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Cloud-Based Water Level Mapping Utility

CI-WATER Project

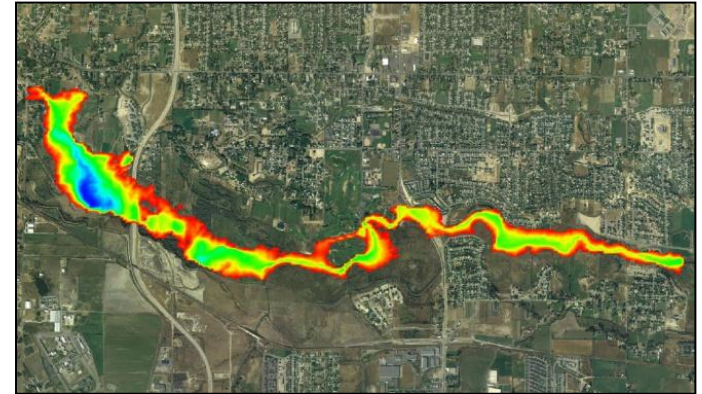


CI-WATER: Cyberinfrastructure to Advance High Performance Water Resource Modeling

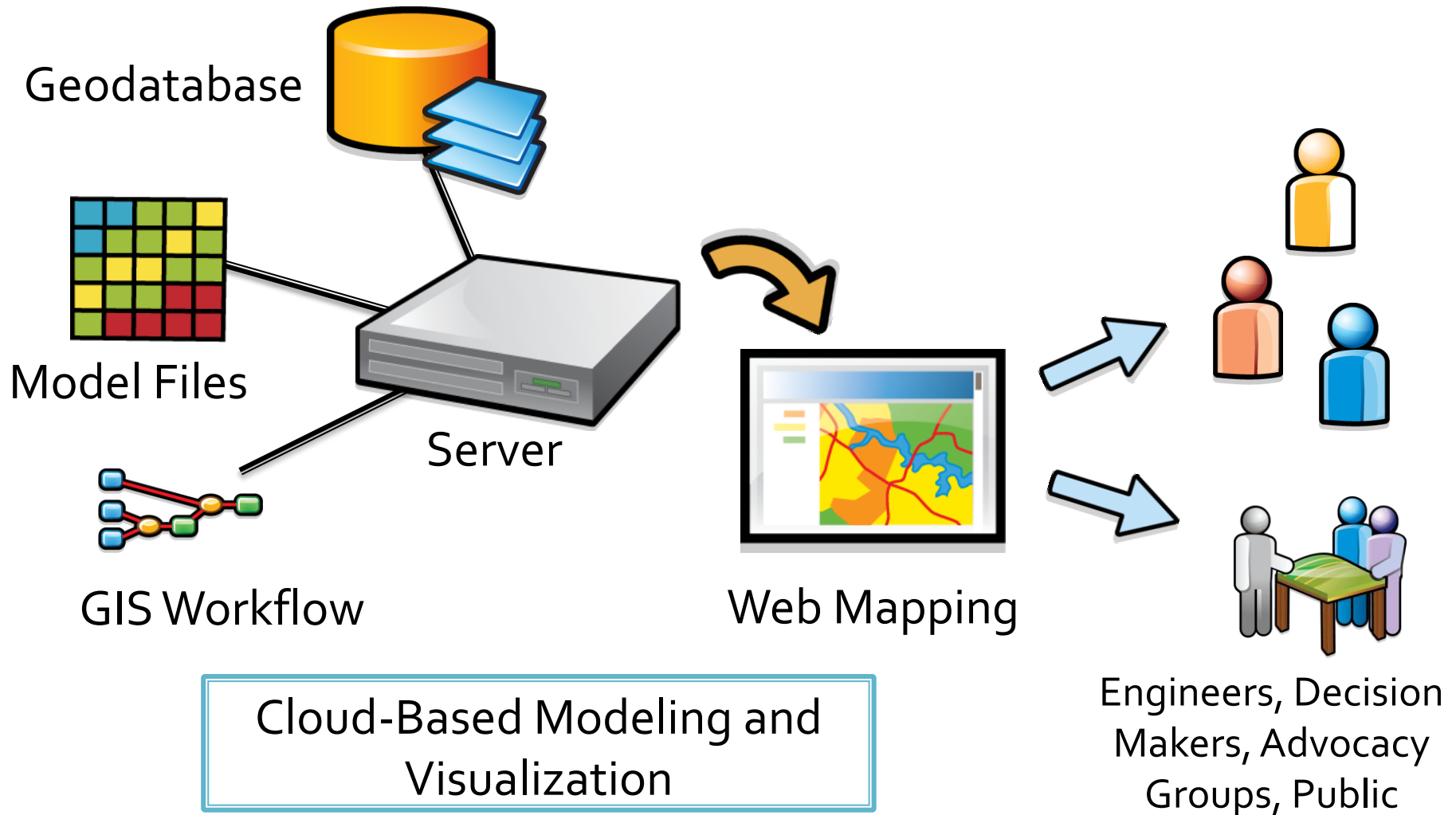


Project Objectives

1. Enhance cyberinfrastructure facilities
2. Enhance access to data- and computationally-intensive modeling
3. Advance high-resolution multi-physics watershed modeling
4. Promote STEM learning and water science engagement



Component 2 Objective



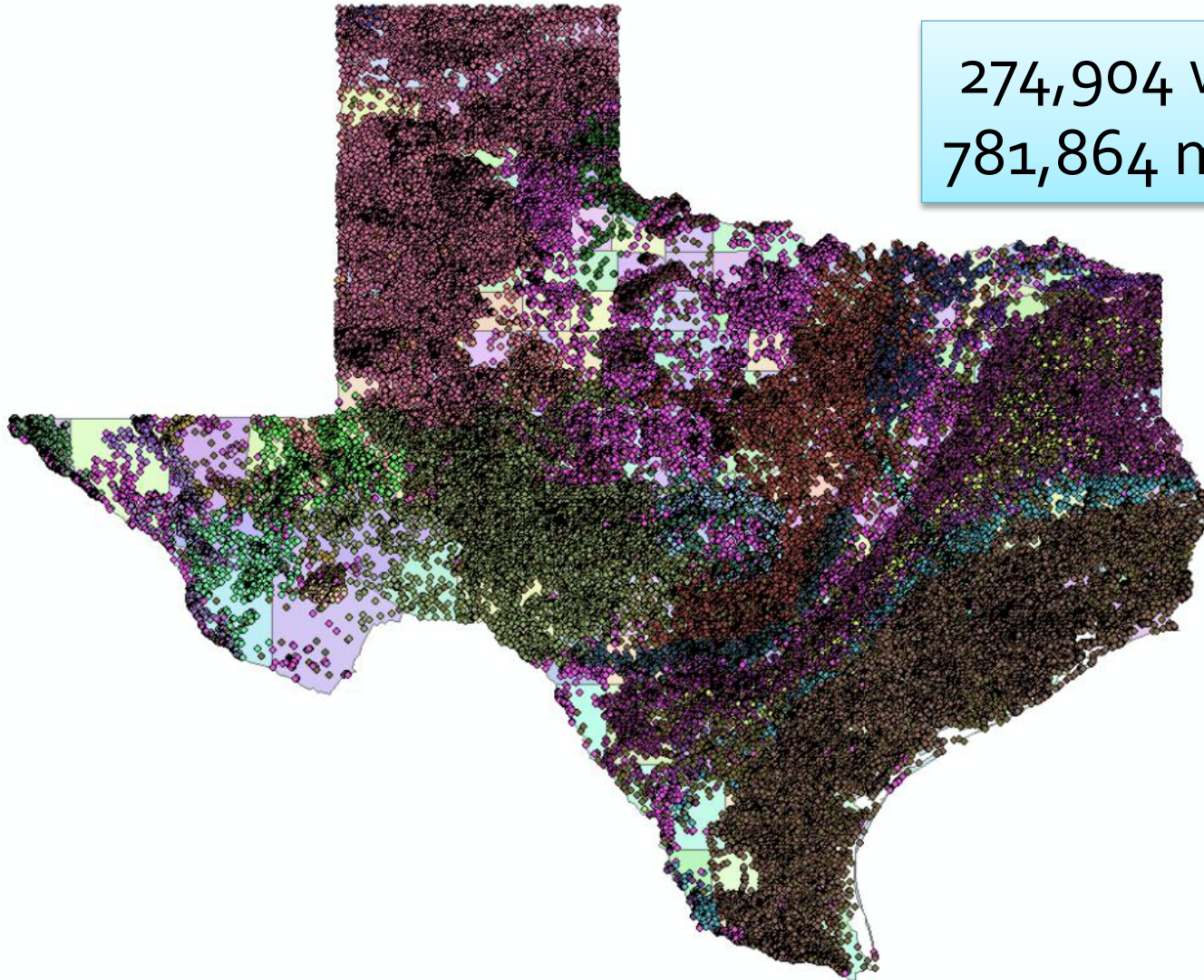
Cloud-Based Water Level Mapping Utility

Detailed maps showing water level changes over time are essential for aquifer management and planning



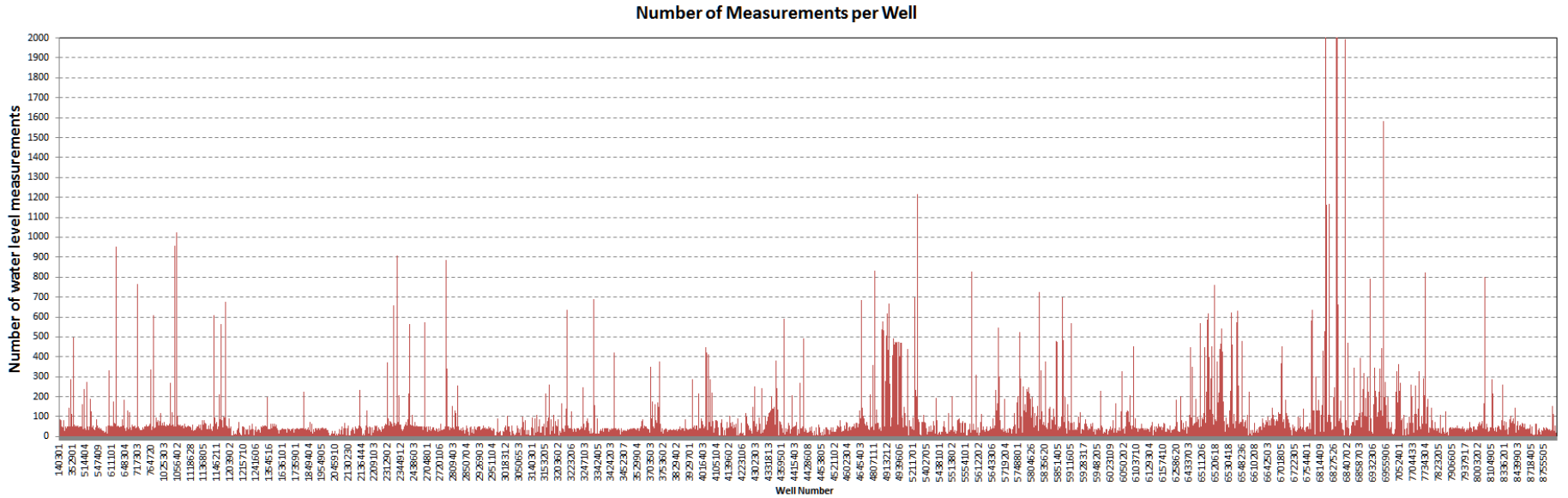
TWDB Well Database
Arc Hydro GW Tools
Python-Based Workflow
Google Earth Web Plug-in

