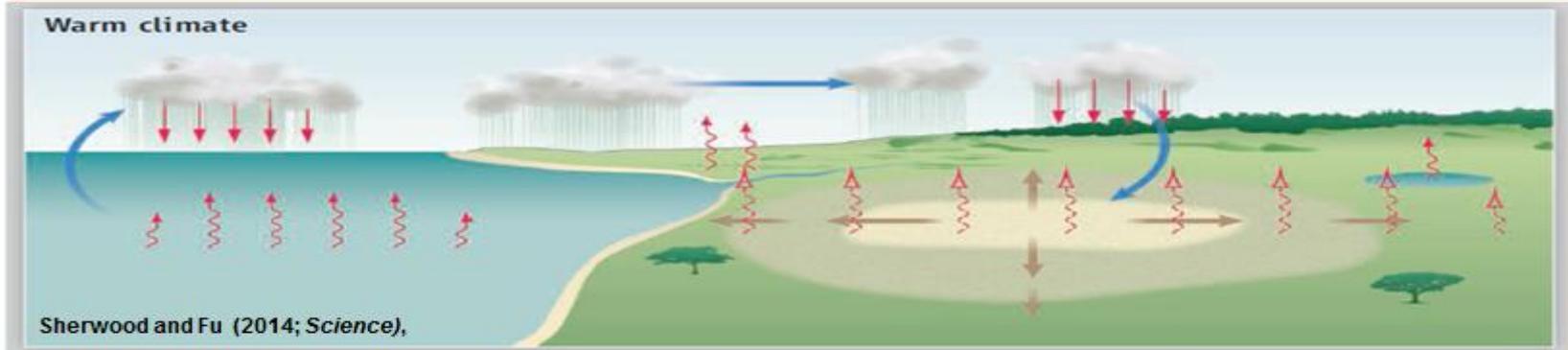
Ascending/descending



# Motivation

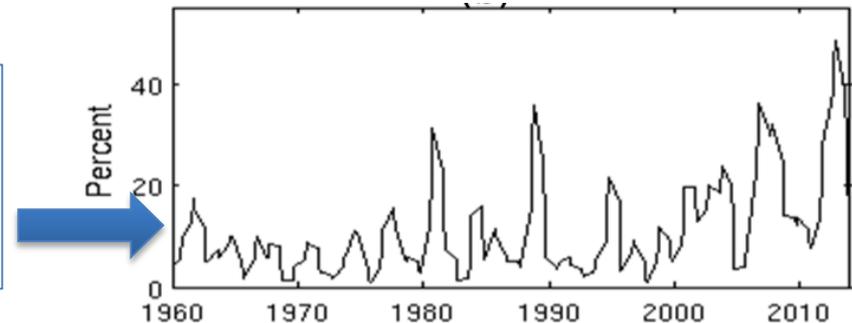


The key factor in drying over land is that land surfaces (and the air just above them) warm, on average, about 50% more than ocean surfaces (M. M. Joshi *et al.* 2008).



VPD is an absolute measure of the moisture deficit of the atmosphere and is expected to increase in a warming climate.

Time series of percent area of CONUS in which 3-month standardized VPD is more than 1.25 standard deviation above normal.



