AIRS Application for drought and fire:
Current status and future plans

Ali Behrangi
Stephanie Granger
Jet Propulsion Laboratory, California Institute of Technology
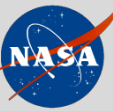
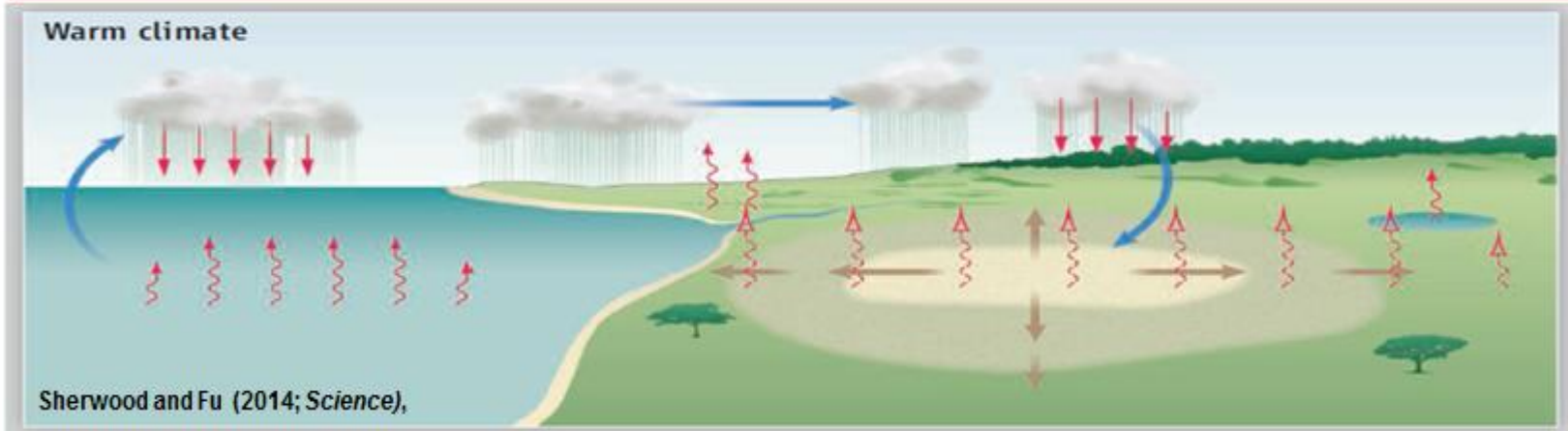*Thanks to:*
**Steve Licata, Yixin Wen, Alireza Farahmand**

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).

Warm climate

Sherwood and Fu (2014; *Science*),

SVPDI>1.5

This suggests that

(VPD= e_s-e) will increase over land

VPD=Vapor pressure deficit

Jet Propulsion Laboratory
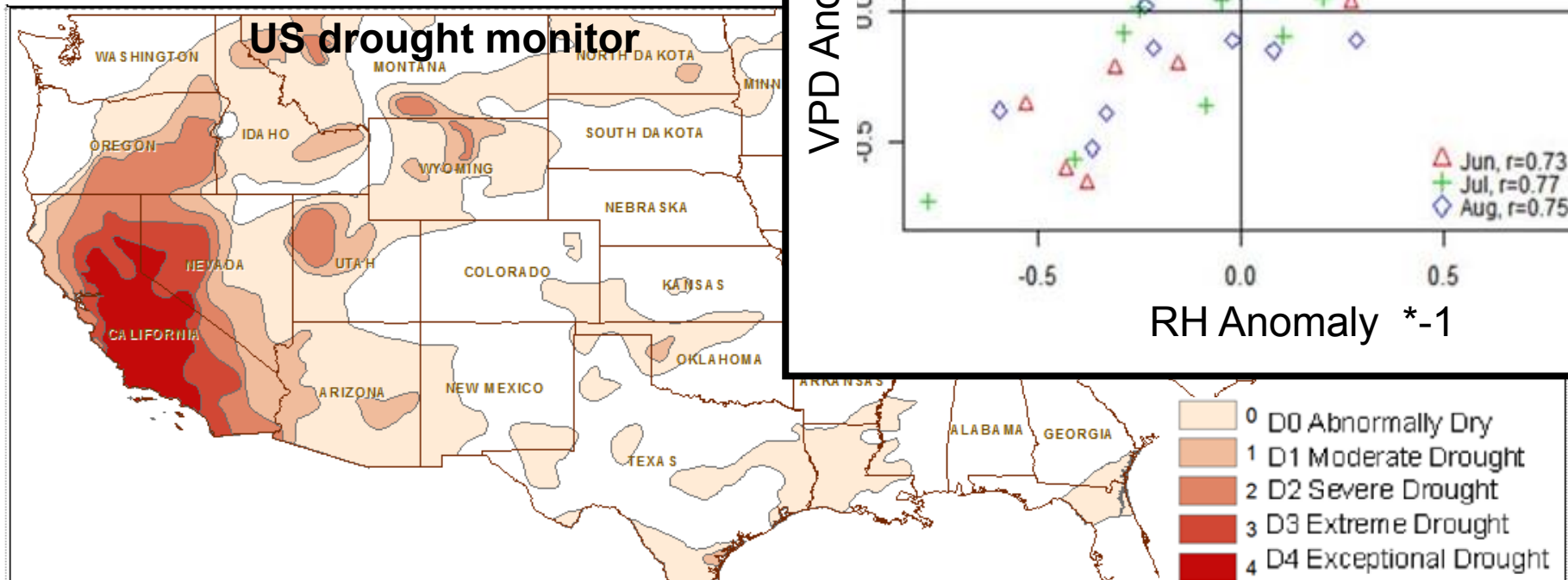California Institute of Technology
Pasadena, California
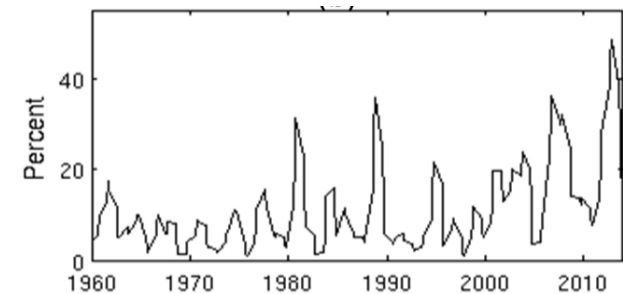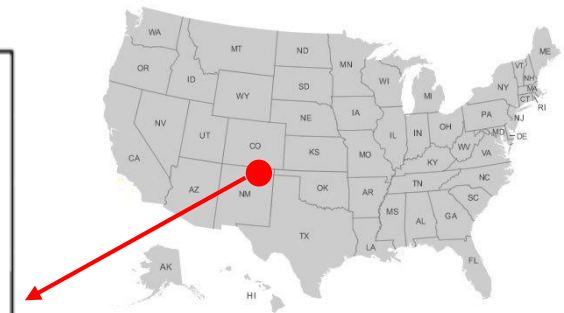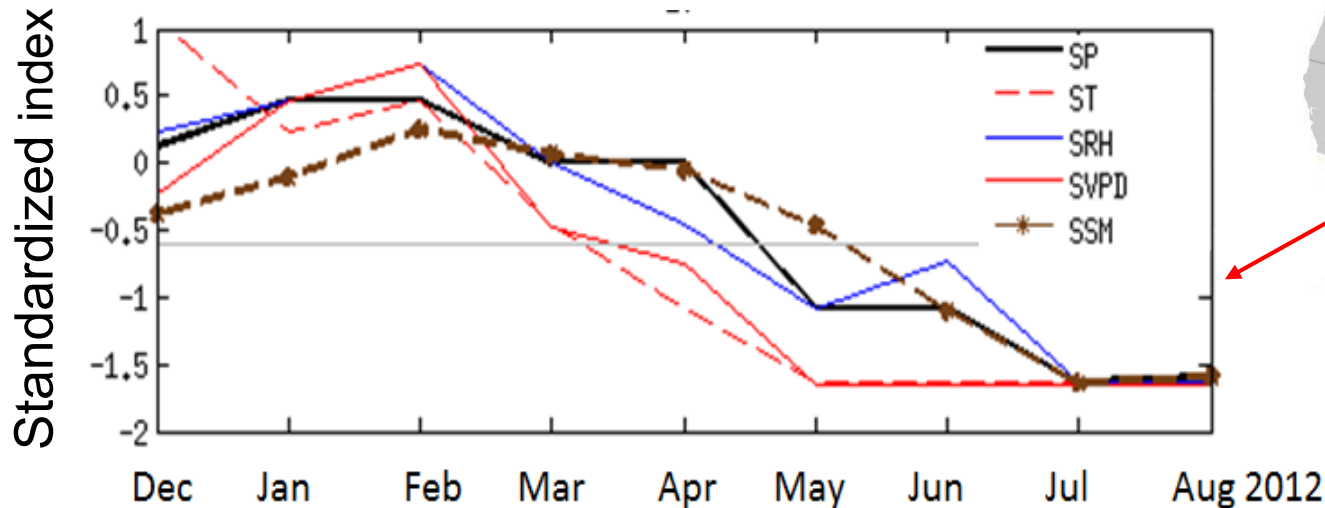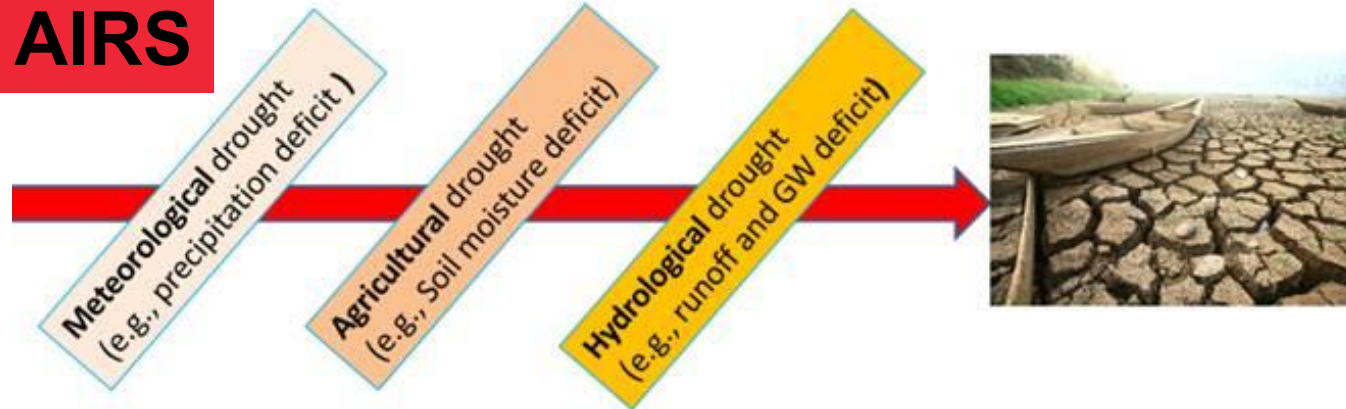
Behrangi et al. (2016)

