USGS
science for a changing world

Real-Time Lake and Reservoir Meteorological and Vertical Water-Quality Monitoring

Seventh National Monitoring Conference

Session E1: Continuous Real-Time Monitoring: Applications in Lakes and Estuaries, 2:05pm

Reed Green, U.S. Geological Survey, Arkansas Water Science Center

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

Automated Real-Time Controls

GSM / GOES Data Telemetry

Database Server

WEB Display

Modeling Server

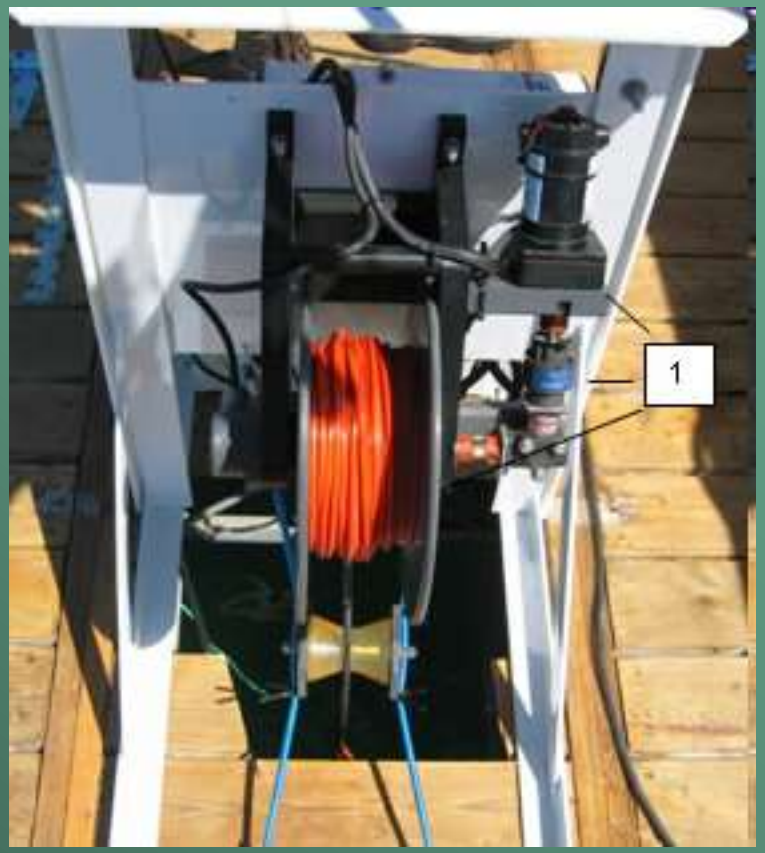
- Run 3-D Models, Real-Time
- Run Real-Time Simulations

USGS

Lake Houston Monitoring – Platform, Winch and Data Sonde

USGS

Lake Mead Monitoring – Platform, Meteorological Instruments, Winch and Data Sonde



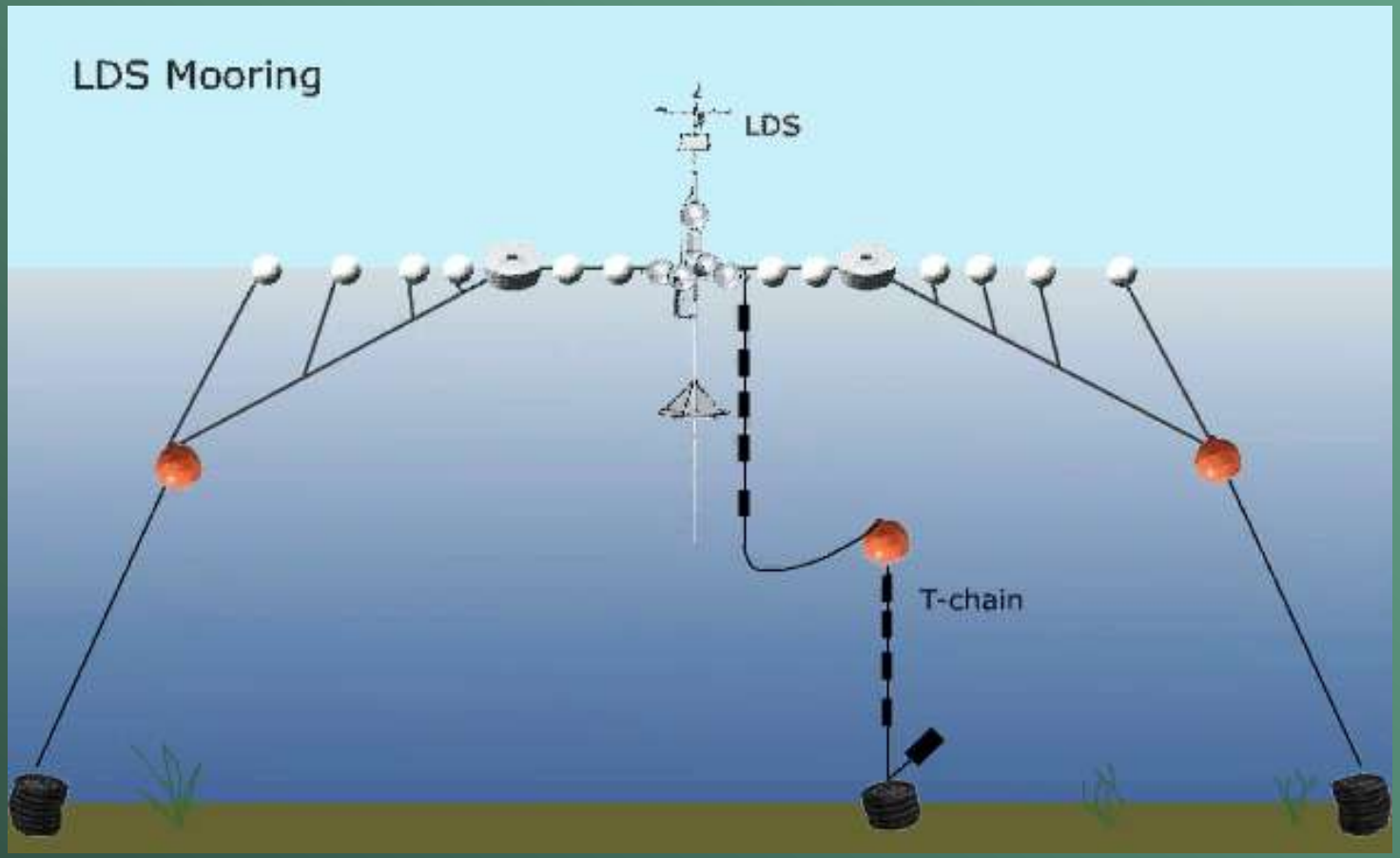
USGS

Beaver Lake Monitoring – Meteorological Instruments, Thermistor, and Dissolved Oxygen String

