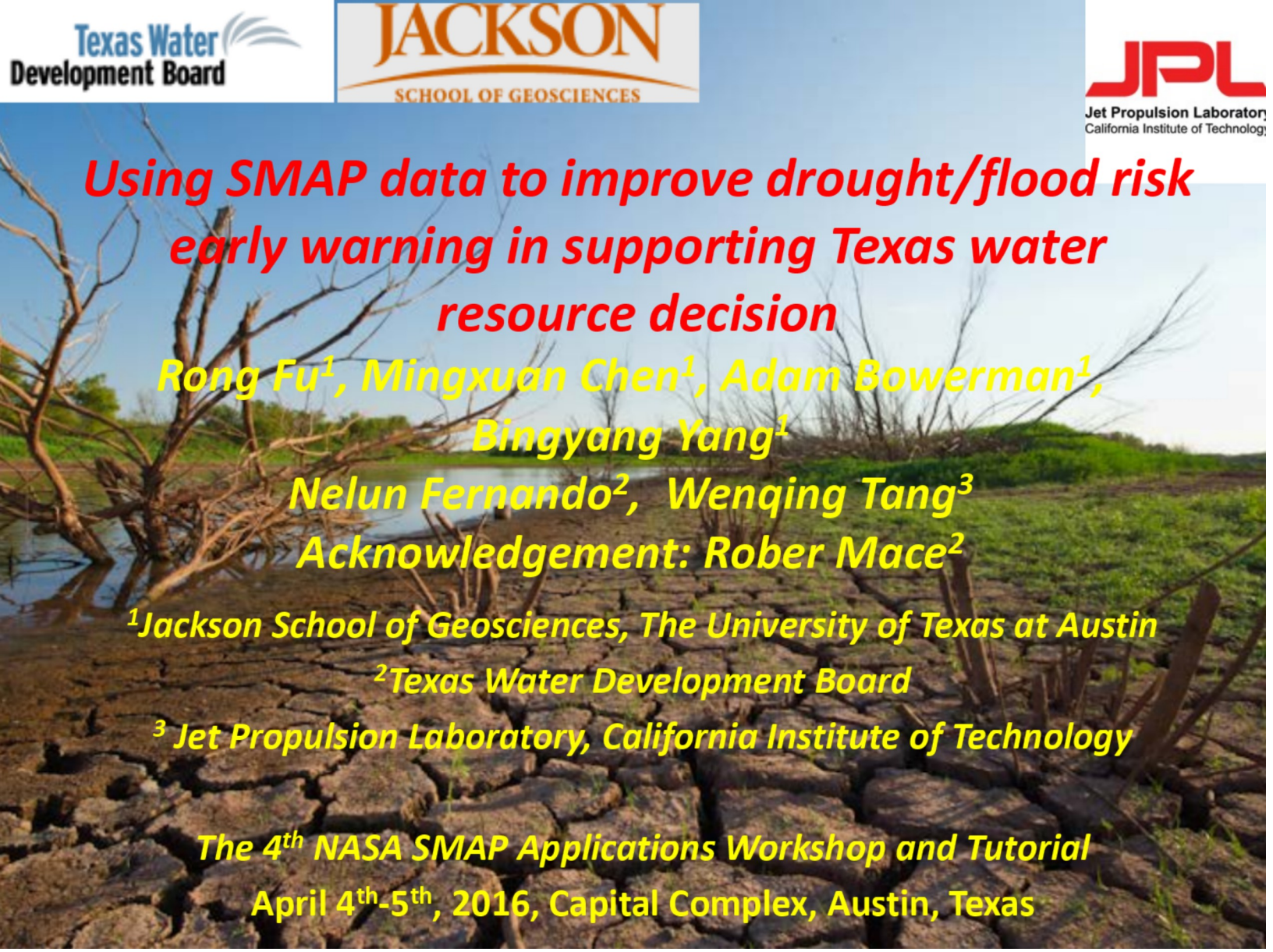

Using SMAP data to improve drought/flood risk early warning in supporting Texas water resource decision

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Acknowledgement: Rober Mace[2]

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The 4th NASA SMAP Applications Workshop and Tutorial

April 4th-5th, 2016, Capital Complex, Austin, Texas

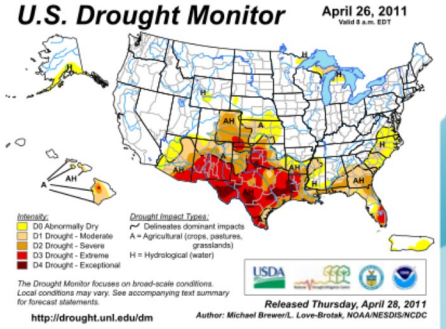
Regional and Global Drought/Flood Impacts:

