AIRS drought application and beyond: Opportunities, challenges, and future direction

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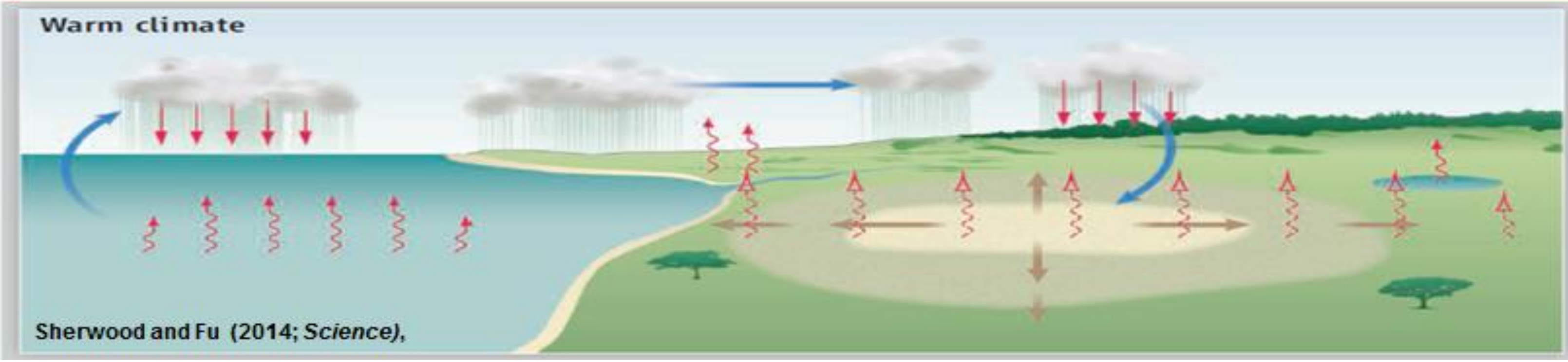
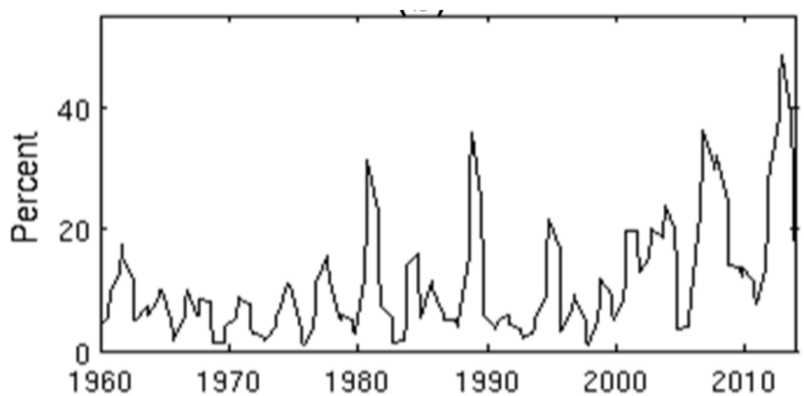
Why AIRS is important ?

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= e_s-e) will increase

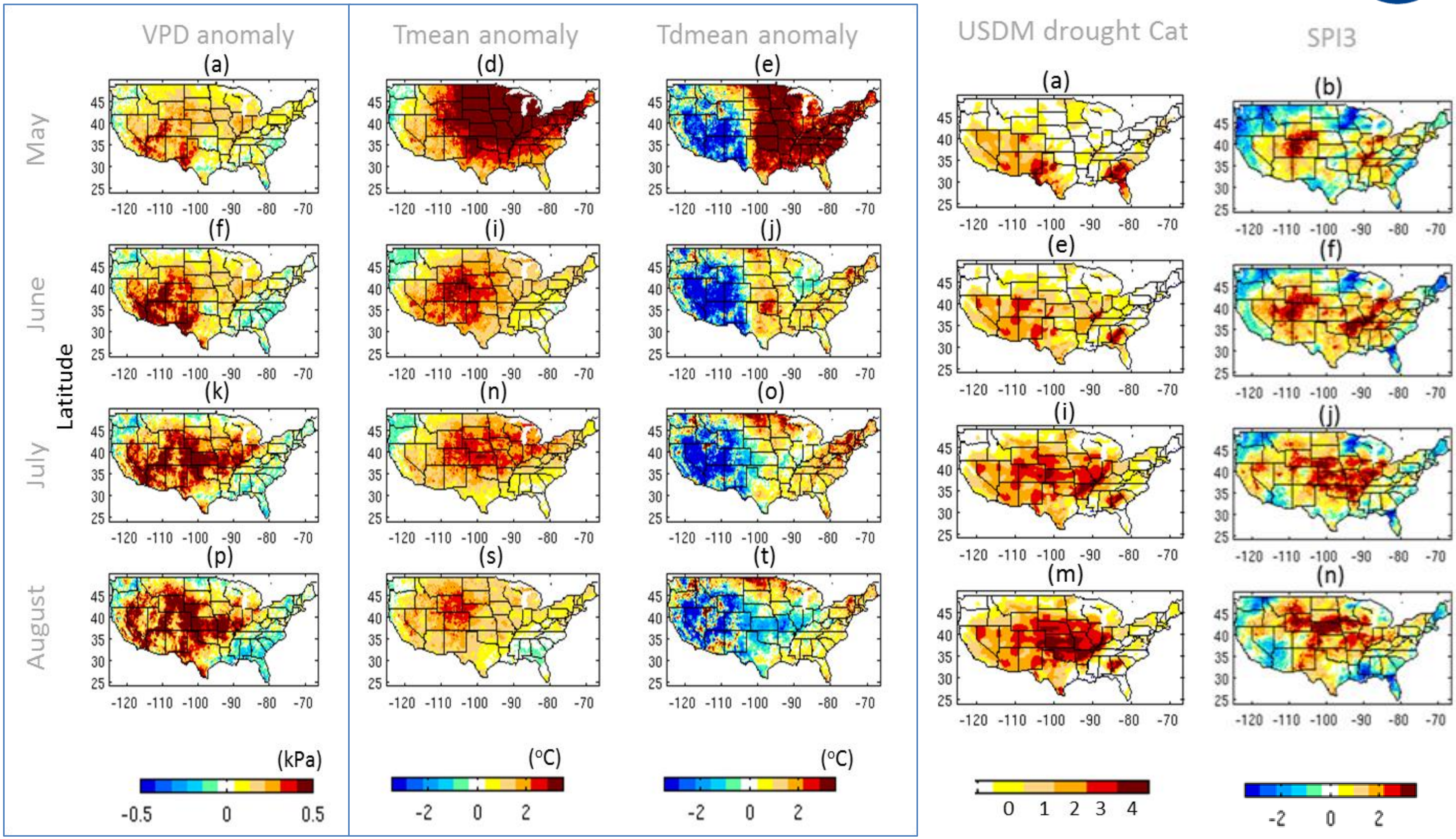
Time series of percent area of CONUS in which 3-month standardized VPD is more than 1.25 standard deviation above normal.



- The analysis of recent observational data shows that associations of ENSO and PDO with U.S. drought have weakened over time (Kam et al. 2014).
- Droughts are becoming less associated with oceanic variability (Kam et al. 2014) [and more with atmospheric variability]

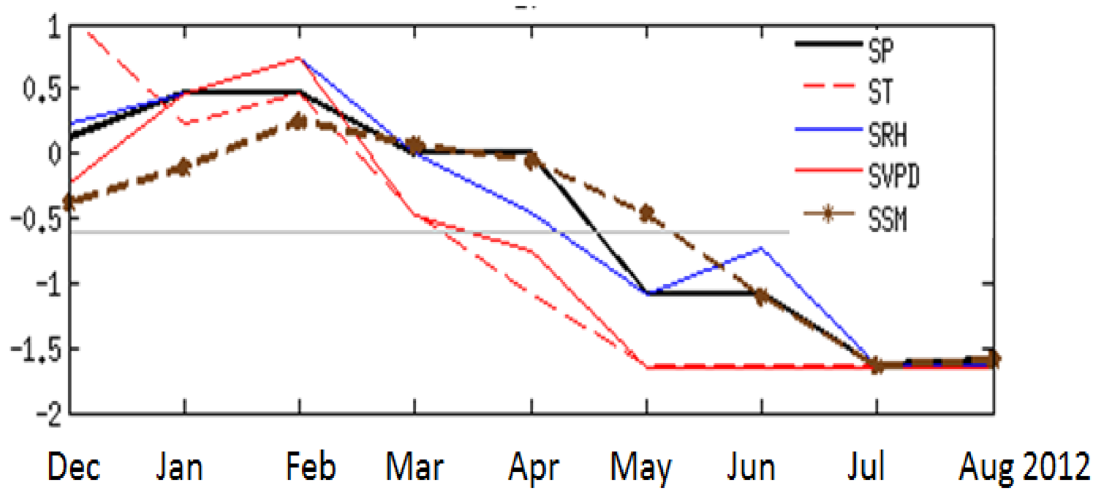
AIRS help understand drought development processes