# Evaluation of AIRS product

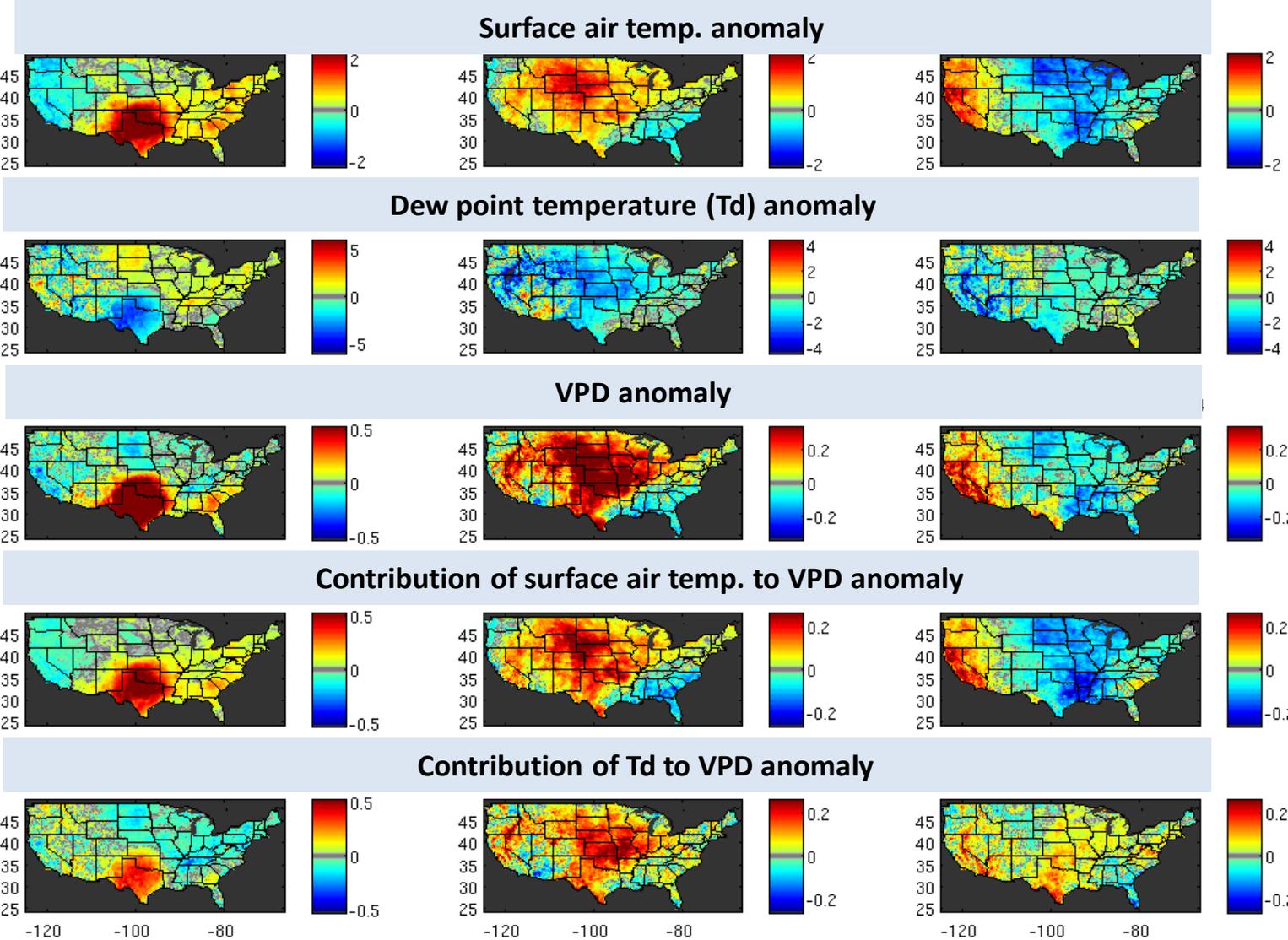


## PRISM (2003-2013)

2011 Texas

2012 US Midwest

2014 California



# Evaluation of AIRS product



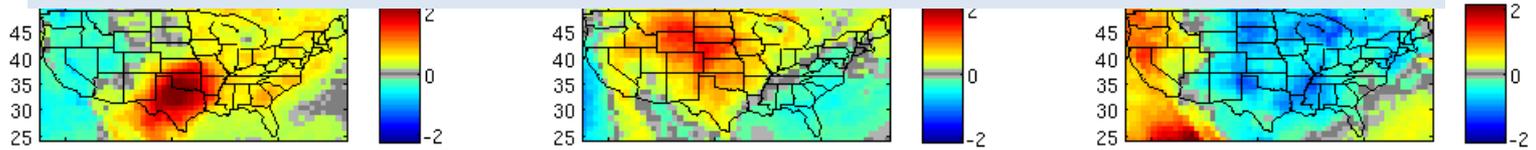
## AIRS (2003-2013)

