

*Sub-seasonal to Seasonal Forecasting and Predictive Needs in Texas**

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WSWC/CDWR Workshop

on

Improving Sub-Seasonal to Seasonal (S2S) Precipitation Forecasting

**Unless specifically noted, this presentation does not necessarily reflect official Board positions or decisions.*

Texas: *Poster Child for Climate Variability*



Lake Travis during the 2010-2014 drought

Source: Texas Parks and Wildlife Department



**Fischer Store Bridge
Memorial Day flood of 2015**

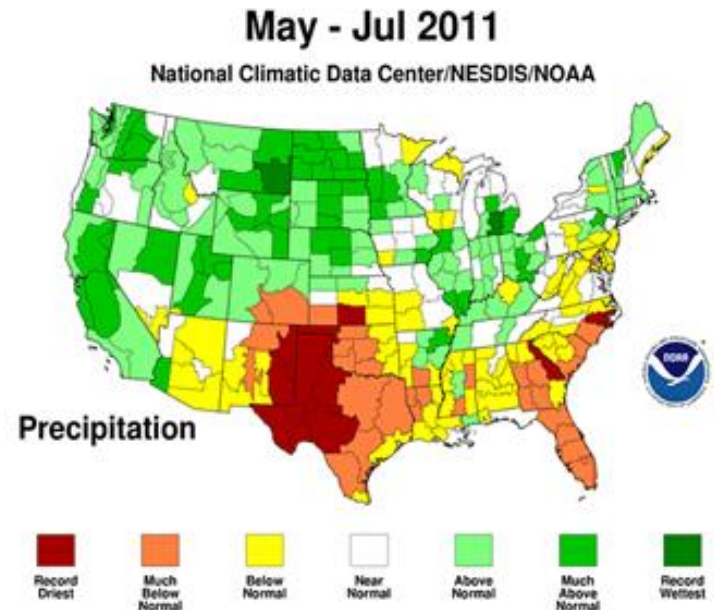
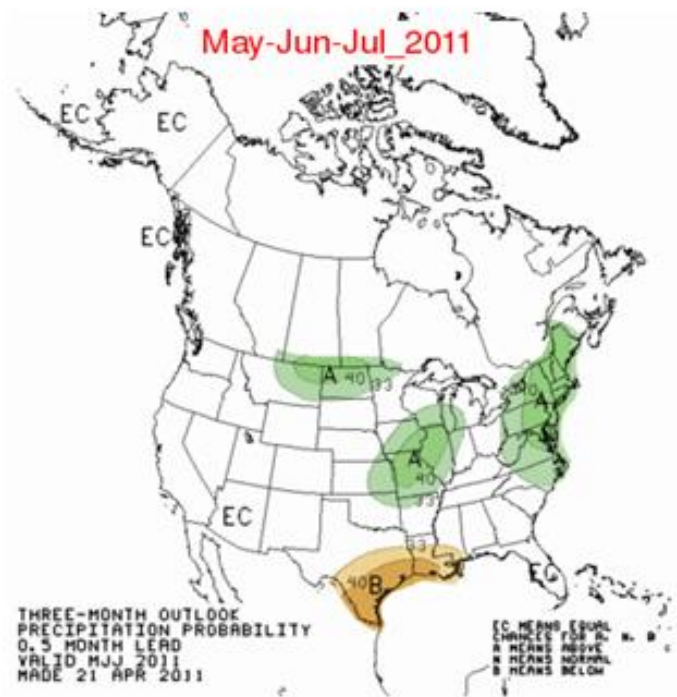
Source: <http://www.mysanantonio.com/news/local/article/TXDoT-Two-bridges-wrecked-in-the-Central-Texas-6294892.php#photo-8047612>

How do we manage near-term drought risk?
How do we minimize catastrophic flood losses?

May–July (MJJ): 2011 Rainfall Forecast

NOAA/CPC's forecast of MJJ 2011

Observed MJJ 2011



- Spring intensification of 2011 drought (not forecast)
- Forecasts of MJJ rainfall = early warning of intense summer drought

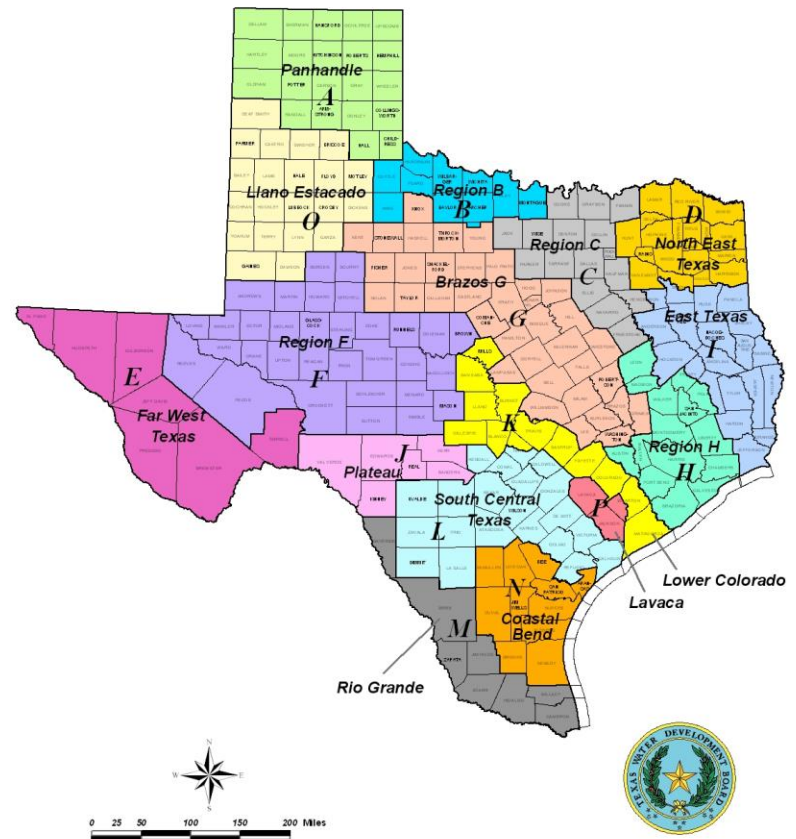
Reference: Fernando, D.N., Mo, K.C., Fu, R., Pu, B., Bowerman, A., Scanlon, B.R., Solis, R.S., Yin, L., Mace, R.E., Mioduszewski, J.R. and Ren, T., 2016. What caused the spring intensification and winter demise of the 2011 drought over Texas? *Climate Dynamics*, 47: 3077. doi:10.1007/s00382-016-3014-x.

Changes to Drought Planning After 2011

- Texas Administrative Code § 358.3 (1)
Rule Modification:

- Plans must provide for the preparation for, and response to, drought conditions.
- Water User Groups must have:
 - *Drought response triggers for all water sources*
 - *A drought water management strategy (short-term demand reduction)*
- Seek information on forecast drought conditions.

