Texas reservoir evaporation
Upgrading the monitoring network

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Texas reservoirs – over 1.2 million acres of water for recreation and water supply

- Good news:
  - *Texas reservoir capacity equals 4.4 years max water use*
Texas reservoirs – over 1.2 million acres of water for recreation and water supply

- **Good news:**
  - Texas reservoir capacity equals 4.4 years max water use

- **Bad news:**
  - factoring in evaporation losses, reservoirs only hold 2.5 years supply
  - Inflows in drought years largely go to meet in-stream flow requirements

*Photo credit: Austin American Statesman*
Evaporation and water availability

- WRAP model uses monthly evaporation to calculate firm yield and availability.
- If evaporation data are biased high, less water is available for uninterruptible supplies.
- If evaporation data are biased low, firm yield is too high and critical infrastructure is at risk.

*Figure 2.5* Statewide 92-Quad 1954-2018 Average of Annual Evaporation (blue solid) and Annual Two-Month Maximum (green dotted) and Minimum (red dashed) Evaporation.
Current reservoir evaporation monitoring network

Class A pans
- 60 in Texas plus neighboring states
- 18 TWDB Coop sites
- 64 NWS sites
- Looking to add data from IBWC and Mexico
Issues with current monitoring program

- Limited spatial coverage
- Low temporal resolution
- Large uncertainty in monthly values
- Additional uncertainty from data aggregation

Quad 305 evaporation, 1954 - 2018
A multi-pronged approach to evaporation monitoring

Goals

- Upgrade and improve current network of Class A pans
- Directly measure open water evaporation
- Calculate evaporation from meteorological data
- Help develop remote sensing tools to monitor reservoir evaporation
A multi-pronged approach to evaporation monitoring

**Strategies**

1. Estimate open water evaporation using buoy stations
2. QC buoys with one floating pan evaporation station and one floating eddy covariance station
3. Upgrade Class A pan stations with automated data readings and pan refills, and supplemental meteorological measurements
4. Install new Class A pans in areas without evaporation observations, and
5. Compute evaporation from meteorological measurements at Class A pan and Texmesonet sites.
Project locations

[Map showing various locations and reservoirs with markers for project locations.]
Buoy measurement of open water evaporation

Data for combined equation potential evaporation
- Air temperature/humidity
- Wind speed/direction
- Net radiation
- Barometric pressure
- Water surface temperature
- Water column temperature
QC for open water evaporation

- Collision floating pan at Twin Buttes Reservoir
  - *Includes quarterly flux chamber measurements*
  - *Plus meteorological instrumentation*

- Eddy covariance system at rotating locations
Pan site upgrades

- Add meteorological instruments
- Automate pan level readings
- Automate pan filling
- Connect sites to internet for real-time data acquisition

Add water when the water depth in the pan drops too much

Take water out of the pan when the water depth rises too much
Calculated evaporation

- Several meteorological networks in place
- Evaluate different methods for calculation
  - CRLE
  - Penman-type
- Assess applications
  - Major reservoirs
  - Ponds and tanks
Correlation between Class A Pan and Penman-Montieth evaporation

\[ y = 0.5072x + 1.7794 \]

\[ R^2 = 0.4213 \]
Measured and modeled pan levels
Measured and modeled evaporation losses for rain-free periods
Pan vs Penman-Montieth evaporation

Calm winds, temperature stratification in pan

8.7 %
Field measurement challenges

- Lake system down March 2019 due to lightning strike
- Datalogger, modem, and several sensors destroyed
- Floating pan system problematic from the start
- On-going calibration issues
- Re-grouping for 2020
Questions?

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