

# Regional Groundwater Assessments of the Groundwater Resources Program



# Presentation Outline

- Describe the GWRP's Regional GW Availability Assessments
- Discuss importance of monitoring data to modeling
- Provide examples of how monitoring and modeling complement each other

# The Groundwater Resources Program (GWRP)

is the principal USGS Program  
for assessing the Nation's groundwater availability  
at the regional and national scale.



It also spearheads the development of cutting edge technology for the analysis of groundwater using numerical models, geophysical techniques, and the application of alternatives methods.

<http://water.usgs.gov/ogw/gwrp/>

# Why Regional/National GW Assessments?

- Large-scale regional assessments are critical for proper resource management under complex, uncertain, and changing environment and social conditions.
- Many aquifer systems cross political (State, municipality, or district) boundaries.
- Can establish baselines and provide context for understanding how water demands interact with entire hydrologic system.
- Provide consistent and integrated information across political boundaries that is useful to those who use and manage the resource.

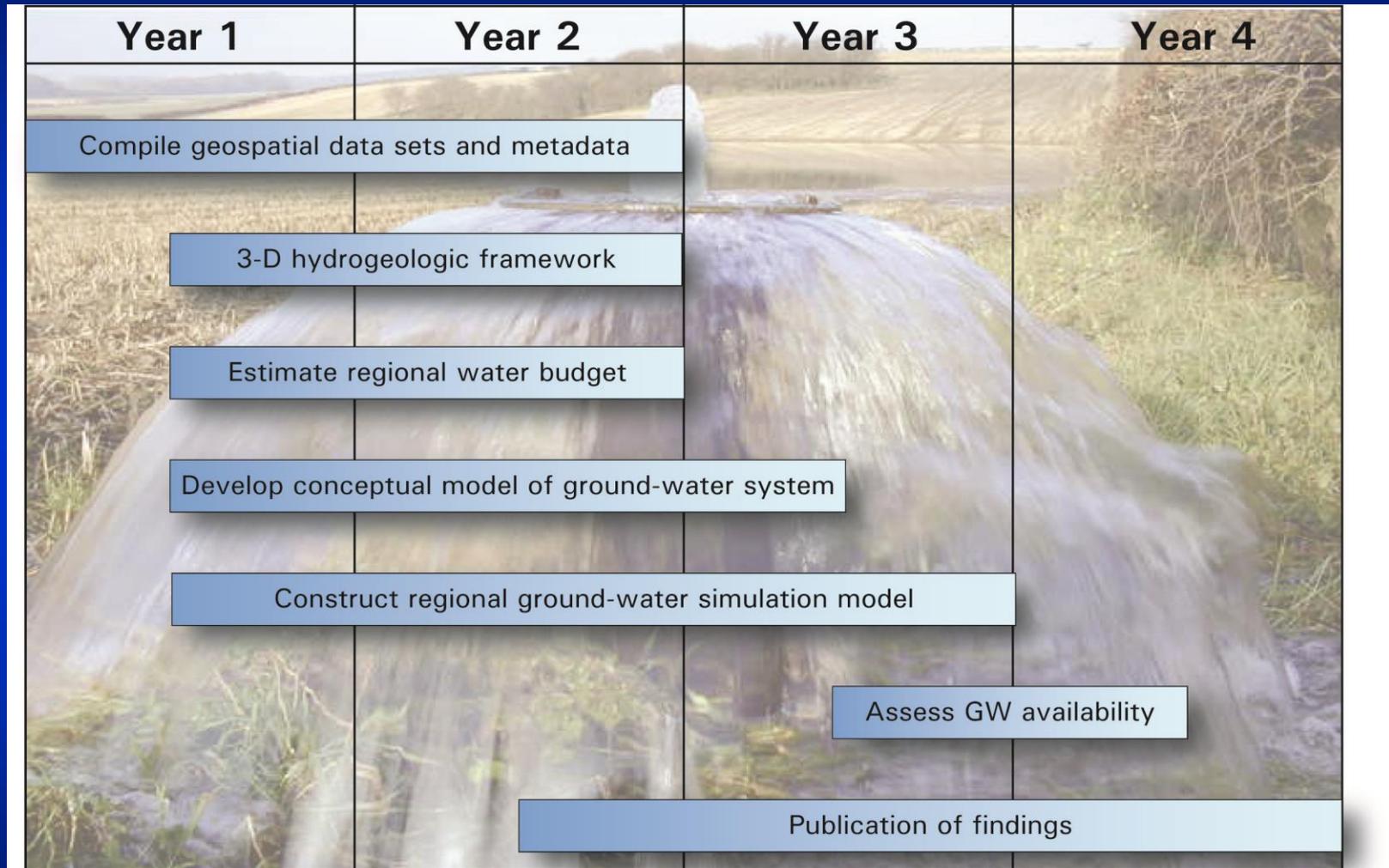
# Regional GW Availability Studies

## Objectives

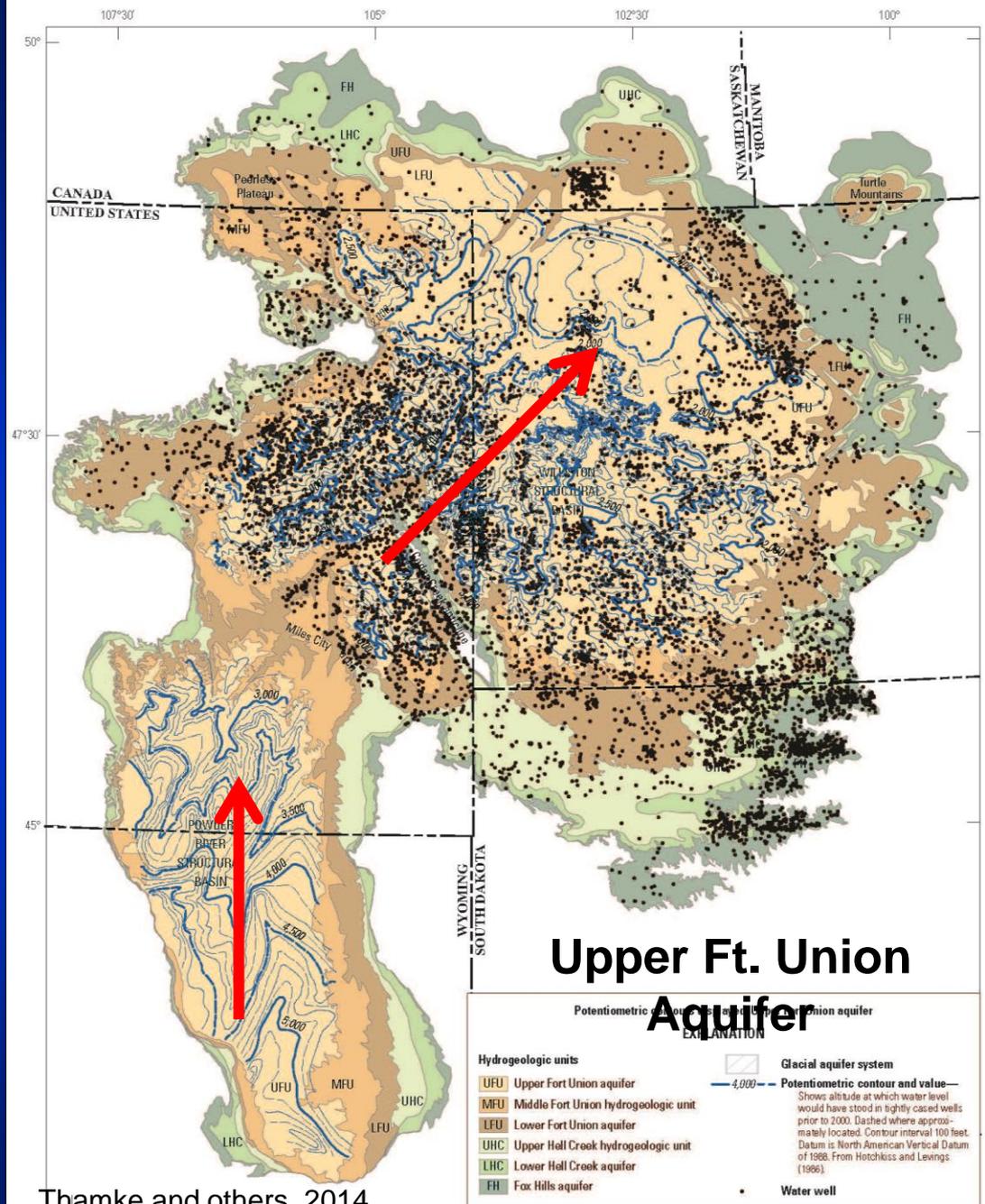
- Quantify current ground-water resources
- Evaluate how these resources have changed over time
- Provide tools to forecast system responses to stresses from future human and environmental uses.



