The CUAHSI Hydrologic Information System

Presented by Dr. Tim Whiteaker

The University of Texas at Austin

21 October, 2010

About the Speaker

PhD 2004

Research Associate

What You Will Learn

- What is the CUAHSI **Hydrologic Information System** (HIS)
  - History
  - Why people use it
- How to **access** data in HIS
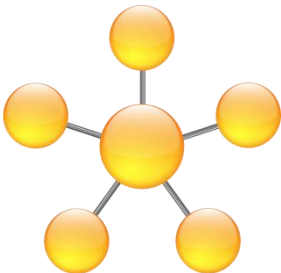- How to **publish** your data with HIS

Outline
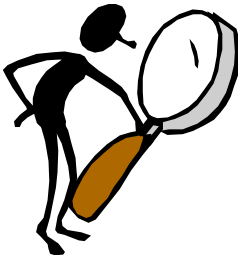
- The HIS Story

- HIS components
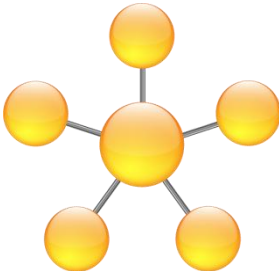
- Putting the pieces together

Outline

- ***The HIS Story***

- HIS components

- Putting the pieces together

HIS Connects People with Data

- The CUAHSI* Hydrologic Information System (HIS) provides web services, tools, standards and procedures that enhance access to more and better data for hydrologic analysis.

his.cuahsi.org

*Consortium of Universities for the Advancement of Hydrologic Science, Inc.

Temperature Near Aguascalientes
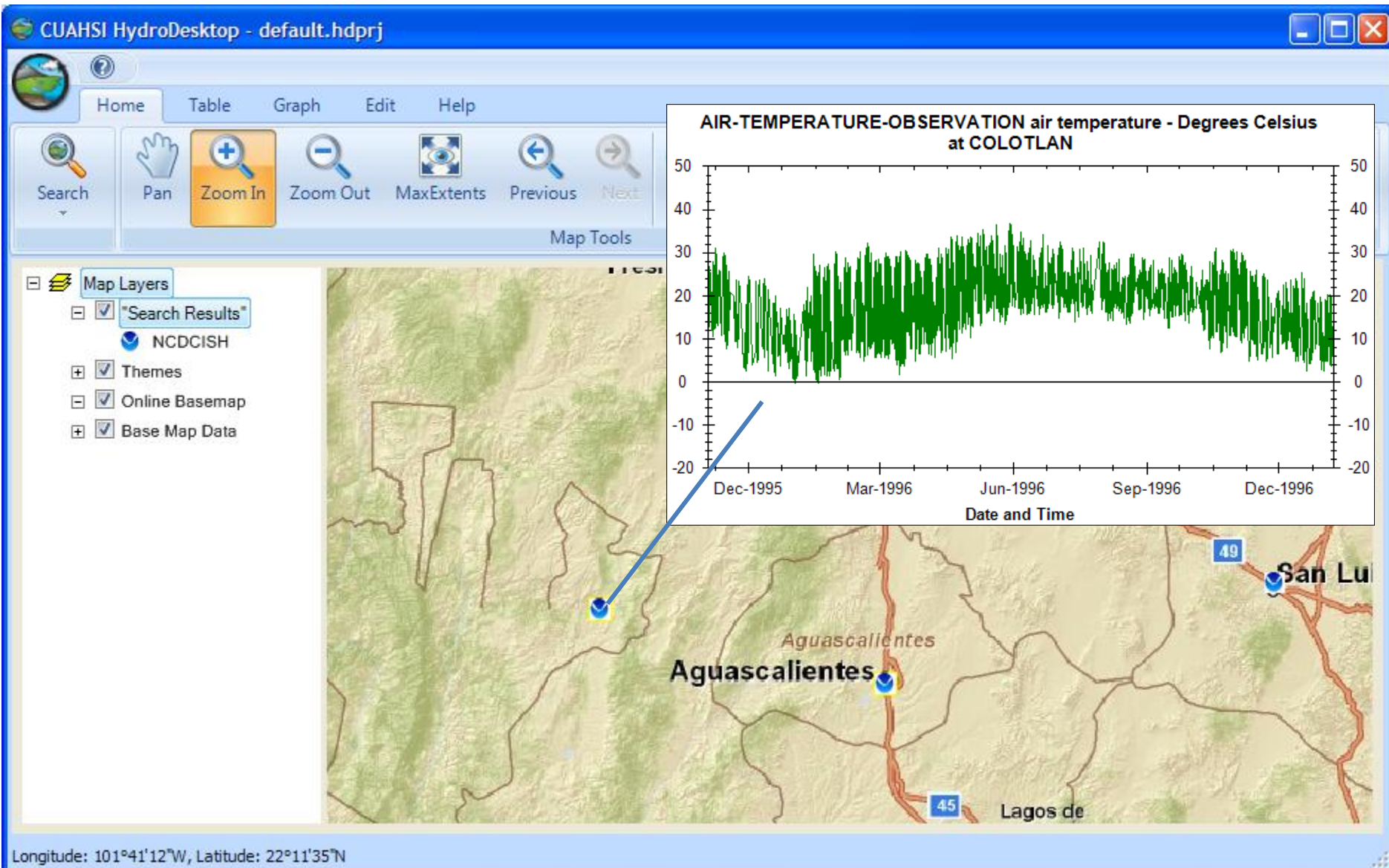
What is CUAHSI
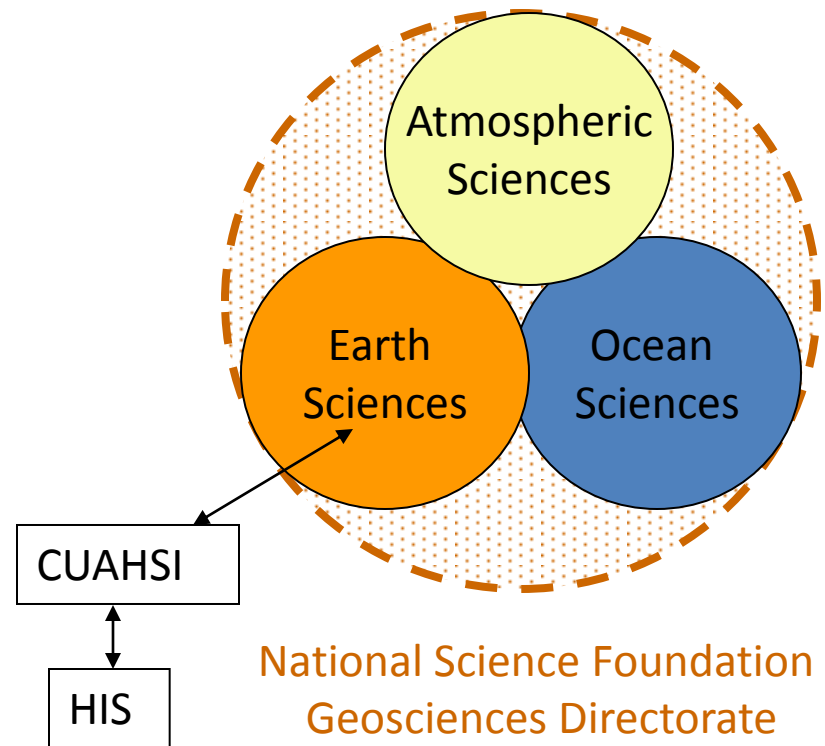
Consortium of **U**niversities
for the **A**dvancement of **H**ydrologic **S**cience, **I**nc

- Formed in **2001**
- Develops **infrastructure and services to advance hydrologic science** in US universities

www.cuahsi.org

Atmospheric Sciences

Earth Sciences

Ocean Sciences

CUAHSI

HIS

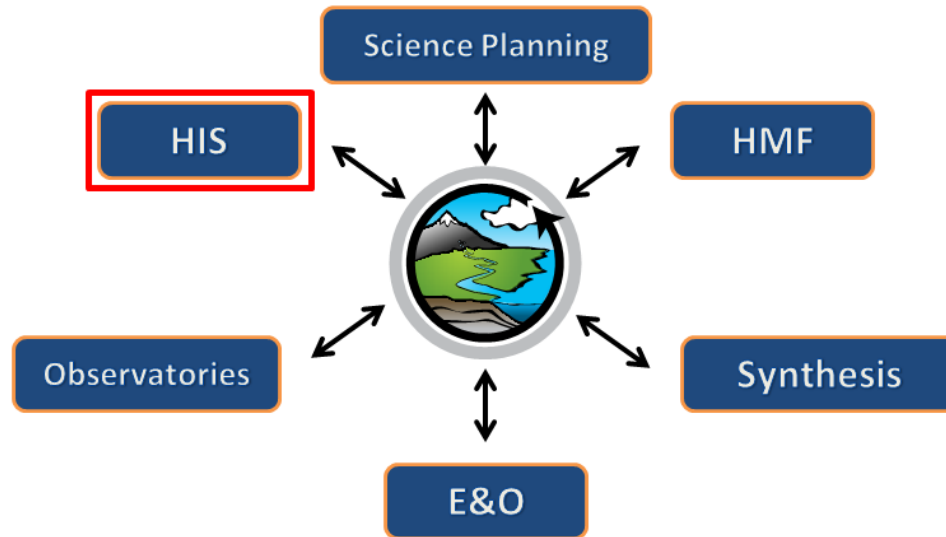National Science Foundation Geosciences Directorate
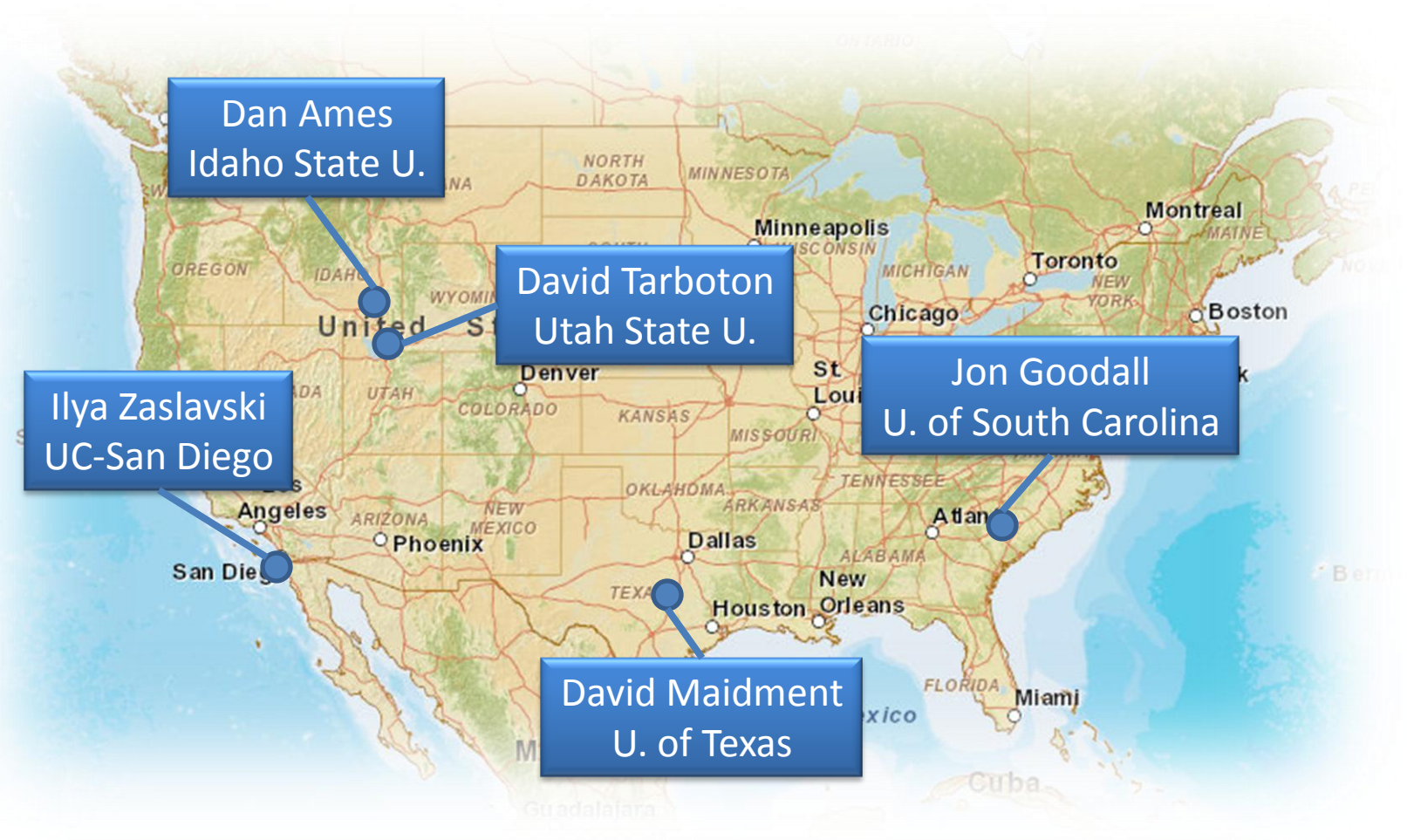
CUAHSI Member Institutions

112 North American universities, and 16 international affiliates
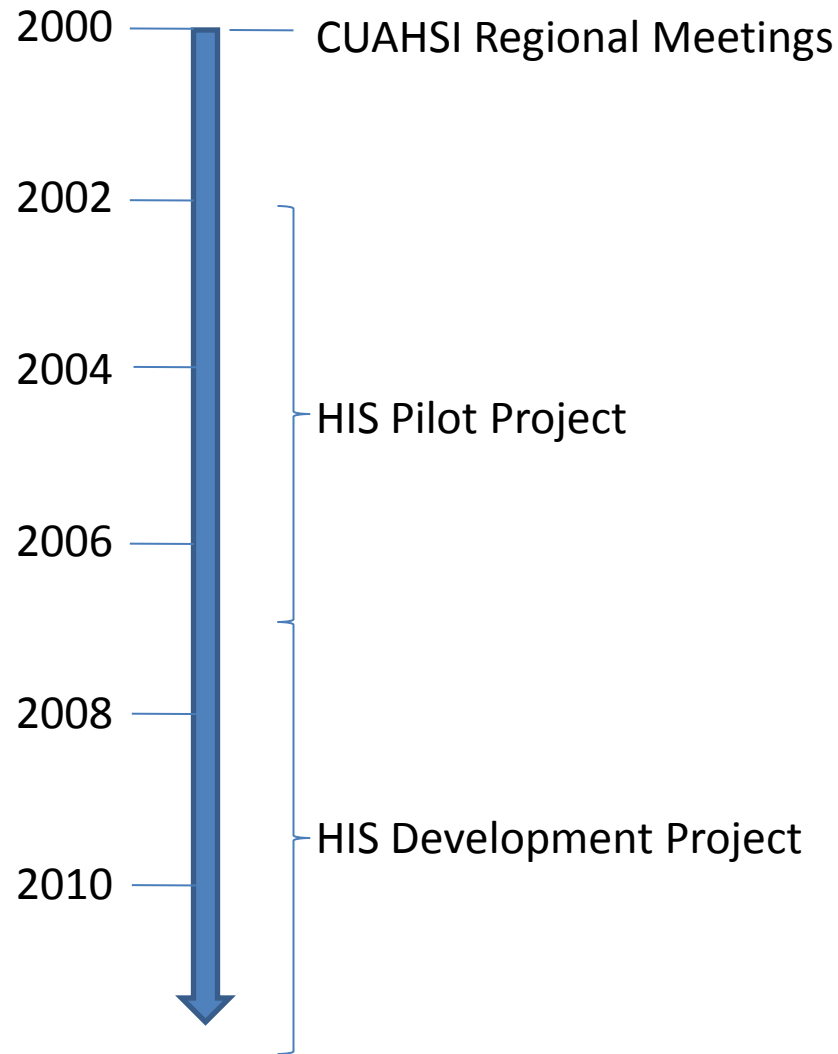
CUAHSI Hydrologic Information Systems Project

David R. Maidment

The University of Texas at Austin

(HIS Project Leader)

HIS Team Principle Investigators
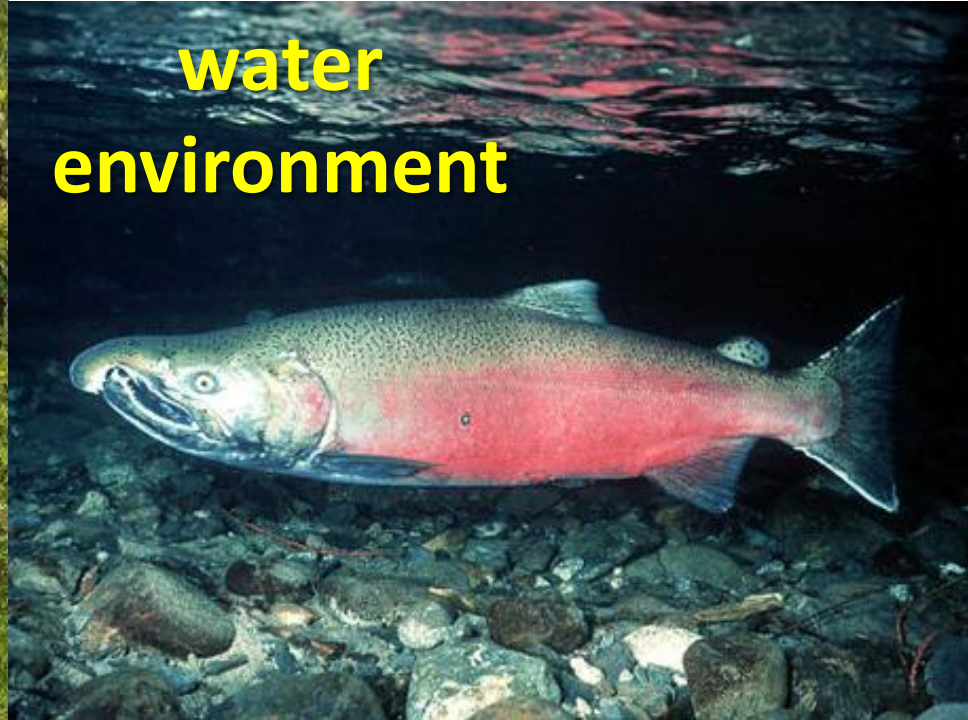
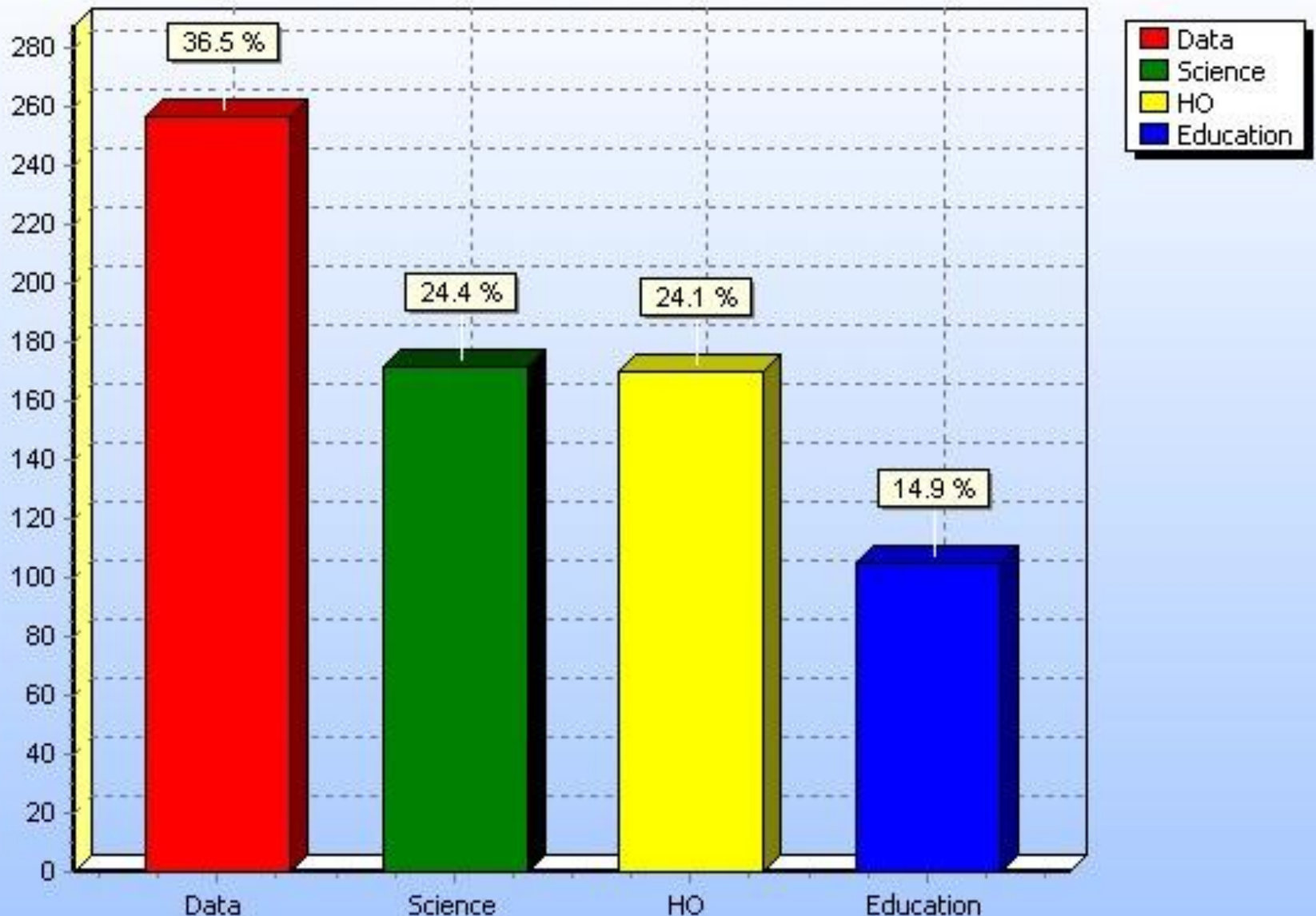# CUAHSI HIS Development

too much water
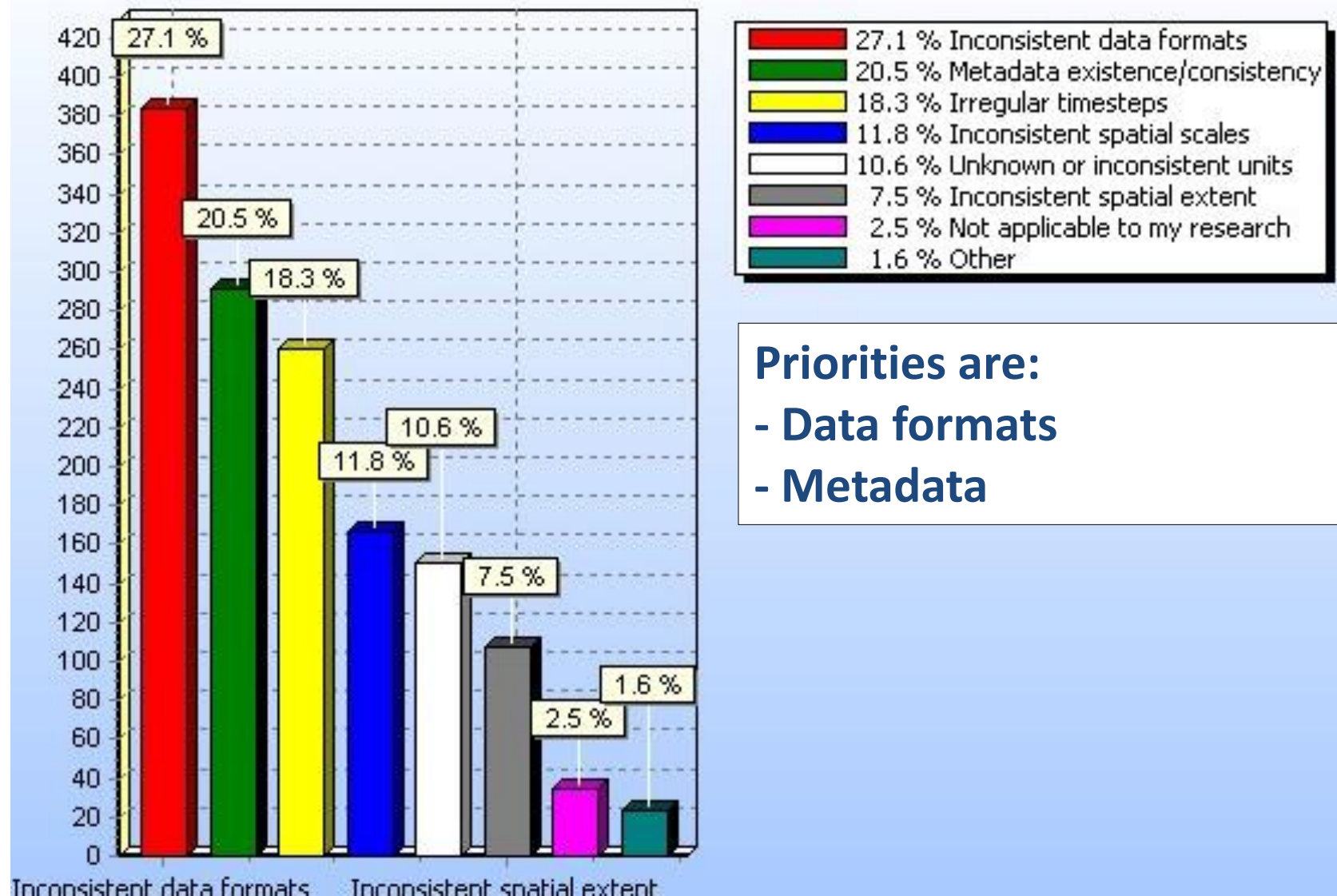
too little water

dirty water

water environment

# Please rank these four HIS service categories for helping you.

Conclusion: Data services are the highest priority

Which of the following data analysis difficulties are most important for HIS to address?

