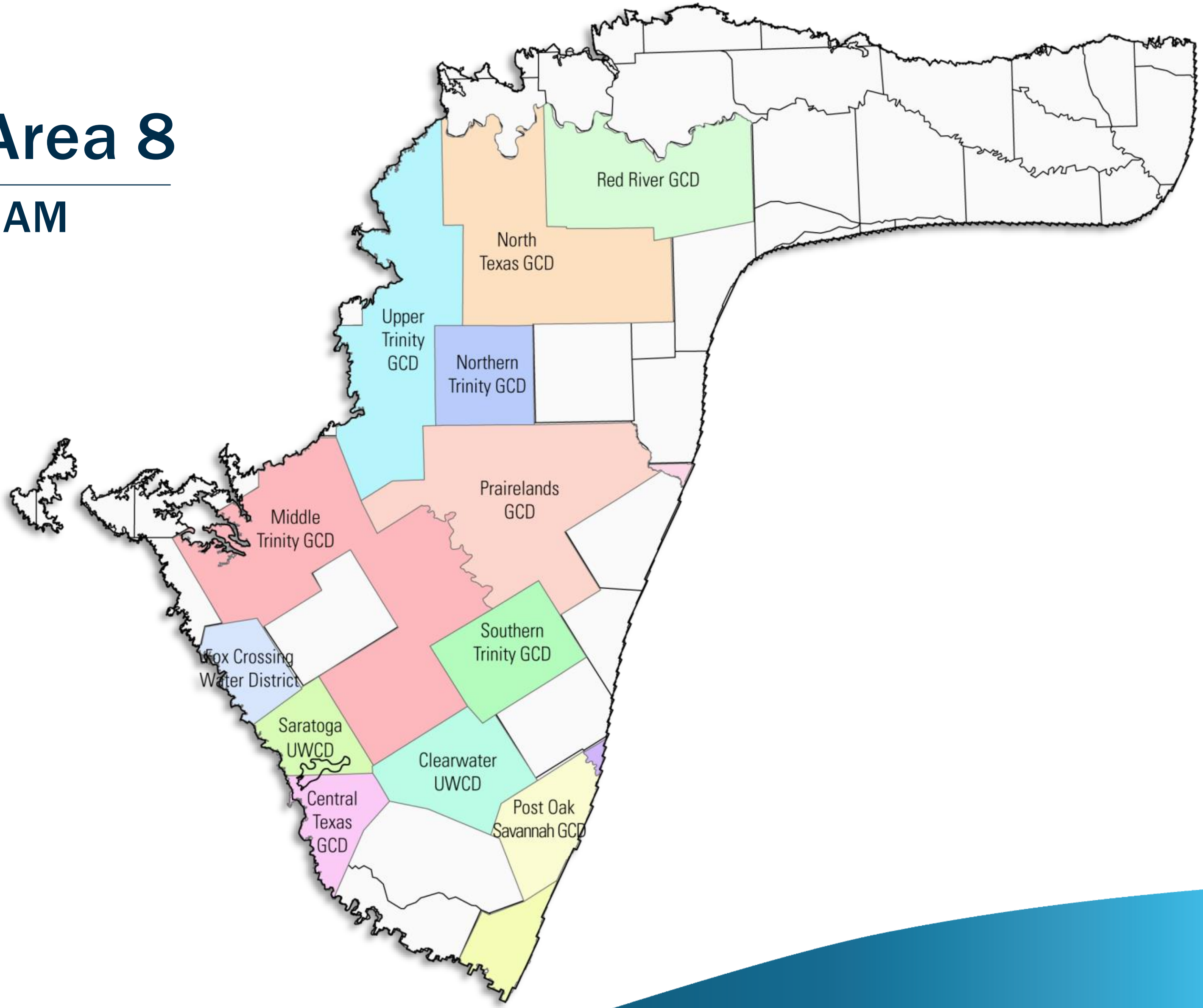
Groundwater Management Area 8

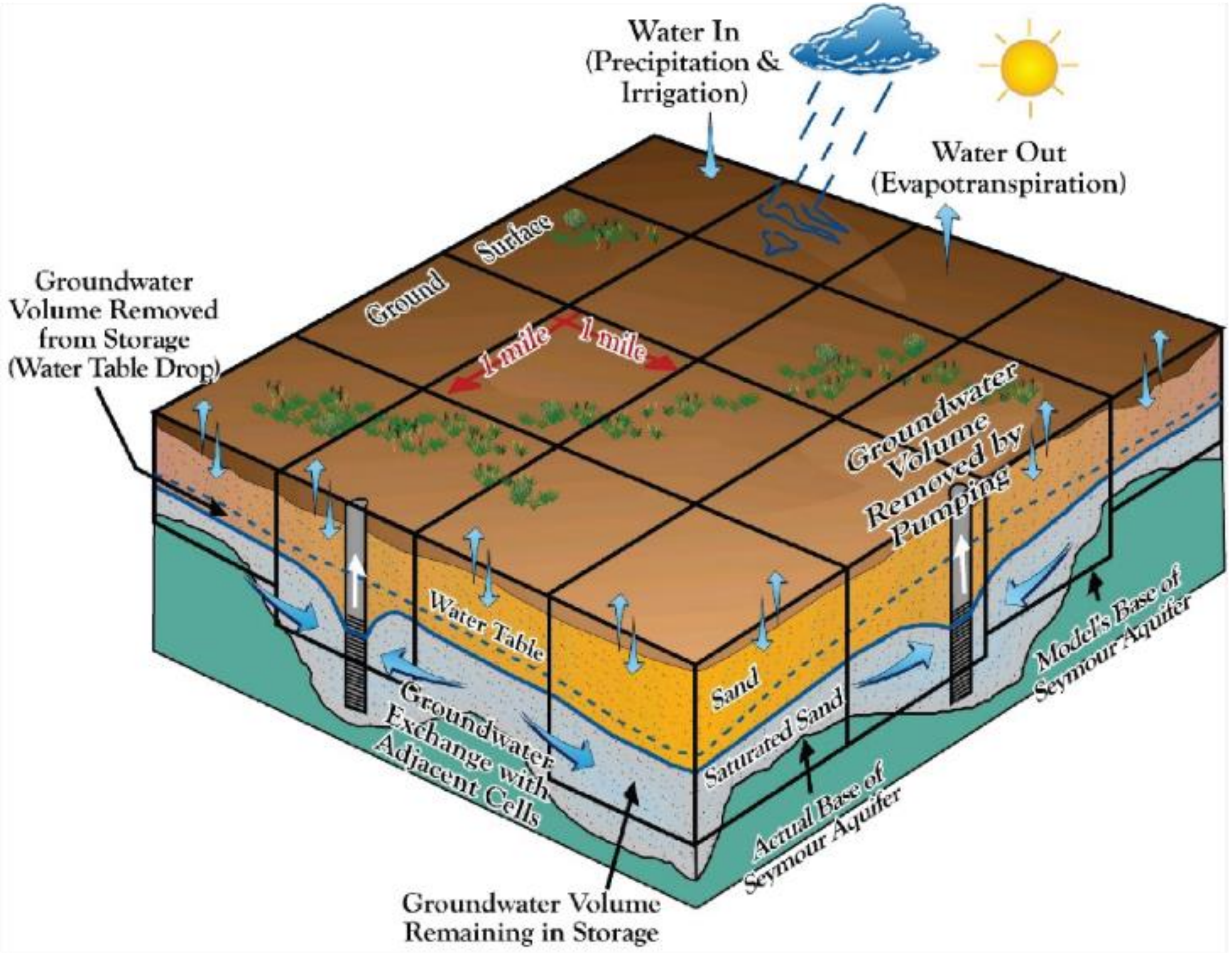
Northern Trinity and Woodbine Aquifers GAM update



May 15th, 2024

INTERA

Numerical Groundwater Model: Model Cells and their interactions



Note that the NTGAM model has 1/4th mi x 1/4th mile cells

Texas Water Development Board

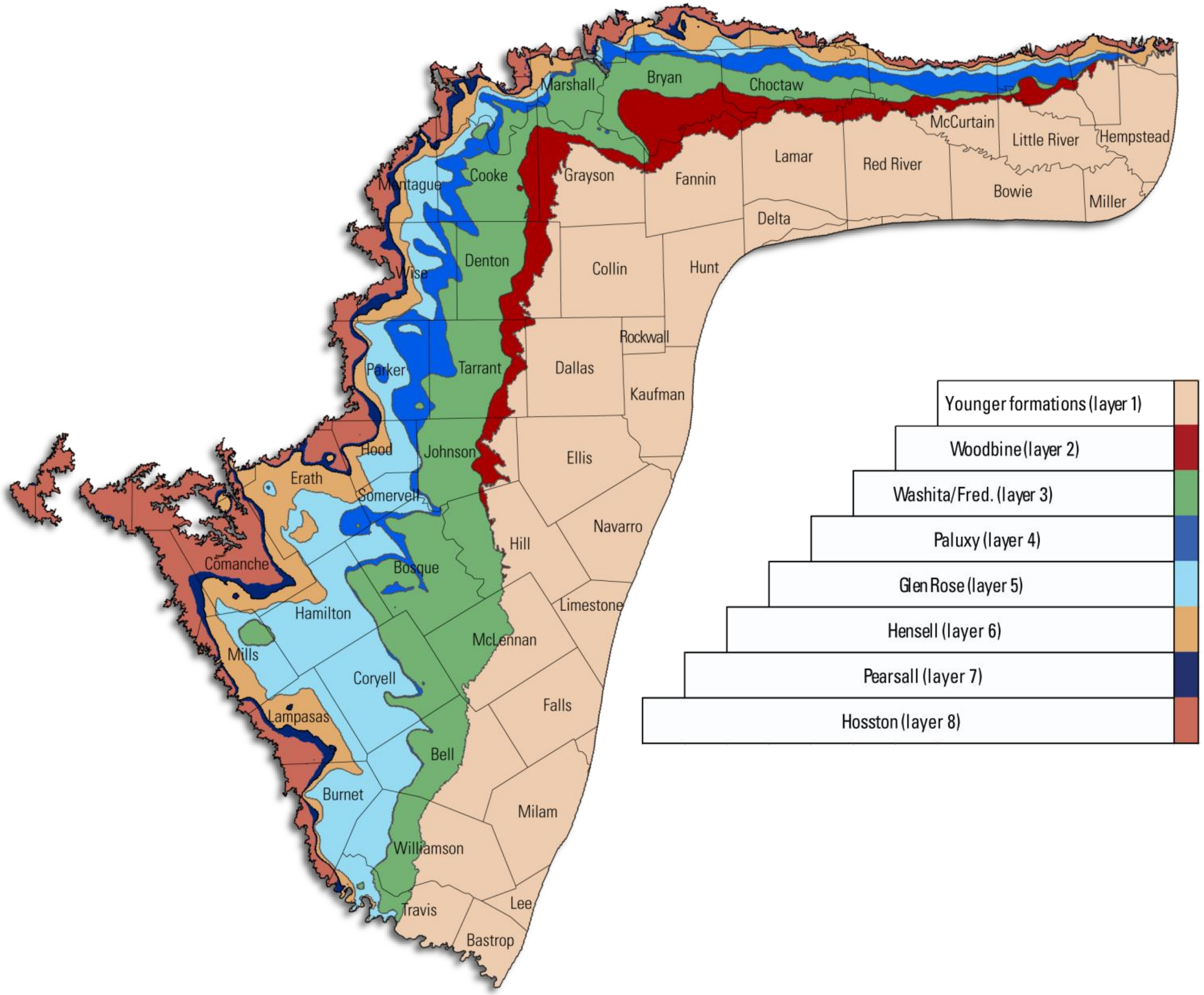
Configuration

Layering

- **Layer 1:** Surficial units/younger formations
- **Layer 2:** Woodbine
- **Layer 3:** Washita/Fredericksburg
- **Layer 4:** Paluxy
- **Layer 5:** Glen Rose
- **Layer 6:** Hensell
- **Layer 7:** Pearsall
- **Layer 8:** Hosston
- Pass-through cells used for units that have outcropped (*new feature*)
- Structure update

Time Discretization

- **1889:** Steady State (Predevelopment)
- **1890–2020:** Annual stress periods
- (extended from the end date of the 2014 model from 2012 to 2020)



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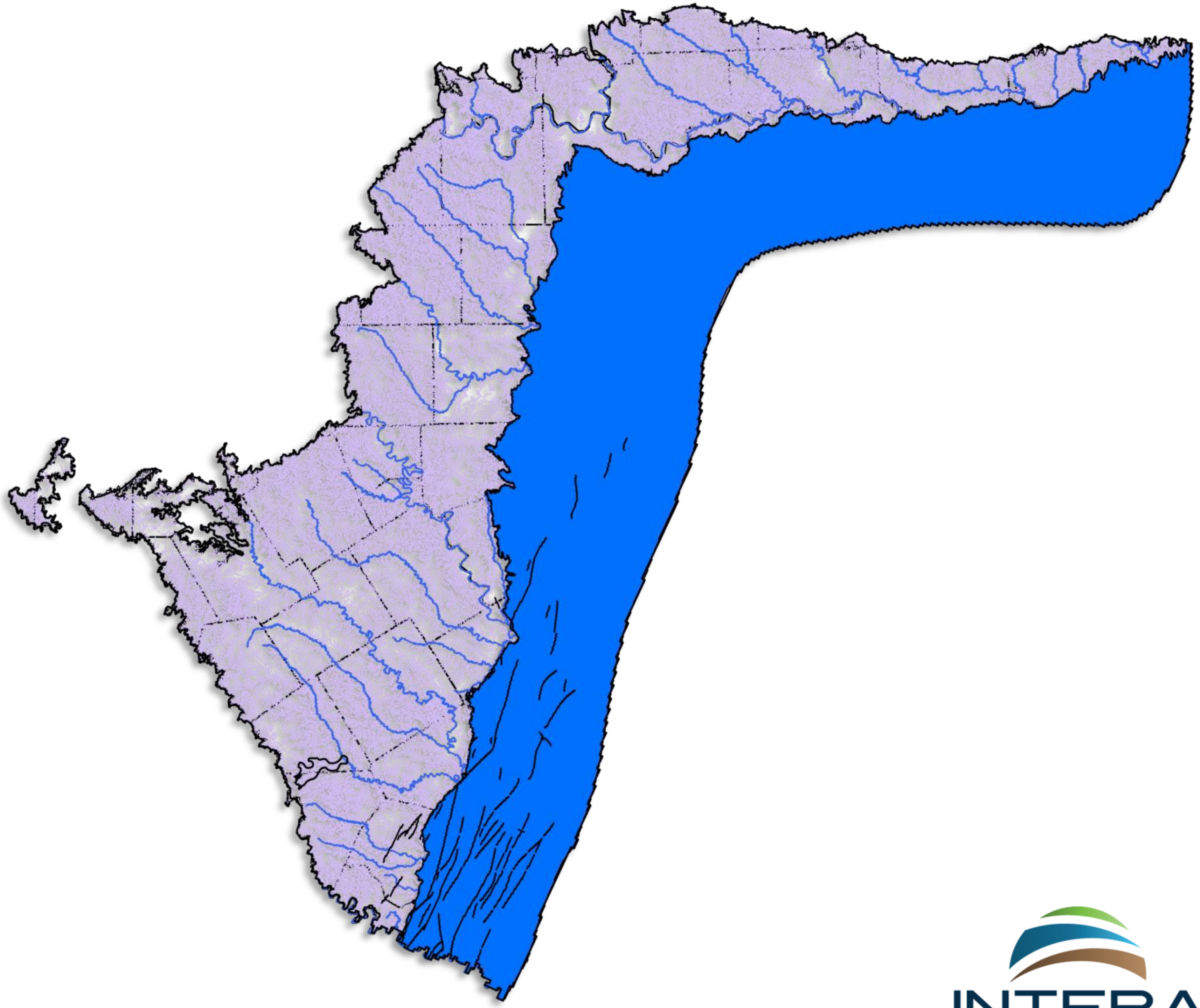
Model Boundaries