# Associated Major Work Activities



Geospatial data sets--Location of wells used to develop potentiometric surfaces of the Upper Ft. Union Aquifer in the Williston structural basins



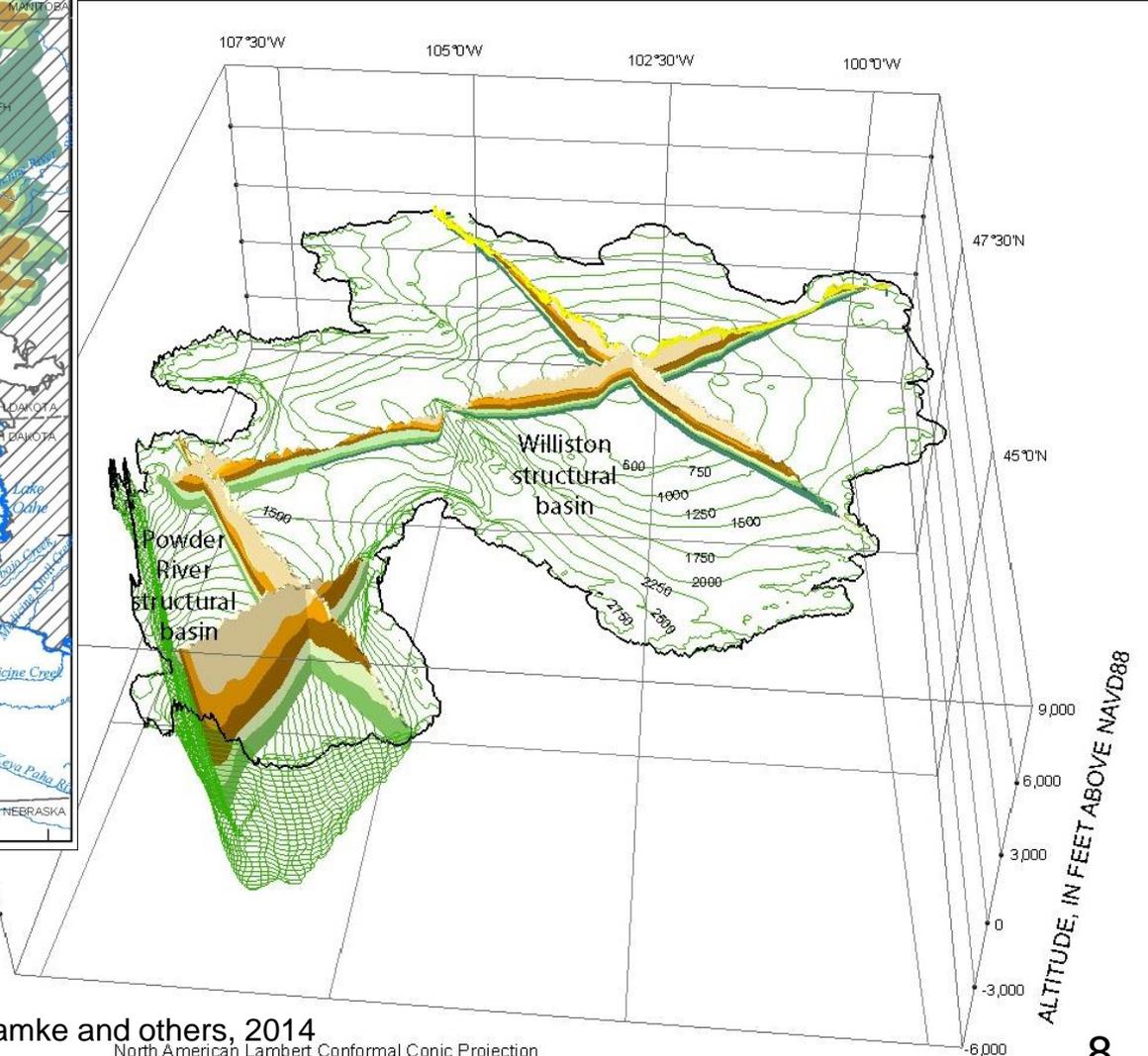
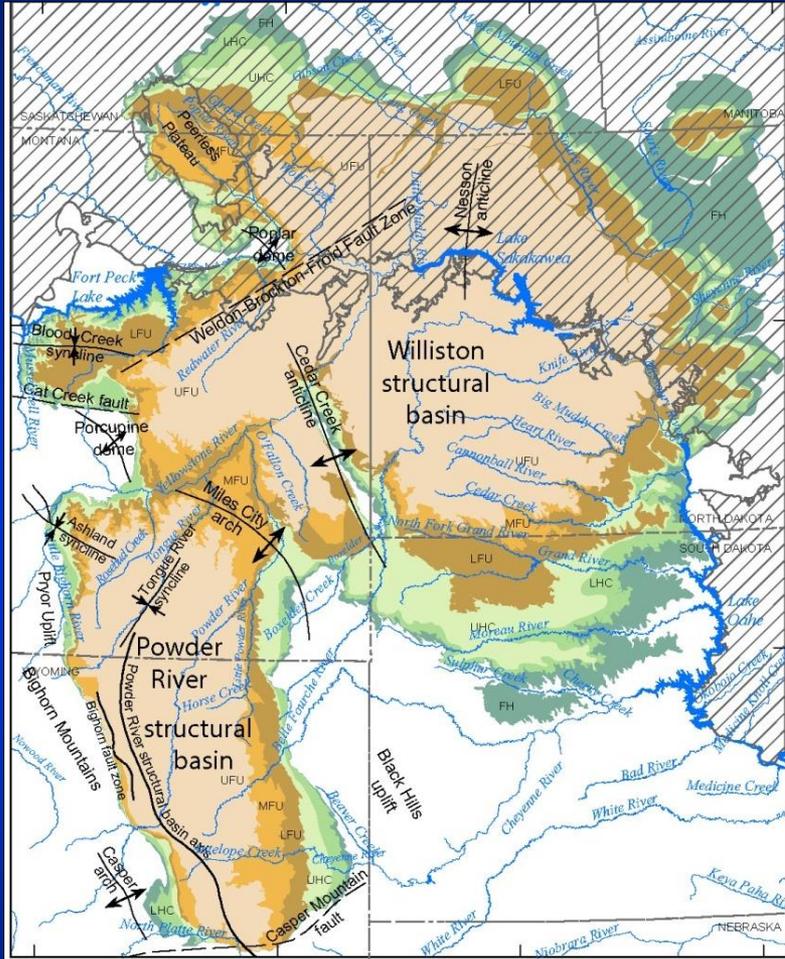
Thamke and others, 2014

Base modified from U.S. Geological Survey and other Federal digital data, various scales  
 North American Lambert Conformal Conic projection  
 North American Datum 1983

Interactive pdf 0 50 100 KILOMETERS 7 MILES



# Hydrogeologic Framework

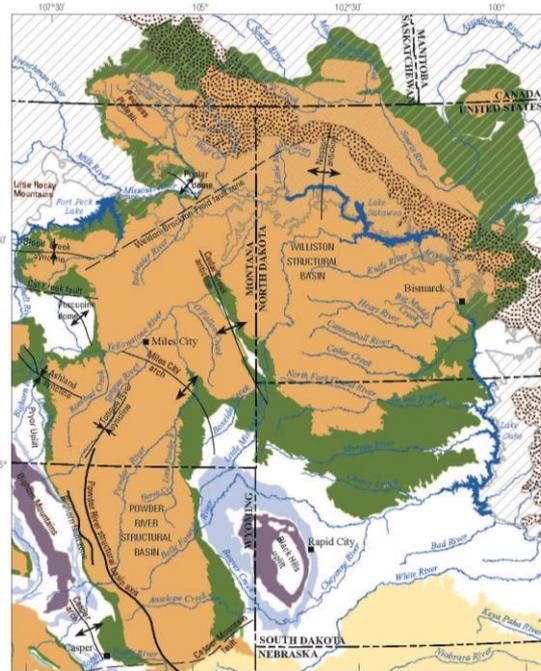


Thamke and others, 2014  
 North American Lambert Conformal Conic Projection  
 North American Datum 1988

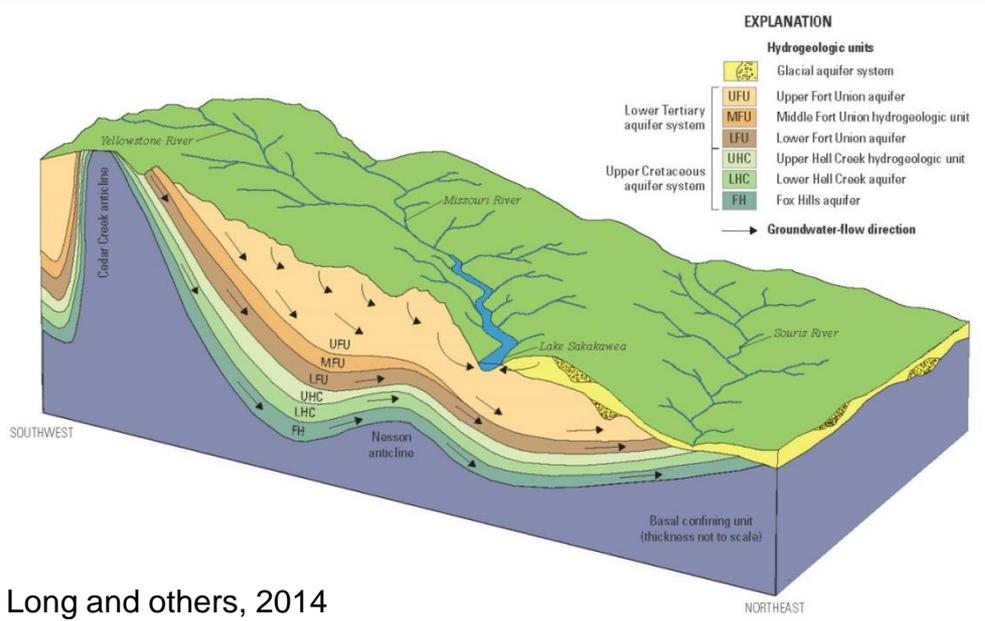
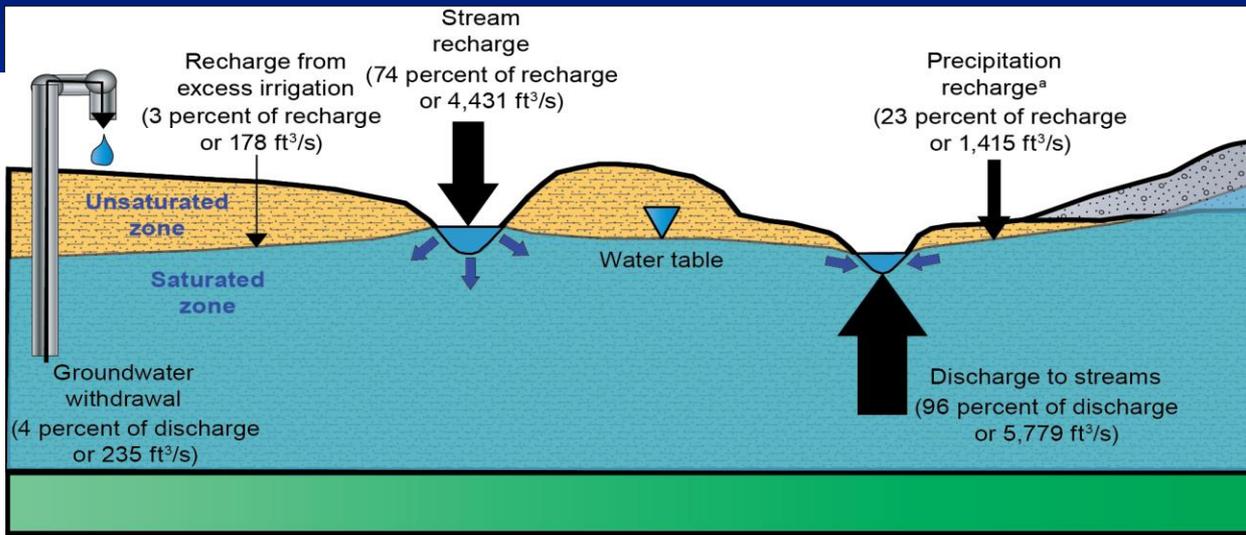
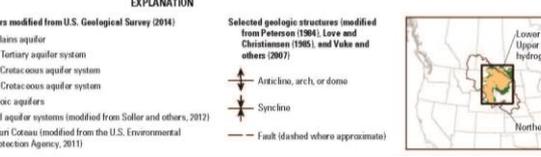
Vertical scale exaggerated x20