AIRS and US drought monitor (USDM)

March 2016

VPD Anomaly

RH Anomaly

US drought monitor

0 D0 Abnormally Dry
1 D1 Moderate Drought
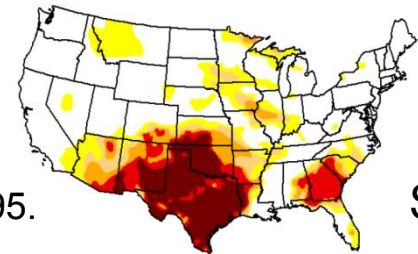2 D2 Severe Drought
3 D3 Extreme Drought
4 D4 Exceptional Drought
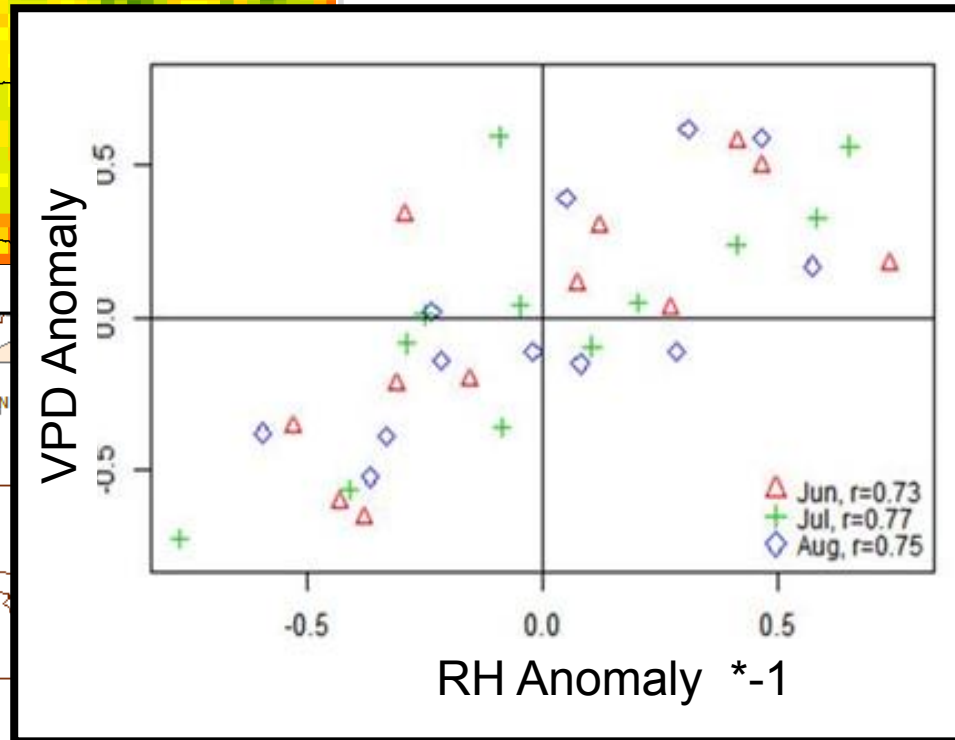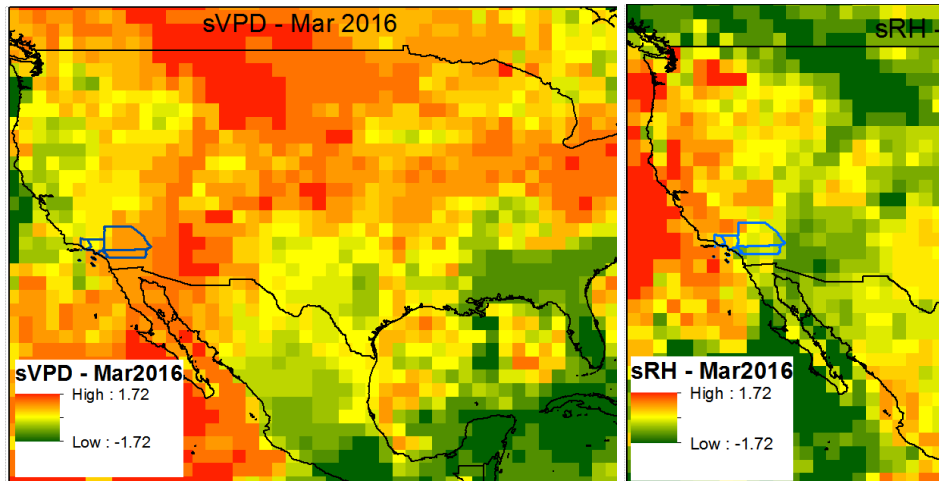
Case study

- **2011 Texas Drought**

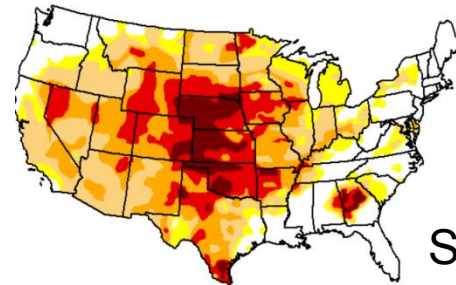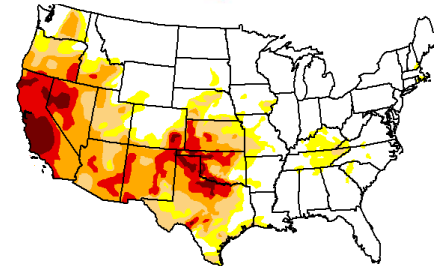2011 drought was the worst one-year drought in Texas since 1895.

USDM
Sept

- **2012 US Midwest Drought**

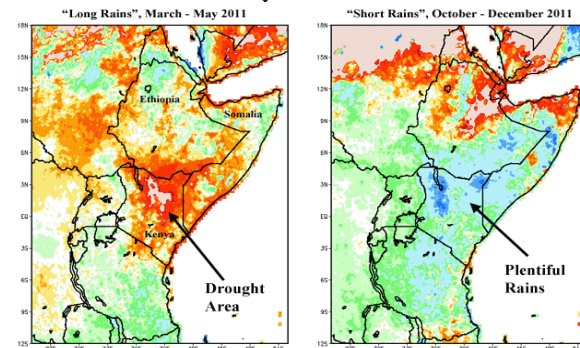caused $12 billion in damages mainly from agricultural losses [Henderson and Kauffman, 2012].
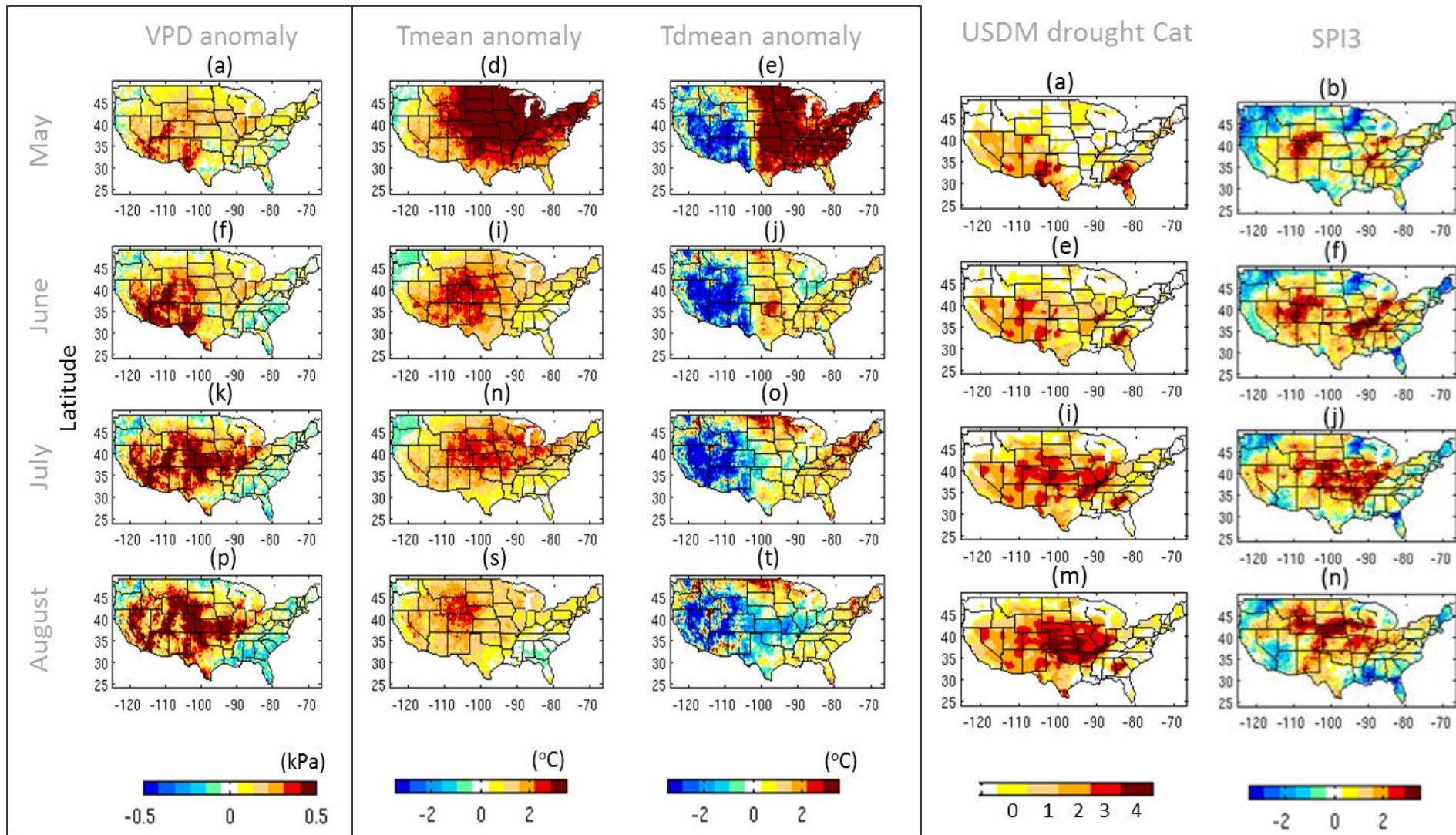
Sept

- **2014 California Drought**

June

- **2010-11 East Africa Drought**

AIRS helps understand drought development processes
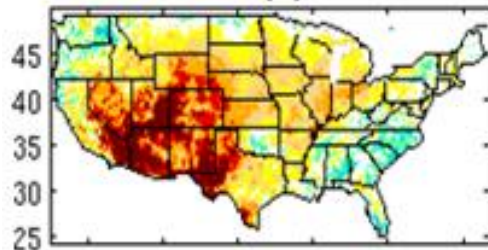
2012 drought