- **River cells:** Younger formations and major rivers (in blue)
- **Drain cells:** Remove excess water from layer 1 and simulate early time flowing wells (in pink)
- **Horizontal Flow Barrier cells:** Represent faults and prevents flow from outcrop to younger formations in layer 1 (in black)



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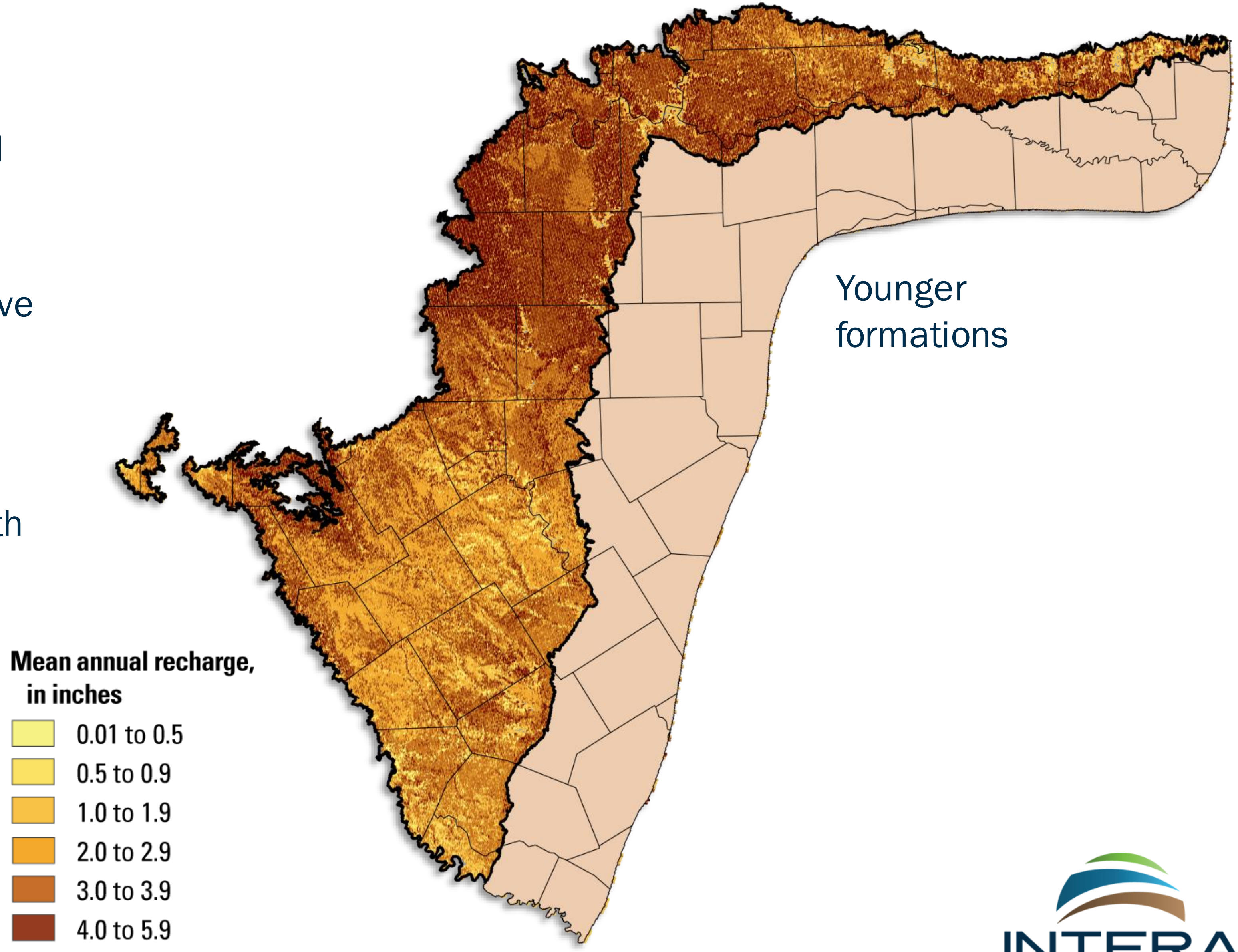
Recharge

- Spatially distributed recharge obtained from the SWB code (RWH&A). 1980 recharge shown at right.
- Recharge is applied to the highest active cell (typically layer 1) in the model
- Recharge is not applied to the younger formations—same as the 2014 model
- Greater amount of recharge in the north and northeastern areas of the model



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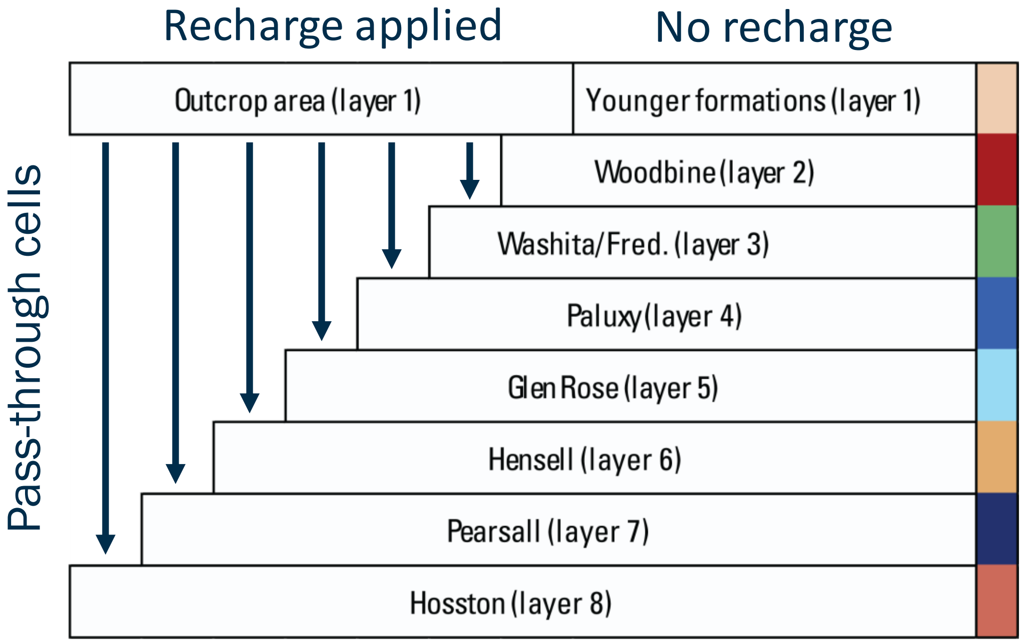
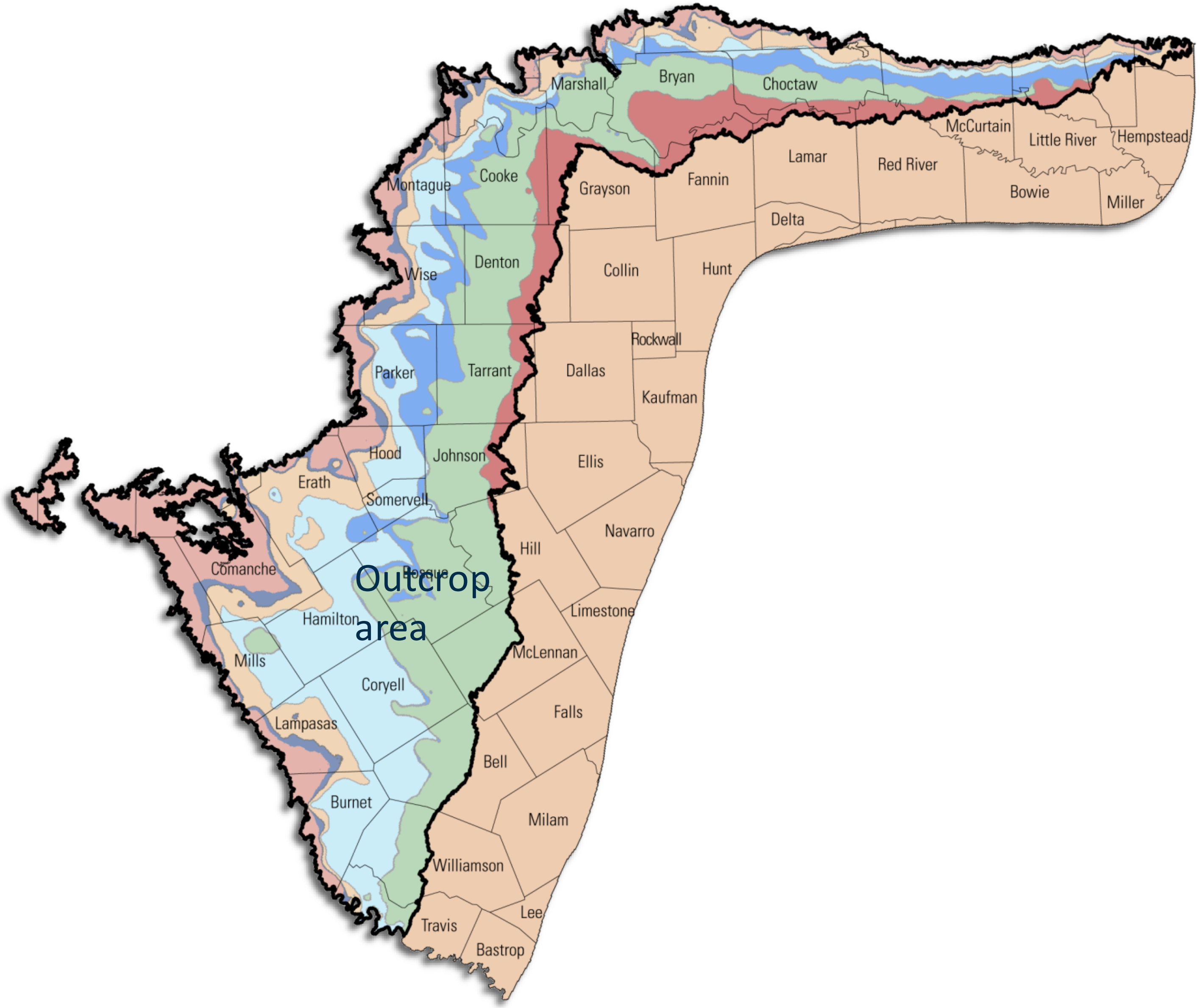
Recharge

- Recharge applied only to the outcrop area (inside the black outline at right) as in the previous model.
- Layer 1 is primarily used to route excess recharge to model river and stream cells—<u>a smaller amount infiltrates down to depth</u>





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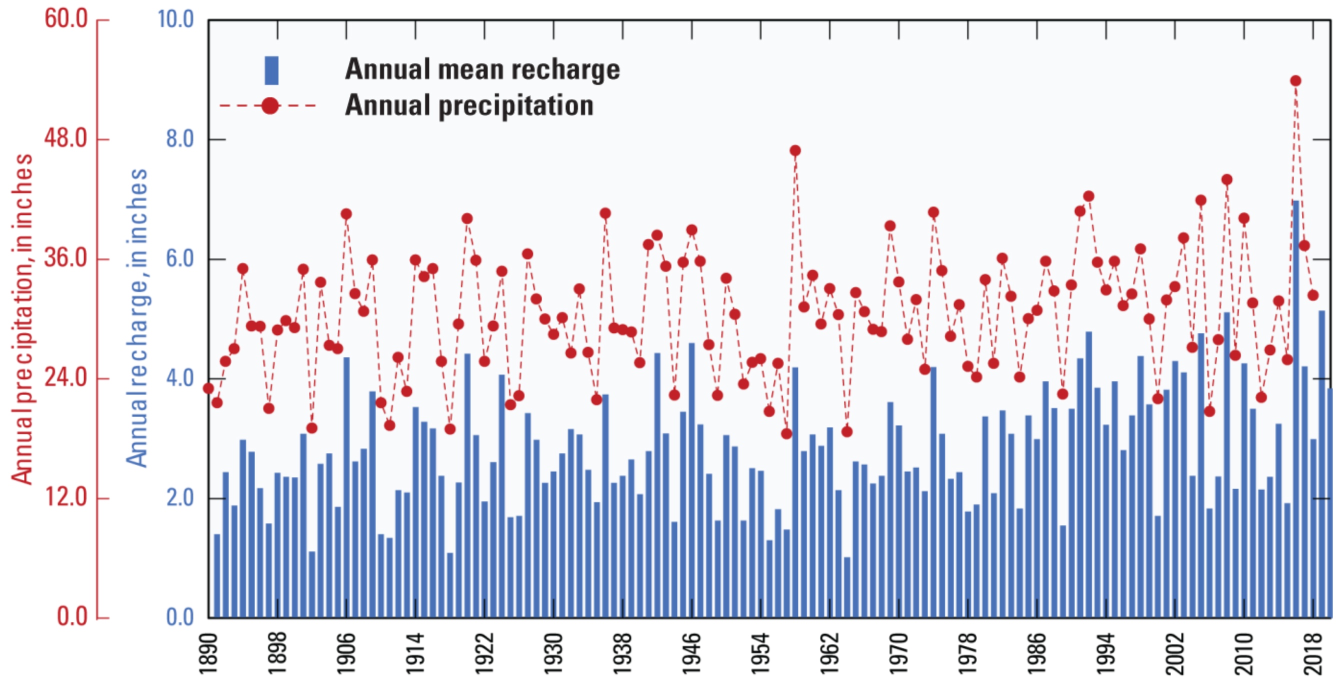
Recharge

- Average precalibration recharge of 2.8 inches/year during 1890–2020. Only part of this amount infiltrates to the deeper system
- Average precipitation of 31 inches/year during 1890–2020. Surficial recharge is ~9% of precipitation

Location	Recharge rate (in/yr)	Reference	Technique
Kendall	1.3	Ashworth, 1983	Baseflow discharge
Hill Country	1.5 (0.07 - 4.6)	Bluntzer, 1992	Baseflow discharge
Northern Trinity	4.4	Dutton et al., 1996	Groundwater modeling
Northern Trinity	0.04 - 0.3	Dutton et al., 1996	Groundwater modeling
Northern Trinity	1.2	Klemt et al., 1975	Assumed
Hill Country	2.2	Kuniansky and Holligan, 1994	Groundwater modeling
Hill Country	2.1 - 6.0	Kuniansky, 1989	Baseflow
Kendall	2.2	Mace et al., 2000	Baseflow
Hill Country	1.4	Mace et al., 2000	Groundwater modeling
Kendall	1.5	Reeves, 1967	Baseflow
Kerr	1	Reeves, 1969	Baseflow

Source: Scanlon et al., 2002.

