

# The CUAHSI Hydrologic Information System

Consortium of Universities for the  
Advancement of Hydrologic Science, Inc.  
(CUAHSI)

<http://www.cuahsi.org>

# HIS Project Team

- **University of Texas at Austin** – David Maidment (PI), Tim Whiteaker
- **San Diego Supercomputer Center** – Ilya Zaslavsky, David Valentine, Tom Whitenack
- **Utah State University** – David Tarboton, Jeff Horsburgh
- **CCNY**– Michael Piasecki
- **University of South Carolina** – Jon Goodall, Tony Castronova
- **Idaho State University** – Dan Ames, Jiri Kadlec
- **Tufts University**—Alva Couch, Alex Bedig



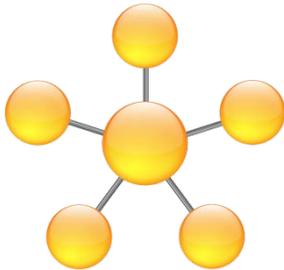
# Outline



- The HIS Story



- HIS components



- Putting the pieces together

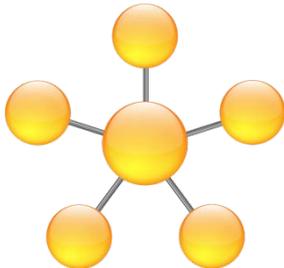
# Outline



- *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 analysis.

[his.cuahsi.org](http://his.cuahsi.org)

# What kind of data does HIS support?

- HIS is designed for *in situ* (e.g., sensor) data collected at *a fixed point*.
- Archetype: Stream flow at a gage on a river
- Sensor can measure any physical, chemical, or biological property
- Relaxing assumptions
  - Moving platform data can be represented (but not as efficiently as custom designed database)
  - Time series can be associated with polygon or arc in WaterML 2.0
  - “Simple” laboratory analyses (aquatic chemistry...)

# We Collect Lots of Water Data

Water quantity



Rainfall



Soil water



Water quality



Meteorology



Groundwater

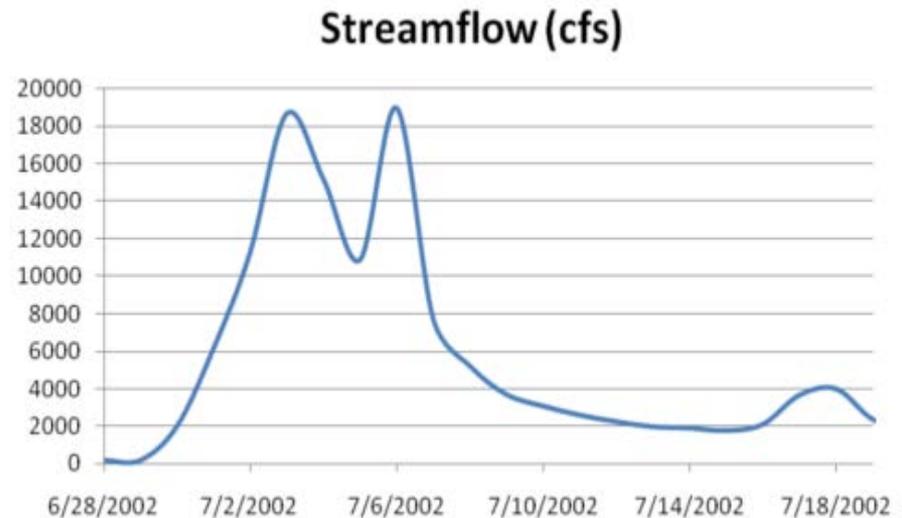




# The Data Have a Similar Structure

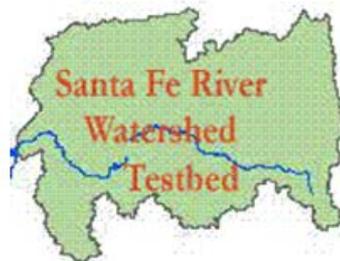
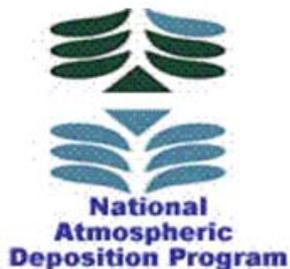


A **point** location in **space**



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

# Data Are Collected by Many Organizations

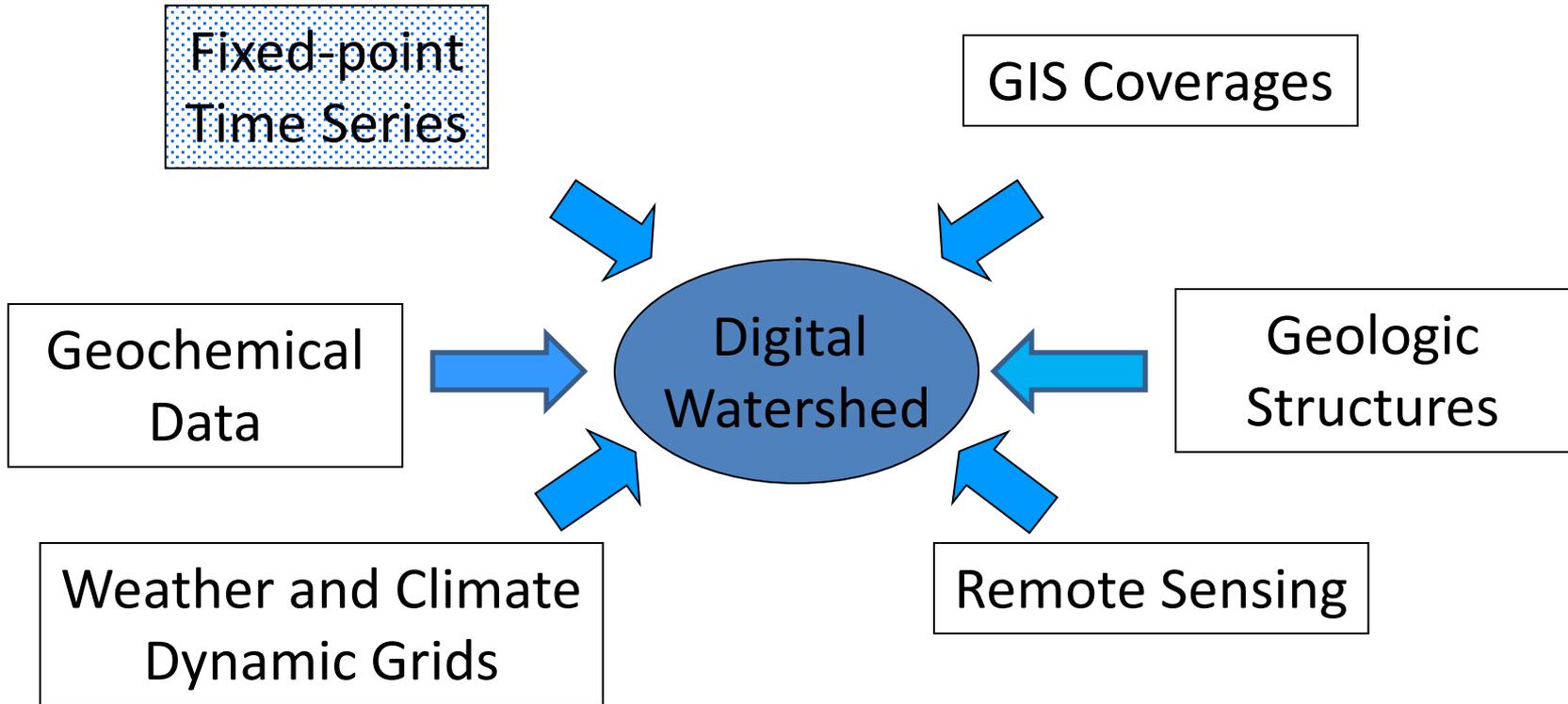


# USA has GIS Data Repository

The screenshot shows the geodata.gov website. The header features the logo "geodata.gov U.S. MAPS & DATA" and the tagline "Your One Stop for Federal, State & Local Geographic Data". Navigation tabs include Home, Search, Maps, Marketplace, Communities, Statistics, and Help Center. The main content area has a search bar with "What:" and "Where:" fields, a "Search" button, and a "Show Advanced Search Options" link. A "Current Featured Topic" section highlights "State, County and Local Governments" with sub-links for "Map Service Examples" and "Key Resources". A sidebar on the left lists "Special Interest" and "Data Categories" with various links. At the bottom, there is a 3D topographic map of a landscape with a river and a small town.