# Regional Water Budget and Conceptual Model

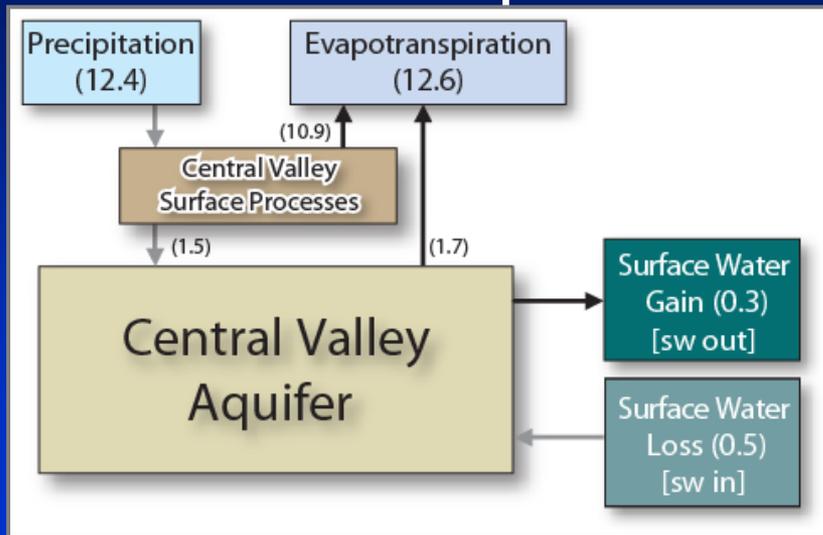


Base modified from U.S. Geological Survey and other Federal digital data, various scales  
 North American Lambert Conformal Conic projection  
 North American Datum: 1983