TWDB Well Database



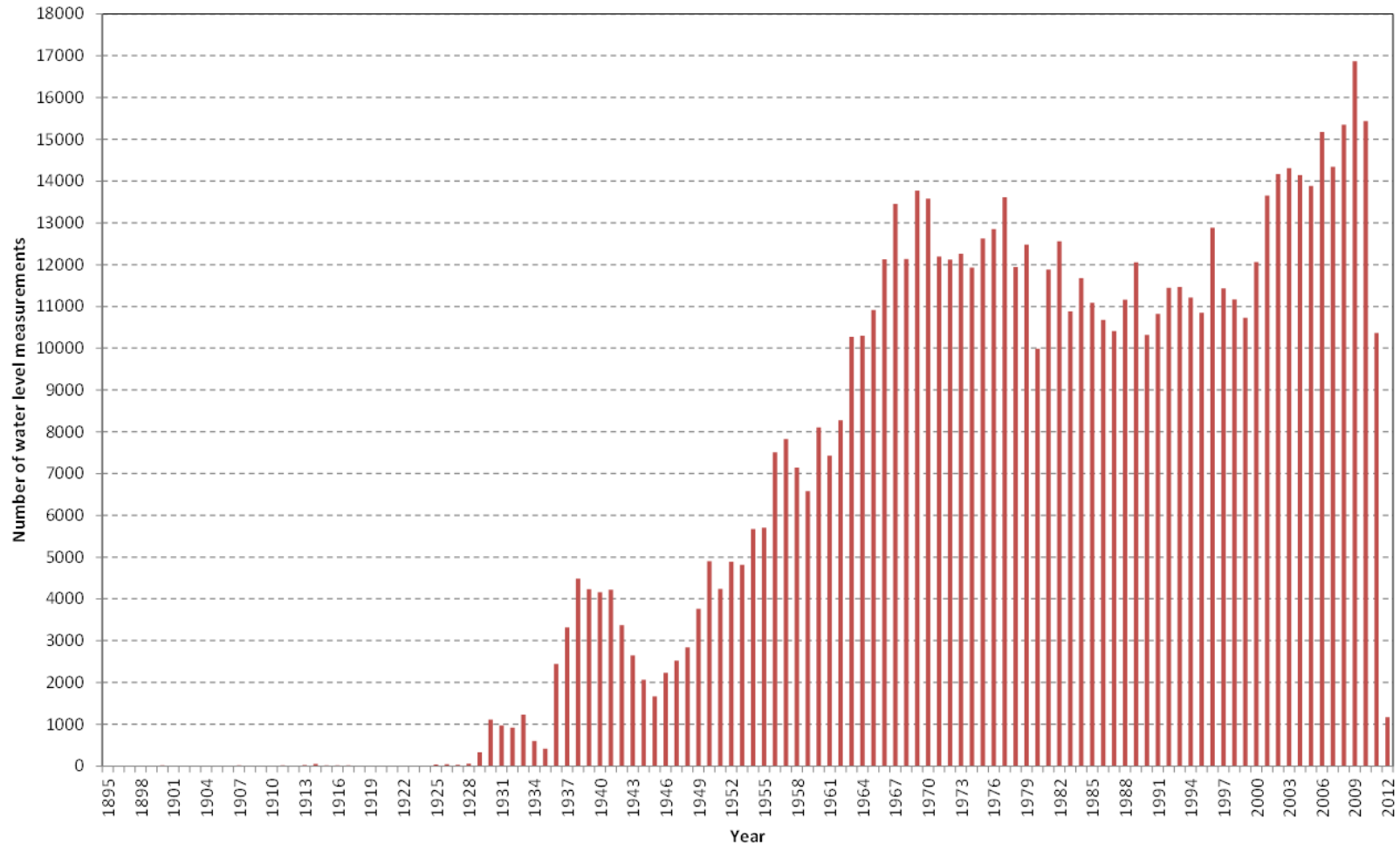
274,904 wells w/meas.
781,864 measurements

Measurements per Well



Measurements per Year

Number of Measurements per Year

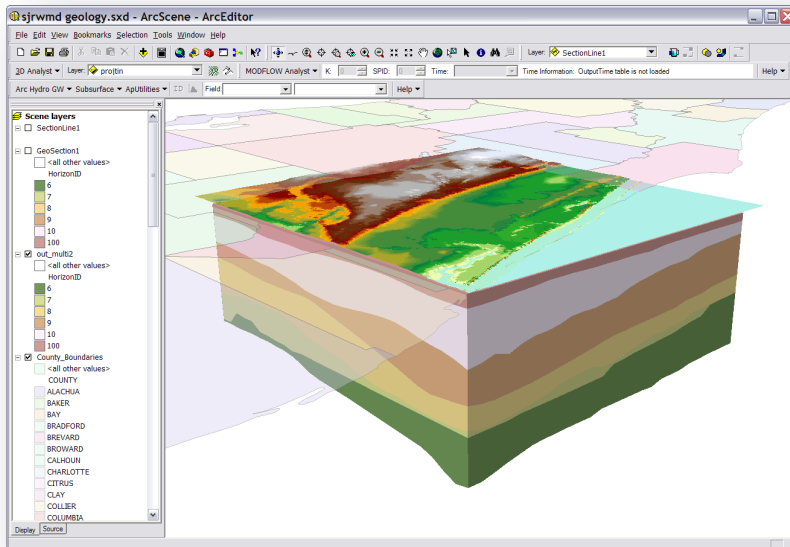
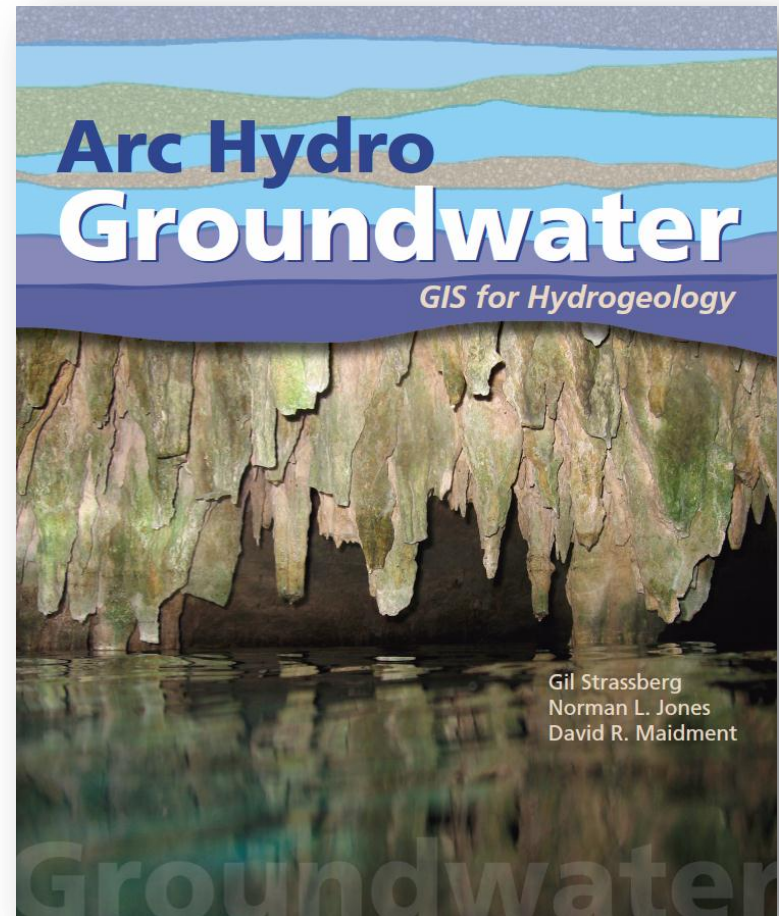


Arc Hydro Groundwater

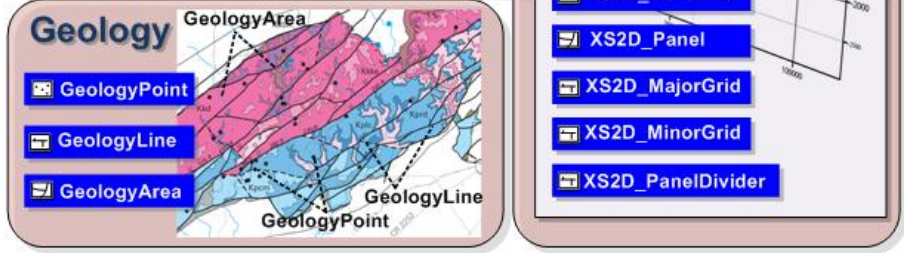
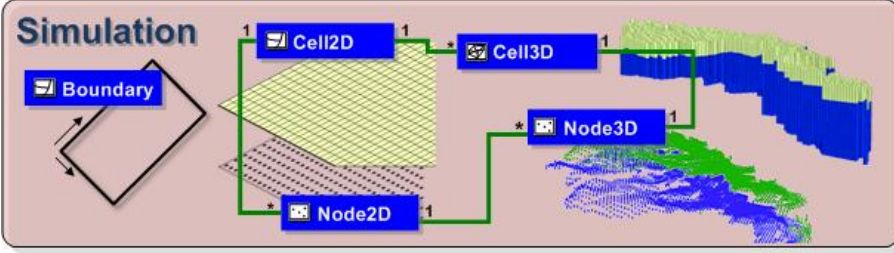
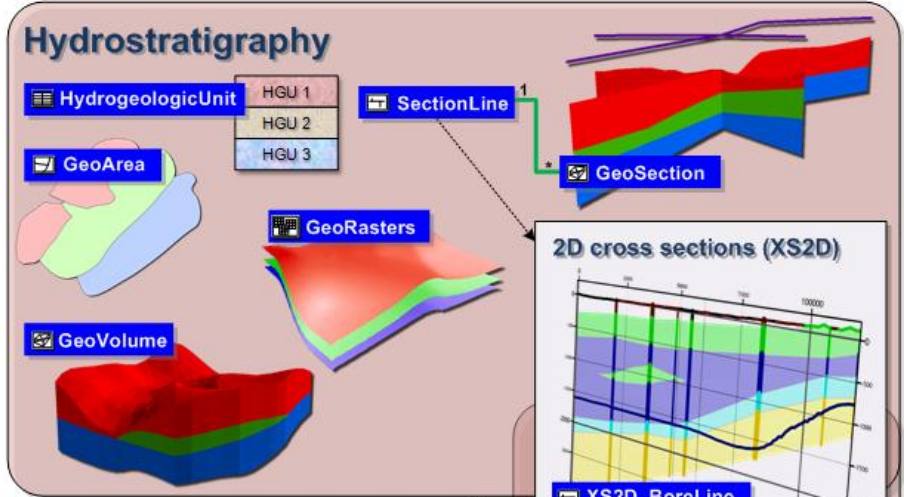
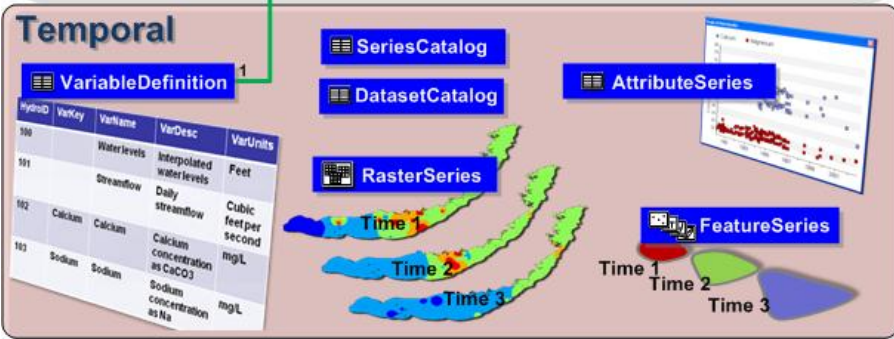
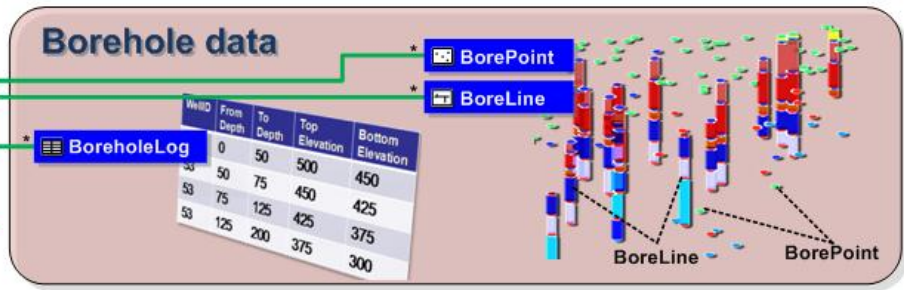
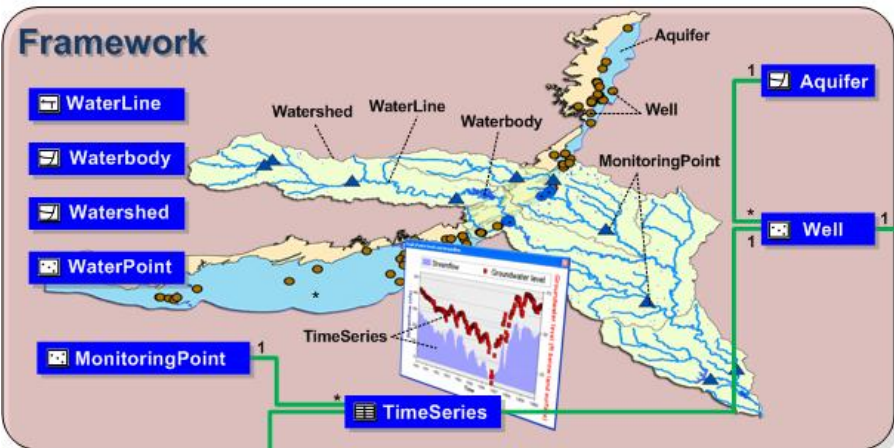