Regional Water Planning Areas



Updates to TWDB's Rainfall Forecast Tool

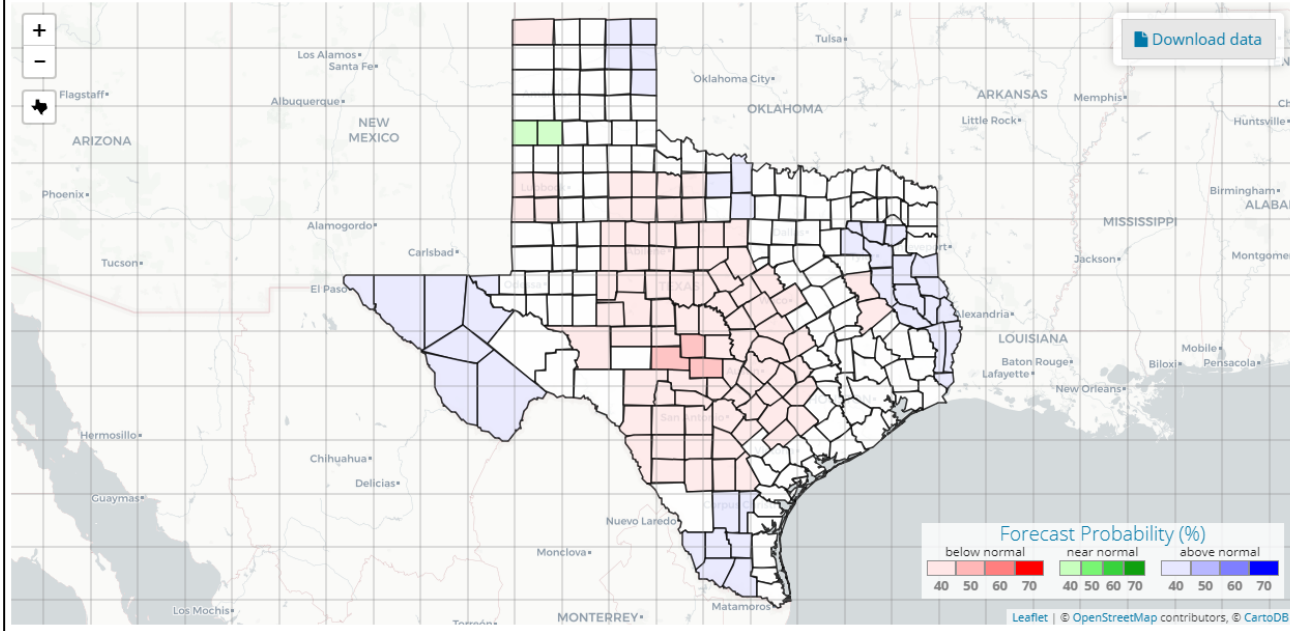
Forecast of Average May–July Rainfall

Issued: May 1, 2018

Current (3.0-Month Lead) Forecast

Past Lead-time Forecasts

Click on county for forecast details



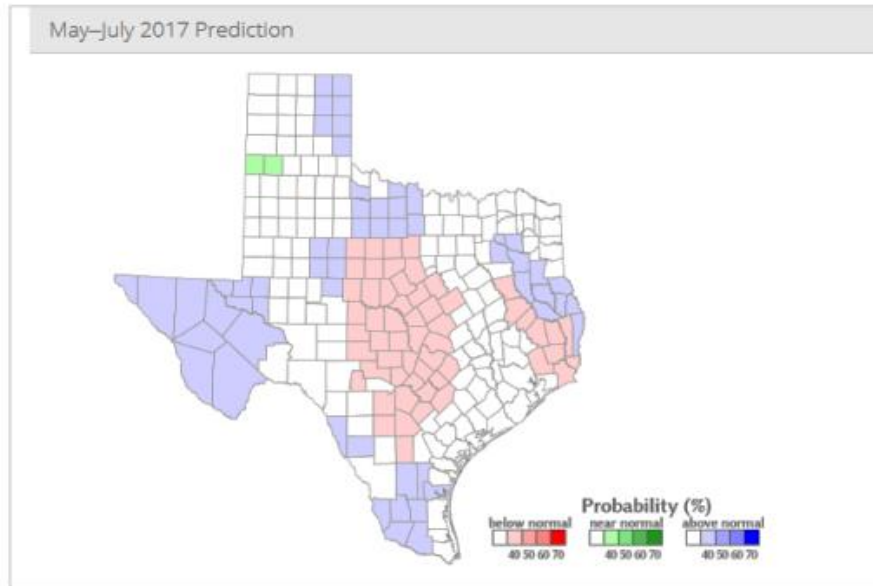
- Hybrid dynamical-statistical forecasts (mid-Jan–end-Mar)
- Process-based statistical for forecast issued mid-Apr and beginning of May (end-Apr ICs)
- County-level forecasts

Source: <http://www.waterdatafortexas.org/drought/rainfall-forecast>
<http://www.waterdatafortexas.org/drought/rainfall-forecast-info>

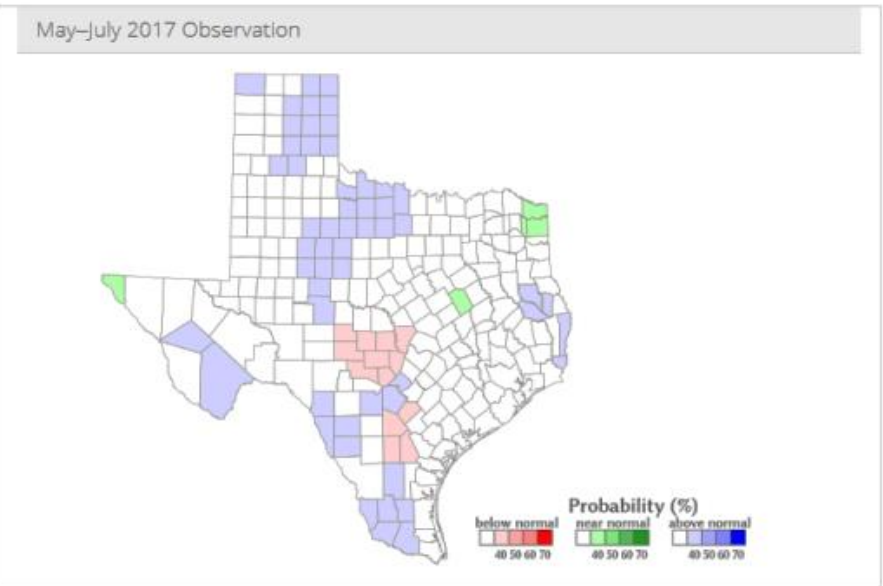
Reference: Fernando, D.N., et al. 2015. Early warning of summer drought over Texas and the south central United States: spring conditions as a harbinger of summer drought. Texas Water Development Board. 41 pp. http://www.twdb.texas.gov/publications/reports/technical_notes/doc/TechnicalNote15-02.pdf

Tool Performance in 2017

Prediction



Observation



Skill metrics:

- **Heidke Skill Score (overall score of forecasts) = 0.48**
- **Brier Skill Score for the three forecast categories**
 - Below normal: 0.24
 - Near-normal: 0.13
 - above-normal: 0.34