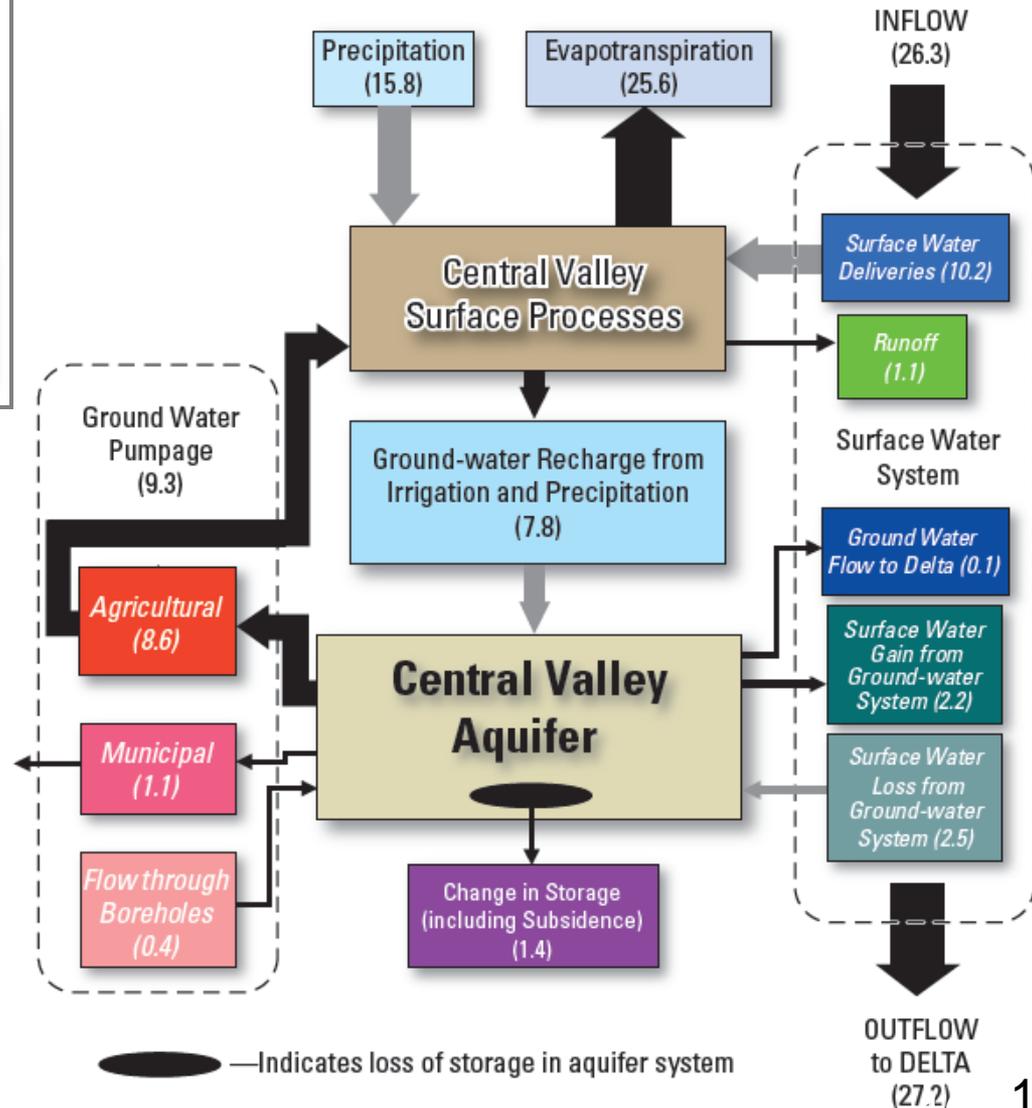


# Fine Tune Regional Water Budget with Simulation Model

## Pre-development



## 1962-2003/Engineered

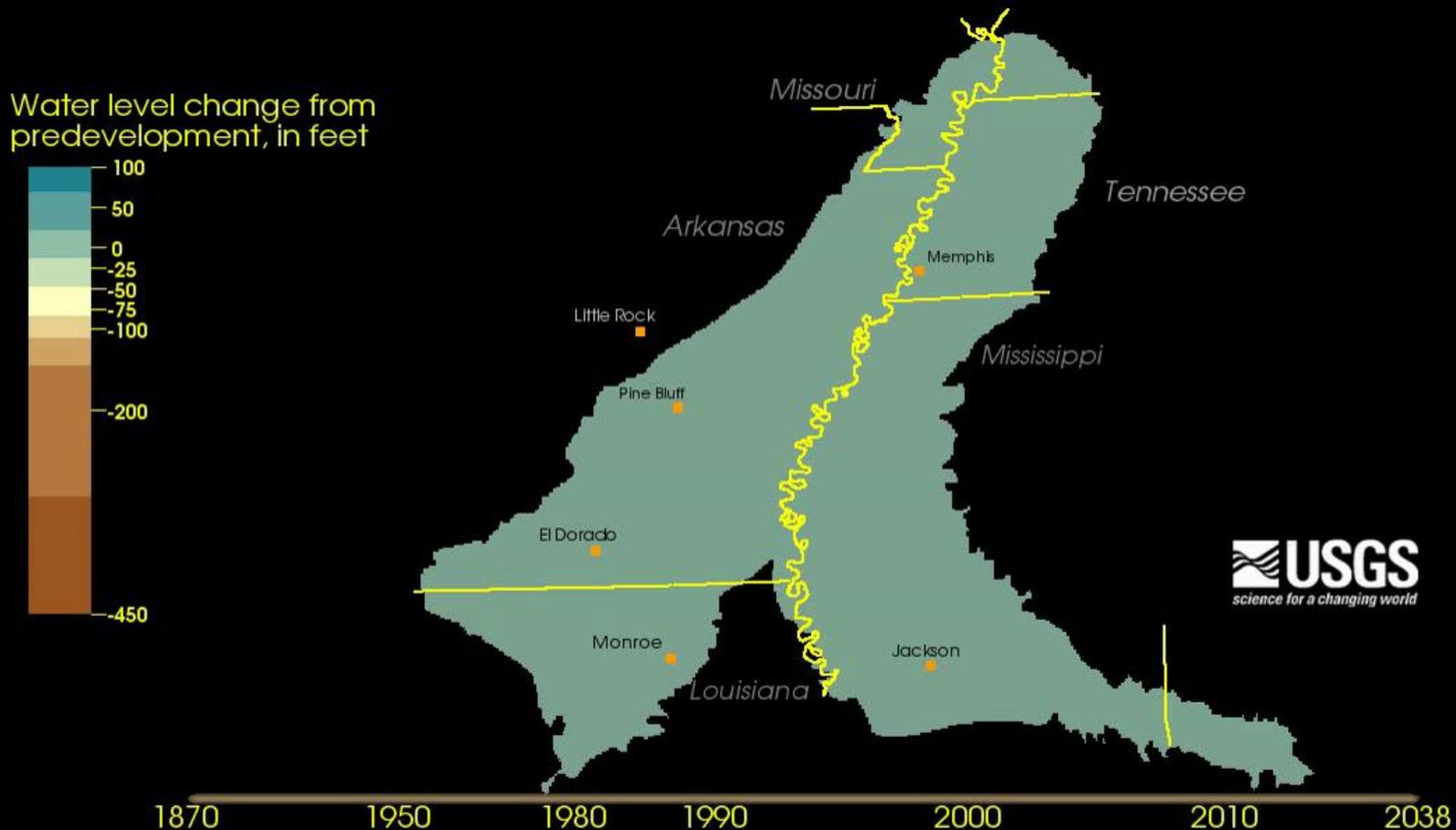


Natural → Engineered

Simple → Complex

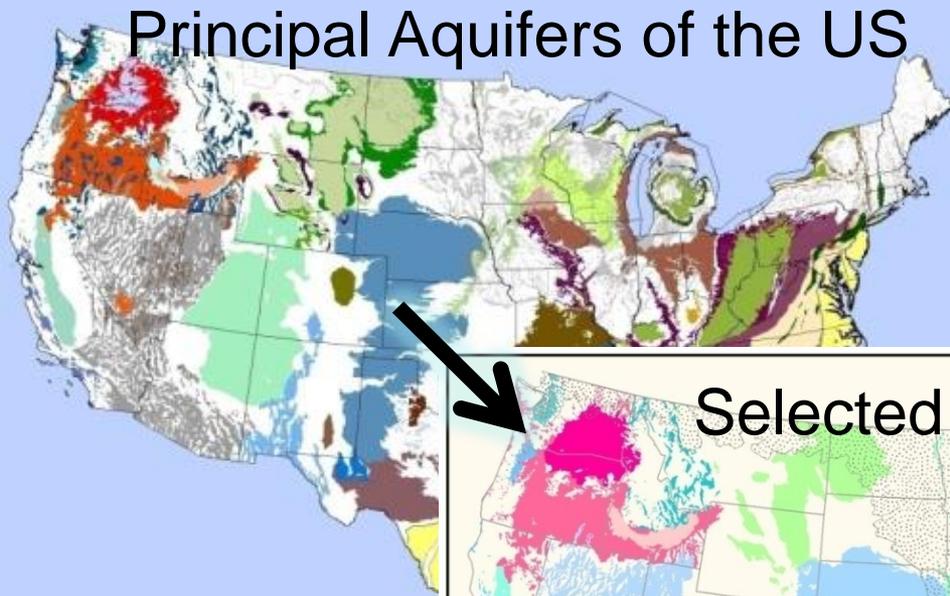
2 million acre-feet/year recharge /discharge → 12 million acre-feet/year recharge /discharge

# Mississippi Embayment—middle Claiborne (Sparta) aquifer Simulated Model Results 1870 to 2038



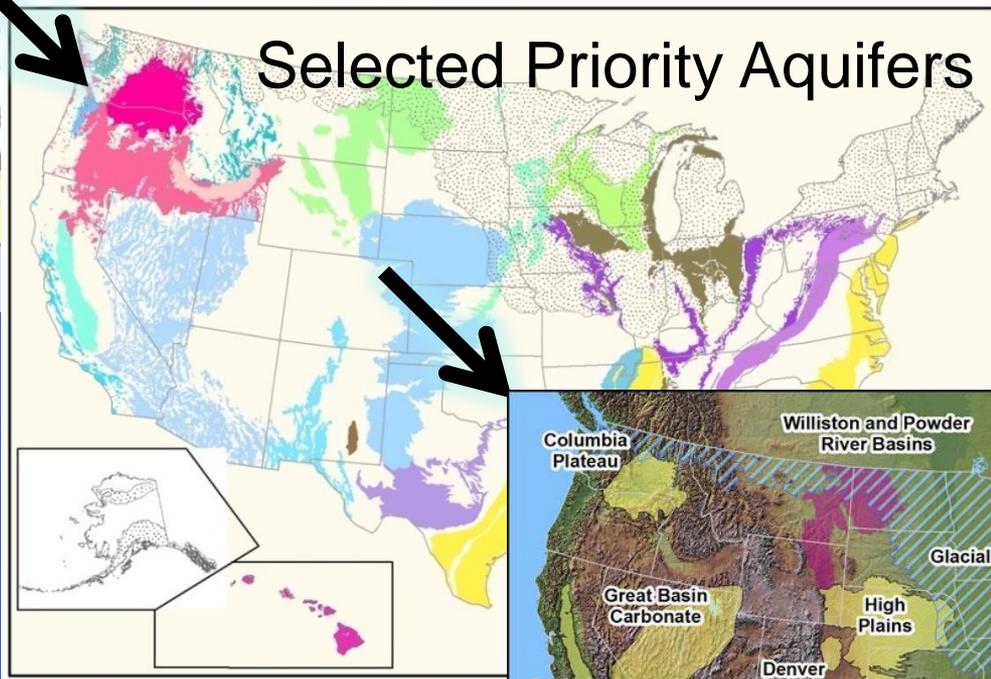
Tool capable of forecasting system response

# Principal Aquifers of the US

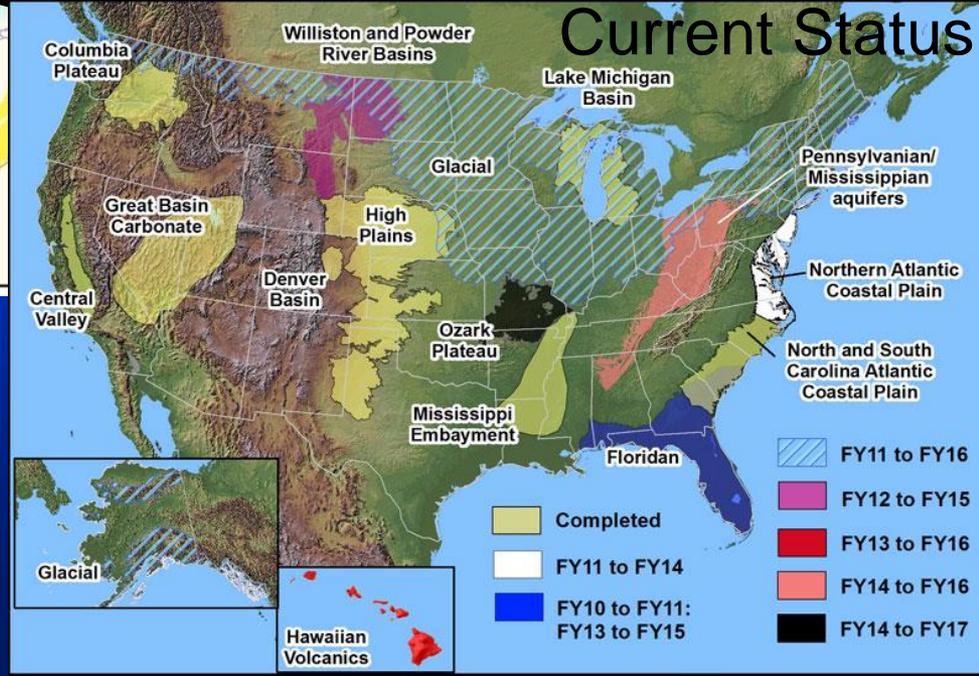


# Regional Groundwater Availability Studies

## Selected Priority Aquifers



## Current Status



**USGS**  
 mission for a changing world

Ground-Water Resources Program  
**Ground-Water Availability in the United States**

Circular 1323  
 U.S. Department of the Interior  
 U.S. Geological Survey

Reilly and others, 2008

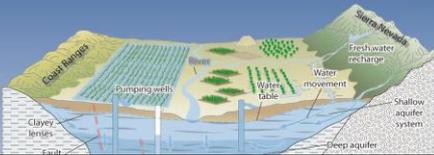


# Final Reports To Date



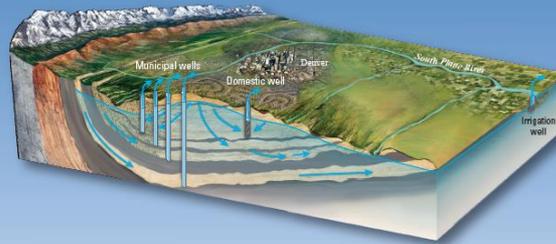
GROUND-WATER RESOURCES PROGRAM

## Ground-Water Availability of the Central Valley Aquifer, California



GROUNDWATER RESOURCES PROGRAM

## Groundwater Availability of the Denver Basin Aquifer System, Colorado



Professional Paper 1770

U.S. Department of the Interior  
U.S. Geological Survey



Groundwater Resources Program

## Groundwater Availability of the Mississippi Embayment



National Water Availability and Use Pilot Program

## Water Availability and Use Pilot: A Multiscale Assessment in the U.S. Great Lakes Basin

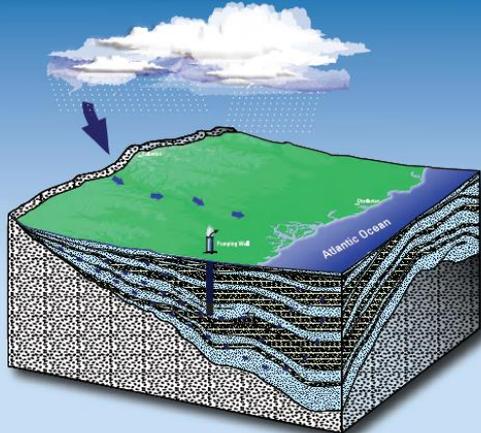


Professional Paper 1778



GROUNDWATER RESOURCES PROGRAM

## Groundwater Availability in the Atlantic Coastal Plain of North and South Carolina



Professional Paper 1773

U.S. Department of the Interior  
U.S. Geological Survey

# Making a Difference to Stakeholders

## Central Valley Aquifer

- Bureau of Reclamation along with CA Dept. of Water Resources use Central Valley hydrologic modeling (CVHM) tool (Faunt, 2009) and info developed from regional assessment to:
  - Understand how water moves through the aquifer system
  - Predict water-supply scenarios
  - Analyze subsidence
  - Address issues related to water competition in CA
  - Currently, tool being updated to cover period of recent severe drought providing capability to assess/forecast affects hydrologic conditions and subsidence

## Denver Basin Aquifer System

- USGS coordinated with the Colorado (CO) Water Conservation Board and CO Division of Water Resources (DWR) in regional evaluation study. CO State Engineers Office (DWR) using modeling tool (Paschke, 2011) to evaluate tributary gw flow in the alluvial and bedrock aquifers. Model has also been used to design water-level monitoring networks for rural Douglas and Elbert Counties.