2012 drought



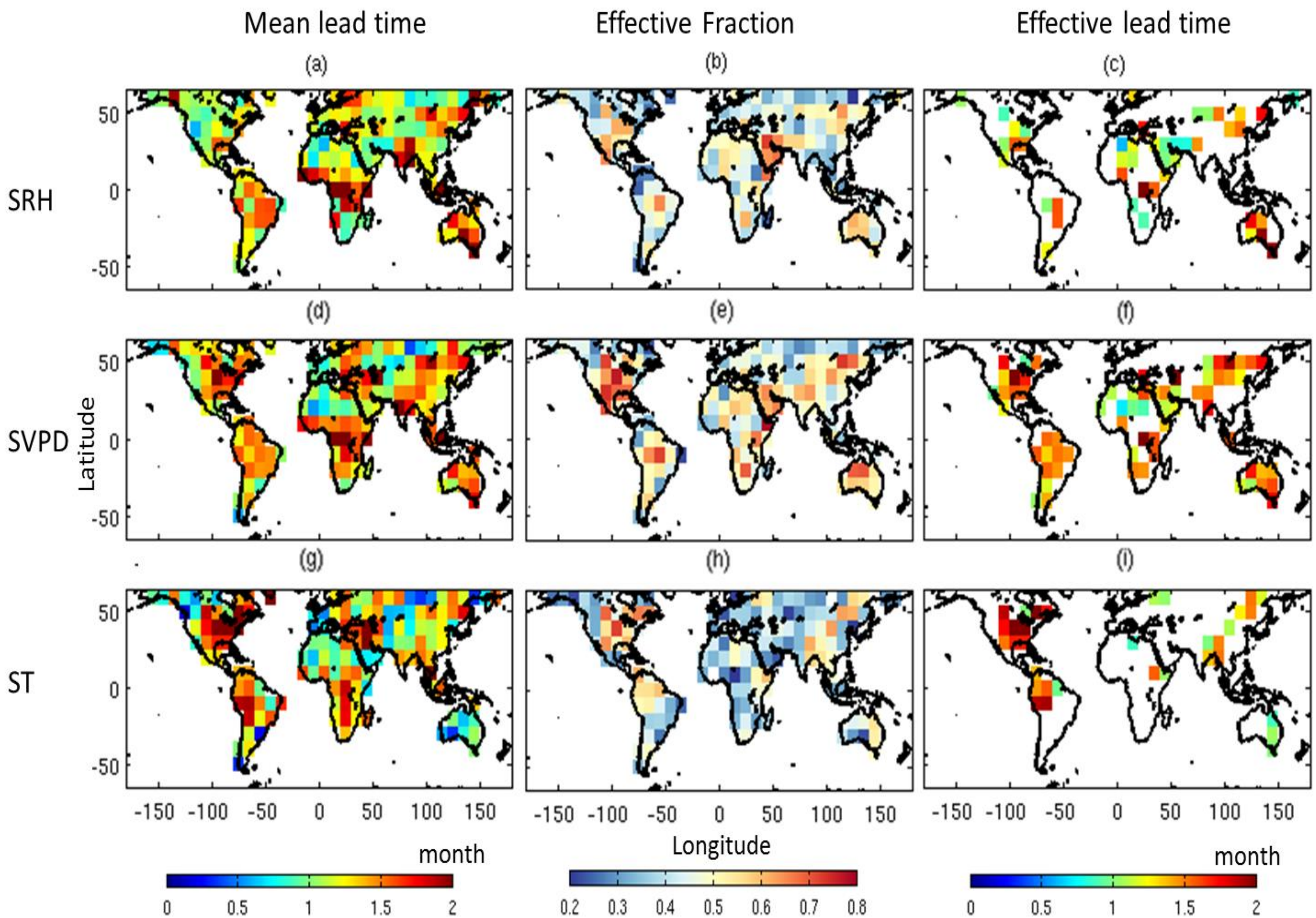
Behrangi, A., P. Loikith, E. Fetzer, H. Nguyen, and S. Granger, 2015: Utilizing Humidity and Temperature Data to Advance Monitoring and Prediction of Meteorological Drought. *Climate*, **3,** 999-1017.

Early detection of drought onset

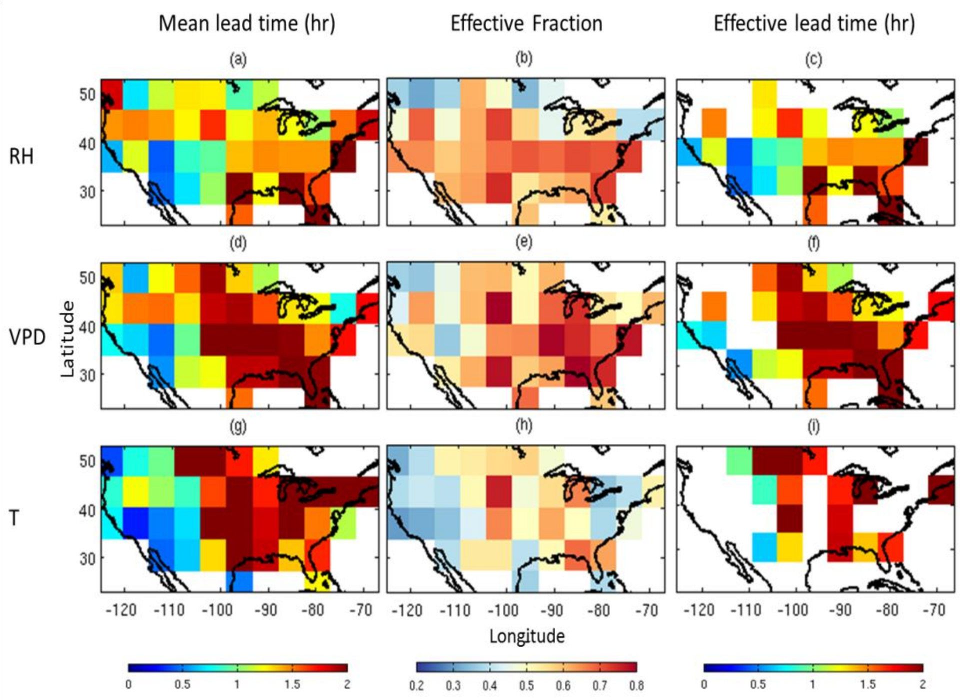


Time series of corresponding SP, SRH, SVPD, ST, and SSM for a grid box (latitude 38.5°N, longitude 103.5°W) at the central US during the 2012 drought. SSM is calculated from MERRA and the rest of the indices are calculated from PRISM.