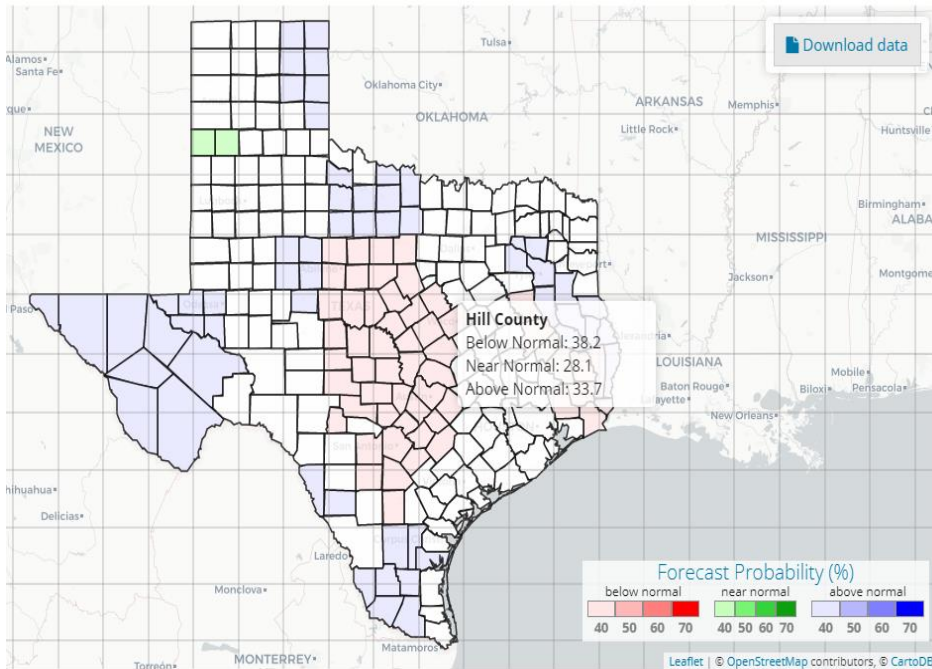
Skill

$-\infty$ to 0: skill worse than climatology

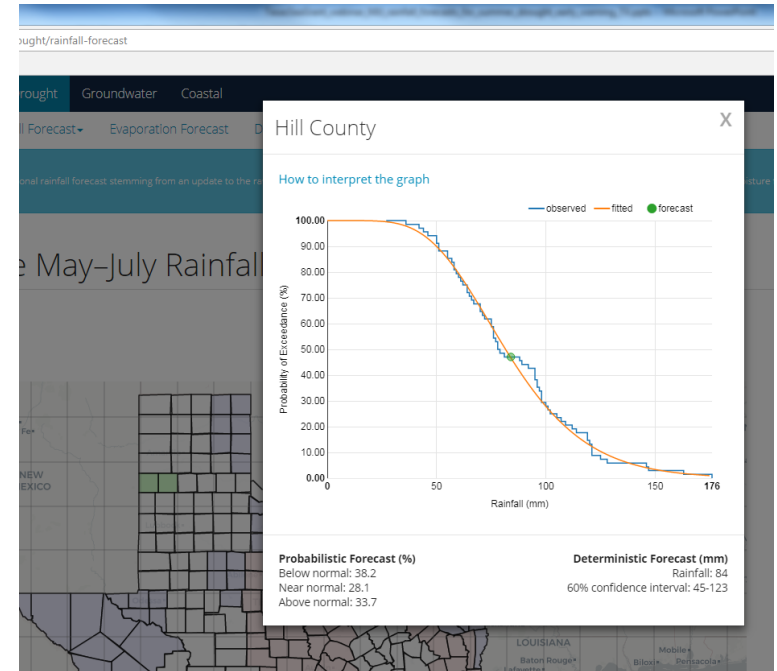
= 0: no skill over climatology

0 to 1: skill better than climatology

Deriving Information Products from Forecast

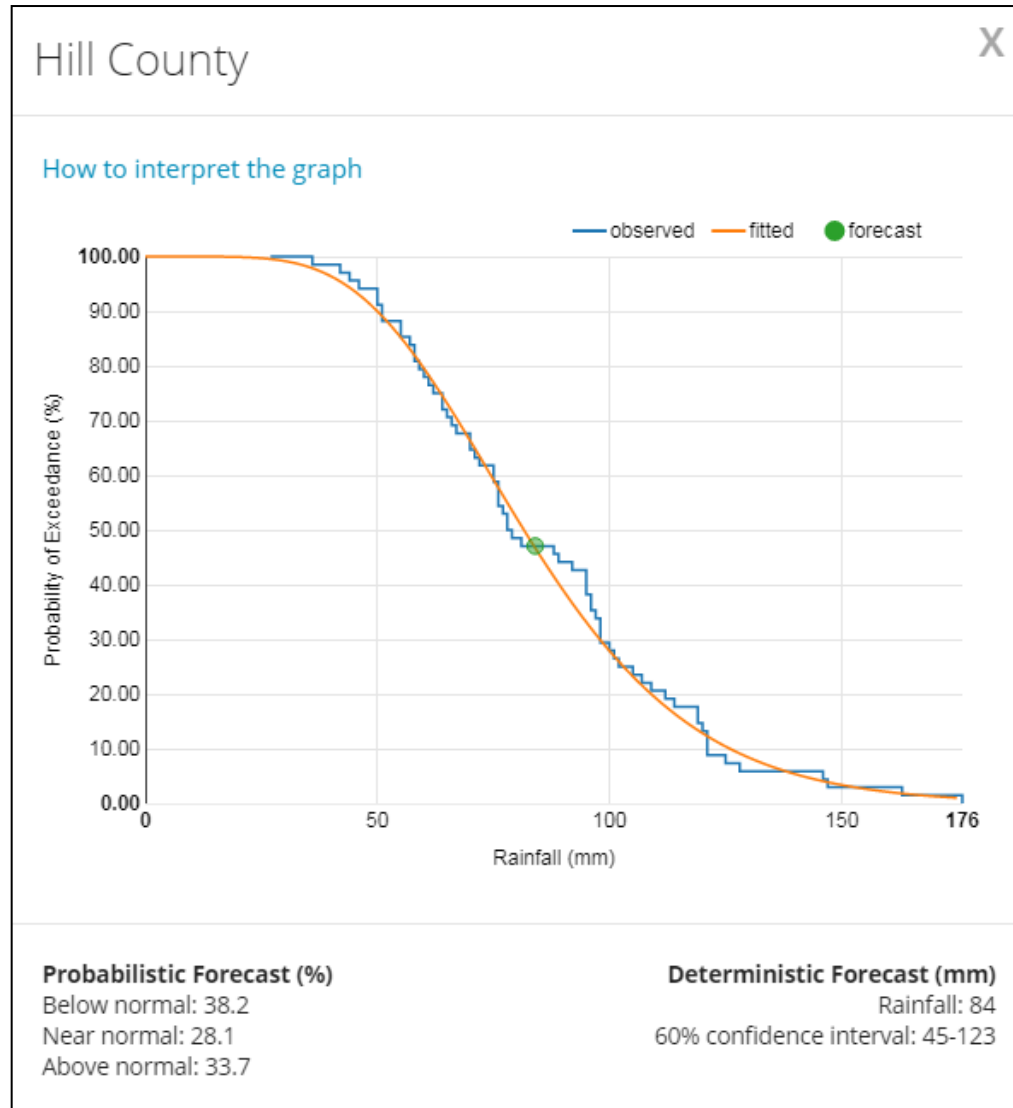


Hover over county to obtain a **probabilistic forecast** to ascertain whether upcoming season will be below-, near-, or above-normal.



Click on county to obtain **probability of exceedance (POE)** plot for historical rainfall over location. Forecast rainfall quantity shown as green dot.