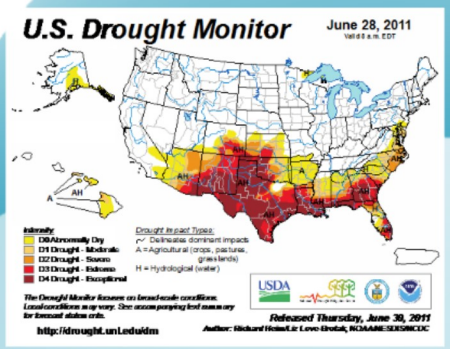
- *During 1980-2011: droughts occurred in 16 out of 21 years in US, with total cost of $210 B adjusted to 2011 (Smith and Katz 2013);*
- *The 2011 Texas Drought agriculture loss: $7.6B.*
- *The 2015 Central Texas Memory Day Flood: 24 people killed, sustained damage on 1400 homes, 1000 people displayed. (San Antonio Express-News)*

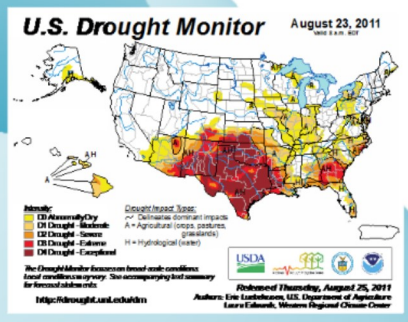
The 2011 Texas Drought

- **Seasonal forecast unable to predict major summer droughts in recent years, including the 2011 Texas Drought (Hoerling et al. 2013).**

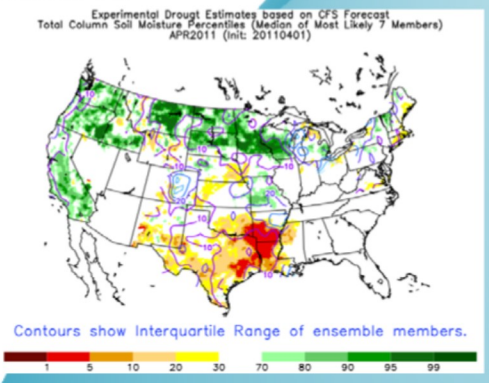
Observation

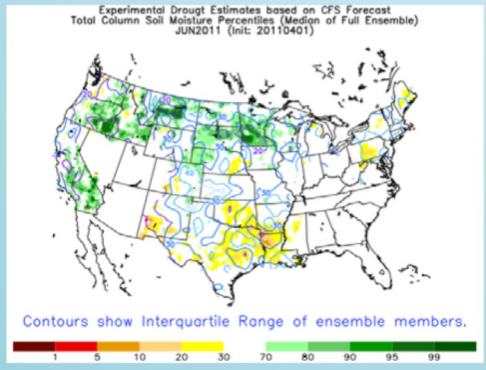


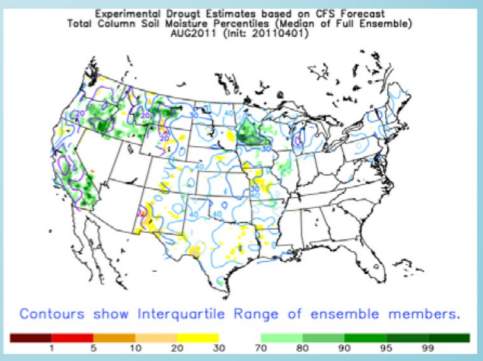




Prediction





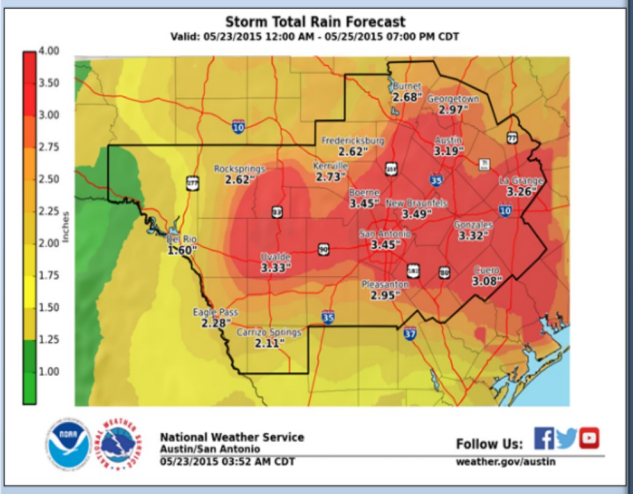


The 2015 Central Texas Memory weekend flood

- **Wet pattern was predicted and waning was issued, but underestimate the magnitude by nearly a fact of five.**

Wet Weather Pattern For The Holiday Weekend...