USGS

Beaver Water District

Self-Adjusting Mooring System



USGS

Meteorological Station

USGS

Beaver Water District

Meteorological Station

USGS

Beaver Water District

Lake Monitoring Station

USGS

Beaver Water District

Operation and Maintenance

- Clean underwater thermistors and dissolved oxygen sensors, every 3 – 5 weeks
- Calibrate meteorological instruments, once annually (return to factory for calibration)
- Calibrate underwater thermistors and dissolved oxygen sensors, twice annually (return to factory for calibration)

USGS

Servicing the Underwater Thermistors and DO Sensors

USGS

Beaver Water District

Servicing the Underwater Thermistors and DO Sensors

USGS

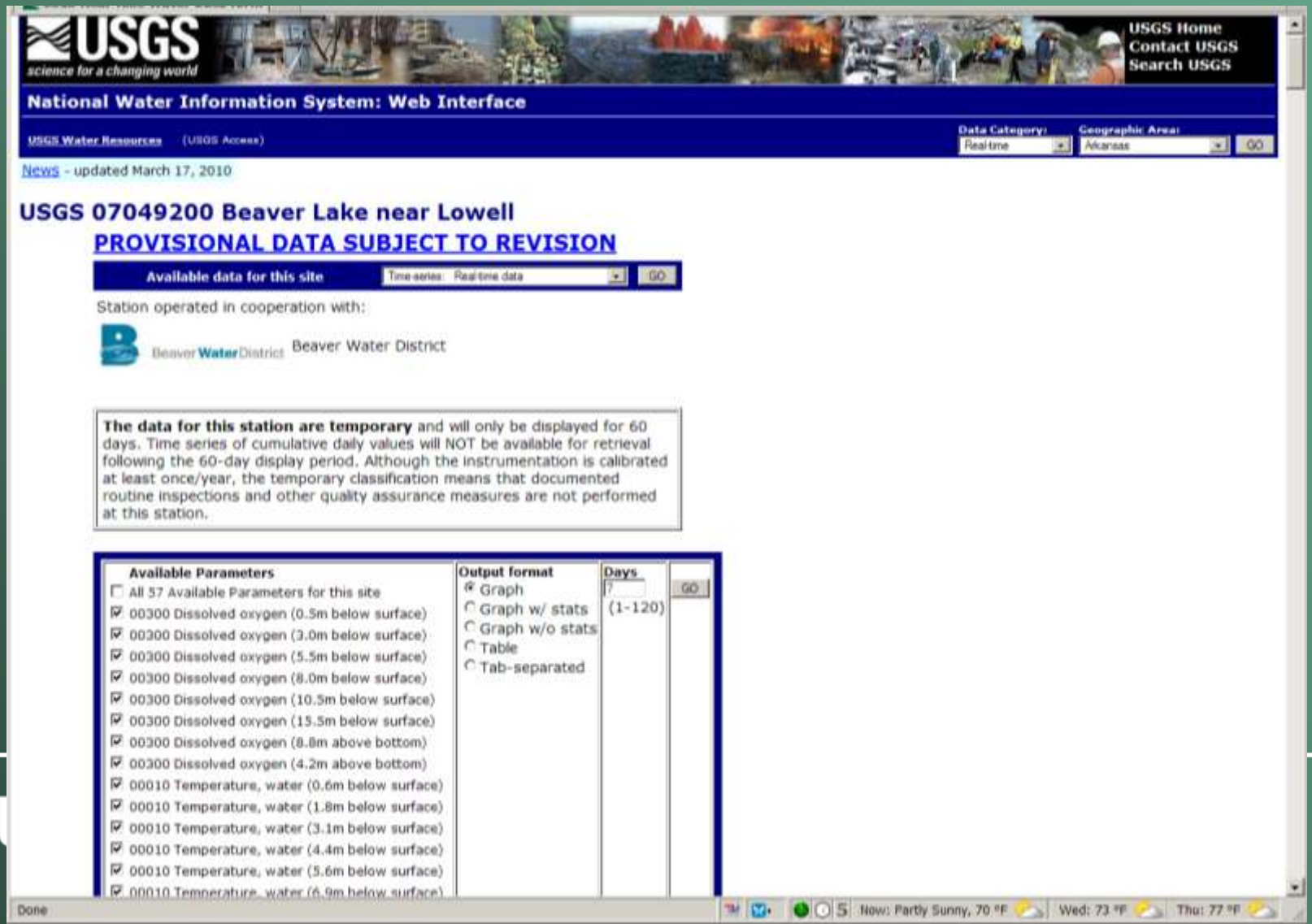
Beaver Water District

Servicing the Underwater Thermistors and DO Sensors

USGS

Beaver Water District

USGS NWIS Web Display



Water Temperature

USGS Real-Time Water Data for USGS 07049200 Beaver Lake near Lowell - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://waterdata.usgs.gov/ar/nwis/uv?cb_00010=on&format=gif_default&period=20&site_no=07049200

USGS Real-Time Water Data for...

[Summary of all available data for this site]

Temperature, 0.6m below surface, water, degrees Celsius

Most recent instantaneous value: 17.7 04-20-2010 13:12 CDT

Create presentation-quality / stand-alone graph

parm 00010 DD16

Done

Now: Partly Sunny, 72 °F Wed: 73 °F Thu: 77 °F

Wind Speed

USGS Real-Time Water Data for USGS 07049200 Beaver Lake near Lowell - Mozilla Firefox