# Making a Difference to Stakeholders

## North and South Carolina Atlantic Coastal Plain Aquifer System

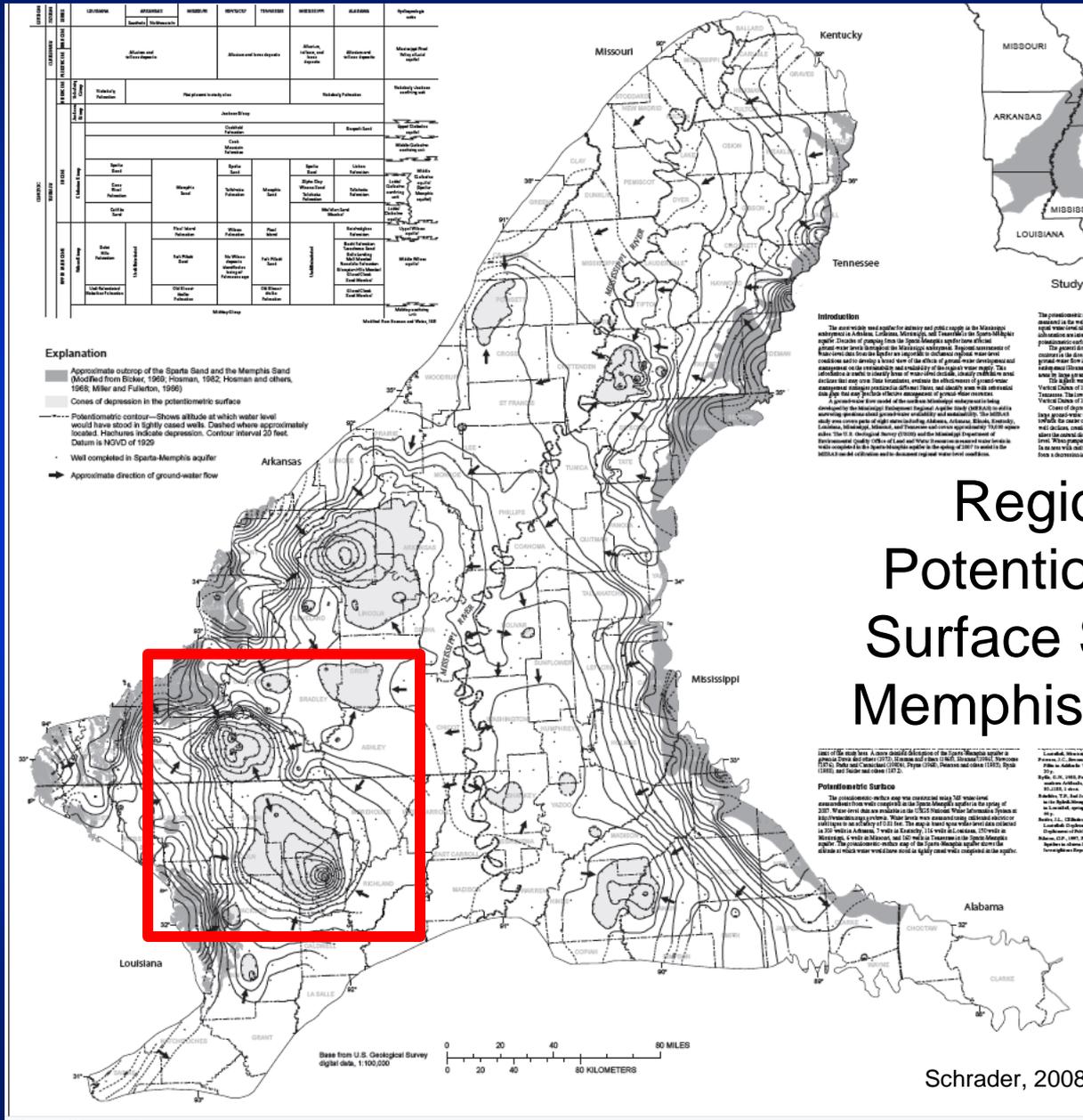
- The regional gw assessment resolved longstanding discrepancies in the interpretation of the hydrogeologic framework of the border region (Gellici and Lautier, 2010). Additionally, primary state environmental regulatory agency in SC (SC Dept. of Health and Environmental Control) is using the modeling tool (Campbell and Coes, 2010) to assist in the GW Capacity Use Program that regulates withdrawals in certain counties.

## Mississippi Embayment Regional Aquifer System

- Modeling tool (Clark and Hart, 2009) developed is being used to assist water managers in Arkansas in the development of the Arkansas Water Plan (Arkansas Natural Resources Commission, 2014).
- *“Without the USGS groundwater availability modeling tool, the State of Arkansas would be somewhat blind as to the future of our water resources availability, and how to protect it.”* — J. Randy Young, Executive Director, Arkansas Natural Resources Commission
- 5 additional spin-off studies have resulted and were instrumental in addressing a variety of area stakeholder’s groundwater issues and concerns.

# Monitoring Essential to Modeling

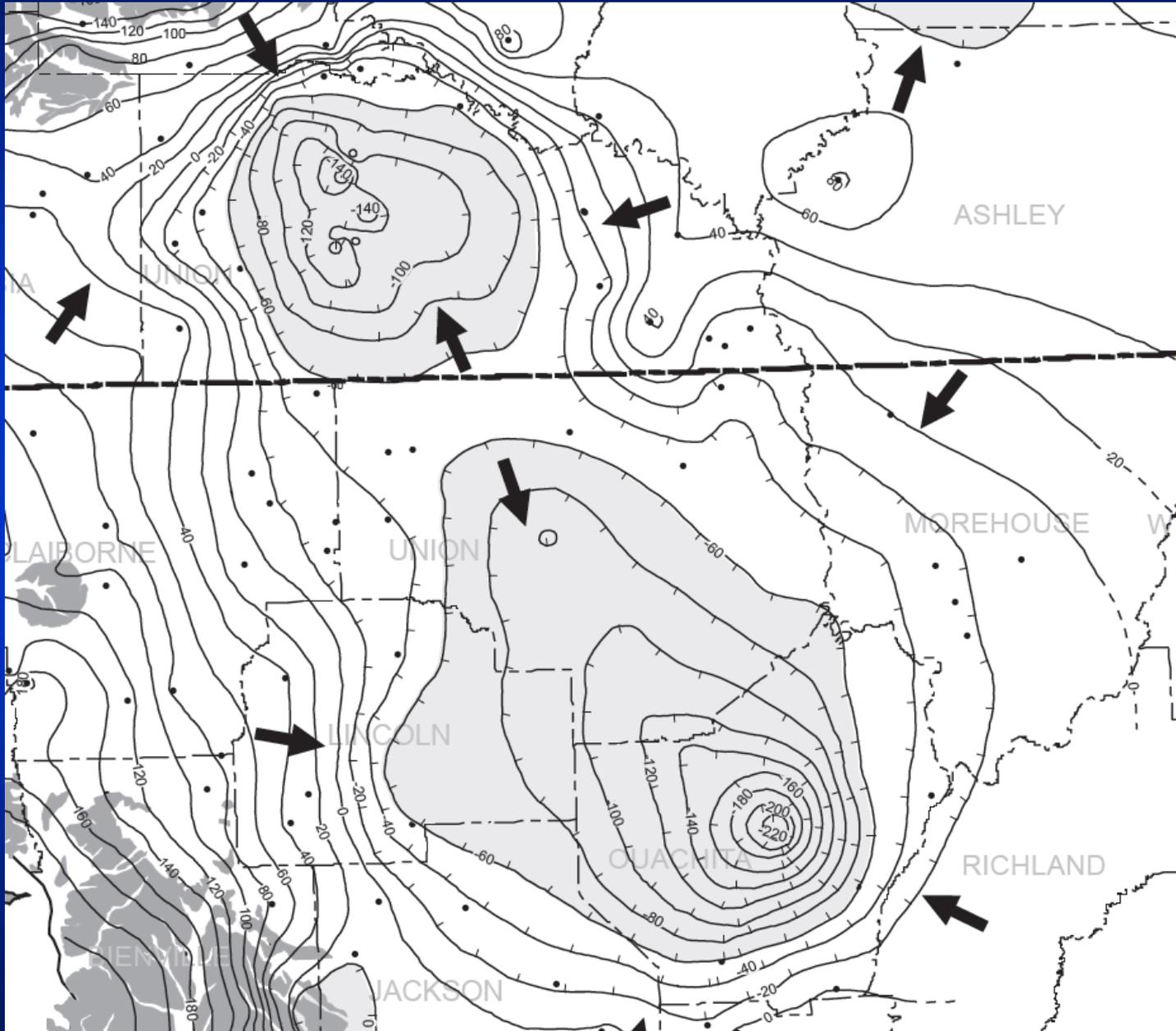
Measured values (contours)