Behrangi et al. (2015)

Behrangi, A., P. Loikith, E. Fetzer, H. Nguyen, and S. Granger, 2015: Utilizing Humidity and Temperature Data to Advance Monitoring and Prediction of Meteorological Drought. *Climate*, **3,** 999-1017.
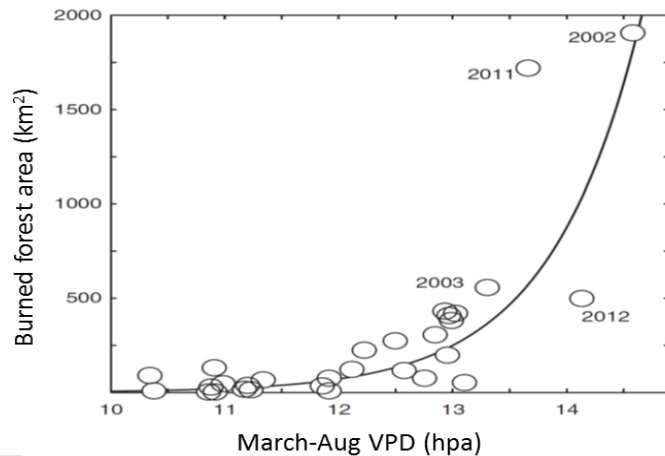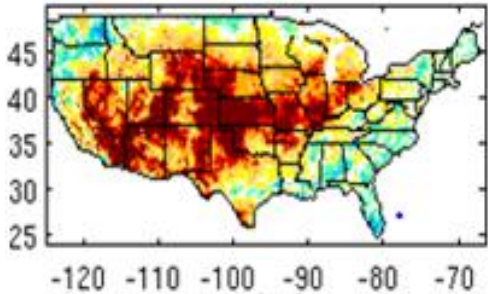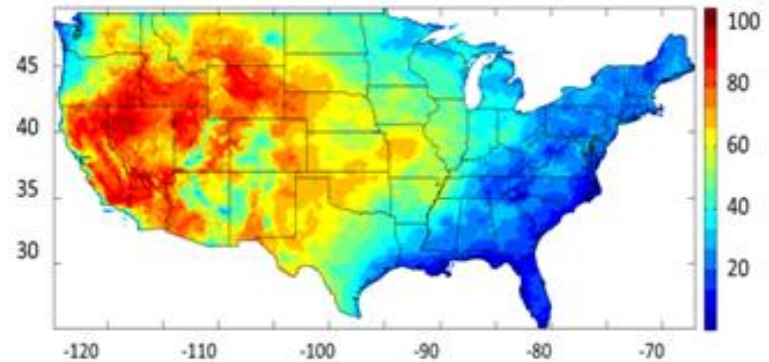
VPD and Fire

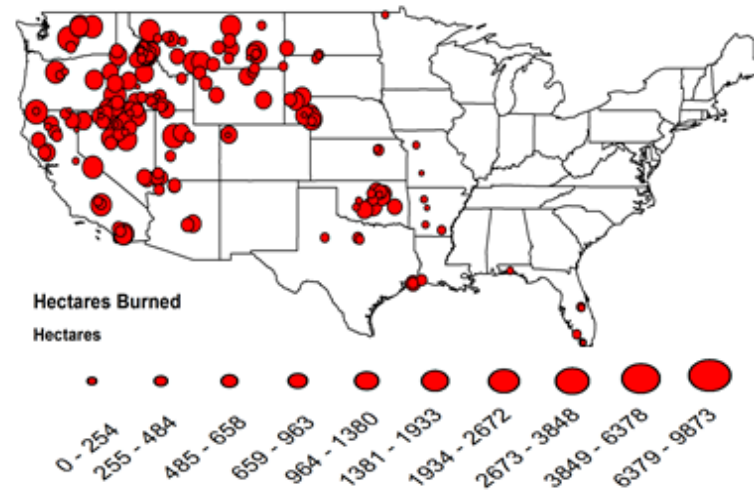## VPD anomaly

June

July

Annual burned forest area *v.* mean March–August VPD in SW forest area during 1894–2013. The figure is from Williams et al. (2014a)
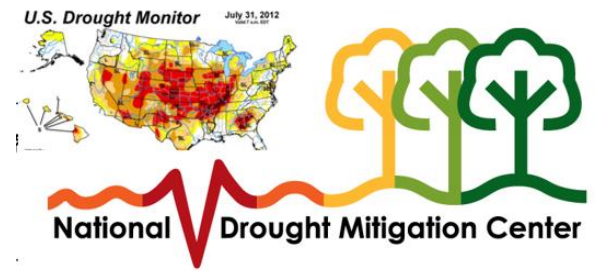
August 2012

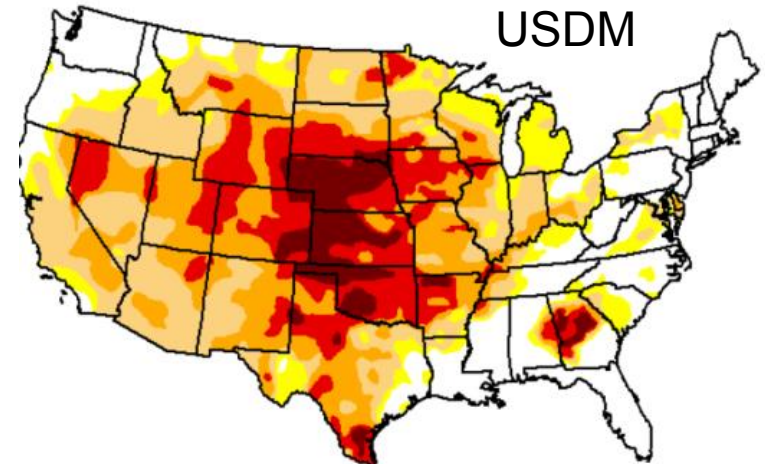The **national fire danger rating system (NFDRS)** energy release component (ERC)
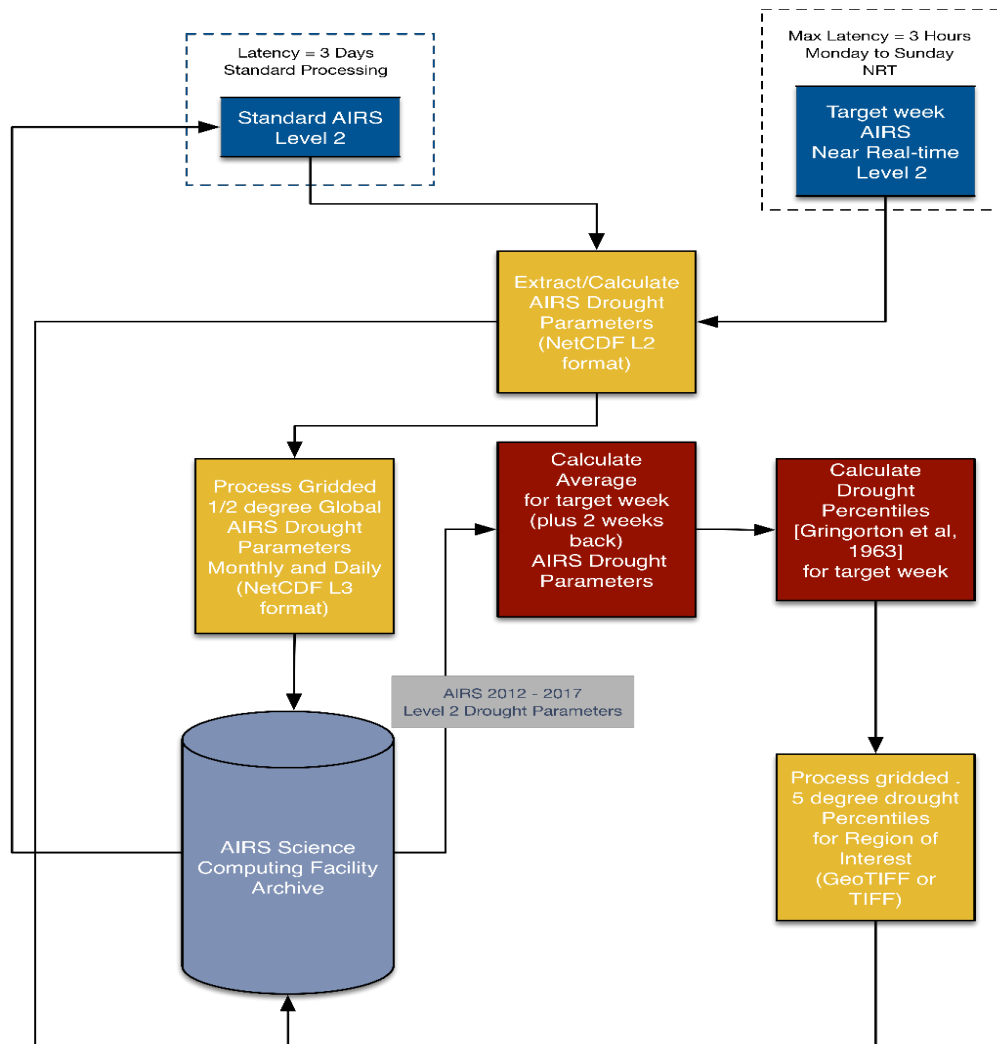

Fire occurrence : hectares burned

Collaboration with
The National Drought Mitigation Center (NDMC)
U.S. Drought Monitor (USDM)

20160519

USDM

AIRS Drought Percentile Products – Processing Flow

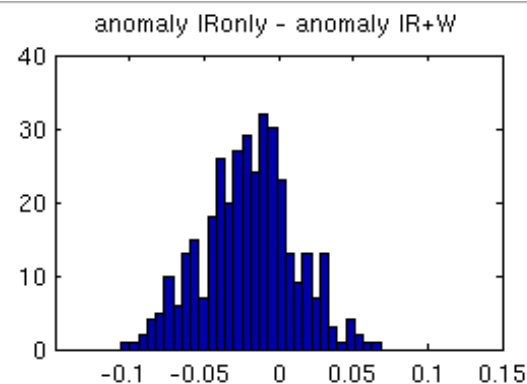## Producing ½ degree ; Near real-time percentiles for T, RH, VPD