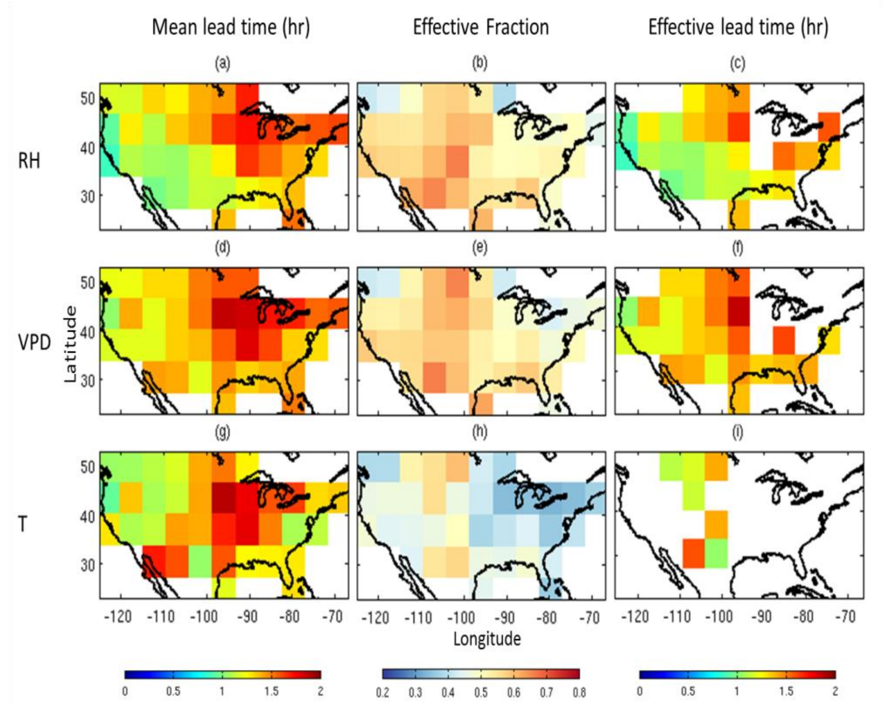
Early detection of drought onset



The length of data record matters

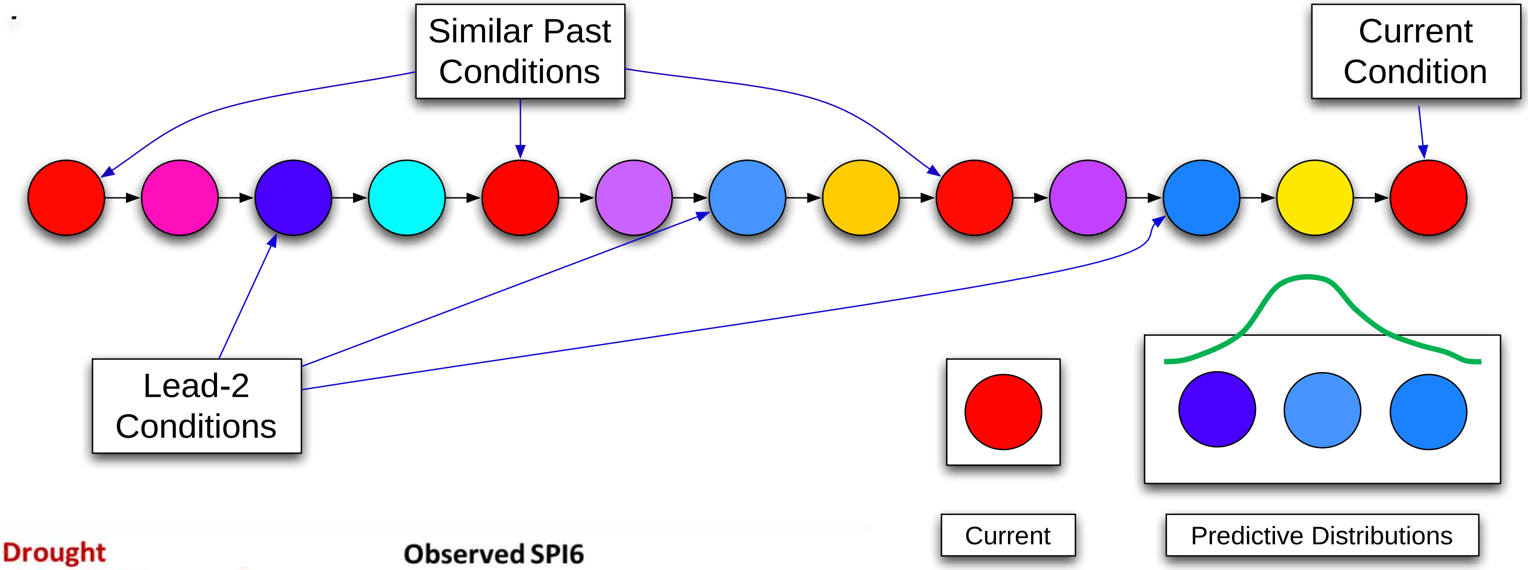


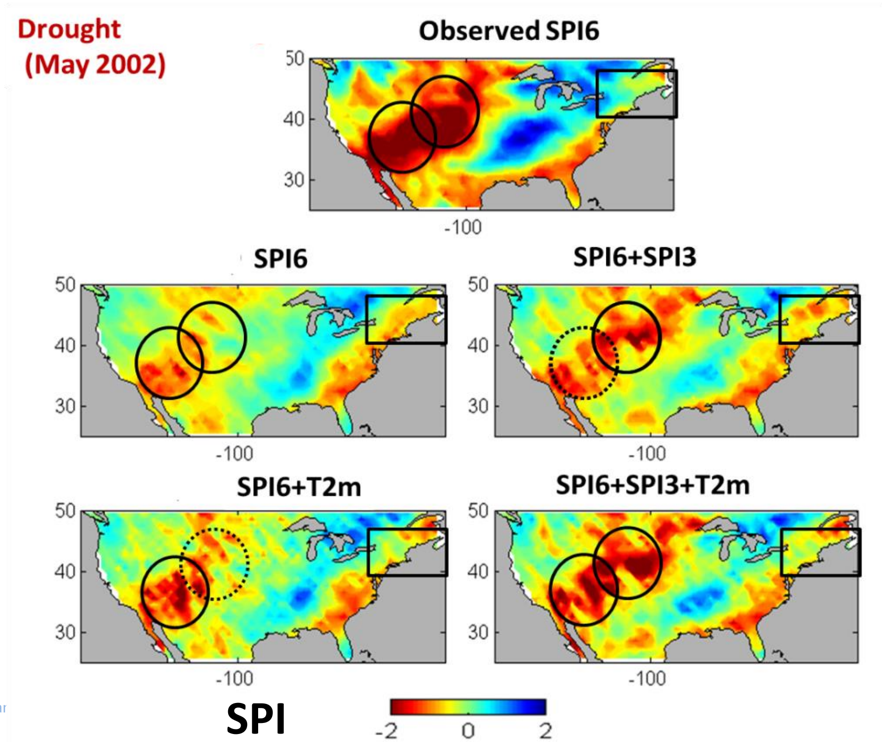
Constructed from 12 years (2003-2014) of PRISM data.



Similar to figure at left, but constructed from 65 years (1960-2014) of PRISM data.

Temperature is important for Seasonal precipitation forecast

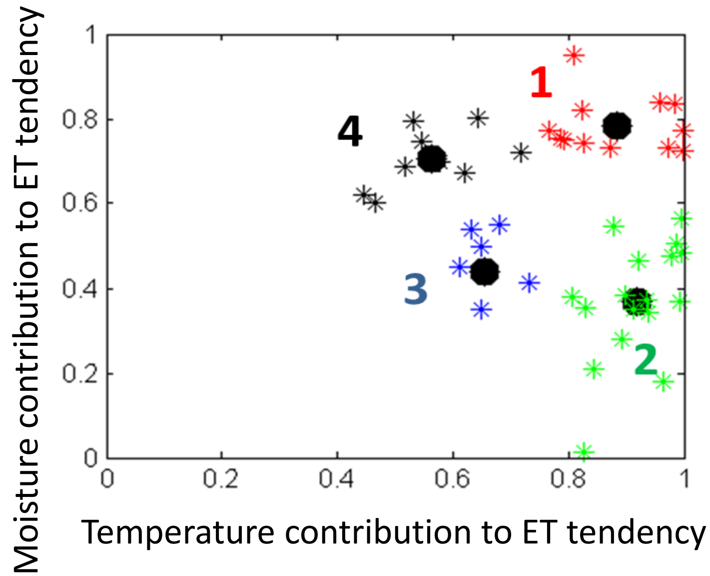




3 month lead predictions based on initial conditions in February 2002

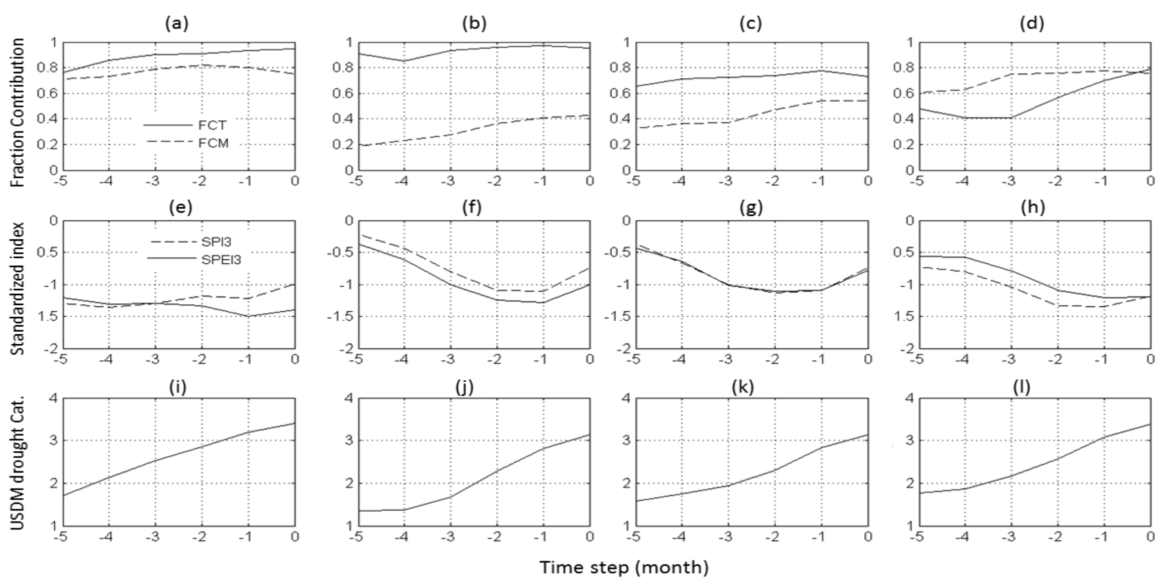
Behrangi, A., H. Nguyen, and S. Granger, 2015: *Probabilistic Seasonal Prediction of Meteorological Drought Using the Bootstrap and Multivariate Information*. Journal of Applied Meteorology and Climatology, **54,** 1510-1522.

AIRS to understand the environment of drought



SPI/SPEI

USDM

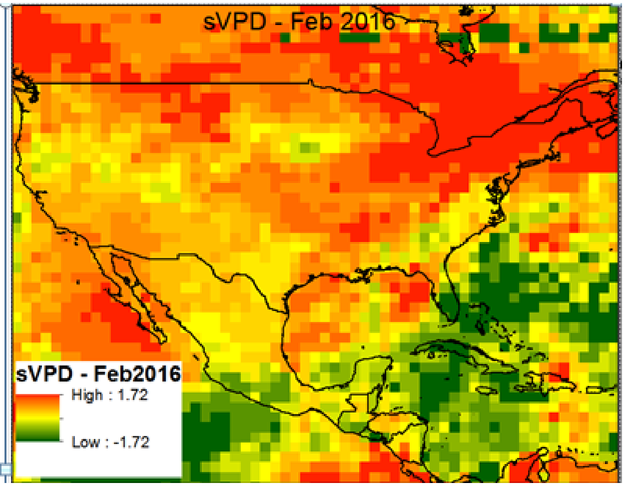


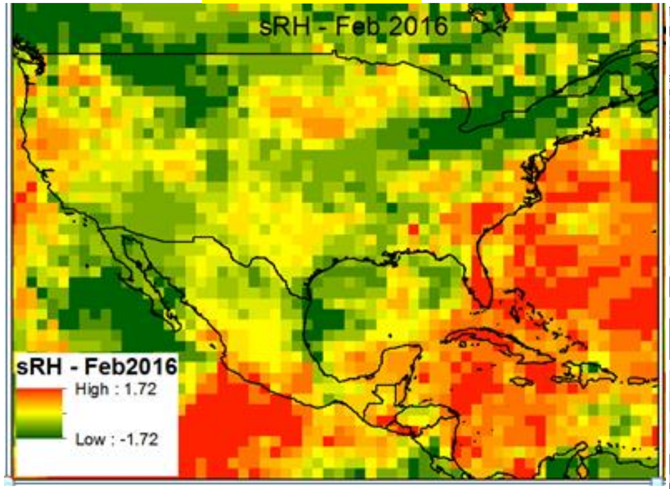
Behrangi, A., P. Loikith, E. Fetzer, H. Nguyen, and S. Granger, 2015: Utilizing Humidity and Temperature Data to Advance Monitoring and Prediction of Meteorological Drought. *Climate*, **3,** 999-1017.