Literature estimates



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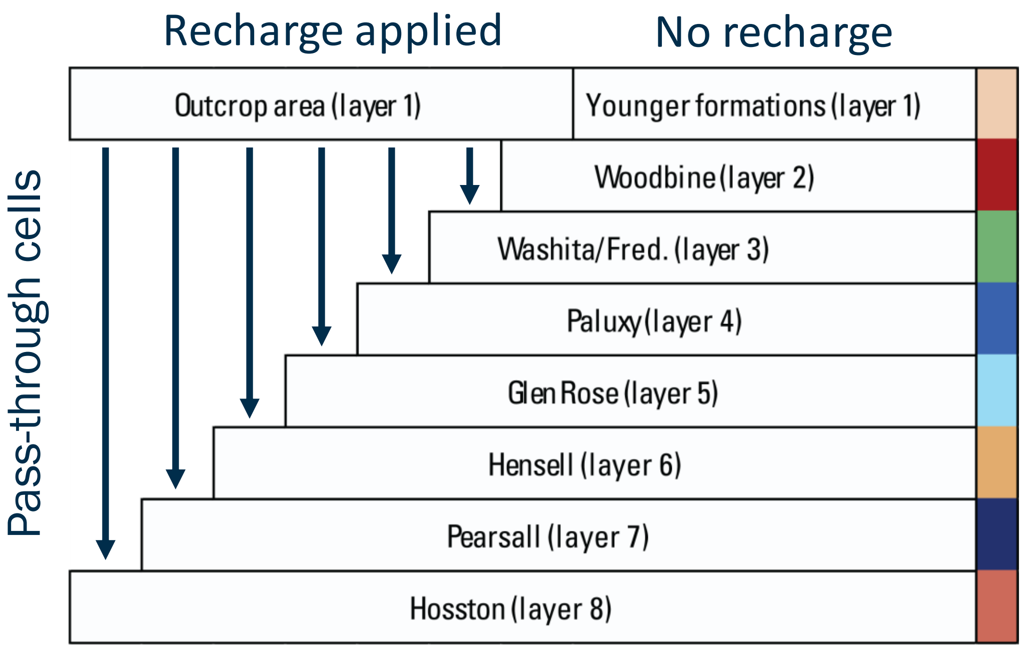
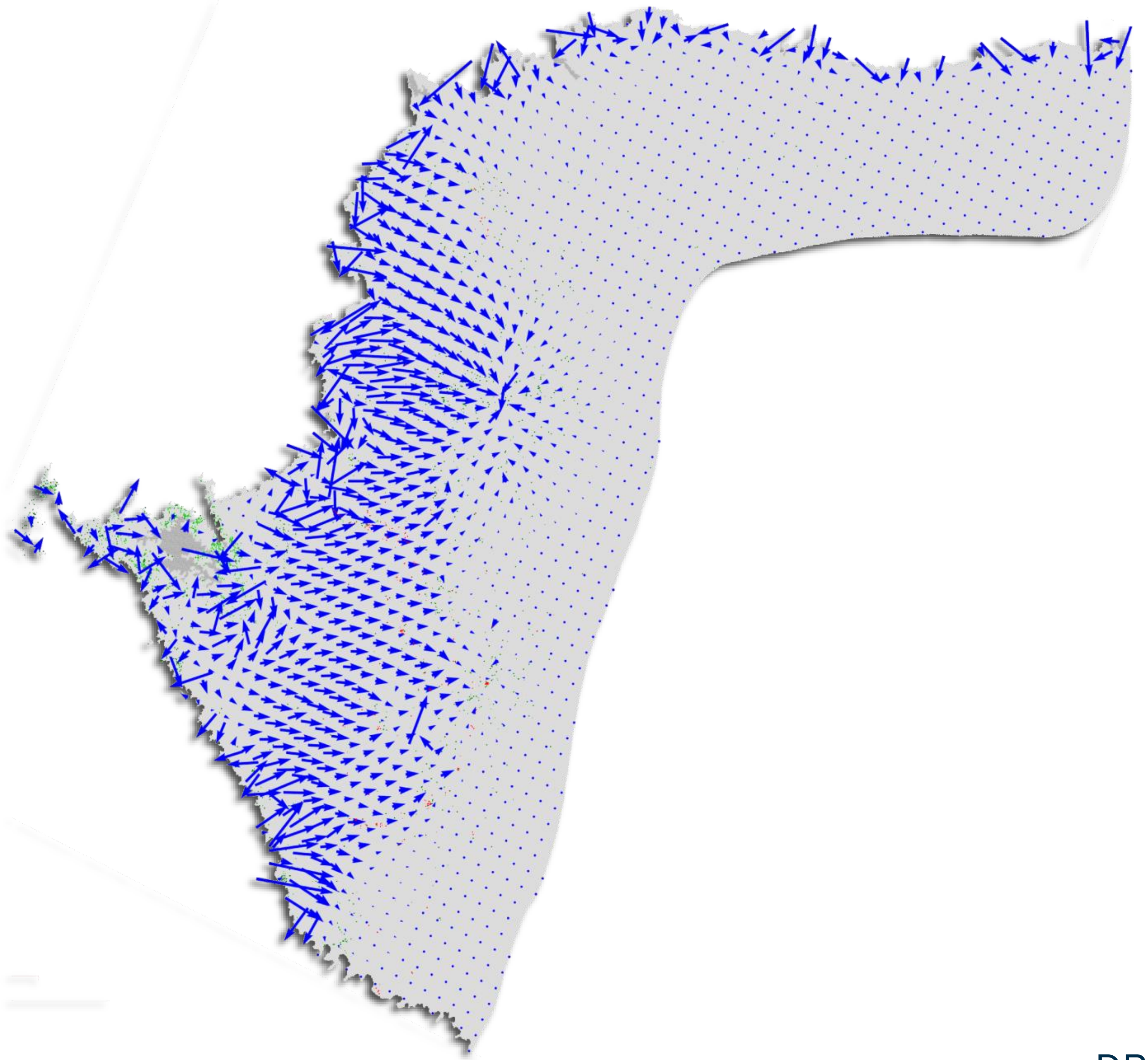
Recharge

- Recharge and groundwater flow shown at right for the Hosston (layer 8)
- Size of the arrows show the magnitude of the groundwater flow
- Recharge moves downdip from surface and to areas of groundwater withdrawal





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Water Use

GCD-supplied production data by well or by permit number.

- Major part of the model update
- Any previous production data supplied to INTERA was retained but replaced with the newer data if duplicate years were received
- Screened intervals, total depths, and GCD-quoted aquifer assignments were considered to assign pumping to model layers

TWDB Water Pumpage Database

- Water pumpage estimates by aquifer, by county, and by use type
- Pumping volumes by year were distributed among TWDB Groundwater Database and Submitted Driller's report database wells
- Census data and TWDB pumping rates (GPCD) by decade for rural domestic estimates
- Pumping volumes by decade were estimated, then linearly interpolated for individual years
- Volumes distributed among TWDB Groundwater Database and Submitted Driller's report database wells

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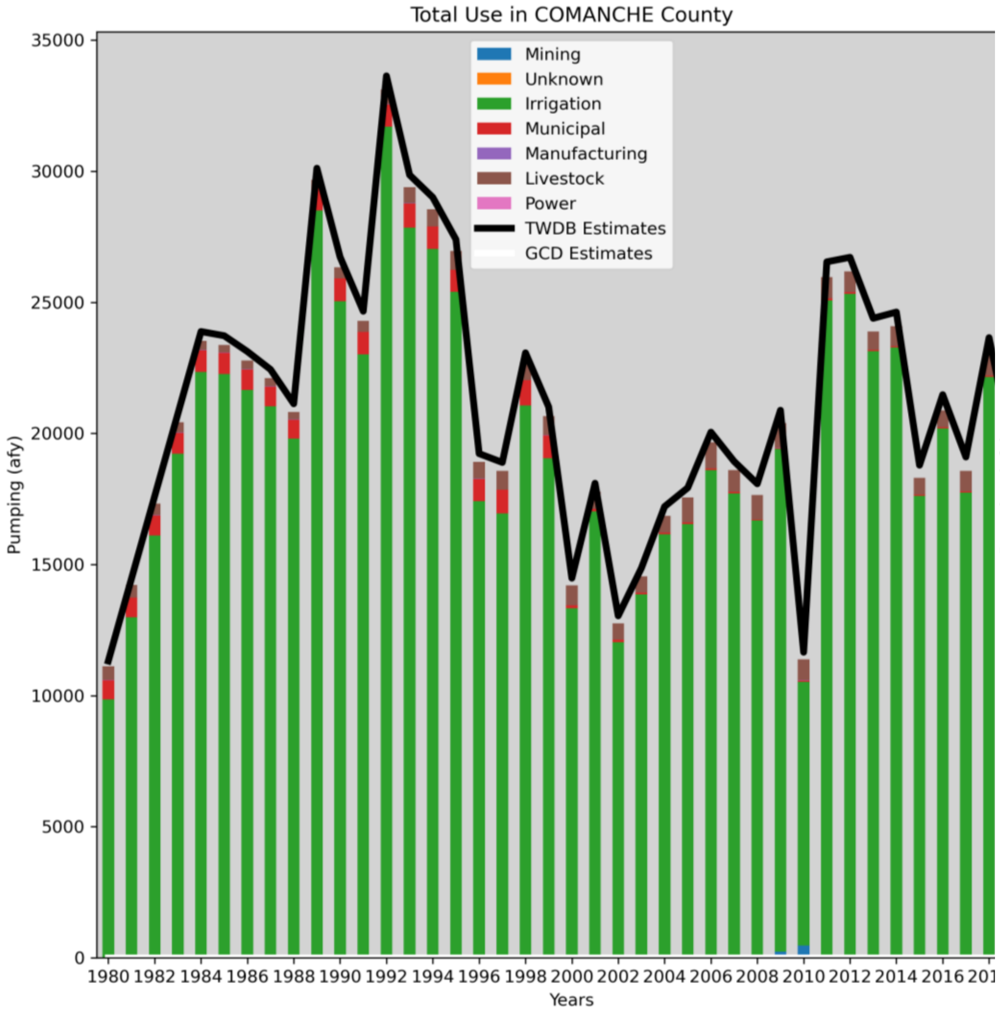
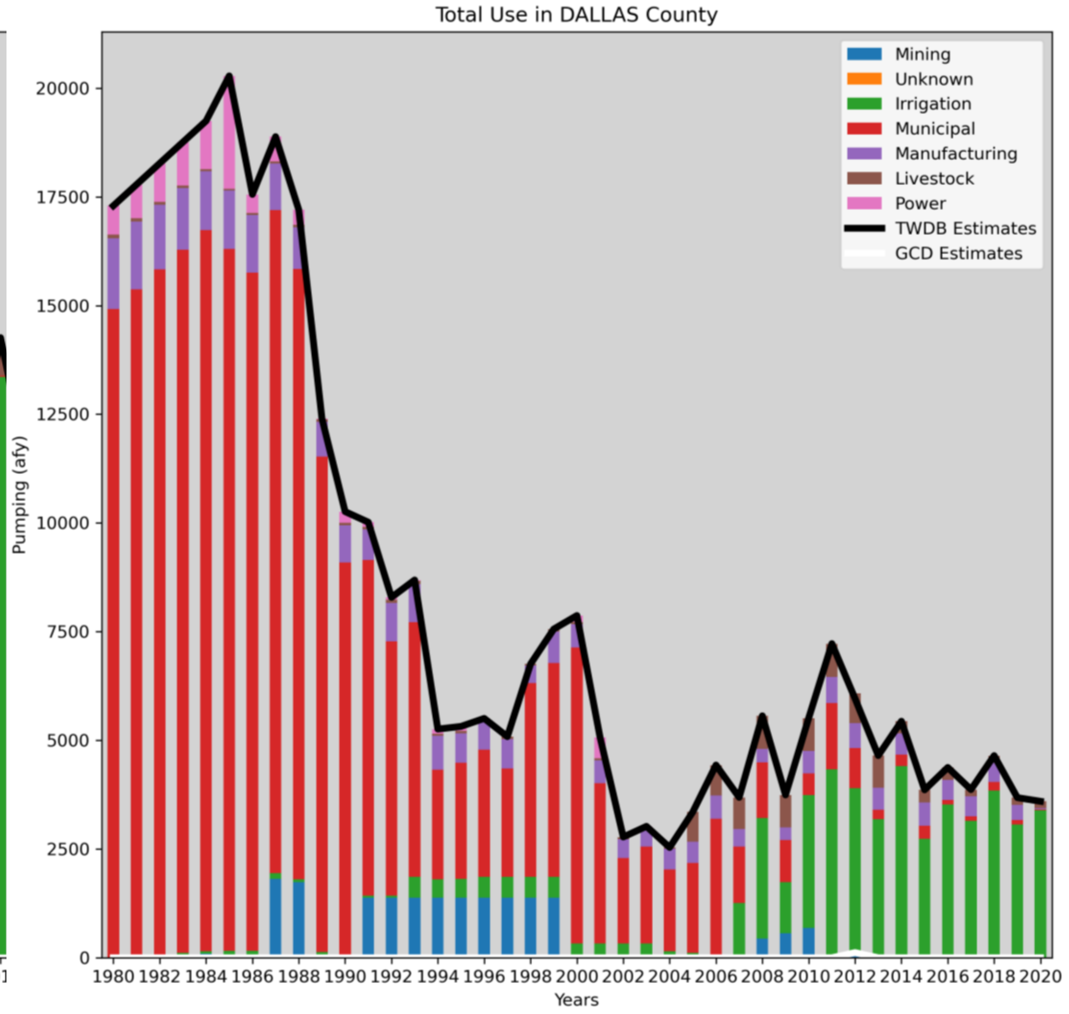
Water Use