Priorities are:
- **Data formats**
- **Metadata**

CUAHSI Hydrologic Information System

Goal: Enhance hydrologic science by facilitating user access to more and better data for testing hypotheses and analyzing processes
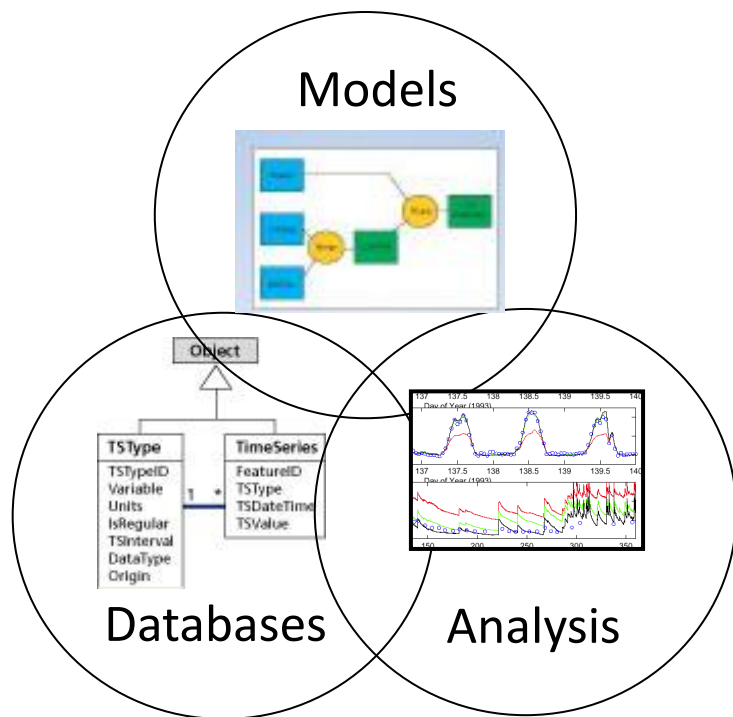
- Advancement of **water science** is critically dependent on integration of **water information**

- It is as important to represent **hydrologic environments** precisely with data as it is to represent **hydrologic processes** with equations
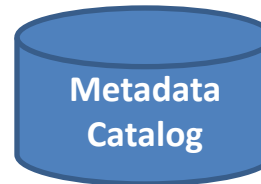
Data Integration

Hydrologic Observations

GIS Data

Digital Watershed

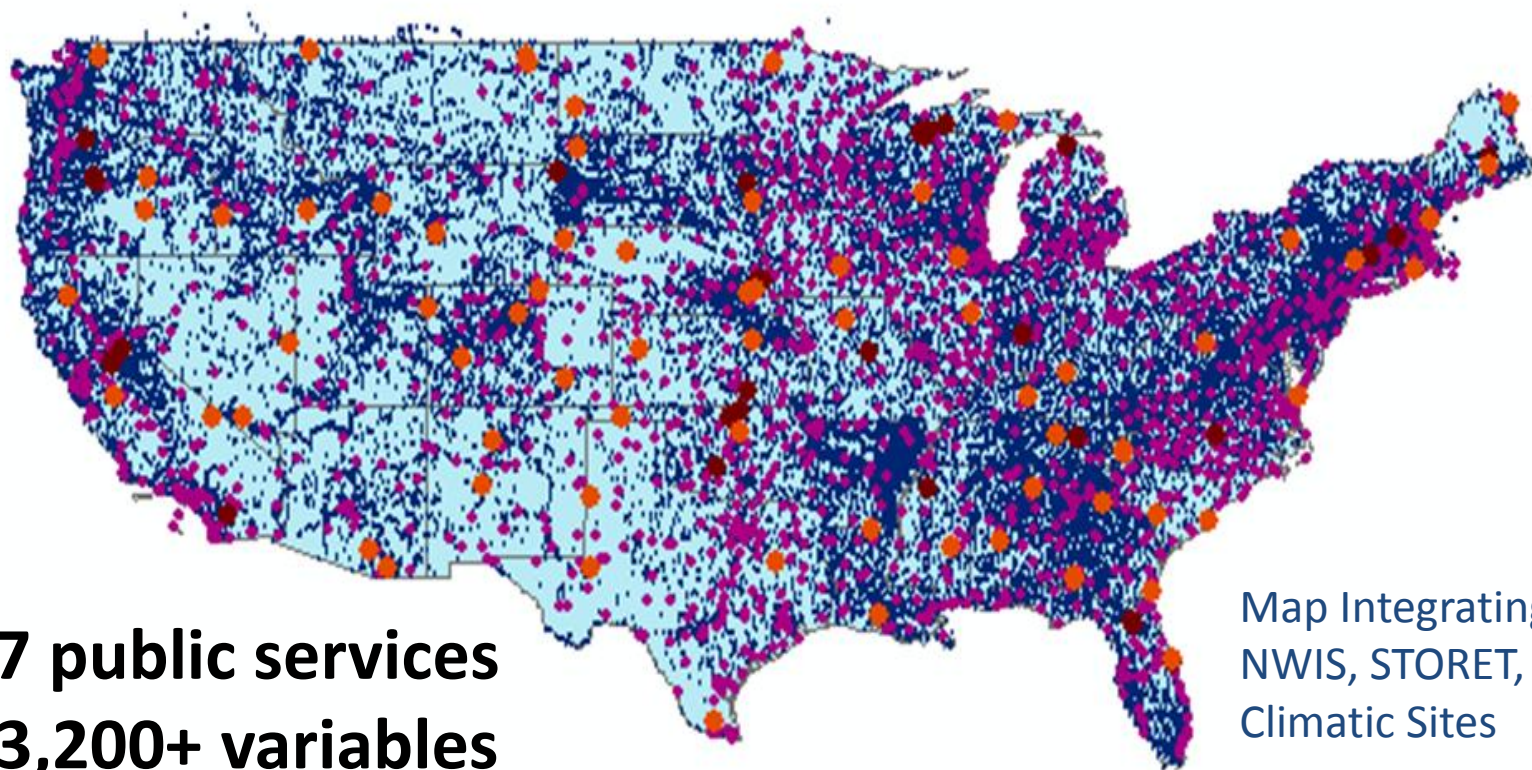Weather and Climate

Remote Sensing
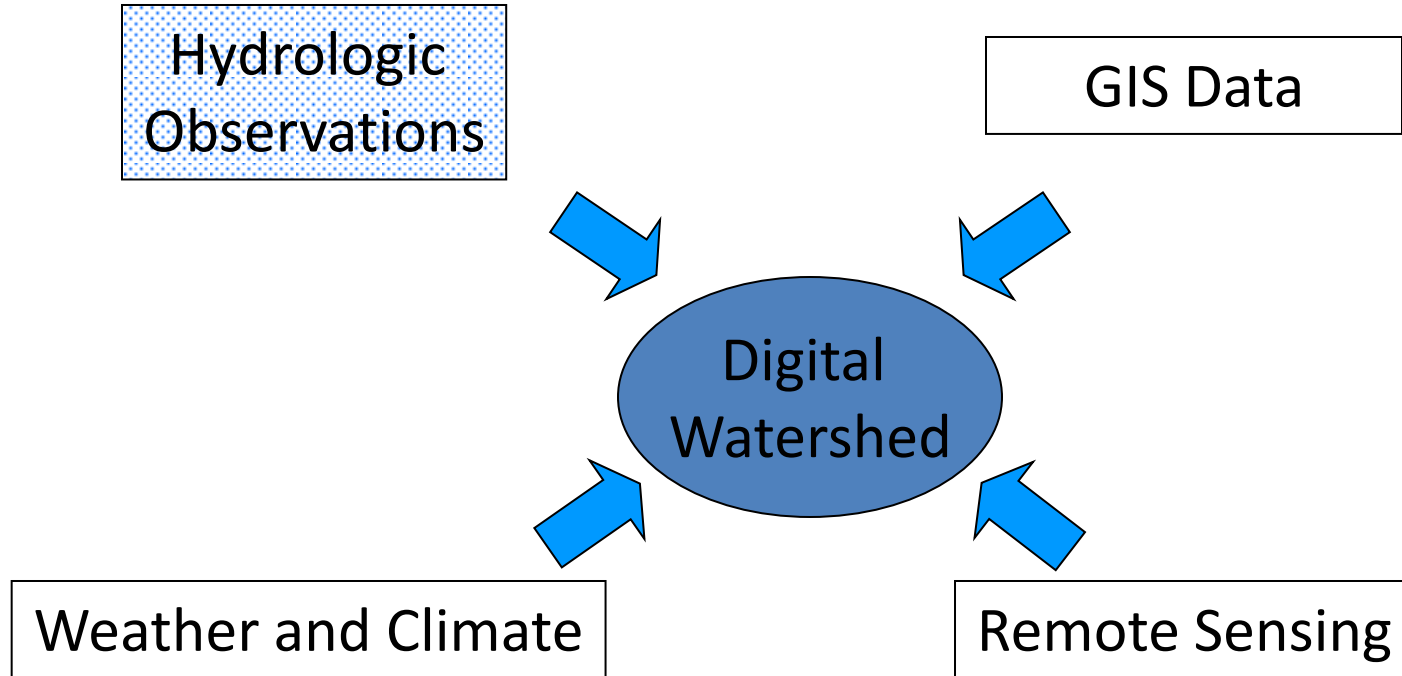
Currently, the focus is on data from monitoring sites at point locations.

The Result

- WaterML language for describing water data

- National catalog of water data sources
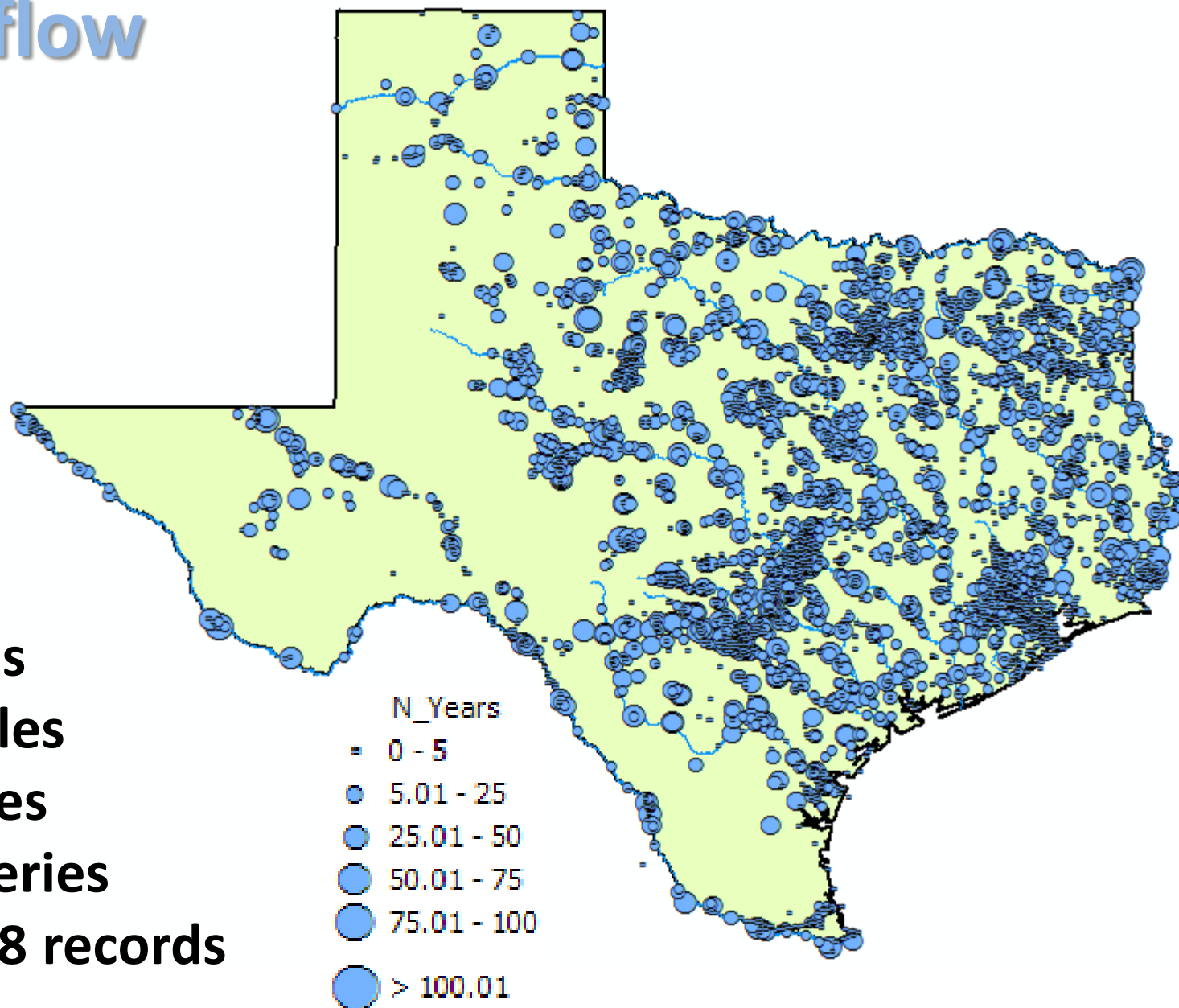
- Free software for data access

WaterML — Standards

Metadata Catalog — Services

Software

CUAHSI Water Data Services, April 2010

47 public services
13,200+ variables
1.8 million sites
22.9 million series
4.7 billion data values