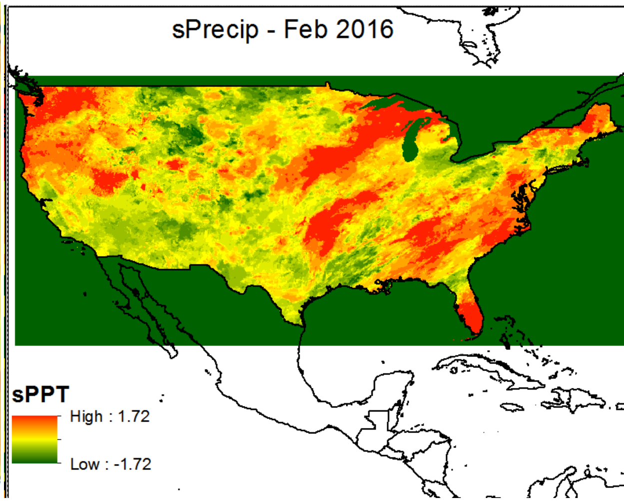
Application :
Opportunities and challenges

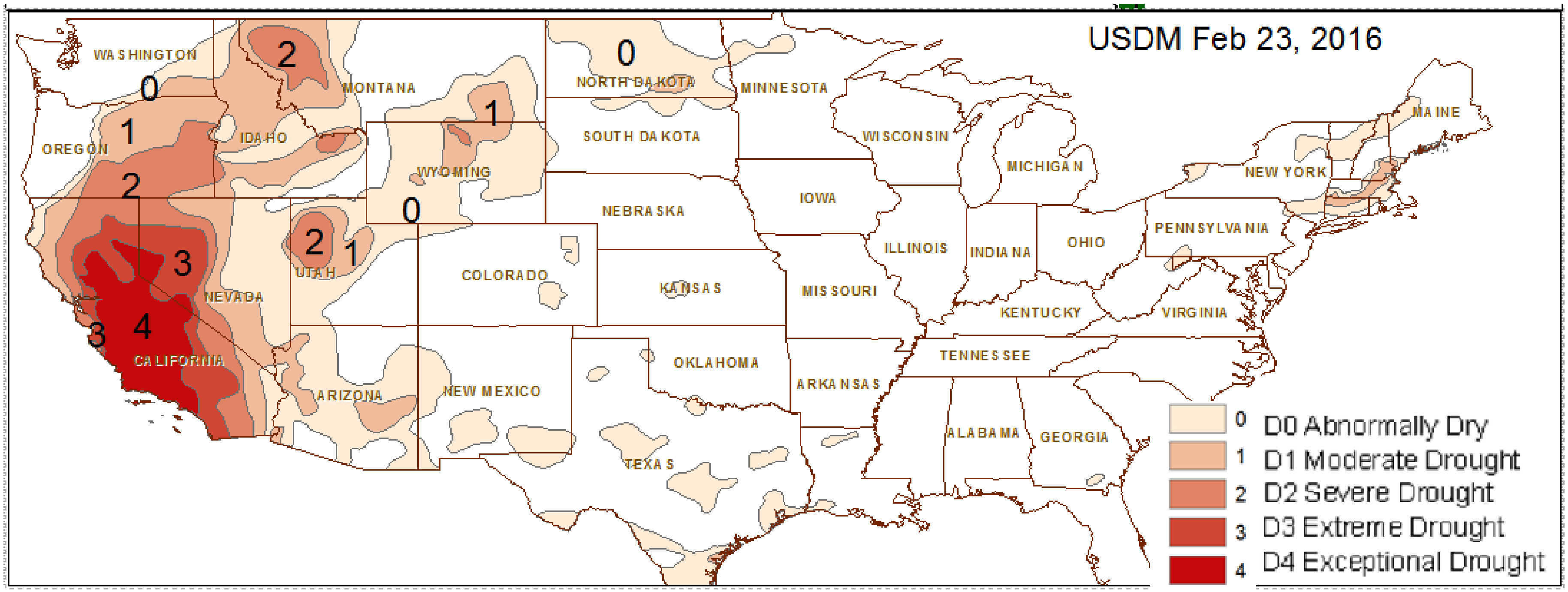
AIRS and US drought monitor (USDM)

Feb 2016





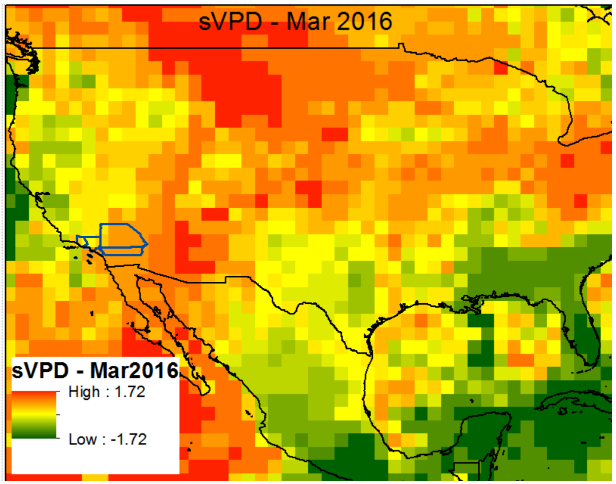


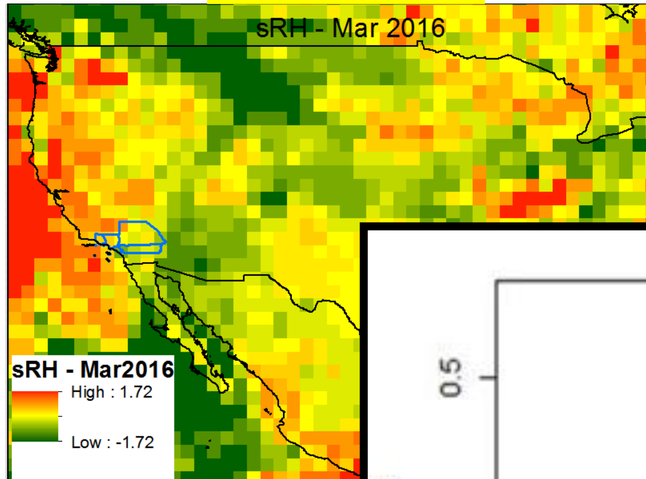


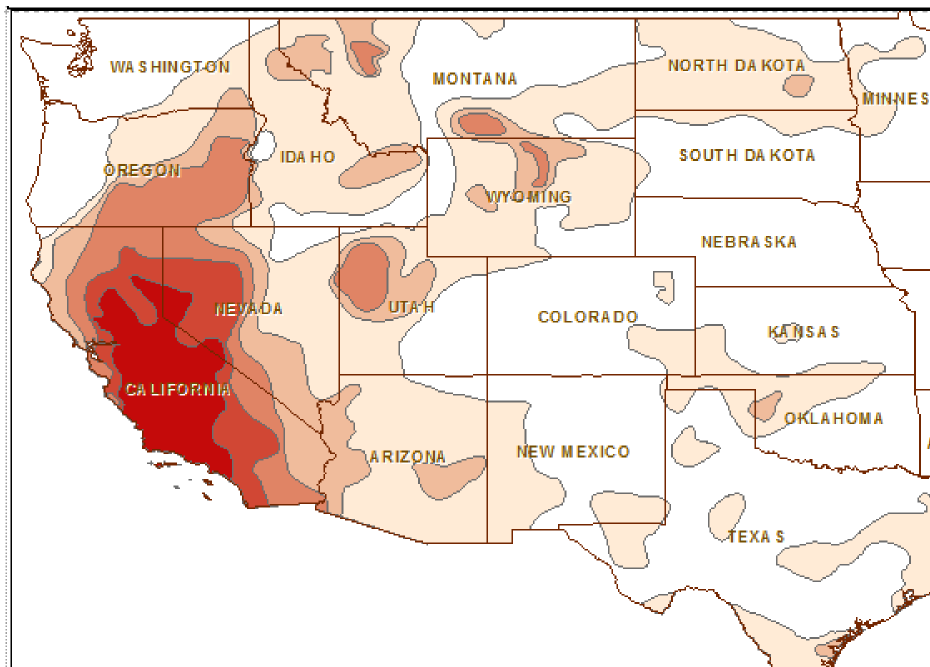
AIRS and US drought monitor (USDM)

