outline

- model parameters
- steady-state calibration
Modeling Team

- Ali Chowdhury
- Robert Mace

Data Team

Structure:  
- Roberto Anaya
- Richard Smith

Pumping:  
- Ian Jones
What is a groundwater model?

- a tool to estimate field conditions
- allows effective use of available data and account for complexities
- expands our ability to better understand and manage the water resources
- increases prediction accuracy of future events to a level far beyond “best judgement” decisions
A Model Cell

- **Recharge**: Rainfall/River
- **Pumping**
- **Evapo-transpiration**

- **Aquifer Thickness**
- **Hydraulic Conductivity**
- **Water Level**
Location of Completed, Ongoing, and Proposed Models for GAM

- **c** = completed
- **o** = ongoing
- **p** = proposed

1. Trinity (Hill Country) \(c\)
2. Hueco Bolson \(c\)
3. Ogallala (northern part) \(c\)
4. Edwards (Barton Springs segment) \(c\)
5. Lower Rio Grande Valley \(o\)
6. Edwards-Trinity Plateau \(o\)
7. Ogallala (southern part) \(o\)
8. Gulf Coast (central part) \(o\)
9. Carrizo-Wilcox (northern part) \(o\)
10. Carrizo-Wilcox (central part) \(o\)
11. Carrizo-Wilcox (southern part) \(o\)
12. Gulf Coast (northern part) \(o\)
13. Edwards (San Antonio segment) \(o\)
14. Edwards (northern segment) \(p\)
15. Trinity (northern part) \(p\)
16. Seymour \(p\)
17. Pecos Alluvium \(p\)
Model area and extent of the Gulf Coast aquifer
Stratigraphic sequence
Surficial geology of the Southern Gulf Coast Aquifer
Conceptual model of the groundwater flow system, southern Gulf Coast aquifer.
Chicot Aquifer

Jasper aquifer

Evangeline aquifer

Burkeville Confining System

Model Layer 1

Active Cells = 5400
Evangeline Aquifer

Model Layer 2
Active Cells 7456
Burkeville Confining System

Model Layer 3
Active Cells = 7270
Approximate thickness of the Evangeline aquifer
Approximate thickness of the Burkeville Confining System
Approximate thickness of the Jasper aquifer
Aquifer geometry along an east-west cross-section

WEST

EAST

Chicot aquifer

Evangeline aquifer

Burkeville Confining System

Jasper aquifer
Aquifer geometry along a north-south cross-section
Recharge distribution based on geology

- 6% of rainfall
- 1% of rainfall
- No recharge
Canal Losses as Recharge?

(TBWE, 1946)
Resacas = .004 cu-ft/d = 3.35E-5 acre-ft/yr
Concrete canals = 0.08 to 0.3 cu-ft/d = 6.7E-4 to 2.5E-3 acre-ft/yr
Cylinder tests = .0337 cu-ft/d = 2.8E-4 acre-ft/yr

Fipps (2000)
Unlined canals = 54 to 1037 acre-ft/yr
Concrete canals = 90 to 1220 acre-ft/yr

Losses may not reach the groundwater
May reach only the shallow perched areas
Discharge through ditches to surface water courses
## Recharge for the Gulf Coast aquifer

<table>
<thead>
<tr>
<th>Source</th>
<th>Recharge (in/yr)</th>
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<tbody>
<tr>
<td>Groschen (1985)</td>
<td>0.06</td>
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<tr>
<td>Ryder (1988)</td>
<td>0 to 6</td>
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<tr>
<td>Dutton and Richter (1990)</td>
<td>0.1 to 0.4</td>
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<td>Noble and others (1996)</td>
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<td>Hay (1999)</td>
<td>.00004 to .04</td>
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<td>Harden and Associates (2001)</td>
<td>3</td>
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<td>This study TWDB (2002)</td>
<td>0 to 1.06</td>
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</table>
Groundwater withdrawal by evapotranspiration is up to 95% of rainfall (Gatewood et al., 1950; Anderson, 1970).
Groundwater withdrawal within the model area (1980-1999)
Hydraulic Conductivity

Chicot aquifer

Evangeline aquifer

Occurrence

log hydraulic conductivity (ft/d)

Occurrence

log hydraulic conductivity (ft/d)
Hydraulic Conductivity used in model calibration

- Chicot aquifer, $K_h = 17$ ft/d, $K_v = 0.01$ ft/d
- Evangeline aquifer, $K_h = 3$ ft/d, $K_v = 0.001$ ft/d
- Burkeville Confining System, $K_h = 0.001$ ft/d, $K_v = 1E-9$ ft/d
- Jasper aquifer, $K_h = 1.8$ ft/d, $K_v = 0.01$ ft/d
Water level in the Chicot aquifer, 1930-1980
Water level in the Evangeline aquifer, 1930-1980
Well 84-55-203, Brooks County (Depth 710, Surface elevation 137-ft)

Well 87-31-503, Hidalgo County (Depth 86, Surface elevation 97-ft)