Map Integrating NWIS, STORET, & Climatic Sites

The largest water data catalog in the world

Streamflow

2 services
7 variables
4,363 sites
11,484 series
9,493,968 records

N_Years
- 0 - 5
- 5.01 - 25
- 25.01 - 50
- 50.01 - 75
- 75.01 - 100
- > 100.01

Streamflow
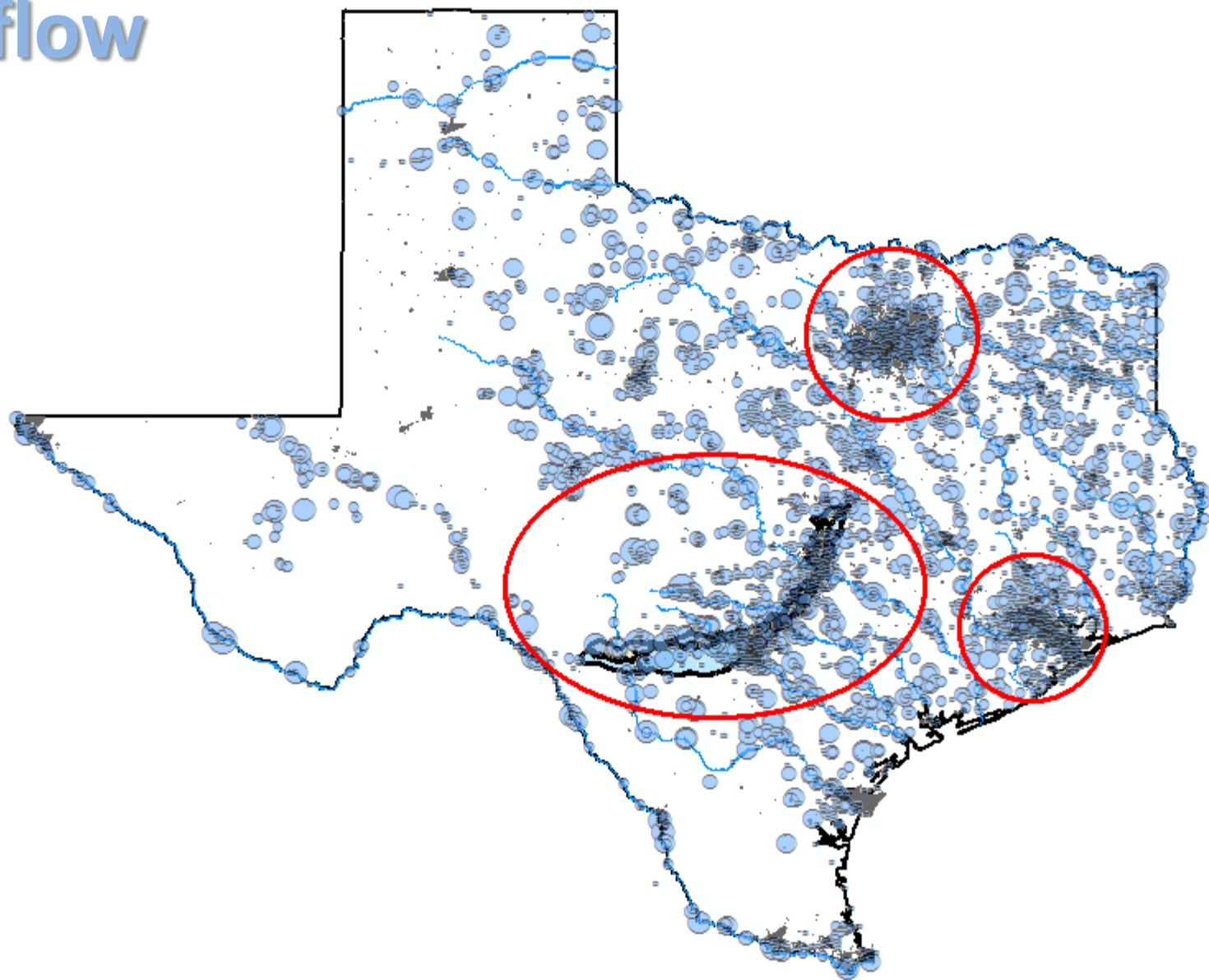
Salinity

5 services
7 variables
6,613 sites
7,912 series
346,813 records

1 - 10
11 - 50
51 - 100
101 - 200
201 - 500
501 - 1000
1001 - 2000
2001 - 5000
5001 - 10,000
10,001 - 20,000
> 20,001
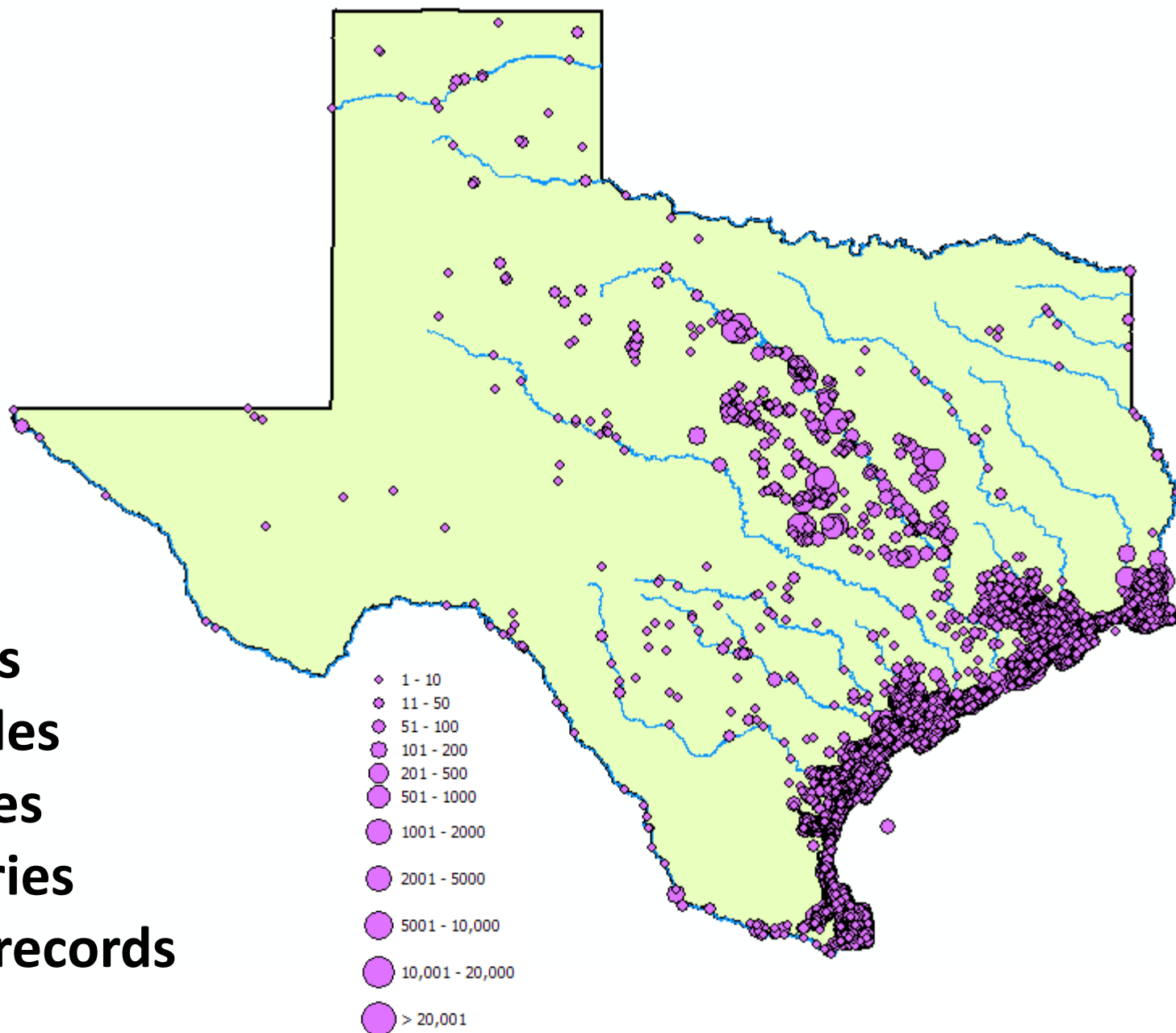
Water Temperature
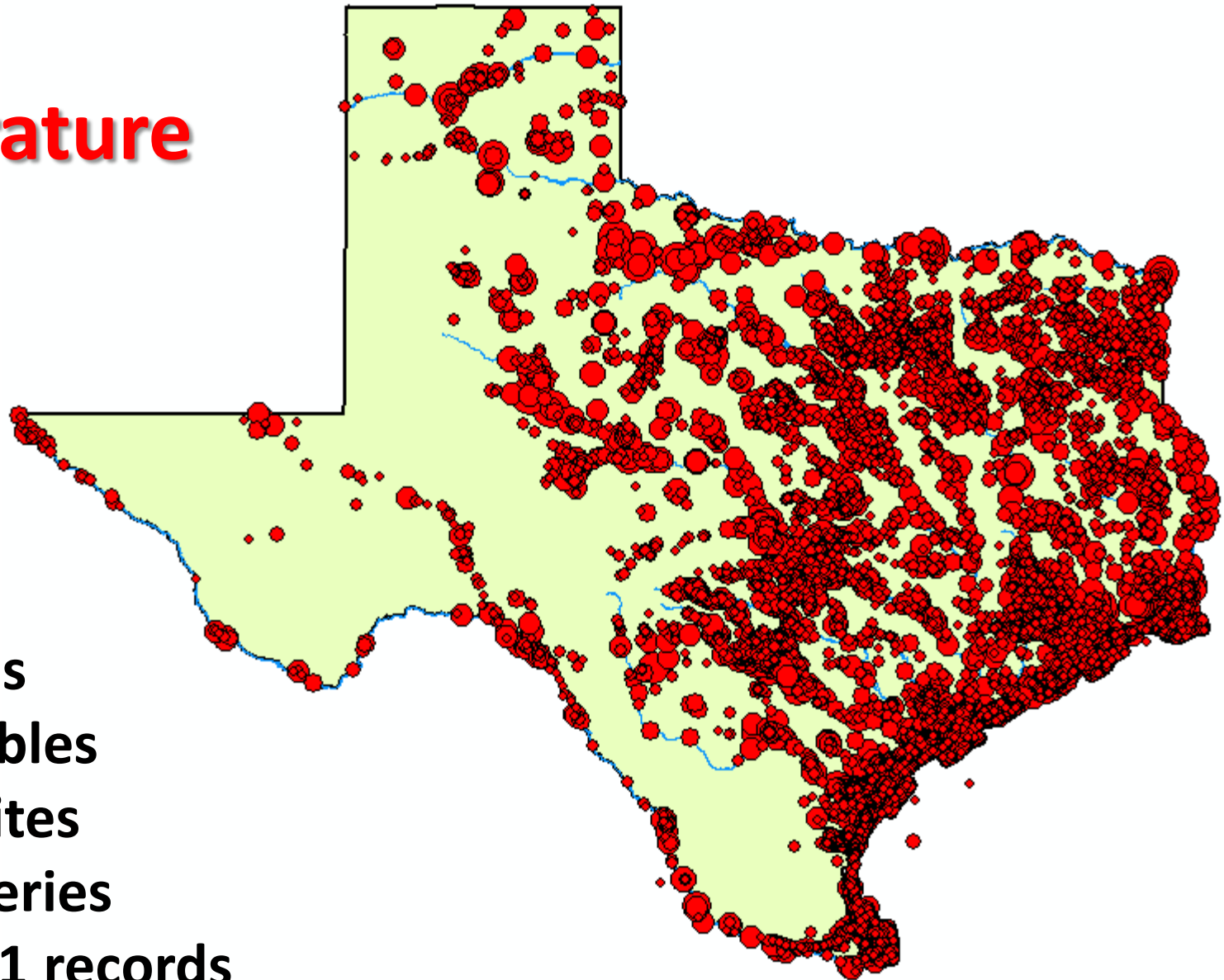
6 services
11 variables
11,158 sites
22,953 series
1,546,841 records

Dissolved Oxygen
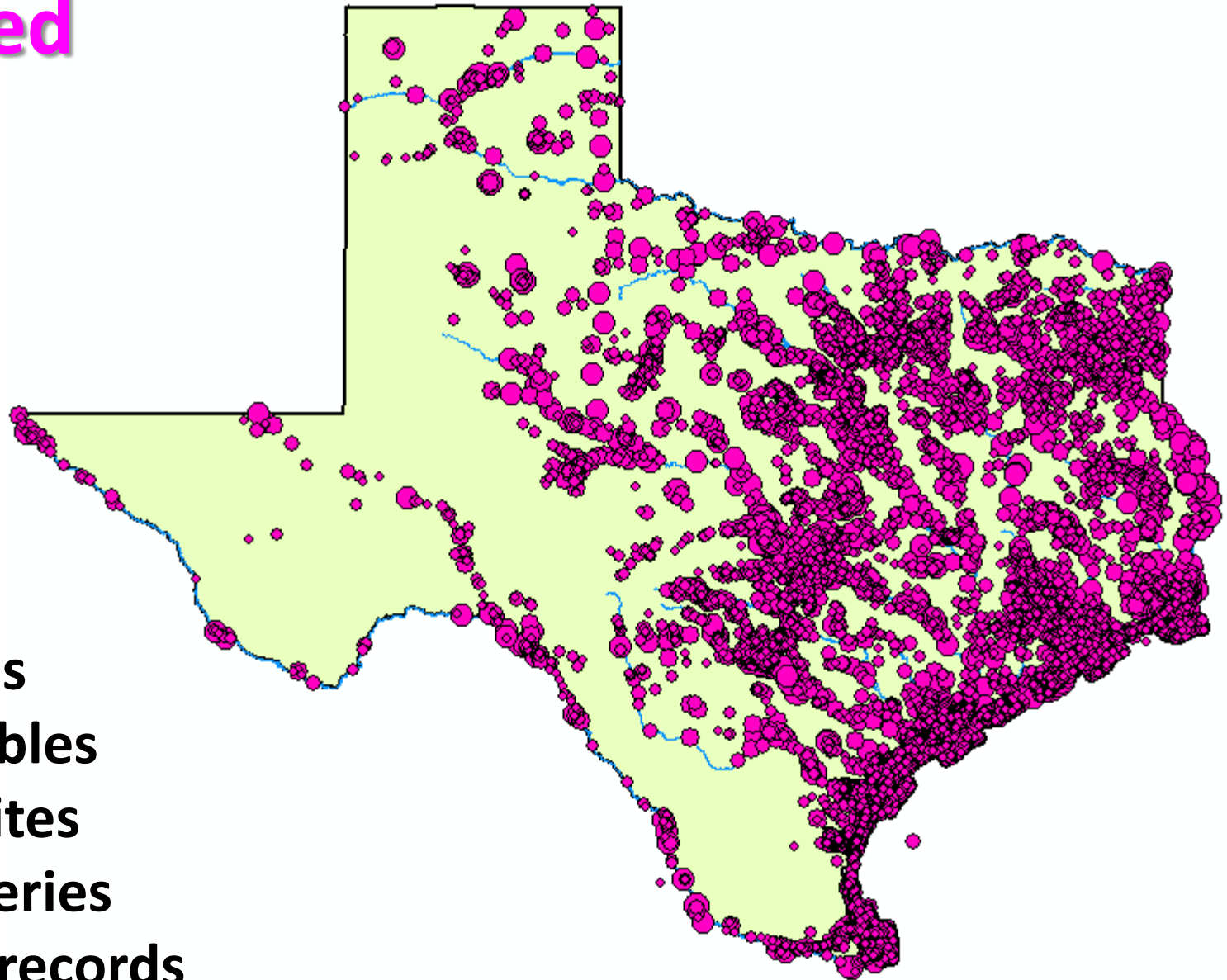
5 services
18 variables
10,823 sites
21,655 series
930,571 records

Bacteria
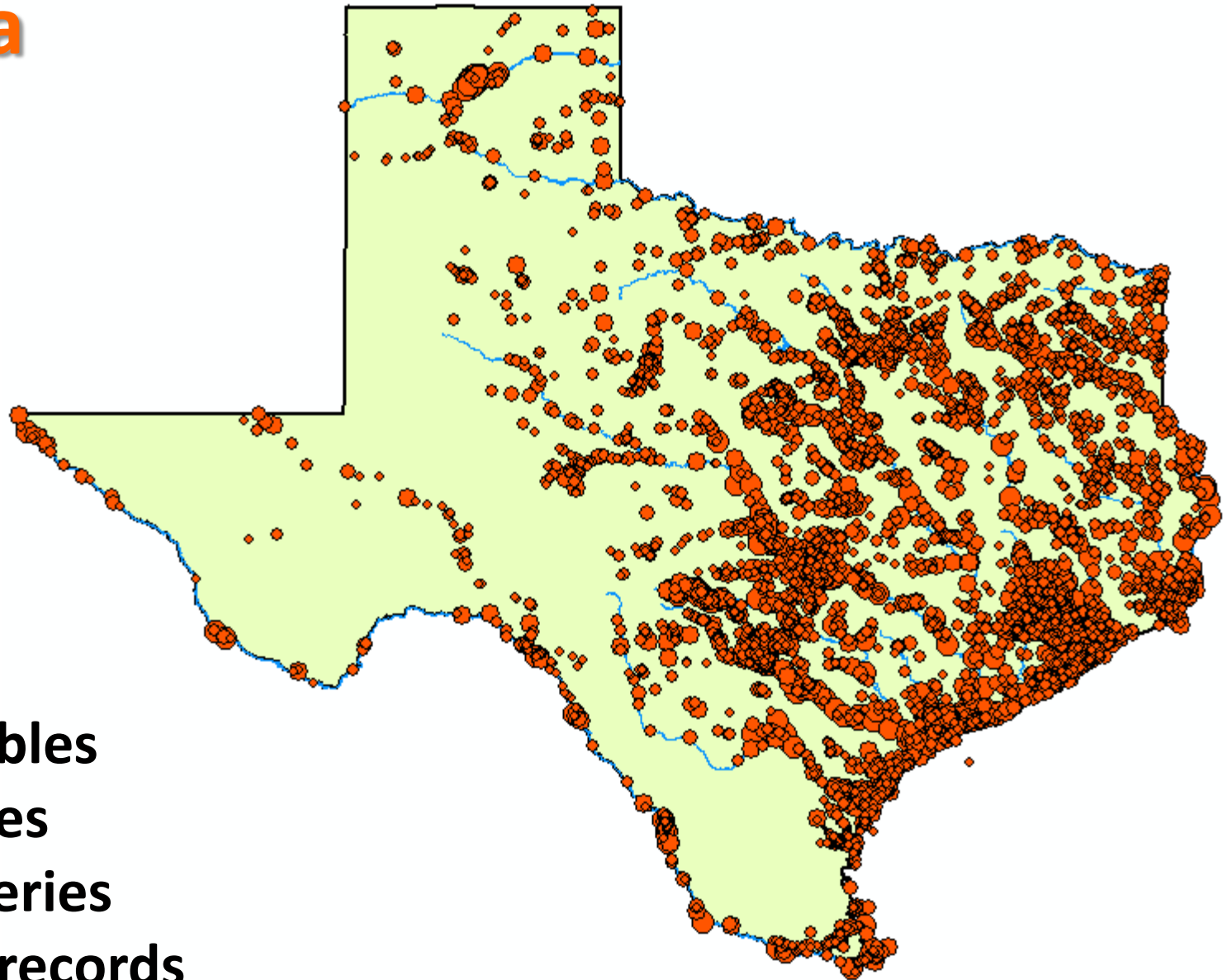
1 service
21 variables
4,801 sites
15,483 series
297,849 records

Nutrients
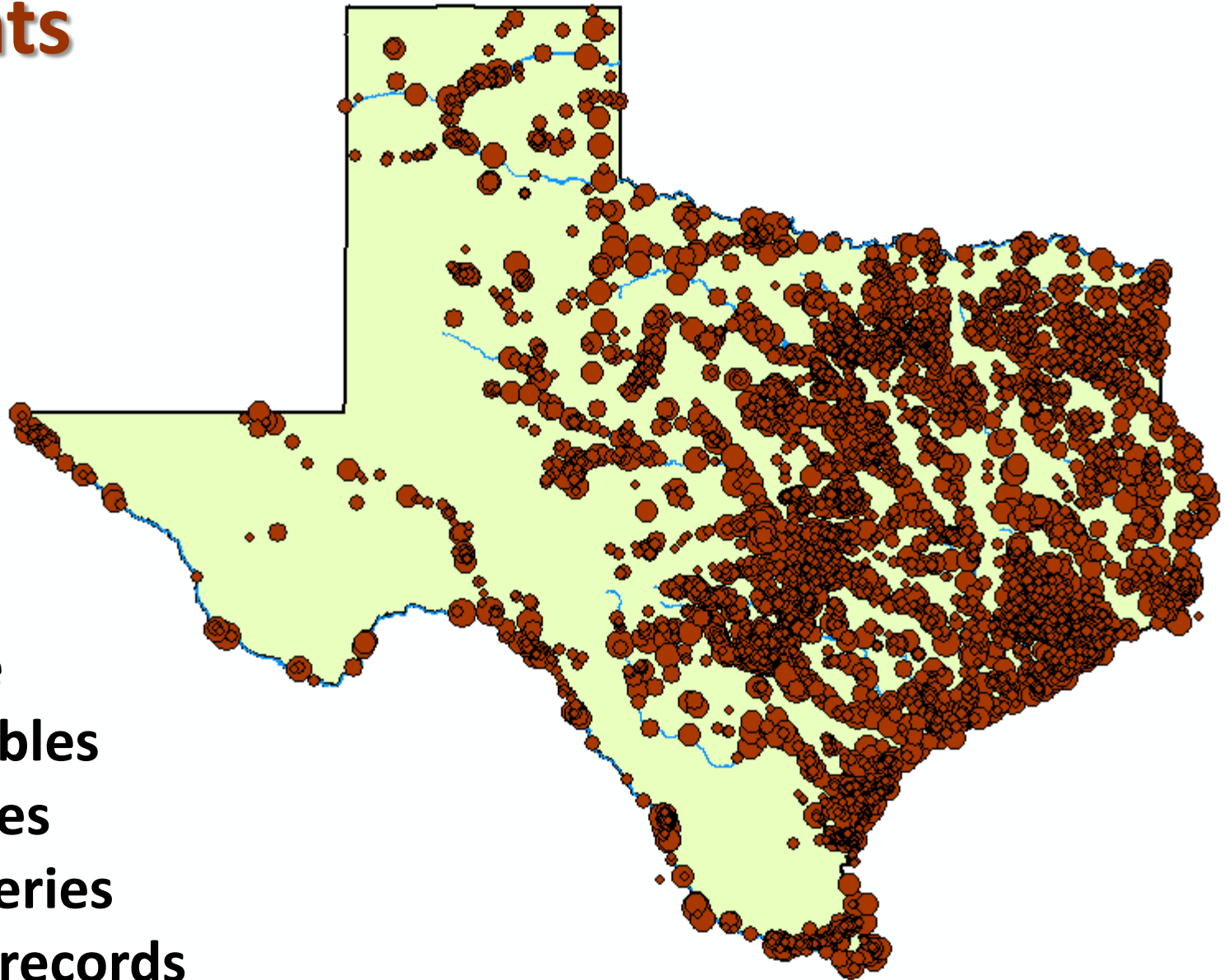
1 service
25 variables
5,635 sites
52,396 series
856,194 records

pH

3 services
7 variables
6,228 sites
16,576 series
785,650 records

For more on the HIS Story
his.cuahsi.org
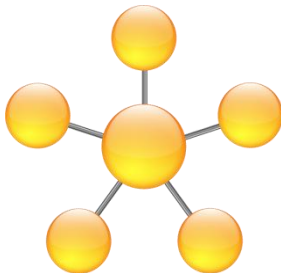
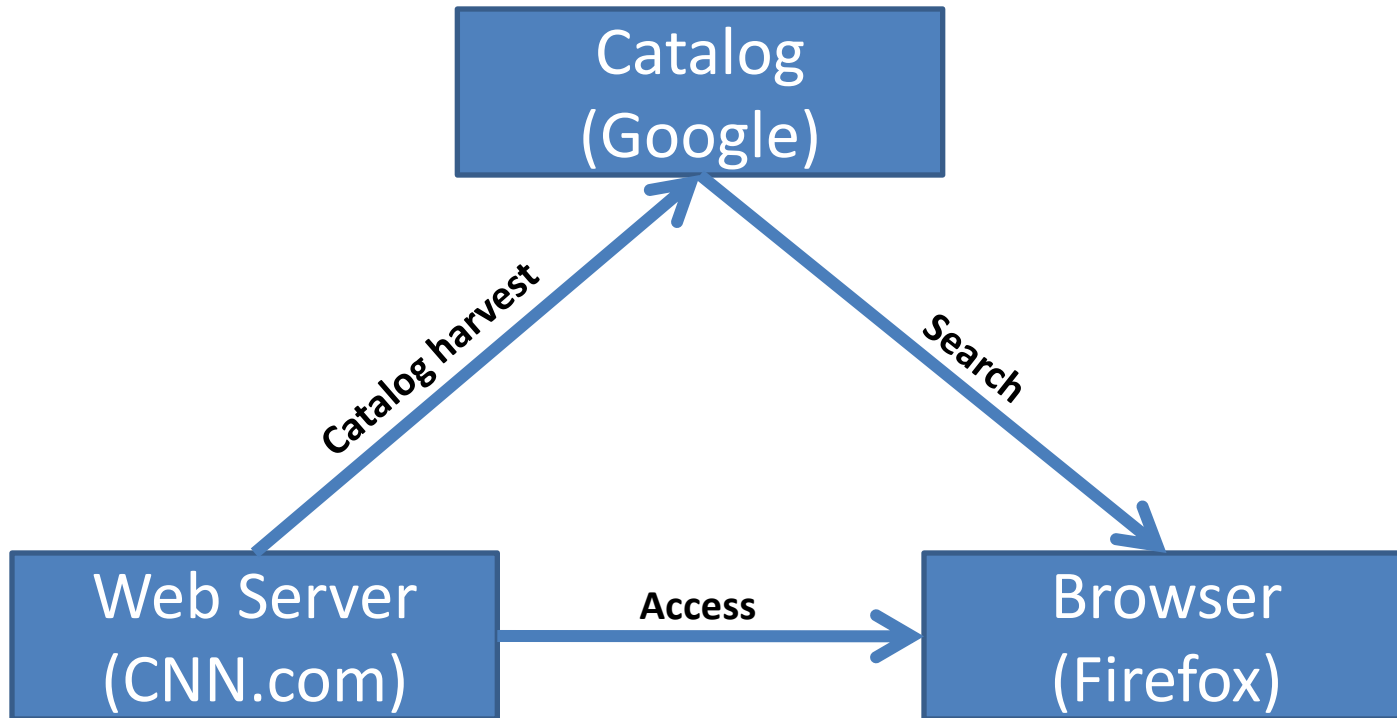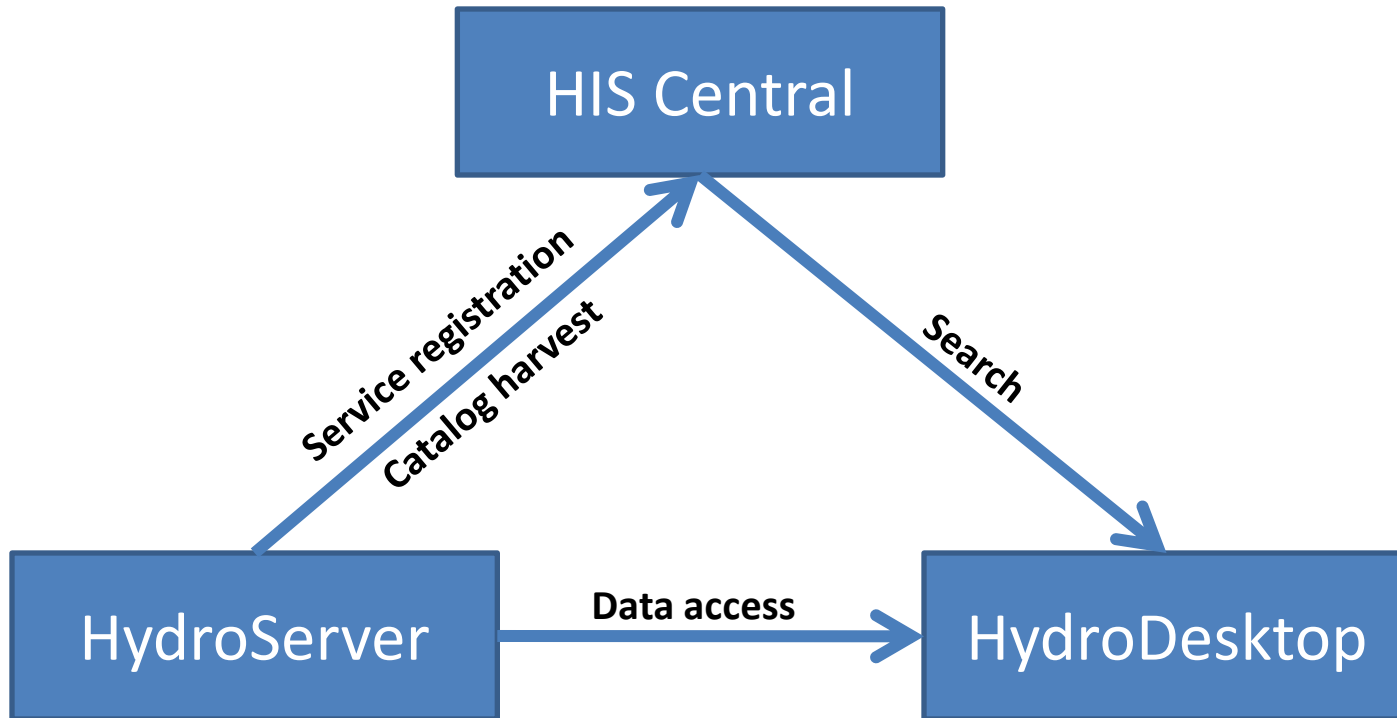# Outline