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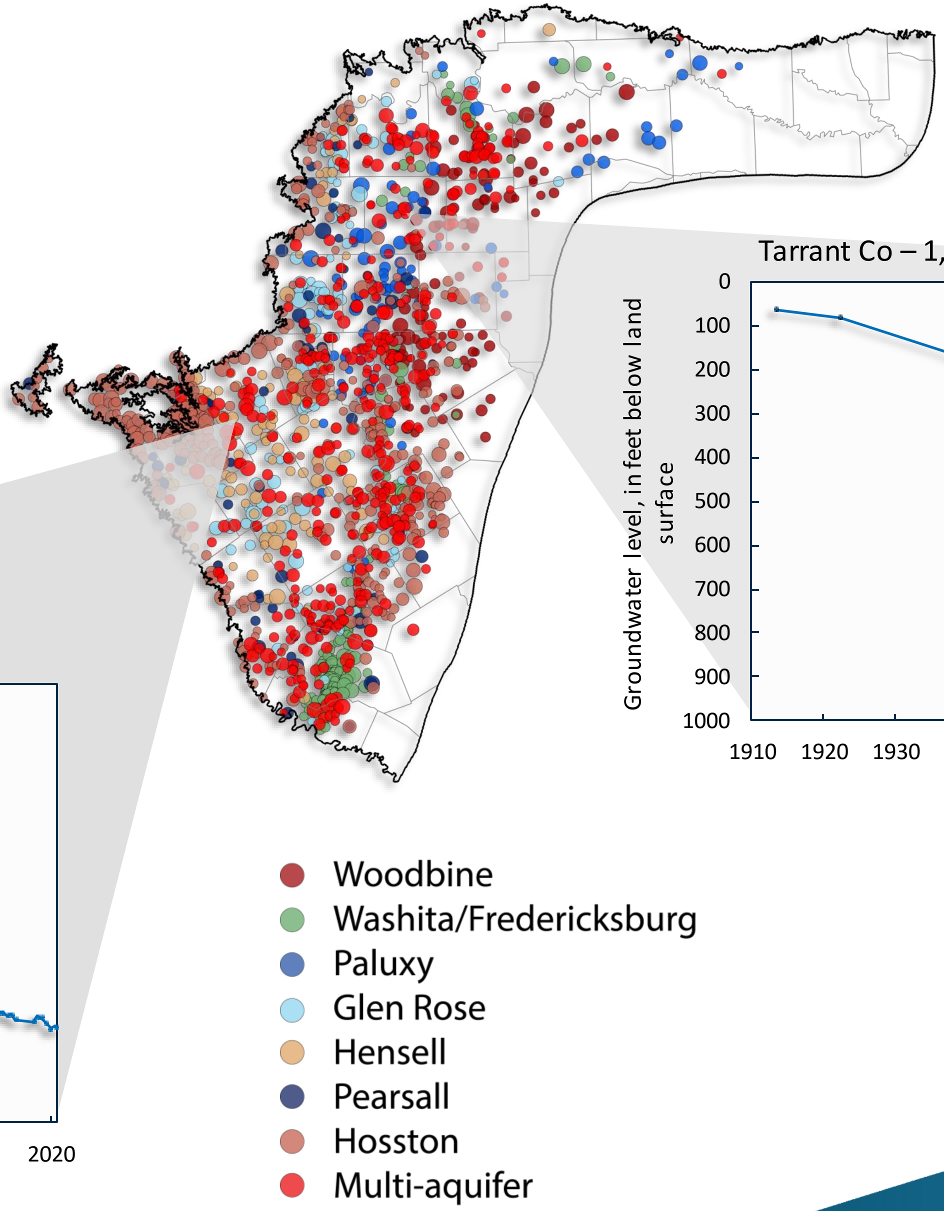
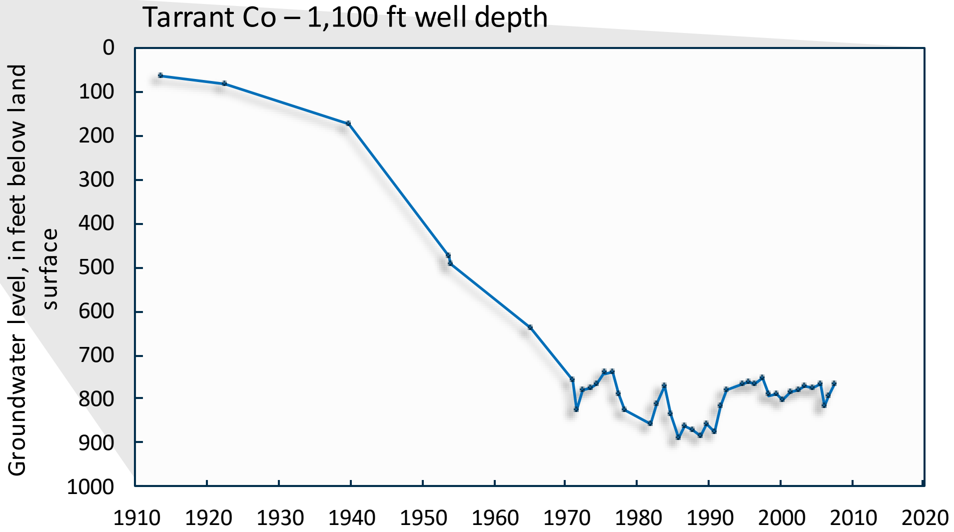
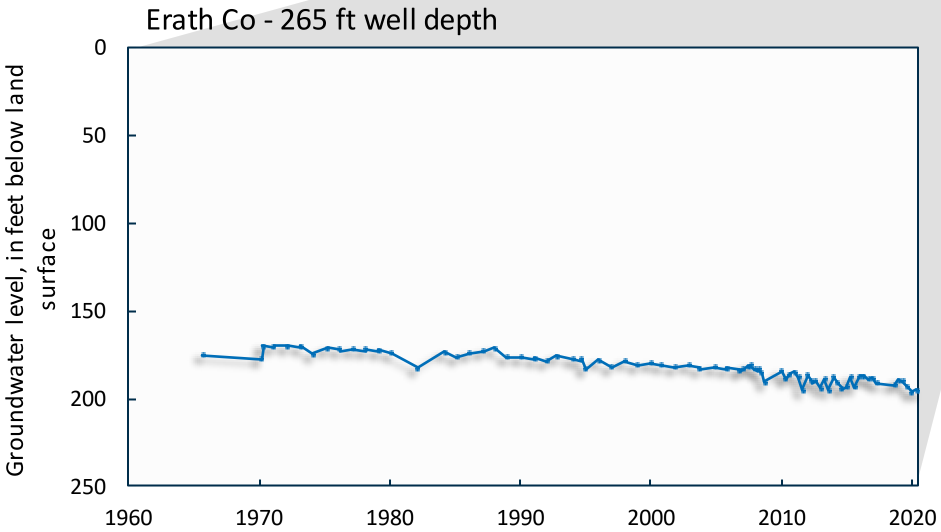
Water Levels

- Differing patterns of water level changes through time across the Trinity Aquifer
- Substantial water level declines in the DFW area historically

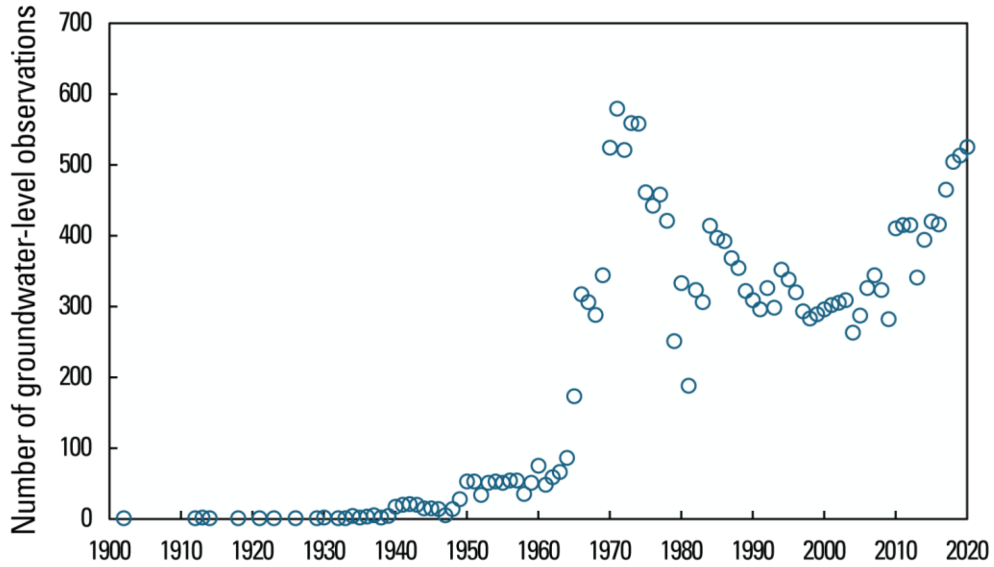


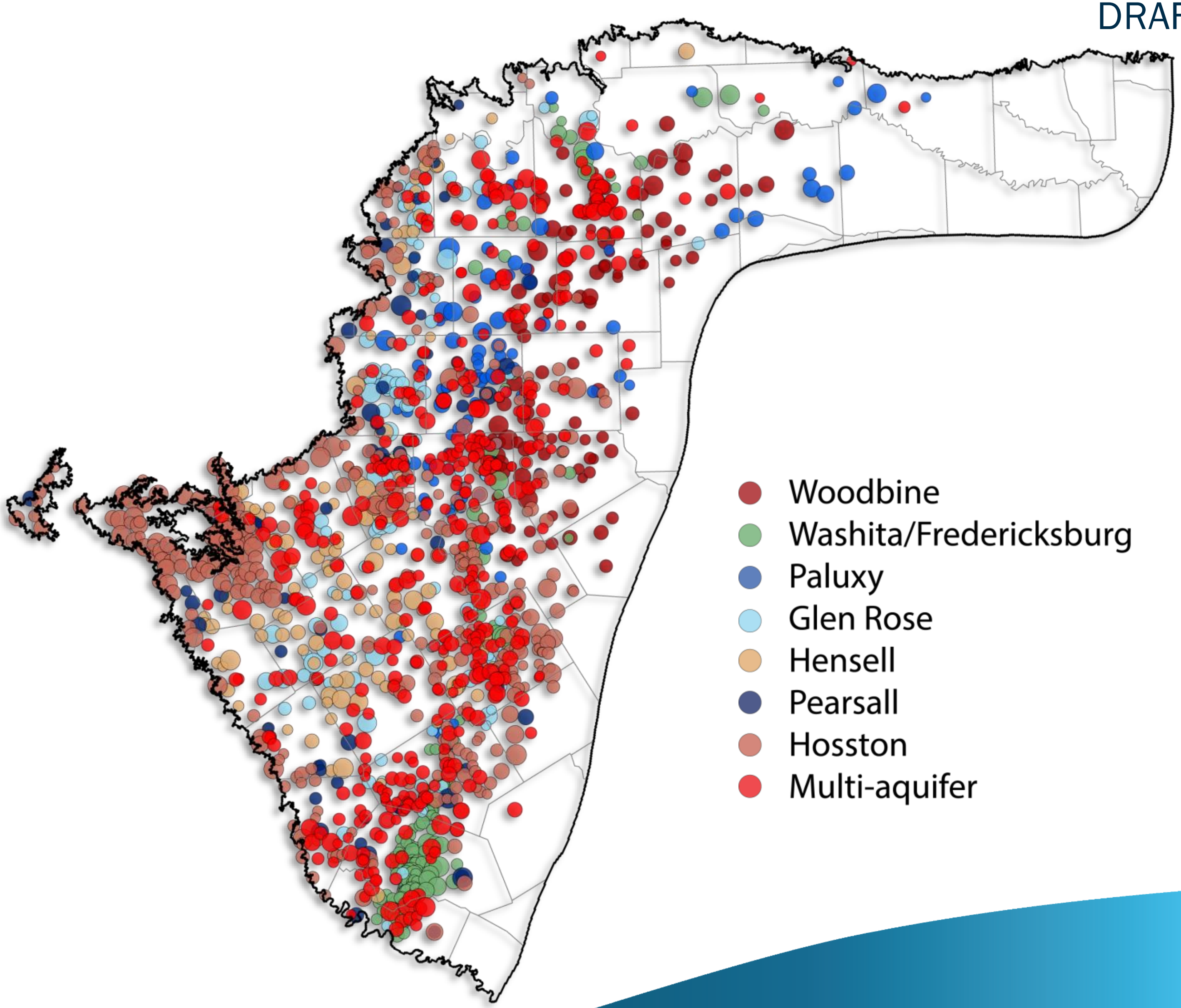




Water Levels

- Greater number of groundwater levels through time as monitoring in the study area has increased
- A programmatic approach was used to prepare groundwater levels used in the model