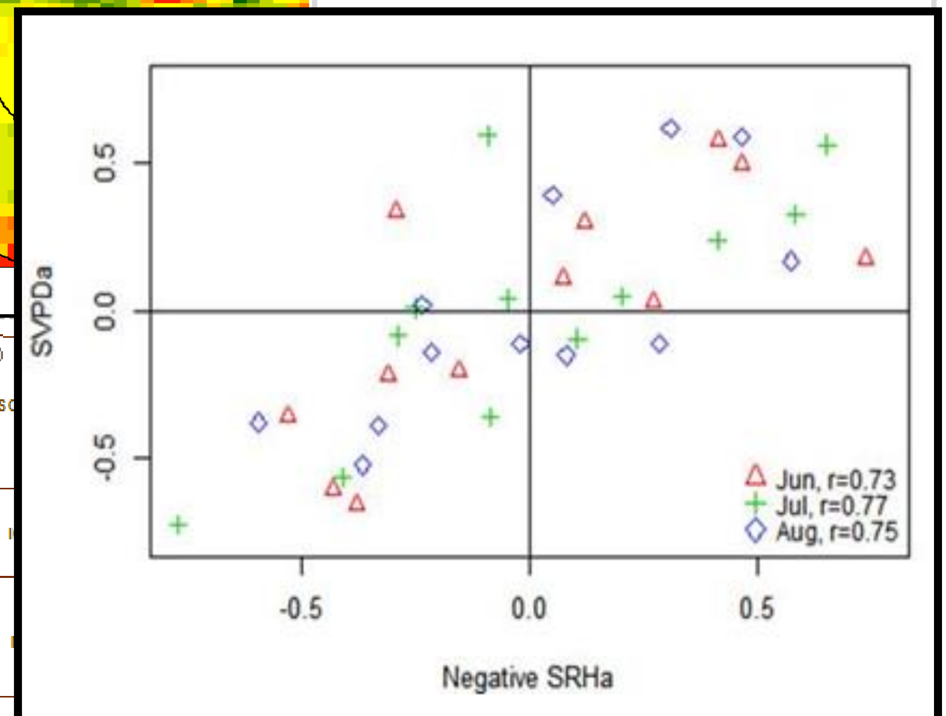
March 2016

March 2016 precip.
Not available yet

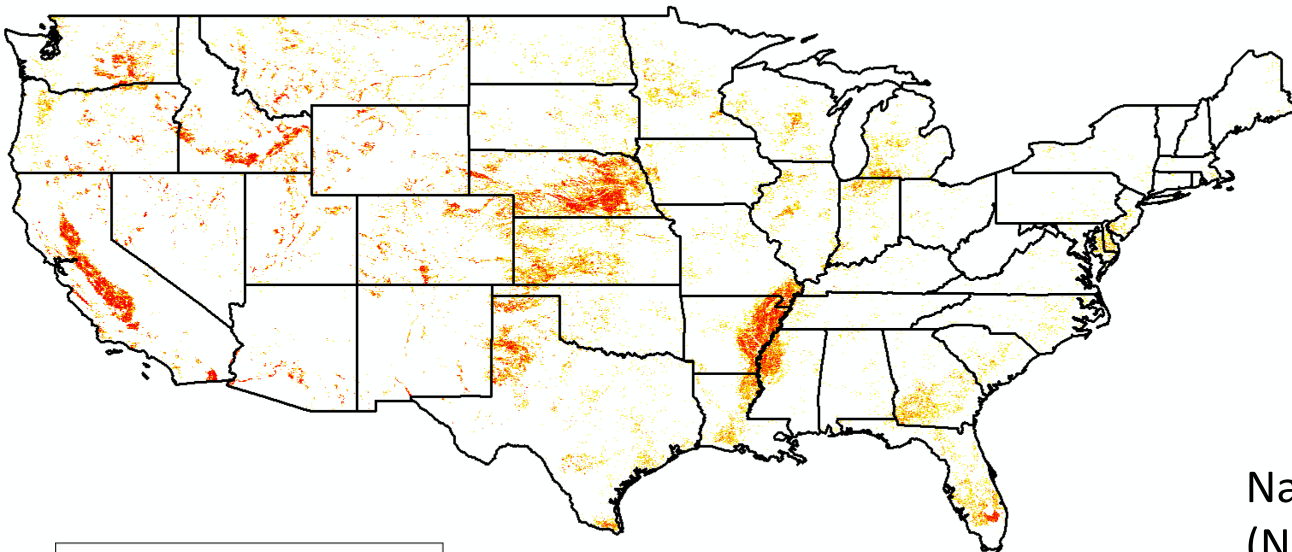






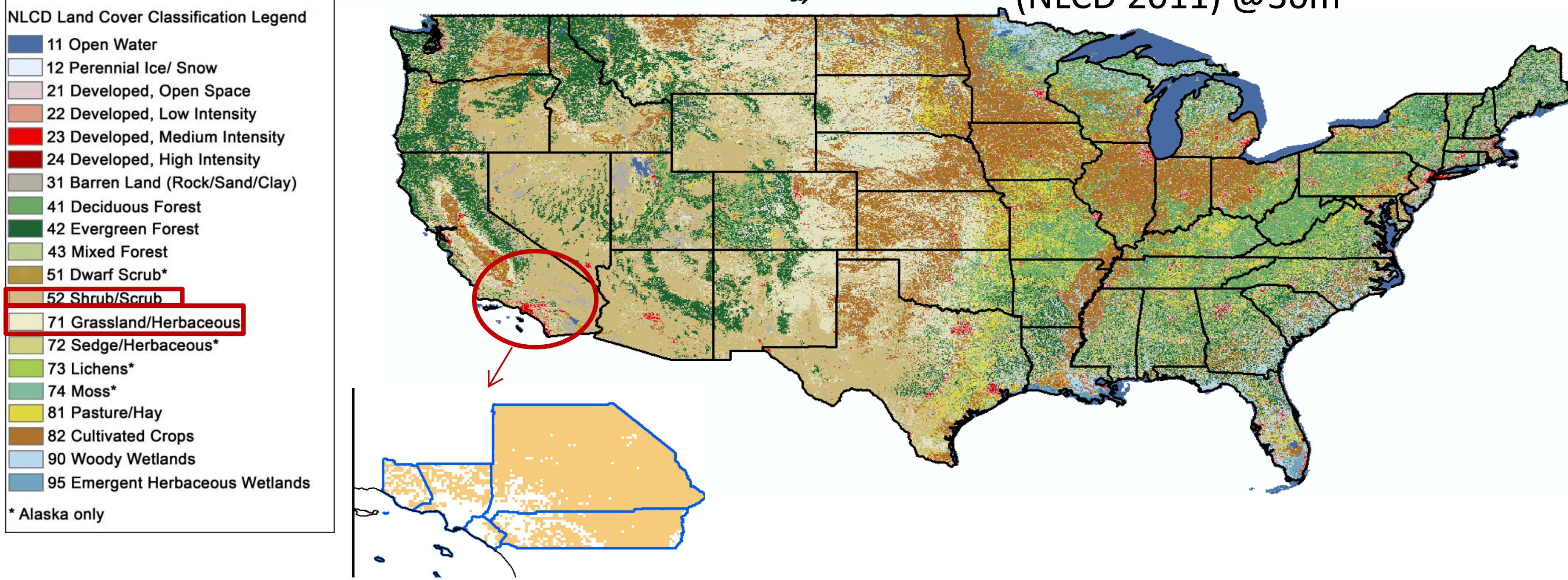


Human impact: Irrigated and non-irrigated regions

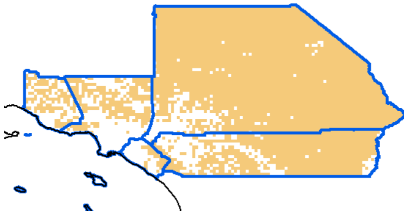


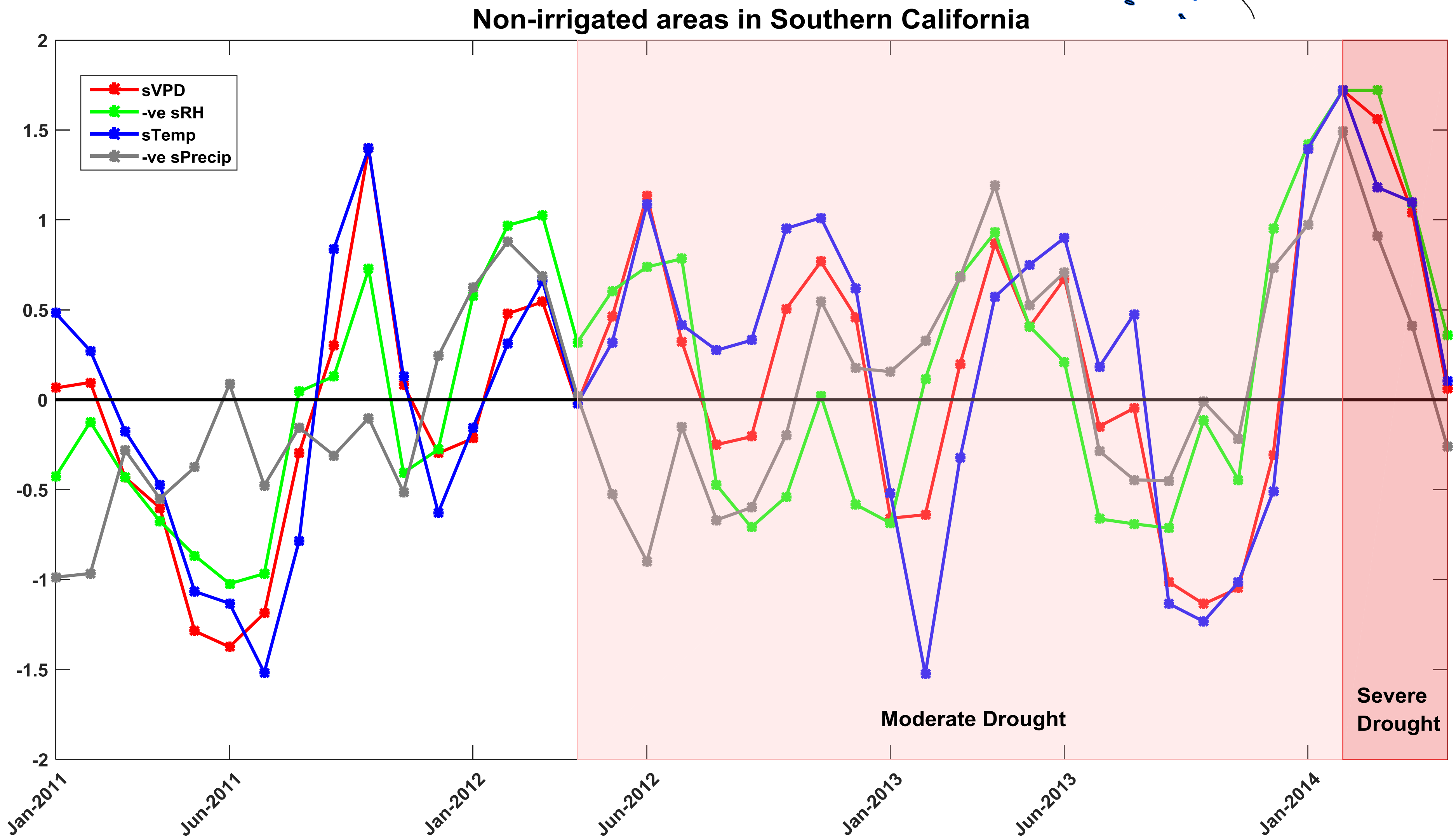
MODIS Irrigated Agriculture Dataset for the U.S. (MIrAD-US 2012) @250m,1km