File Edit View History Bookmarks Tools Help

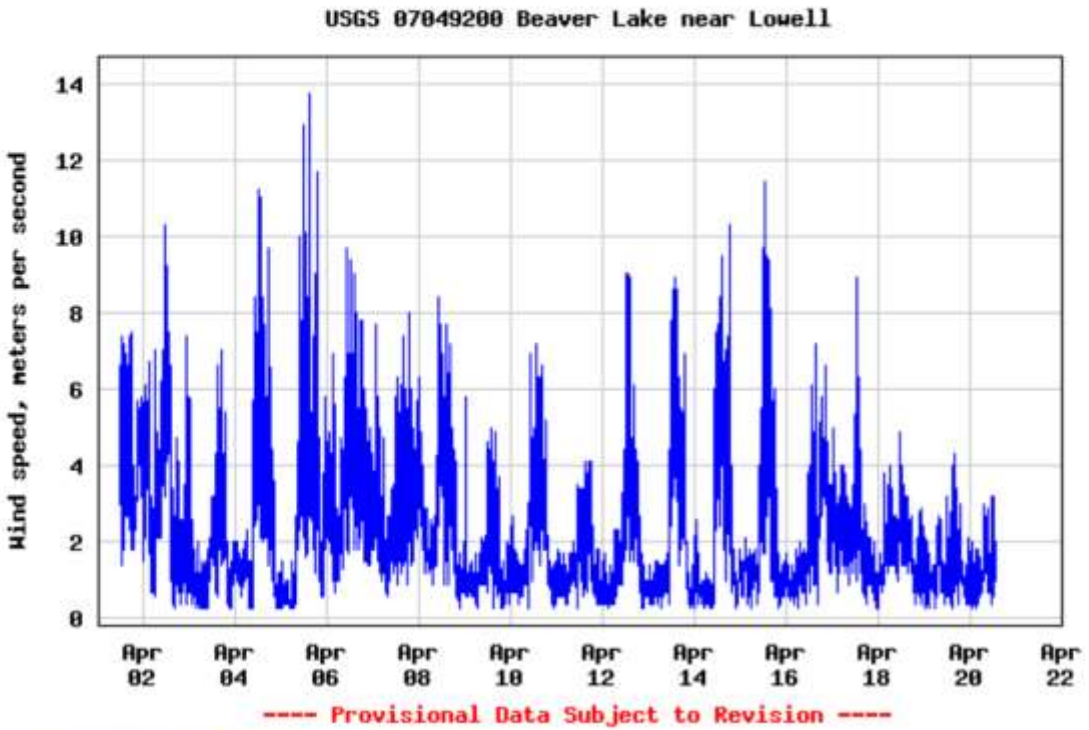
http://waterdata.usgs.gov/ar/nwis/uv?cb_62625=on&format=gif_default&period=20&site_no=07049200

USGS Real-Time Water Data for...

[Summary of all available data for this site]

Wind speed, meters per second

Most recent instantaneous value: 1.0 04-20-2010 13:12 CDT



Create presentation-quality / stand-alone graph

parm 62625 DD34

Done

Now: Partly Sunny, 70 °F Wed: 73 °F Thu: 77 °F

Wind Direction

USGS Real-Time Water Data for USGS 07049200 Beaver Lake near Lowell - Mozilla Firefox

File Edit View History Bookmarks Tools Help

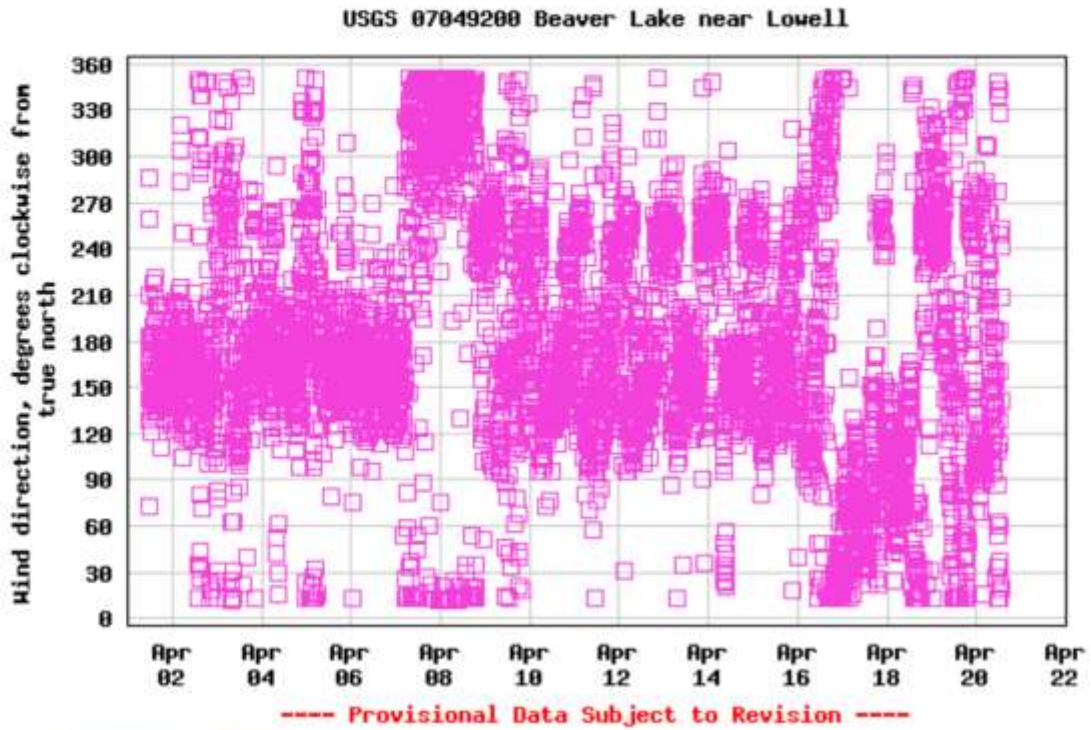
http://waterdata.usgs.gov/ar/nwis/uv?cb_00036=on&format=gif_default&period=20&site_no=07049200

USGS Real-Time Water Data for...

[Summary of all available data for this site]

Wind direction, degrees clockwise from true north

Most recent instantaneous value: 242 04-20-2010 13:12 CDT



Create presentation-quality / stand-alone graph

parm 00036 DD33

Done

Now: Partly Sunny, 70 °F Wed: 73 °F Thu: 77 °F

Short Wave Radiation

USGS Real-Time Water Data for USGS 07049200 Beaver Lake near Lowell - Mozilla Firefox