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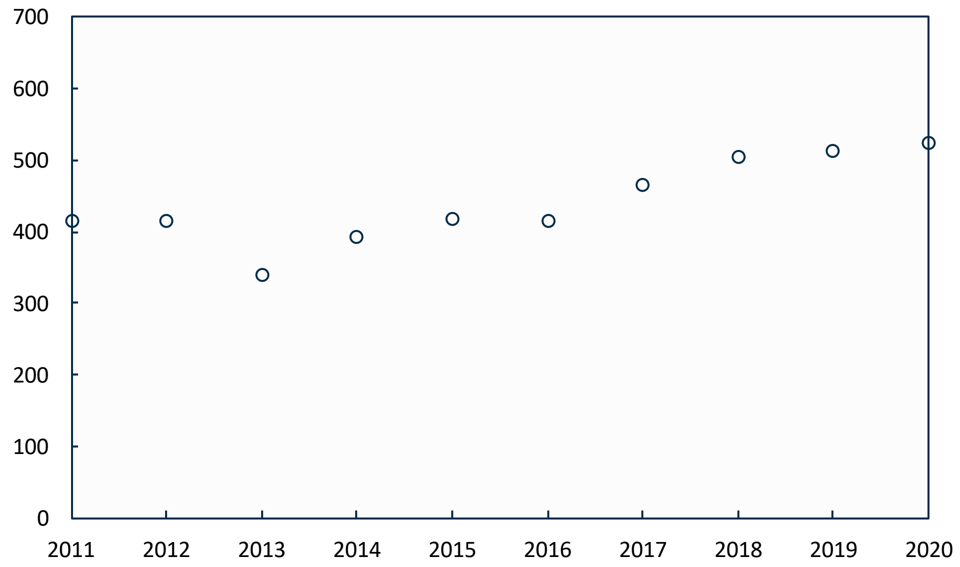
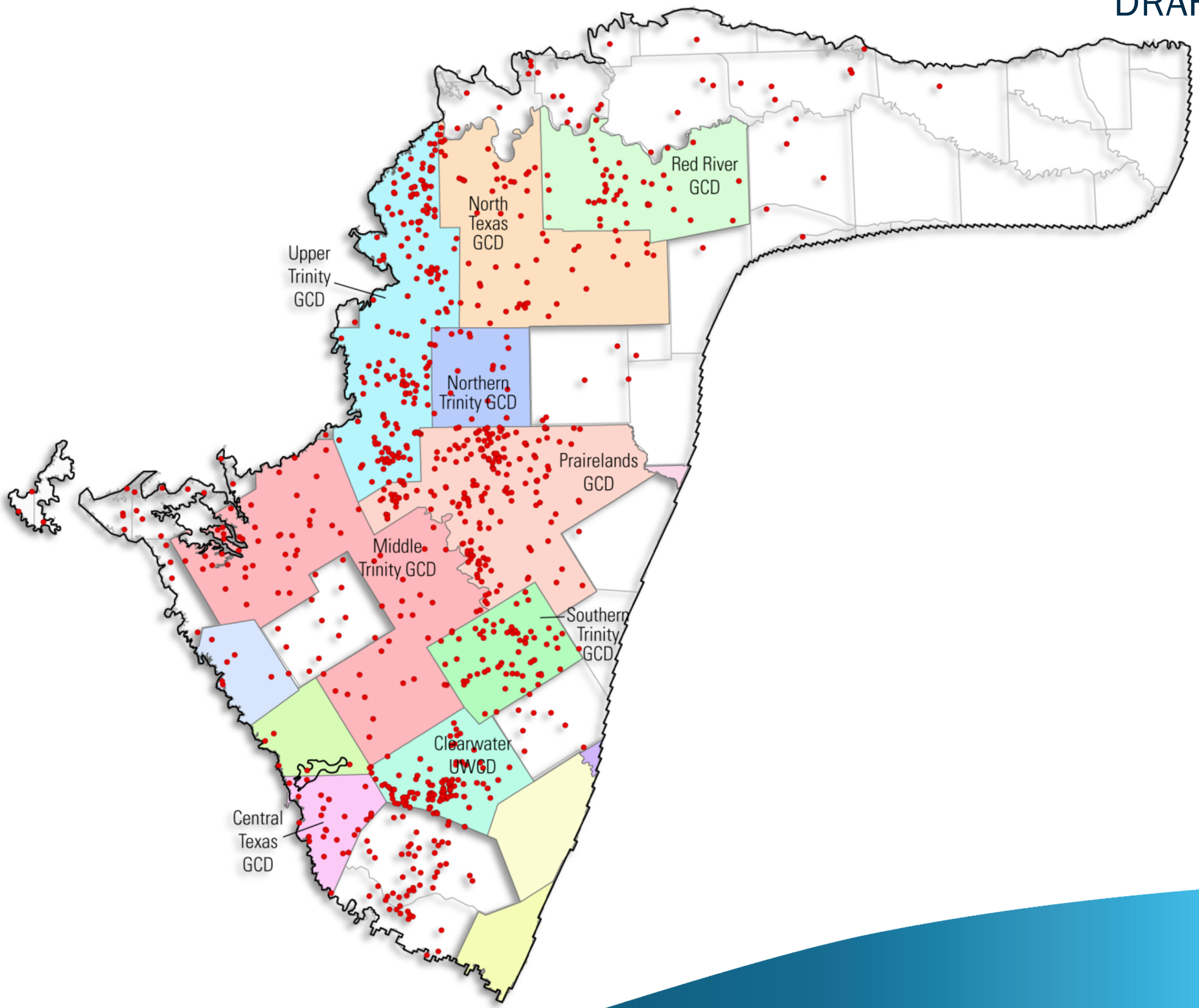
Water Levels

- The model update includes the 2012–2020 time period
- 2012–2020 wells with water levels shown at right
- Data from GCDs and TWDB—checked for duplicates

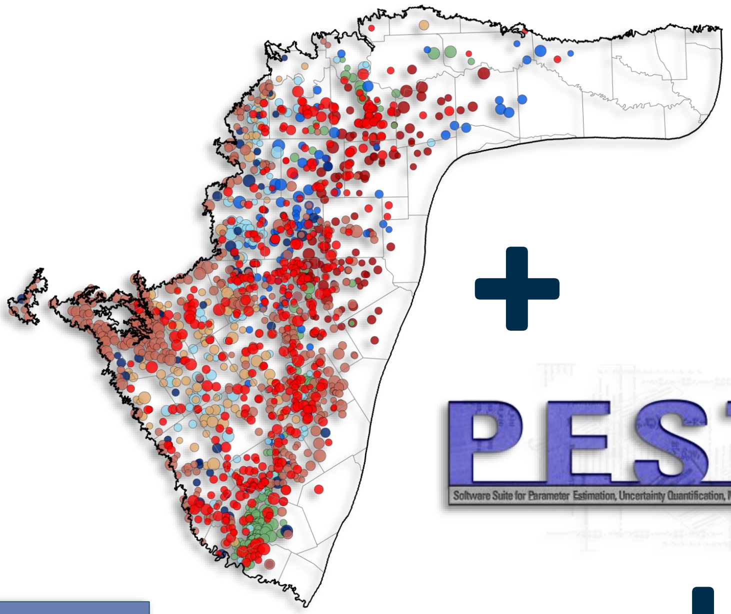


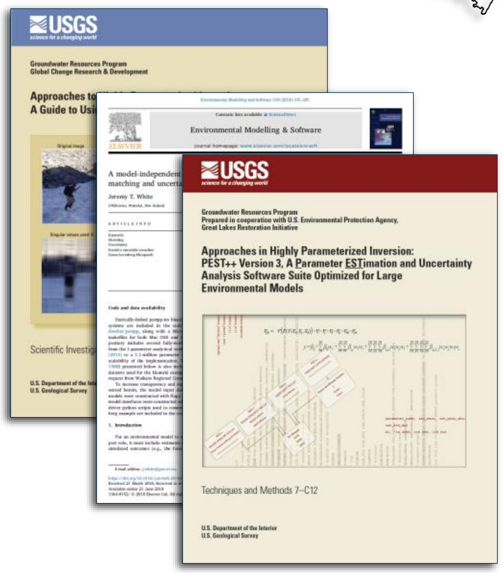


INTERA

Uncertainty Approach

- Assumptions are made when constructing a groundwater model. Each of these assumptions results in uncertainty.
- Uncertainty in the model is propagated to modeled results.
- Model calibration is non-unique. Many ways to calibrate, so there's a range of possible results.
- Use an ensemble rather than a single model to encapsulate this range of results and improve the model predictions
- **Better predictions = better decisions**





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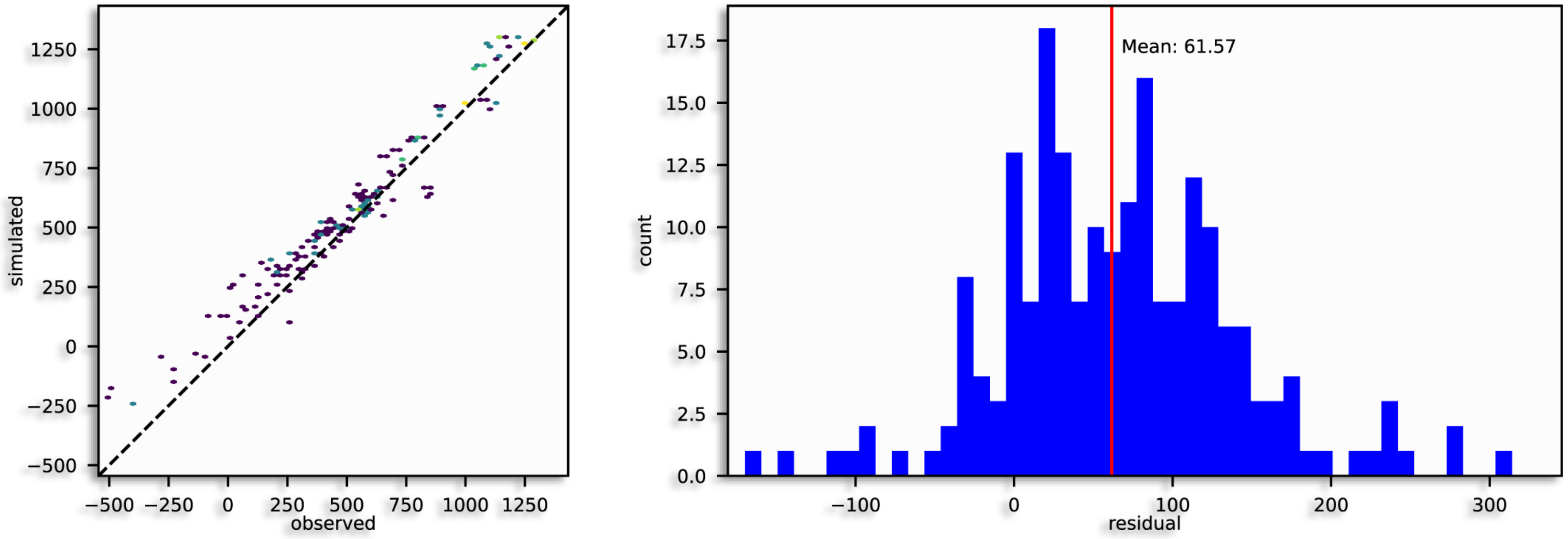
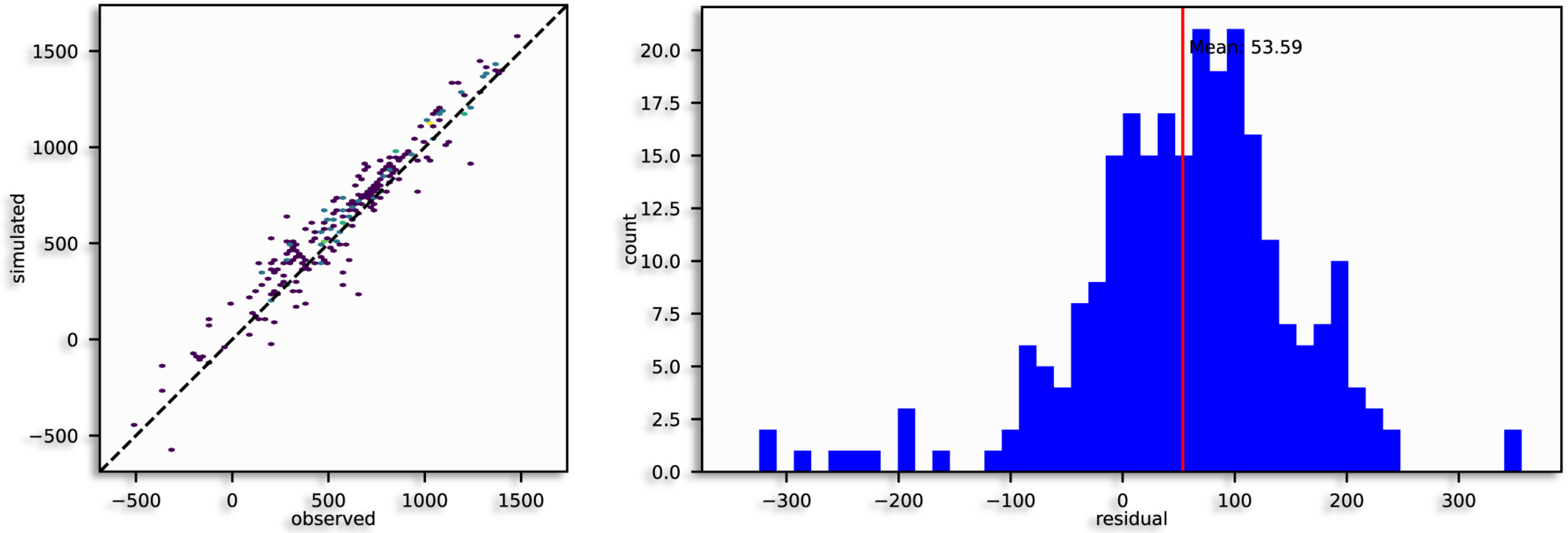
Calibration Results

- Focus the calibration on the most accurate water level data
- 90% of the calibration effort focused on wells with screening information
- Water levels with greater uncertainty include: (1) wells without screening information, and (2) airline measurements
- Decadal-scale results at right

Wells with long-term measurements in multiple units (with screens)



Wells with short-term measurements in multiple units (with screens)



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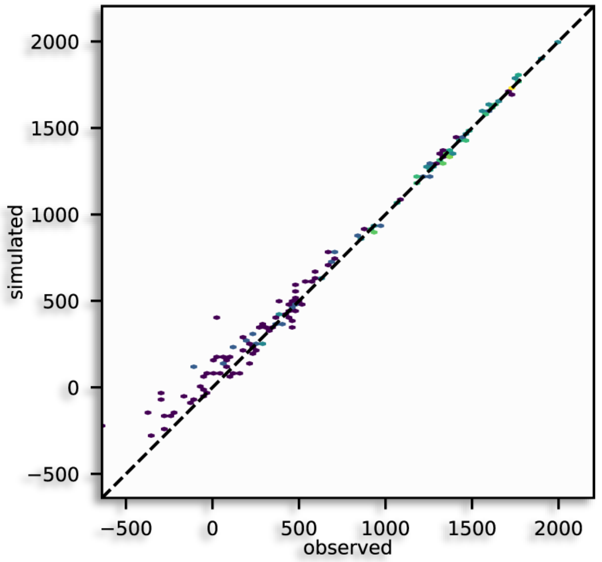
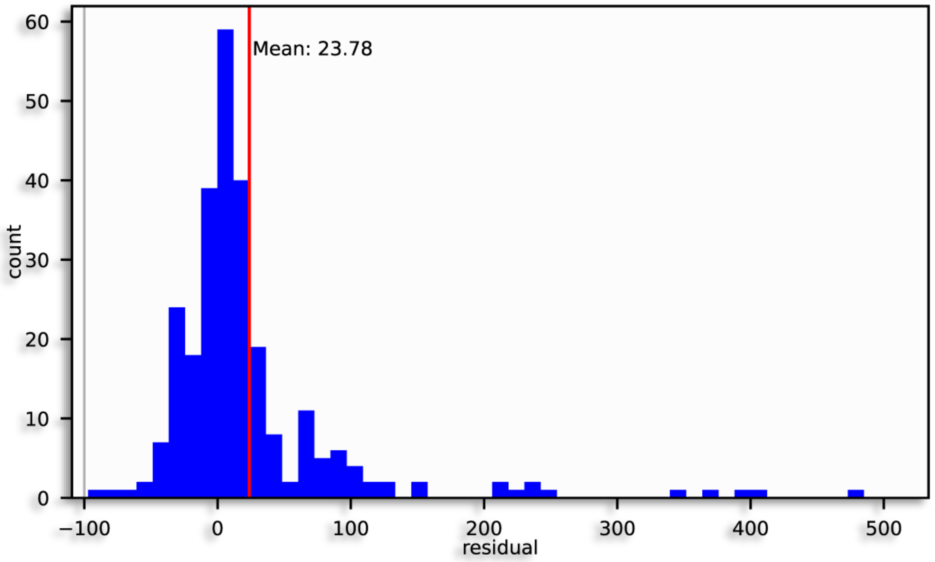
Calibration Results