National Weather Service Austin / San Antonio — 5/23/2015 4:00 AM



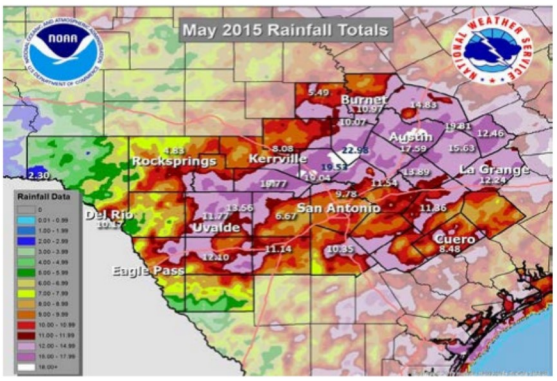
Rainfall totals 1 - 4 inches through Tuesday, with isolated 4-6 inches.

- Another wet period is expected this weekend as a disturbance moves near the region.
- Already saturated grounds will likely lead to further flash flooding concerns.
- Have a plan and Turn Around Don't Drown!

@NWSSanAntonio
weather.gov/ewx

420 AM CDT
Sat May 23 2015
National Weather Service
Austin/San Antonio, TX

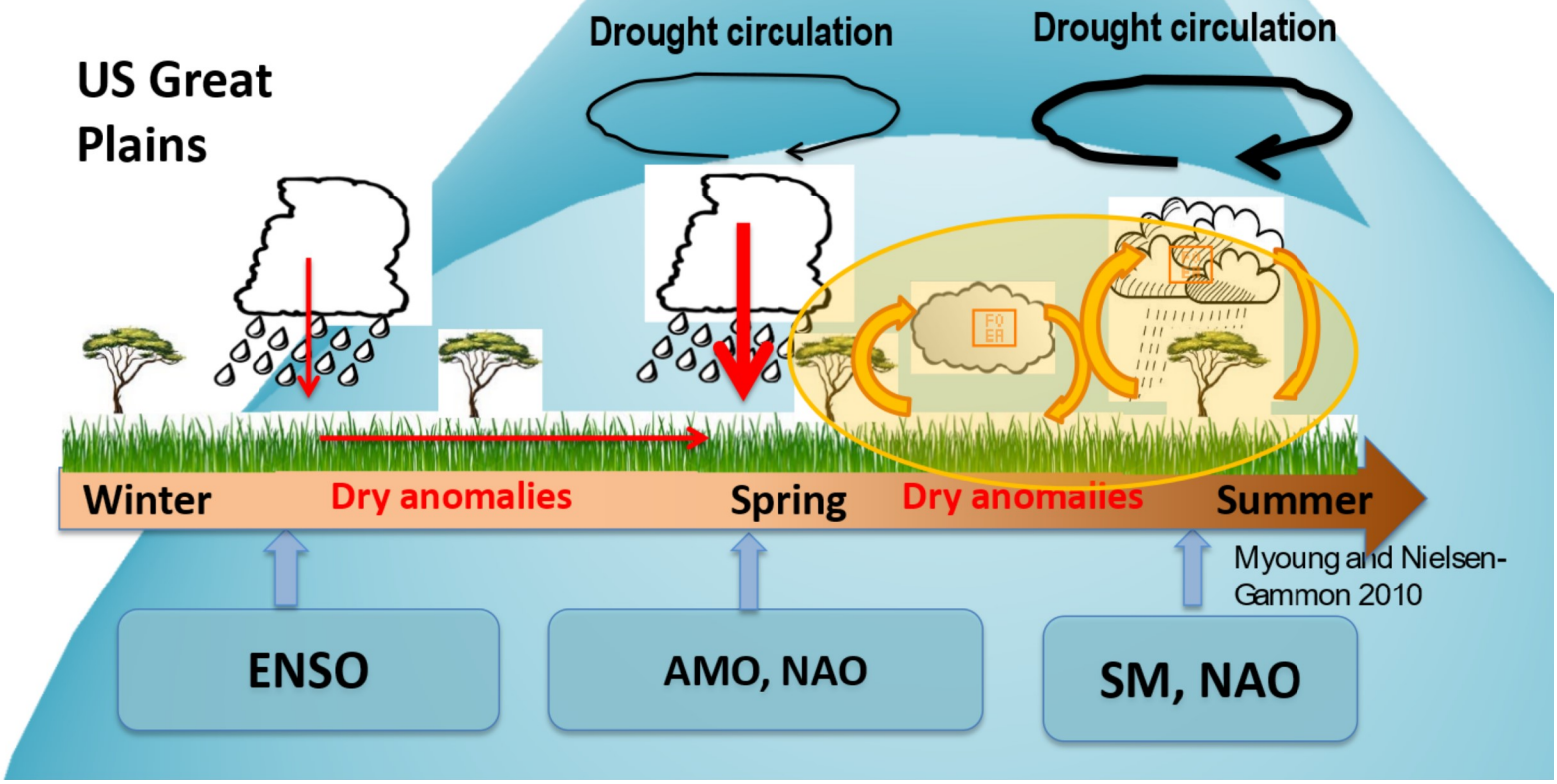
Observed Rainfall



- ***How can we applying our research results to improve drought and flood risk early warning for Texas and US Great Plains?***

What cause the observed drought persistence (predictability) from spring to summer?