2011 Texas

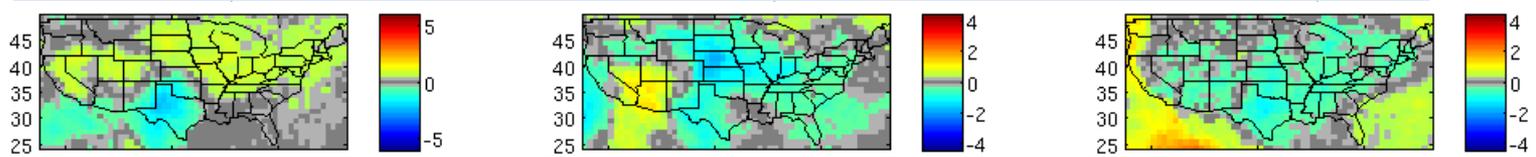
2012 US Midwest

2014 California

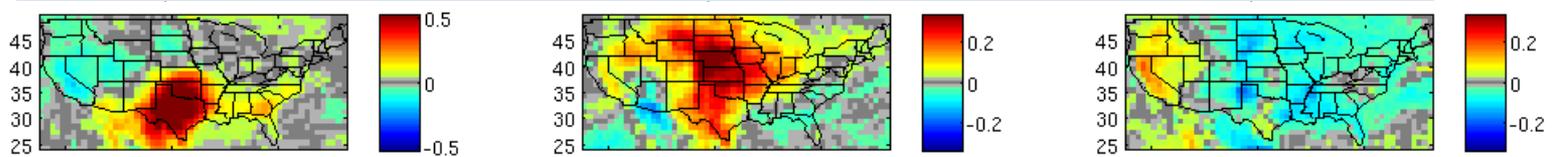
### Surface air temp. anomaly



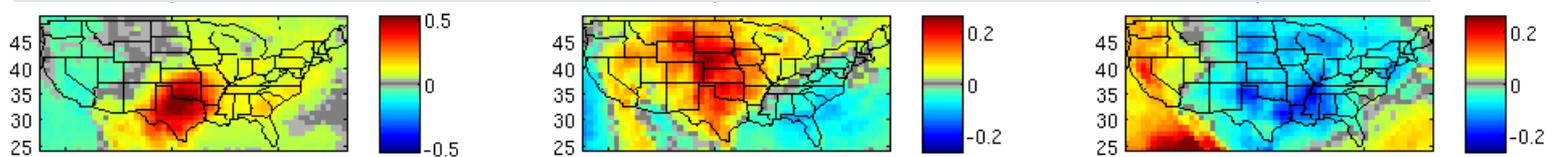
### Dew point Temperature (Td) anomaly



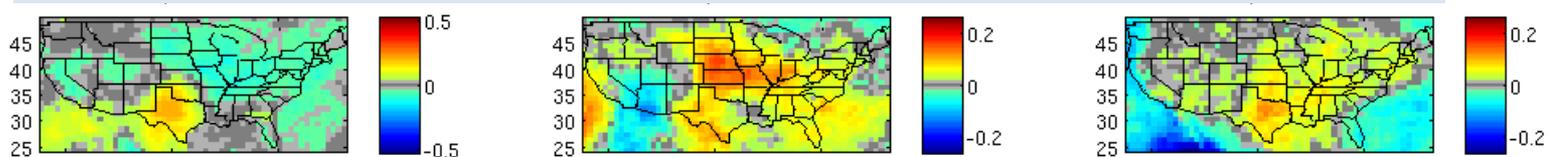
### VPD anomaly



### Contribution of surface air temp. to VPD anomaly



### Contribution of Td to VPD anomaly



-120 -100 -80

JAS

-120 -100 -80

JAS

-120 -100 -80

AMJ



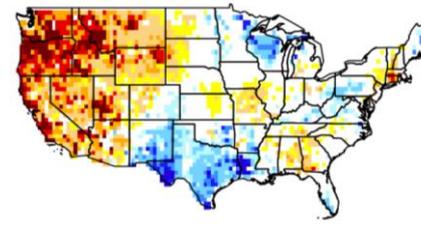