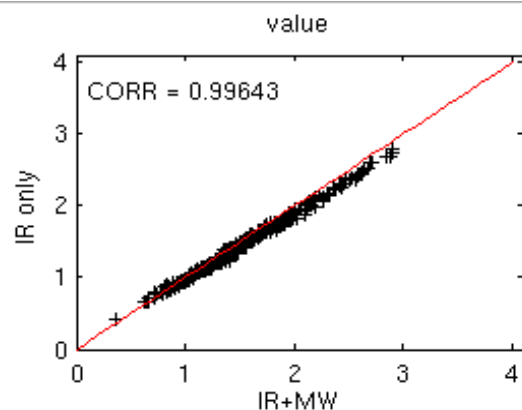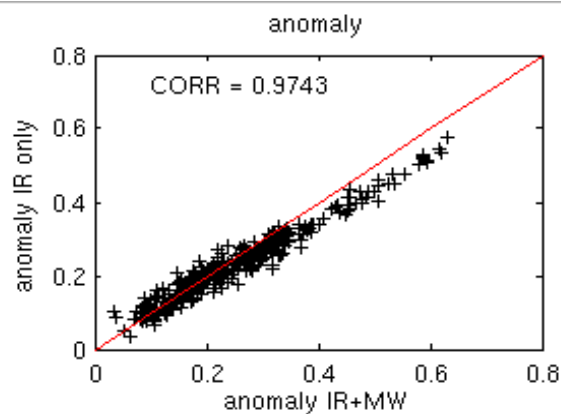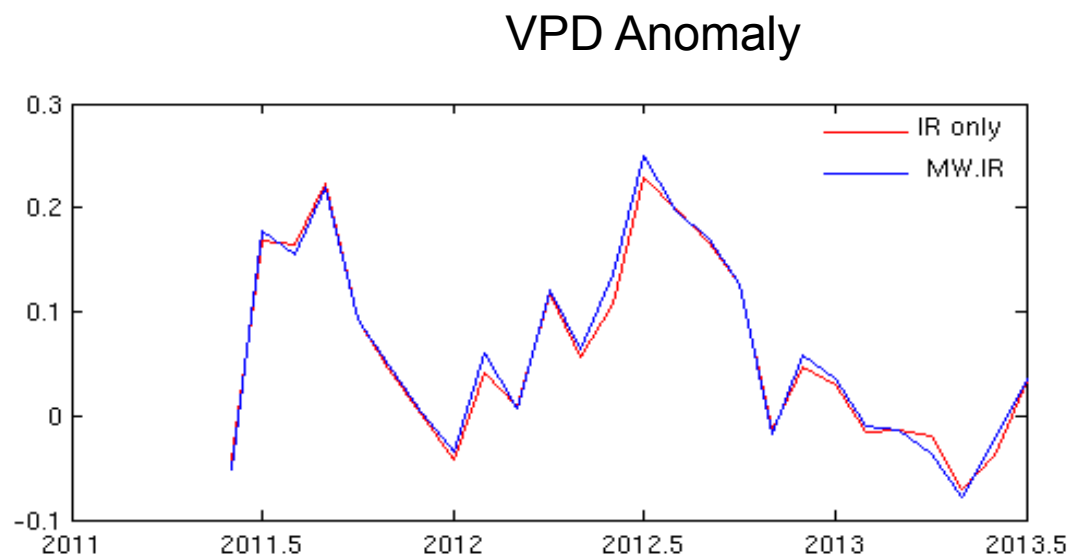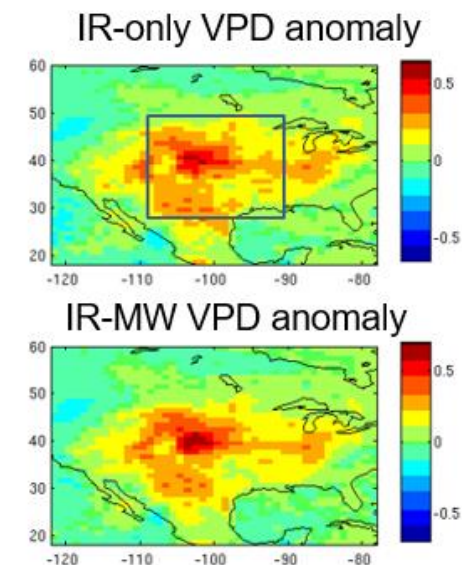**Credit:**
Stephanie Granger
Steve Licata

Assessing the impact of AMSU loss on drought analysis
Comparing MW-IR and IR-only retrievals over Midwest drought

Current Status

❑ Automated near real-time production of T, RH and VPD as percentiles for USDM

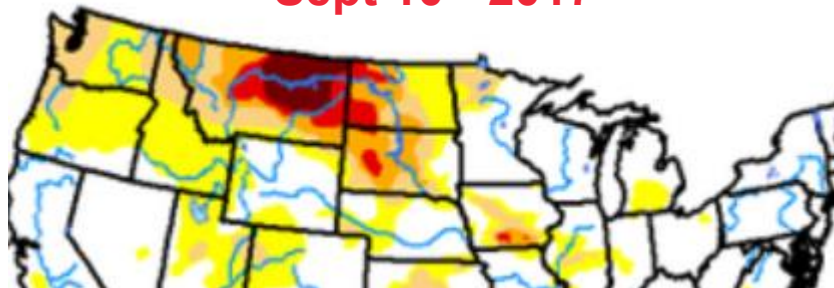(delivered every Monday; USDM automatically pulls from our ftp site)

❑ Since May 2017 - USDM incorporates AIRS drought products into data stack for authors
  – 7 , 28, and 56 day window
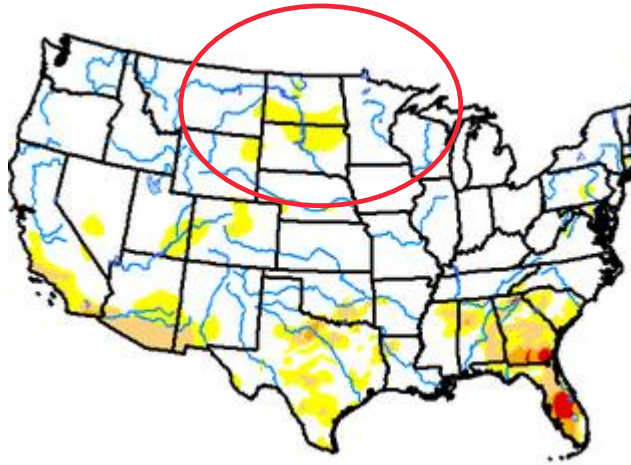
Case study:
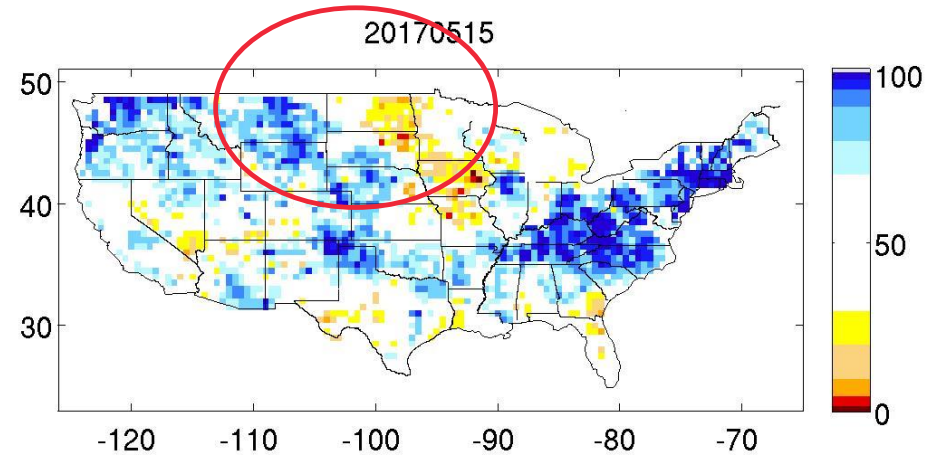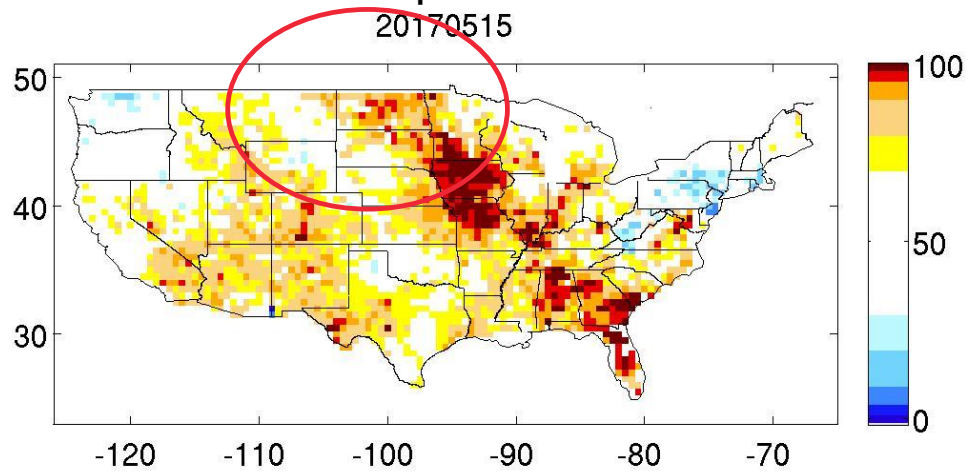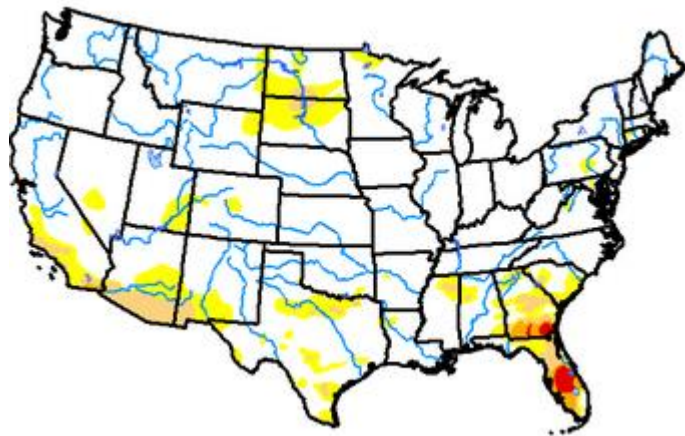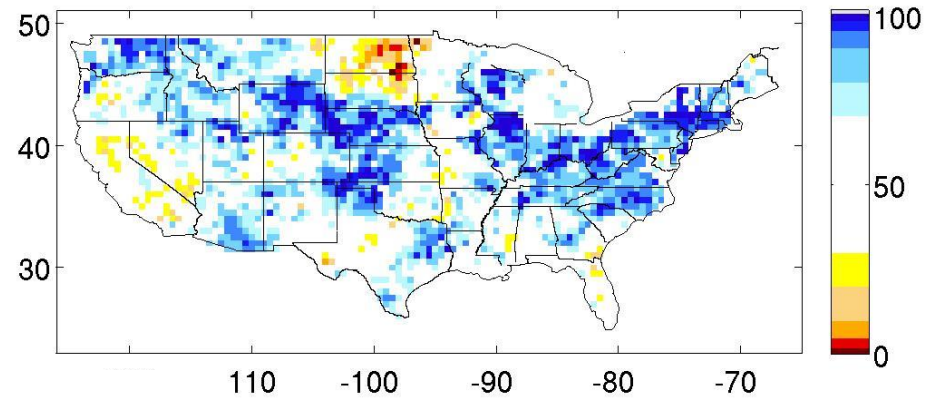## Recent drought over Montana, N&S Dakota