Probability of Exceedance Plot

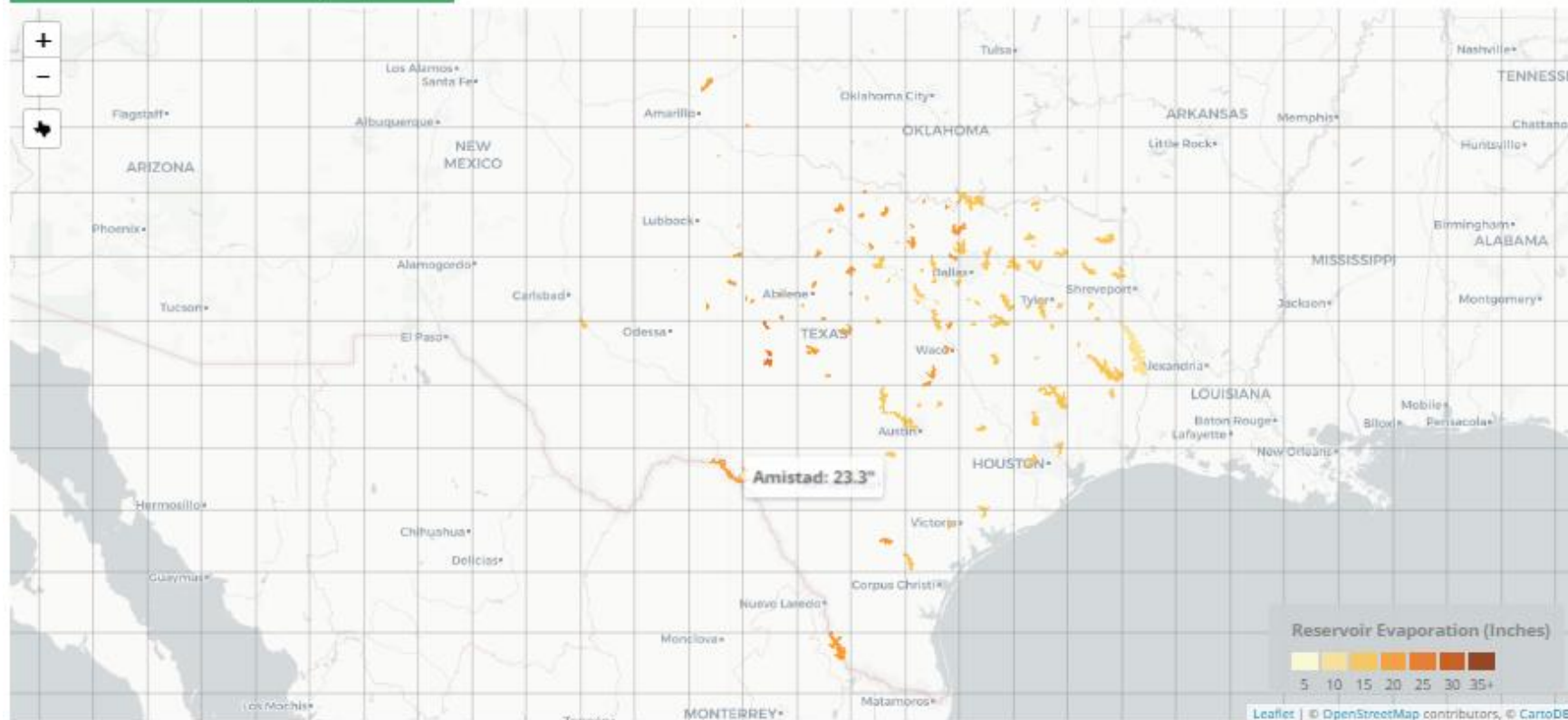


TWDB's reservoir evaporation rate forecast

Forecast of Total May–July 2018 Reservoir Evaporation

Issued: May 1, 2018

Hover over reservoir on map for evaporation value.



Source: <https://waterdatafortexas.org/drought/evaporation-forecast>

Forecasts for Drought Contingency Planning



- Issued experimental reservoir storage forecasts for the 2017 MJJ season.
- Meant to guide the implementation of drought contingency triggers for these reservoirs.
- Brazos River Authority plans to include the MJJ rainfall forecast in the 2019 revision of its Drought Contingency Plan.

Planned tool update: provide forecasts by HUC 10 boundaries.



Aquilla Lake

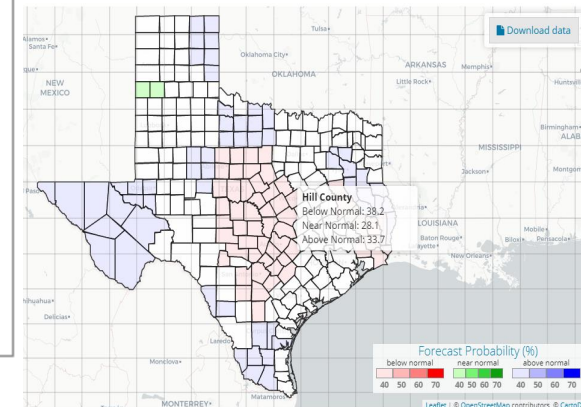
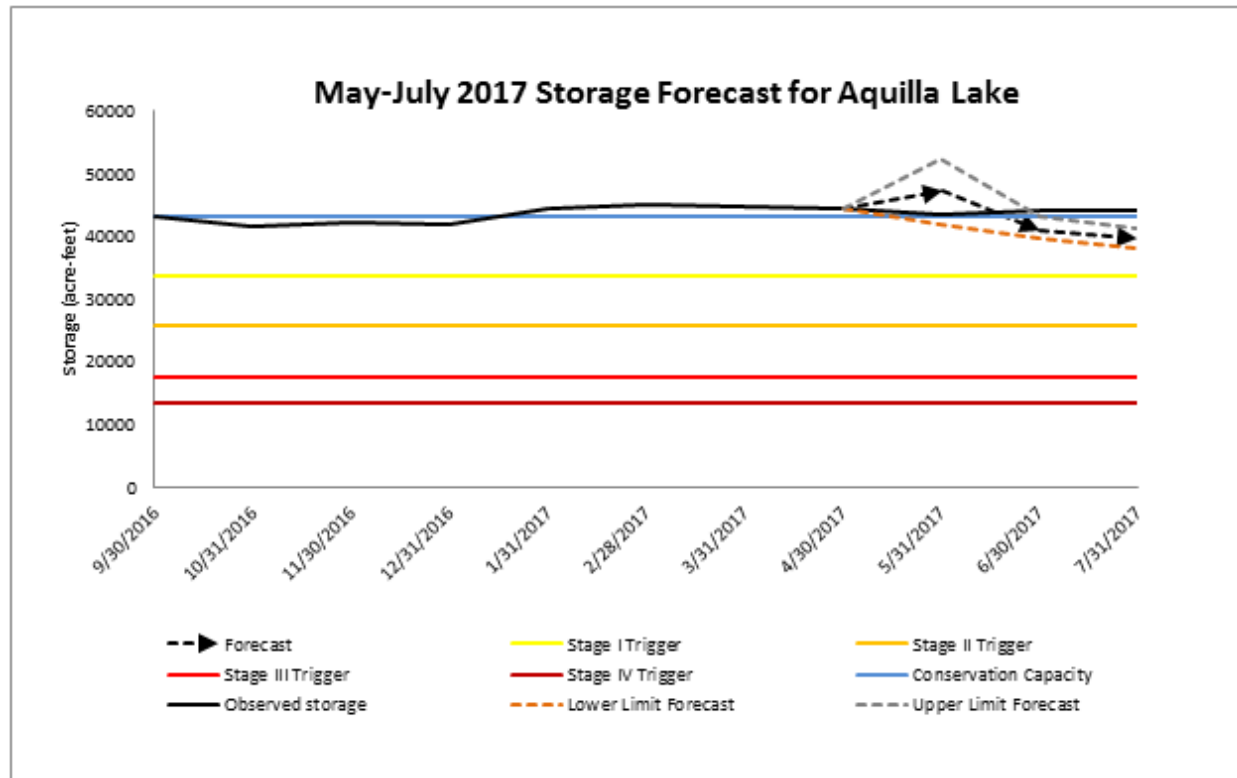