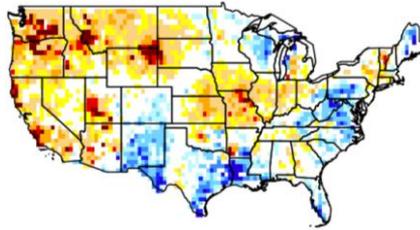
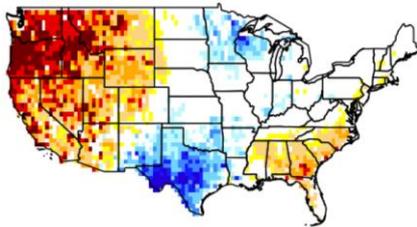
Near-Surface Air Temperature

Near-Surface Relative Humidity

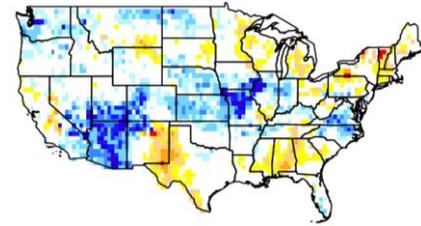
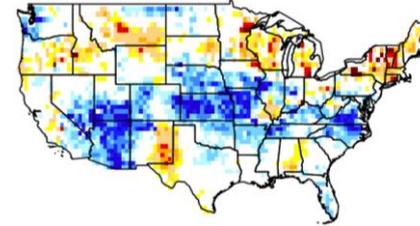
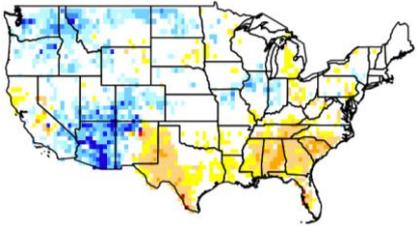
Vapor Pressure Deficit

USDM Drought Categories

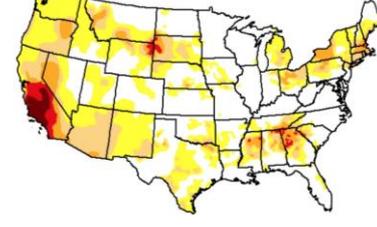
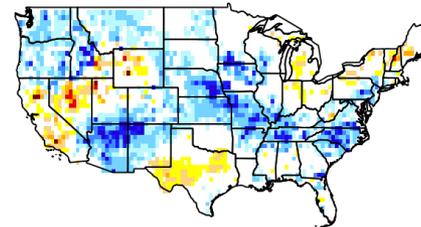
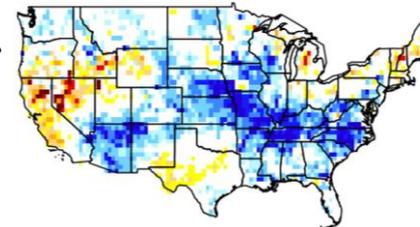
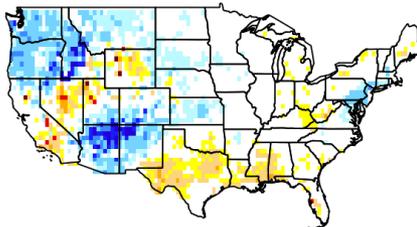
June, 2016  
Week 1