File Edit View History Bookmarks Tools Help

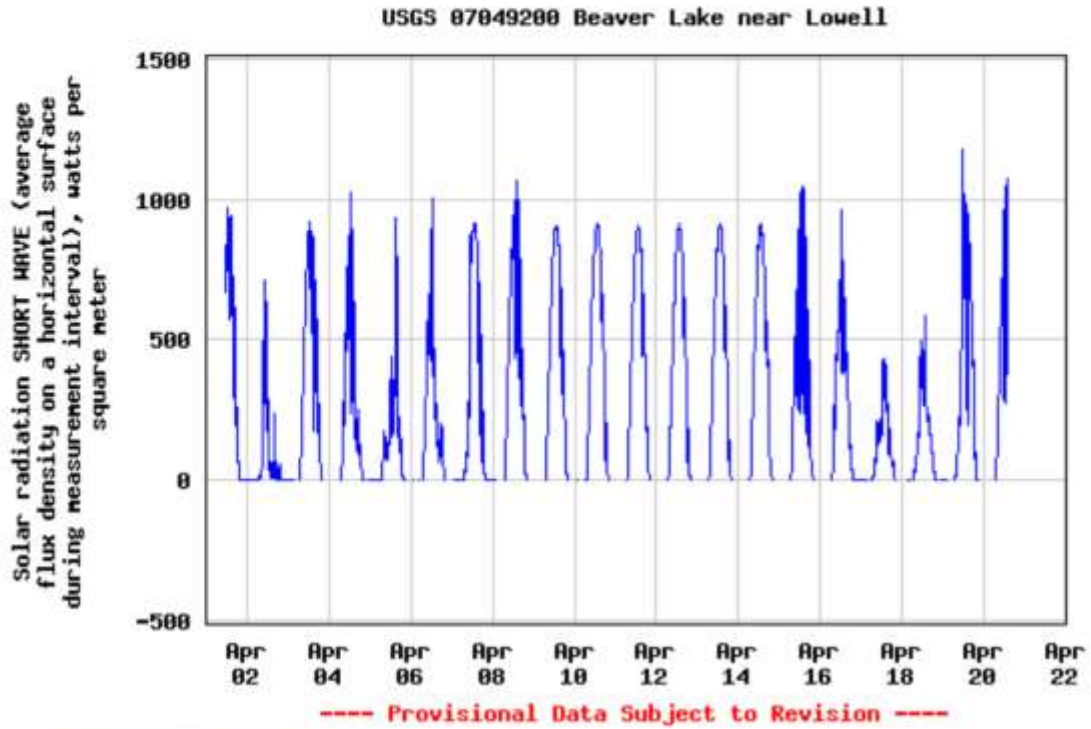
http://waterdata.usgs.gov/ar/nwis/uv?cb_99986=on&format=gif_default&period=20&site_no=07049200

USGS Real-Time Water Data for...

[Summary of all available data for this site]

Solar radiation SHORT WAVE (average flux density on a horizontal surface during measurement interval), watts per square meter

Most recent instantaneous value: 1,080 04-20-2010 13:12 CDT



Create presentation-quality / stand-alone graph

parm 99986 DD35

Done

Now: Partly Sunny, 70 °F Wed: 73 °F Thu: 77 °F

Air Temperature

USGS Real-Time Water Data for USGS 07049200 Beaver Lake near Lowell - Mozilla Firefox

File Edit View History Bookmarks Tools Help

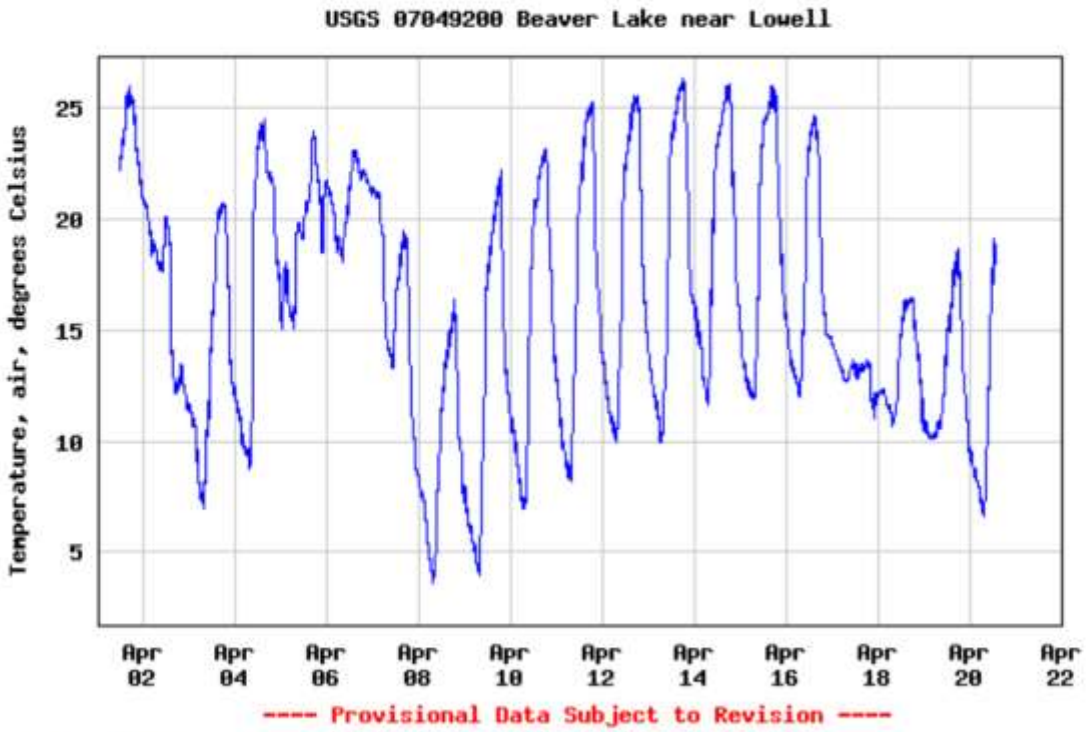
http://waterdata.usgs.gov/ar/nwis/uv?cb_00020=on&format=gif_default&period=20&site_no=07049200

USGS Real-Time Water Data for...

[Summary of all available data for this site]