Lake Limestone



Proctor Lake

Forecast and Observed Storage: *Aquilla Lake*

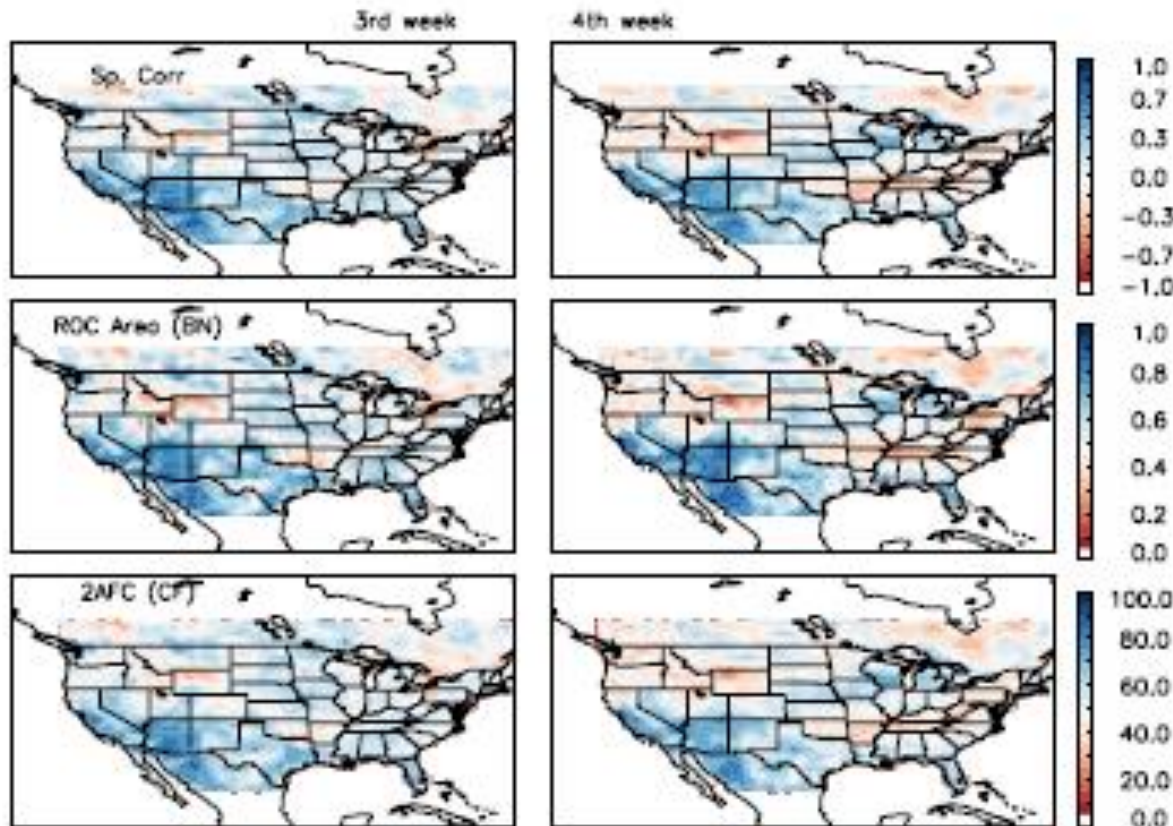


https://waterdatafortexas.org/reservoirs/reports/MJJ2017_reservoir_storage_forecasts_Aquilla_Limestone_Proctor.pdf

Trigger levels for each water source available at: https://www.brazos.org/Portals/0/generalPdf/DCP_10-2012.pdf

MJJ sub-seasonal forecast tests (on-going)

Skill Comparison for MAY 1 hr- Ground or Water Sfc. Evaporation

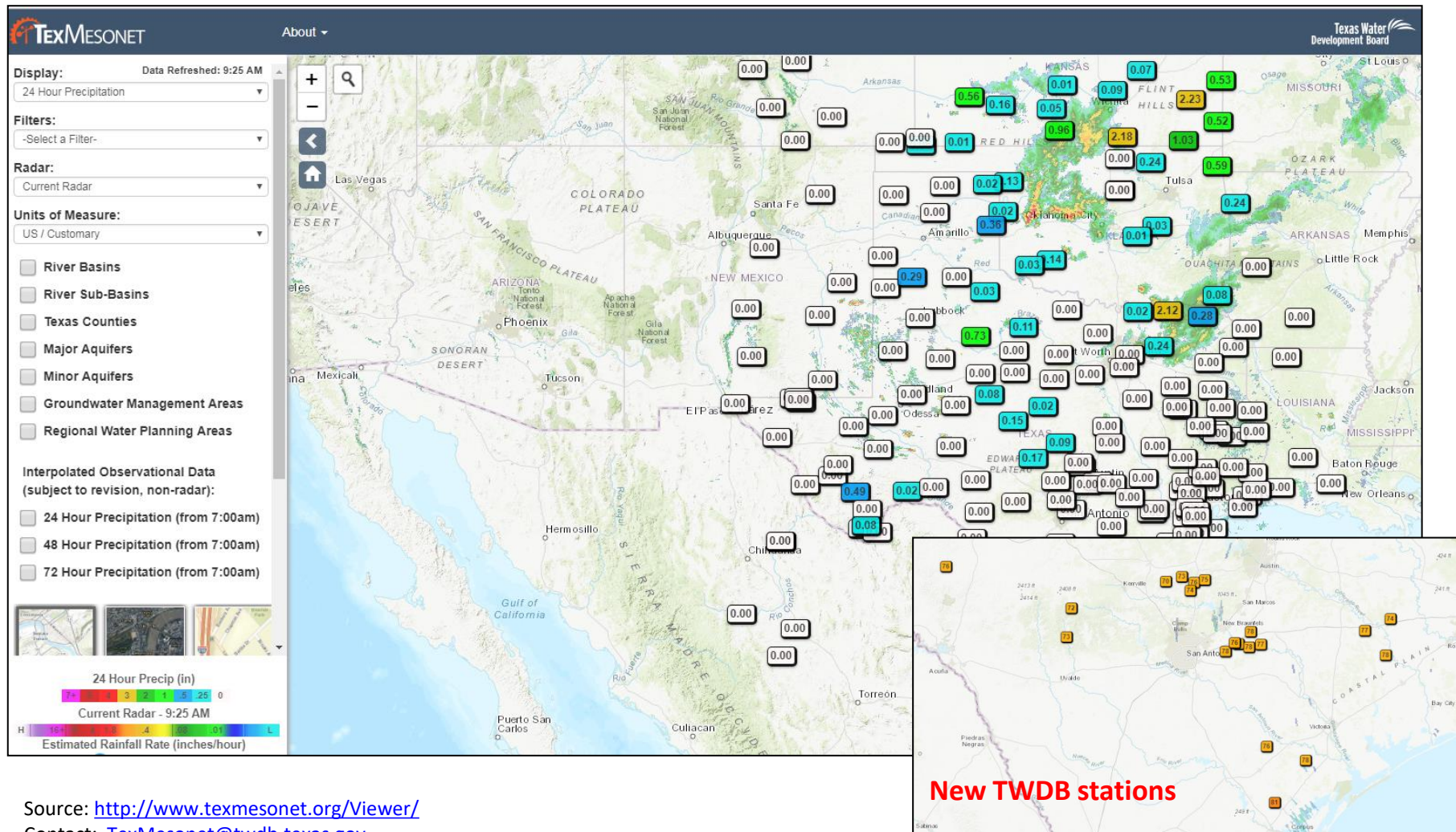


- Work by Dr. Sudip Chakraborty in Rong Fu's research group (UCLA)
- SubX data (CFSv2)
- Ongoing tests:
 - Sub-seasonal forecast skill using ICs of MJJ predictors within season