- The HIS Story

- ***HIS components***
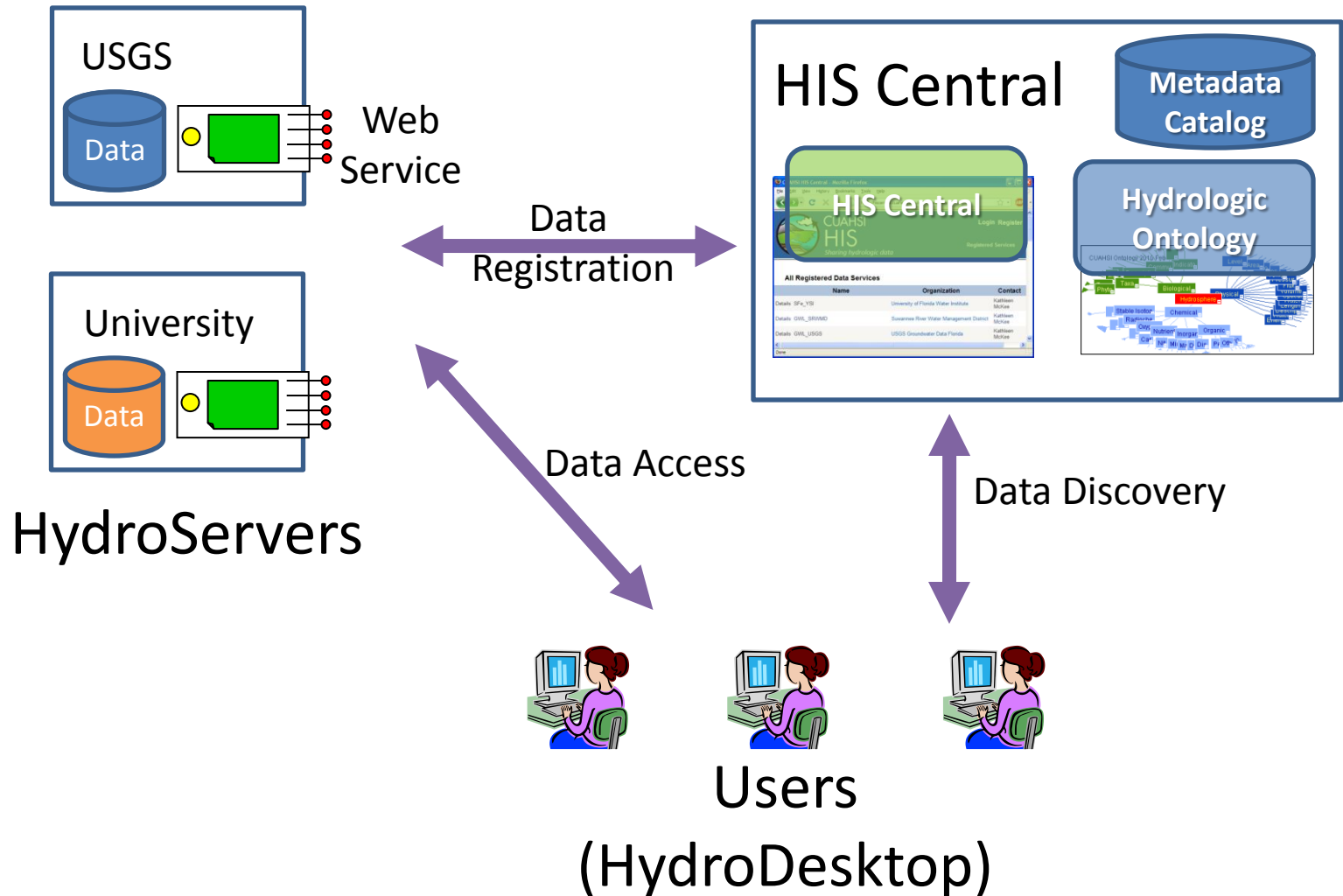
- Putting the pieces together

Web Paradigm

Services-Oriented Architecture for Water Data

HIS System Overview

Water Data

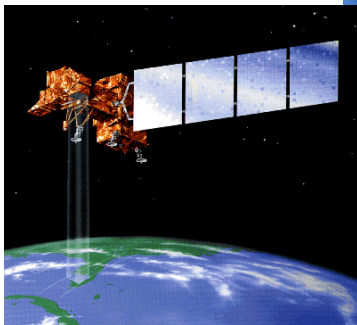Water quantity and quality
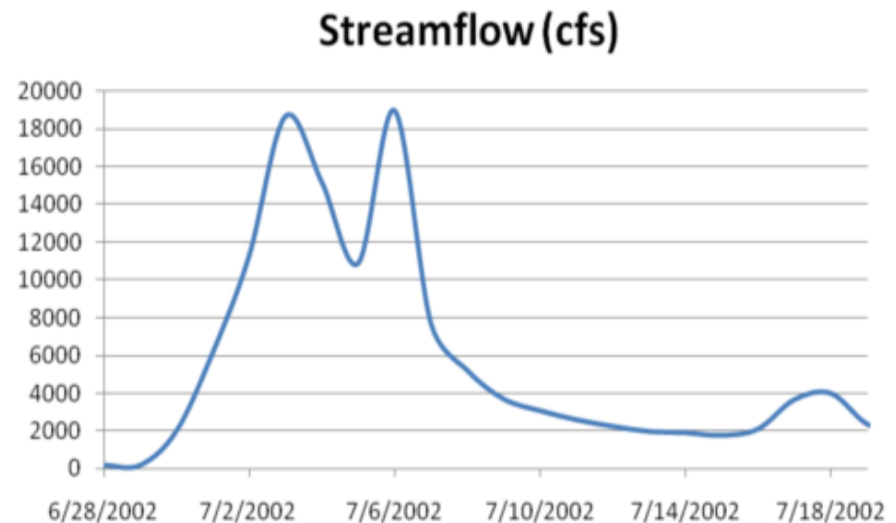
Soil water

Rainfall & Snow

Modeling

Meteorology

Remote sensing
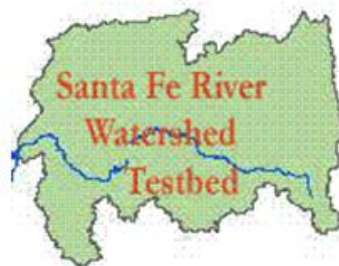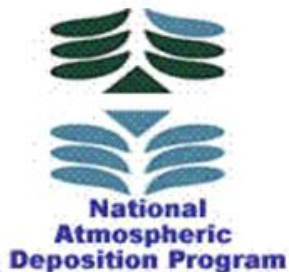
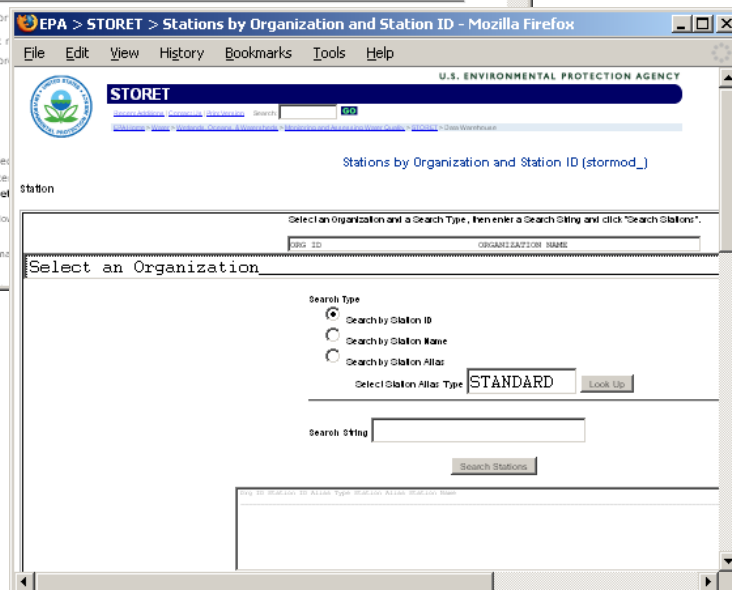# Point Observations Time Series

A **point** location in **space**

Streamflow (cfs)

A **series** of values in **time**

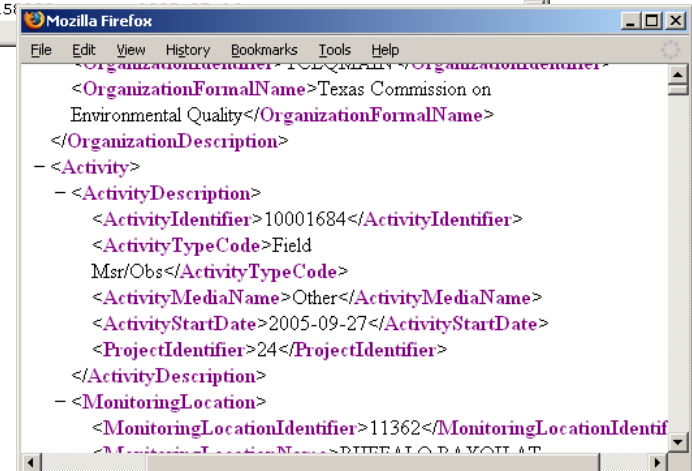# Sources of Observations Data
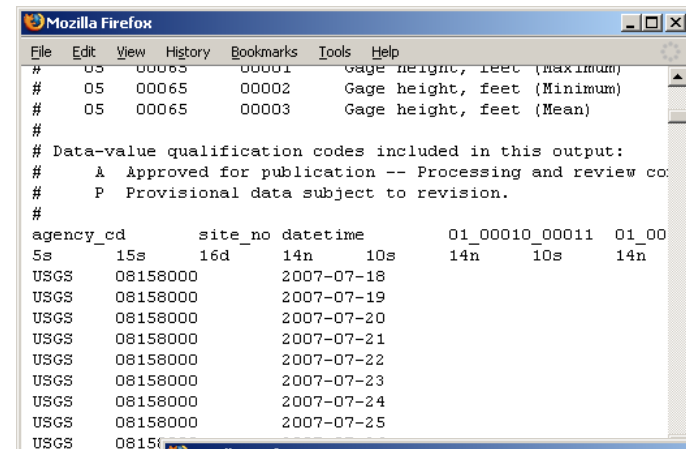
Getting Water Data (the old way)

Different Query Pages

Different Query Responses

Web Pages and Web Services

http://www.safl.umn.edu/

http://his.safl.umn.edu/SAFLMC/cuahsi_1_0.asmx

Uses Hypertext Markup Language (HTML)

WaterOneFlow

Developmental service. This service is internal CUAHSI use, and evaluation.

The following operations are supported. For a formal definition, please review the **Service Description**.

- **GetSiteInfo**
  Given a site number, this method returns the site's metadata. Send the site code in this format: 'NetworkName:SiteCode'

- **GetSiteInfoObject**
  Given a site number, this method returns the site's metadata. Send the site code in this format: 'NetworkName:SiteCode'

- **GetSites**
  Given an array of site numbers, this method returns the site metadata for each one. Send the array of site codes in this format: 'NetworkName:SiteCode'

- **GetSitesXml**
  Given an array of site numbers, this method returns the site metadata for each one. Send the array of site codes in this format: 'NetworkName:SiteCode'

- **GetValues**
  Given a site number, a variable, a start date, and an end date, this method returns a time series. Pass in the sitecode and variable in this format: 'NetworkName:SiteCode' and 'NetworkName:Variable'

- **GetValuesObject**
  Given a site number, a variable, a start date, and an end date, this method returns a time series. Pass in the sitecode and variable in this format: 'NetworkName:SiteCode' and 'NetworkName:Variable'

- **GetVariableInfo**
  Given a variable code, this method returns the variable's name. Pass in the variable in this format: 'NetworkName:Variable'

- **GetVariableInfoObject**
  Given a variable code, this method returns the variable's siteName. Pass in the variable in this format: 'NetworkName:Variable'

Uses WaterML
(a Markup Language for water data)

HTML as a Web Language

Hyper**T**ext
Markup **L**anguage

Text and Pictures
in Web Browser

<title>Texas Water Development Board</title>
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN">
<html>
 <head>
  <meta name = "Robots" content = "index,follow">
  <meta name = "Priority" content = "home,twdb,homepage">
  <meta name = "Author" content = "Texas Water Development Board, Agency Number 580">
  <meta name = "Title" content = "Texas Water Development Board">
  <meta name = "Description" content = "Texas Water Development Board Home Page">
  <meta name = "Keywords" content = "water,drought,rain,conservation,groundwater,surfacewater,lake,reservoir,hydrology,geology,desalination,TWDB,loans,grants,wastewater,sewage,Clean Water,Drinking Water,State Revolving Fund,planning,State Water Plan,GIS,Geographic Information Systems,Mapping,data">

WaterML as a Web Language

Streamflow data in WaterML language

Discharge of the San Marcos River at Luling, June 28 - July 18, 2002

```
- <values count="21">
    <value qualifiers="A" dateTime="2002-06-28T00:00:00">203</value>
    <value qualifiers="A" dateTime="2002-06-29T00:00:00">195</value>
    <value qualifiers="A" dateTime="2002-06-30T00:00:00">2010</value>
    <value qualifiers="A" dateTime="2002-07-01T00:00:00">6170</value>
    <value qualifiers="A" dateTime="2002-07-02T00:00:00">11300</value>
    <value qualifiers="A" dateTime="2002-07-03T00:00:00">18700</value>
    <value qualifiers="A" dateTime="2002-07-04T00:00:00">15200</value>
    <value qualifiers="A" dateTime="2002-07-05T00:00:00">10900</value>
    <value qualifiers="A" dateTime="2002-07-06T00:00:00">19000</value>
    <value qualifiers="A" dateTime="2002-07-07T00:00:00">7720</value>
    <value qualifiers="A" dateTime="2002-07-08T00:00:00">5230</value>
    <value qualifiers="A" dateTime="2002-07-09T00:00:00">3710</value>
    <value qualifiers="A" dateTime="2002-07-10T00:00:00">3090</value>
    <value qualifiers="A" dateTime="2002-07-11T00:00:00">2610</value>
    <value qualifiers="A" dateTime="2002-07-12T00:00:00">2260</value>
    <value qualifiers="A" dateTime="2002-07-13T00:00:00">1990</value>
    <value qualifiers="A" dateTime="2002-07-14T00:00:00">1920</value>
    <value qualifiers="A" dateTime="2002-07-15T00:00:00">1780</value>
    <value qualifiers="A" dateTime="2002-07-16T00:00:00">2120</value>
    <value qualifiers="A" dateTime="2002-07-17T00:00:00">3680</value>
    <value qualifiers="A" dateTime="2002-07-18T00:00:00">4010</value>
    <qualifier qualifierCode="A" network="USGS" vocabulary="dv_rmk_cd">Approved for publication -- Processing and review completed.</qualifier>
</values>
```
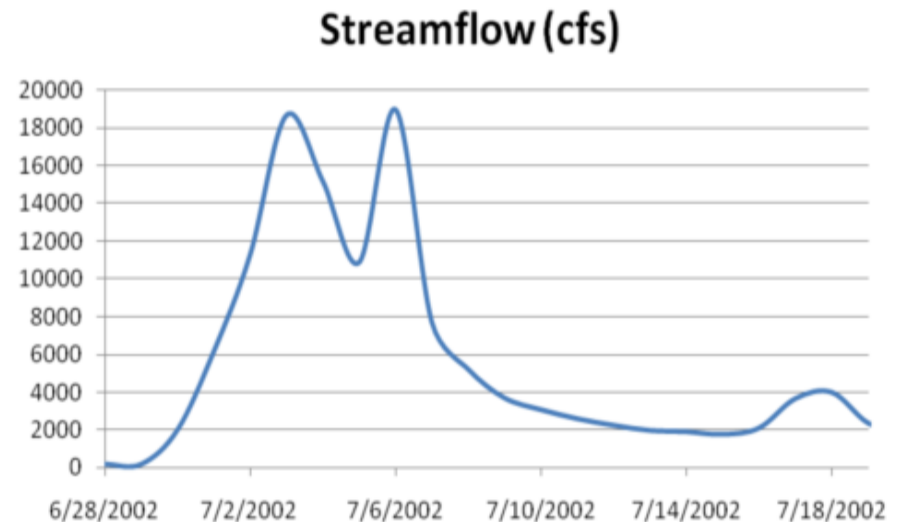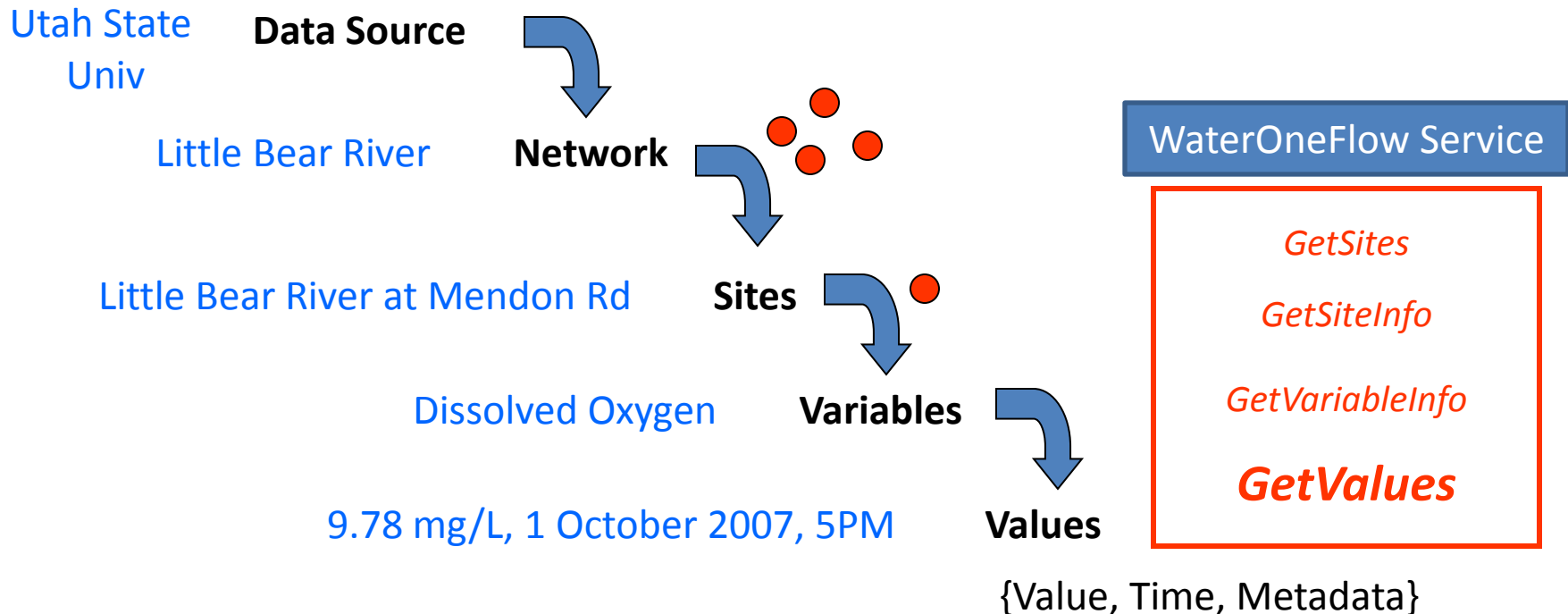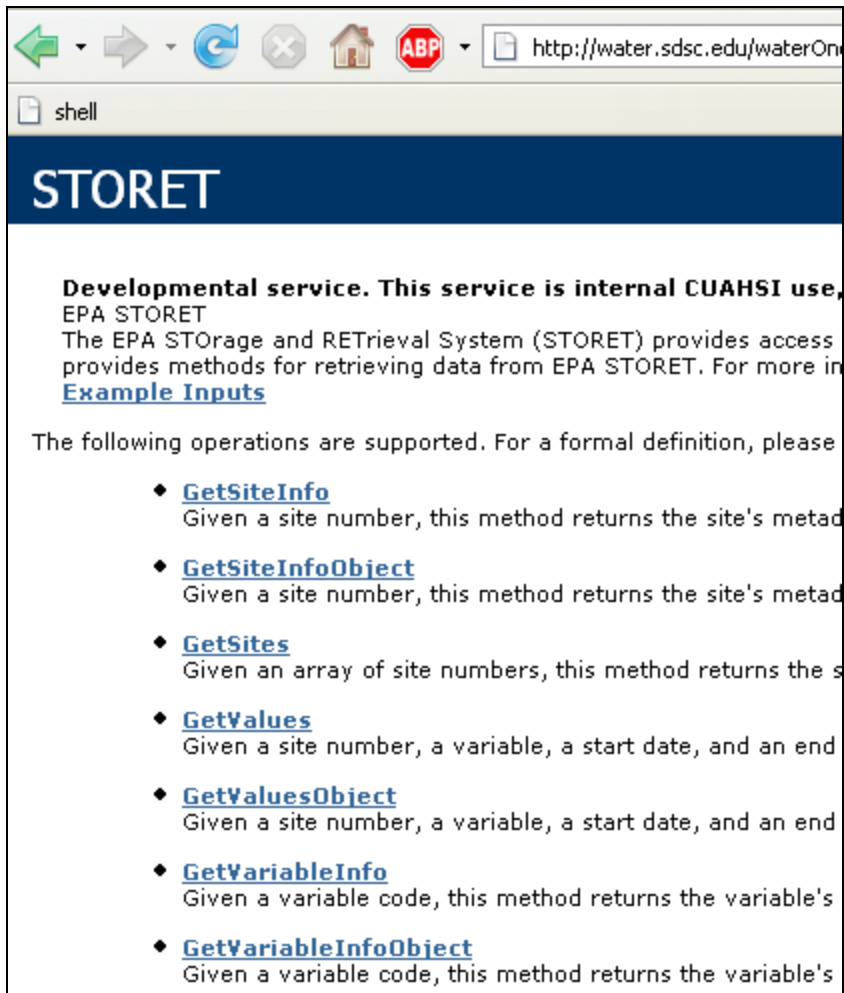
Streamflow (cfs)