Sept 10th 2017

2017 05 15

USDM

RH percentile

20170515

VPD percentile

20170515
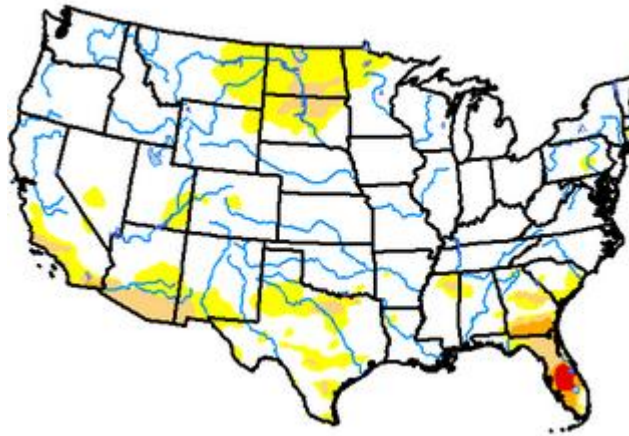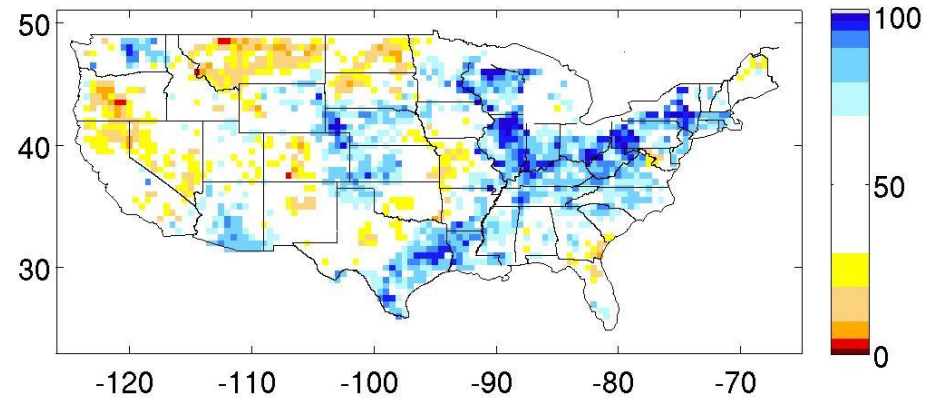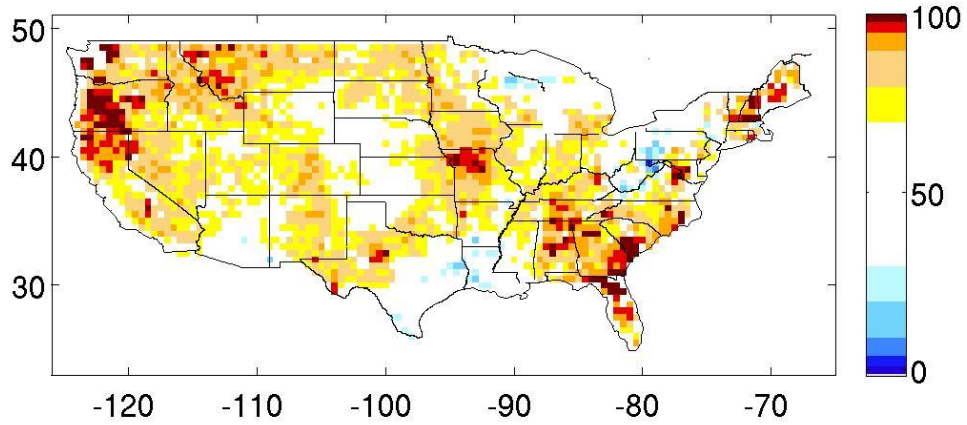
USDM

RH percentile

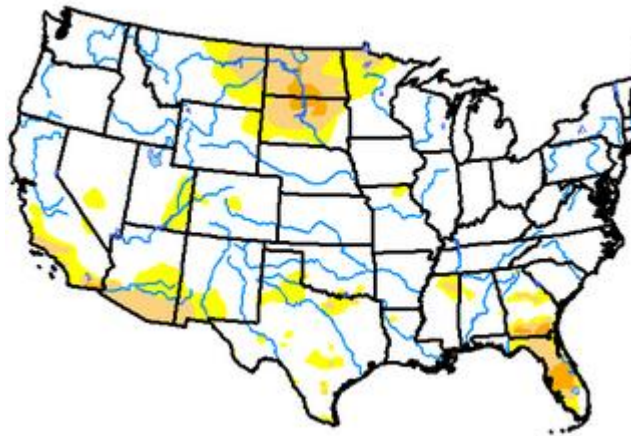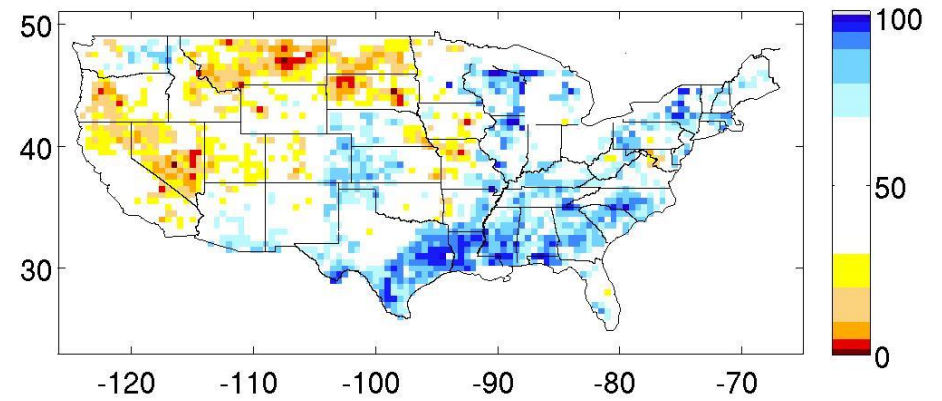20170522

VPD percentile

20170522
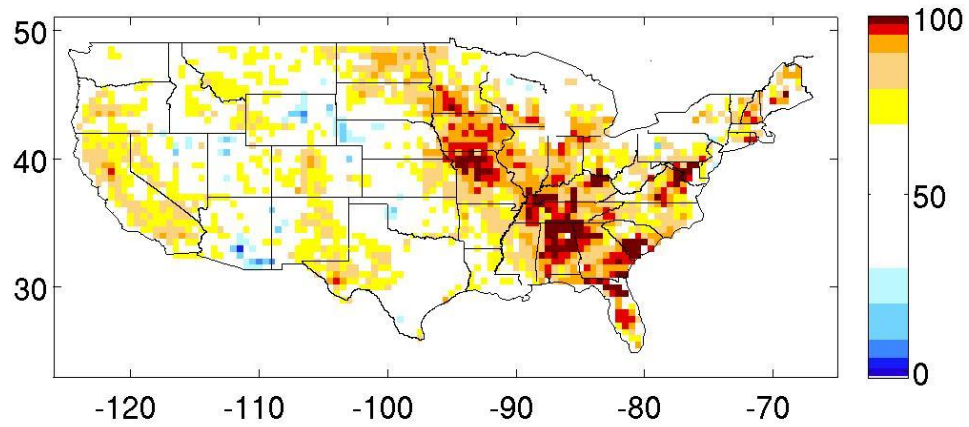
USDM

RH percentile

20170529
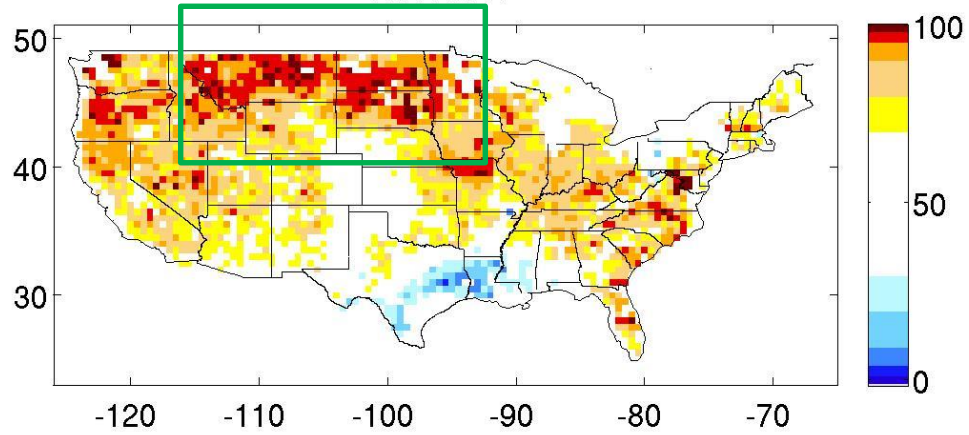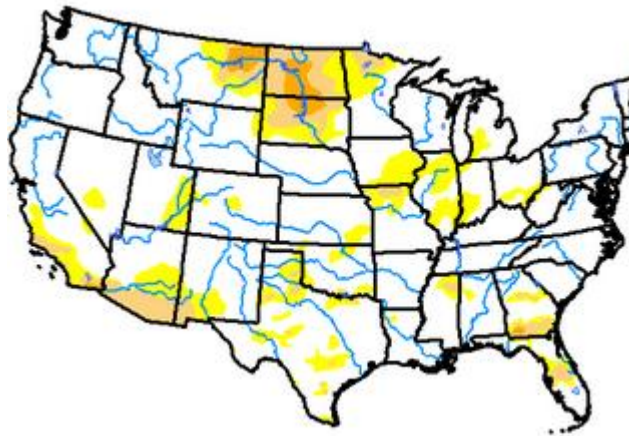
VPD percentile