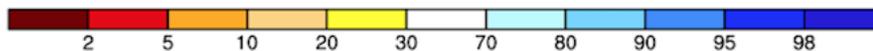
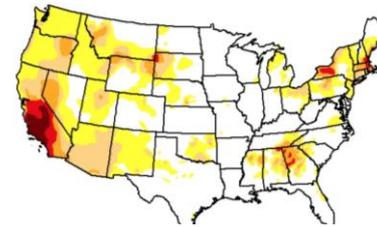
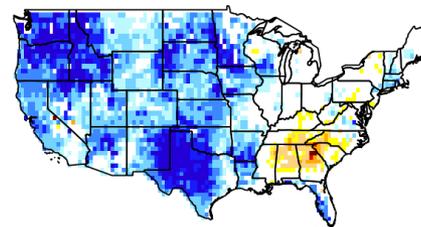
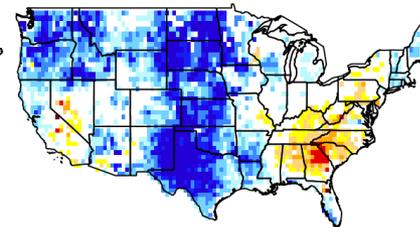
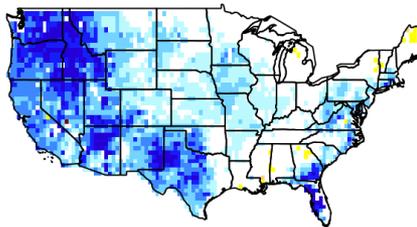
July, 2016  
Week 1



Aug, 2016  
Week 1



Sep, 2016  
Week 1





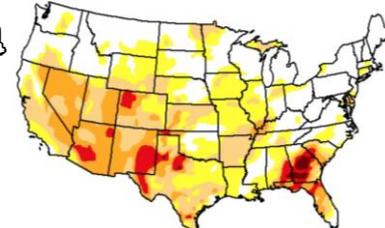
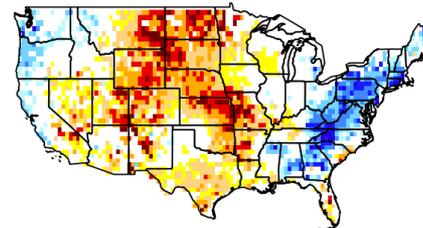
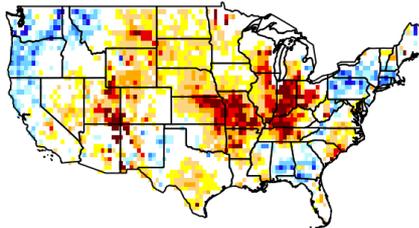
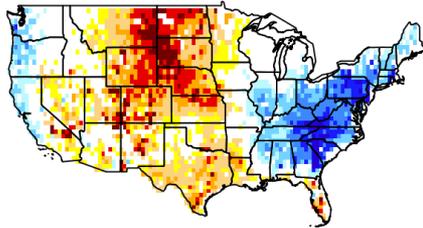
Near-Surface Air Temperature

Near-Surface Relative Humidity

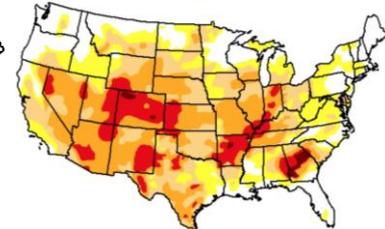
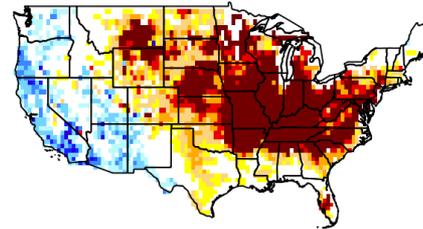
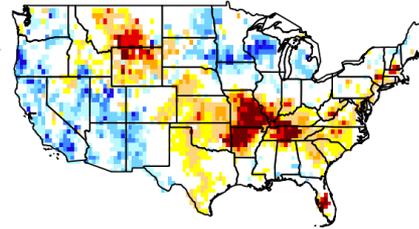
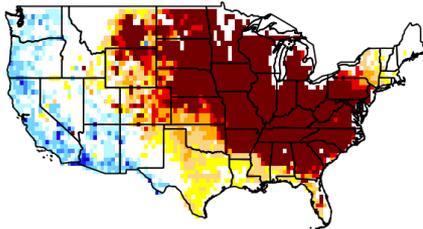
Vapor Pressure Deficit