...but nothing equivalent for water data

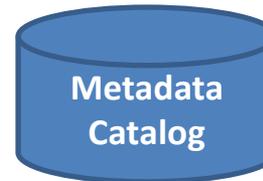
# Data Integration



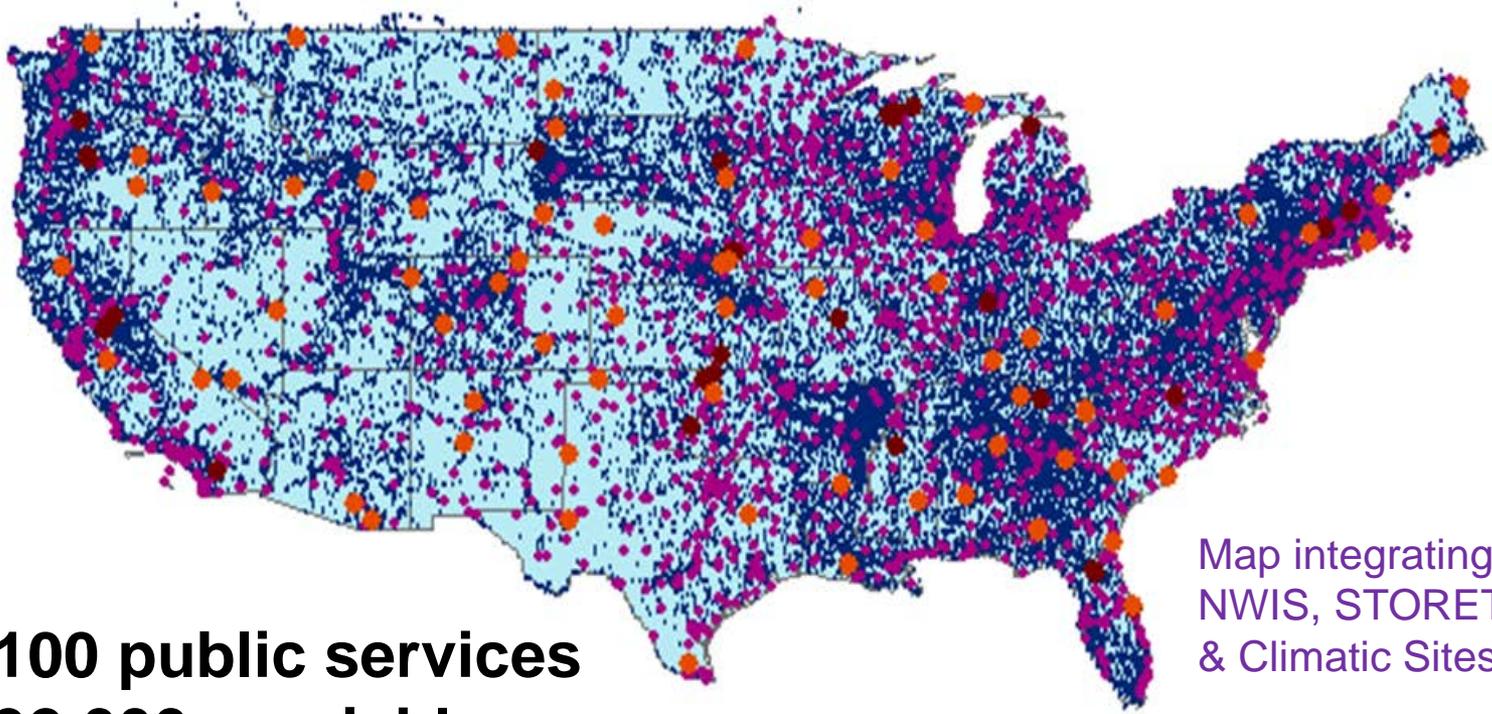
*Currently, the focus is on data from monitoring sites at point locations.*

# The Result

- WaterML language for describing water data
- Global (?) catalog of water data sources
- Free software for data access



# Metadata Catalog, October, 2012

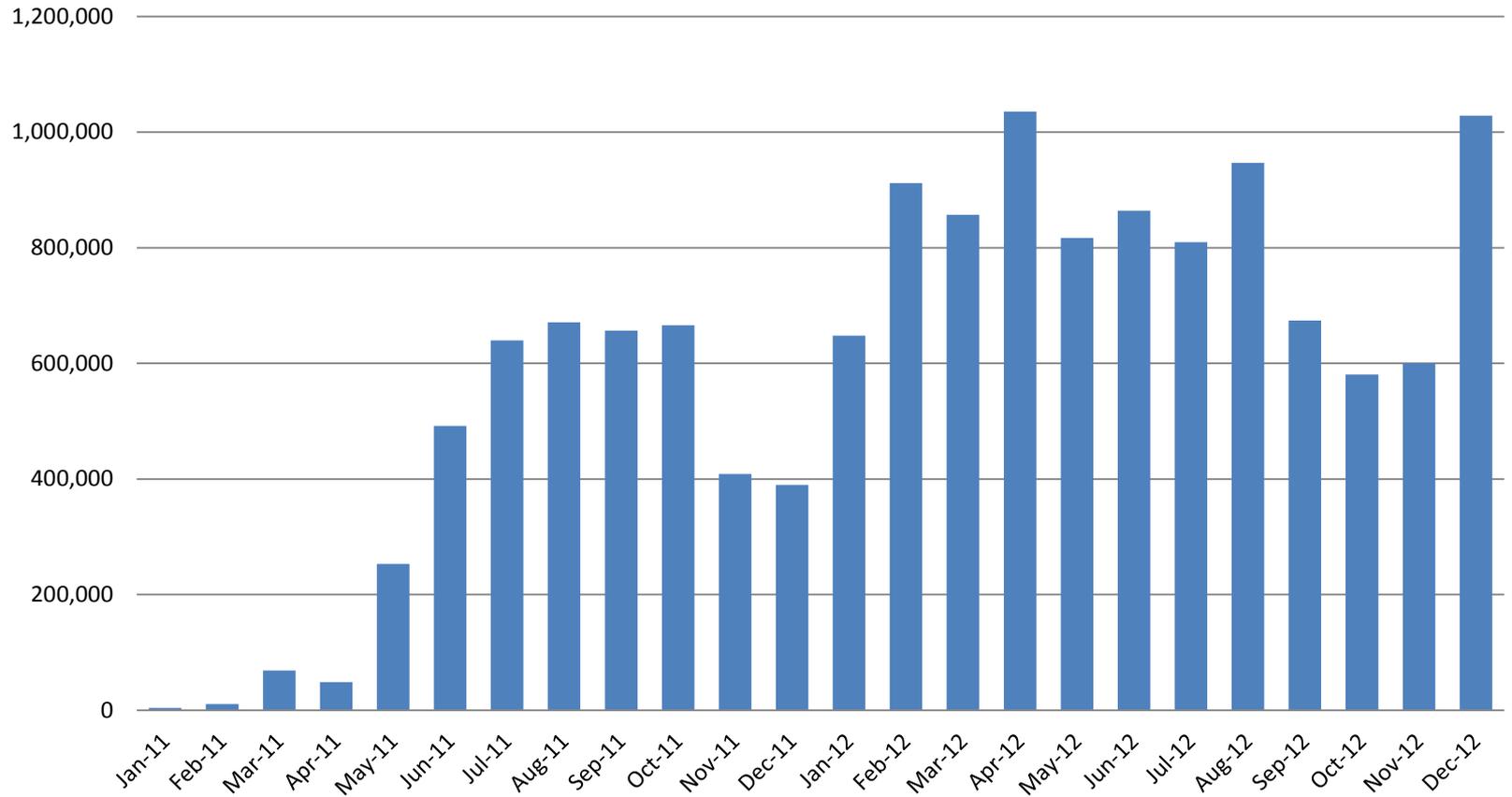


Map integrating  
NWIS, STORET,  
& Climatic Sites

**100 public services**  
**32,000+ variables**  
**2.79 million sites**  
**33.9 million series**  
**Referencing 18+ billion data values**

# HIS Usage

## Number of Time Series Downloaded



# For more on the HIS Story

[his.cuahsi.org](http://his.cuahsi.org)

The screenshot displays the CUAHSI HIS website interface. At the top left is the CUAHSI HIS logo with the tagline "Sharing hydrologic data". To the right, a blue banner contains the text: "CUAHSI's Hydrologic Information System (CUAHSI-HIS) provides web services, tools, standards and procedures that enhance access to more and better data for hydrologic analysis." Below the banner is a navigation menu with links for Home, How To, Components, Community, Publications, About Us, and Contact Us. A Google Custom Search box is also present.

The main content area features a paragraph: "The CUAHSI Hydrologic Information System (HIS) is an internet-based system for sharing hydrologic data. It is comprised of databases and servers, connected through web services, to client applications, allowing for the publication, discovery and access of data." Below this is a diagram titled "Key Components of CUAHSI-HIS:".

The diagram illustrates the relationships between three main components:

- HydroServer Data Publication** (bottom left)
- HIS Central Data Discovery** (top center)
- HydroDesktop and other clients Data Access** (bottom right)

The connections between these components are as follows:

- An arrow labeled **Metadata Services** (Service Registration and Catalog Harvesting) points from HydroServer to HIS Central.
- An arrow labeled **Search Services** (Geographic, Semantic, Time and Network Search) points from HIS Central to HydroDesktop.
- An arrow labeled **Data Services** (Water and Spatial Data) points from HydroServer to HydroDesktop.

On the right side of the page, there are two sections:

- Quick Links**: A list of links including HydroDesktop, HydroExcel, HydroGet, FetchWaterML, WaterML Web Services, ODM Database, HydroServer, Master Controlled Vocabulary, HydroTagger, and HIS Central.
- What's New**: A list of recent updates, including "Hydrologic Data Needs Survey", "Hope to see you at the Water Data Service Workshop, July 21-22, 2010", and "HIS at the AWRA Spring Specialty Conference: GIS & Water Resources VI".

The bottom left corner of the browser window shows the text "Done".