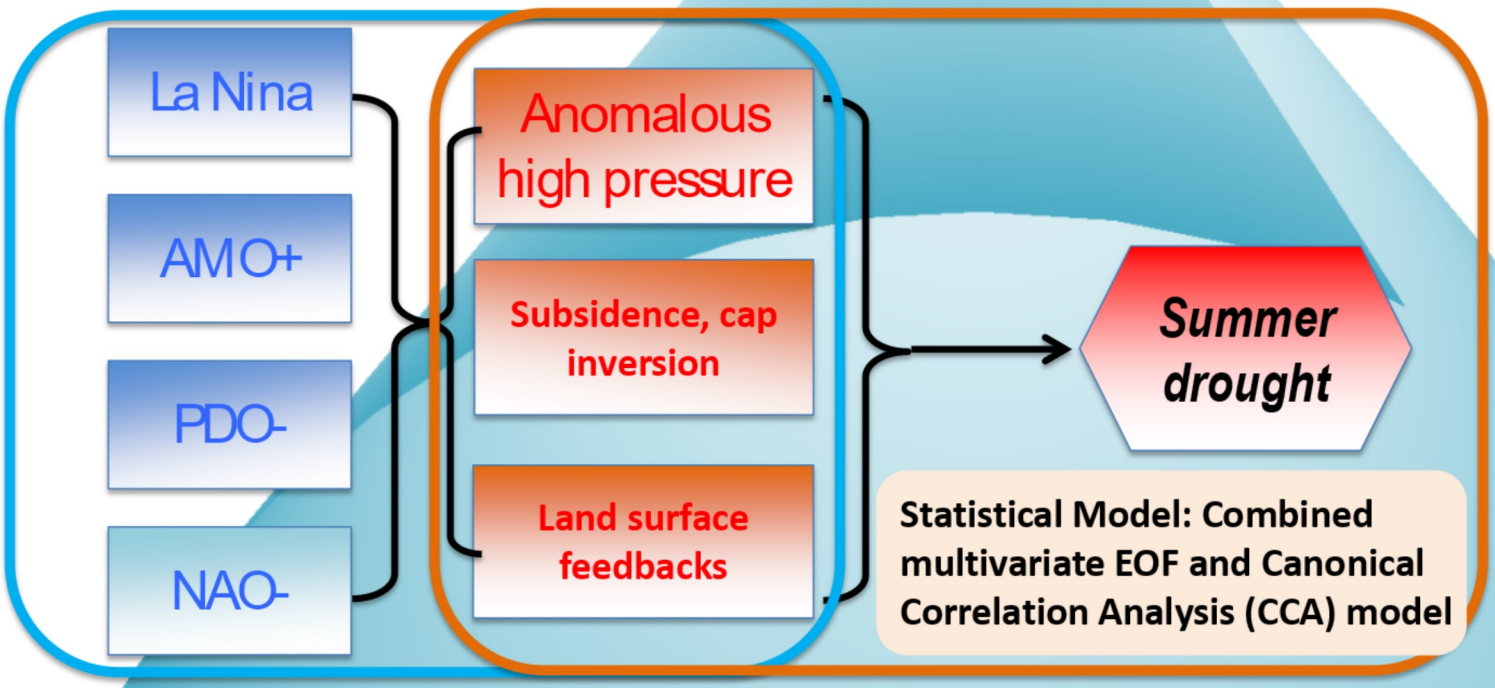
Pu et al. 2016, JGR-atmo
Fernando et al 2016, Climate Dynamics
Sun et al 2016, JGR-bio
Fu et al. 2016, in preparation



A hybrid physical-empirical model approach:

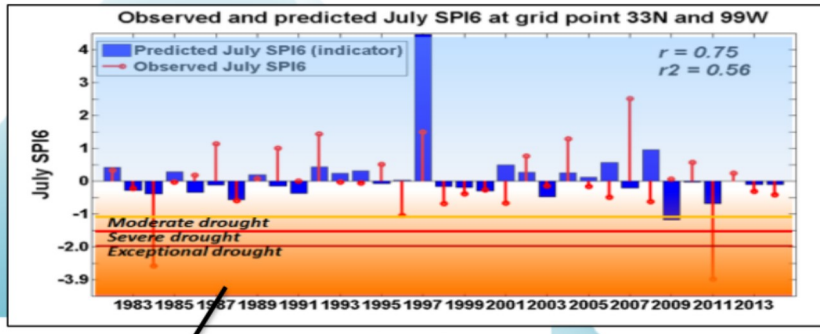
Winter → Spring: climate **model prediction/projection**

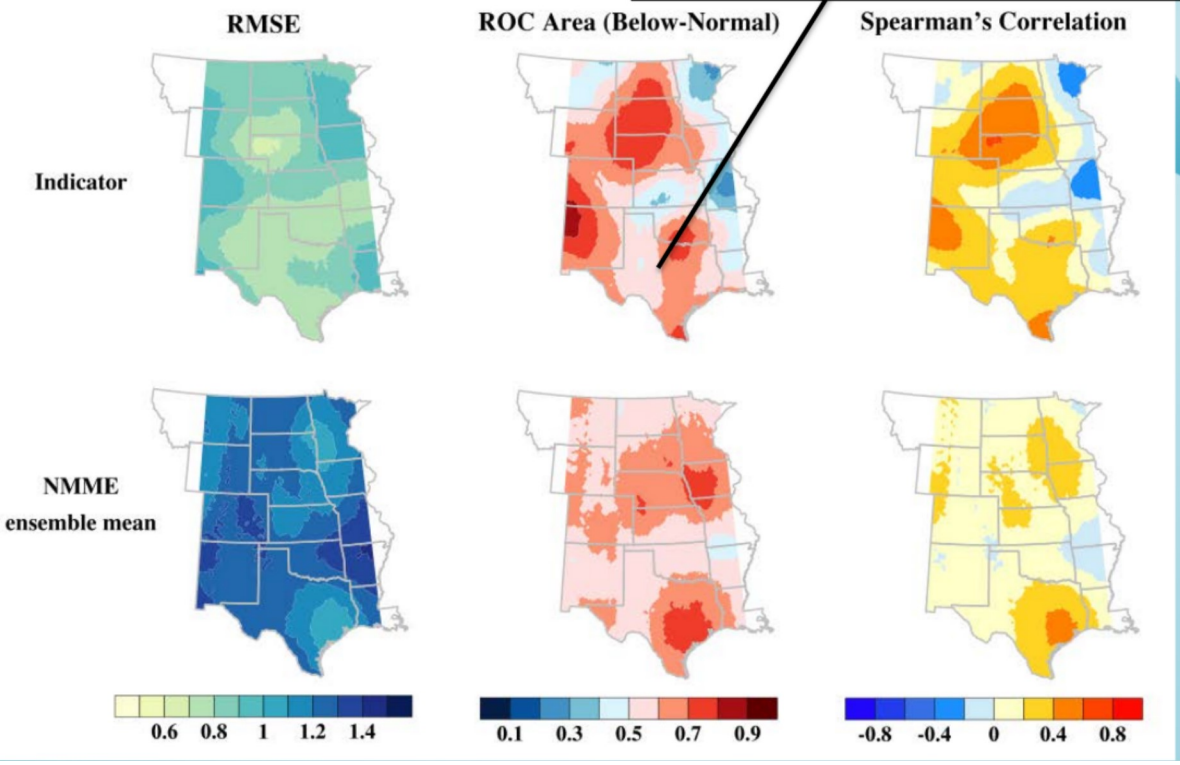
Spring → **Summer: empirical model prediction/projection**