Layer 8 – Hosston aquifer calibration

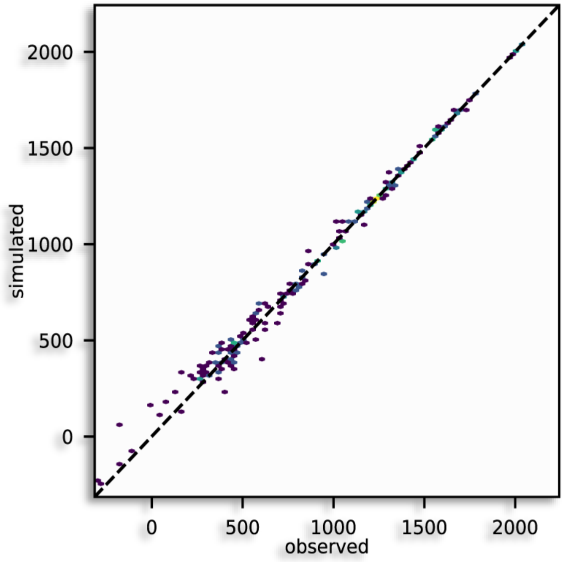
- Generally, a large percentage of wells with screening information in the Hosston
- Decadal-scale results at right

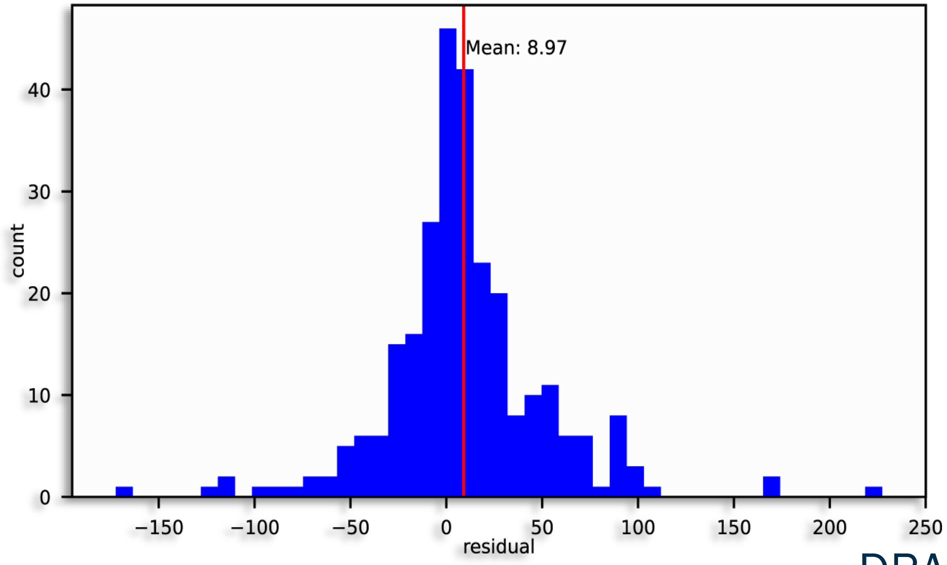
Long-term wells – Hosston (with screens)





Short-term wells – Hosston (with screens)





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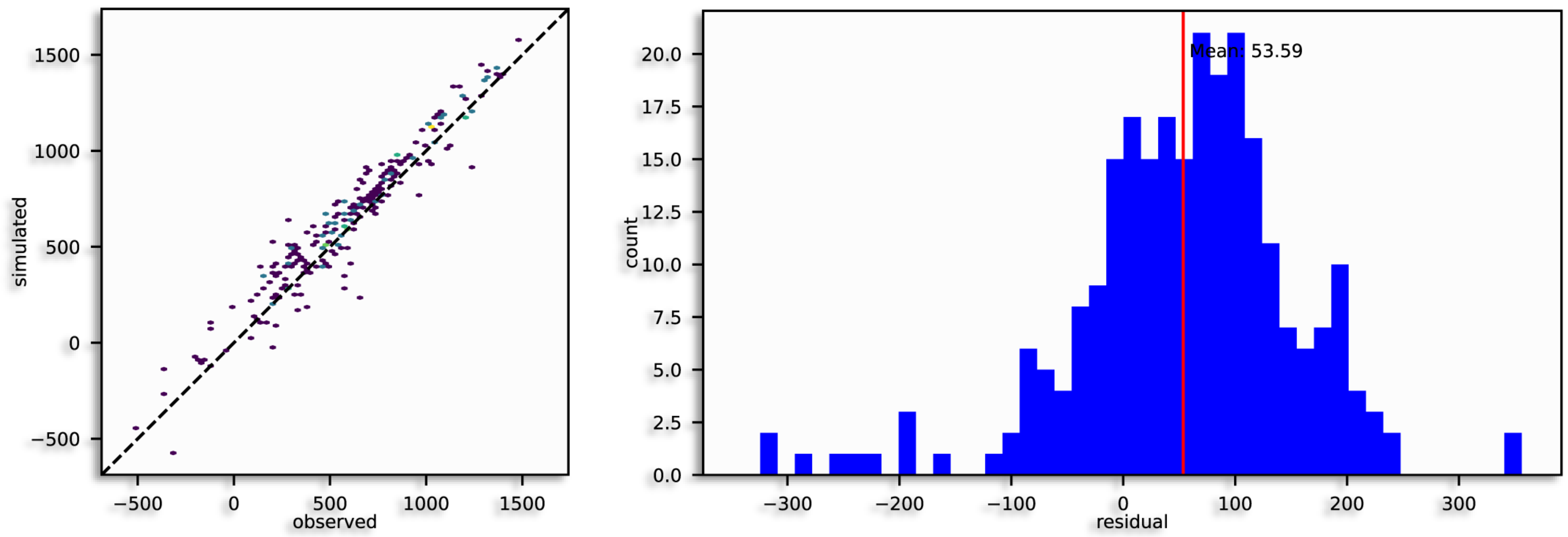
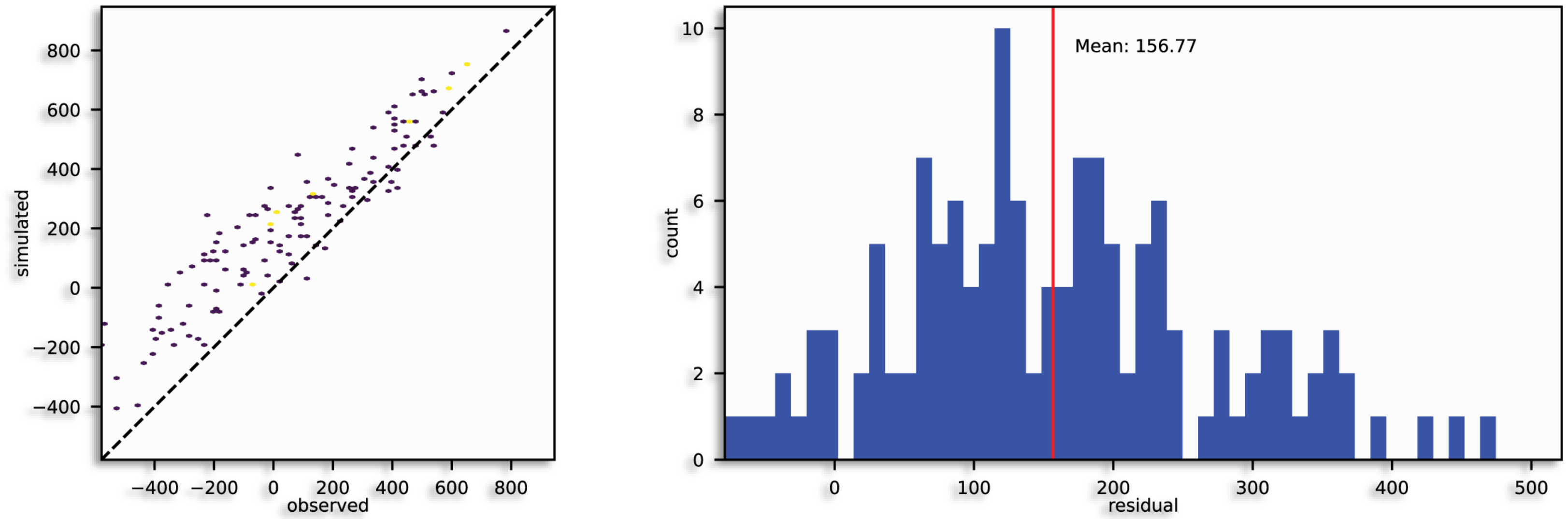
Calibration Results

- Focus the calibration on the most accurate water level data
- 90% of the calibration effort focused on wells with screening information
- Water levels from airline measurements tended to have substantially greater residuals in the model
- Decadal-scale results at right

Short-term wells completed in multiple units (with screens)



Short-term wells completed in multiple units (airline measurements with screens)

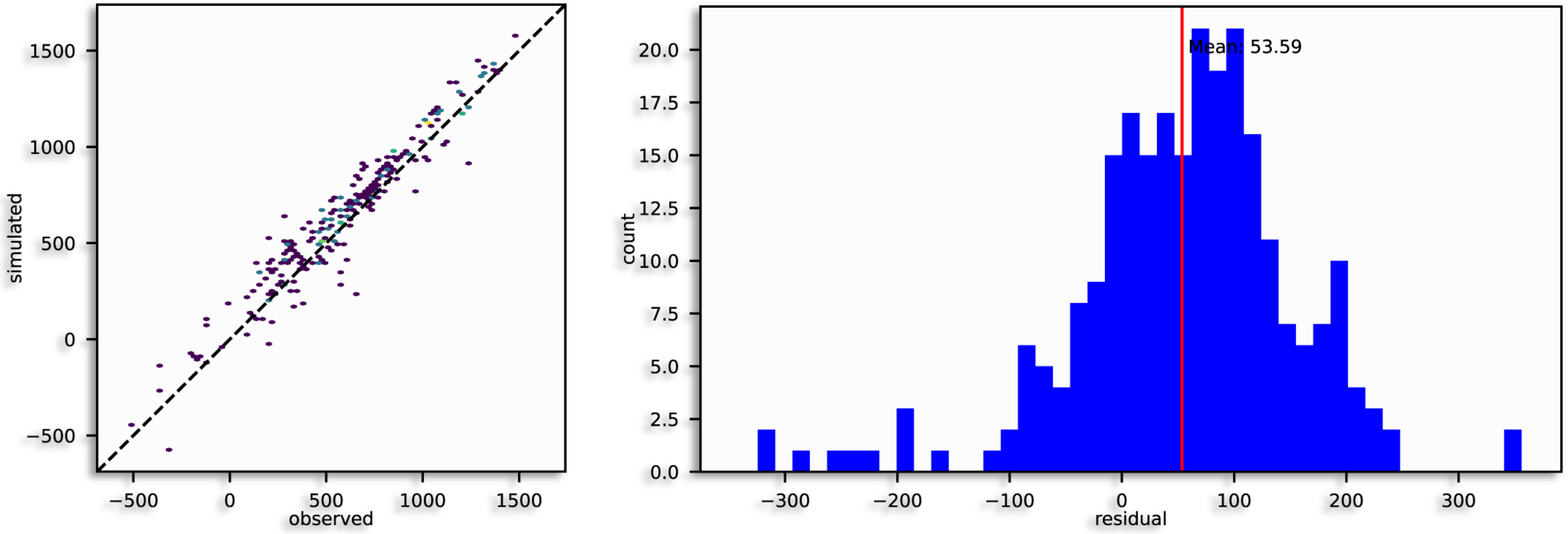


DRAFT

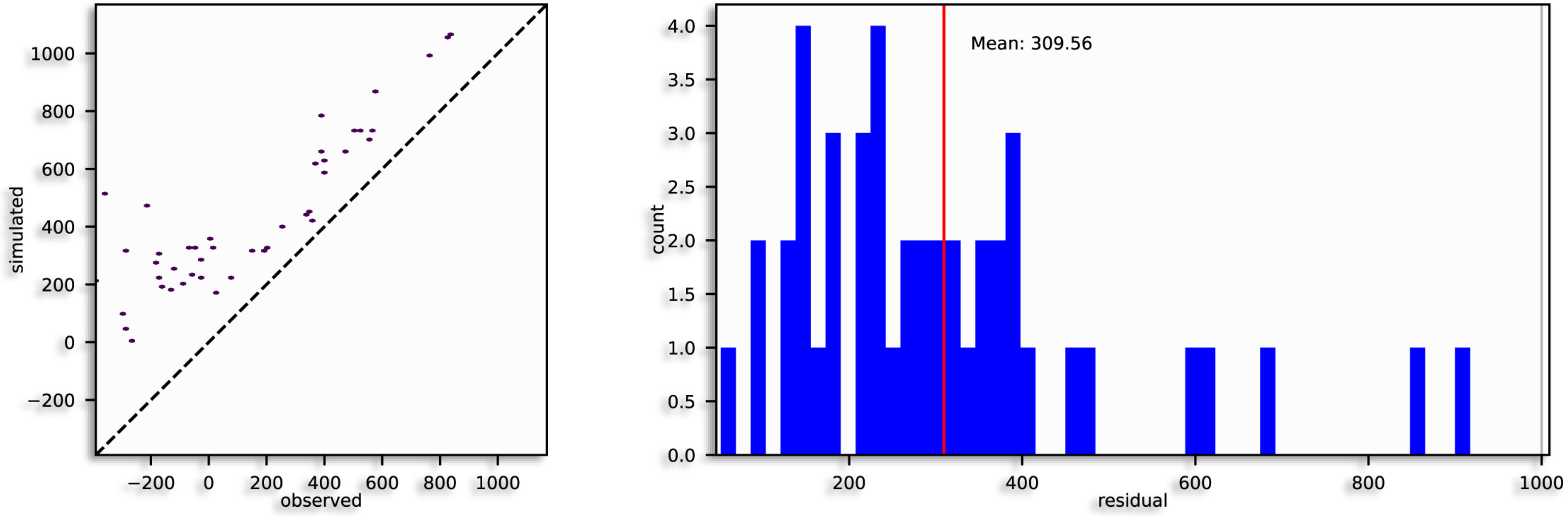
Calibration Results

- Focus the calibration on the most accurate water level data
- 90% of the calibration effort focused on wells with screening information
- Water levels from airline measurements in wells without screening information tended to have the greatest residuals in the model
- Decadal-scale results at right

Short-term wells completed in multiple units (with screens)



Short-term wells completed in multiple units (airline measurements, no screens)