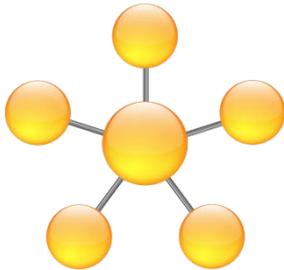
# Outline



- The HIS Story

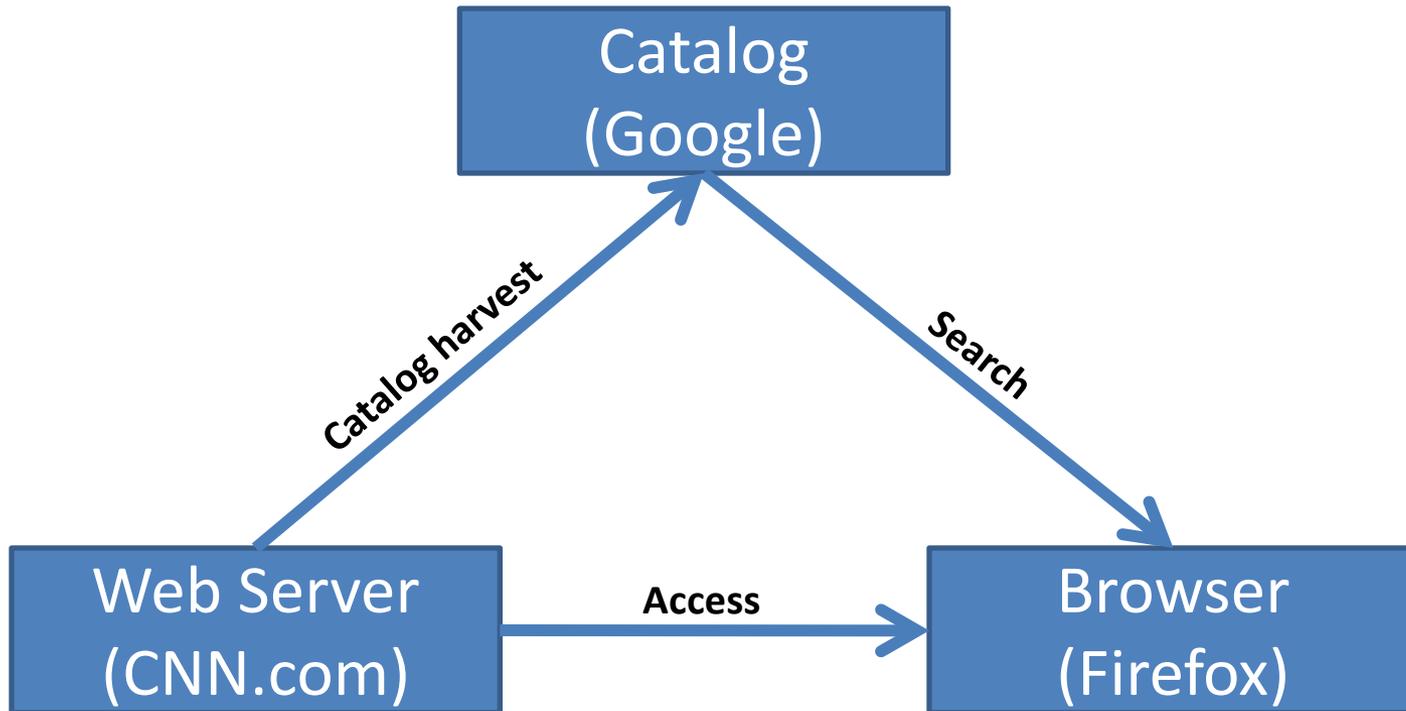


- *HIS components*

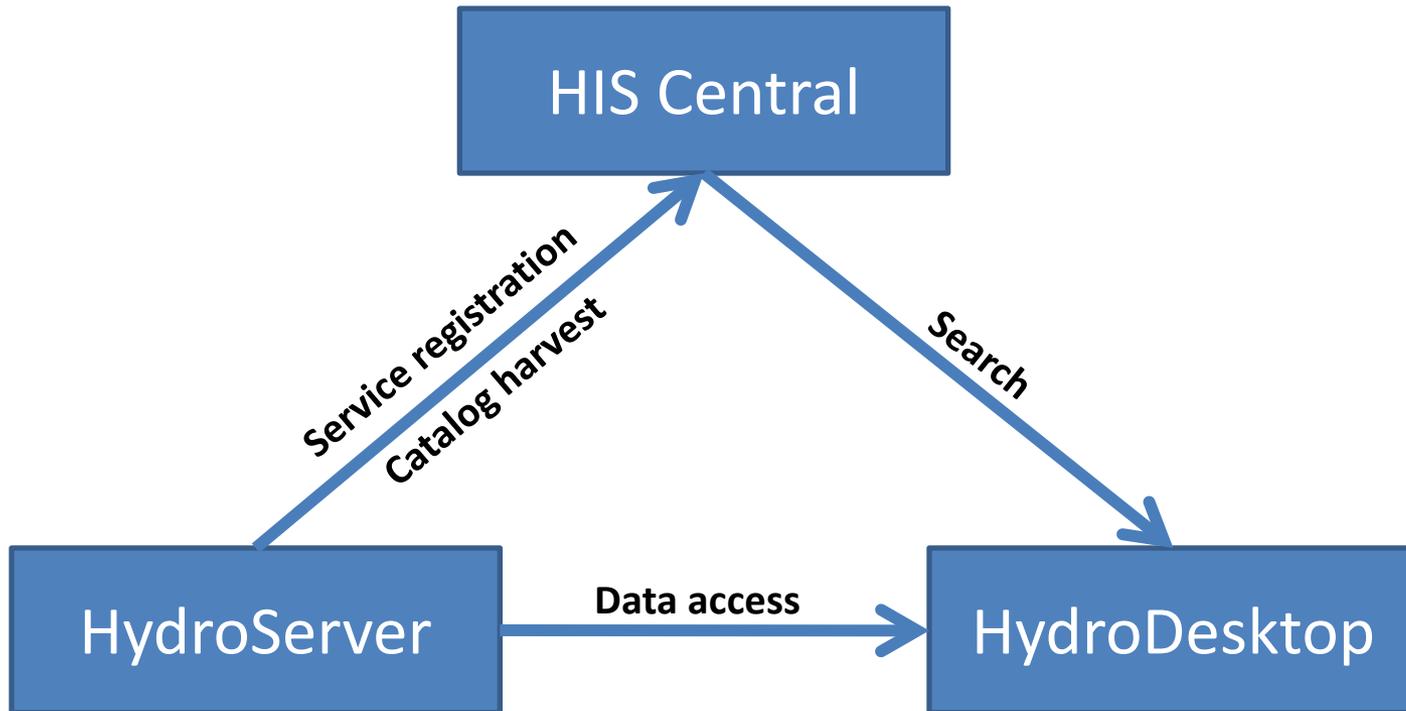


- Putting the pieces together

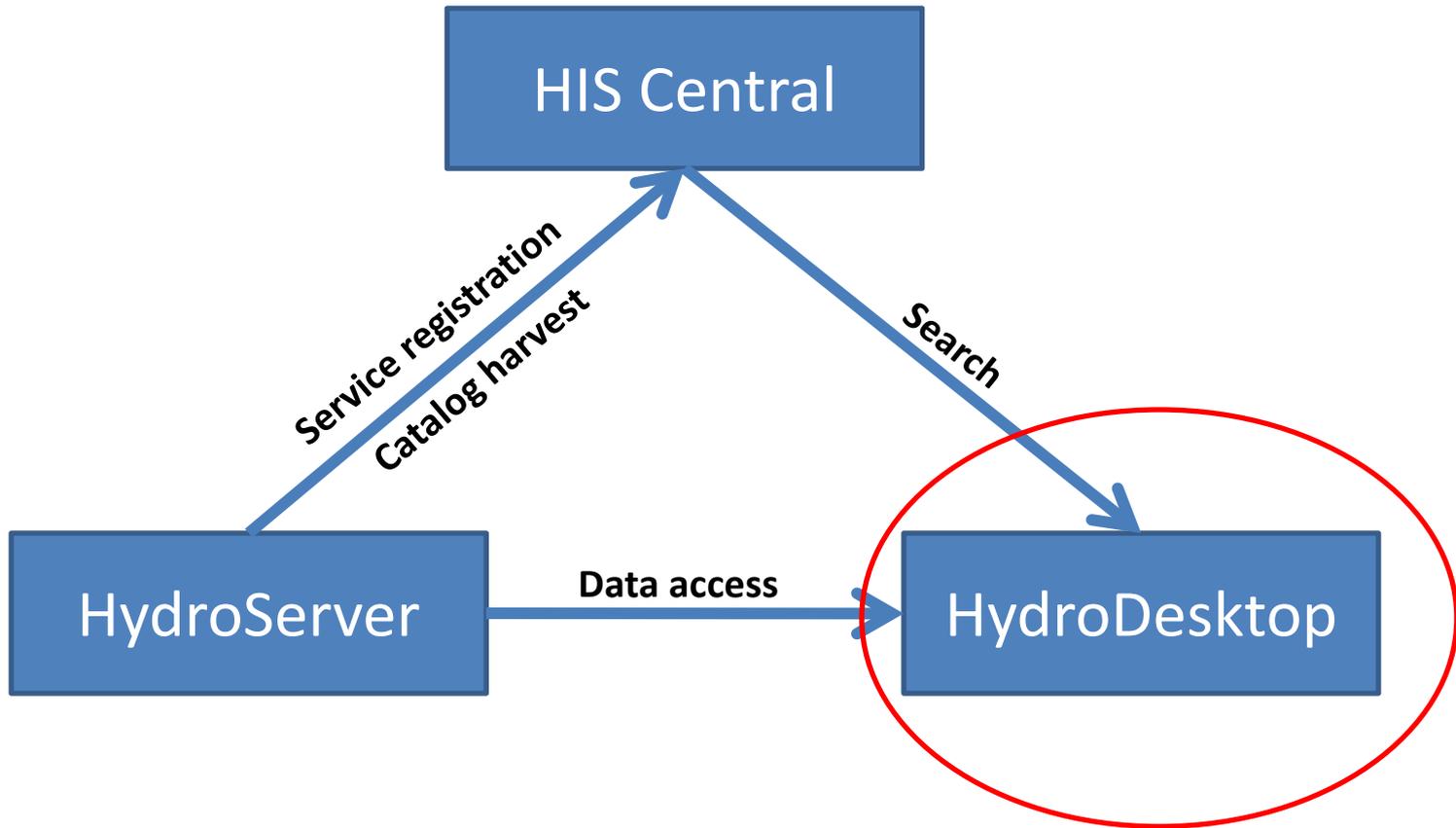
# Web Paradigm



# Services-Oriented Architecture for Water Data



# Services-Oriented Architecture for Water Data



# HydroDesktop

- Free, open source solution for HIS data access
- [www.hydrodesktop.org](http://www.hydrodesktop.org)



The screenshot shows the HydroDesktop project page on CodePlex. The page includes a navigation menu with tabs for Home, Downloads, Documentation, Discussions, Issue Tracker, Source Code, People, and License. A search bar is located in the top right corner. The main content area features a "Project Summary" section with a description of the application and a "Building the HydroDesktop Team" section with a list of links for further information. A sidebar on the right contains a "Download" button, a table of project details (CURRENT, DATE, STATUS, RATING, MORE), an "Activity" section with a table of statistics (Page Views, Visits, Downloads, Application Runs), and a "View Detailed Stats" button.

**HydroDesktop**  
CUAHSI Open Source Hydrologic Data Tools

CodePlex Open Source Community

twitvine Sign Out CodePlex Home

Search all CodePlex projects Search

Home Downloads Documentation Discussions Issue Tracker Source Code People License RSS

Create New Page Edit View All Comments Print View Page Info Change History (all pages) Search Wiki & Documentation

Home

Getting HydroDesktop, Presentations and Publications, Version Features, Sample Data, Workshops and Training

## Project Summary

HydroDesktop is a free and open source desktop application developed in C# .NET that serves as a client for CUAHSI HIS WaterOneFlow web services data and includes data discovery, download, visualization, editing, and integration with other analysis and modeling tools.

### Building the HydroDesktop Team

This is an open project that is actively seeking partners to help with coding and testing. If you are interested in working with us on the project, please introduce yourself using the [Discussions](#) tab. Also, you may want to start by reading the HydroDesktop [Functional Specifications](#). Finally you may want to take a quick look at the [Presentations and Publications](#) that introduce and describe the project. We look forward to meeting you and working with you on this project!