AQUAVEO

Data model and tools for managing
groundwater data in ArcGIS

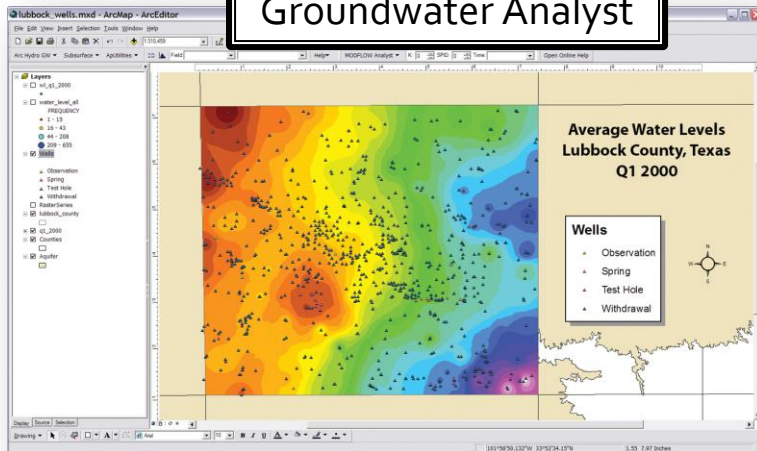


Arc Hydro GW Data Model

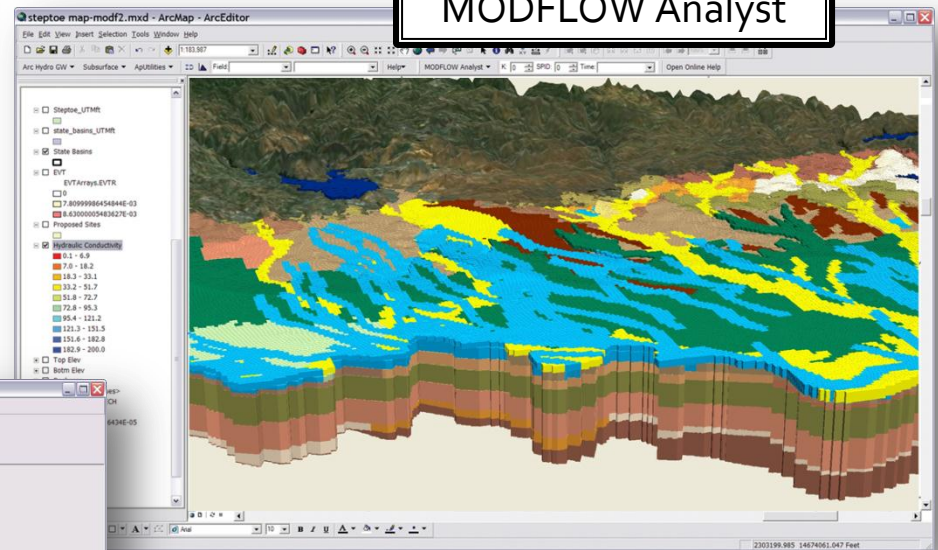


Arc Hydro GW Tools

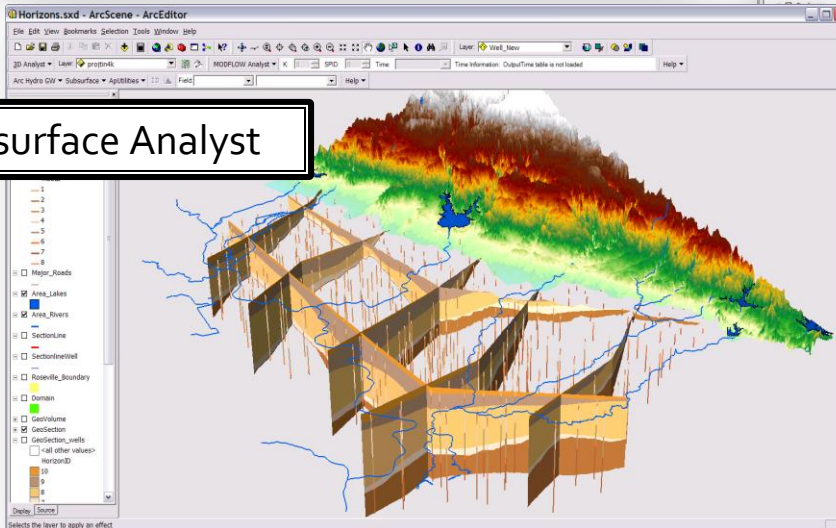
Groundwater Analyst



MODFLOW Analyst

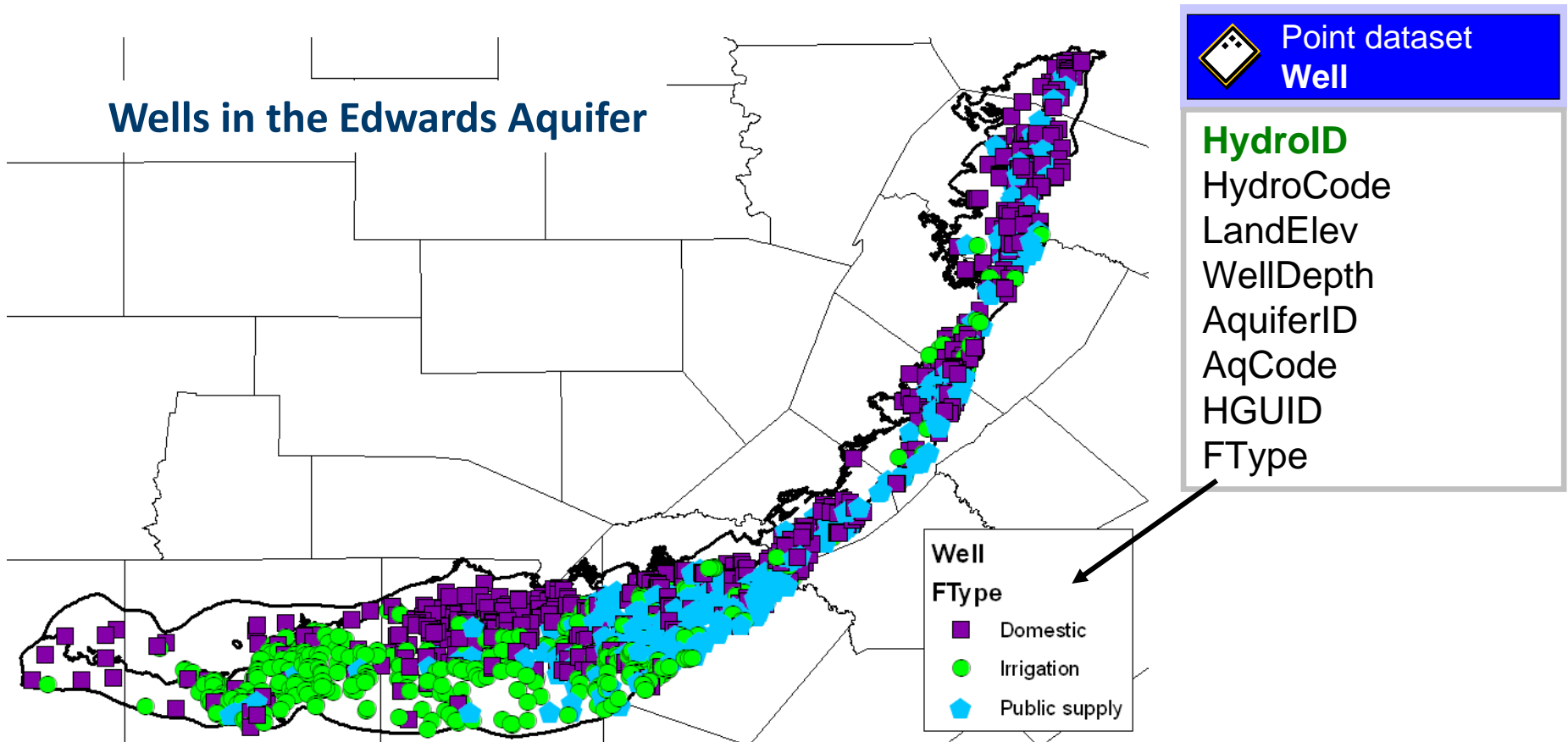


Subsurface Analyst



Wells

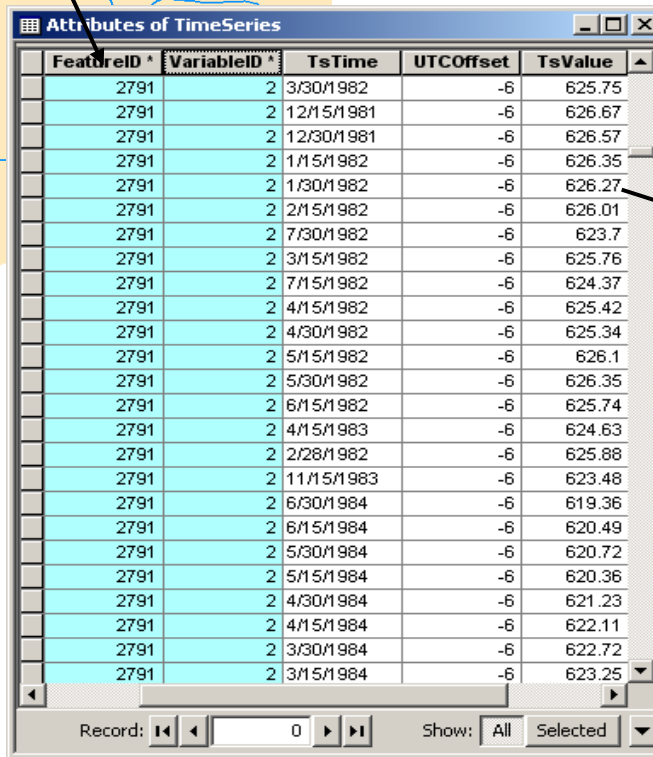
- The Well location is defined as a 2D point in the Well feature class
- In the Arc Hydro model we only predefine a set of basic attributes