USDM Drought Categories

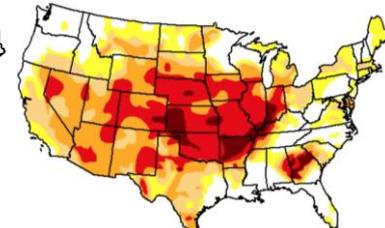
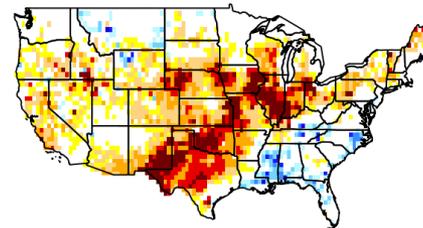
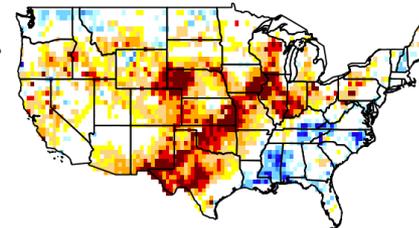
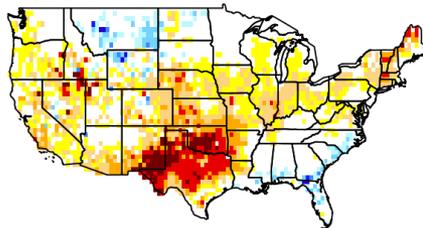
June, 2012  
Week 1



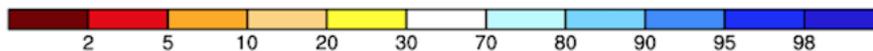
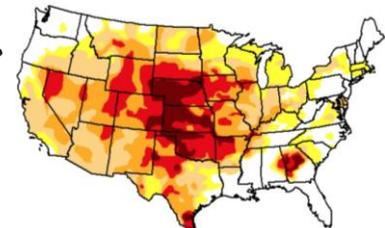
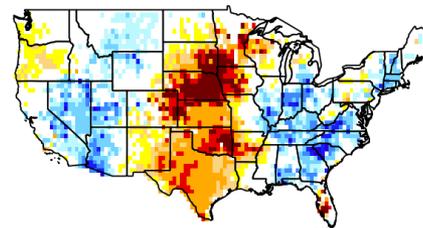
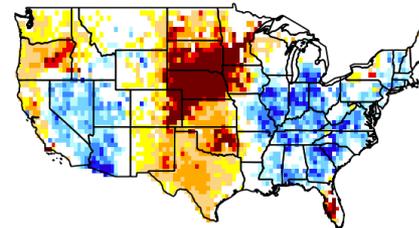
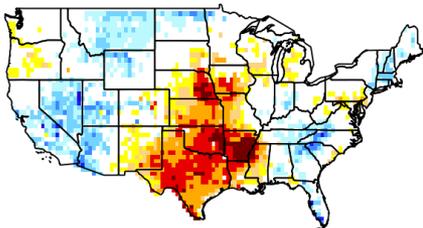
July, 2012  
Week 1



Aug, 2012  
Week 1



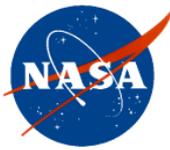
Sep, 2012  
Week 1





# Summary

- AIRS Standardized VPD (SVPD) and T, RH and VPD percentile products show promise for drought detection.
  - Observational-based
  - Global coverage
  - Could be combined with other data for improved drought detection and understanding
- Automating generation of T, RH and VPD as percentiles to be used experimentally by USDM.
- Other potential applications of the AIRS VPD product:
  - Fire
  - Plant stress
  - Agriculture