- » Go to the Discussions Page <http://hydrodesktop.codeplex.com/Thread/List.aspx> to introduce yourself
- » Look at the [Database Structure](#) for HydroDesktop
- » Read the [Functional Specifications](#)
- » Look at the [Documentation](#) for HydroDesktop users and developers

★ Mark as a favorite project

**Download**

CURRENT	1.1 Beta RC6
DATE	Tue Aug 31 2010 at 7:00 AM
STATUS	Beta
RATING	No Ratings 412 downloads
MORE	<a href="#">View all downloads</a>

### Activity

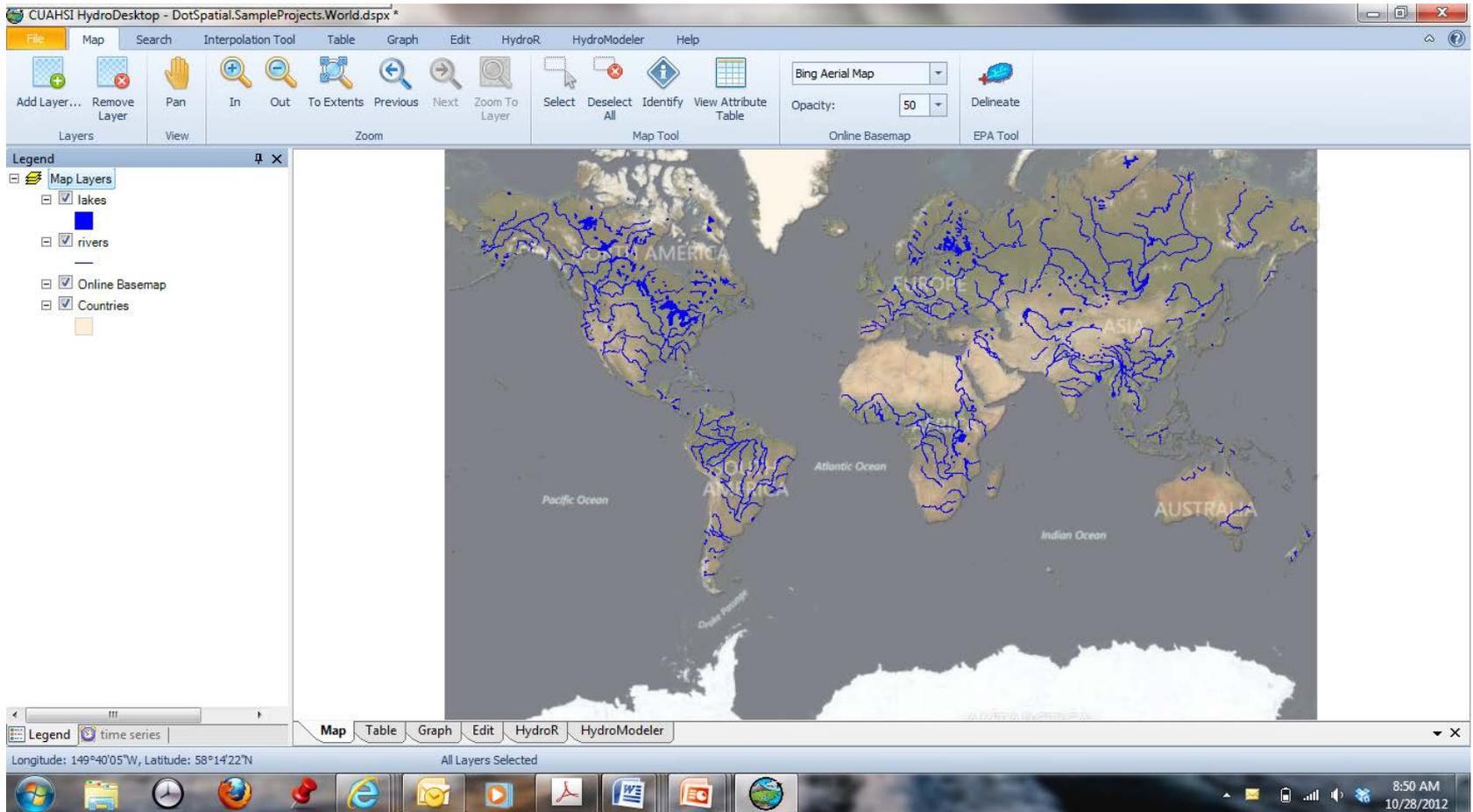
7 30 All days

Page Views	1556
Visits	284
Downloads	198
Application Runs	N/A

[View Detailed Stats](#)

### Related Projects

# HD-Opening Screen



# Select Area of Interest

The screenshot displays the CUAHSI HydroDesktop application window. The title bar reads "CUAHSI HydroDesktop \*". The menu bar includes "Home", "Table", "Graph", "Edit", and "Help". The toolbar contains various map navigation and analysis tools: Search, Pan, Zoom In, Zoom Out, MaxExtents, Previous, Next, Add, Identify, Select, Attribute, Measure, Delineate, EPA Tool, and Online Basemap. The "Map Tools" section is active, showing "ESRI World Street Map" and "Opacity 100".

On the left, the "Map Layers" panel is open, showing a list of layers with checkboxes: Themes, Online Basemap, Base Map Data, lakes, rivers, U.S. HUC, U.S. Counties, Canada Provinces (highlighted), U.S. States, and Countries. The "Canada Provinces" layer is expanded, showing "NAME".

The central map shows a geographical view of the Niagara region, including Lake Ontario, Hamilton, St. Catharines, and Buffalo. Major roads and water bodies are visible.

On the right, a search panel is open with tabs for "Area", "Options", "Keywords", "Results", and "Search Management". The "Area" tab is selected. It shows "Active Layer" as "Canada Provinces" and "Select Field" as "NAME". The "Select Search Parameter" list includes "NAME", "Alberta", "British Columbia", "Manitoba", "New Brunswick", "Newfoundland and L...", "Northwest Territories", "Nova Scotia", "Nunavut", and "Ontario".

Below the search panel, there is a "Search Summary" section with "Server" as "HIS Central" and "Area" as "0 features selected". A "Web Services" section shows "All Webservices selected". A "Keywords" section has a "Date Range" of "6/15/2006 ::: 6/15/2011". A "Run Search" button is located at the bottom right of the search panel.