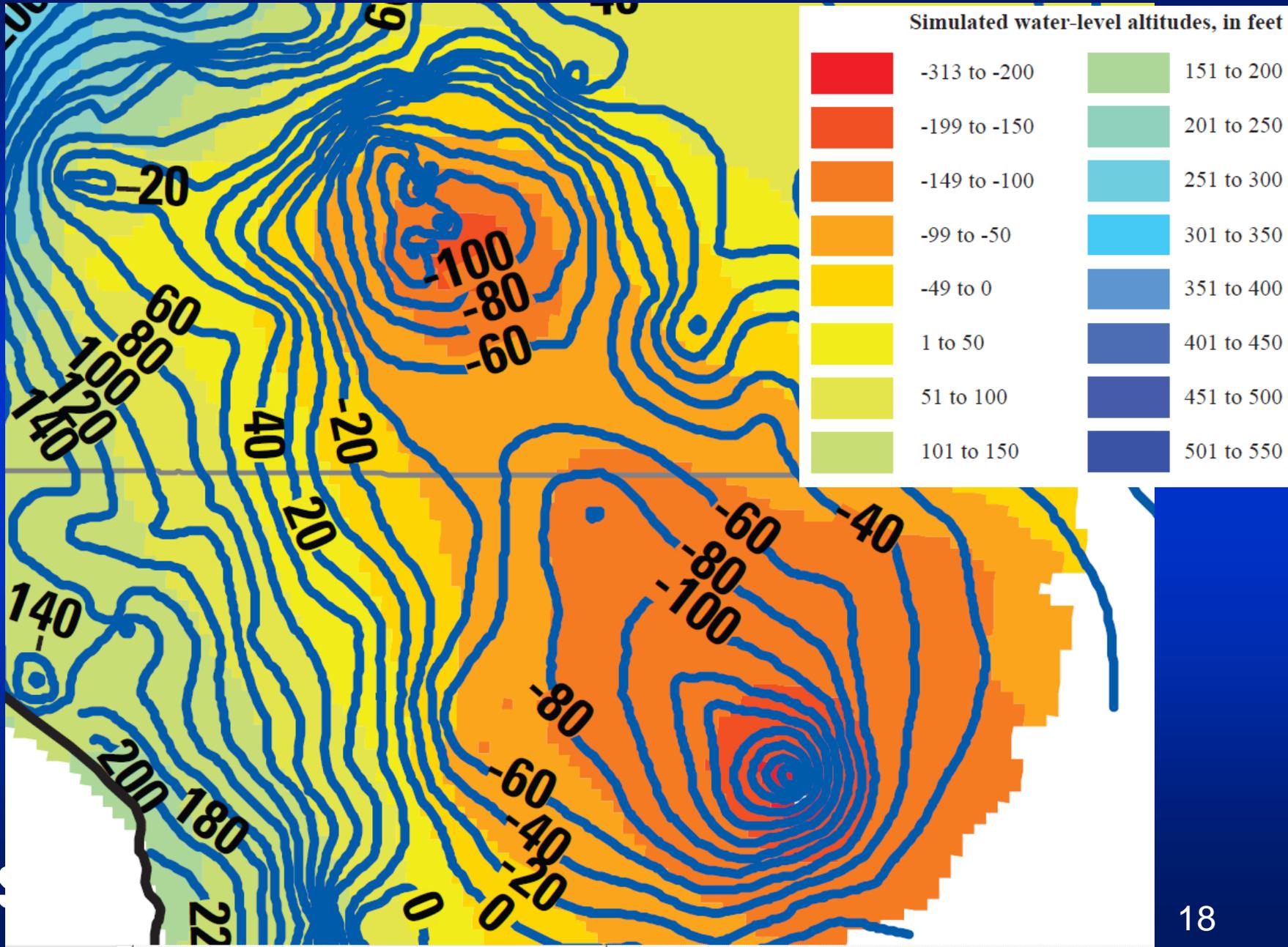
## Regional Potentiometric Surface Sparta-Memphis Aquifer

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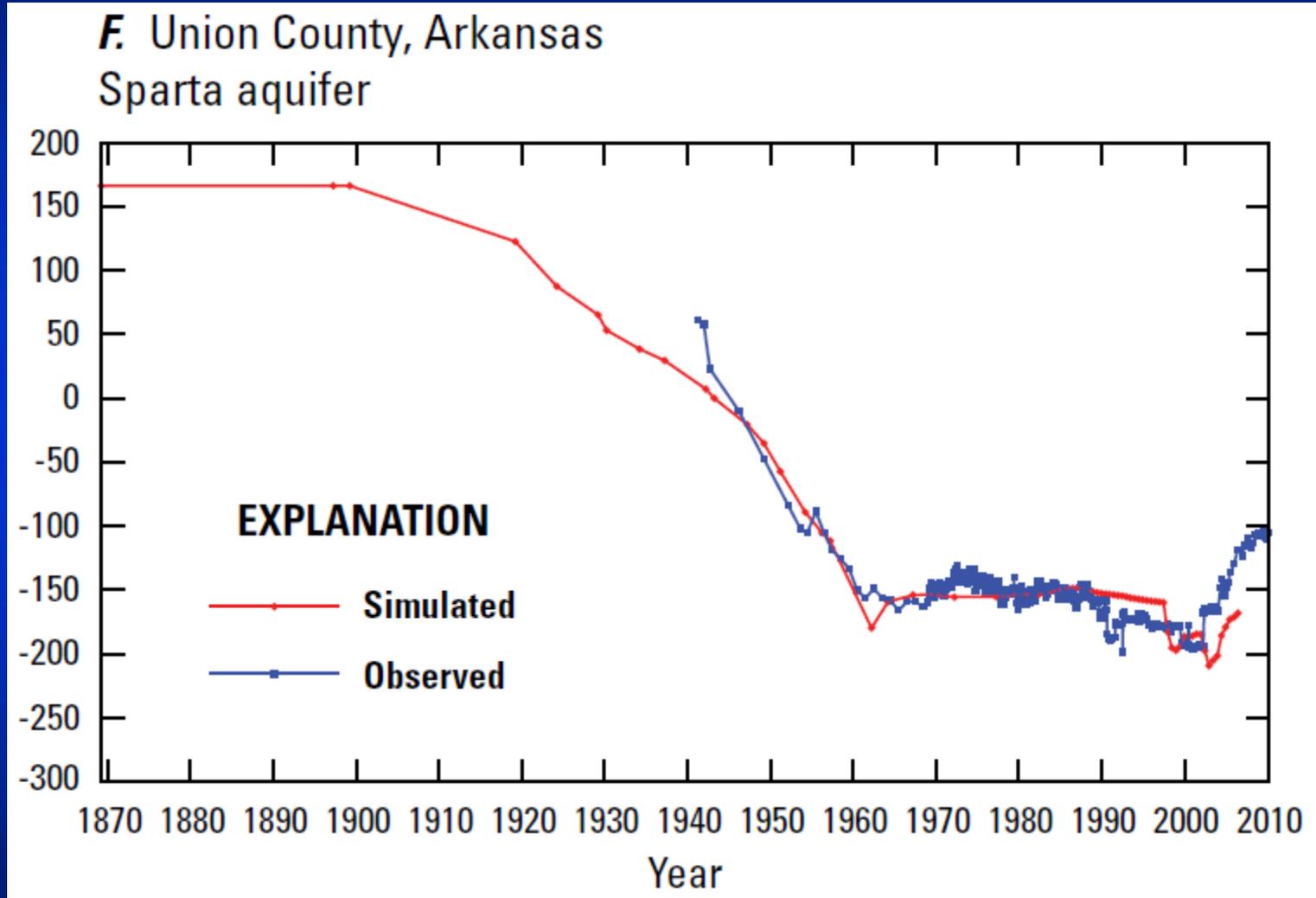
Measured values  
(contours)



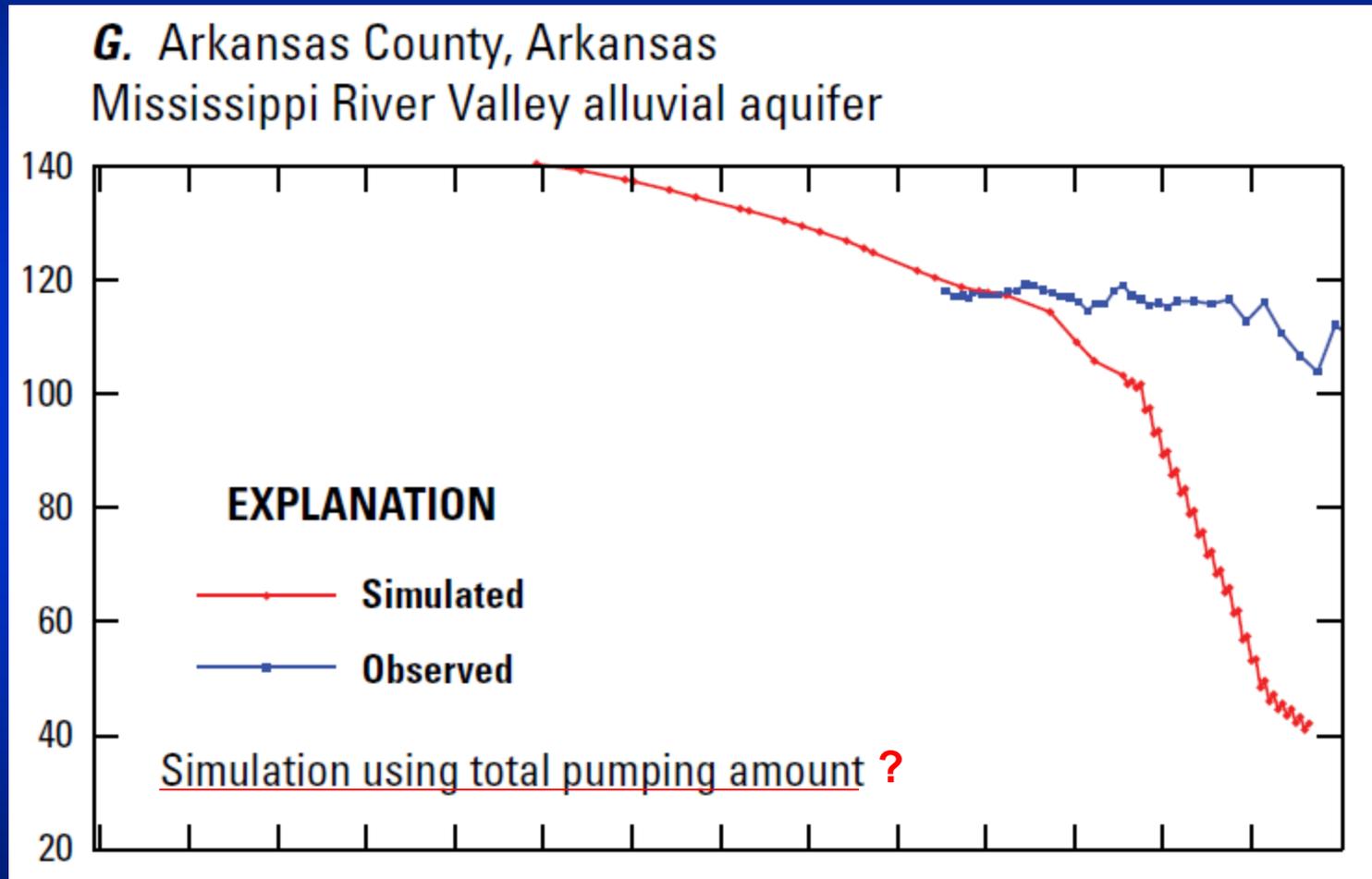
# Measured (contours) Compared to Simulated (colors)