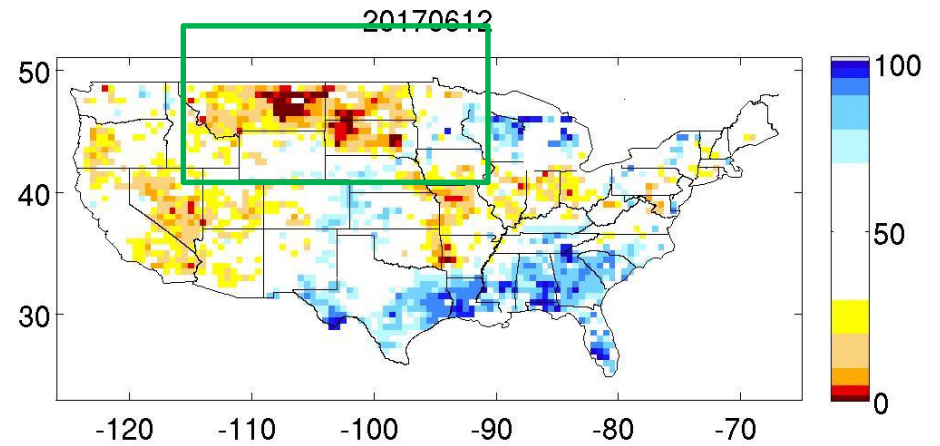20170529

USDM

RH percentile
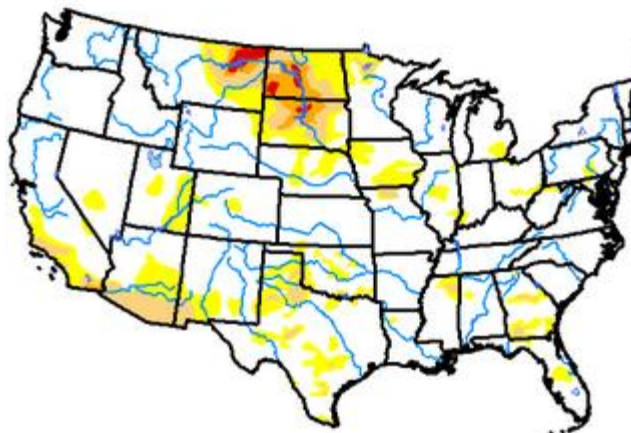
20170605

VPD percentile

20170605

USDM

RH percentile
20170612

VPD percentile
20170612
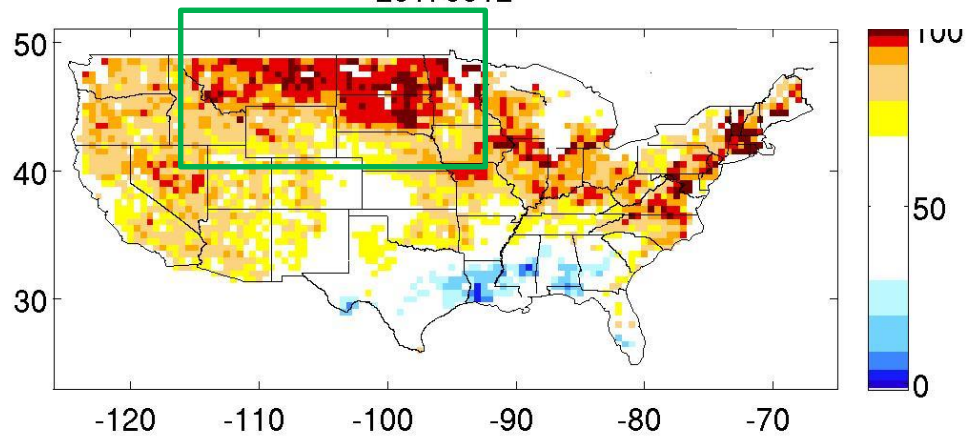
USDM

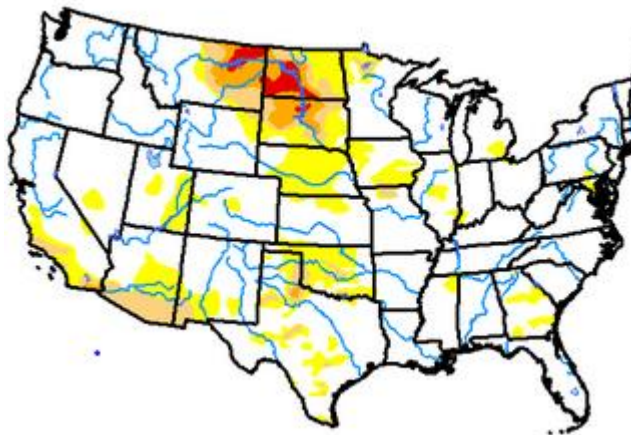## RH percentile
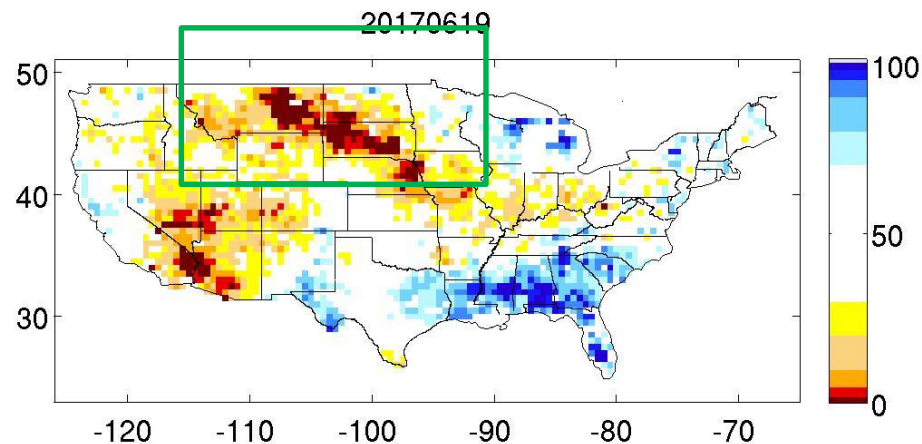
20170619

VPD percentile
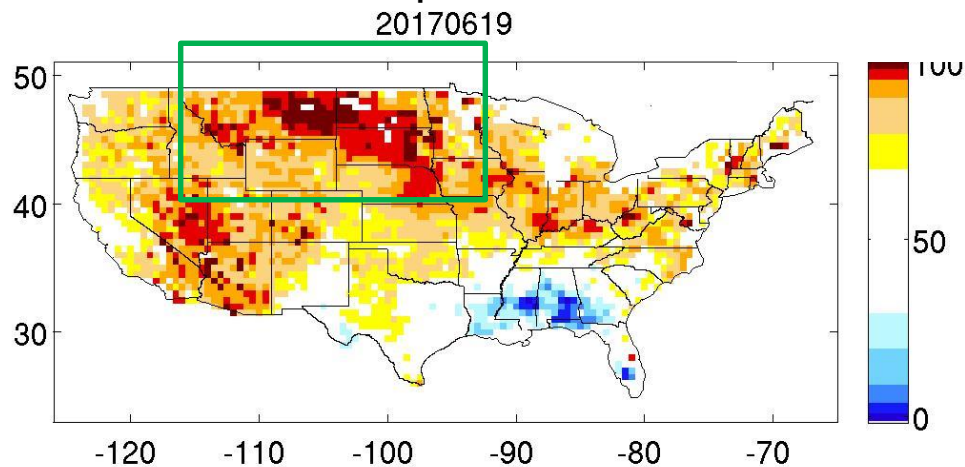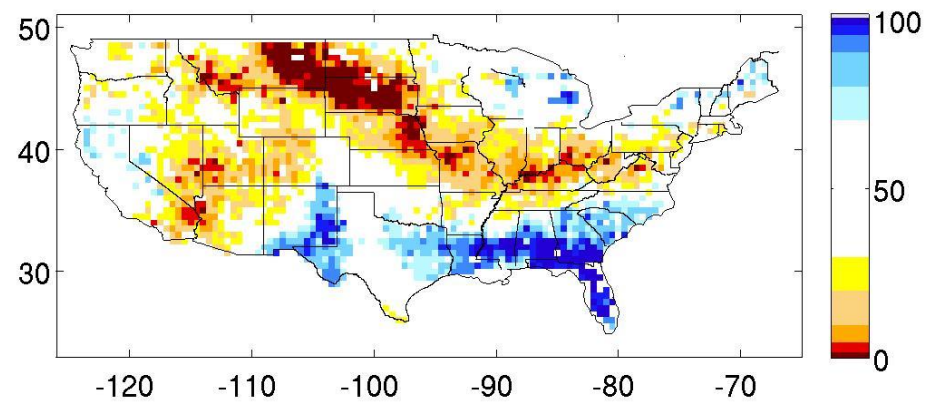

20170619

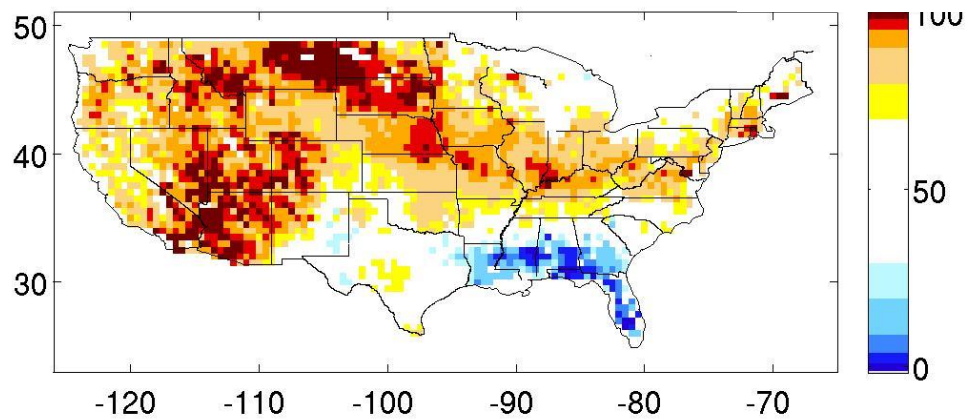**June 19th, 2017**

Vegetation health NOAA START
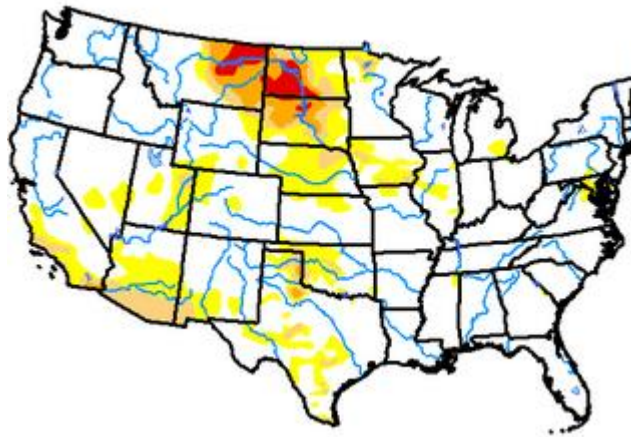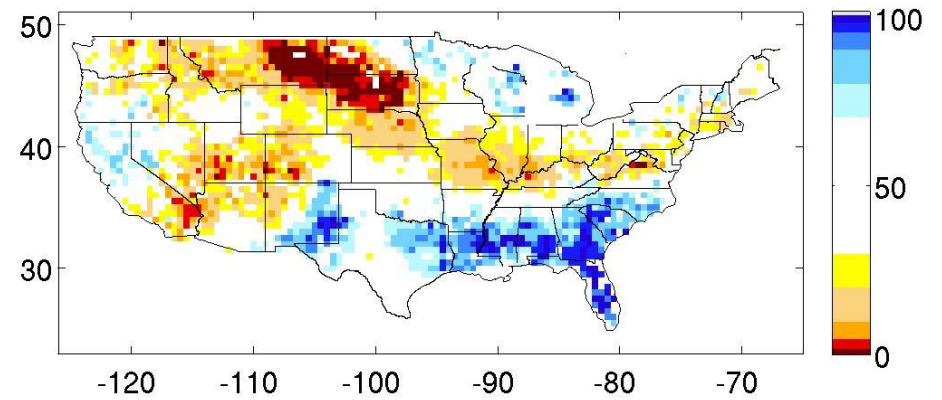
USDM