At the bottom left of the application window, the coordinates are displayed: "Longitude: 78°26'10"W, Latitude: 42°54'11"N".

# Select Constituents of Interest

The screenshot displays the CUAHSI HydroDesktop software interface. The main window shows a map of a river basin with various data layers overlaid. The 'Map Layers' panel on the left lists several layers, including 'Search Results', 'Themes', 'Online Basemap', 'Base Map Data', and 'U.S. HUC'. The 'Search Results' layer is active, showing a table of data points. The table has columns for 'Data Source', 'Site Name', and 'Var Name'. The table shows two rows of data: one for NPCA at the Virgil site with Streamflow data, and another for NPCA at the Decew site with Streamflow data. The 'Save data to...' section offers options to save to a 'New Theme' or an 'Existing Theme'. The 'Search Summary' section provides details about the search area, including the server (HIS Central), the search area (rectangle), and the keywords (Discharge, stream, Coliform, fecal, Nutrient). The 'Date Range' is set from 6/15/2006 to 6/15/2011. A 'Run Search' button is visible at the bottom right of the search summary section.

Longitude: 78°34'27"W, Latitude: 43°10'51"N

# Examine Metadata

Attribute Table Editor

Edit View Selection Tools

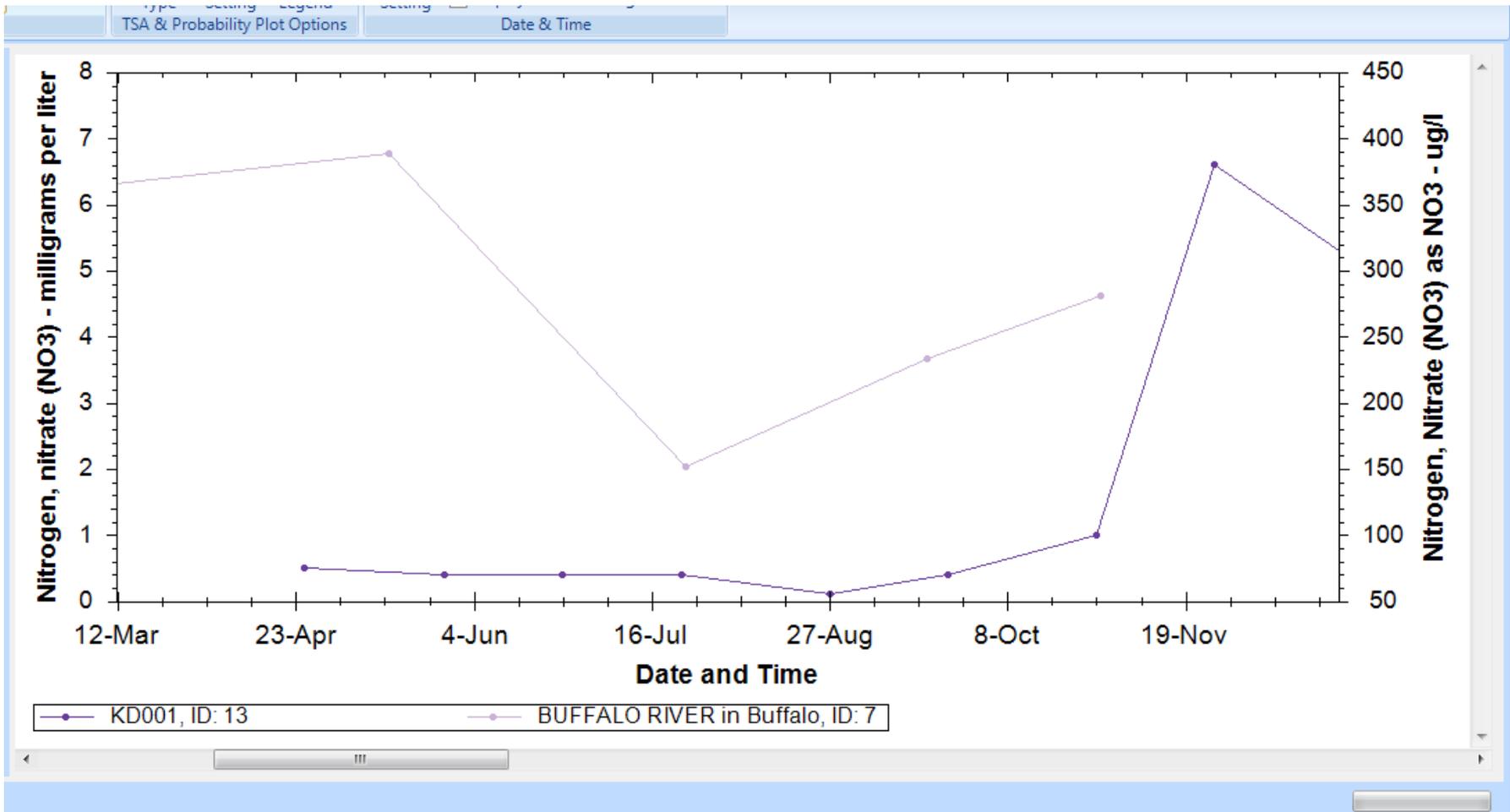
DataSource	SiteName	VarName	SiteCode	VarCo
EPA	CAYUGA CREEK IN Cheektowaga	Inorganic nitrogen (nitrate and nitrite) as N	EPA:21NYDECA:...	EPA:3
EPA	CAZENOVIA CREEK In Buffalo	Inorganic nitrogen (nitrate and nitrite) as N	EPA:21NYDECA:...	EPA:3
EPA	BUFFALO R. IN BUFFALO	Inorganic nitrogen (nitrate and nitrite) as N	EPA:21NYDECA...	EPA:3
EPA	MUD CREEK IN RAYMOND	Inorganic nitrogen (nitrate and nitrite) as N	EPA:21NYDECA:...	EPA:3
NWISIID	NI1093	NH3+orgN, wf	NWISIID:431500...	NWISI
NWISIID	E2642	NH3+orgN, wf	NWISIID:425749...	NWISI
EPA	BUFFALO R. IN BUFFALO	Nitrite as N	EPA:21NYDECA...	EPA:1
NWISIID	NI1093	Nitrite, wf	NWISIID:431500...	NWISI
NWISIID	E2642	Nitrite, wf	NWISIID:425749...	NWISI
NWISIID	E2642	Nitrite, wf	NWISIID:425749...	NWISI
EPA	CAYUGA CREEK IN Cheektowaga	Nitrogen, Kjeldahl	EPA:21NYDECA:...	EPA:3
EPA	MUD CREEK IN RAYMOND	Nitrogen, Kjeldahl	EPA:21NYDECA:01	EPA:3
EPA	TONAWANDA CREEK IN Rapids	Nitrogen, Kjeldahl	EPA:21NYDECA:...	EPA:3
EPA	CAZENOVIA CREEK In Buffalo	Nitrogen, Kjeldahl	EPA:21NYDECA:...	EPA:3
EPA	BUFFALO CREEK In Gardenville	Nitrogen, Kjeldahl	EPA:21NYDECA:...	EPA:3
EPA	BUFFALO RIVER in Buffalo	Nitrogen, Kjeldahl	EPA:21NYDECA:...	EPA:3
EPA	RANSOM CREEK IN CLARENCE	Nitrogen, Kjeldahl	EPA:21NYDECA:...	EPA:3
NPCA	FR001	Nitrogen, nitrate (NO3)	NPCA:FR001	NPCA:
NPCA	WR010	Nitrogen, nitrate (NO3)	NPCA:WR010	NPCA:
NPCA	WW001	Nitrogen, nitrate (NO3)	NPCA:WW001	NPCA:

# Select Series for Download

The screenshot displays the CUAHSI HydroDesktop application window. The main map area shows a satellite view of the Niagara River region with numerous data points overlaid, including red squares, blue triangles, and green squares. The 'Map Layers' panel on the left is expanded to show 'Search Results' with a list of selected series: EPA (red square), NPCA (green square), NWISDV (blue triangle), NWISIID (blue triangle), and NWISUV (blue triangle). Below this, the 'Themes' panel is also expanded, showing 'Niagara Tribs' with sub-items NPCA and NWISUV. Other map layers include 'Online Basemap', 'Base Map Data' (lakes, rivers), 'U.S. HUC', 'U.S. Counties', 'Canada Province' (NAME), 'U.S. States' (NAME), and 'Countries'. The 'Search Results' panel on the right shows a table with 15 selected series out of 438. The table has columns for Data Source, Site Name, and Variable Name. Below the table are options to save data to a new theme or an existing theme, and a 'Download Data' button. The 'Search Summary' panel shows the server as HIS Central, the area as a rectangle with coordinates, and the keywords as Discharge, stream, Coliform, fecal, and Nutrient. A 'Run Search' button is at the bottom right.

Longitude: 79°04'18"W, Latitude: 42°52'11"N

# View Data



# GIS fully integrated with HIS

The screenshot displays the CUAHSI HydroDesktop interface. The main window shows a map of the Austin, Texas area with several blue triangles indicating data points. The interface includes a menu bar (Home, Table, Graph, Edit, Help), a toolbar with various GIS tools (Search, Pan, Zoom In, Zoom Out, Max Extents, Previous, Next, Add, Identify, Select, Attribute, Measure), and a Map Layers panel on the left. The Map Layers panel lists several layers, including "Search Results", "NWISDV", "Themes", "Online Basemap", "Base Map Data", "lakes", "rivers", "U.S. HUC", "U.S. Counties", "U.S. States", "Canada Provinces", and "Countries".