# How well can we mimic reality with a model?

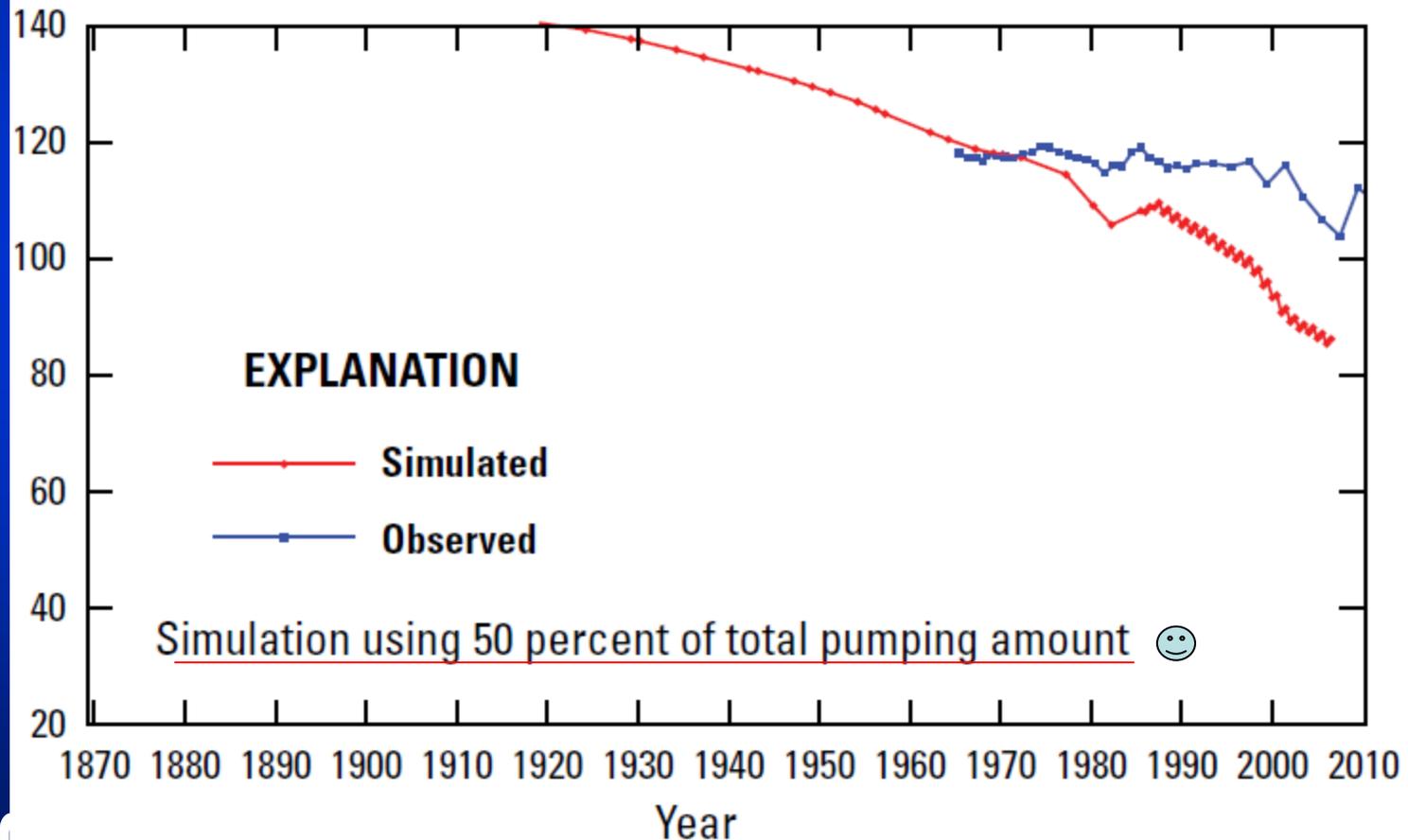


# What does monitoring tell us about water use? -- Is the model a poor fit or is water use poorly estimated? --

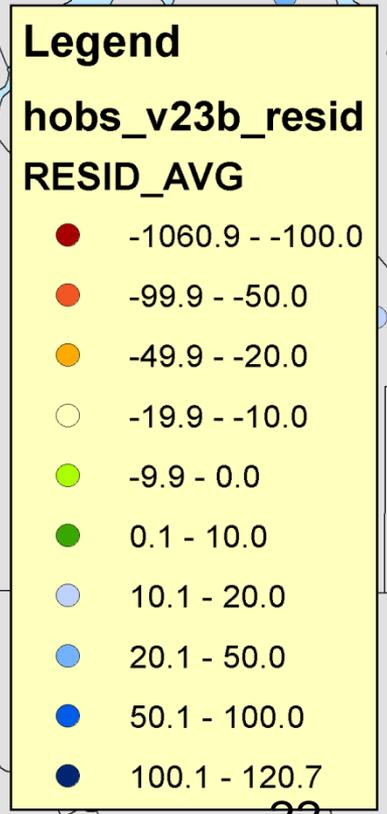
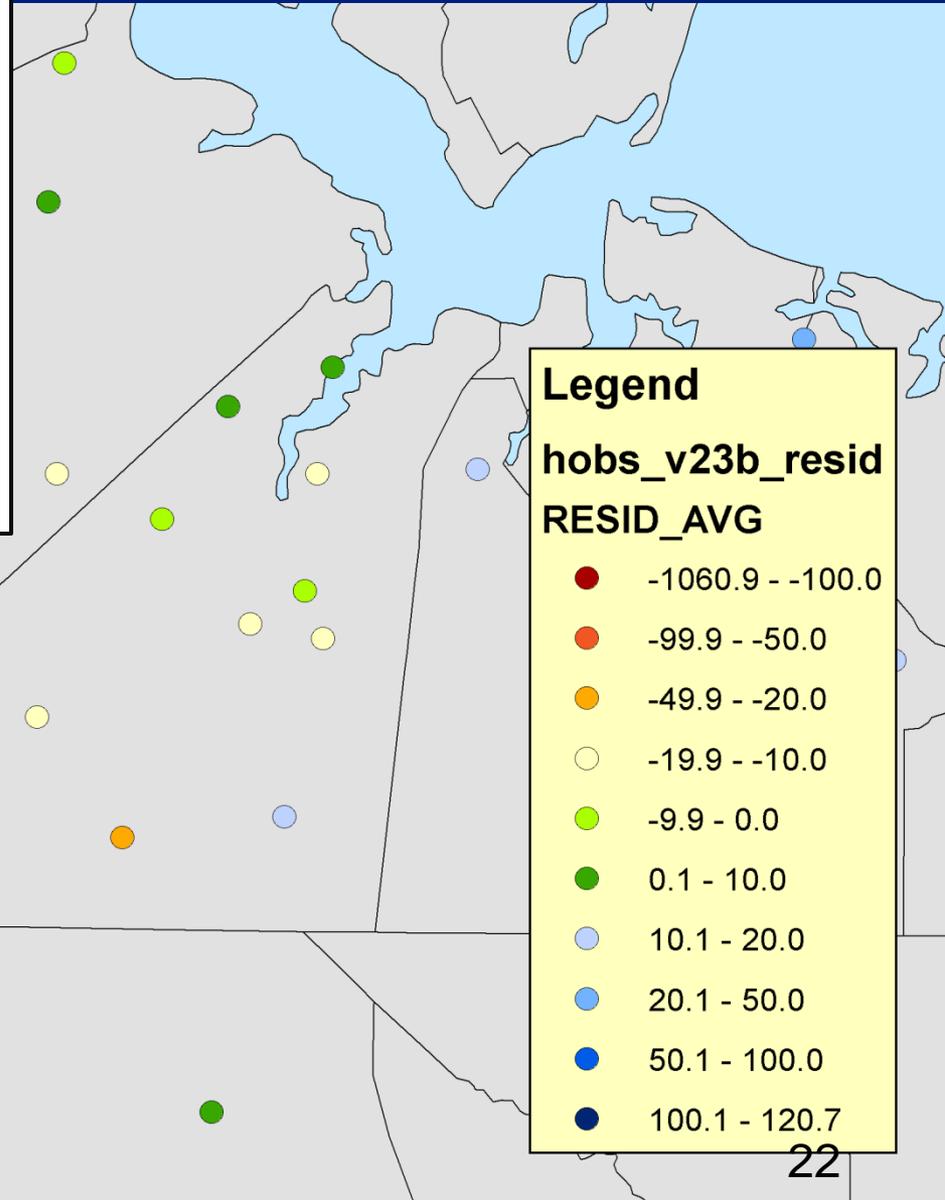
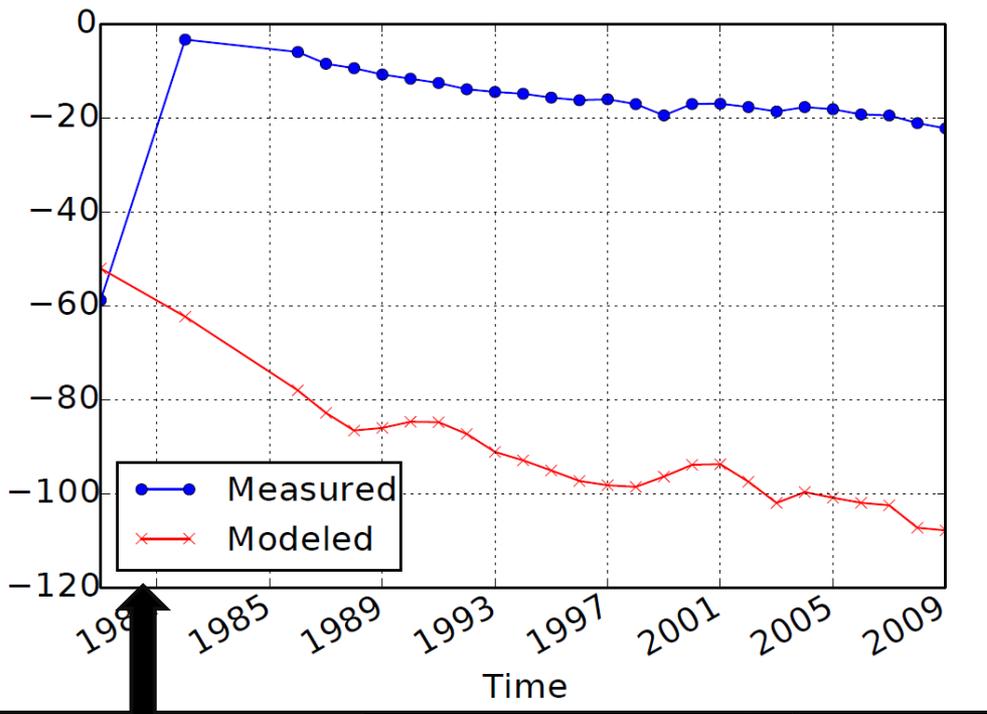