Fernando et al. 2015 TWDB Tech Note

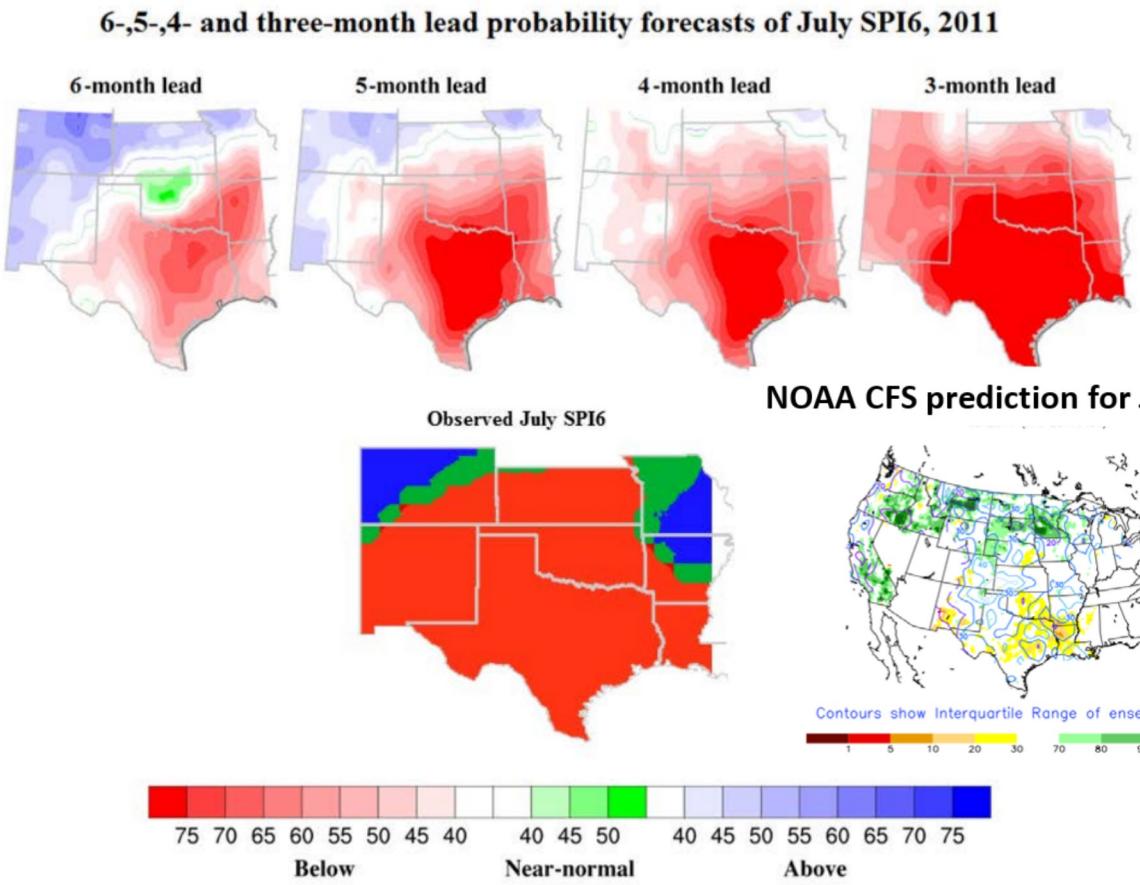
- ***The statistic prediction out-performs the state-of-art dynamic prediction (NMME ensemble seasonal prediction for 1982-2013)***





6-3 month leadtime hindcast of the 2011 drought:

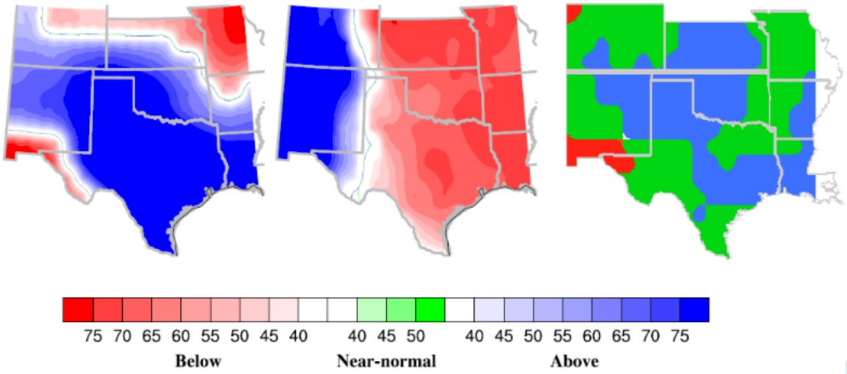
Our drought early warning system would have predicted the 2011 Drought!

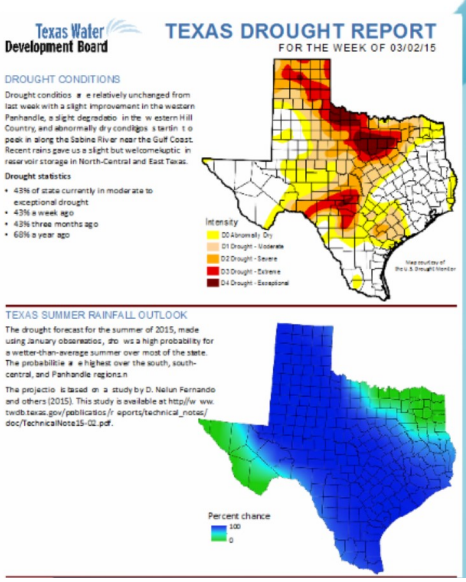


Prediction for 2014 and 2015 Summer:

Collaboration with TWDB and JPL/SMAP

2014 MJJ Rainfall Anomalies

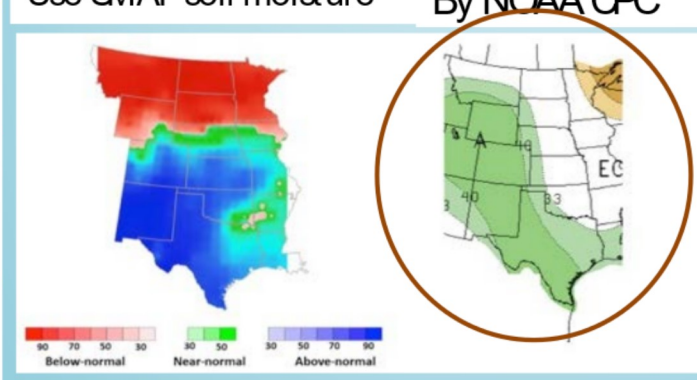




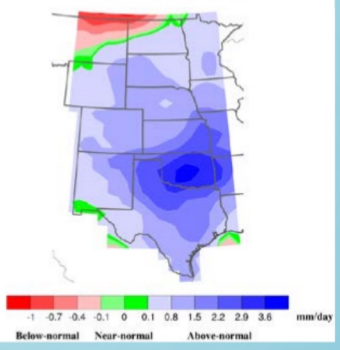
2015 prediction of May-July rainfall anomalies

Use SMAP soil moisture

By NOAA CPC

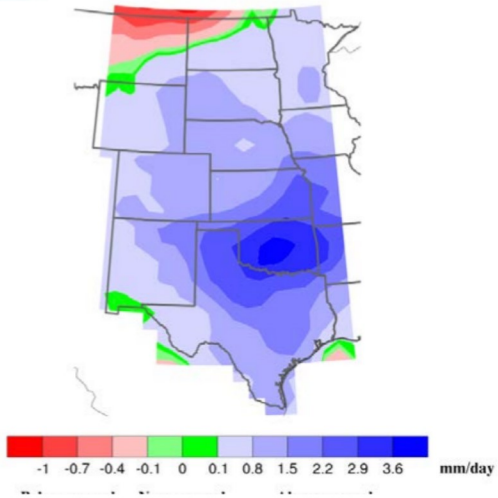


Observed

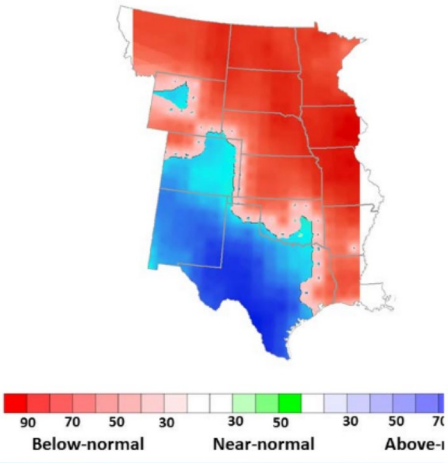


- ***Both SMAP and SMOS inputs lead to improved May-July rainfall anomalies prediction.***
- ***SMAP soil moisture input provides overall the best summer rainfall prediction over the US Great Plains, but has dry bias in NE TX, SE. OK, LA and AR, in 2015.***
- ***SMOS soil moisture input leads to less dry bias over NE Texas and SE OK.***