Overlaid on the map is a white callout box containing the following text:

- Metadata catalog
- Ontology keywords
- WaterOneFlow/WaterML

On the right side of the interface, there is a search panel with tabs for "Area", "Options", "Keywords", "Results", and "Search Management". The "Keywords" tab is active, showing a search input field with "Discharge, stream" and a list of search results. A second white callout box is overlaid on the search panel, containing the text:

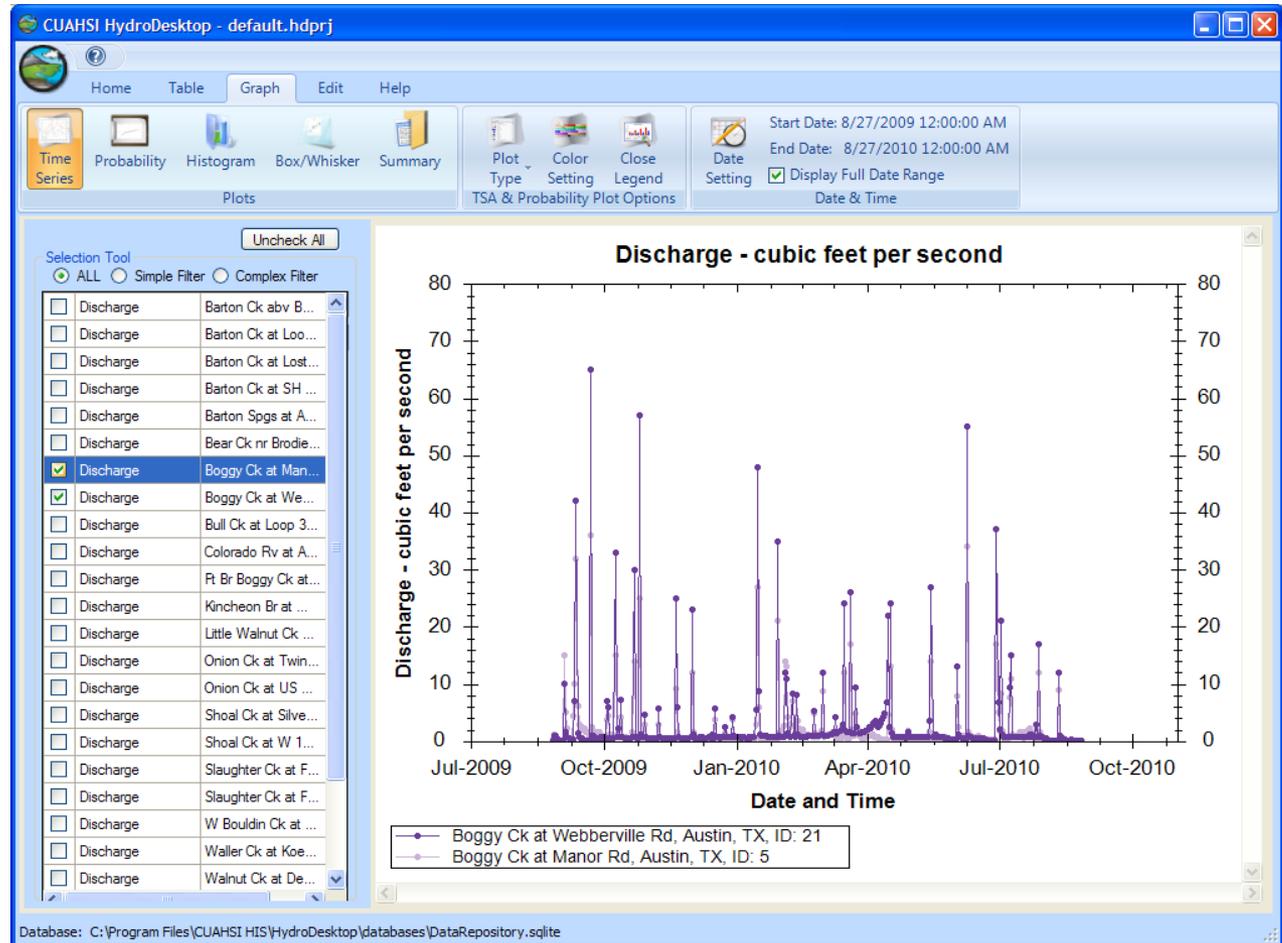
Discovery  
Access  
Analysis

At the bottom of the search panel, there is a "Run Search" button and a "Keywords Display" section with radio buttons for "List", "Tree", and "Both". The "Date Range" is set to "8/27/2009 :: 8/27/2010".

The status bar at the bottom of the window displays the coordinates: "Longitude: 97°23'39\"W, Latitude: 30°23'28\"N".

# Built-in Analysis

- Tables
- Graphs
- Editing
- Export



# Prototype Web-based Client

https://data.cuahsi.org/#

Prototype HIS Faceted Search Between 2000-01-01 and 2013-01-09 API HIS My Data (7)

### Available Data

- Sample Medium (5 options)
- Organization (4 options)
- Variable Name (1287 options)
- Data Type (3 options)
- Value Type (4 options)
- Network (7 options)

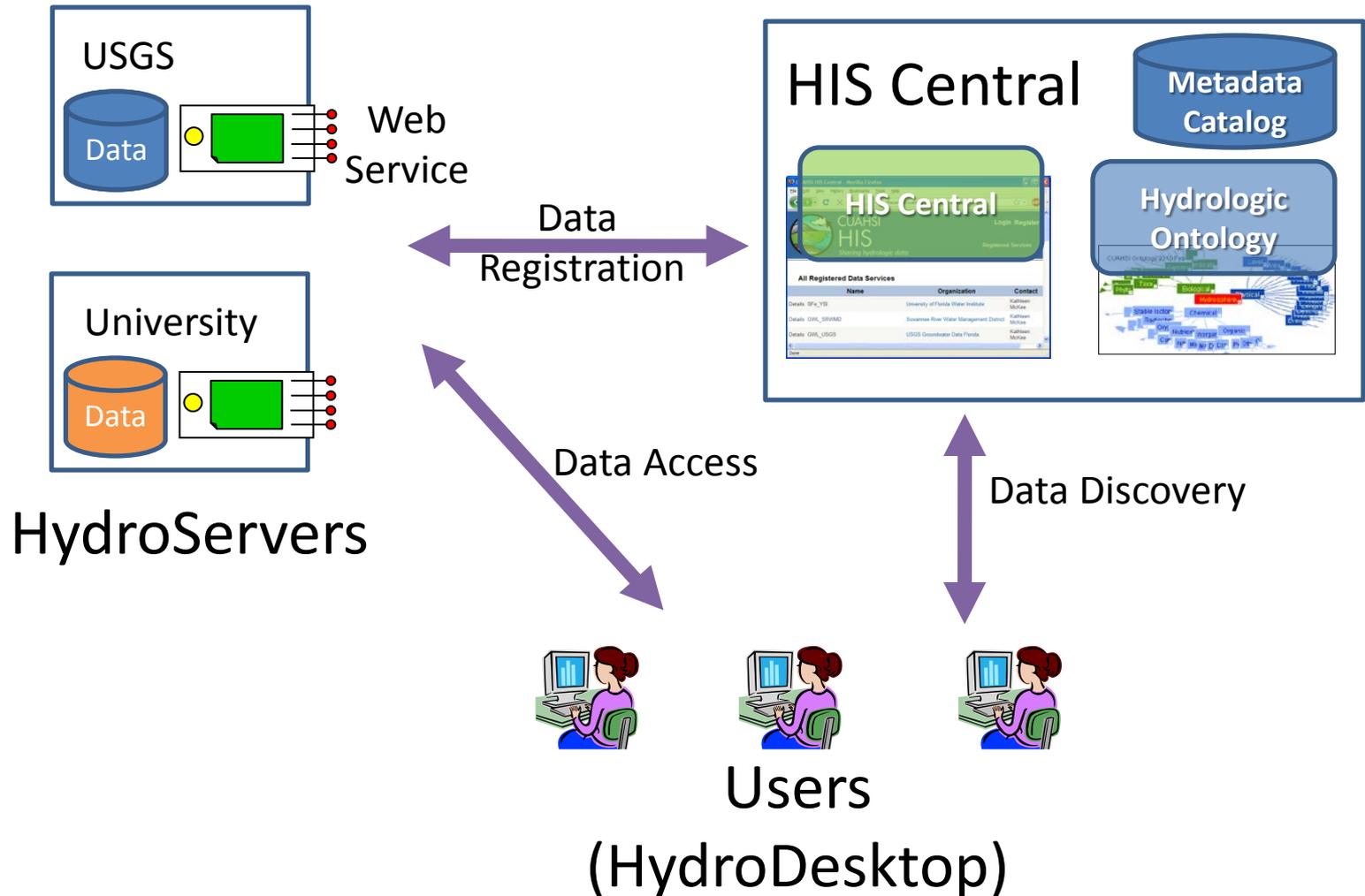
**Search**

Showing sites of data where Data Type equals Instantaneous, or Sporadic, or Continuous on the map.