# Same Model – evaluating reduced water use

**G.** Arkansas County, Arkansas  
Mississippi River Valley alluvial aquifer



# Long-term Simulated and Observed Water-level in the Potomac-Patapsco Aquifer



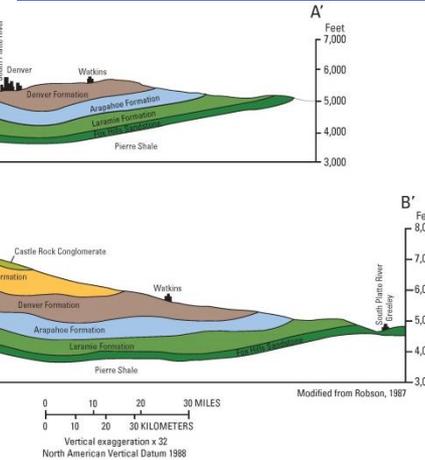
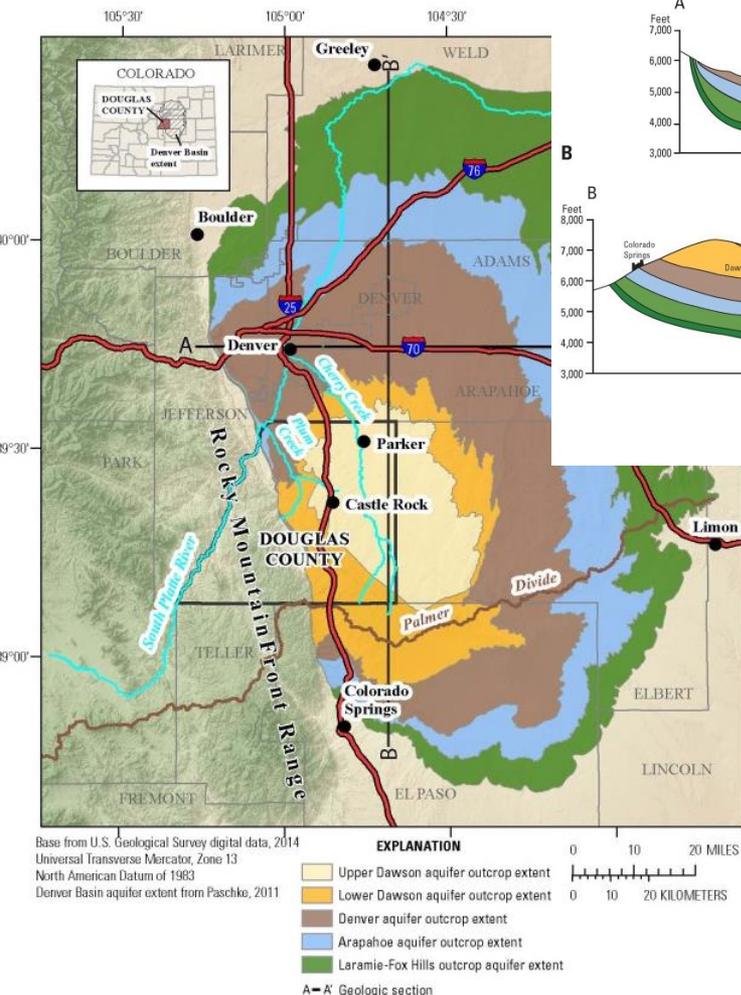
Well collapse results in much shallower screen interval; Problem with water level revealed by nearby wells in the same aquifer.



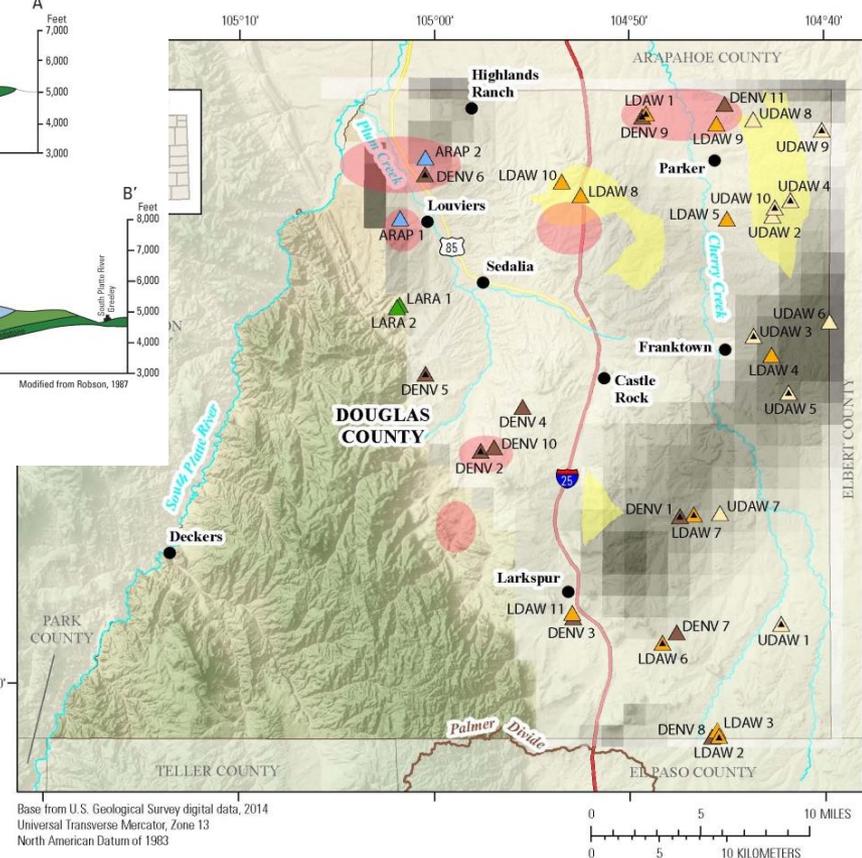
# Models ↔ Monitoring

Denver Basin bedrock aquifer system, CO

Areas identified as being of interest for groundwater monitoring



Generalized geologic section



USGS  
 GROUNDWATER RESOURCES PROGRAM  
**Groundwater Availability of the Denver Basin Aquifer System, Colorado**

Professional Paper 1770  
 U.S. Department of the Interior  
 U.S. Geological Survey



### USGS Groundwater Information

#### Groundwater Resources Program

- Home
- Regional GW Studies
- GW & Environment
- Methods & Modeling
- Publications
- Data & Information
- Intranet



#### New & Noteworthy

- National Brackish Groundwater Assessment
- Press Release: [New USGS Tool Expedites Assessment of Seawater Intrusion in Coastal Aquifer Systems](#)
- Press Release: [Deficit in Nation's Aquifers Accelerating](#)
- Press Release: [New USGS Report Updates Decline of High Plains Aquifer Groundwater Levels](#)
- Journal Article: [Review: Groundwater in Alaska](#)
- Technical Announcement: [Groundwater's Greater Role in Waterways Demonstrated in Virginia](#)
- Technical Announcement: [How Does Groundwater Pumping Affect Streamflow?](#)

[Past listings...](#)

#### USGS Groundwater Watch

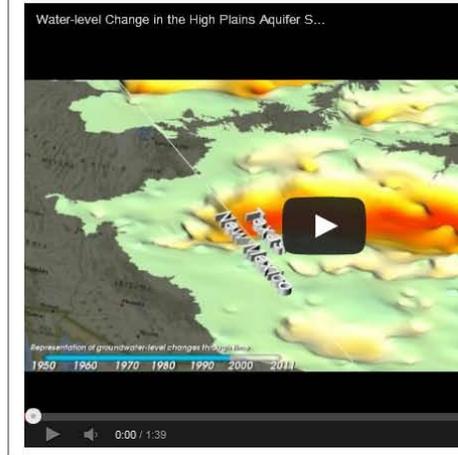
USGS maintains a network of active wells to provide basic statistics about groundwater levels.



#### USGS Groundwater Resources Program

The Groundwater Resources Program provides the objective scientific information and develops the interdisciplinary understanding necessary to assess and quantify the availability of the Nation's groundwater resources.

#### Animation: Water-level Change in the High Plains Aquifer System



#### National and Regional Groundwater Studies

- National Brackish Groundwater Assessment
- Overview of USGS Regional Groundwater Studies
- Groundwater Availability
  - Pennsylvanian and Mississippian Aquifer System of the Appalachian Plateaus
  - Ozark Plateaus Aquifer System
  - Hawaii Volcanic-Rock Aquifers
  - Williston and Powder River Basins
  - Glacial Aquifer System
  - North Atlantic Coastal Plain Aquifer System
  - Floridan Aquifer System
  - High Plains Aquifers
- Water Availability & Use
  - U.S. Great Lakes Basin
  - Southwest Alluvial Basins Project



#### Highlighted GWRP Publications

[Hydrogeology and Hydrologic Conditions of the Northern Atlantic Coastal Plain Aquifer System from Long Island, New York, to North Carolina](#)  
USGS Scientific Investigations Report 2013-5133

[Report to Congress: Progress Toward Establishing a National Assessment of Water Availability and Use](#)

#### Groundwater & the Environment

- Recharge
  - Climate Variability Effects
  - Groundwater Age Dating & Recharge
  - Chloride Mass Balance in Streams to Estimate Recharge



# Questions ???

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