Well 88-42-401, Cameron County (Depth 362, Surface elevation 45-ft)

Well 87-42-103, Starr County (Depth 58, Surface elevation 145-ft)
Well 87-31-601, Hidalgo County
(Depth 80 ft, Surface elevation 87 ft)

Well 88-34-101, Willacy County
(Depth 870 ft, Surface elevation 40 ft)

Well 88-26-303, Willacy County
(Depth 871 ft, Surface elevation 32 ft)

Well 88-02-403, Kenedy County
(Depth 1099 ft, Surface elevation 29 ft)
Matching measured and simulated water levels

Root Mean Squared Error (RMS) = 36 feet
Simulated water levels, Chicot aquifer
Simulated water levels, Evangeline aquifer
Next Step..

- Transient Verification (1980-2000)
- Predictive Model Runs (2000-2050)
<table>
<thead>
<tr>
<th>Participant</th>
<th>Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glenn Jarvis</td>
<td>Law Offices MP, Region M</td>
</tr>
<tr>
<td>Lee Kirkpatrick</td>
<td>Texas State bank, Region M</td>
</tr>
<tr>
<td>Mary Lou Campbell</td>
<td>Mercedes, Region M</td>
</tr>
<tr>
<td>Robert Gonzalez</td>
<td>Eagle Pass Waterworks, Region M</td>
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<td>Charles Browning</td>
<td>North Alamo Water Supply Corporation</td>
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<td>Guadalupe Carlos Garza</td>
<td>Roma</td>
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<td>Mercurio Martinez</td>
<td>Webb County Judge</td>
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<tr>
<td>James Matz</td>
<td>Harlingen</td>
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<td>Donald McGhee</td>
<td>Hydro Systems Inc. - Harlingen</td>
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<tr>
<td>Adrian Montemayor</td>
<td>Water Utilities, Laredo</td>
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<td>Ray Prewett</td>
<td>Texas Citrus Mutual</td>
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<tr>
<td>Xavier Villarreal</td>
<td>T &amp; J Office Supply</td>
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<tr>
<td>Israel Tamez</td>
<td>Willacy County</td>
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<tr>
<td>Eleanor Garcia, Jr.</td>
<td>City of Raymondville</td>
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<tr>
<td>Neil H.</td>
<td>TWDB, Harlingen</td>
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<tr>
<td>Robert Gonzalez</td>
<td>City of Eagle Pass</td>
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<tr>
<td>Ali Chowdhury</td>
<td>TWDB, Austin</td>
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<tr>
<td>Ralph Boecker</td>
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<tr>
<td>Ernesto Alanis</td>
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<tr>
<td>Carlos Rubinstein</td>
<td>TNRCC Watermaster</td>
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<tr>
<td>Ernesto Reyes</td>
<td>USFWS</td>
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<tr>
<td>Randy Blackmansion</td>
<td>TPWD</td>
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<tr>
<td>Felipe C.</td>
<td>CILA Sec. Mexico</td>
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<tr>
<td>Garey Carter</td>
<td>AEP</td>
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<td>James Oliver</td>
<td>Olmito WSC</td>
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<td>Monica Monk</td>
<td>USFWS</td>
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<td>A. Salgado</td>
<td>MEXCON</td>
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<tr>
<td>Jim Darling</td>
<td>City of McAllen</td>
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<tr>
<td>Lucile H.</td>
<td>BPUB</td>
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<tr>
<td>Tomas Rodriguez</td>
<td>Webb County</td>
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<tr>
<td>Sonny Hinojosa</td>
<td>Hidalgo County Irrigation District #2</td>
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The Third Stakeholder Advisory Forum for the Lower Rio Grande Valley GAM was held on April 26, 2002 in McAllen in conjunction with the Region M RWPG meeting.

Q: Would the model help locate potential aquifers and estimate groundwater availability?
A: The GAM model will help estimate groundwater availability in the aquifer. The model could locate drawdown areas, identify pumping effect on the Rio Grande and other source areas.

Q: Could the model estimate volumes of fresh and brackish waters in the aquifers?
A: We said that the model itself does not consider water quality. We could however estimate the volumes based on water quality distribution in the aquifers. We indicated that we are trying to better understand the geochemical evolution of the groundwater using isotopes and chemical parameters that will help answer questions related to water quality issues.

Q: NRS Consulting is installing major desalination wells for a number of Water Supply Authorities in the Valley. They inquired whether the model would be able to determine what quality waters would they be drawing over time and how pumping may negatively impact the groundwater source areas.
A: We said the model would identify the extent of the drawdown cone over different times. MT3D code when used in combination with MODFLOW should be able to determine solute migration.

Q: Some members asked whether they should be clearing the mesquite for making more groundwater available?

A: Model calibration indicated that a significant amount of groundwater is lost to evapo-transpiration. We indicated that mesquites with their deep root systems act as a significant sink for the groundwater. We said that several studies suggest that removal of phreatophytes cause a rise in the water table.