Temperature, air, degrees Celsius

Most recent instantaneous value: 18.6 04-20-2010 13:12 CDT



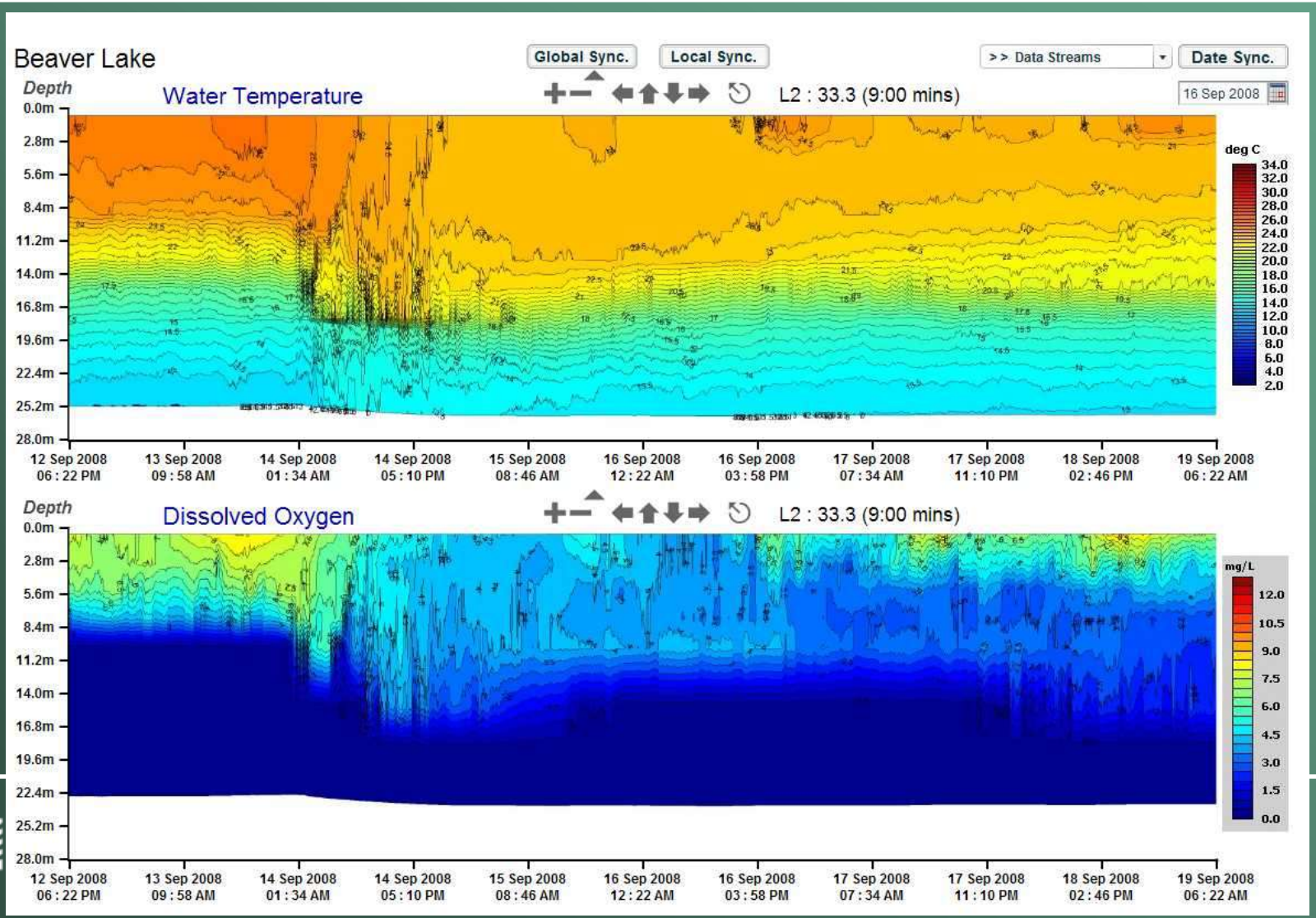
Create presentation-quality / stand-alone graph

parm 00020 DD38

Done

Now: Partly Sunny, 70 °F Wed: 73 °F Thu: 77 °F

Depth and Time Contours



Data Uses

- Basic information – water-column profile trends (curiosity)
- Drinking-water intake gate elevation (decision support)
- Forecasting disintegration of the thermocline and mixing of the hypolimnion (decision support)
- Angler (fisheries) information – *Reed...Nice to have data again....water is warming up nicely...whites are moving and stripers are showing up at my favorite point...life is good! Greg* (decision support)
- Driving real-time hydrodynamic and water-quality models (data-driven monitoring and decision support)

USGS

Central Arkansas Water

Beaver Water District

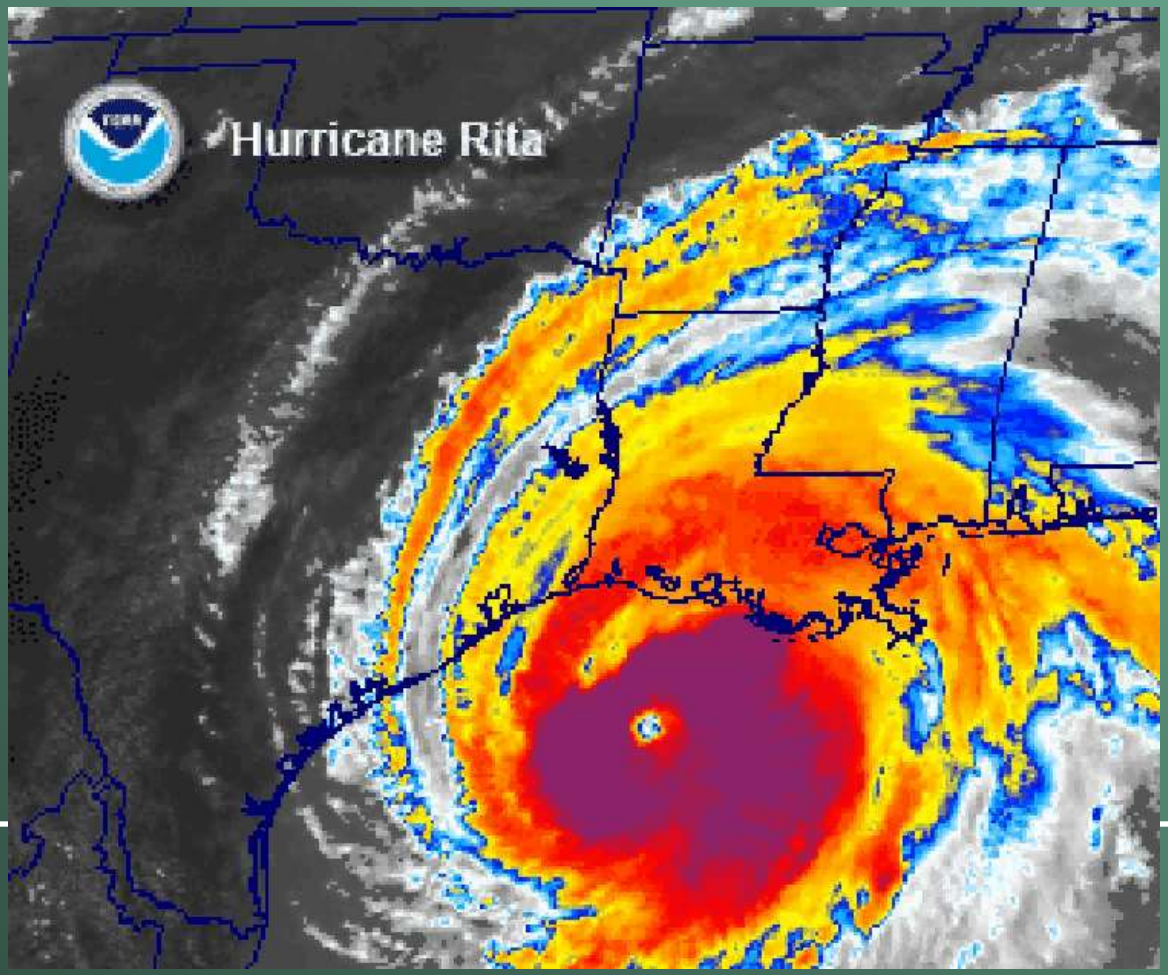
Data-Driven Monitoring

- In lakes, samples are collected most often, at fixed points in space and time.
- Now, with advances in sensor technology and data telemetry,
  - we can let the data drive the monitoring,
  - using real-time 3-D lake and reservoir simulation tools to identify opportunities to sample at different times, at different locations, to capture events that might otherwise go unnoticed.