WaterML includes location, variables, and time series


```
<timeSeriesResponse xmlns:gml="http://www.opengis.net/gml" xmlns:xlink="http://www.w3.org/1999/xlink"
                    xmlns:xsd="http://www.w3.org/2001/XMLSchema"
                    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                    xmlns:wtr="http://www.cuahsi.org/waterML/"
                    xmlns="http://www.cuahsi.org/waterML/1.0/">
  <queryInfo>...</queryInfo>
  <timeSeries>
    <sourceInfo xsi:type="SiteInfoType">
      <siteName>Colorado Rv at Austin, TX</siteName>
      <siteCode siteID="1389">08158000</siteCode>
      <timeZoneInfo>...</timeZoneInfo>
      <geoLocation>...</geoLocation>
      <note>Agency:USGS</note>
    </sourceInfo>
    <variable>
      <variableCode vocabulary="USGS">00060</variableCode>
      <variableName>Discharge</variableName>
      <dataType>Average</dataType>
      <units>cfs</units>
      <options>...</options>
    </variable>
    <values>
      <value qualifiers="A" dateTime="2007-01-01T00:00:00">143</value>
      <value qualifiers="A" dateTime="2007-01-02T00:00:00">231</value>
      <value qualifiers="A" dateTime="2007-01-03T00:00:00">112</value>
      <value qualifiers="A" dateTime="2007-01-04T00:00:00">398</value>
      <value qualifiers="A" dateTime="2007-01-05T00:00:00">182</value>
      <value qualifiers="A" dateTime="2007-01-06T00:00:00">212</value>
      <value qualifiers="A" dateTime="2007-01-07T00:00:00">120</value>
      <value qualifiers="A" dateTime="2007-01-08T00:00:00">131</value>
      <value qualifiers="A" dateTime="2007-01-09T00:00:00">132</value>
      <value qualifiers="A" dateTime="2007-01-10T00:00:00">133</value>
      <qualifier qualifierCode="A" network="USGS" vocabulary="dv_rmk_cd">
        Approved for publication -- Processing and review completed.'</qualifier>
    </values>
  </timeSeries>
</timeSeriesResponse>
```
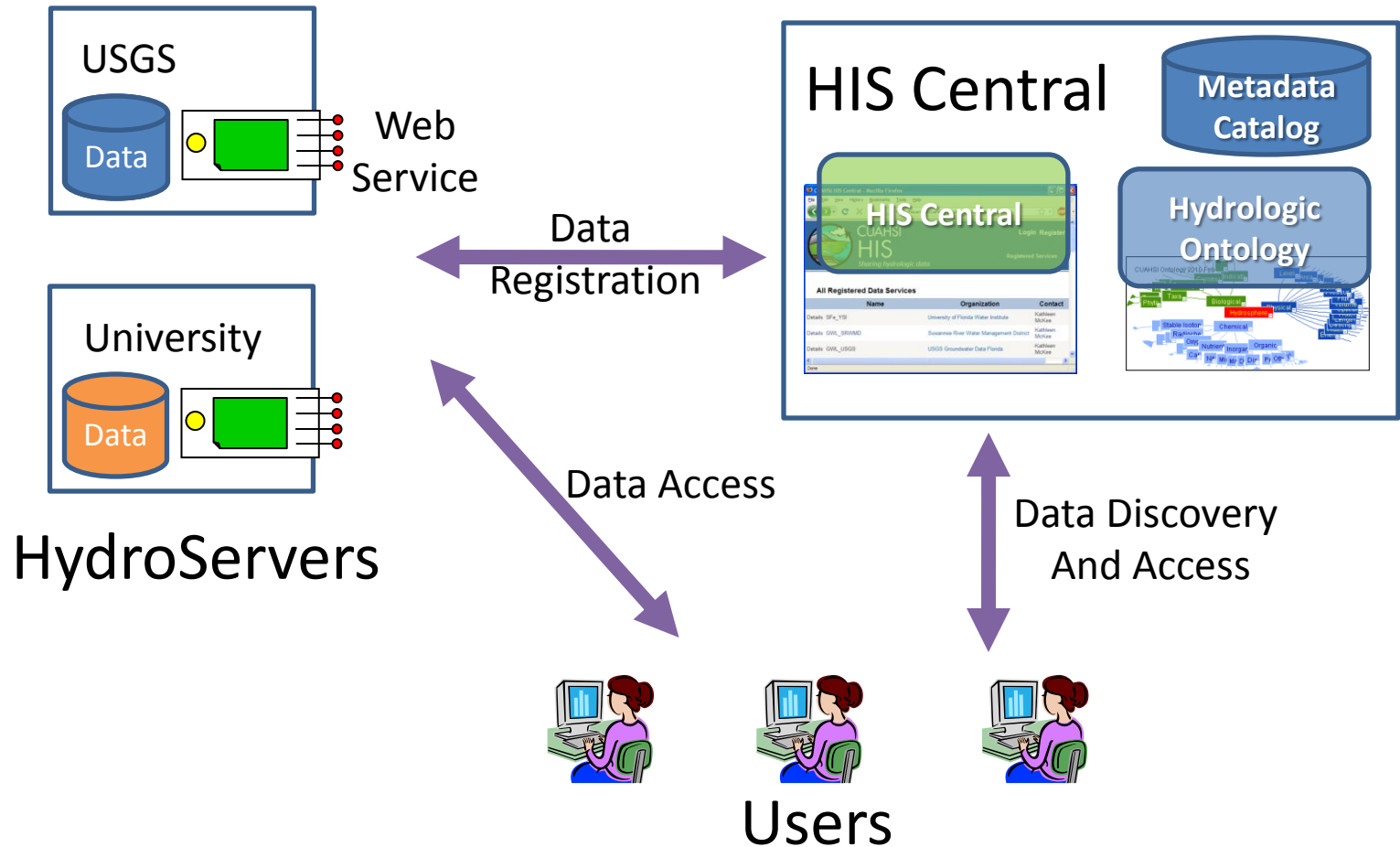
location

variable

time series
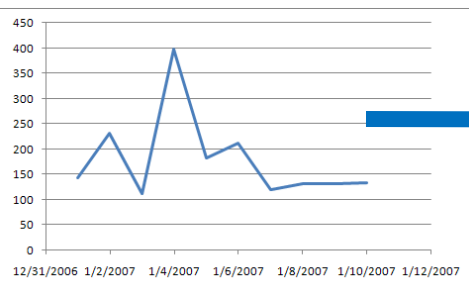
Point Observations Information Model

Utah State Univ

Data Source

Little Bear River

Network

Little Bear River at Mendon Rd

Sites

Dissolved Oxygen

Variables

9.78 mg/L, 1 October 2007, 5PM

Values

WaterOneFlow Service

GetSites

GetSiteInfo

GetVariableInfo

GetValues

{Value, Time, Metadata}

- A **data source** operates an observation network
- A **network** is a set of observation sites
- A **site** is a point location where one or more variables are measured
- A **variable** is a property describing the flow or quality of water
- A **value** is an observation of a variable at a particular time
- **Metadata** provide additional information about the value

WaterOneFlow

- ## Set of **query** functions

- ## Returns data in **WaterML**

WaterML and WaterOneFlow

WaterML is an XML language for communicating water data
WaterOneFlow is a set of web services based on WaterML

HIS System – HydroServer

HydroServer Goals

- A platform for publishing space-time hydrologic datasets that:
  - Provides local control of data
  - Makes data universally available
  - Is open source (hydroserver.codeplex.com)

Point Observations Data

Ongoing Data Collection

Historical Data Files

ODM Database

Internet Applications

Data presentation, visualization, and analysis through Internet enabled applications
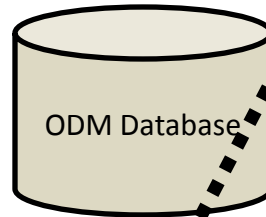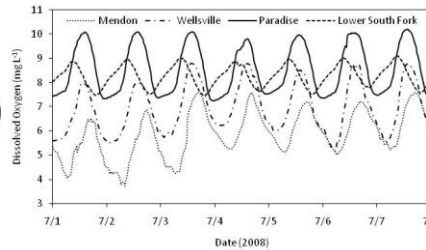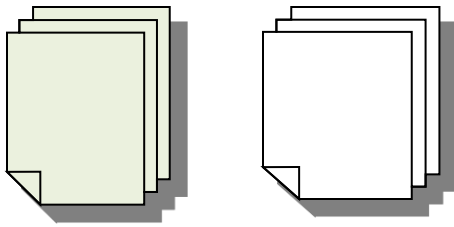
GIS Data
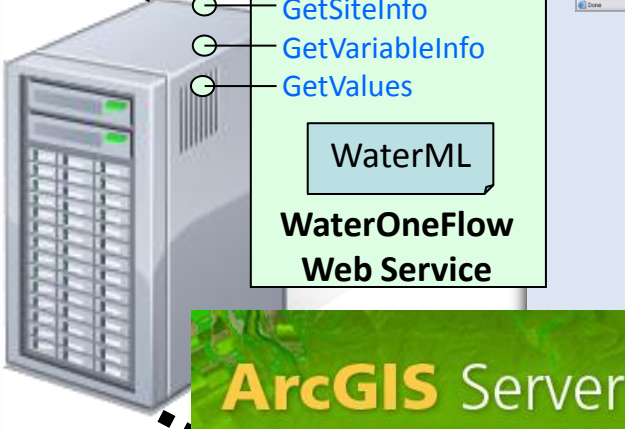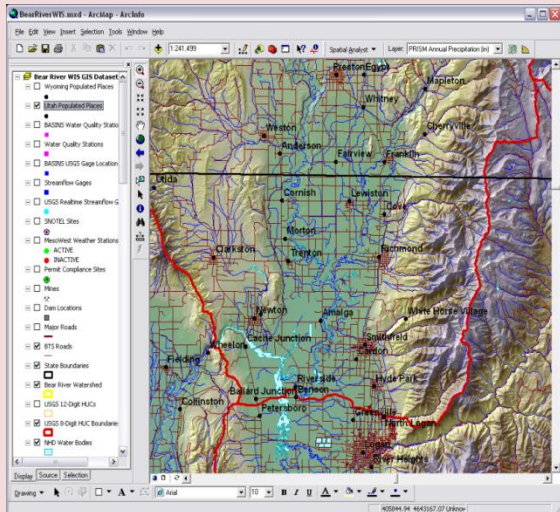
GetSites
GetSiteInfo
GetVariableInfo
GetValues

WaterML

WaterOneFlow Web Service

ArcGIS Server

HydroServer

Data Storage – Relational Database
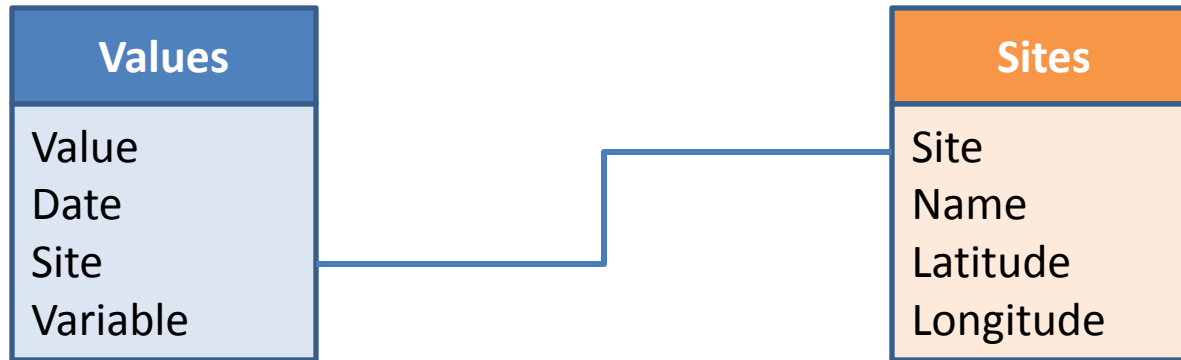
Simple Intro to "What Is a Relational Database"

Observations Data Model
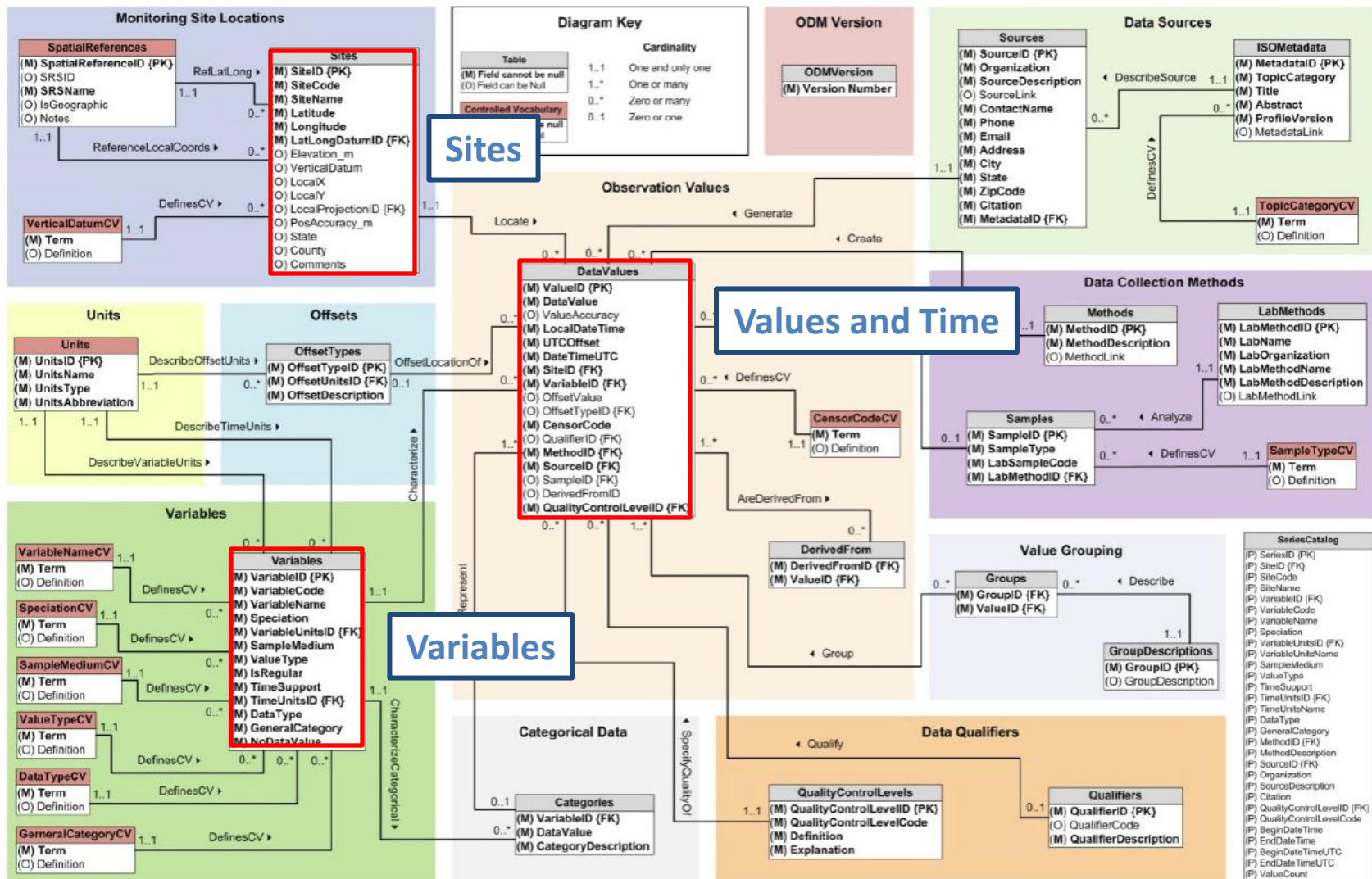
Horsburgh, J. S., D. G. Tarboton, D. R. Maidment and I. Zaslavsky, (2008), "A Relational Model for Environmental and Water Resources Data," Water Resour. Res., 44: W05406, doi:10.1029/2007WR006392.

Observations Data Model (ODM)
A Relational Model at the Single Observation Level
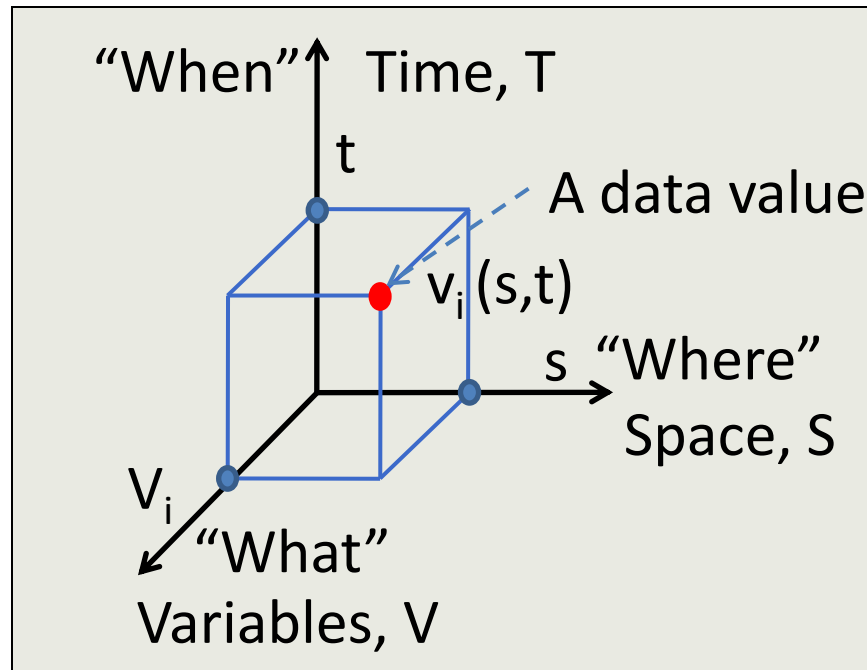
- **Observations** made at points
- Metadata for **unambiguous interpretation**
- Traceable heritage from **raw** measurements to **usable** information
- **Standard format** for data sharing
- **Cross dimension** retrieval and analysis

Publication of Point Observations Data

- Loading Data into ODM Databases
  - ODM Data Loader
  - ODM Streaming Data Loader
- Editing and managing data
  - ODM Tools
- Implementation of WaterOneFlow Web Services

Tools available at: http://his.cuahsi.org

ODM Data Loader

ODM Streaming Data Loader

ODM Tools

WaterOneFlow
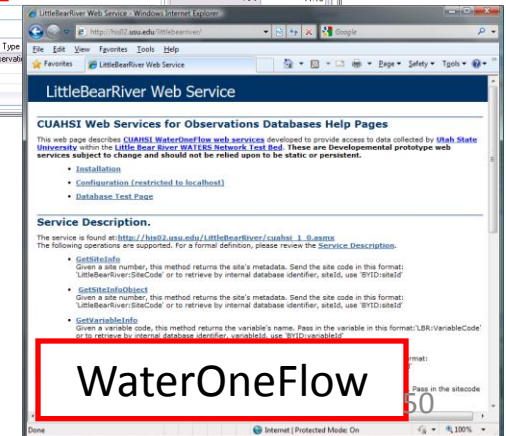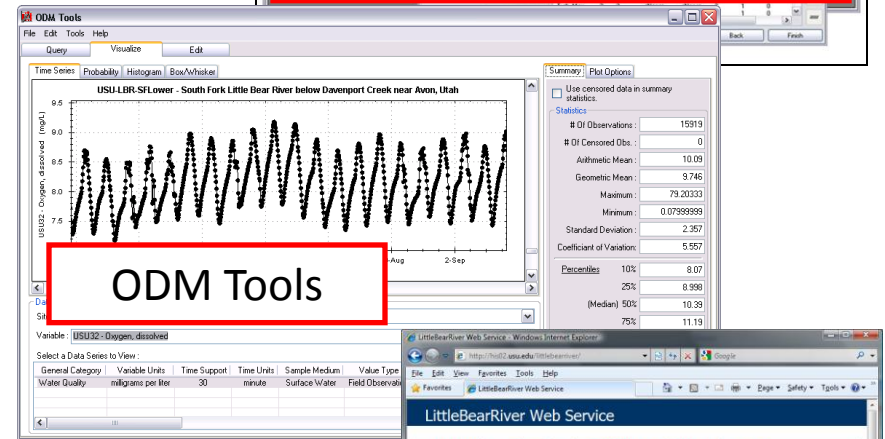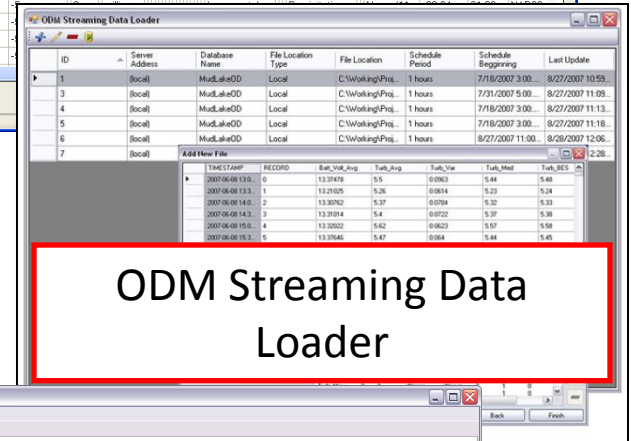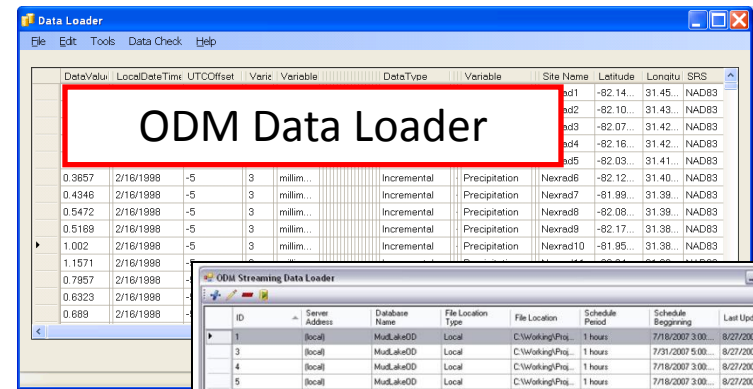
Publication of Spatial (GIS) Datasets

- Publishing spatial datasets using ArcGIS Server
  - Using OGC standards that can be consumed by a number of GIS clients
  - WMS, WFS, WCS
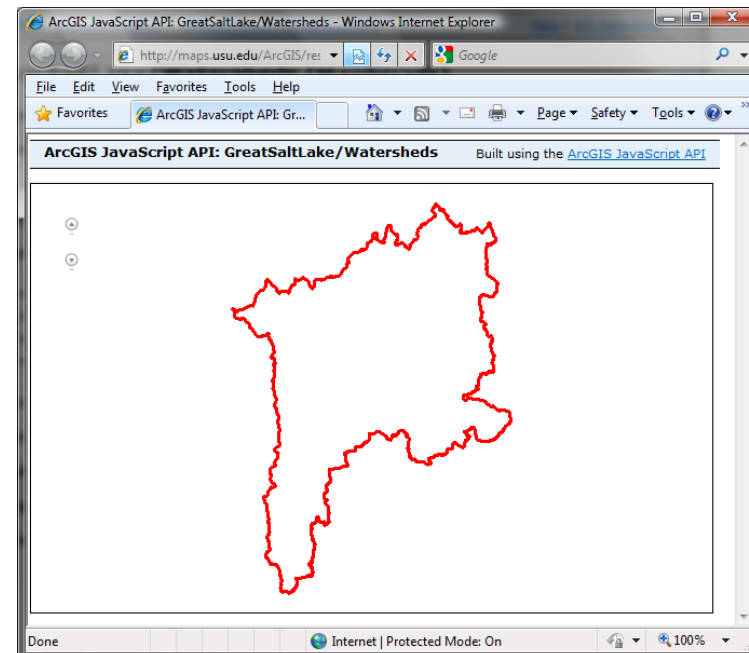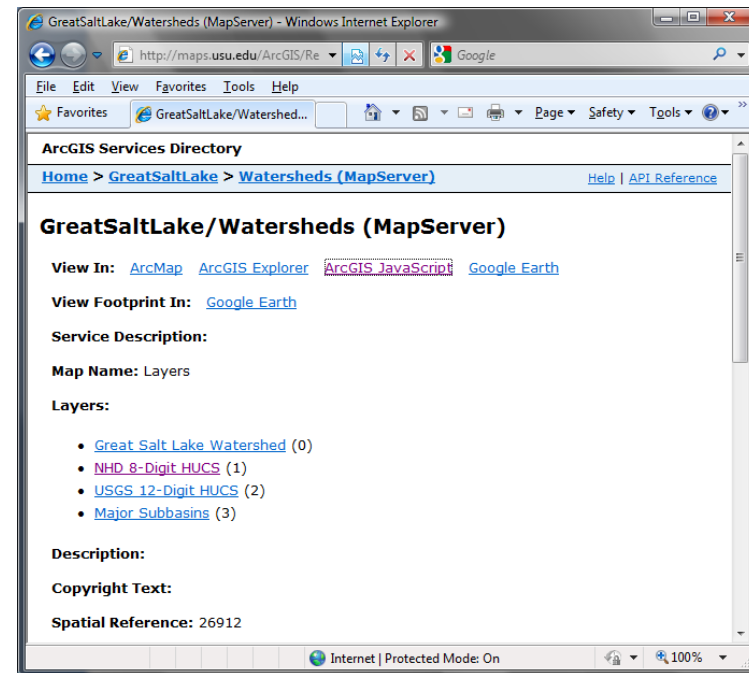
Data Presentation Via a Map Interface