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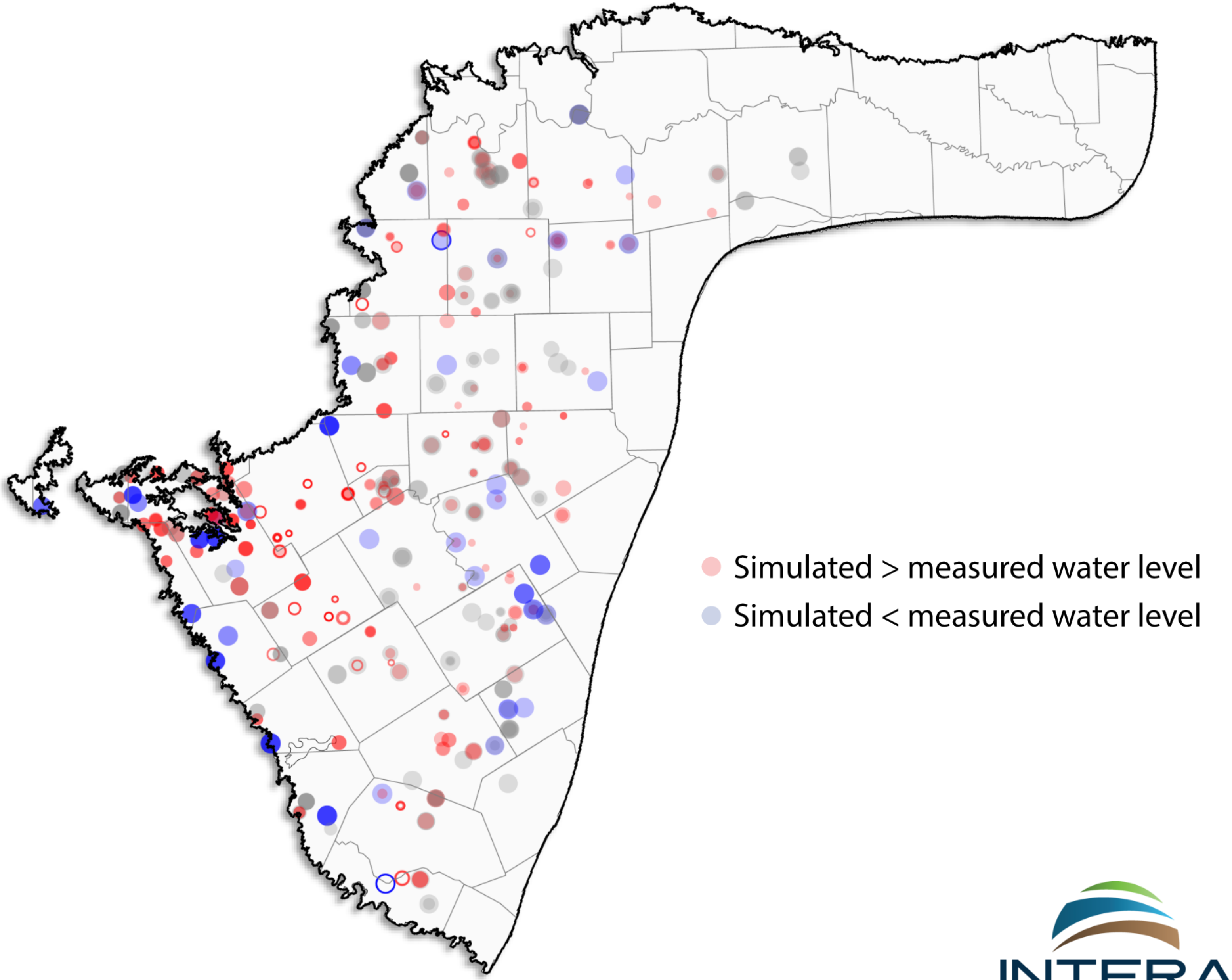
Calibration Results

- Spatial mix of simulated water levels above and below the measured values
- Water levels shown are for wells with screened information without airline measurements
- Decadal-scale results at right



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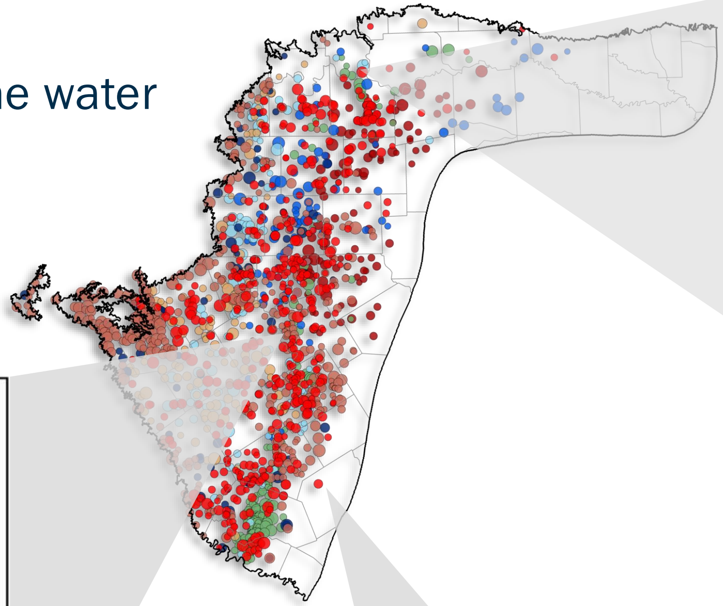
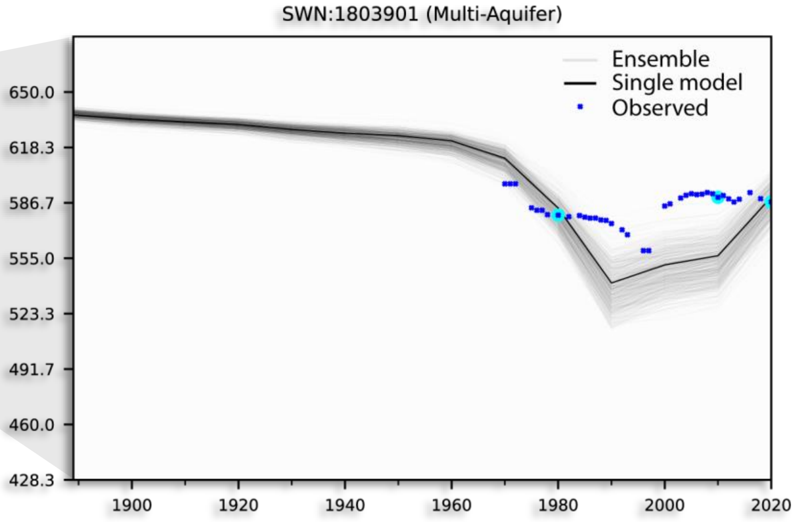
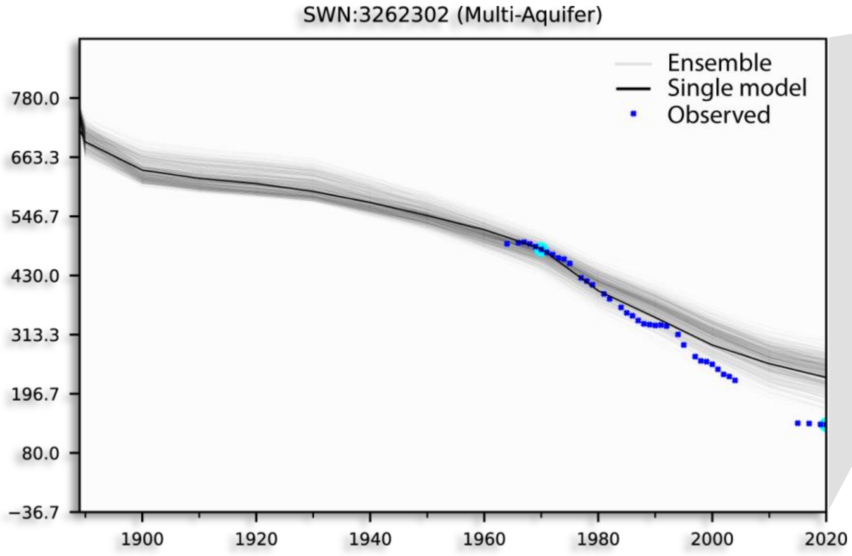
Calibration Results

- Positive progress with the model calibration to groundwater levels
- Generally replicating the trend of the water level data in most areas

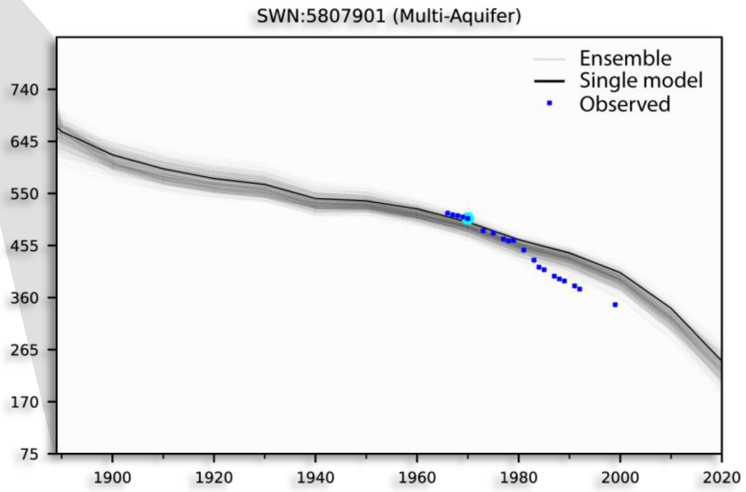




Grayson County



Hill County

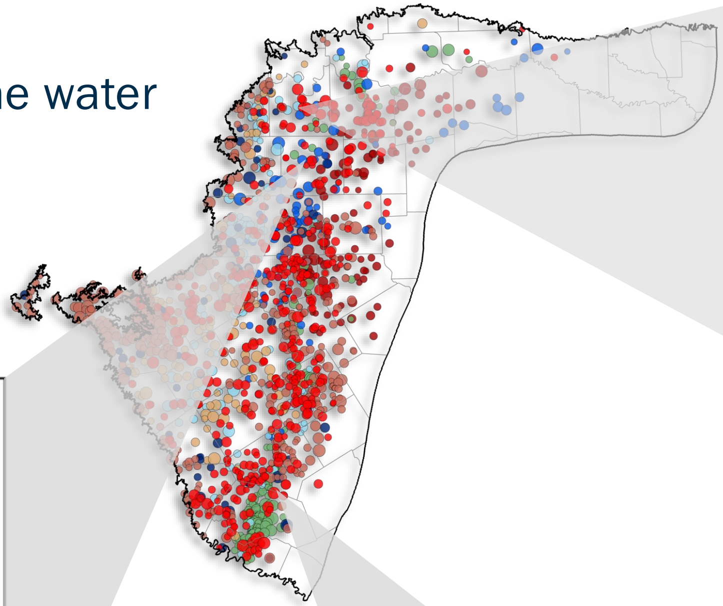


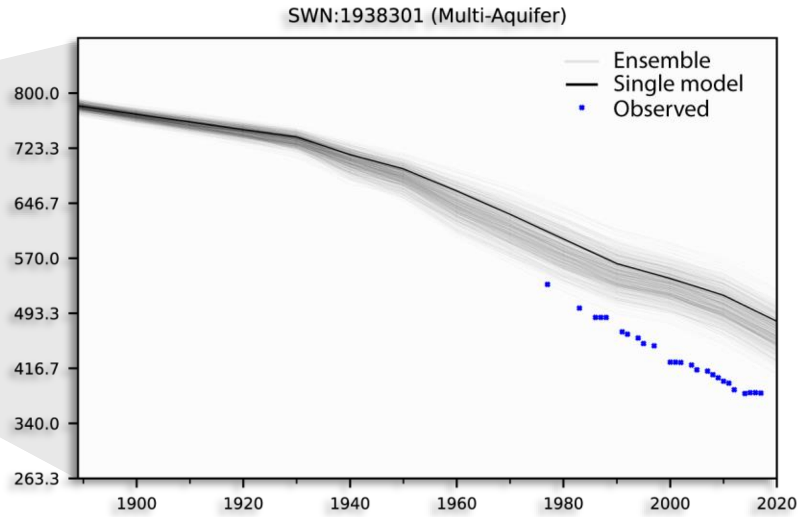
Milam County

DRAFT

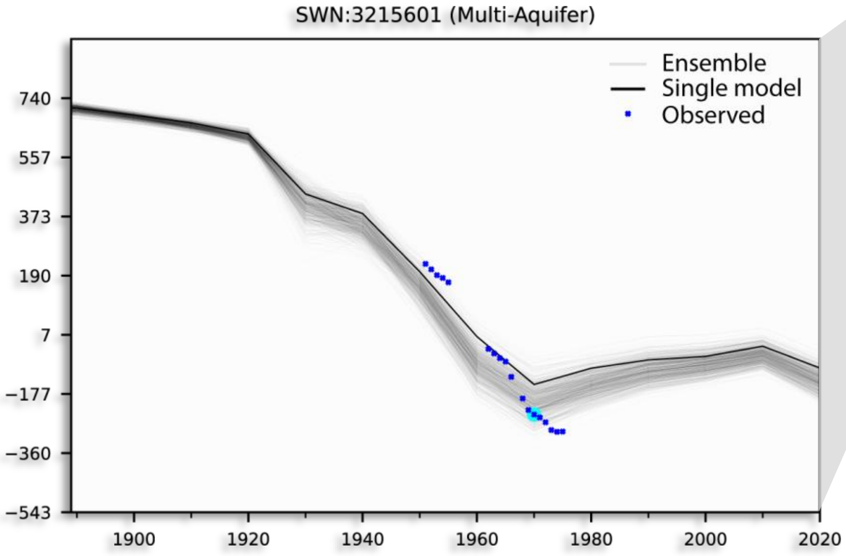
Calibration Results

- Positive progress with the model calibration to groundwater levels
- Generally replicating the trend of the water level data in most areas