USGS

Guiding Principle

- If we can simulate it, we can monitor it.



USGS

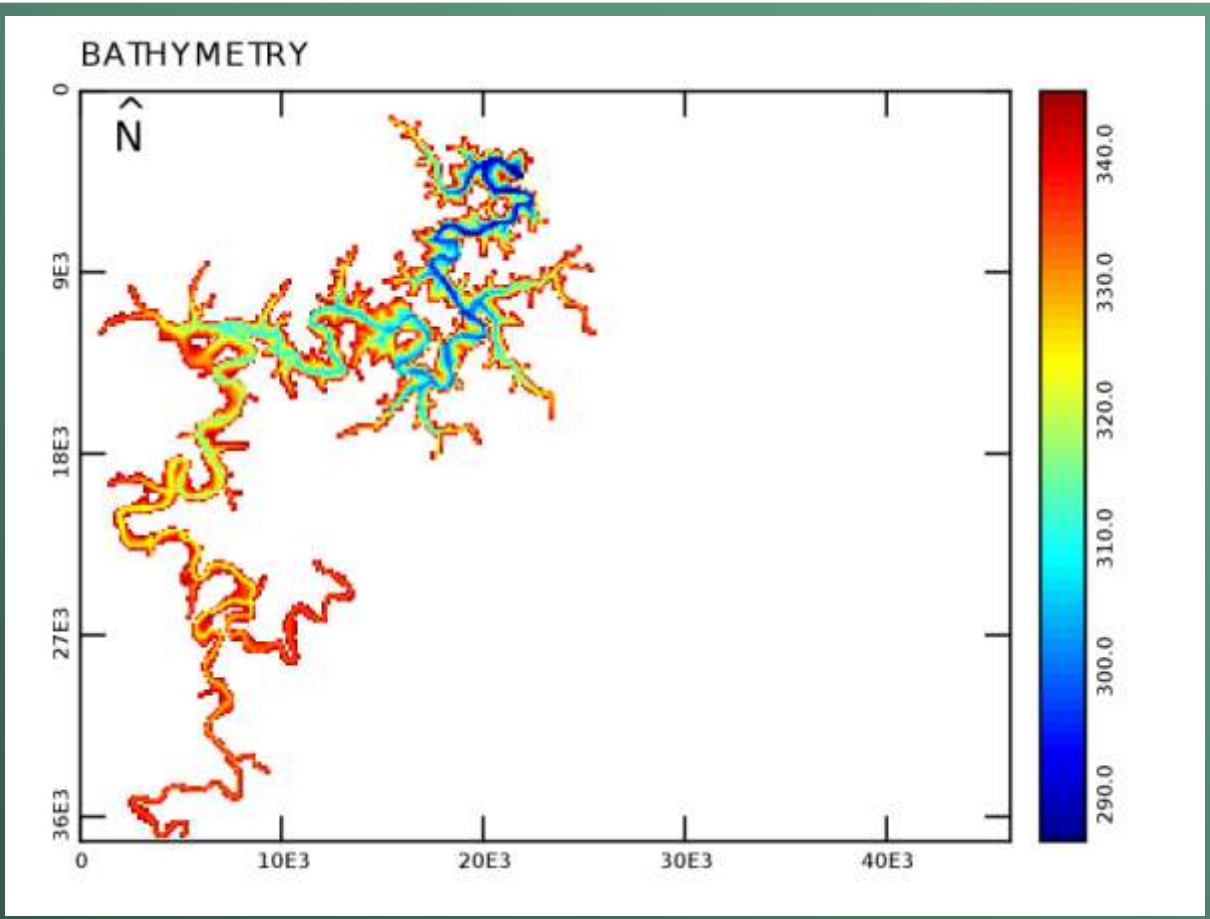
Beaver Lake, northwest Arkansas

- Impounded mountain valley
- Deep, long, thin, dendritic
- Hydroelectric, flood control
- 4 drinking water intakes
- Recreation
- Fisheries and wildlife habitat

