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


How do we manage near-term drought risk?
How do we minimize catastrophic flood losses?
May–July (MJJ): 2011 Rainfall Forecast

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

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.
Updates to TWDB’s Rainfall Forecast Tool

Forecast of Average May–July Rainfall

Issued: May 1, 2018

- 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)  

Tool Performance in 2017

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:
- \(-\infty \text{ to } 0\): skill worse than climatology
- \(0\): no skill over climatology
- \(0 \text{ to } 1\): 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

Hill County

How to Interpret the Graph

Probabilistic Forecast (%)
- Below normal: 38.2
- Near normal: 28.1
- Above normal: 33.7

Deterministic Forecast (mm)
- Rainfall: 84
- 60% confidence interval: 45-123
TWDB’s reservoir evaporation rate forecast

Forecast of Total May–July 2018 Reservoir Evaporation

Issued: May 1, 2018

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.
Forecast and Observed Storage: *Aquila Lake*

[Image of a graph showing storage forecast for Aquilla Lake for May-July 2017.]

*Sources:*

- Forecast and observed storage for Aquilla Lake can be found at: [https://waterdatafortexas.org/reservoirs/reports/MJJ2017_reservoir_storage_forecasts_Aquilla_Limestone_Proctor.pdf](https://waterdatafortexas.org/reservoirs/reports/MJJ2017_reservoir_storage_forecasts_Aquilla_Limestone_Proctor.pdf)
- Trigger levels for each water source are available at: [https://www.brazos.org/Portals/0/generalPdf/DCP_10-2012.pdf](https://www.brazos.org/Portals/0/generalPdf/DCP_10-2012.pdf)
MJJ sub-seasonal forecast tests (on-going)

- 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
Locations of new streamflow gauges

New TWDB flood gages: installed at September 1, 2017

Newly installed, flood hardened gages

National Weather Service
Advanced Hydrologic Prediction Service
water.weather.gov/ahps1

BLANCO RIVER AT SAN MARCOS

Observations courtesy of US Geological Survey

NOTE: River forecasts for this location take into account past precipitation and the precipitation amounts expected approximately 12 hours into the future from the forecast issuance time. Forecasts for the Blanco River at San Marcos are issued routinely year-round.
Model Calibration: *flood forecasting*

Planned improvements: *ungauged watersheds*

- 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

Source: https://waterdatafortexas.org/coastal/hydrology
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?

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http://www.usbr.gov/drought/applications.html
Grant: R15AP00184, FY 2015
Additional slides
MJJ 2017: NOAA/CPC Forecast
Aquilla storage

![Graph showing the storage levels of the Aquilla reservoir over time, with data points for January 2017 to March 2018. The graph indicates the dead pool, conservation pool, and flood pool levels.]}
Limestone storage
Proctor storage

Reservoir Storage (thousand acre-feet)

Conservation Pool
Flood Pool