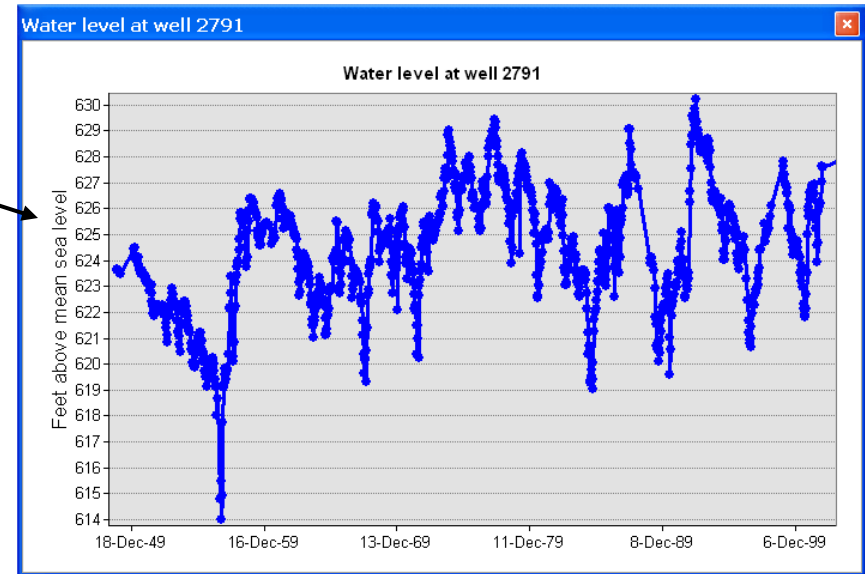
Time Series Processing

Well HydroID = 2791

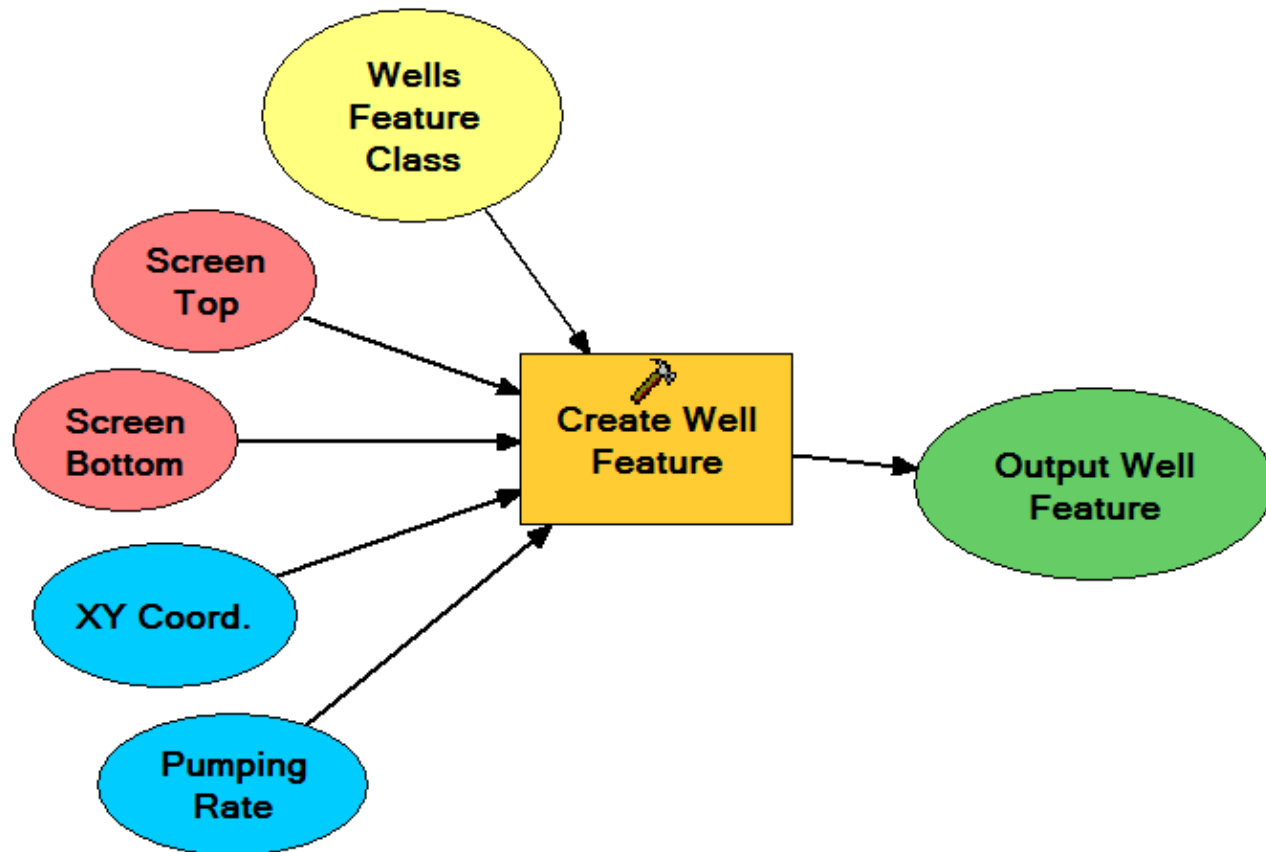
- FeatureID of the time series = **HydroID** of the spatial feature (e.g. Well)



FeatureID *	VariableID *	TsTime	UTCOffset	TsValue
2791	2	3/30/1982	-6	625.75
2791	2	12/15/1981	-6	626.67
2791	2	12/30/1981	-6	626.57
2791	2	1/15/1982	-6	626.35
2791	2	1/30/1982	-6	626.27
2791	2	2/15/1982	-6	626.01
2791	2	7/30/1982	-6	623.7
2791	2	3/15/1982	-6	625.76
2791	2	7/15/1982	-6	624.37
2791	2	4/15/1982	-6	625.42
2791	2	4/30/1982	-6	625.34
2791	2	5/15/1982	-6	626.1
2791	2	5/30/1982	-6	626.35
2791	2	6/15/1982	-6	625.74
2791	2	4/15/1983	-6	624.63
2791	2	2/28/1982	-6	625.88
2791	2	11/15/1983	-6	623.48
2791	2	6/30/1984	-6	619.36
2791	2	6/15/1984	-6	620.49
2791	2	5/30/1984	-6	620.72
2791	2	5/15/1984	-6	620.36
2791	2	4/30/1984	-6	621.23
2791	2	4/15/1984	-6	622.11
2791	2	3/30/1984	-6	622.72
2791	2	3/15/1984	-6	623.25