5:36 AM  
1/9/2013

<https://data.cuahsi.org>

# HIS System Overview



# Getting Water Data (the old way)

## Different Query Pages

## Different Query Responses

USGS Surface-Water Daily Data for the Nation - Mozilla Firefox

USGS Home Contact USGS Search USGS

National Water Information System: Web Interface

USGS Water Resources Data Category: Surface Water Geographic Area: United States GO

USGS Surface-Water Daily Data for the Nation

Surface-water [daily data example](#).

Select sites which meet all of the following criteria:  
Define one or more values for each of the following site-selection criteria: --- or select [new criteria](#)

EPA > STORET > Stations by Organization and Station ID - Mozilla Firefox

U.S. ENVIRONMENTAL PROTECTION AGENCY

STORET

Stations by Organization and Station ID (stormod\_)

station

Select an Organization and a Search Type, then enter a Search String and click "Search Stations".

ORG ID ORGANIZATION NAME

Select an Organization

Search Type

Search by Station ID  
 Search by Station Name  
 Search by Station Alias

Select Station Alias Type: STANDARD Look Up

Search String

Search Stations

Mozilla Firefox

agency_cd	site_no	datetime	01_00010_00011	01_00
USGS	08158000	2007-07-18	14n	10s
USGS	08158000	2007-07-19		
USGS	08158000	2007-07-20		
USGS	08158000	2007-07-21		
USGS	08158000	2007-07-22		
USGS	08158000	2007-07-23		
USGS	08158000	2007-07-24		
USGS	08158000	2007-07-25		
USGS	08158000			

Mozilla Firefox

```
<OrganizationIdentifier>10001684</OrganizationIdentifier>
<OrganizationFormalName>Texas Commission on
Environmental Quality</OrganizationFormalName>
</OrganizationDescription>
- <Activity>
- <ActivityDescription>
<ActivityIdentifier>10001684</ActivityIdentifier>
<ActivityTypeCode>Field
Msr/Obs</ActivityTypeCode>
<ActivityMediaName>Other</ActivityMediaName>
<ActivityStartDate>2005-09-27</ActivityStartDate>
<ProjectIdentifier>24</ProjectIdentifier>
</ActivityDescription>
- <MonitoringLocation>
<MonitoringLocationIdentifier>11362</MonitoringLocationIdentifier>
<MonitoringLocationName>DREYFUS DAM/OUTLET
```

# WaterML includes location, variables, and time series

```

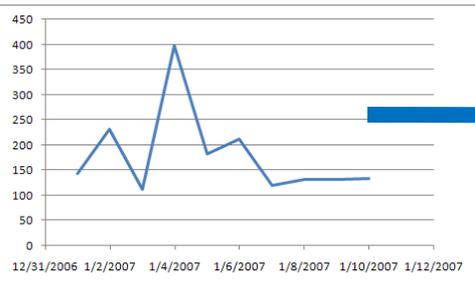
<timeSeriesResponse xmlns:gml="http://www.opengis.net/gml" xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:wtr="http://www.cuahsi.org/waterML/"
  xmlns="http://www.cuahsi.org/waterML/1.0/">
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  <timeSeries>
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      <geoLocation>...
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    </sourceInfo>
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      <variableName>Discharge</variableName>
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      <value qualifiers="A" dateTime="2007-01-02T00:00:00">231</value>
      <value qualifiers="A" dateTime="2007-01-03T00:00:00">112</value>
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      <value qualifiers="A" dateTime="2007-01-05T00:00:00">182</value>
      <value qualifiers="A" dateTime="2007-01-06T00:00:00">212</value>
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      <value qualifiers="A" dateTime="2007-01-09T00:00:00">132</value>
      <value qualifiers="A" dateTime="2007-01-10T00:00:00">133</value>
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        Approved for publication -- Processing and review completed.</qualifier>
    </values>
  </timeSeries>
</timeSeriesResponse>
  
```



location



variable



time series

# Web Pages and Web Services

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



UNIVERSITY OF MINNESOTA One Stop | Directories | Search U. of M.

What's inside

- About Us
- Personnel
- Research
- Facilities
- Publications
- Awards
- Seminar Series
- External Academic Review Board
- Prospective Students

**SAFL Home**

---

Related Links

- [NCED](#)
- [Dept. of Civil Engineering](#)
- [Dept. of Geology & Geophysics](#)
- [Geology & Geophysics](#)
- [Evolution. &](#)

## ST. ANTHONY FALLS LABORATORY

ENGINEERING, ENVIRONMENTAL, BIOLOGICAL, AND GEOPHYSICAL FLUID MECHANICS

### Research Spotlight: Summer Interns Rock



Summer interns Daniela Martinez and Viviana Berrios measure rock size on the Sandy River in Oregon, where they conducted field research relating to the removal of the Marmot Dam. To learn more about other research conducted by our summer interns, please [click here](#).

For previous Research Spotlight pages, please [click here](#).

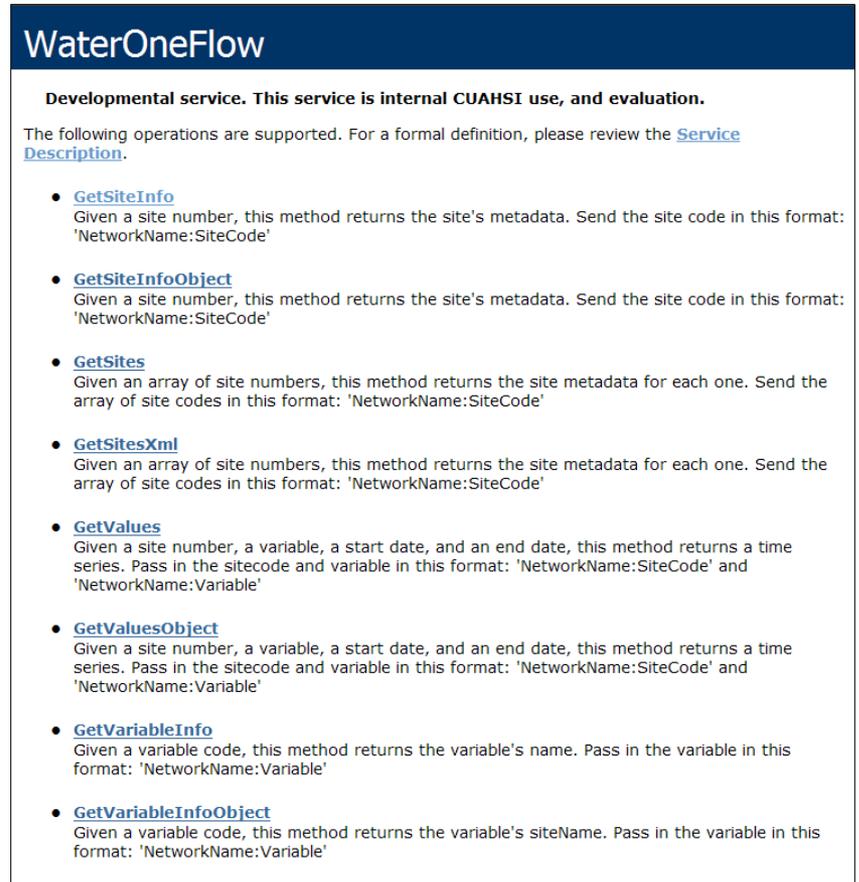
### Who We Are

SAFL is the world's only fluid-mechanics laboratory that uses a natural waterfall as its prime water source. For nearly 70 years researchers from around the world have been visiting our unique location on an island in the Mississippi River to conduct research for developing innovative and sustainable engineering solutions to major environmental, water-resources, and energy-related problems. We would like to extend our warmest invitation to visit our facilities and talk with our research staff and students.

SAFL is also proud to be the headquarters for the [National Center for Earth-surface Dynamics \(NCED\)](#), an NSF Science and Technology Center.

Uses Hypertext Markup Language ([HTML](#))

[http://his.safl.umn.edu/SAFLMC/cuahsi\\_1\\_0.asmx](http://his.safl.umn.edu/SAFLMC/cuahsi_1_0.asmx)



## 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](#).

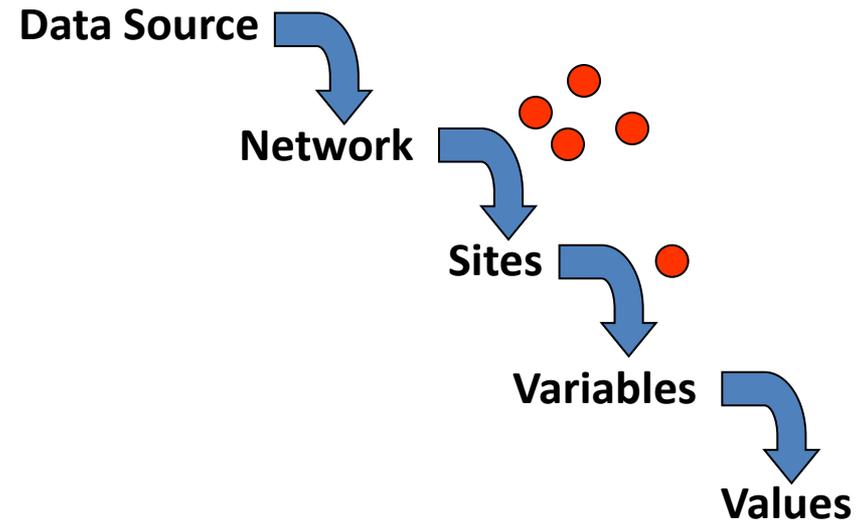
- [GetSiteInfo](#)**  
Given a site number, this method returns the site's metadata. Send the site code in this format: 'NetworkName:SiteCode'
- [GetSiteInfoObject](#)**  
Given a site number, this method returns the site's metadata. Send the site code in this format: 'NetworkName:SiteCode'
- [GetSites](#)**  
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](#)