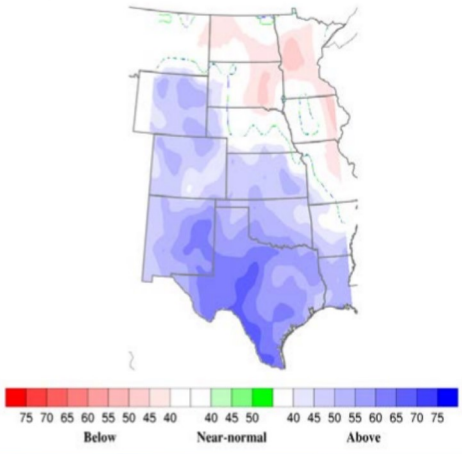
Observed



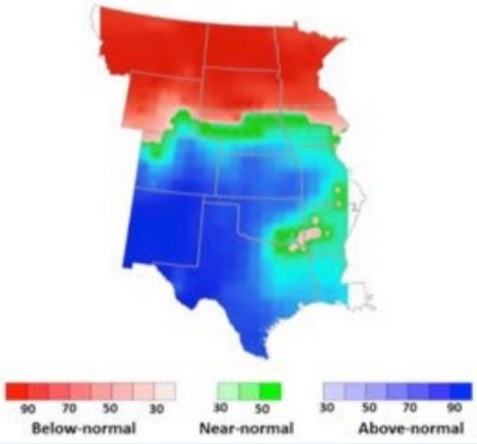
Prediction using Soil moisture from CFS



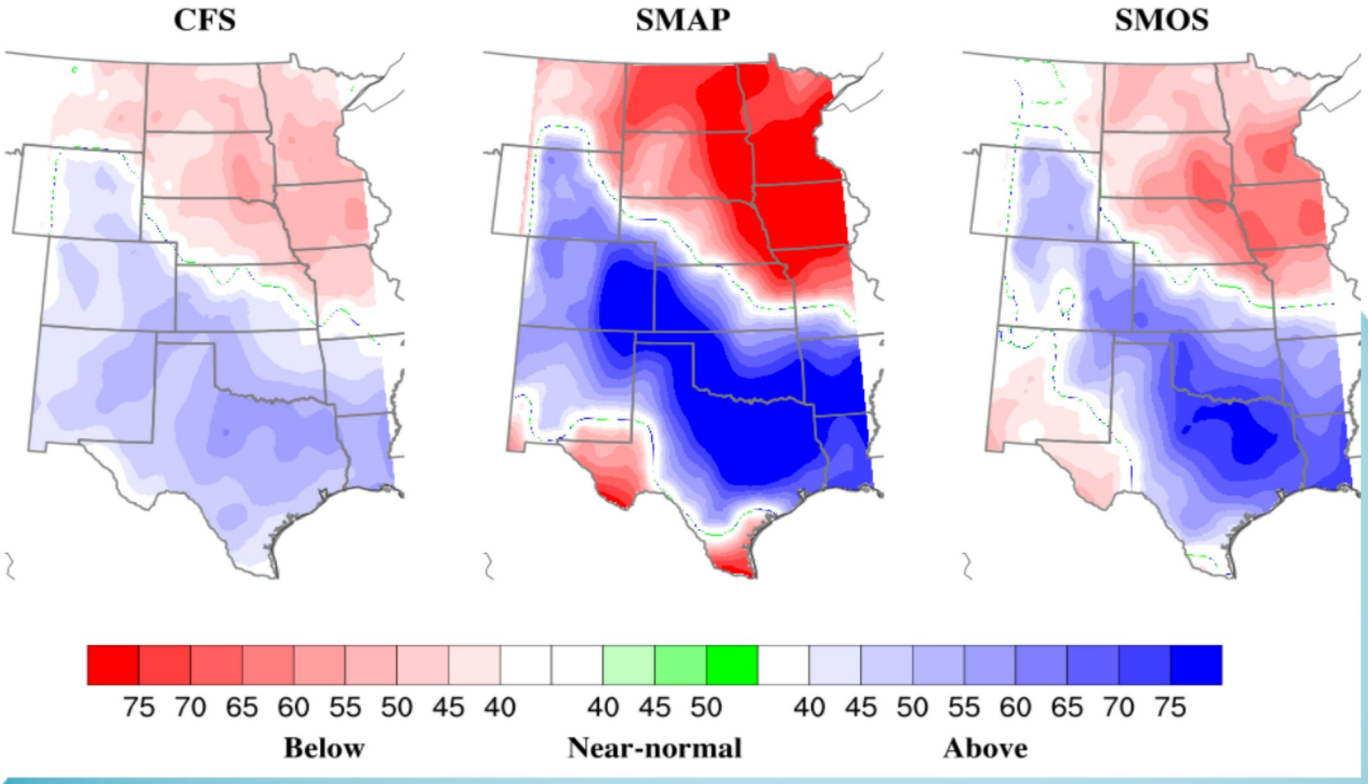
Prediction using Soil moisture from SMOS



Prediction using Soil moisture from SMAP



Forecaset 2016 MJJ rainfall for the Great Plains



Support state drought policy using improved drought early warning information:

Funding Opportunity Announcement No. R15AS00046

WaterSMART:
Drought Resiliency Project Grants for Fiscal Year 2015

U.S. Department of the Interior
Policy and Administration
Bureau of Reclamation
Denver, Colorado

May 2015

- **US Bureau of Reclamation Drought Resiliency Project awarded to TWDB: Tool for the early warning of impending summer drought over Texas**
  - Water user groups in Texas are required to have a strategy for reducing water use when water sources reach certain drought response trigger levels. By providing early warning of drought probability, early response measures may be taken to mitigate the impacts of drought and to reduce the need for more severe use restrictions. The forecasts will be updated on a bi-weekly basis and made accessible to water managers across the state through the Water Data for Texas website.

Exploring an early warning of flash flood or "rain bomb" index using SMAP data

- **Bowerman et al., Ongoing research using observation in 1979-2015**
- **Pu et al. 2016, JRG-atmo**