National Land Cover Dataset (NLCD 2011) @30m

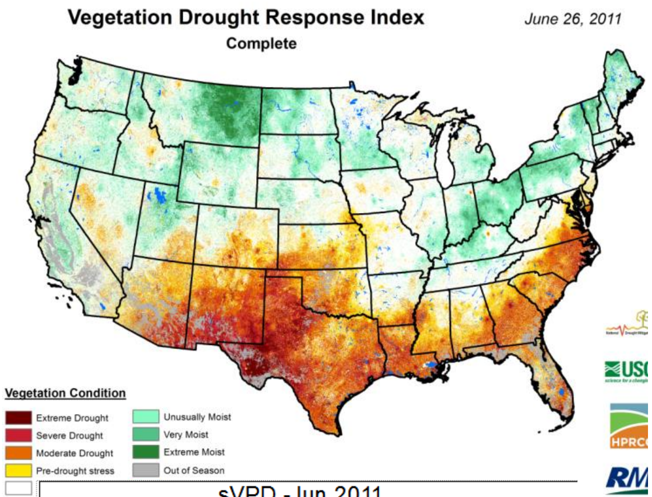


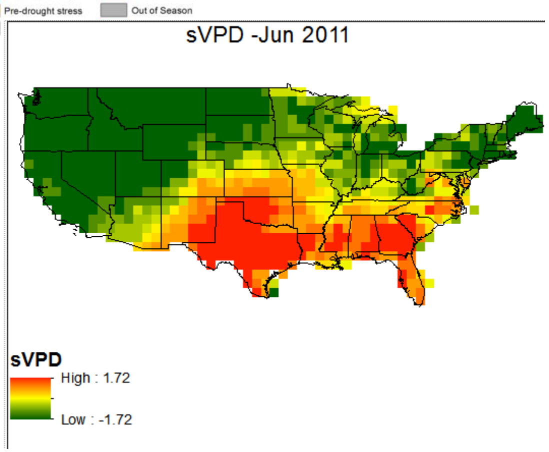
AIRS should contribute to USDM

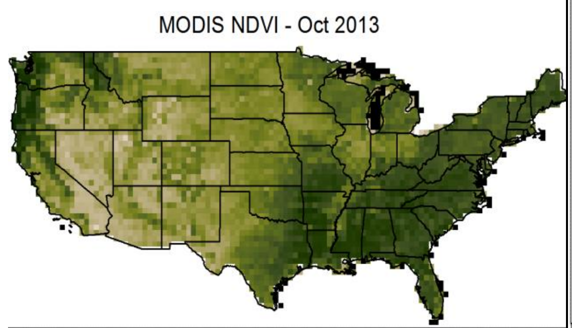


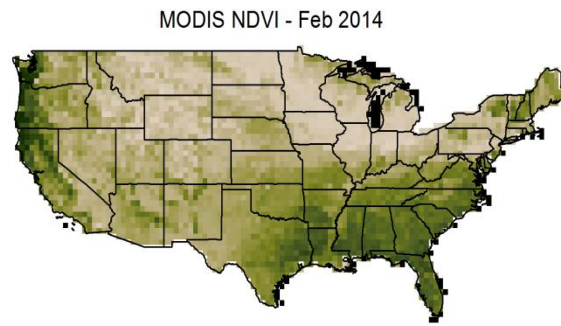


Impact on vegetation dryness

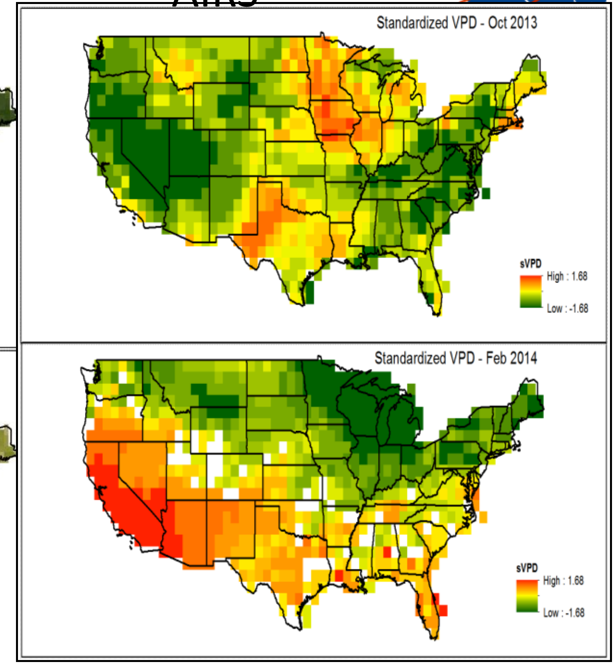








AIRS

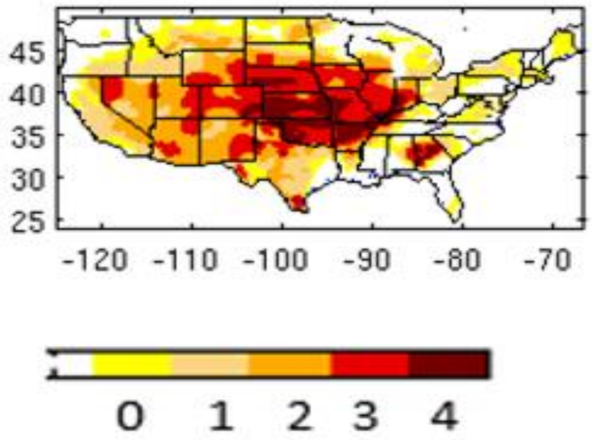


Annual burned forest area *v.* mean March–August VPD in SW forest area during 1894–2013. The figure is from Williams et al. (2014a)

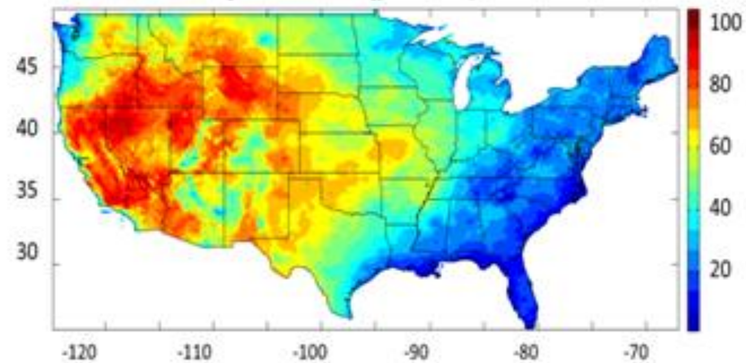
VPD and Fire danger

August 2012

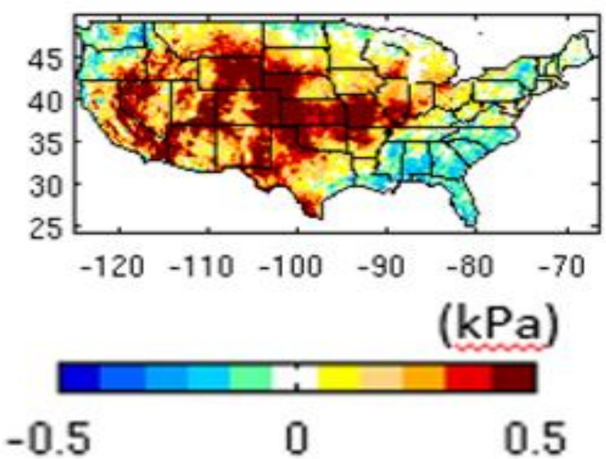
USDM drought category



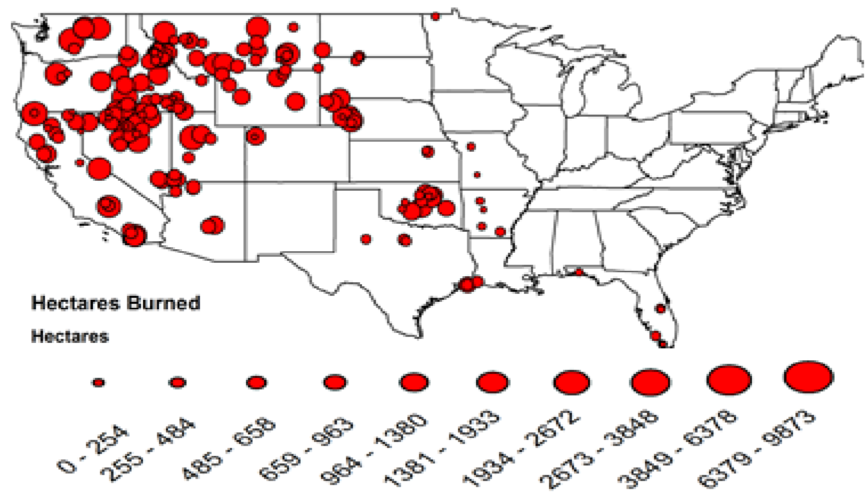
The **national fire danger rating system (NFDRS)** energy release component (ERC)