RH percentile

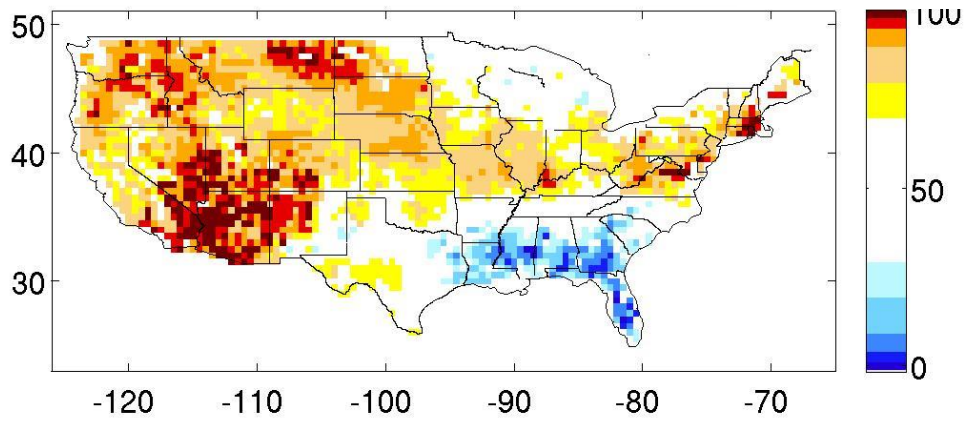20170626

VPD percentile
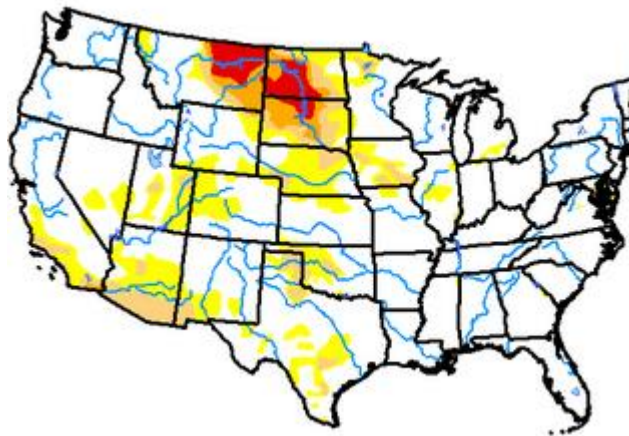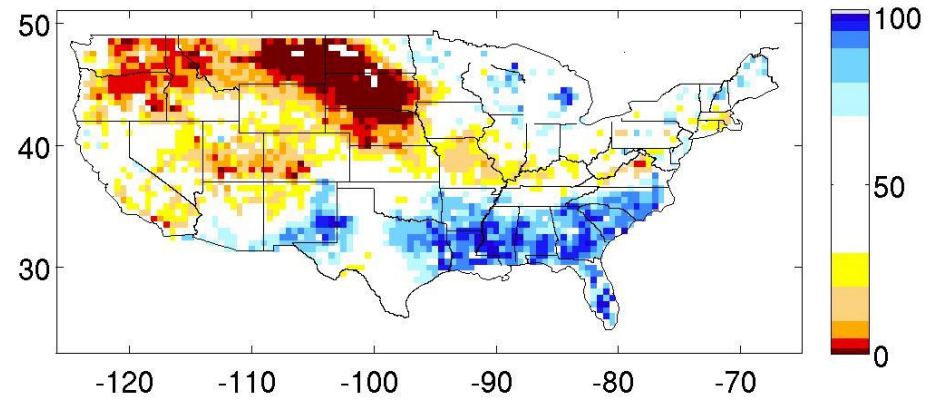
20170626

USDM

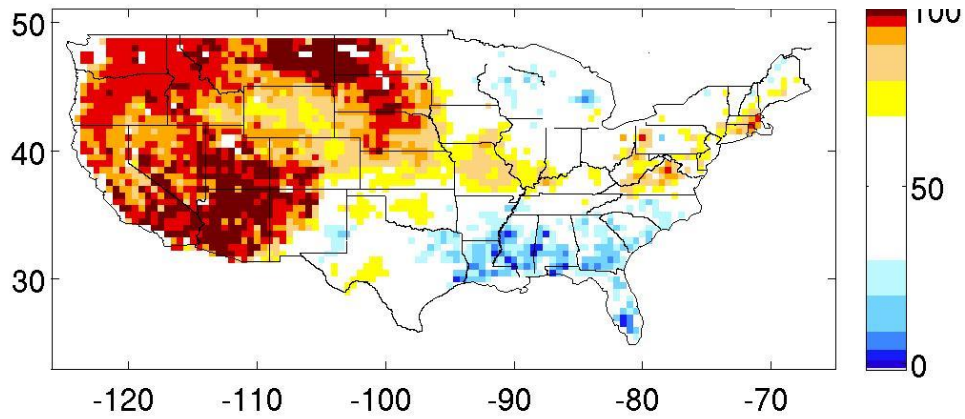RH percentile

20170703

VPD percentile
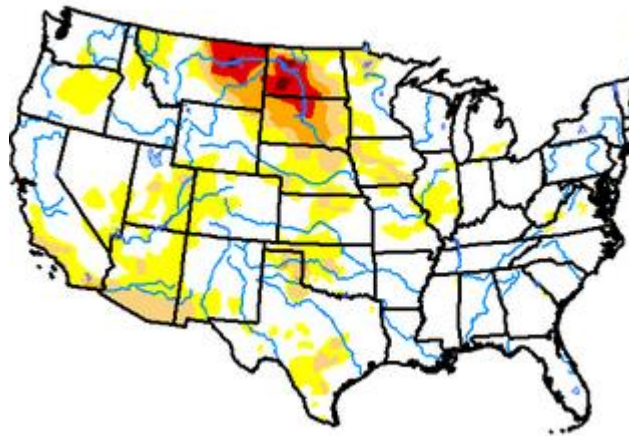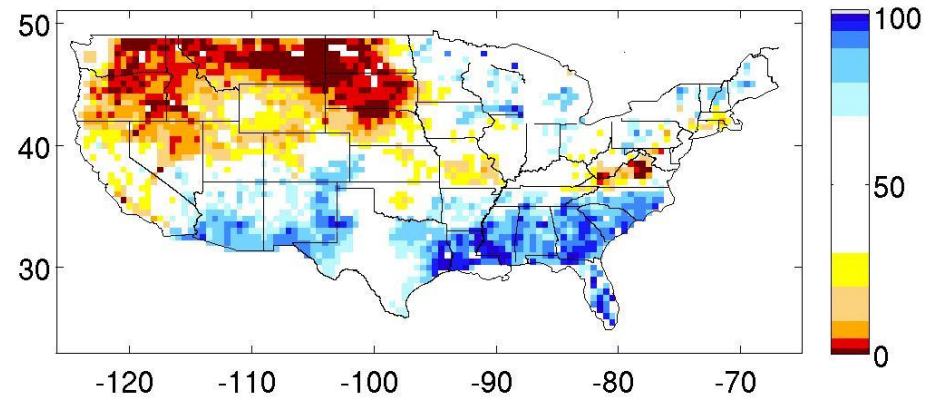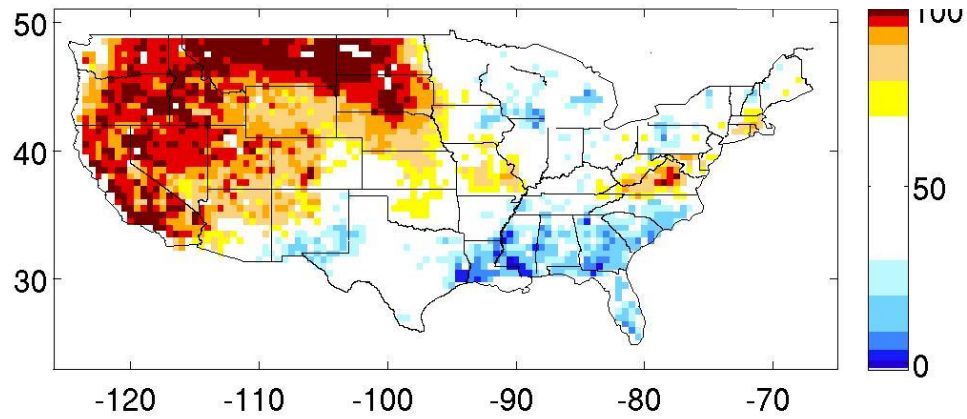
20170703