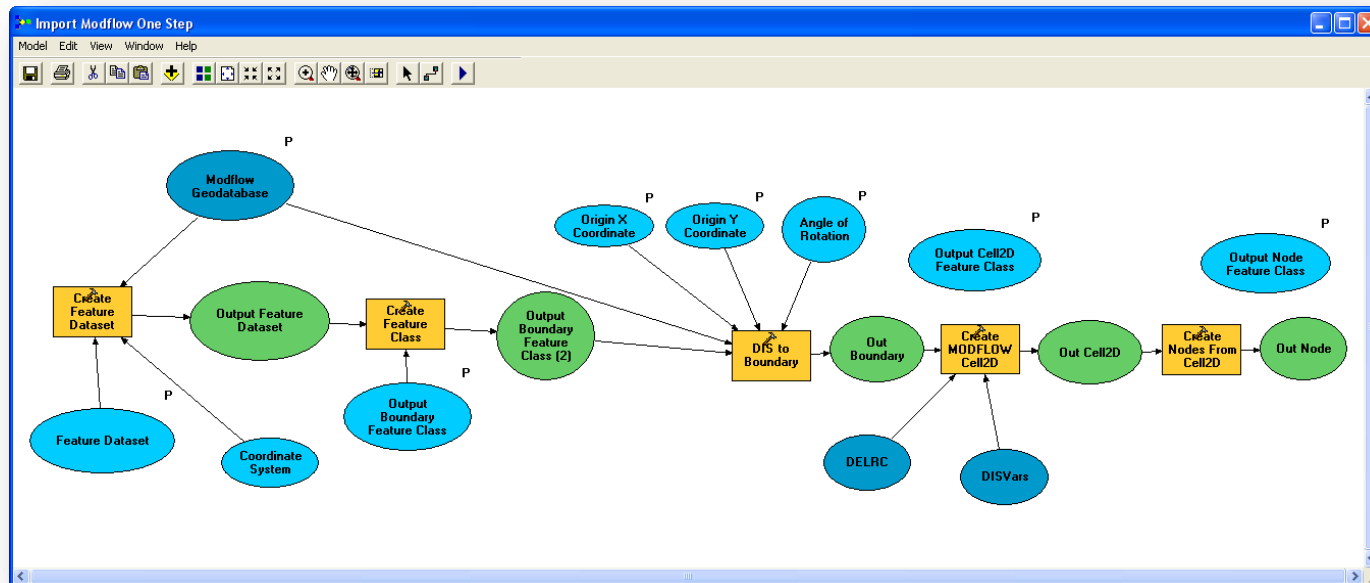


Geoprocessing Tools

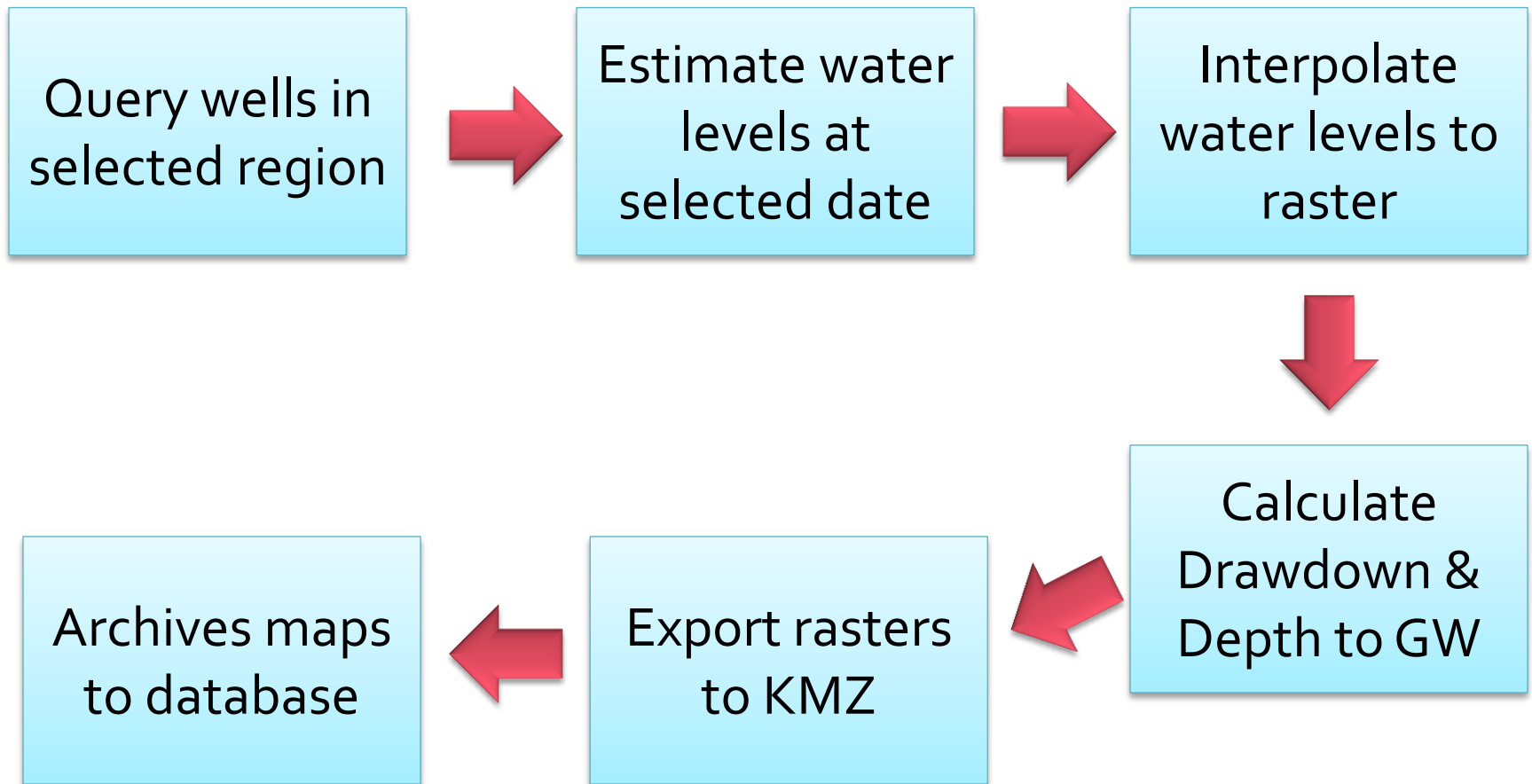


Geoprocessing Tools - Workflows

- GP tools enable the development of **workflows** as models or scripts
- **Extendable** – You can create your own workflows
- Leverage low-level tools to **create new tools**

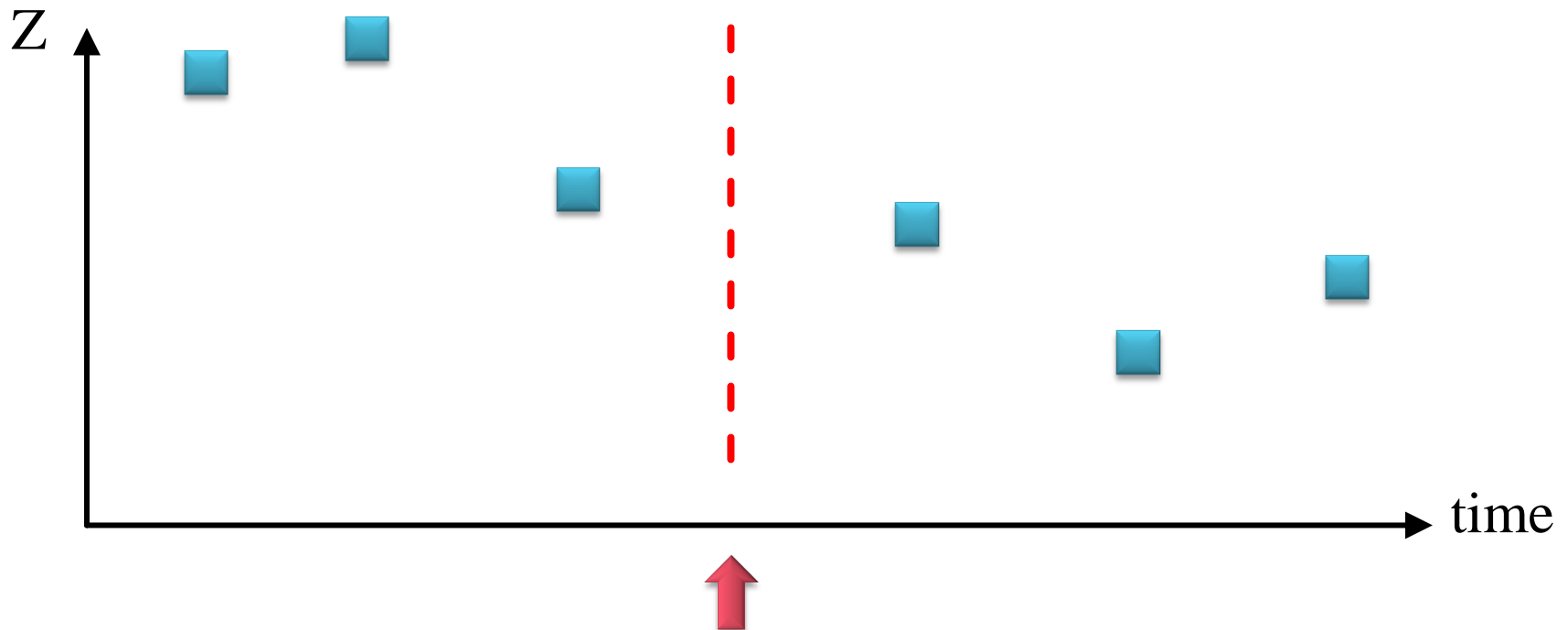


Workflow Components

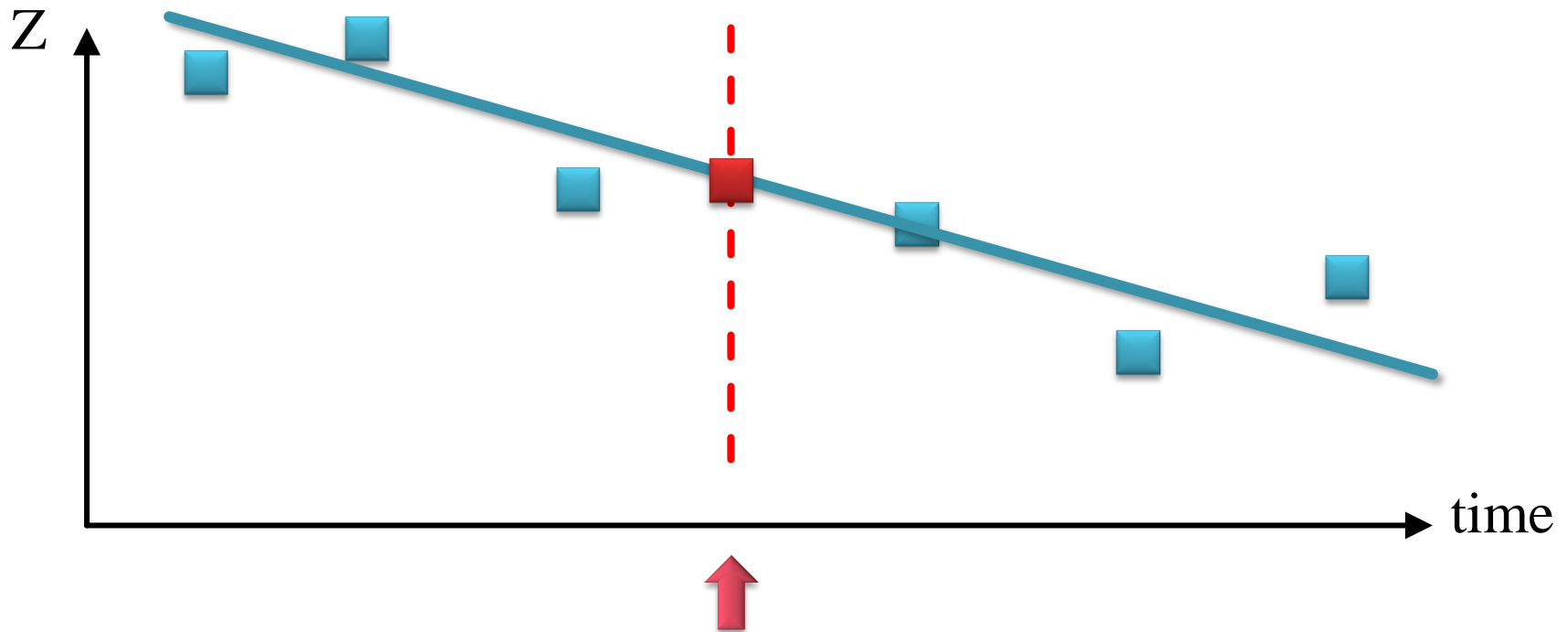


Time Series Interpolation

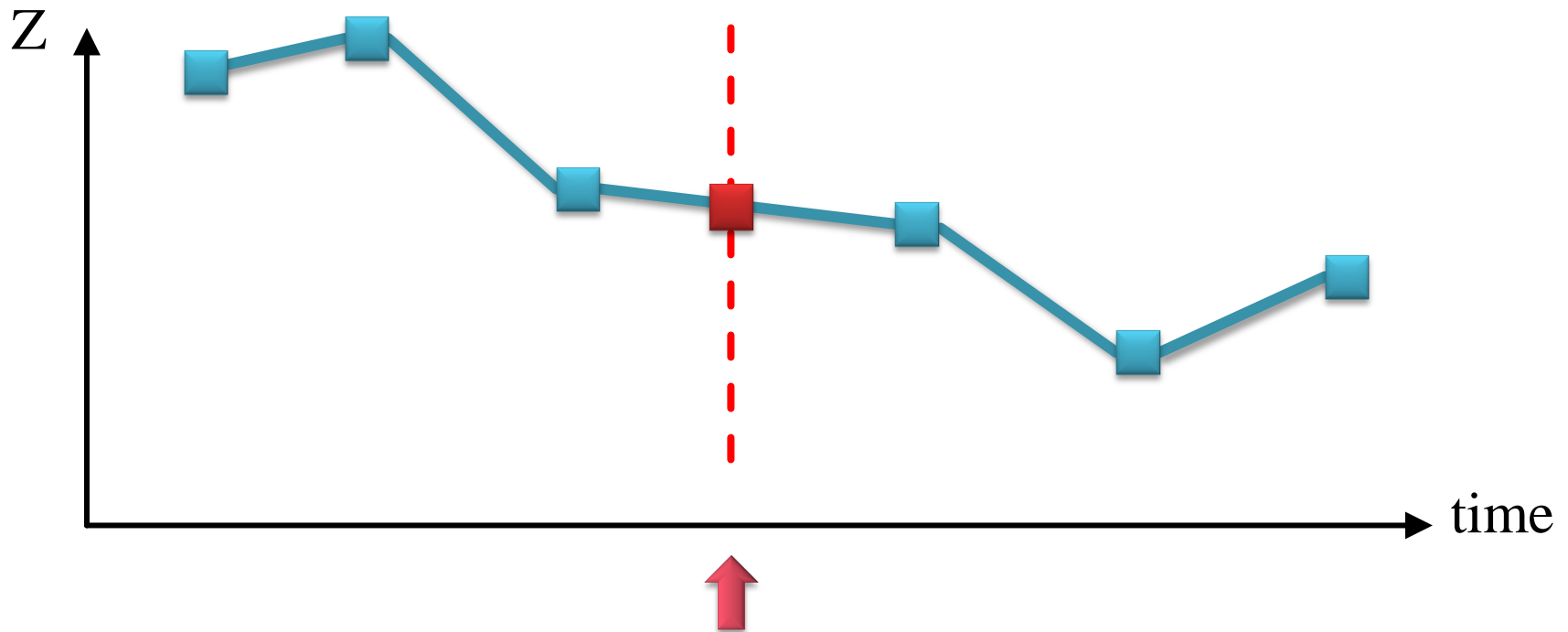
- Water levels are measured sporadically
- To get a value at each well, we must perform time series interpolation