VPD anomaly

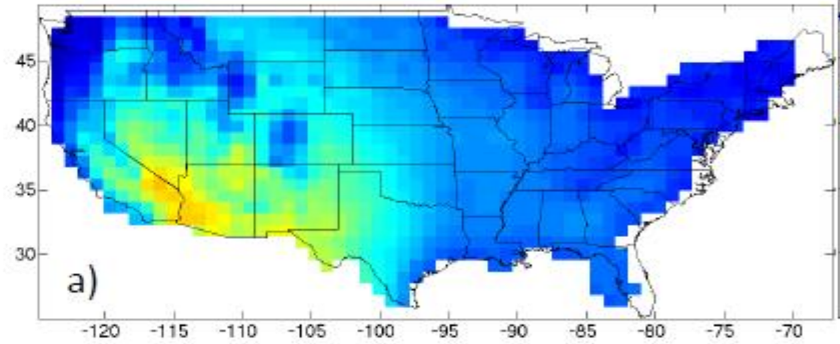


Fire occurrence : hectares burned

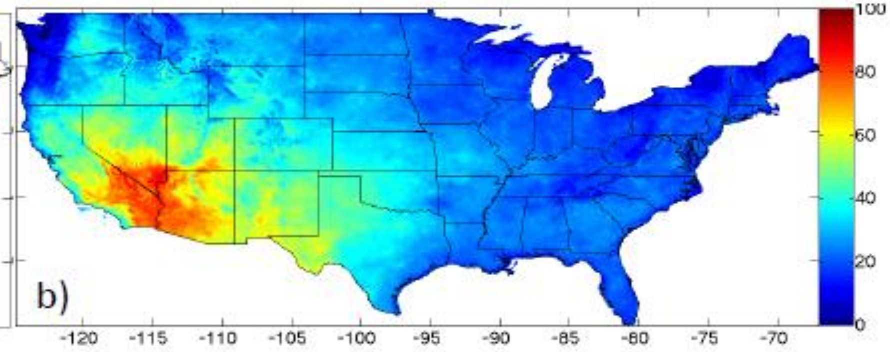


VPD and Fire danger

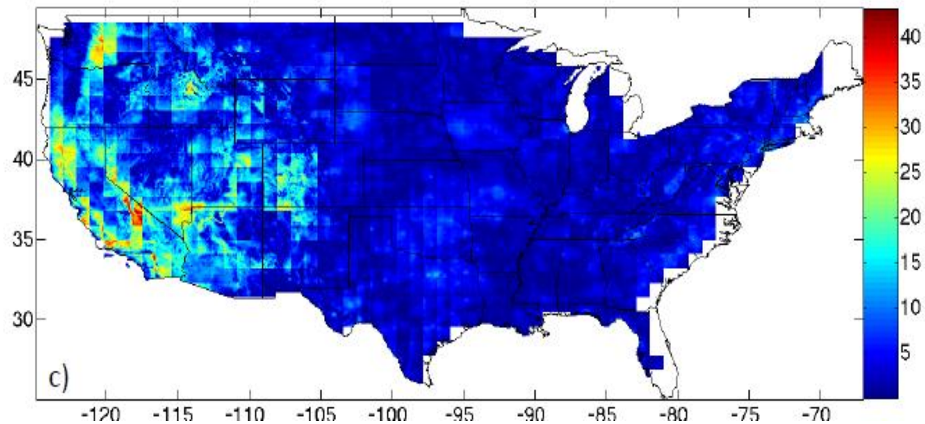
ERC using AIRS surface T and RH



ERC using Reanalysis data (U of Idaho)



The absolute difference between mean ERC of AIRS and reanalysis

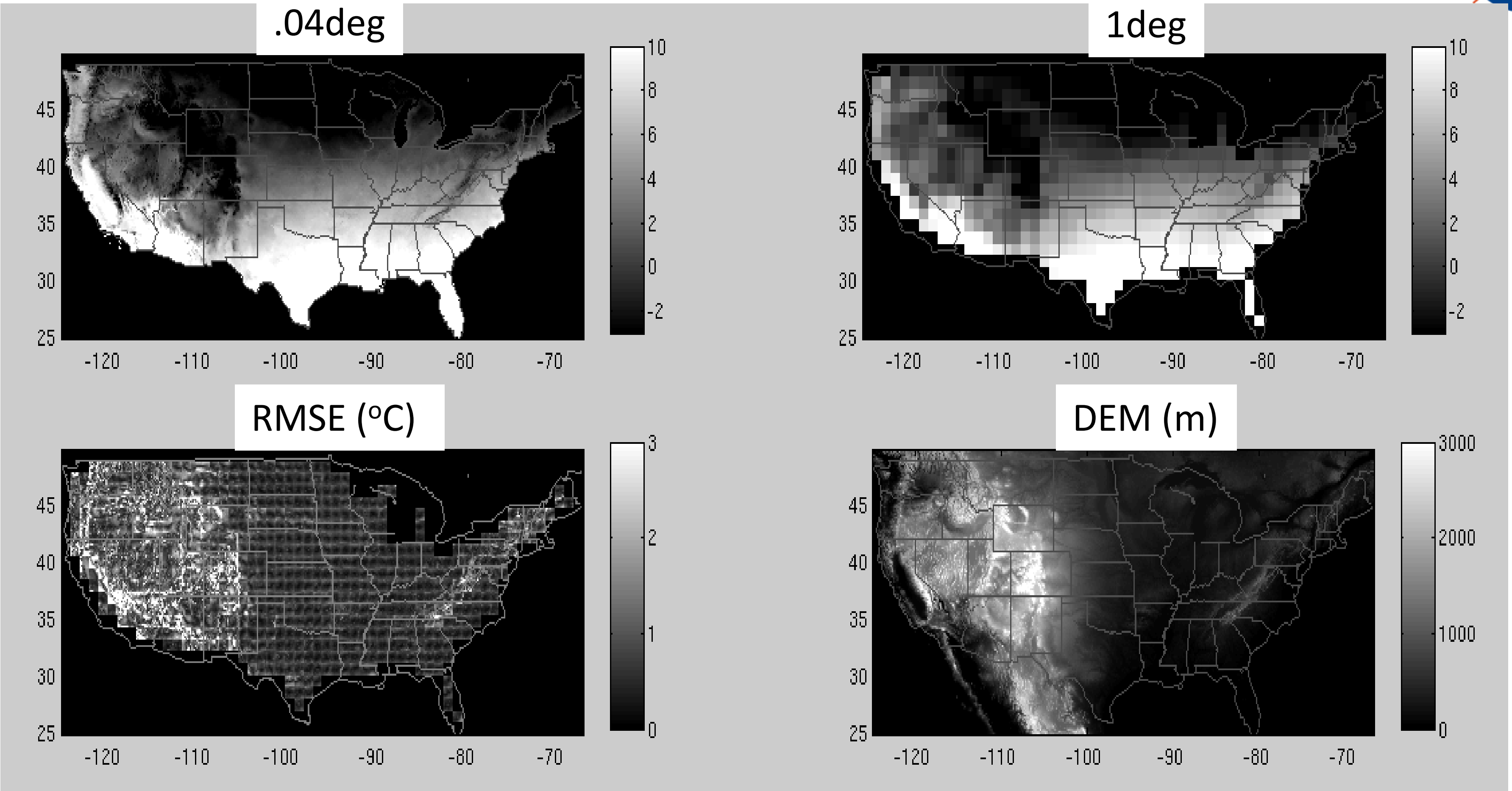


Natasha Stavros

d) Weather stations

e) Topography

Moving from 4km to 100 km grid can cause >3 °C temperature difference



Summer (2010-2012)

More than 3 °C in temperature is easily seen due to the spatial scale issue:

Suggestion : higher resolution data ?