- Internet map Server built using ArcGIS

- Web browser client

- Combine spatial data and observational data

- Launch data visualization tools

http://maps.usu.edu/map/
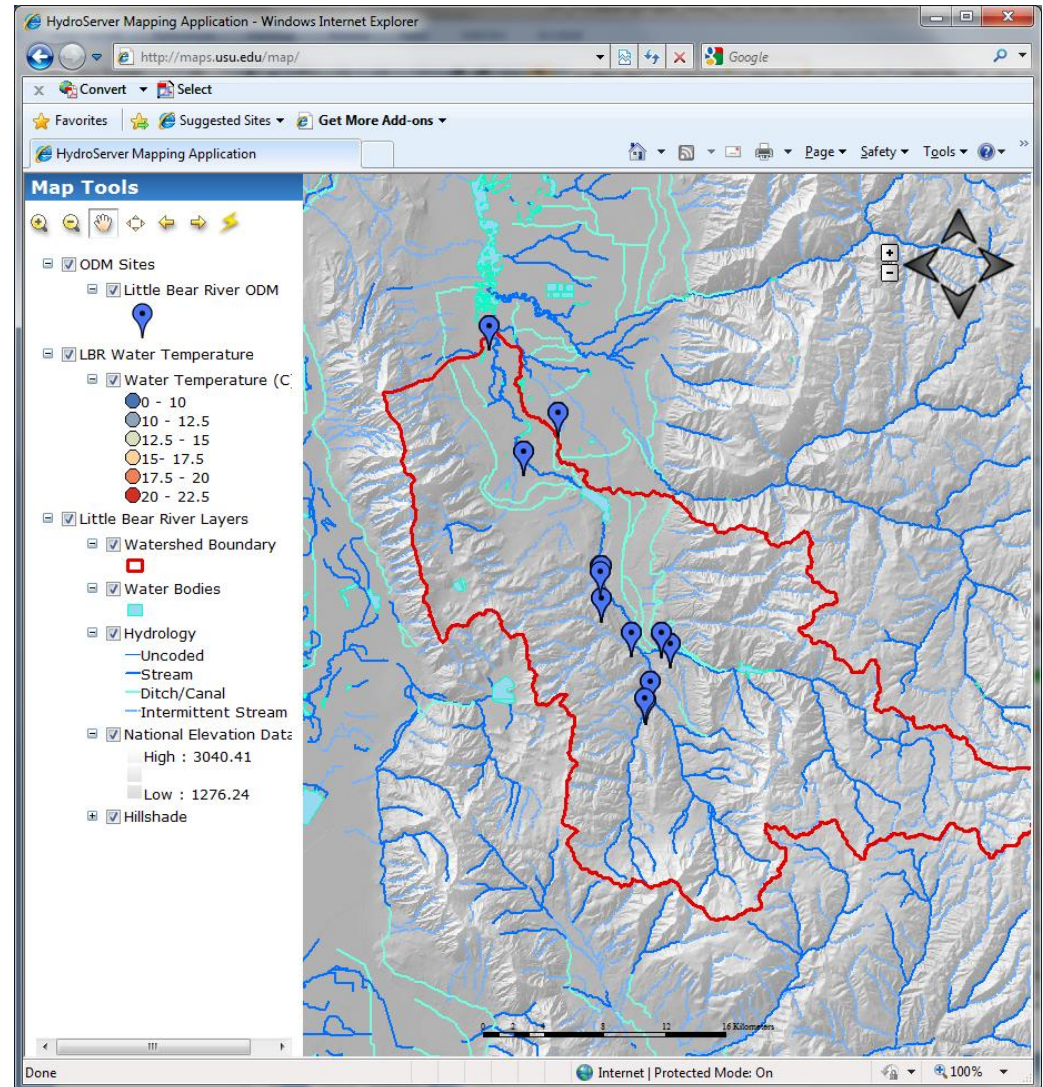
Data Preview, Visualization, and Analysis
Time Series Analyst

- Web browser client
- Descriptive statistics
- Linked to the map application
- Data preview and download

http://icewater.usu.edu/tsa/
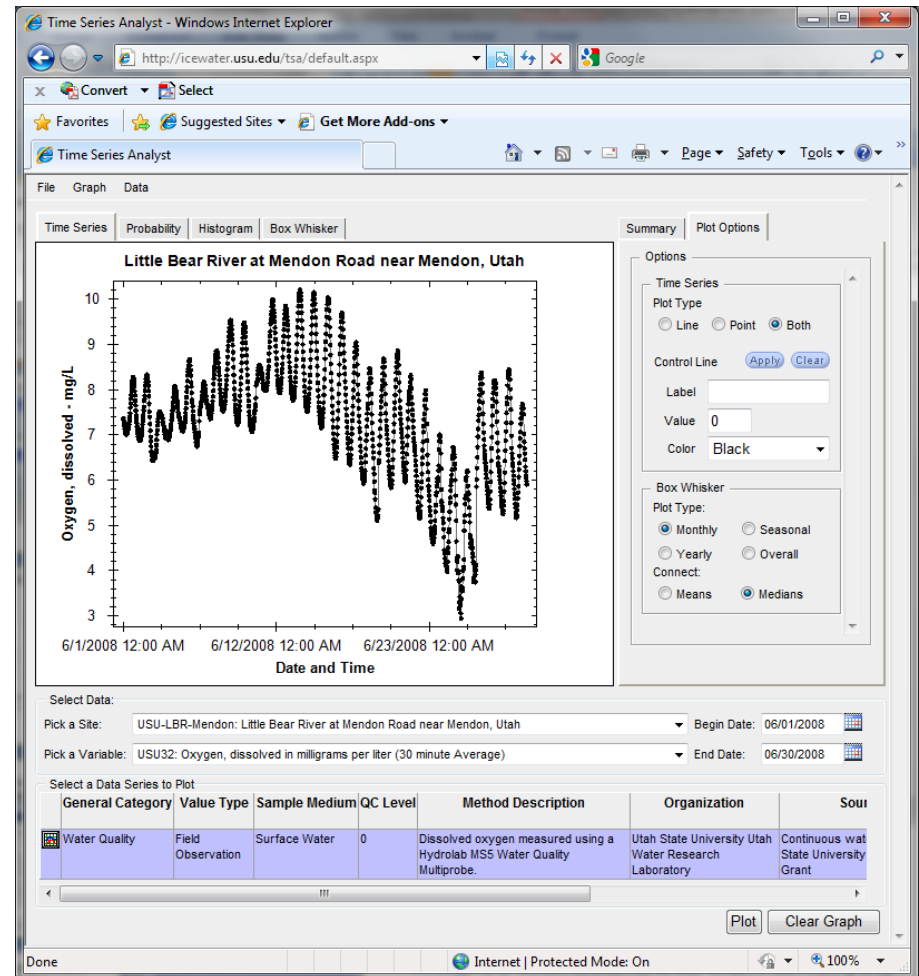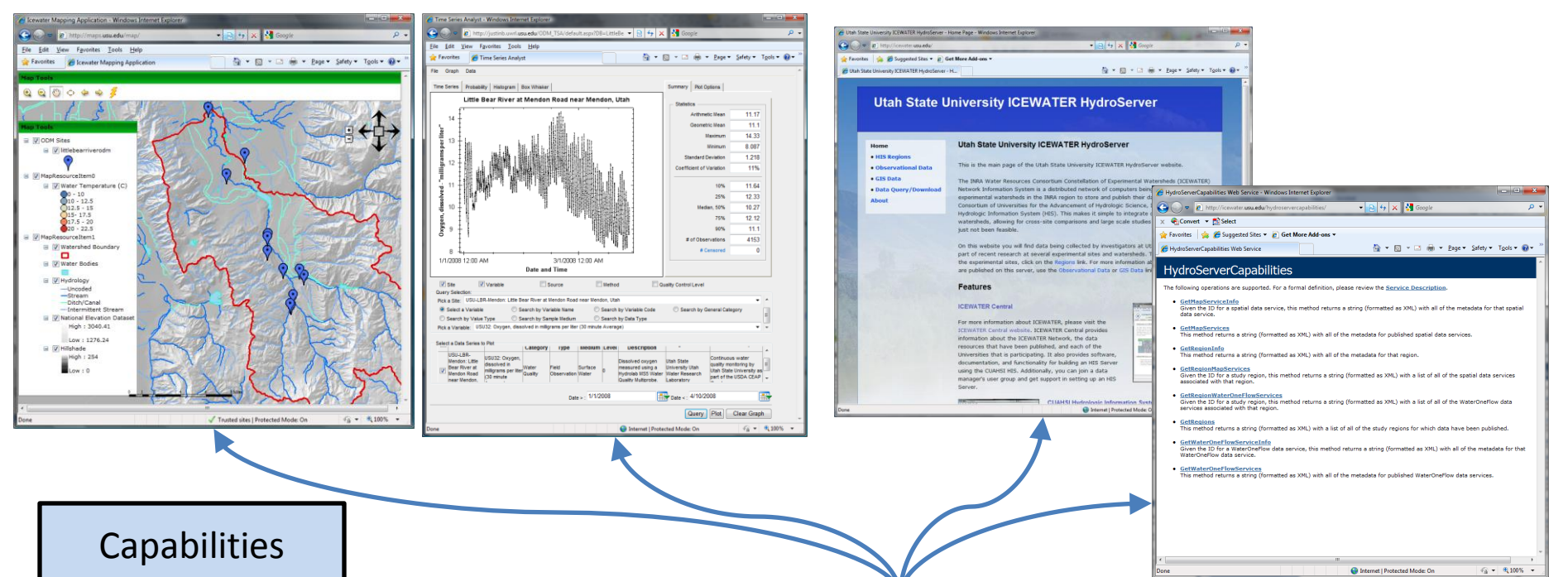
Capabilities Database Configuration Tool

WaterOneFlow Services

HydroServer Capabilities Database

Spatial Services

WaterOneFlow
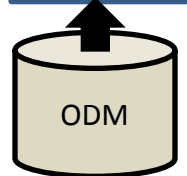
WaterOneFlow

WaterOneFlow

ODM

ODM

ODM
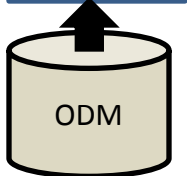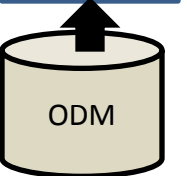
ODM Databases and Web Services
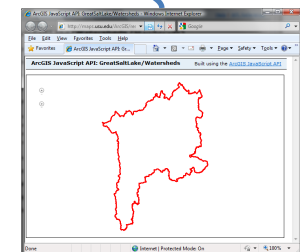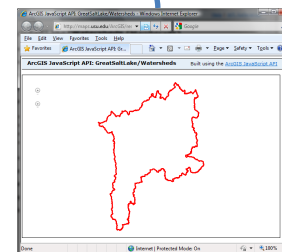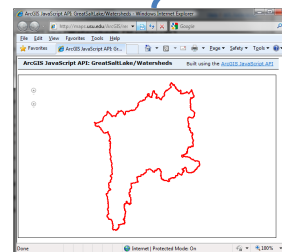
ArcGIS Server Spatial Data Services

HydroServer Capabilities Web Service

- Publish capabilities of each HydroServer
  - Published observational data services
  - Published spatial data services
  - Information transmitted in XML format

- **Makes HydroServers self describing**
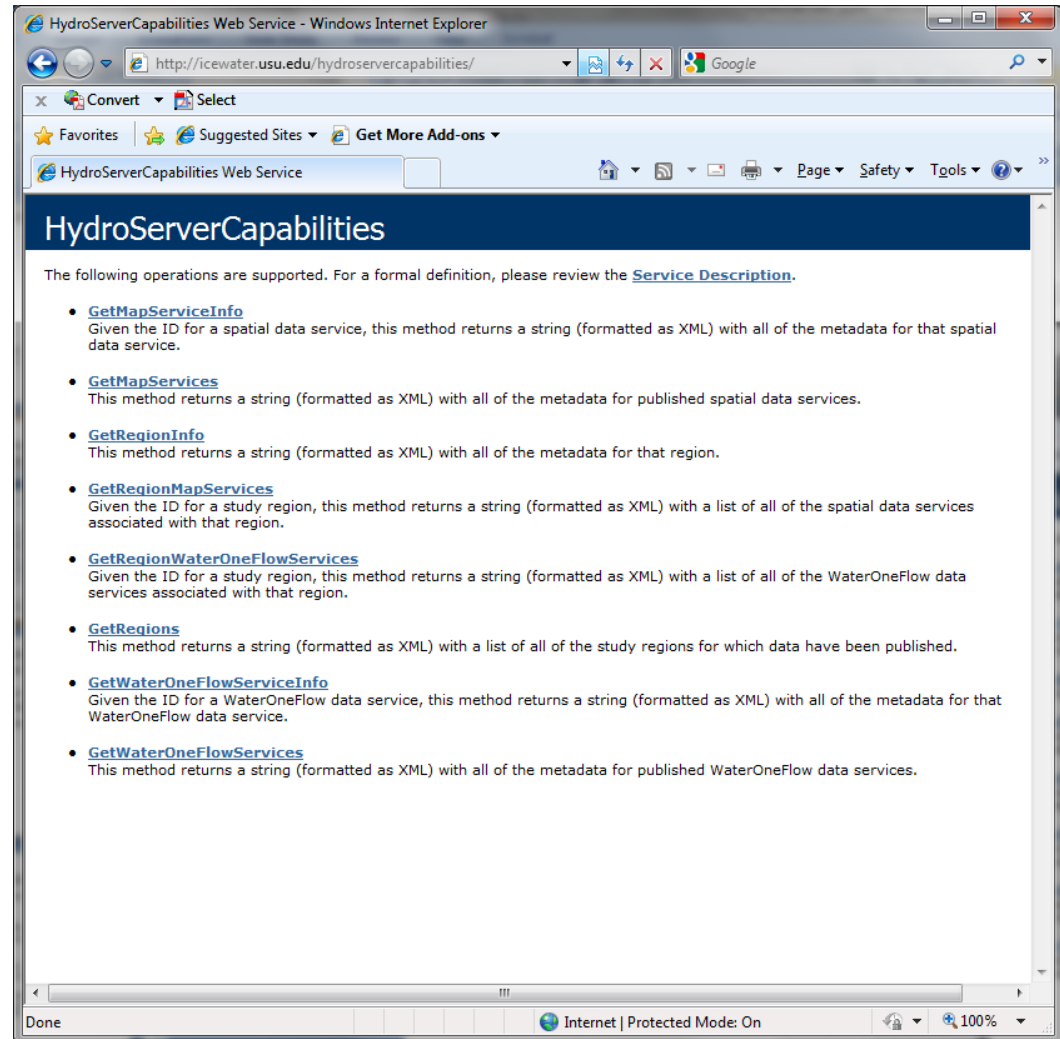
HydroServer Website

- HydroServer home page
- Observational data services
- GIS data services
- Online map
- Time Series Analyst
- Data Query and Download

http://icewater.usu.edu
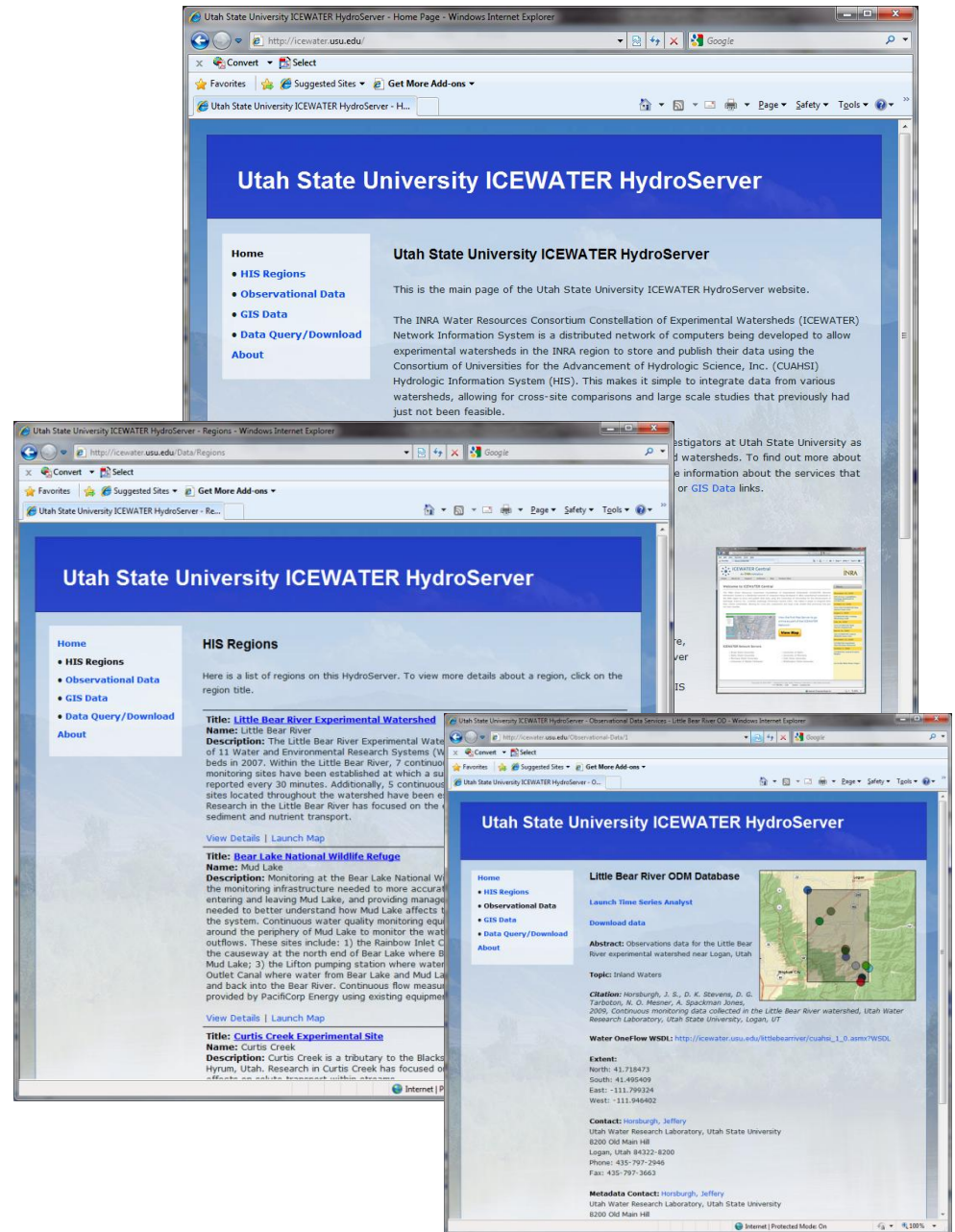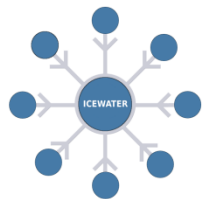
ICEWATER – A Regional HIS

- **ICEWATER** – **I**NRA **C**onstellation of **E**xperimental **WATER**sheds
- Coalition of 8 universities

- Point Observations
  - Stream gages
  - Water quality sampling
  - Weather stations
  - Soil moisture
  - Snow monitoring
  - Groundwater level/quality
- Spatially Distributed Data
  - Land use/cover
  - Terrain
  - Hydrography

http://icewater.inra.org
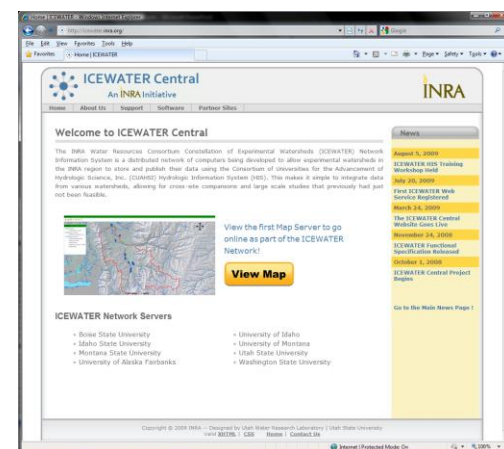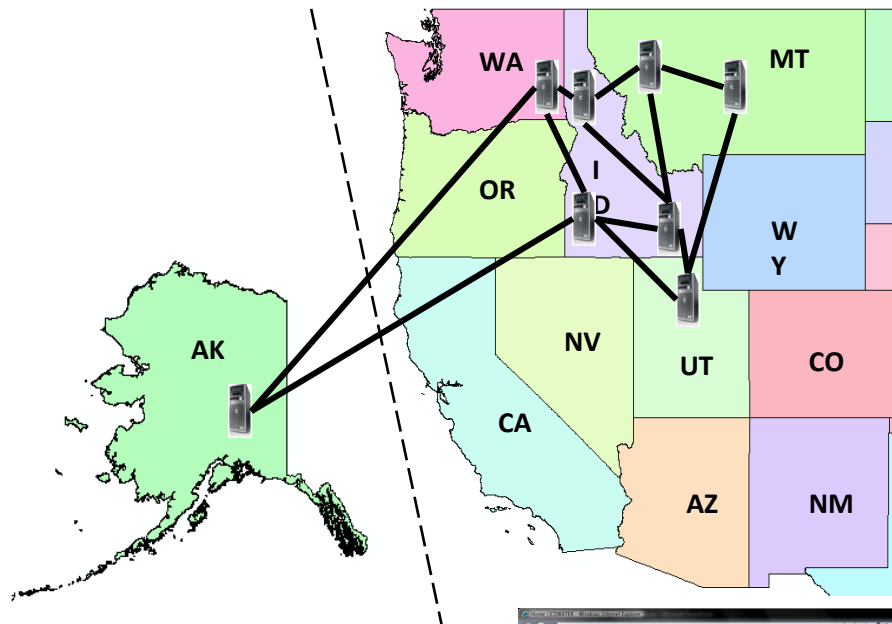
How Do I Create a HydroServer?