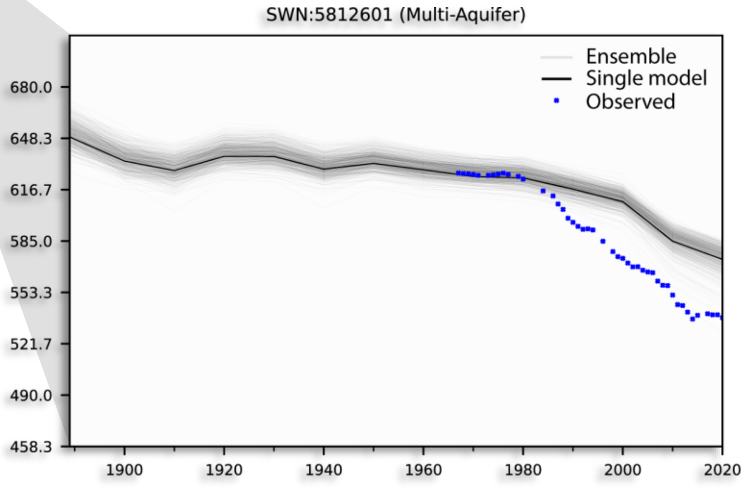




Cooke County



Tarrant County



Williamson County

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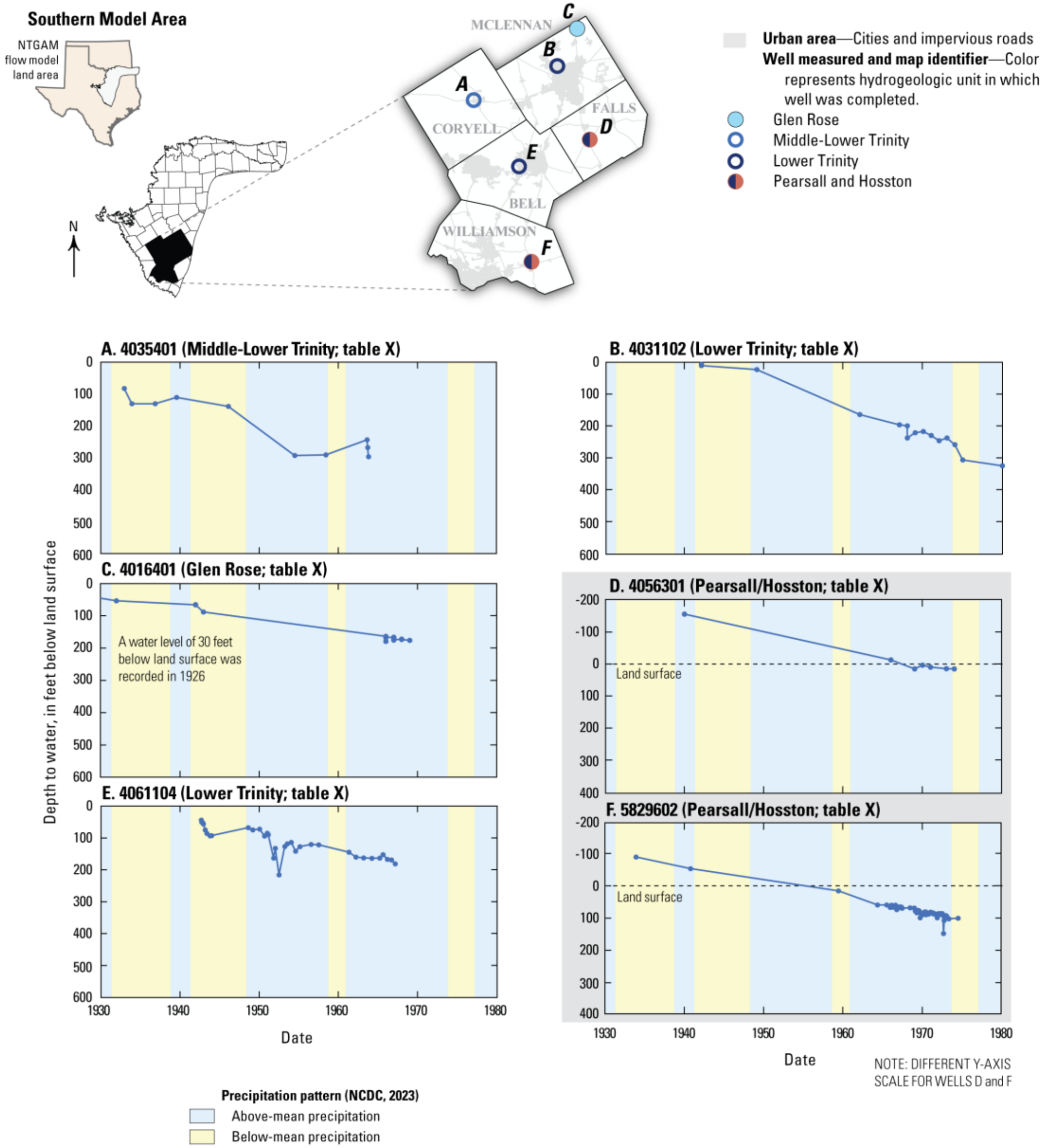
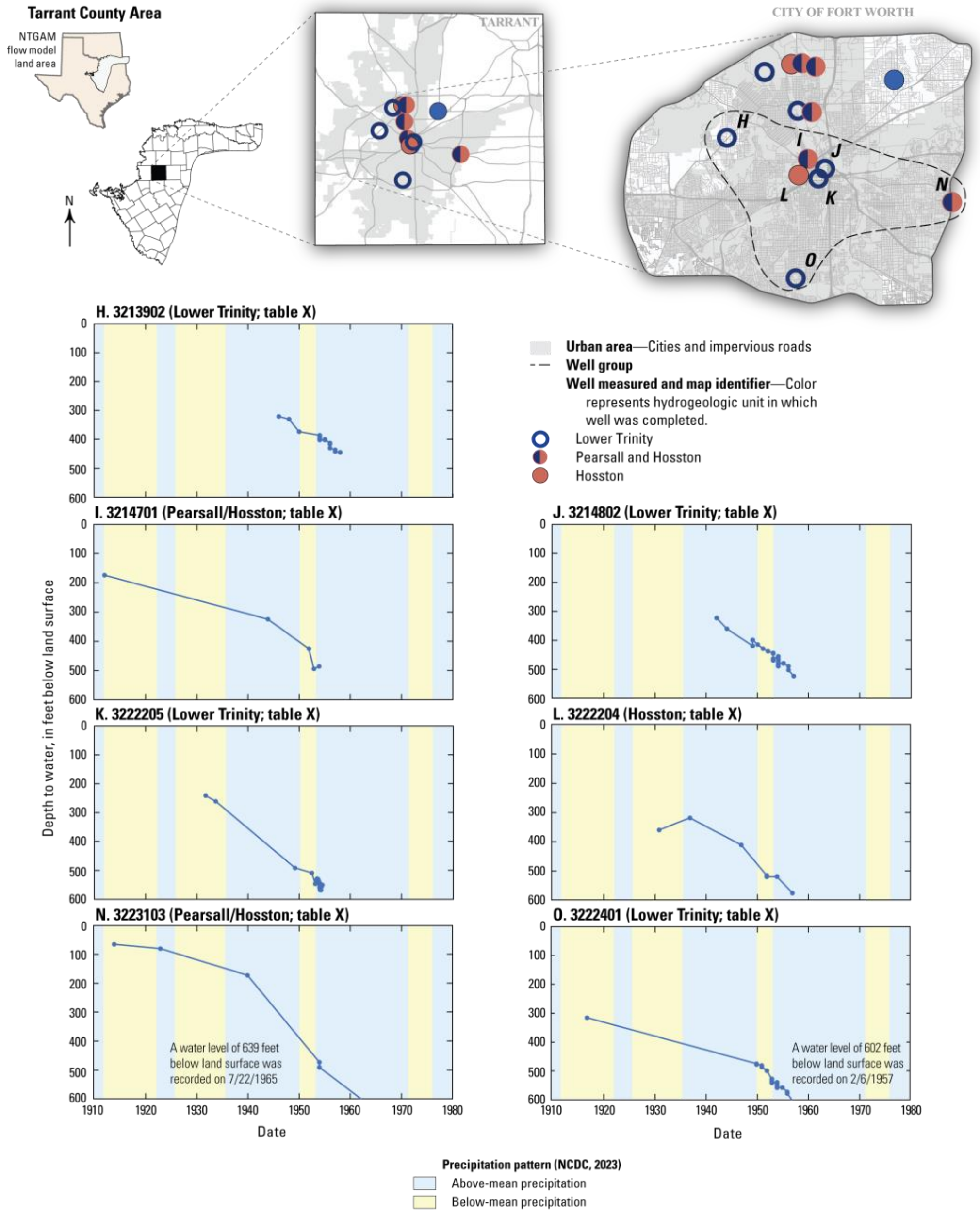
Report Figures





Note:precip shading still to be updated...

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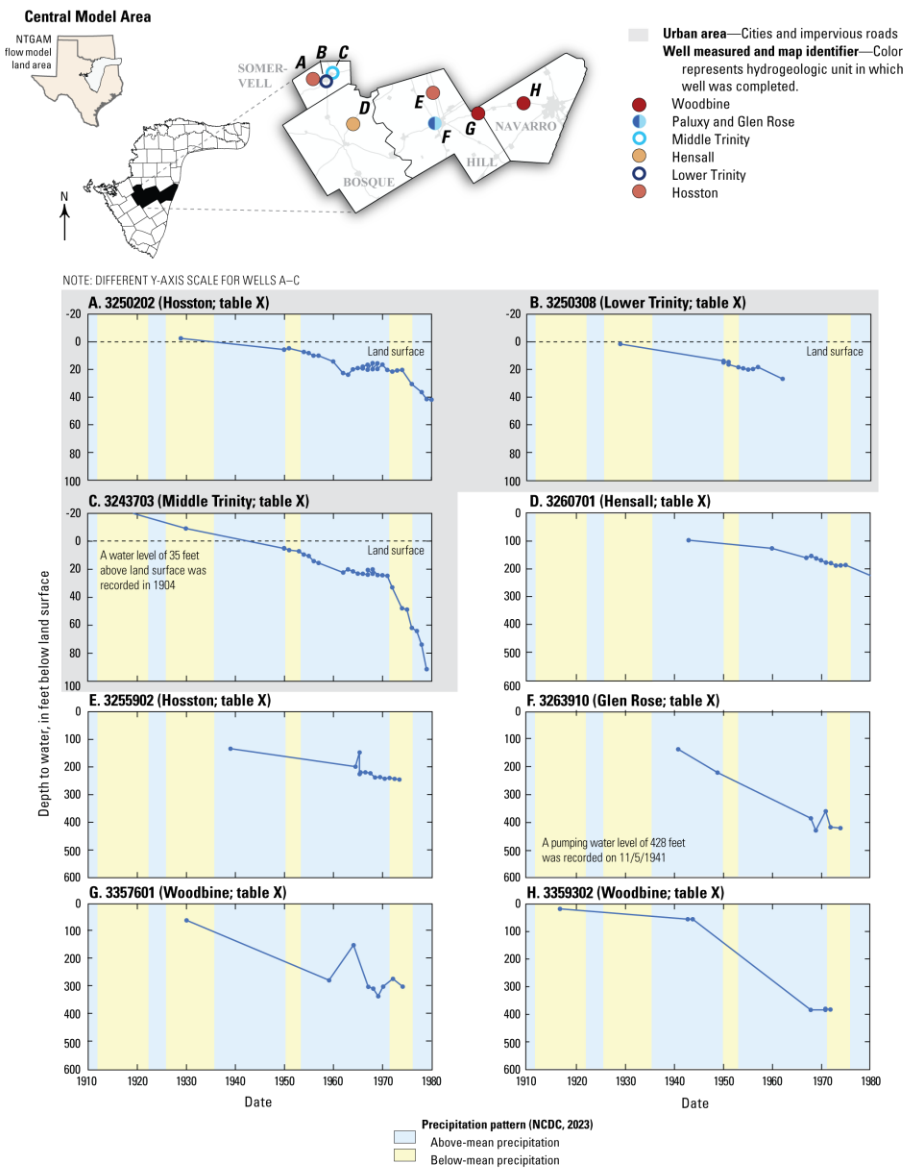
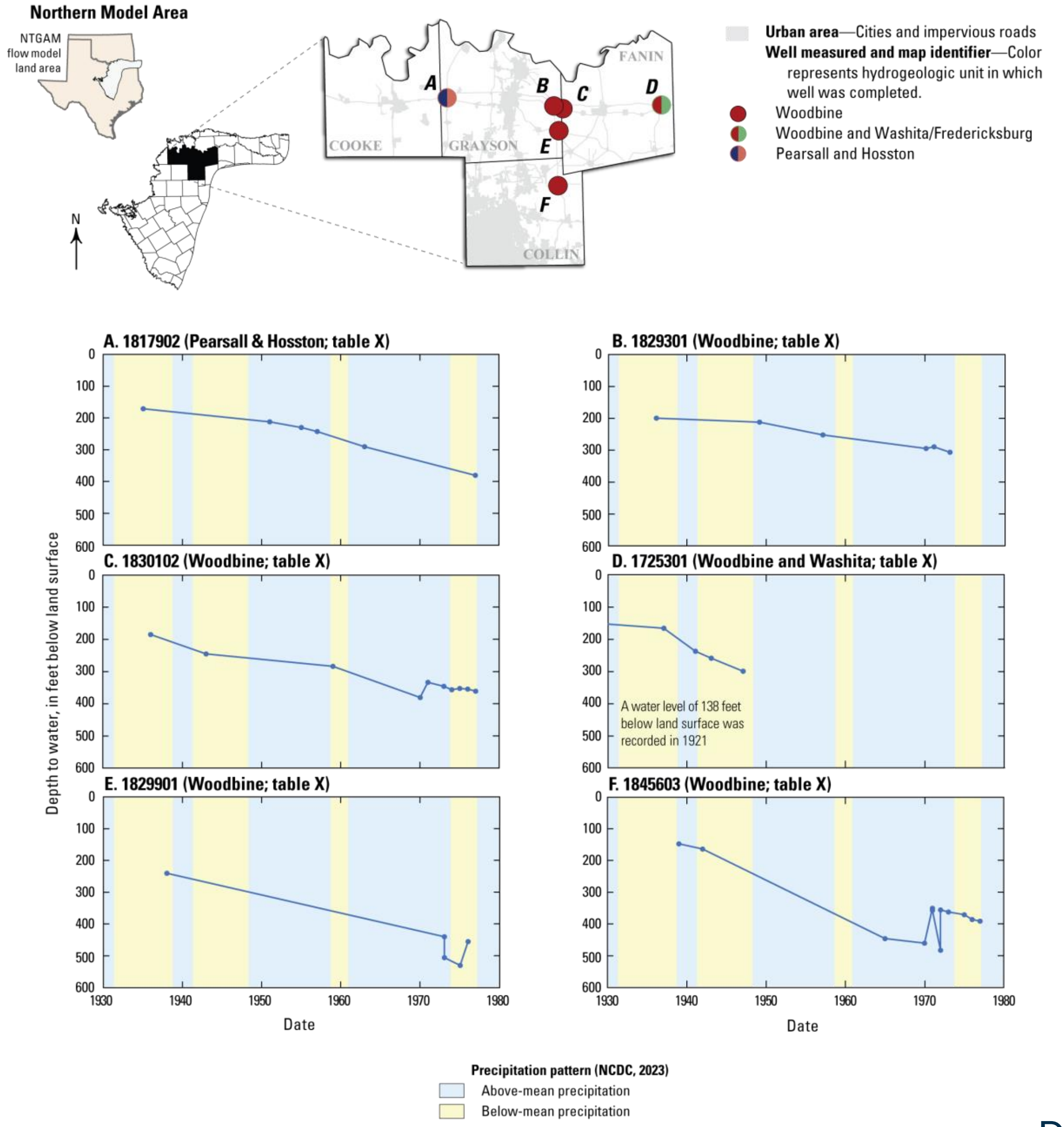
Report Figures





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