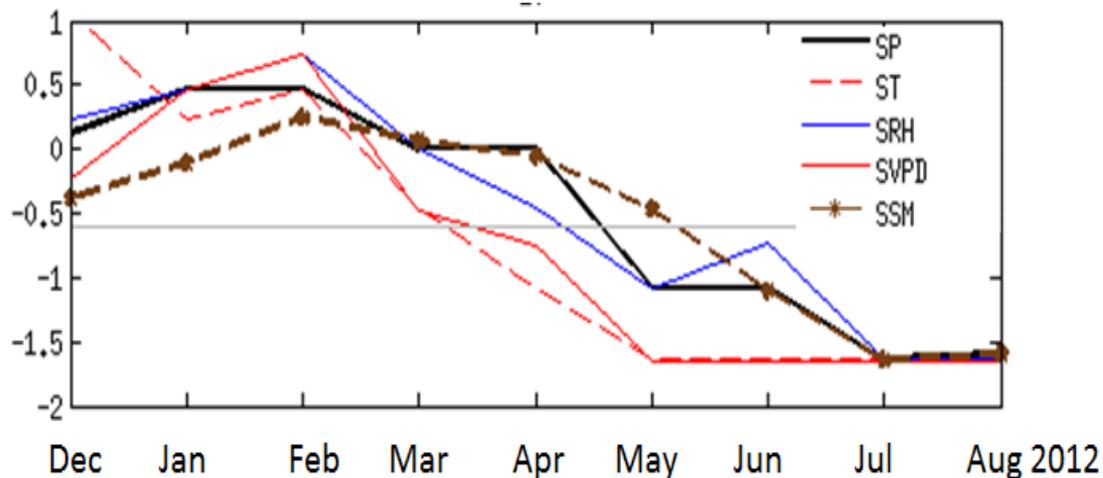


Thank you

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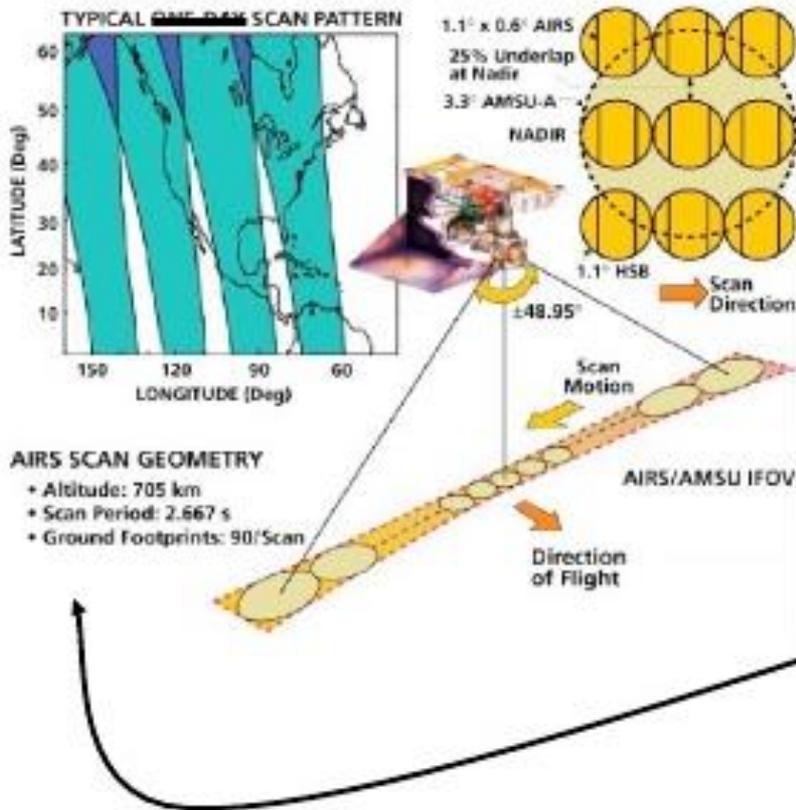
[Ali.Behrangi@jpl.nasa.gov](mailto:Ali.Behrangi@jpl.nasa.gov)

# Early detection of drought onset



Time series of corresponding SP, SRH, SVPD, ST, and SSM for a grid box (latitude 38.5°N, longitude 103.5°W) at the central US during the 2012 drought. SSM is calculated from MERRA and the rest of the indices are calculated from PRISM.

# AIRS Geometry and Sampling



1. AMSU footprint, 45 km across at nadir, contains 9 AIRS spectra

– THIS IS THE RETRIEVAL GRANULARITY.

2. Viewing swath 30 AMSU footprints or ~1650 km wide.

3. The result: 2,916,000 IR spectra and 324,000 microwave spectra & retrievals per day

**AIRS Temperature and humidity products are at ~45km resolution**