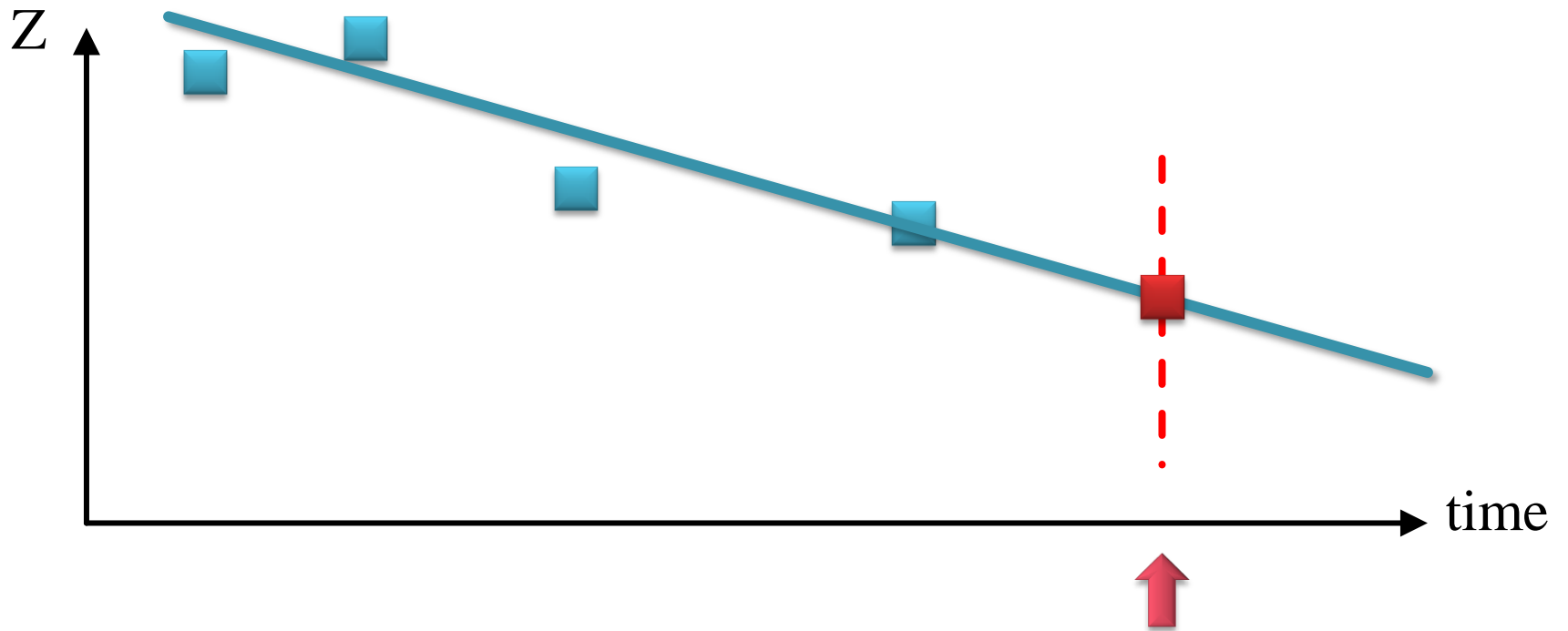
Least Squares Fit



Least Squares Fit, $n=2$



Least Squares Fit, Extrapolation



Automated Water Table Mapping Tool

Tool Input and Map View New

▼ Tool: Generate Water Table Maps

Select By:

Area:

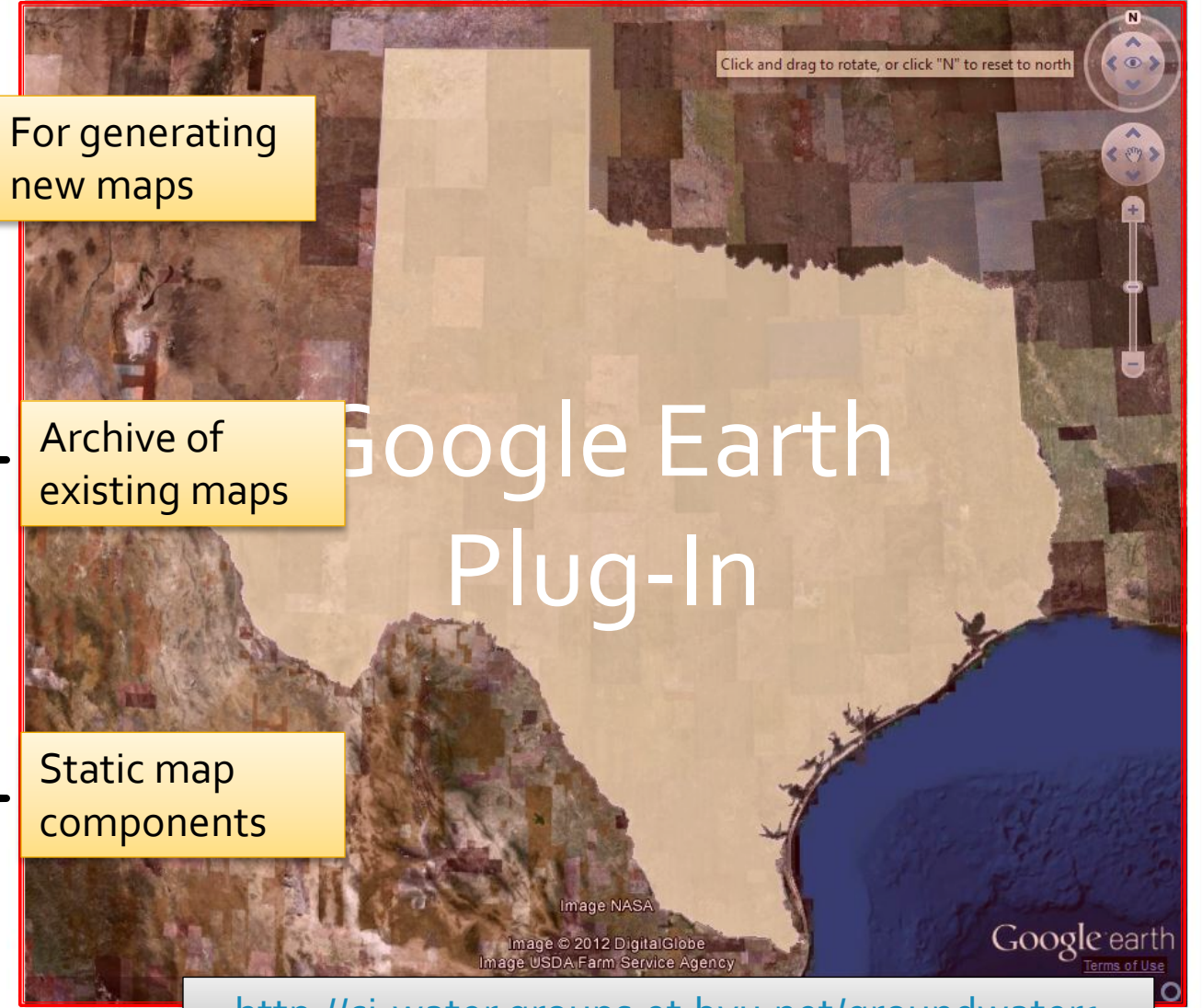
Start Date:

▼ Output Options

End Date:

PDF Report

- ▶ Tool Results
- ▼ Water Table Maps
-
- ▶ Texas: depth to groundwater, 12/25/2008
 - ▶ Texas: depth to groundwater, 12/25/2009
 - ▶ Texas: water elevation, 12/25/2008
 - ▶ Texas: water elevation, 12/25/2009
 - ▶ Lower Colorado: depth to groundwater, 12/25/2008
 - ▶ Lower Colorado: water elevation, 12/25/2008
- ▼ Boundaries
- ▶ Major Aquifers
 - ▼ State Boundary
 - ▶ Counties
 - ▶ Water Planning Areas
- ▼ Roads and Cities
- ▶ Borders and Labels
 - ▶ Roads
- ▼ Map Options and Components
- 3D Elevation
 - Navigation
 - Status Bar
 - Historical Imagery
 - Scale



<http://ci-water.groups.et.byu.net/groundwater1>

Automated Water Table Mapping Tool

Tool Input and Map View New

Tool: Generate Water Table Maps

Select By: ▼

Area: **Aquifer**

Start Date:

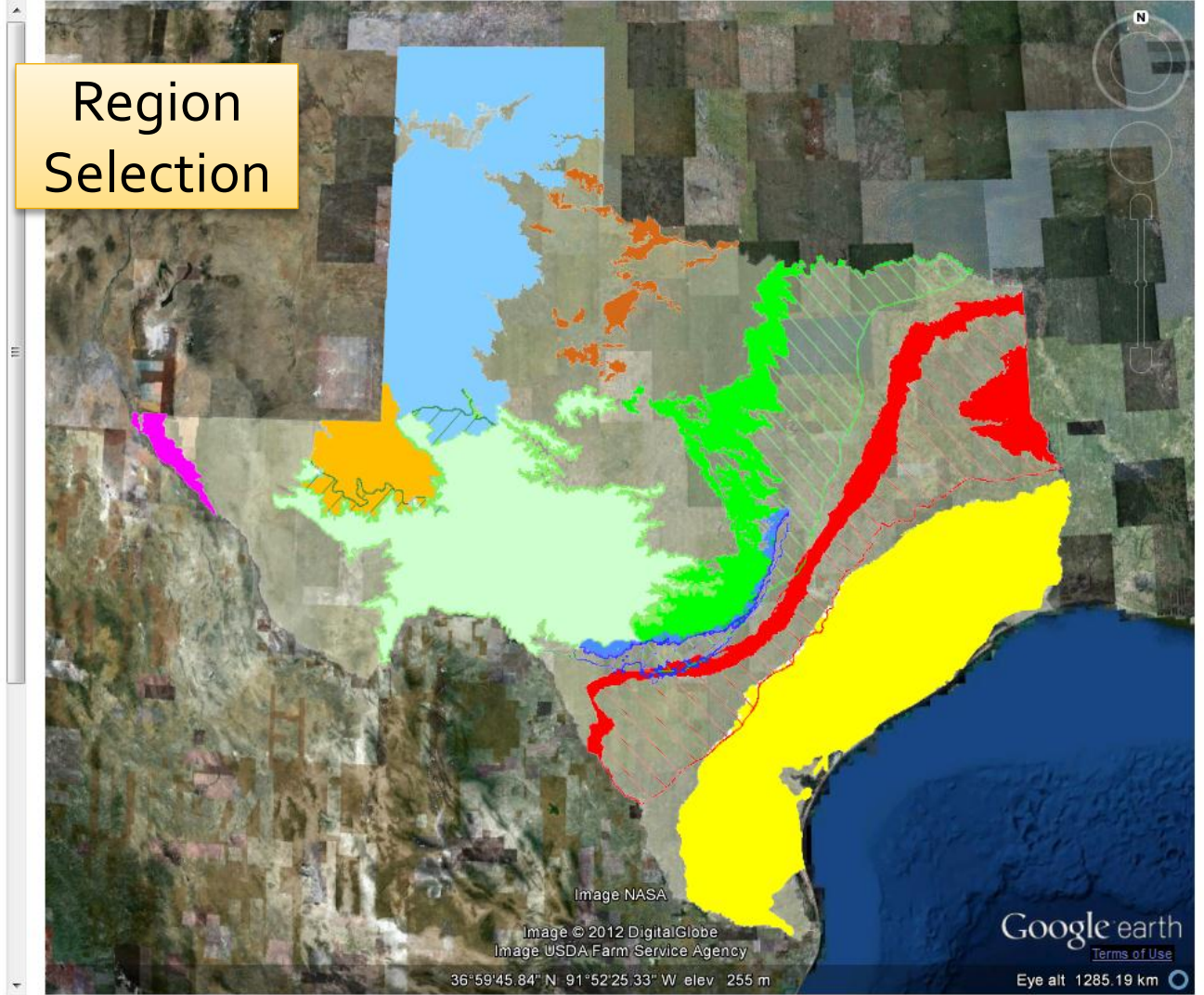
Output Options

End Date:

PDF Report



Region Selection



Tool Results

Water Table Maps

- Texas: depth to groundwater, 12/25/2008
- Texas: depth to groundwater, 12/25/2009
- Texas: water elevation, 12/25/2008
- Texas: water elevation, 12/25/2009
- Lower Colorado: depth to groundwater, 12/25/2008
- Lower Colorado: water elevation, 12/25/2008

Boundaries

Major Aquifers

- Pecos Valley
- Seymour
- Gulf Coast
- Carrizo - Wilcox (outcrop)
- Carrizo - Wilcox (subcrop)
- Hueco - Mesilla Bolson
- Ogallala
- Edwards - Trinity Plateau (outcrop)
- Edwards - Trinity Plateau (subcrop)
- Edwards BFZ (outcrop)
- Edwards BFZ (subcrop)
- Trinity (outcrop)

Automated Water Table Mapping Tool

Tool Input and Map View

New

Tool: Generate Water Table Maps

Select By:

Area:

Start Date:

▶ Output Options

Submit

Tool Results

Results for: Ogallala,
Tool has completed.

[View Detailed Geoprocessing Messages](#)

- ▶ Depth to Groundwater
- ▶ Water Elevation

Water Table Maps

Animation

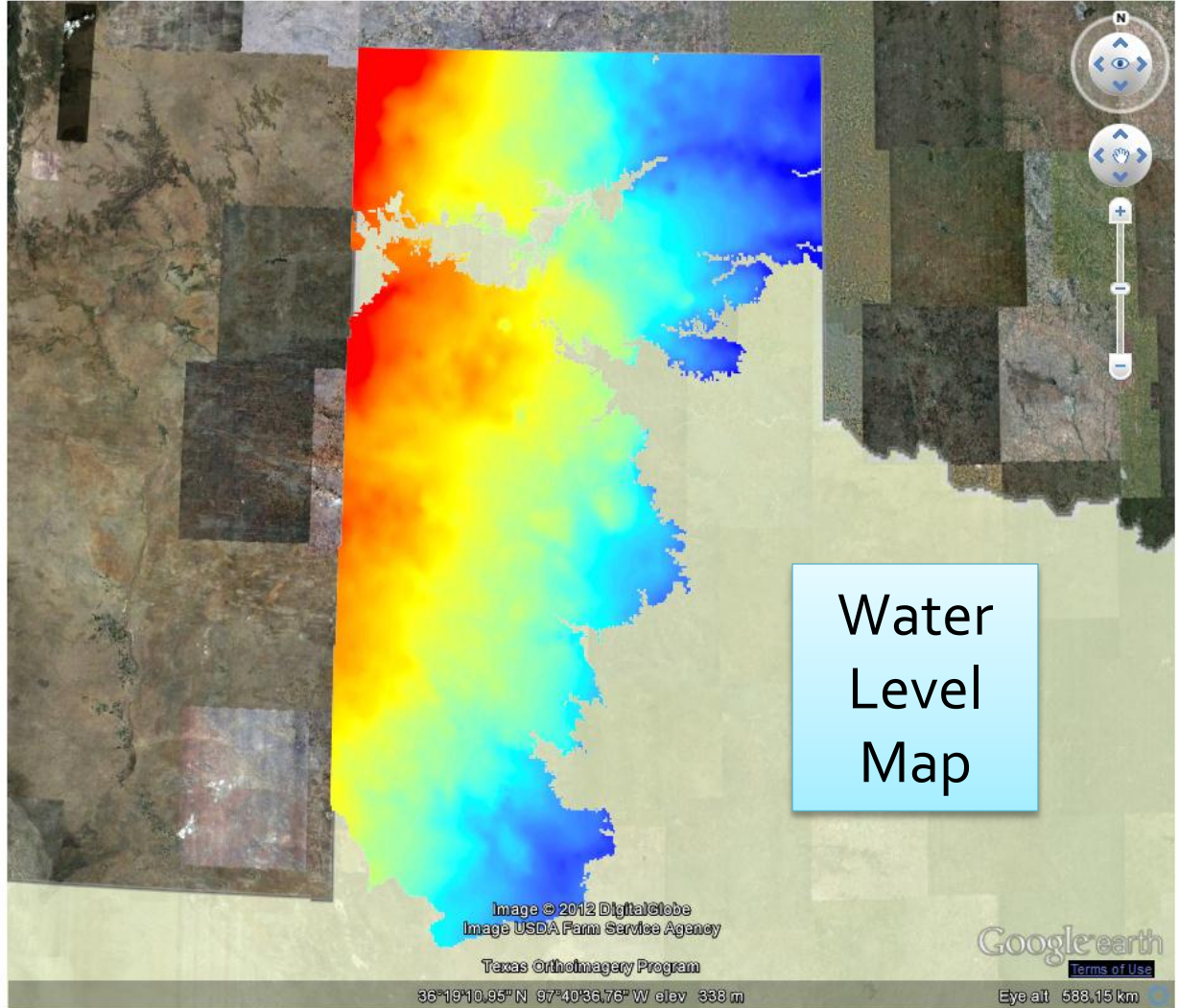
- ▶ Texas: depth to groundwater, 12/25/2008
- ▶ Texas: depth to groundwater, 12/25/2009
- ▶ Texas: water elevation, 12/25/2008
- ▶ Texas: water elevation, 12/25/2009
- ▶ Lower Colorado: depth to groundwater, 12/25/2008
- ▶ Lower Colorado: water elevation, 12/25/2008

Boundaries

- ▶ Major Aquifers
- ▶ State Boundary
- ▶ Counties
- ▶ Water Planning Areas

▶ Roads and Cities

▶ Map Options and Components



Automated Water Table Mapping Tool

Tool Input and Map View

New

Tool: Generate Water Table Maps

Select By:

Area:

Start Date:

Output Options

Submit

Tool Results

Results for: Ogallala,
Tool has completed.

[View Detailed Geoprocessing Messages](#)

Depth to Groundwater

Water Elevation

Water Table Maps

Animation

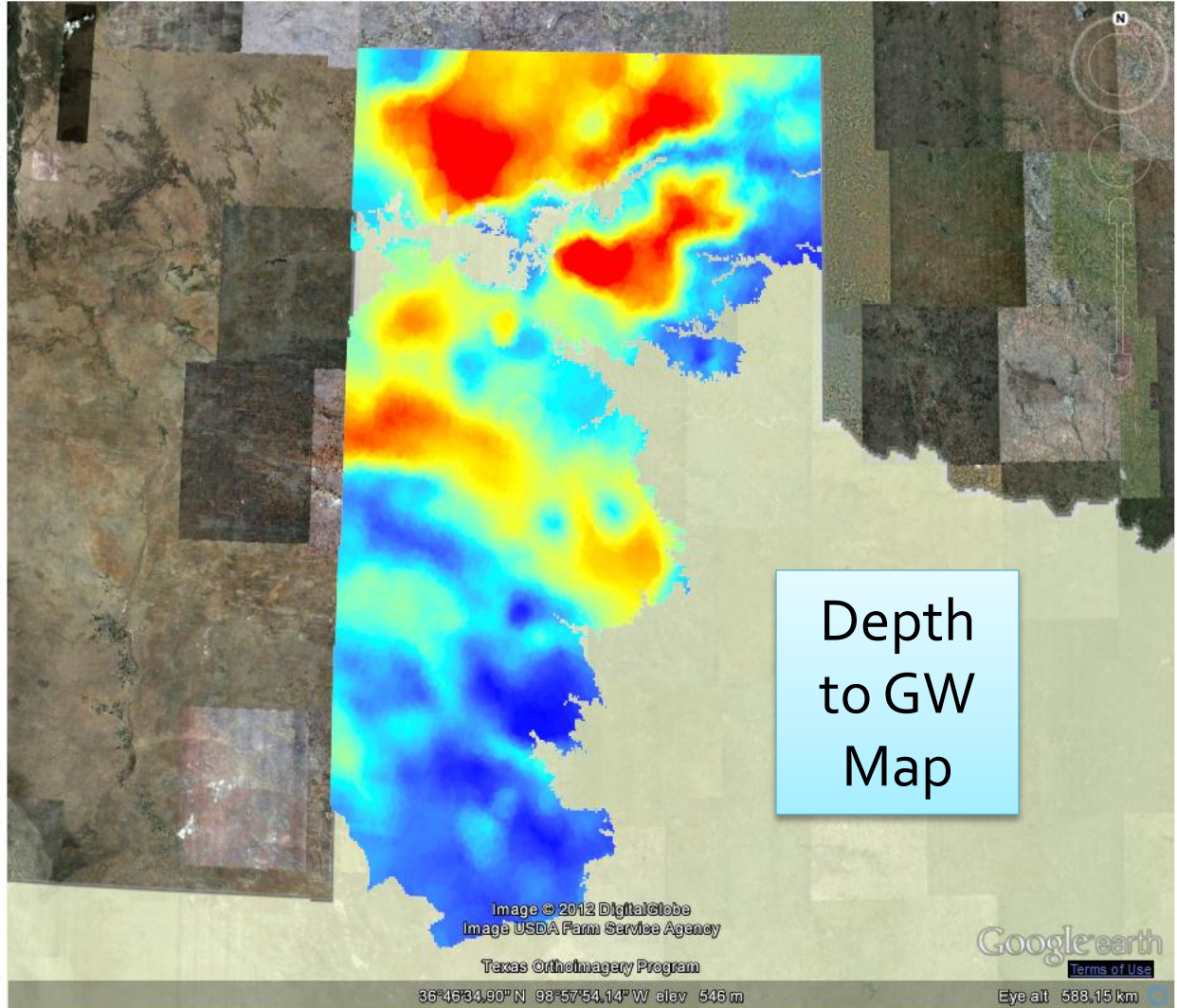
- Texas: depth to groundwater, 12/25/2008
- Texas: depth to groundwater, 12/25/2009
- Texas: water elevation, 12/25/2008
- Texas: water elevation, 12/25/2009
- Lower Colorado: depth to groundwater, 12/25/2008
- Lower Colorado: water elevation, 12/25/2008

Boundaries

- Major Aquifers
- State Boundary
- Counties
- Water Planning Areas

Roads and Cities

Map Options and Components



Automated Water Table Mapping Tool



A Utah-Wyoming Cyberinfrastructure Water Modeling Collaboration

Tool Input and Map View

New

Tool: Generate Water Table Maps

Select By:

Area:

Start Date:

End Date:

Output Options

Tool Results

Water Table Maps

Texas: depth to groundwater, 12/25/2008



High : 1096.48

Low : 8.23723

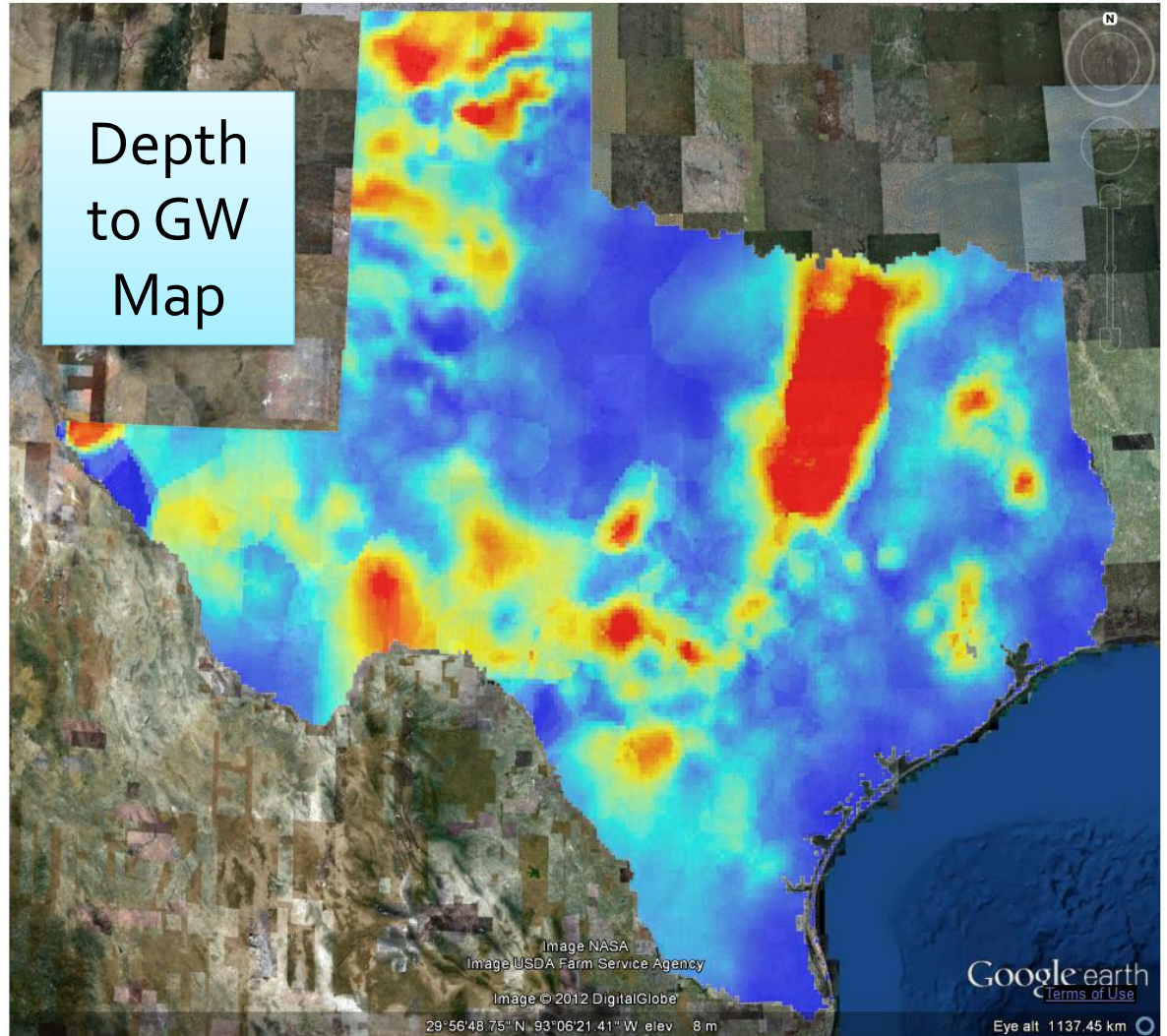
- Texas: depth to groundwater, 12/25/2009
- Texas: water elevation, 12/25/2008
- Texas: water elevation, 12/25/2009
- Lower Colorado: depth to groundwater, 12/25/2008
- Lower Colorado: water elevation, 12/25/2008
- Ogallala Aquifer: depth to groundwater, 12/25/2008
- Ogallala Aquifer: water elevation, 12/25/2008

Boundaries

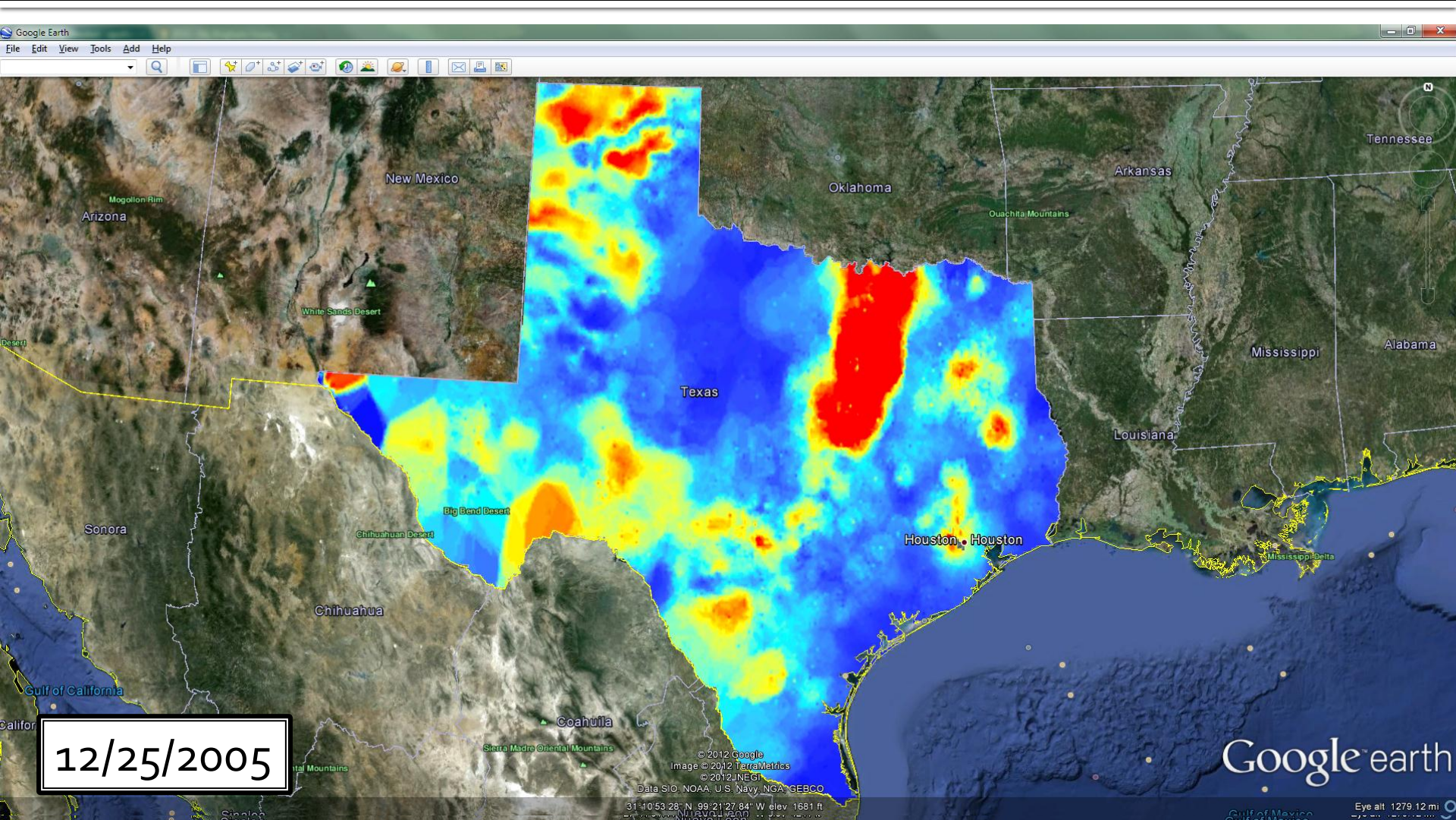
- Major Aquifers
- State Boundary
- Counties
- Water Planning Areas

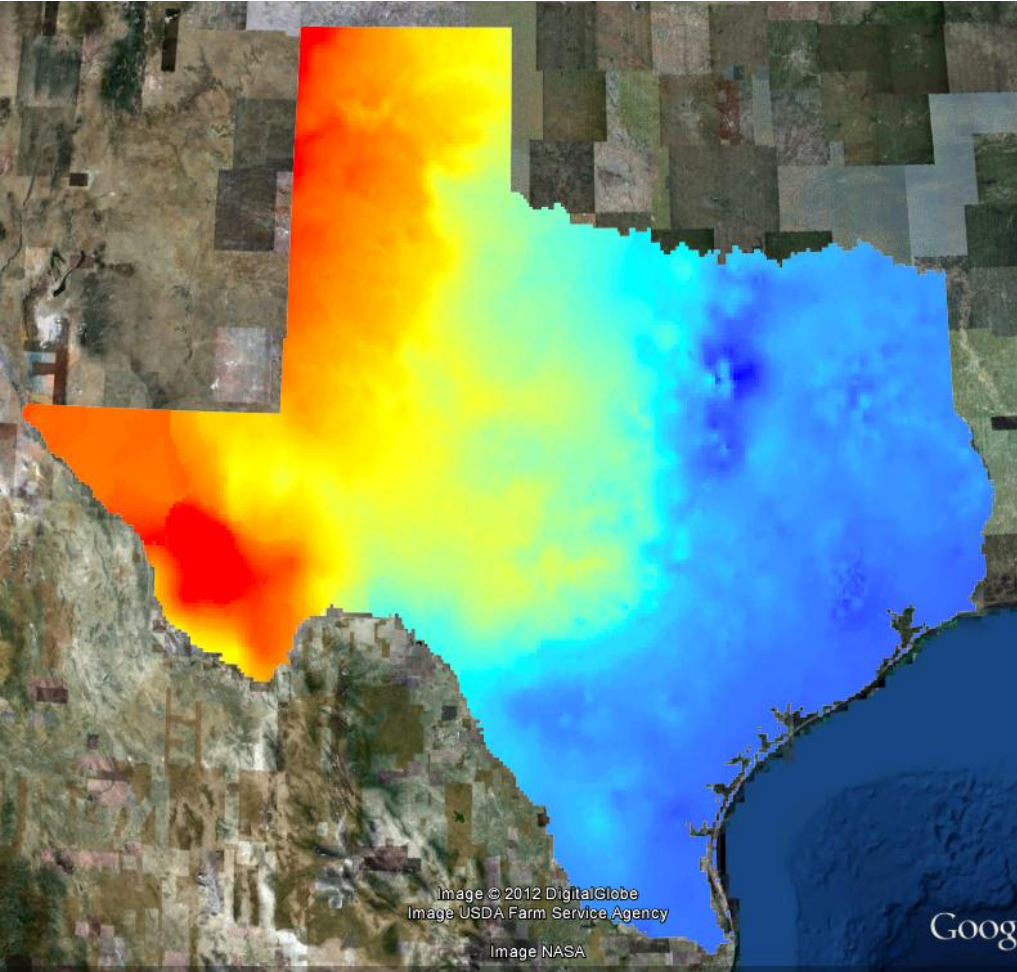
Roads and Cities

Map Options and Components



Animations





Thank You!

Norm Jones

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Special Thanks to:
Michael Burns
Scott Christiansen
Gil Strassberg

<http://www.ci-water.org>

<http://ci-water.groups.et.byu.net/groundwater1>