USDM

RH percentile
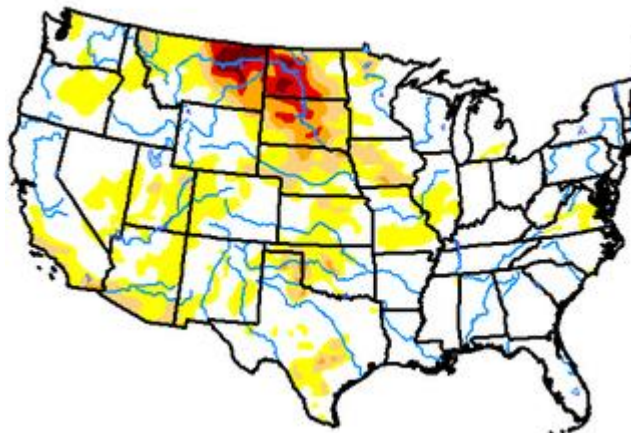20170710

VPD percentile
20170710

USDM

RH percentile

20170717

VPD percentile
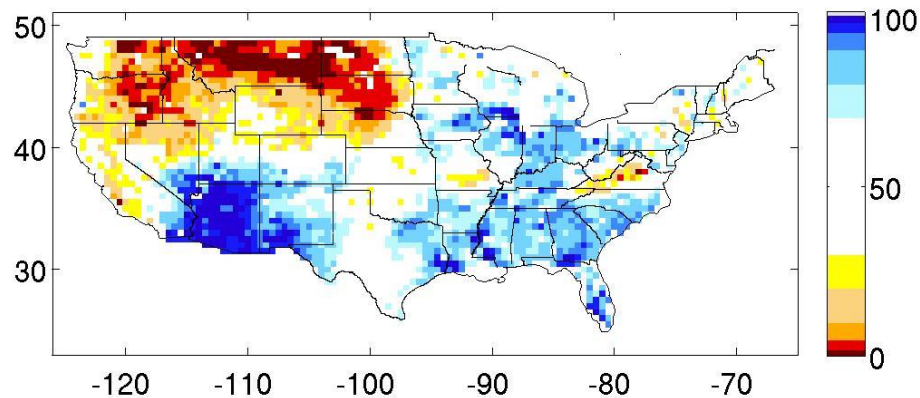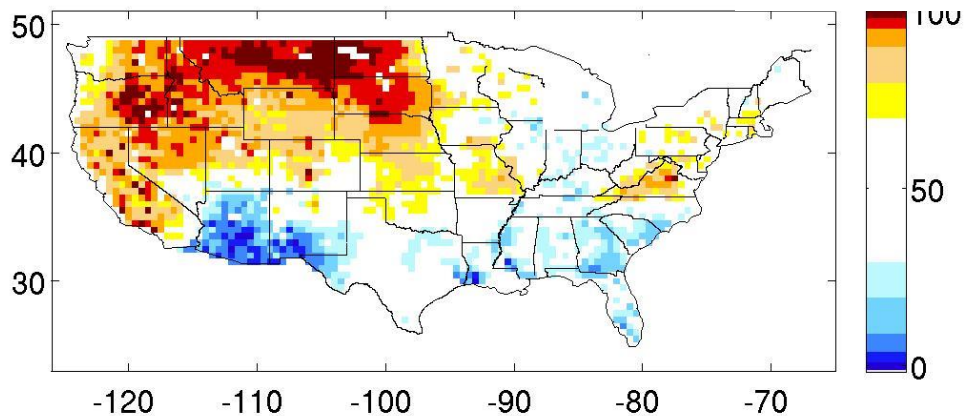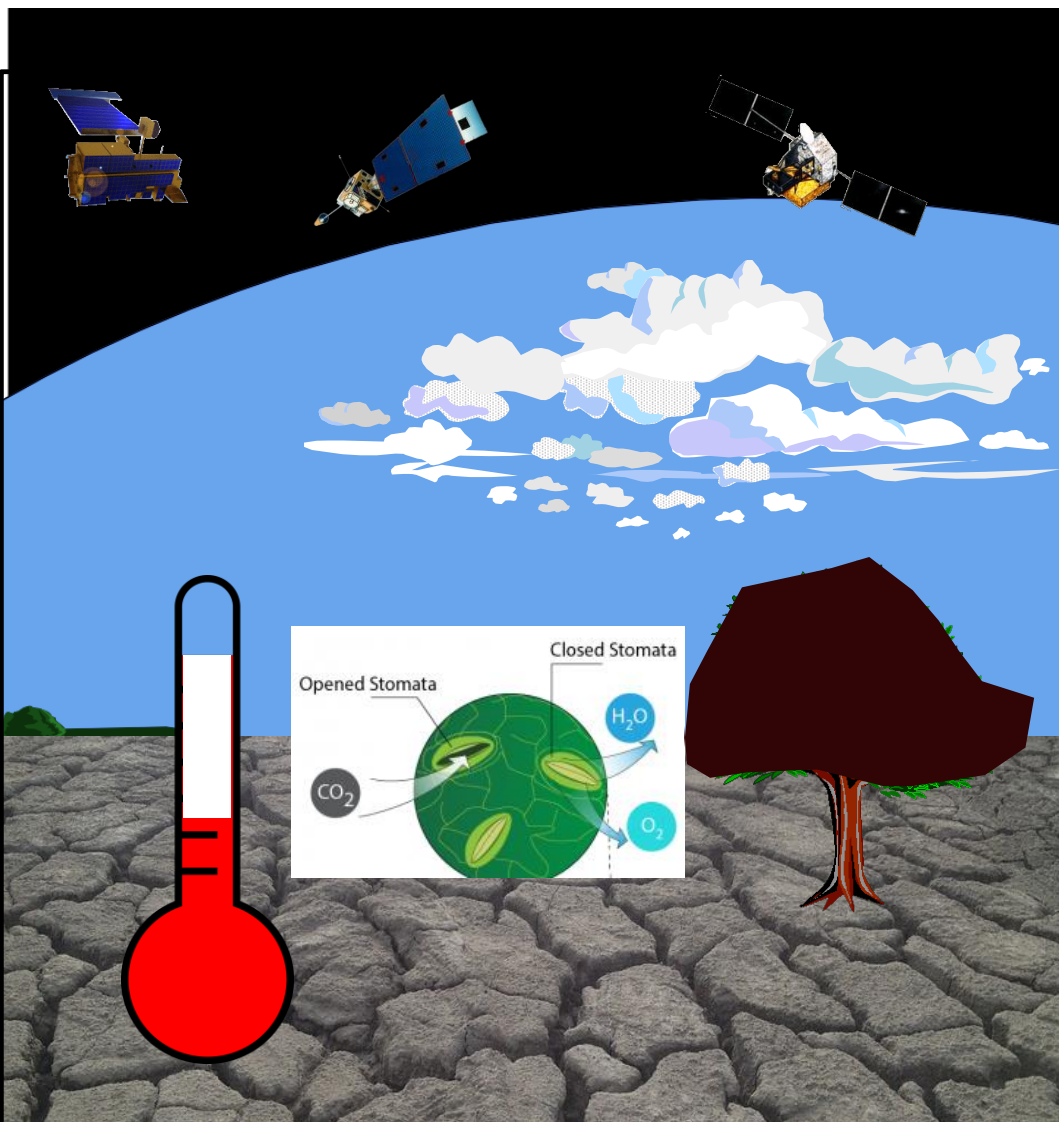
20170717

USDM

RH percentile

20170724

VPD percentile

20170724

AIRS: June 19th

**USDM:
July 24th, 2017**

Drought development is a process:
Relating VPD, NDVI, SIF , PRECIP, Soil moisture,

Environment:
- T ↑ RH ↓ VPD ↑
- Precipitation ↓
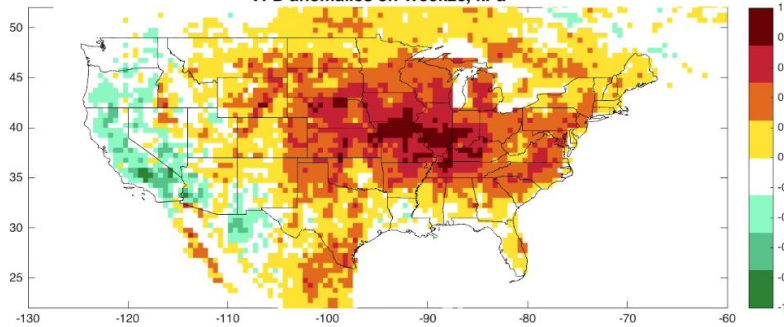- Soil Moisture ↓

Vegetation:
- SIF ↓↓
- NDVI ↓

Credit: Yixin Wen

SIF: solar-induced chlorophyll fluorescence

Example: Timing of the peak drought conditions in 2012
Using VPD anomaly, USDM, VegDRI and QuickDRI
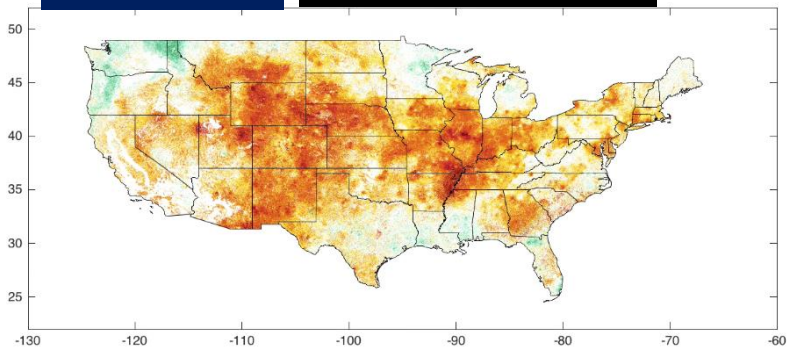
Wen, et al. In prep
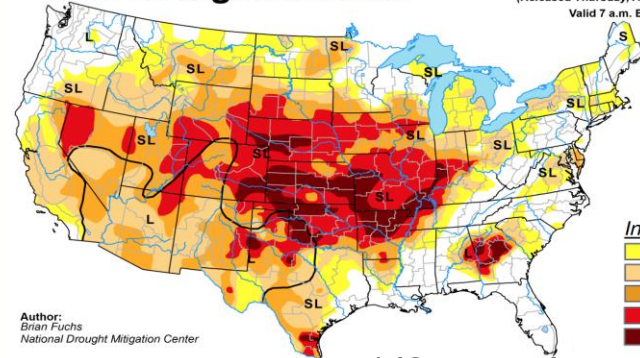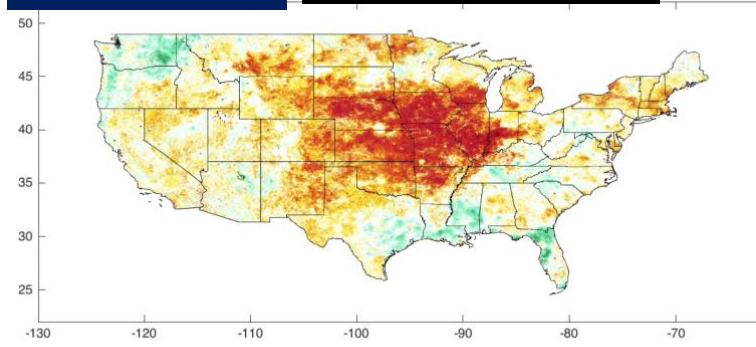
Future Work

- Continue to work with National Drought Mitigation Center (USDM) to refine products

- Assessing irrigated/non-irrigated regions

- Combining the AIRS data with other related observations (e.g., VPD and Soil moisture)

- Utilize our results in decision making process:

  Concept submitted to WWAO to support Missouri Basin Drought Early Warning System (Granger/Behrangi/Svoboda)

- Sustainability of data record (e.g., via NPP, etc.)