Improvements to observing/model systems

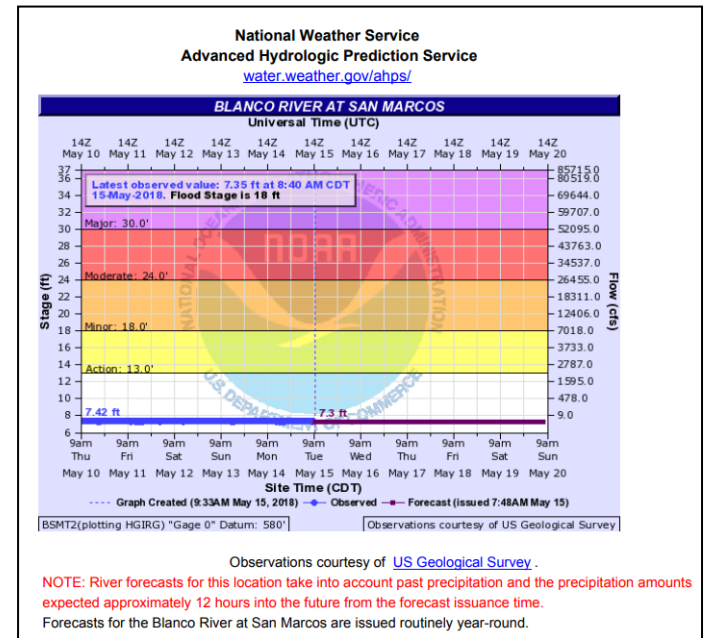
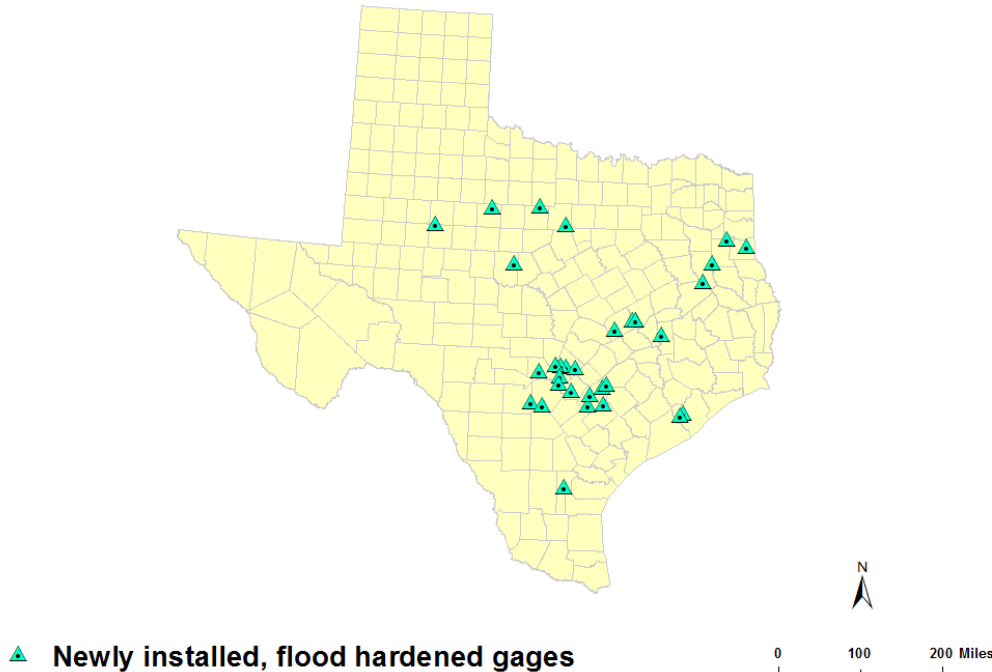
1. TexMesonet (new networks + network of networks)
2. Installation of new flood gauges (key, flood hardened)
3. Bias assessment and post-processor for National Water Model simulations