1. Get a Windows Server Machine with IIS and .NET Framework
2. Install Microsoft SQL Server
3. Install <u>FREE</u> HydroServer software from http://hydroserver.codeplex.com/
   – Database
   – WaterOneFlow
   – Website
4. Install ESRI ArcGIS Server
5. Create Services and Document them in Capabilities database

Why Publish Data with HIS
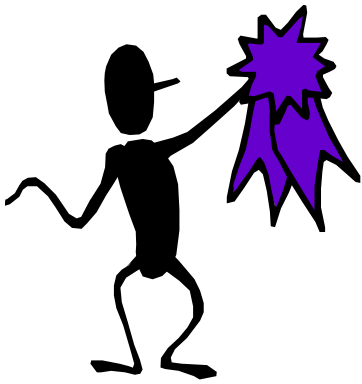
Recognition

Collaboration

Public service
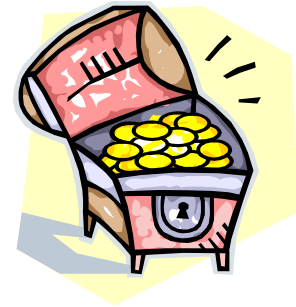
Cost savings

What Have We Covered
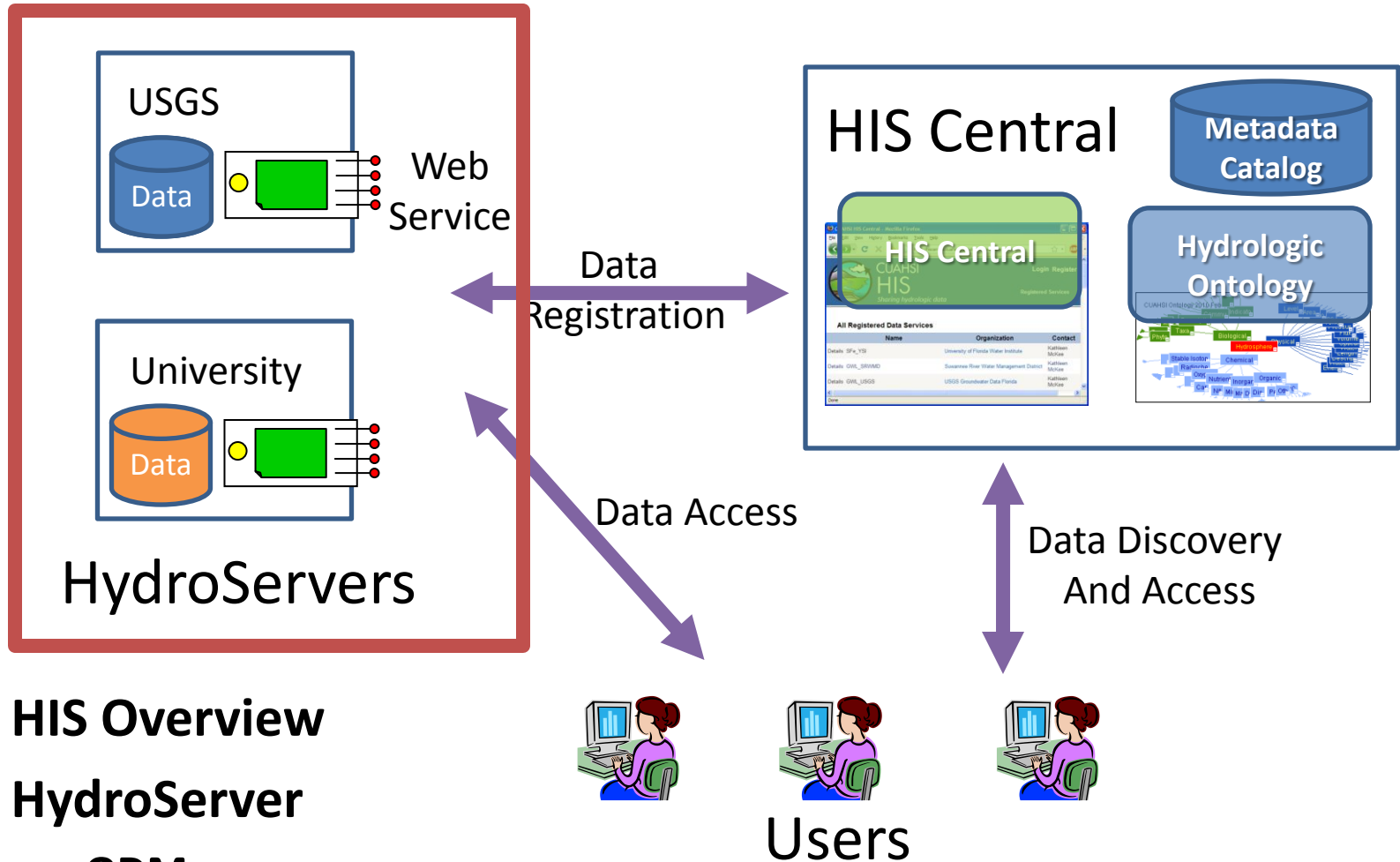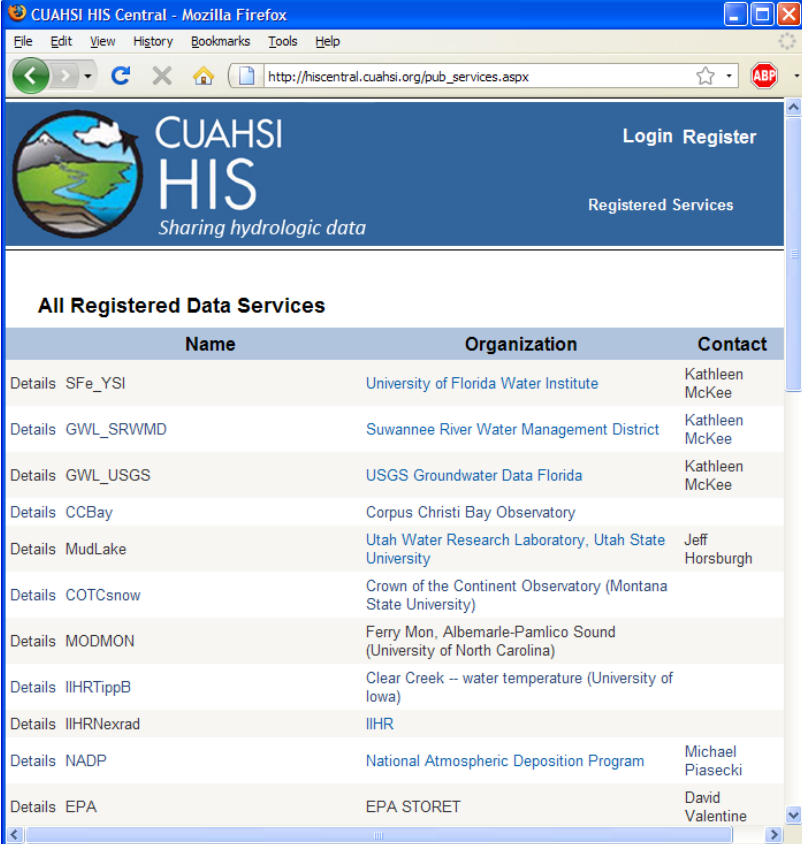
- **HIS Overview**
- **HydroServer**
  - **ODM**
  - **WaterML**

HIS System – HIS Central
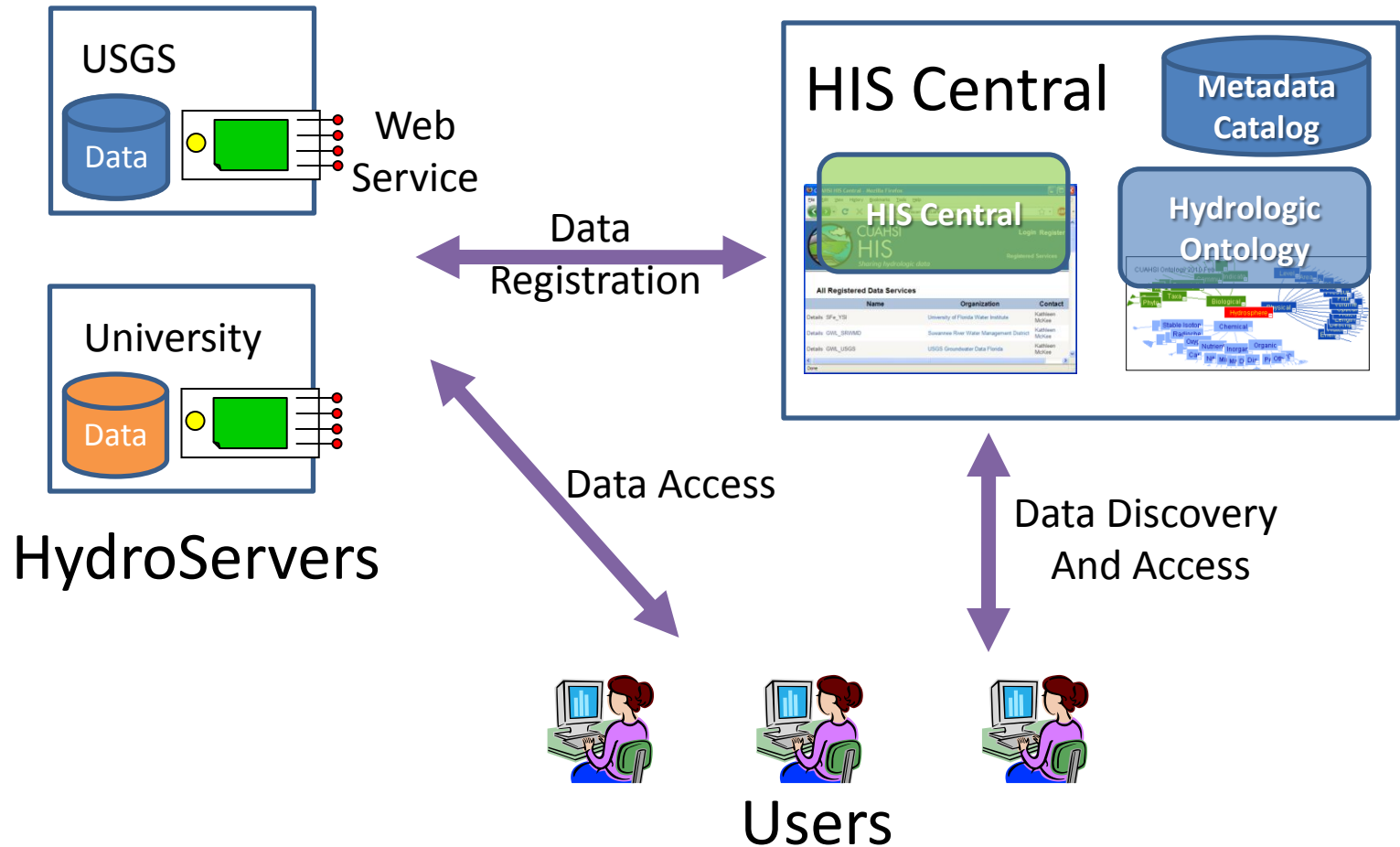
HIS Central

- Publishers
  - Register a data service
- Users
  - Find a data service
- Supported by
  - Metadata Catalog
  - Hydrologic Ontology

http://hiscentral.cuahsi.org

Data Series – Metadata description

There are C measurements of Variable V_i at Site S_j from time t_1 to time t_2

Series Catalog

CUAHSI Water Data Services, April 2010

47 public services
13,200+ variables
1.8 million sites
22.9 million series
4.7 billion data values

Map Integrating NWIS, STORET, & Climatic Sites

The largest water data catalog in the world

Data Heterogeneity

- **Syntactic mediation**
  - Heterogeneity of format

  - Use WaterML to get data into the same format

```
<timeSeries>
- <sourceInfo xsi:type="SiteInfoType">
    <siteName>Colorado Rv at Austin, TX</siteName>
    <siteCode network="NWIS" siteID="4619631">0815800(
  - <geoLocation>
    - <geogLocation xsi:type="LatLonPointType" srs="EPSG
        <latitude>30.24465429</latitude>
        <longitude>-97.694448</longitude>
      </geogLocation>
    </geoLocation>
  </sourceInfo>
- <variable>
    <variableCode vocabulary="NWIS" default="true" variable
    <variableName>Discharge, cubic feet per second</varia
    <units unitsAbbreviation="cfs" unitsCode="35">cubic feet
  </variable>
- <values count="2545">
    <value dateTime="2006-12-31T00:00:00">129</value>
    <value dateTime="2006-12-31T00:15:00">129</value>
    <value dateTime="2006-12-31T00:30:00">129</value>
    <value dateTime="2006-12-31T00:45:00">129</value>
    <value dateTime="2006-12-31T01:00:00">124</value>
    <value dateTime="2006-12-31T01:15:00">129</value>
    <value dateTime="2006-12-31T01:30:00">124</value>
    <value dateTime="2006-12-31T01:45:00">124</value>
    <value dateTime="2006-12-31T02:00:00">124</value>
    <value dateTime="2006-12-31T02:15:00">124</value>
    <value dateTime="2006-12-31T02:30:00">124</value>
    <value dateTime="2006-12-31T02:45:00">122</value>
```

- **Semantic mediation**
  - Heterogeneity of meaning

  - Each water data source uses its **own vocabulary**
  - Match these up with a concept from the **CUAHSI hydrologic ontology**
  - **Make standard scientific data queries** and have these automatically translated into **specific queries** on each data source

Streamflow

FLOW,STREAM,MEANDAILY(CUBICFEETPERSEC)
FLOW:1=NoFlow,2=Low,3=Normal,4=Flood,5=High,6=D
FLOWRATE(GALLONSPERDAY)
FLOWRATEINSTANTANEOUS(MGD)
FLOWSTREAM,INSTANTANEOUS(CUBICFEETPERSEC)
INSTANTANEOUSSTREAMFLOW(CU.METERS/SEC.)
Discharge, cubic feet per second

Water Temperature

Continuous Temperature
Temperature
Temperature, water, degrees Celsius
TEMPERATURE,WATER(DEGREESCENTIGRADE)
TEMPERATURE,WATER(DEGREESCENTIGRADE)24HRMIN
TEMPERATURE,WATER(DEGREESCENTIGRADE,24HRAVG
TEMPERATURE,WATER(DEGREESFAHRENHEIT)
WaterTemperature
WATERTEMPERATURE,#OFMEASUREMENTSIN24-HRS
WATERTEMPERATURE,DEGREESCENTIGRADE,24HRMAX

Nutrients

NITRATENITROGEN,BOTTOMDEPOS.(MG/KG-NDRYWT)
NITRATENITROGEN,DISSOLVED(MG/LASN)
NITRATENITROGEN,TOTAL(MG/LASN)
NITRITE,DISSOLVED(MG/LASN)
NITRITENITROGEN,BOTTOMDEPOS.(MG/KG-NDRYWT)
NITRITENITROGEN,TOTAL(MG/LASN)
NITRITEPLUSNITRATE,BOT.DEPOS.(MG/KG-NDRYWT)
NITRITEPLUSNITRATE,DISS1DET.(MG/LASN)
NITRITEPLUSNITRATE,TOTAL1DET.(MG/LASN)
NITROGEN,AMMONIA,BOTTOMDEPOSITS(MG/KG-N)
NITROGEN,AMMONIA,DISSOLVED(MG/LASN)
NITROGEN,AMMONIA,TOTAL(MG/LASN)
NITROGEN,KJELDAHL,DISSOLVED(MG/LASN)
NITROGEN,KJELDAHL,TOTAL(MG/LASN)
NITROGEN,ORG.KJEL,BOT.DEPOS(MG/KG-NDRYWT)
NITROGEN,ORGANIC,DISSOLVED(MG/LASN)
NITROGEN,ORGANIC,TOTAL(MG/LASN)
NITROGEN,TOTAL(MG/LASN)
NITROGEN,TOTAL,BOTTOMDEPOSITS(MG/KG-NDRYWT)
NITROGENKJELDAHLTOTALBOTTOMDEPDRYWT(MG/KG)
PHOSPHATE,ORTHO(MG/LASPO4)
PHOSPHATE,TOTAL(MG/LASPO4)
PHOSPHORUS,DISSOLVED(MG/LASP)
PHOSPHORUS,TOTAL,BOTTOMDEPOSIT(MG/KGDRYWT)
PHOSPHORUS,TOTAL,WETMETHOD(MG/LASP)

Conceptual Framework

- **Chemical** descriptions from **EPA/USGS Substance Registry System**

  http://www.epa.gov/srs/

- **Physical** descriptions from **CF Conventions**
  - NetCDF Climate & Forecast; 137 variables

  http://cf-pcmdi.llnl.gov/

- **Biological** descriptions from **Integrated Taxonomic Information System**

  http://www.itis.gov/

Thematic Concepts

HydroTagger

Each **Variable** in your data is connected to a corresponding **Concept**

Water Temperature

Continuous Temperature
Temperature
Temperature, water, degrees Celsius
TEMPERATURE,WATER(DEGREESCENTIGRADE)
TEMPERATURE,WATER(DEGREESCENTIGRADE)24HRMIN
TEMPERATURE,WATER(DEGREESCENTIGRADE,24HRAVG
TEMPERATURE,WATER(DEGREESFAHRENHEIT)
WaterTemperature
WATERTEMPERATURE,#OFMEASUREMENTSIN24-HRS
WATERTEMPERATURE,DEGREESCENTIGRADE,24HRMAX

6 services
11 variables
11,158 sites
22,953 series
1,546,841 records

HIS Central *Web Page*

http://hiscentral.cuahsi.org

HIS Central *Web Service*

- Programmatic methods to query the national metadata catalog

- Search by:
  - Location
  - Variable (concept)
  - Date Range
  - Data source (WaterOneFlow service)

hiscentral

The following operations are supported. For a formal definition, please review the **Service Description**.

- **GetMappedVariables**
- **GetMappedVariables2**
- **GetSearchableConcepts**
- **GetSeriesCatalogForBox**
- **GetSeriesCatalogForBox2**
- **GetServicesInBox**
- **GetServicesInBox2**
- **GetSitesInBox**
- **GetSitesInBox2**
- **GetWaterOneFlowServiceInfo**
- **GetWordList**
- **getOntologyTree**
- **getSearchablePaths**
- **getSeriesCatalogInBoxPaged**

http://hiscentral.cuahsi.org/webservices/hiscentral.asmx

HIS System – HIS Desktop
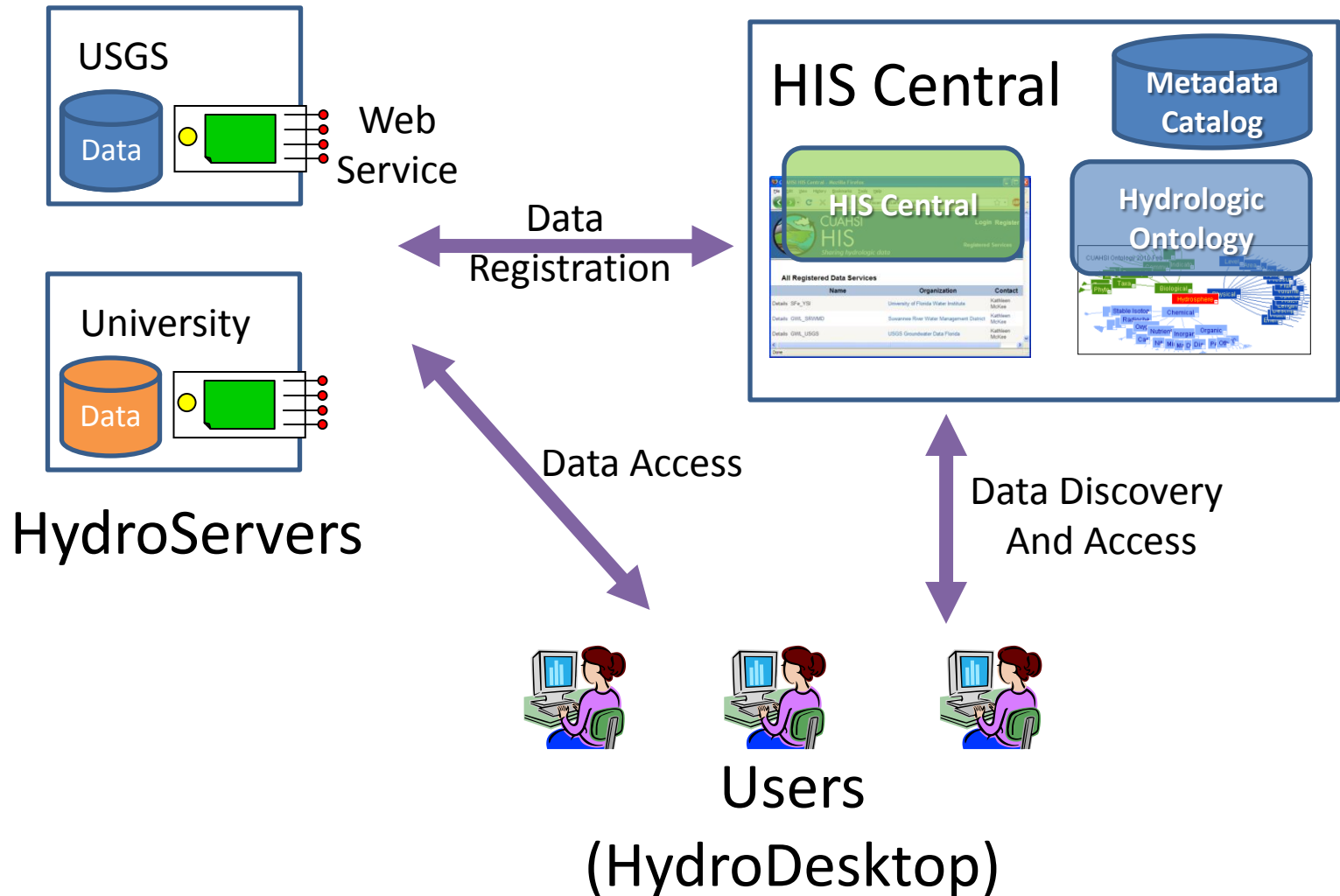
HIS in Familiar Software
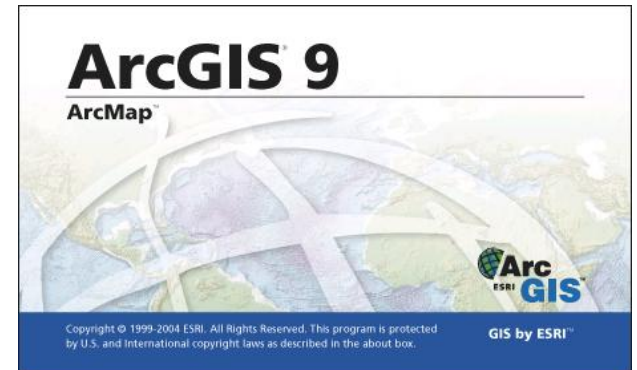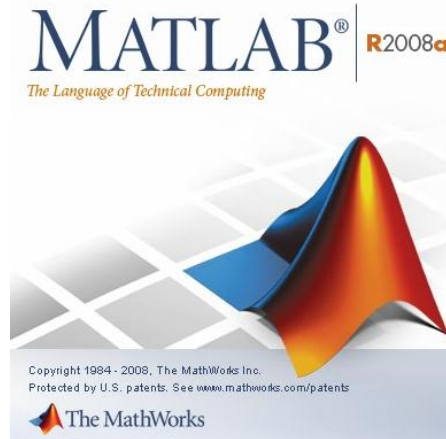
HydroExcel

HydroExcel: WaterOneFlow Excel Client

HydroExcel is an Excel spreadsheet that provides direct access to WaterOneFlow web services, serving data both from national data providers and universities. The spreadsheet uses VBA macros and an object library called HydroObjects to communicate with and retrieve data from WaterOneFlow web services.

