Cloud-Based Water Level Mapping Utility
CI-WATER: Cyberinfrastructure to Advance High Performance Water Resource Modeling
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
Cloud-Based Modeling and Visualization

Component 2 Objective

Geodatabase
Model Files
GIS Workflow

Server

Web Mapping

Engineers, Decision Makers, Advocacy Groups, Public
Detailed maps showing water level changes over time are essential for aquifer management and planning.

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

**Water Level Mapping Utility**

**Outputs**
- Water Levels
- Drawdown
- Depth to GW
TWDB Well Database

274,904 wells w/meas.
781,864 measurements
Measurements per Well

Number of Measurements per Well

Number of water level measurements

Well Number
Measurements per Year

Number of Measurements per Year

Year


Number of water level measurements

0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 11000 12000 13000 14000 15000 16000 17000 18000
Arc Hydro Groundwater

Data model and tools for managing groundwater data in ArcGIS
Arc Hydro GW Data Model

Framework
- WaterLine
- Waterbody
- Watershed
- WaterPoint
- MonitoringPoint
- Aquifer
- Wall
- TimeSeries

Borehole data
- BorePoint
- BoreLine
- BoreholeLog
- Depth
- Top Elevation
- Bottom Elevation

Hydrostratigraphy
- HydrogeologicUnit
- SectionLine
- GeoArea
- GeoRasters
- GeoVolume

Temporal
- VariableDefinition
- SeriesCatalog
- DatasetCatalog
- AttributeSeries
- RasterSeries
- FeatureSeries

Simulation
- Cell2D
- Cell3D
- Node2D
- Node3D

Geology
- GeologyArea
- GeologyLine
- GeologyPoint
- XS2D_BoreLine
- XS2D_Panel
- XS2D_MajorGrid
- XS2D_MinorGrid
- XS2D_PanelDivider

2D cross sections (XS2D)
Arc Hydro GW Tools

Groundwater Analyst

MODFLOW Analyst

Subsurface Analyst
- 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:
  - HydroID
  - HydroCode
  - LandElev
  - WellDepth
  - AquiferID
  - AqCode
  - HGUID
  - FType

Wells in the Edwards Aquifer
Well HydroID = 2791

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

Create Well Feature

Wells Feature Class
Screen Top
Screen Bottom
XY Coord.
Pumping Rate
Output Well Feature
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

- Query wells in selected region
- Estimate water levels at selected date
- Interpolate water levels to raster
- Calculate Drawdown & Depth to GW
- Export rasters to KMZ
- Export rasters to KMZ
- Archives maps to database
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
For generating new maps

Archive of existing maps

Static map components

http://ci-water.groups.et.byu.net/groundwater1
Automated Water Table Mapping Tool

Tool Input and Map View

- **Tool:** Generate Water Table Maps
  - Select By: Aquifer
  - Area: Ogallala
  - 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

Water Level Map
Depth to GW Map
Animations
Thank You!

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