AIRS and Heat index (human comfort)

NOAA's National Weather Service

Heat Index

Temperature (°F)

Relative Humidity (%)

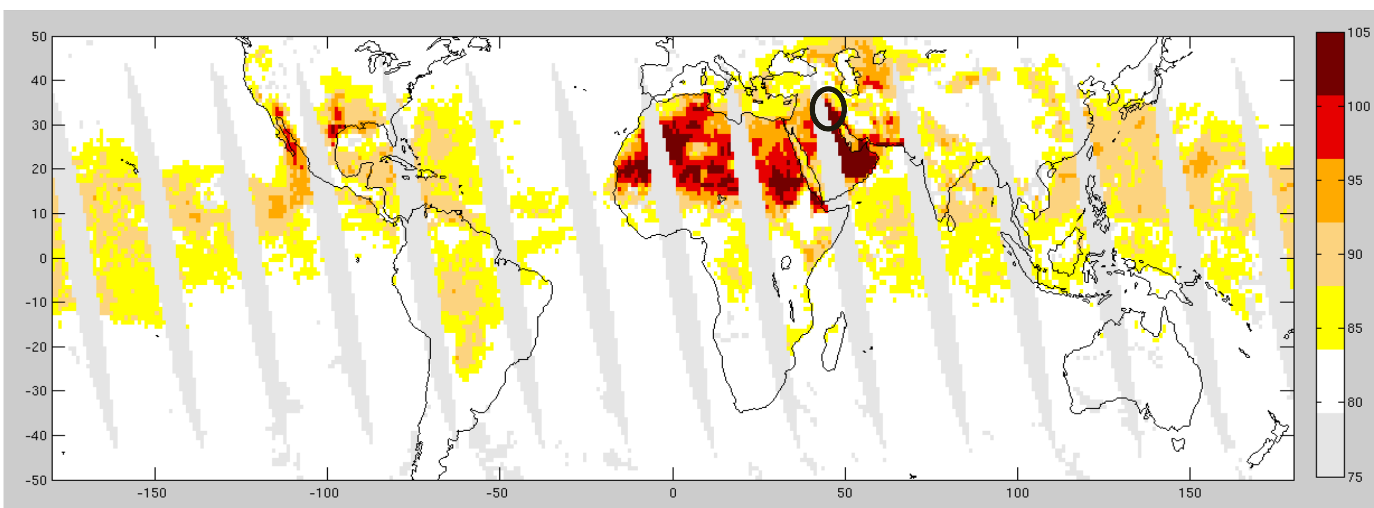
	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

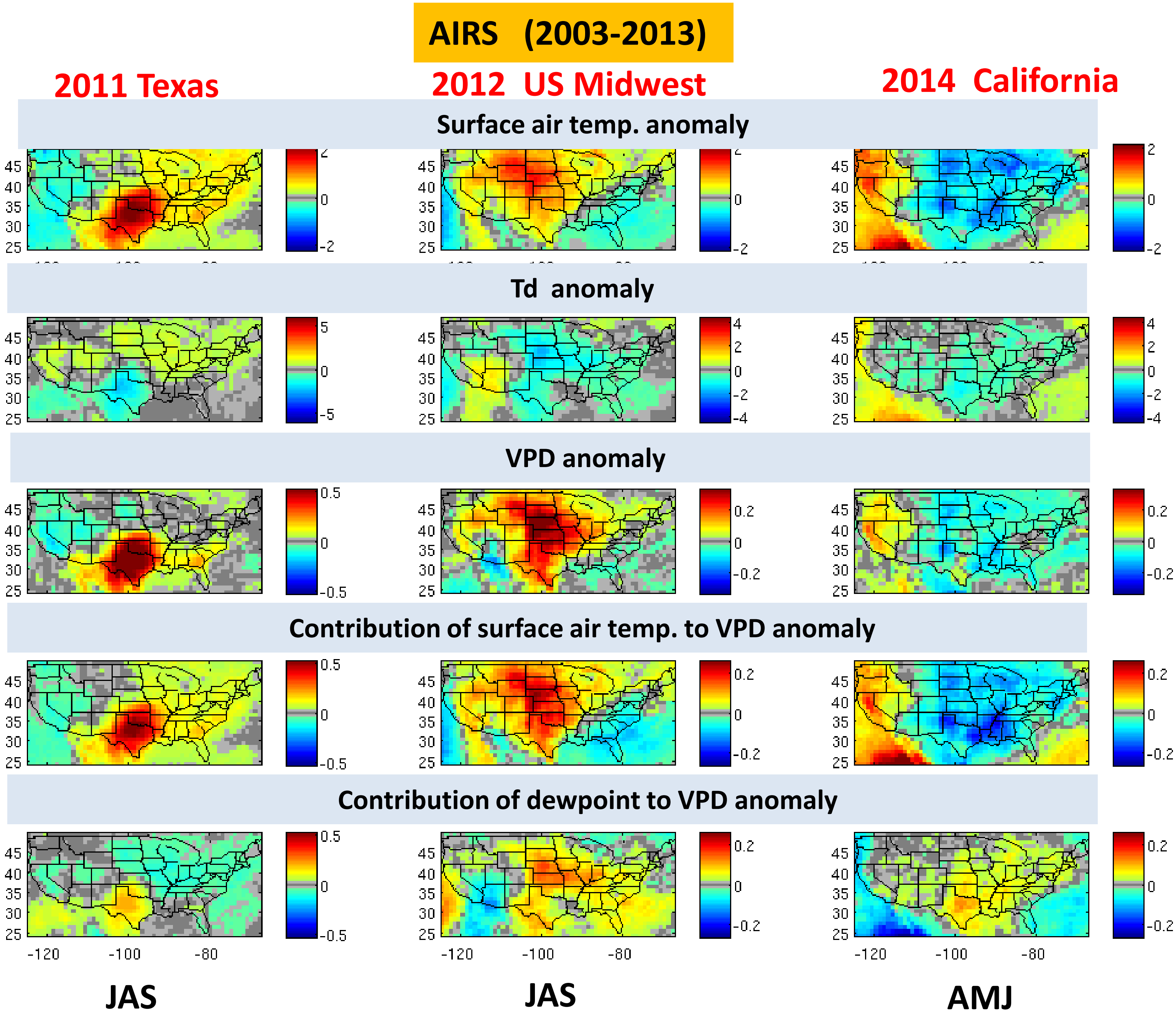
Caution | Extreme Caution | Danger | Extreme Danger

July 31 2015 (Iran Heat Index reached 165F)

AIRS ascending



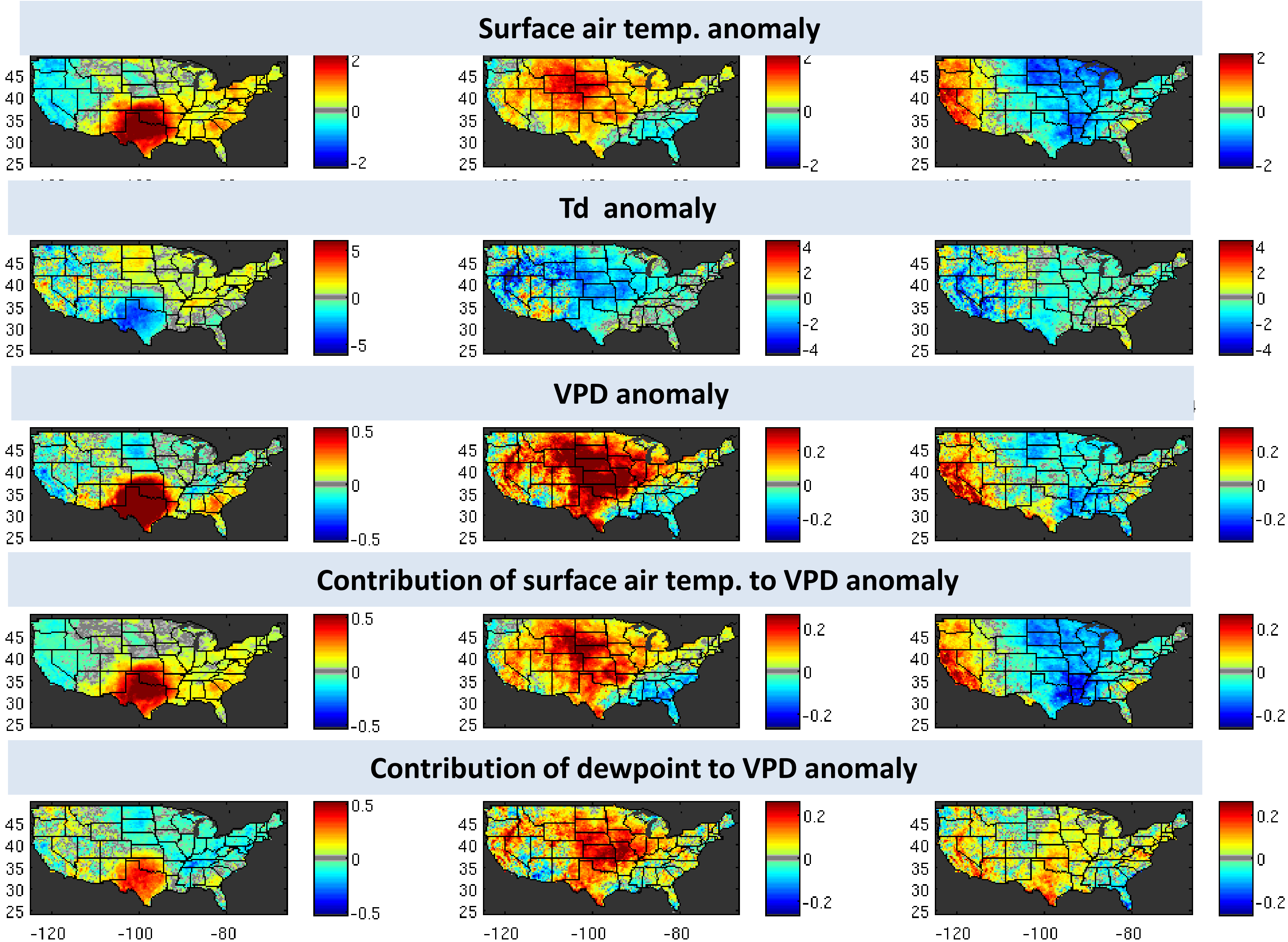
Evaluation of AIRS product



Evaluation of AIRS product

PRISM (2003-2013)

2011 Texas | **2012 US Midwest** | **2014 California**



What is needed:

- More rigorous validation of near surface temperature and humidity is needed: our case studies show that the pattern is captured fairly well, but the magnitude may not be accurate.

- Resolution is important for some applications, especially for regions with rugged topography.