TexMesonet

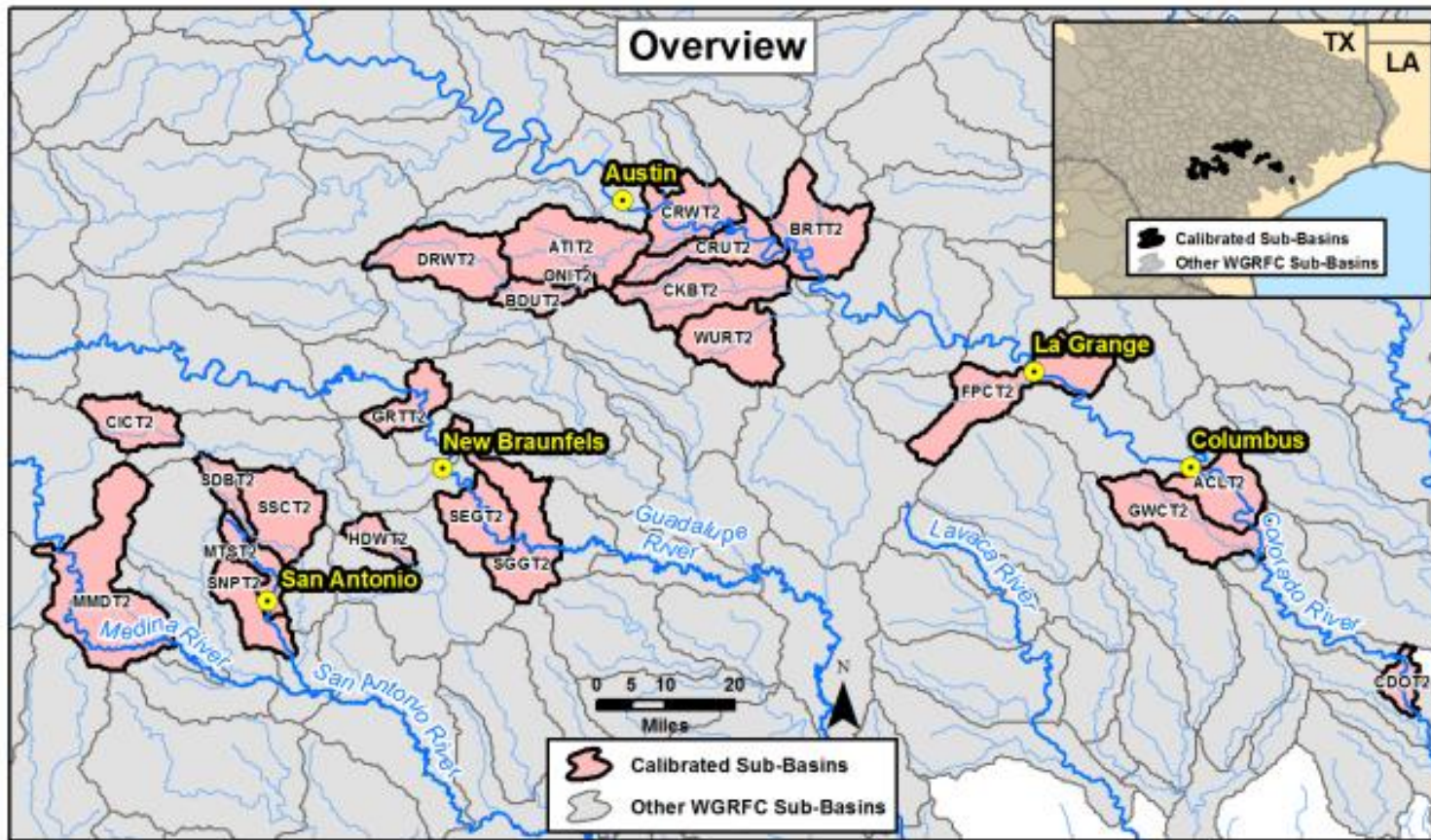


Locations of new streamflow gauges

New TWDB flood gages:
installed at September 1, 2017

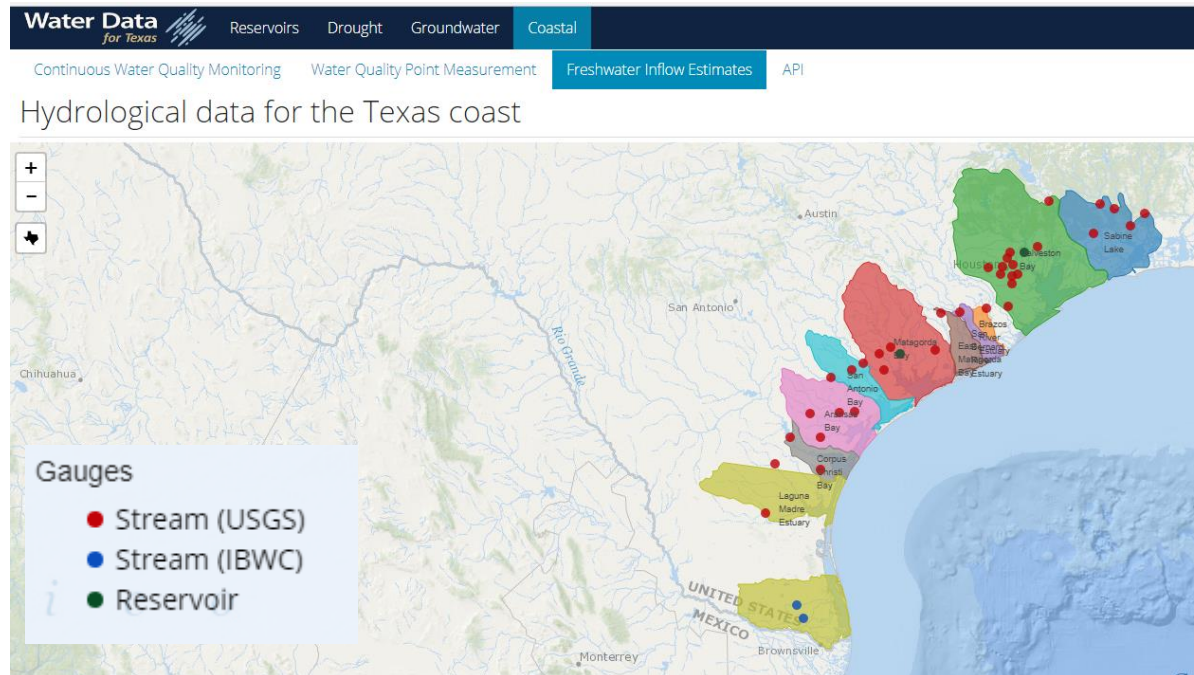


Model Calibration: *flood forecasting*



Source: http://www.twdb.texas.gov/publications/reports/contracted_reports/doc/1600012068_NWS.pdf

Planned improvements: *ungauged watersheds*



Source: <https://waterdatafortexas.org/coastal/hydrology>

- Assess the bias in National Water Model simulations over gauged watersheds
- Develop a post-processor to correct bias
- WGRFC to provide bias-corrected simulations for ungauged watersheds
- Potential to use the National Water Model for operational flood forecasting

Conclusions + wish list

1. There is a need for climate-informed decision support tools

- Drought preparedness/management
- Flood early warning

2. Some existing forecast products have been used by the TWDB to derive hybrid dynamical-statistical rainfall forecasts for the challenging MJJ season.

- Could incorporate enhanced predictability of ridging/blocking for sub-seasonal forecast updates.
- Could incorporate finer spatial resolution surface moisture stress products.

3. Flood early warning could benefit from additional research on atmospheric conditions leading to extreme rainfall

- Could be ARs
- Could be how systems set up to increase moisture flow from the Gulf

Questions?

Contact information

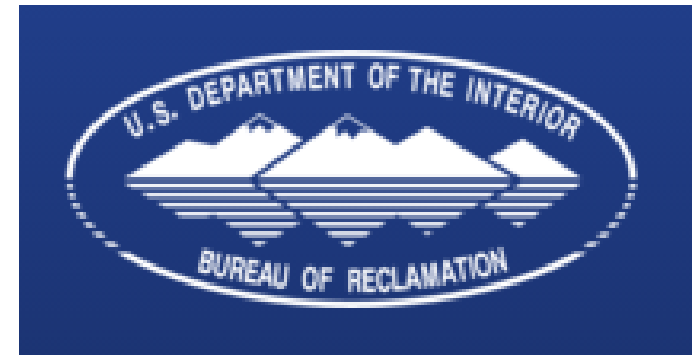
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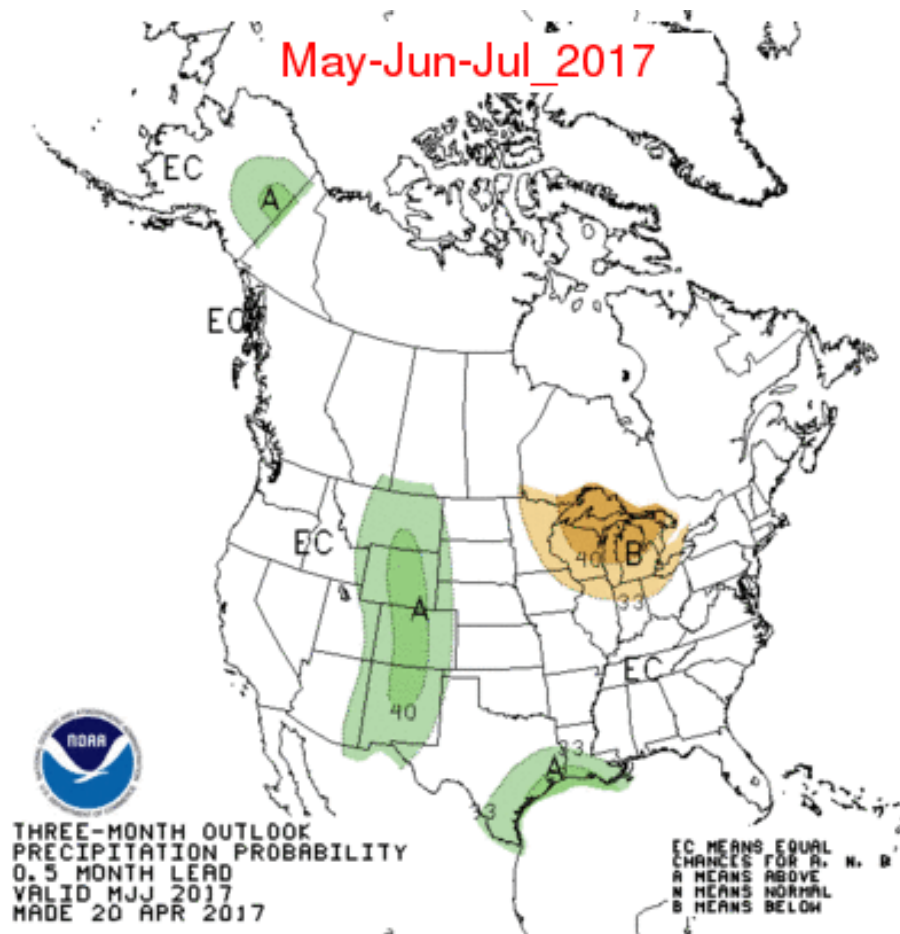