Before you begin:

- Enable Excel macros. Your security settings may prevent the macros in this spreadsheet from running. If macros are disabled, and you don't see an option to enable them, you may need to go into Excel's security settings and allow macros or at least disable macros with notification. You will likely then have to close the spreadsheet and reopen it in order for the macros to work.
- HydroExcel uses HydroObjects, an object library for communicating with the WaterOneFlow web services. So if you want to use HydroExcel, get and install HydroObjects.
- HydroObjects requires the .Net Framework 2.0 from Microsoft. If you are using Office 2003, then Service Pack 3 for Microsoft Office 2003 is also required.

HydroExcel Version 1.1.2 Resources:

This latest version of HydroExcel features right-click menus and additional buttons to improve the workflow, the ability to save raw WaterML files to disk as XML files, and the display of some additional items available in WaterML such as variable speciation.

- Microsoft Office 2003 version [XLS; 7.5M] (requires HydroObjects)
- Microsoft Office 2007 version [XLSB; 1.1M] (requires HydroObjects)
- HydroExcel Version 1.1.2 Software Manual [PDF; 3.8M; 48 pages]

Choosing a Service

Tell HydroExcel which web service to use

Choosing a Site

Google Earth opens, showing our sites

Find sites and variables available from the web service

Let's use this site
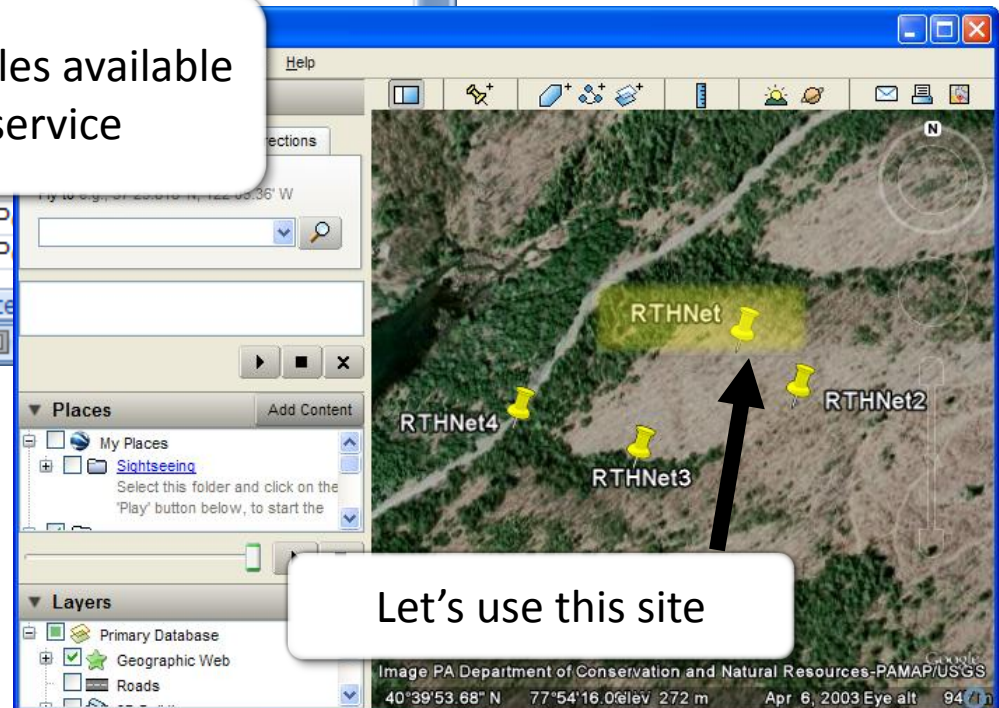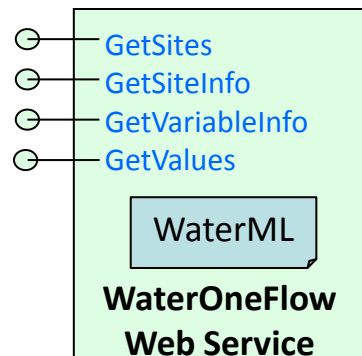
Downloading Time Series

Exploring the Time Series
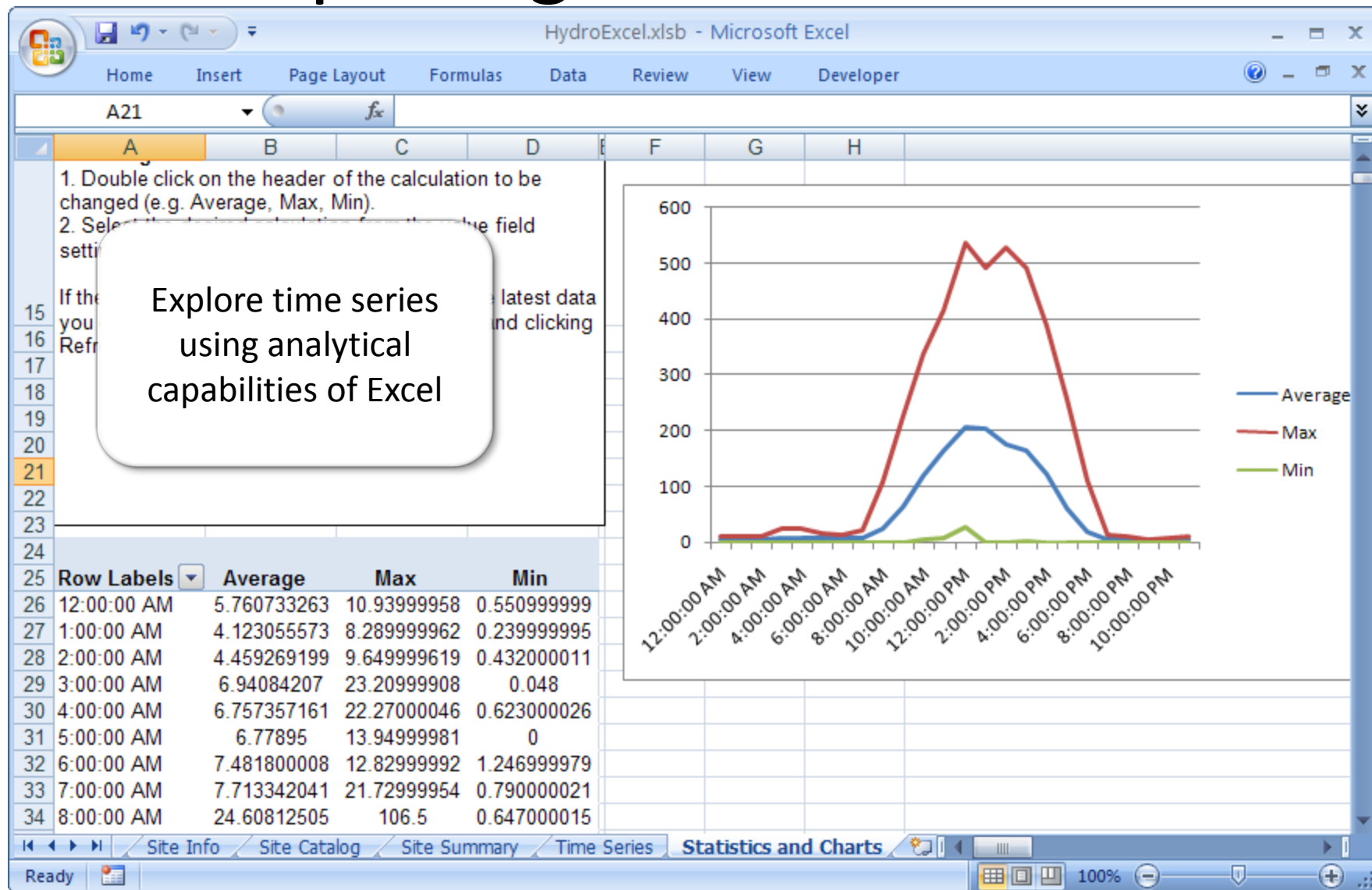
HydroExcel Limitations

- Can't hold much data
- No dates before year 1900
- Not truly geospatially enabled
- Not free

- How can I use HIS in software built to work with HIS from the ground up?

HydroDesktop

- Free, open source solution for HIS data access

- www.hydrodesktop.org

GIS fully integrated with HIS

Built-in Analysis

- Tables
- Graphs
- Editing
- Export
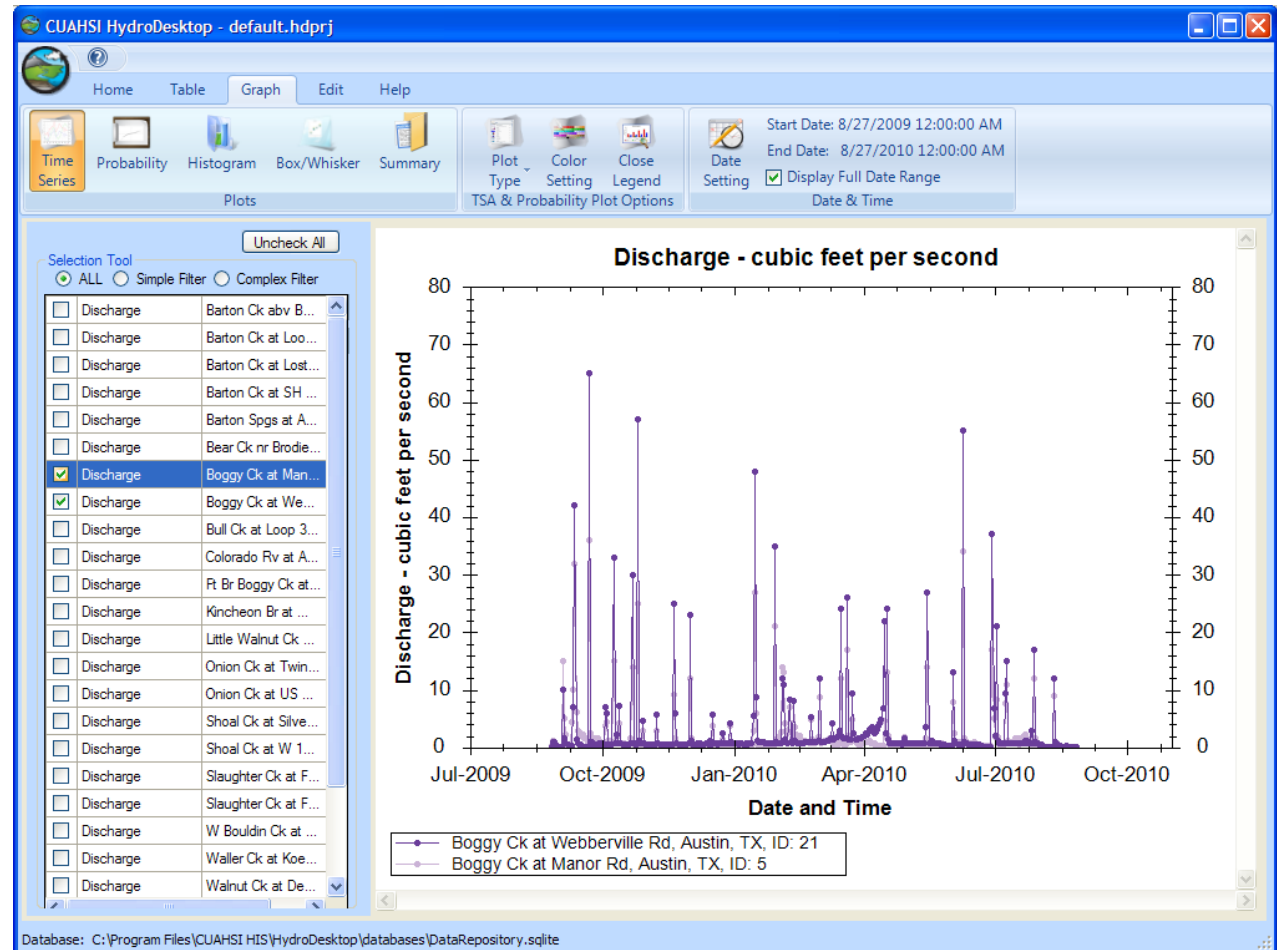
Customizable with Plug-ins

- Community development
- Build on the HydroDesktop framework

Outline

- The HIS Story

- HIS components

- *Putting the pieces together*

Services-Oriented Architecture for Water Data

HIS Overview Report

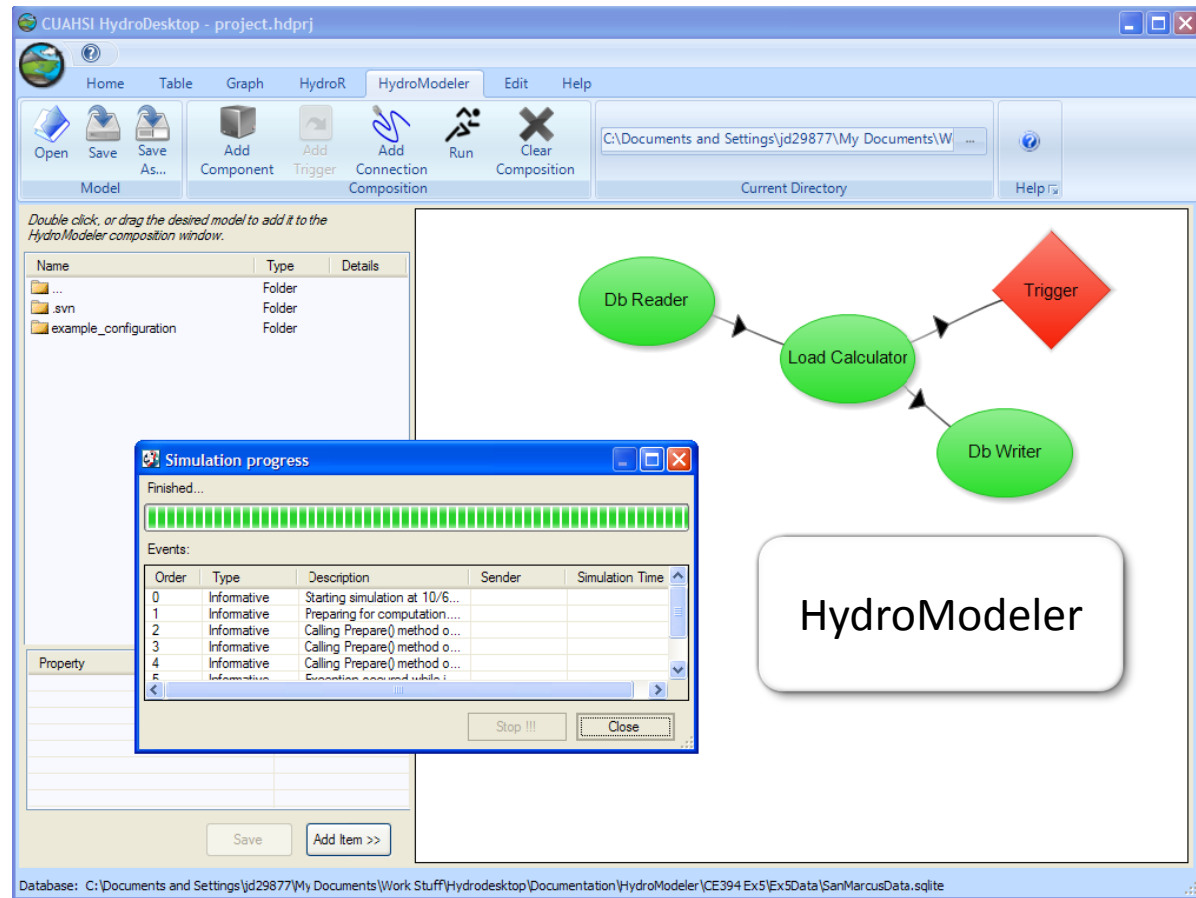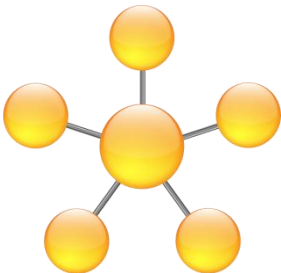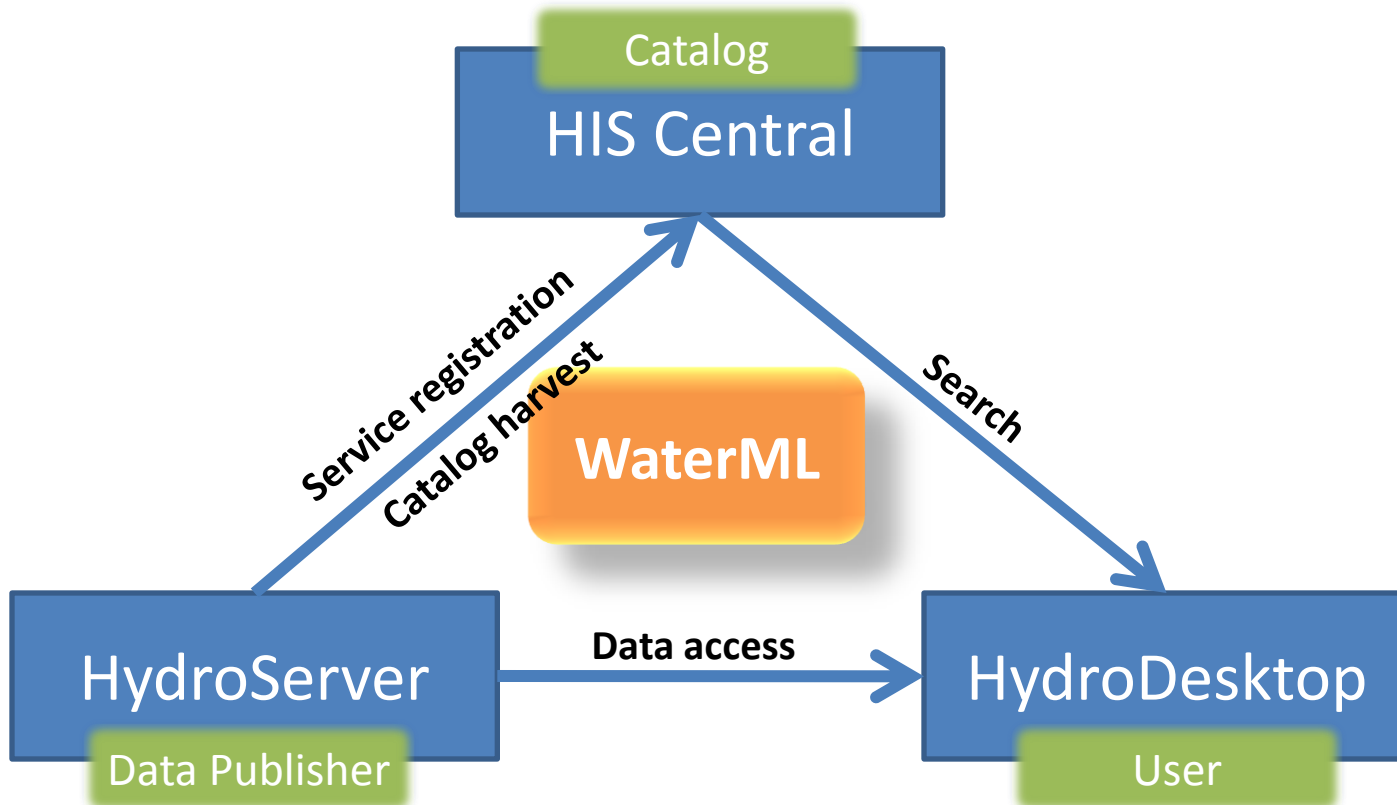- Summarizes the conceptual framework, methodology, and application tools for HIS version 1.1
- Shows how to develop and publish a CUAHSI Water Data Service
- Available at:

CUAHSI HYDROLOGIC INFORMATION SYSTEM: OVERVIEW OF VERSION 1.1

Edited by David R. Maidment
Center for Research in Water Resources
The University of Texas at Austin

July 12, 2008

http://his.cuahsi.org/documents/HISOverview.pdf
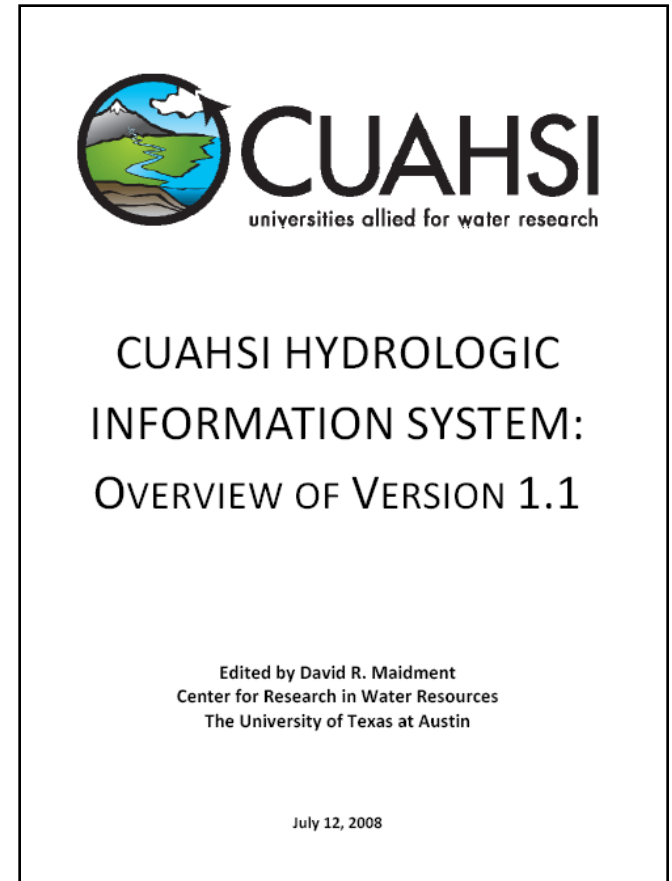
The Road Ahead

- WaterML 2.0
  - World Meteorological Organization
  - Open Geospatial Consortium
  - Hydrology Domain Working Group
- HydroServer – Data access control
- HydroDesktop – Refinement

Put Your Dots on the Map

Start Using HIS

- HIS Website
  - his.cuahsi.org

- HydroDesktop
  - www.hydrodesktop.org

- CUAHSI User Support Specialist
  - Yoori Choi
  - ychoi@cuahsi.org