USGS

Beaver Water District

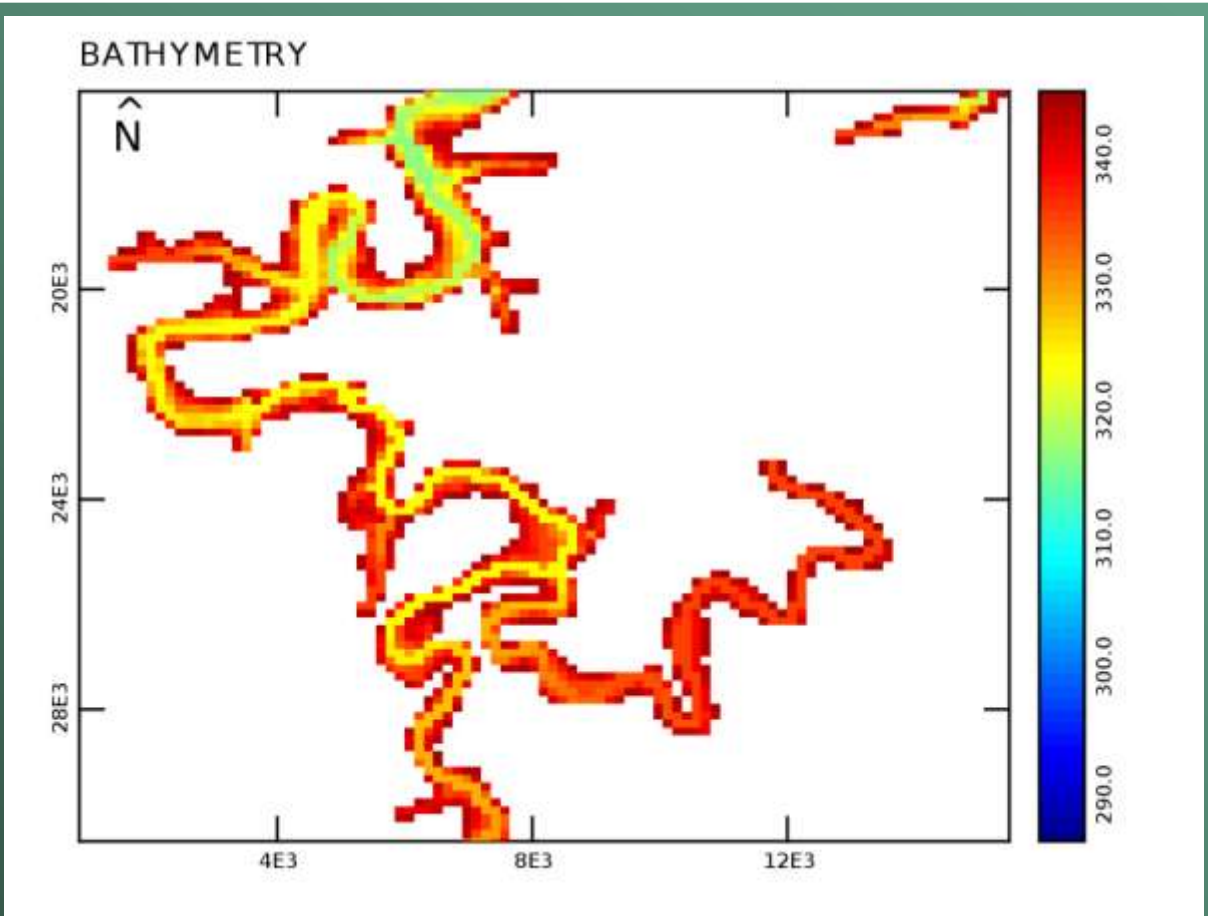
Beaver Lake Bathymetry



USGS

Beaver Water District

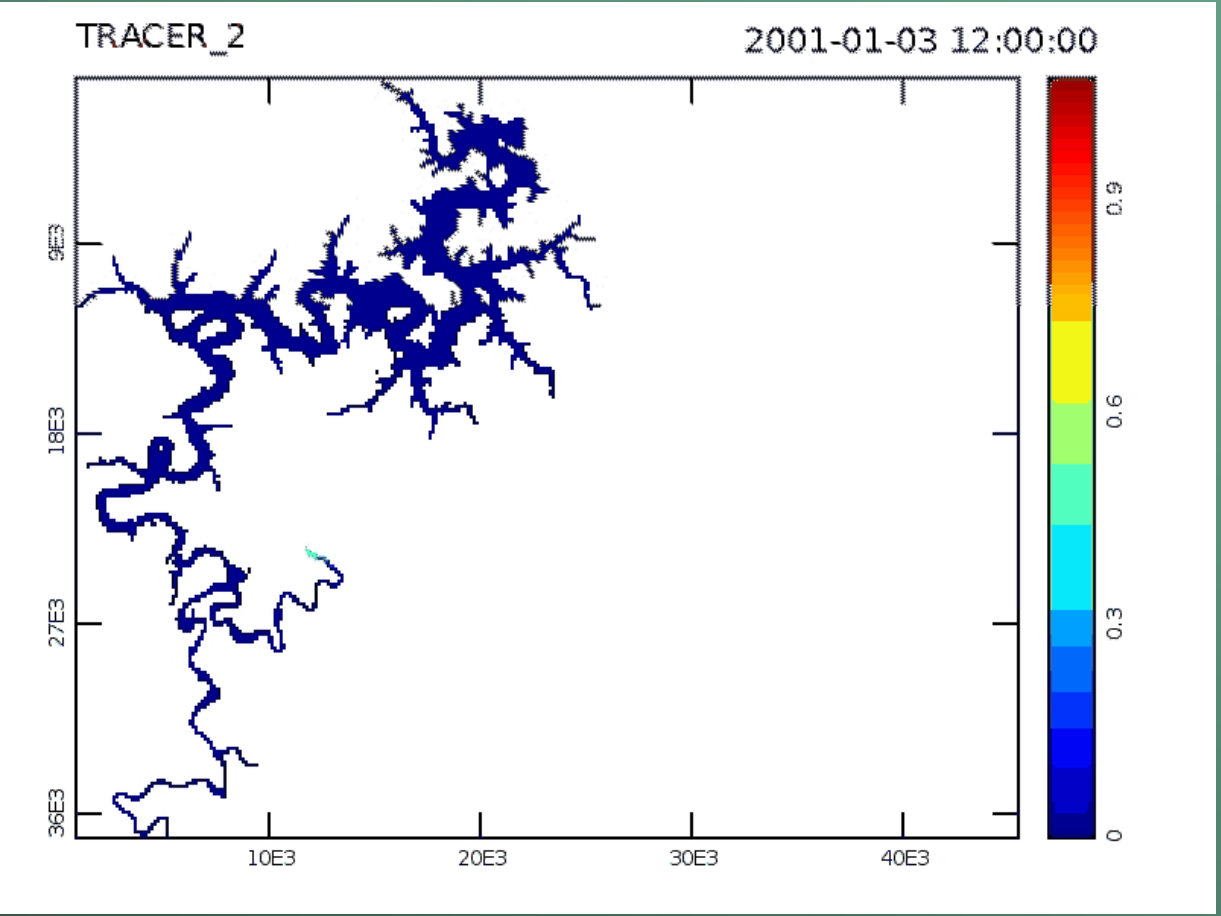
Beaver Lake Bathymetry



USGS

Beaver Water District

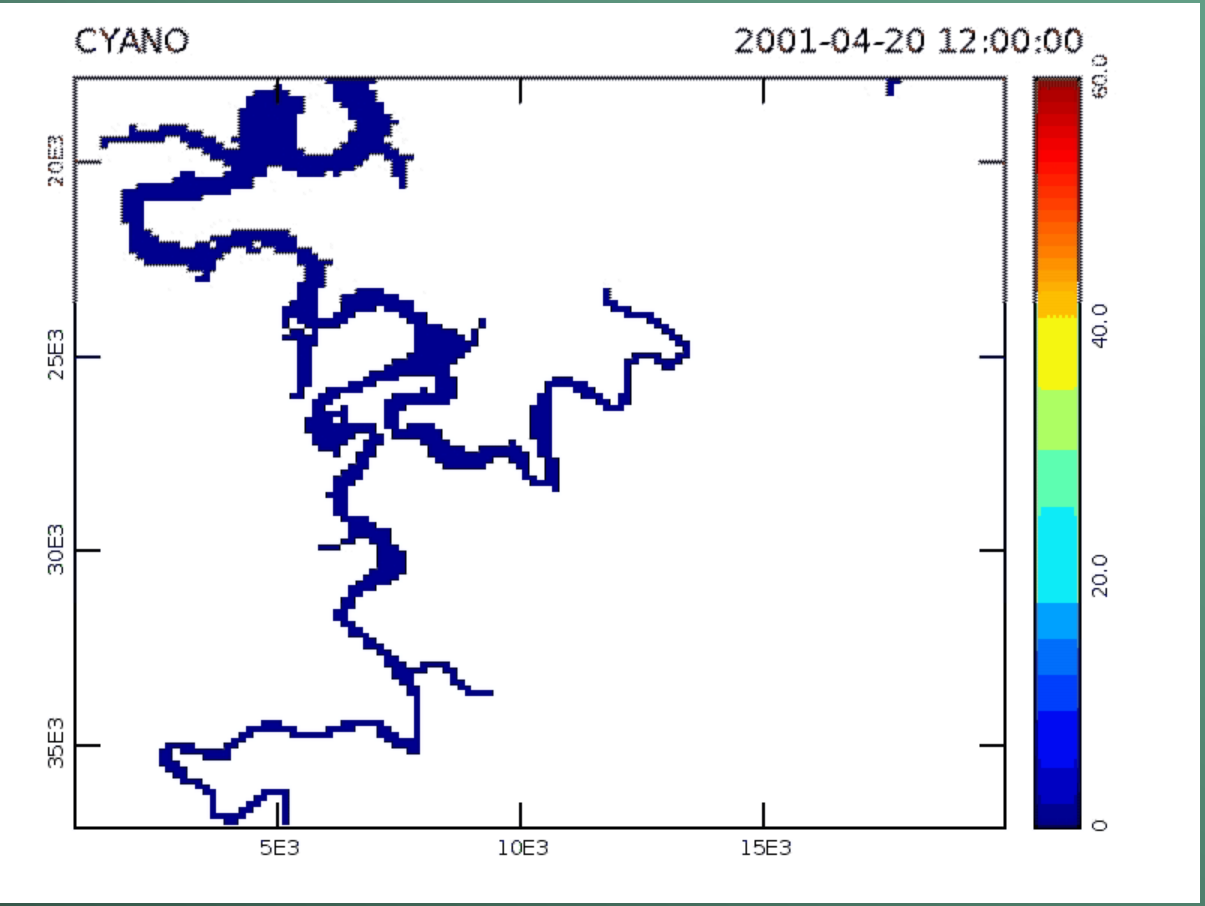
Beaver Lake Tracer Simulation



USGS

Beaver Water District

Beaver Lake Cyanobacteria Simulation



USGS

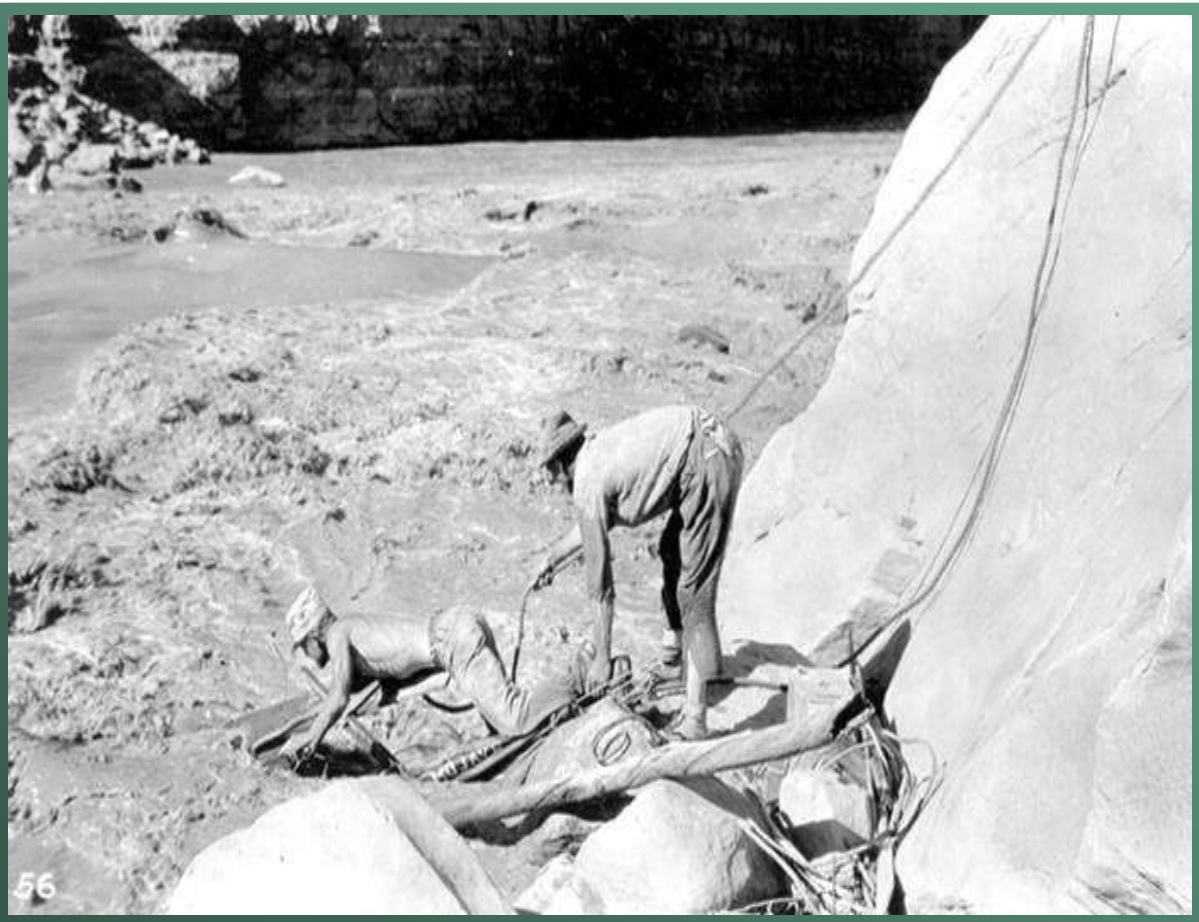
Beaver Water District

Current and Future Activities

- Continue the Beaver Lake real-time monitoring and 3D model development program
- Install new real-time instruments in Lake Maumelle, Arkansas and Great Salt Lake over the next month or two
- Currently working with the Texas Water Science Center to develop a 3D modeling program for Lake Houston, using their existing real-time monitors
- Currently working with the Utah Water Science Center to develop a 3D modeling program on the south arm of the Great Salt Lake
- Developing a new 3D modeling system in Lake Maumelle to replace the existing 2D model

USGS

Questions?



USGS