<http://www.usbr.gov/drought/applications.html>

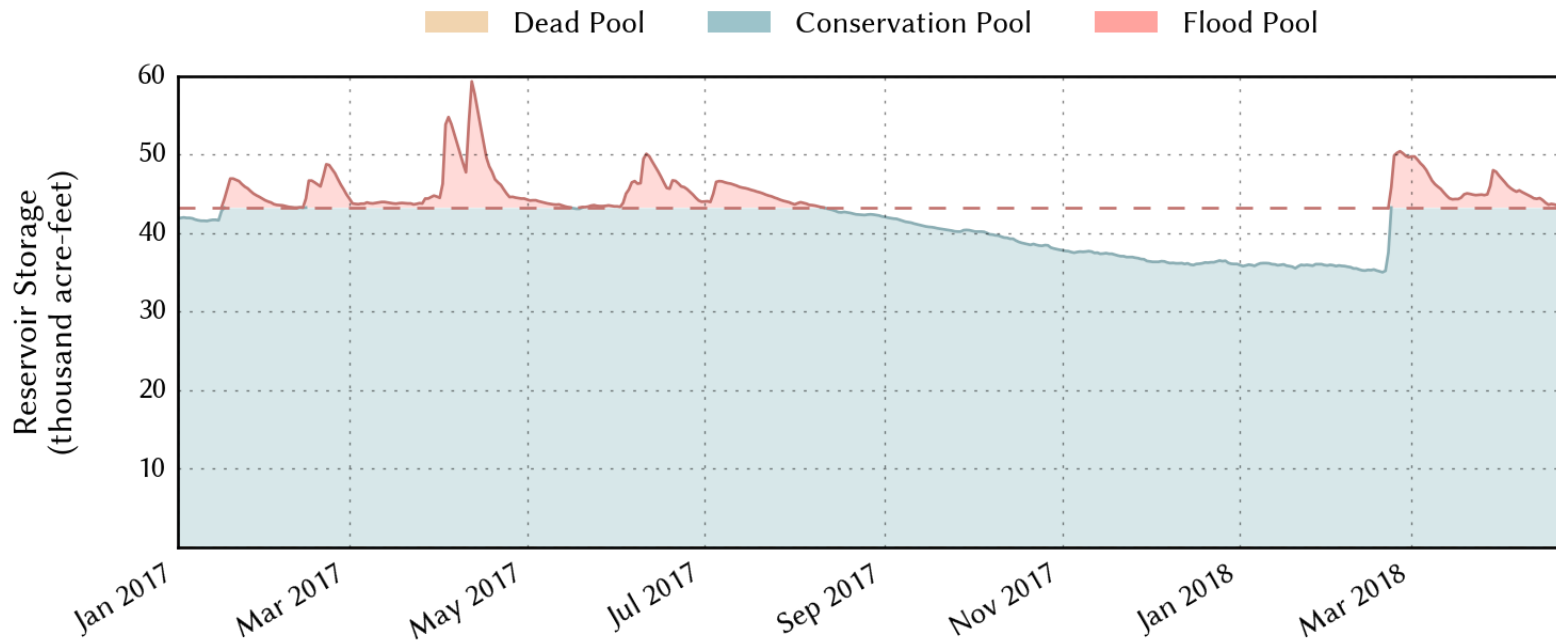
Grant: R15AP00184, FY 2015

Additional slides

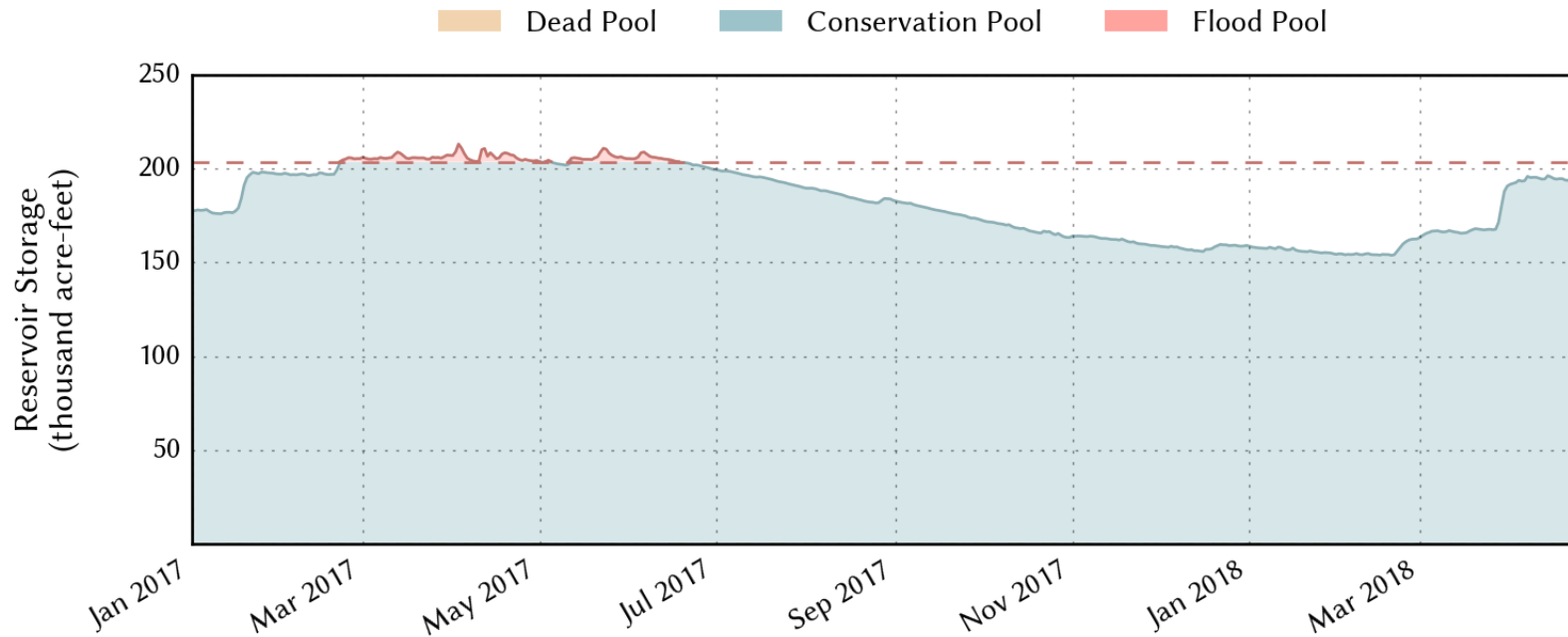
MJJ 2017: NOAA/CPC Forecast



Aquilla storage



Limestone storage



Proctor storage