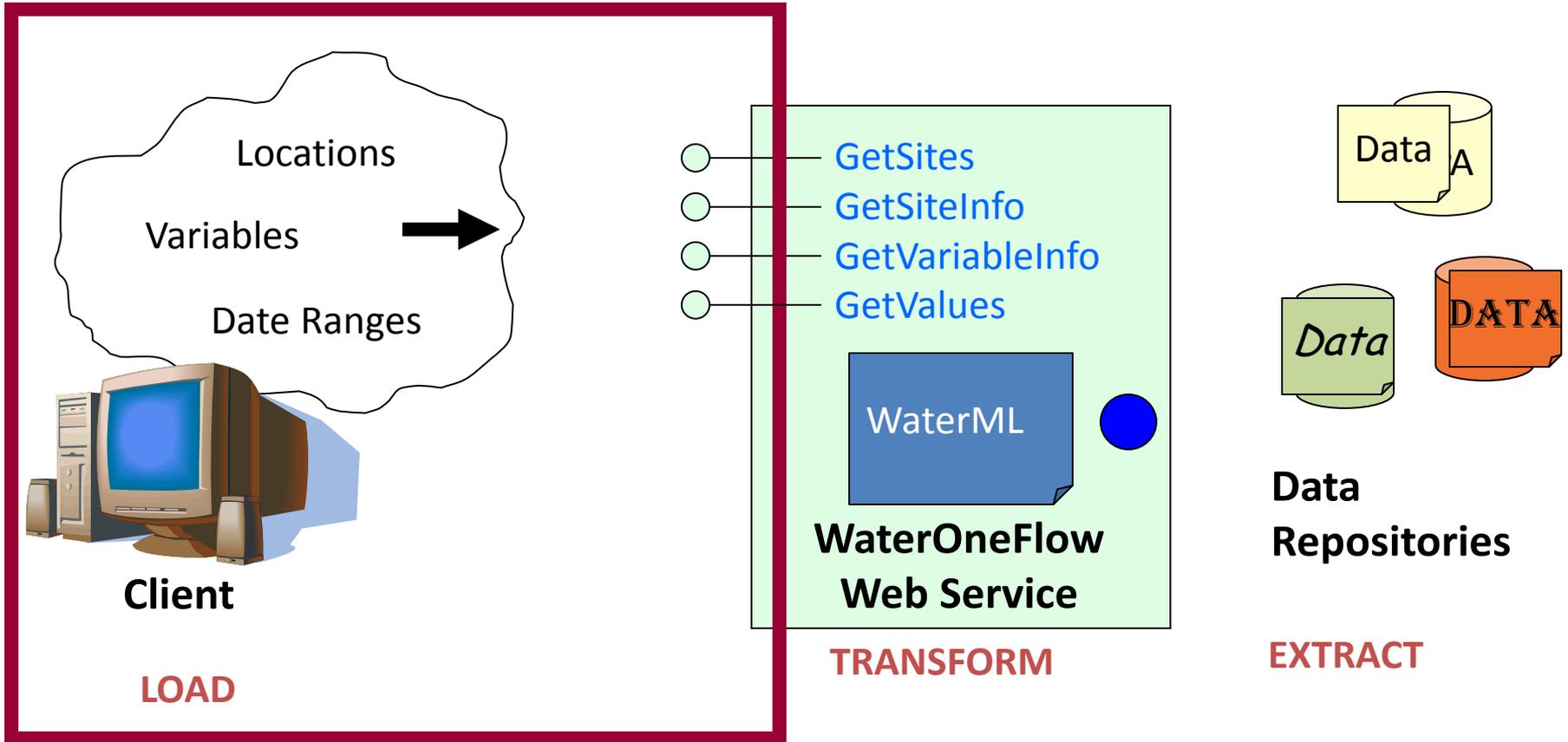
(a Markup Language for water data)

# WaterOneFlow Web Service

- Set of **query** functions
  - Get Sites
  - Get Site Info
  - Get Variable Info
  - Get Values
- Returns data in **WaterML**

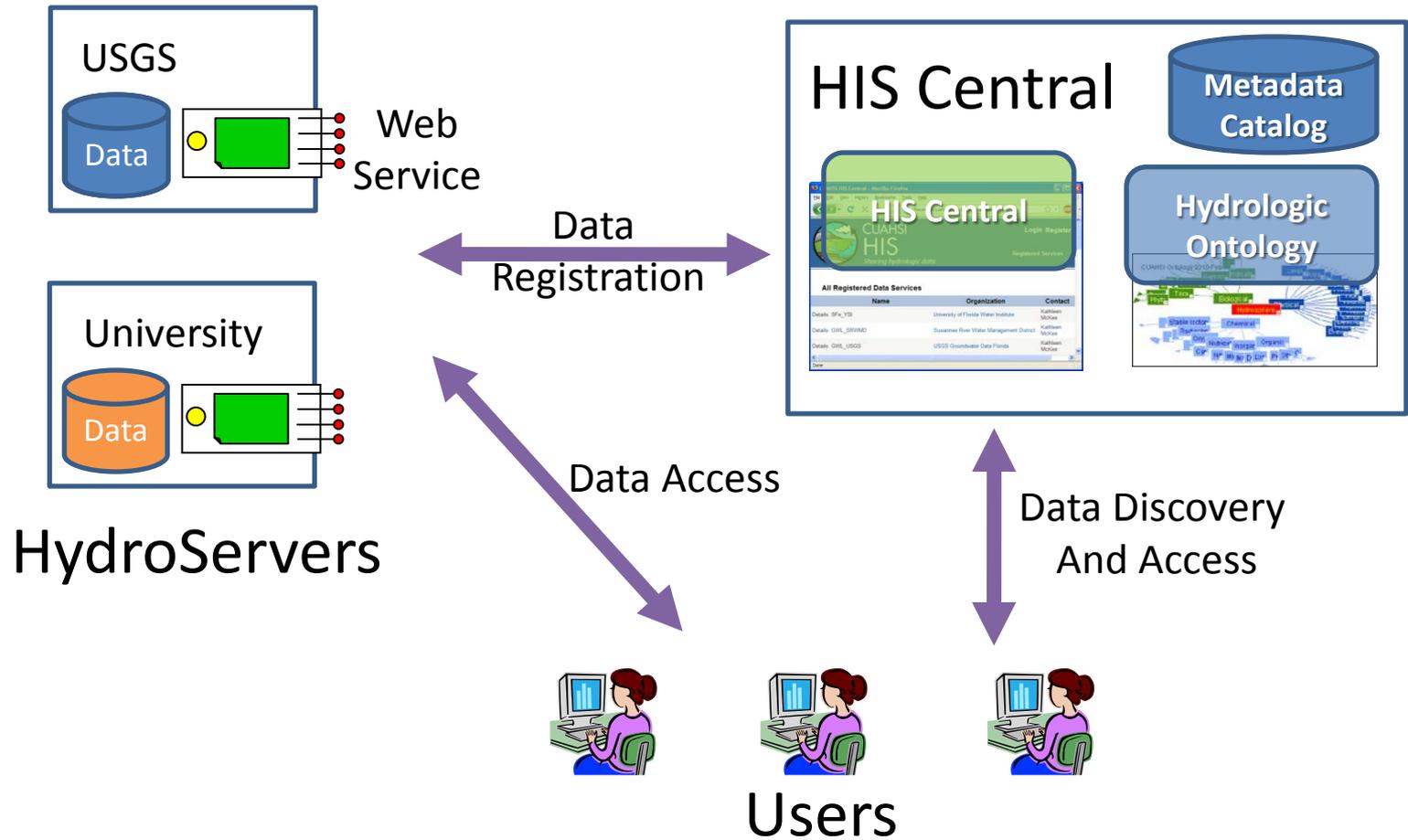


# WaterML and WaterOneFlow



**WaterOneFlow** is how you ask for data  
**WaterML** is the format of what comes back

# HIS System – HydroServer

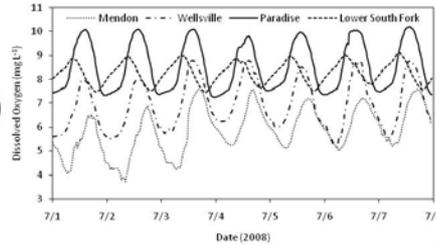


# HydroServer Goals

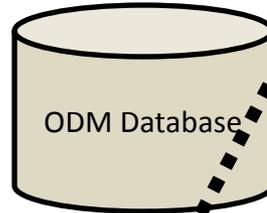
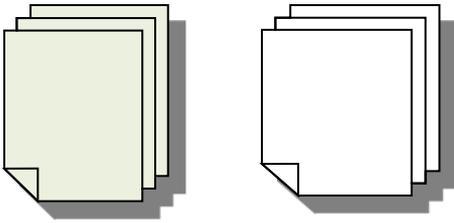
- A platform for publishing space-time hydrologic datasets that:
  - Provides local control of data
  - Makes data universally available
  - Is open source ([hydroserver.codeplex.com](http://hydroserver.codeplex.com))

# Point Observations Data

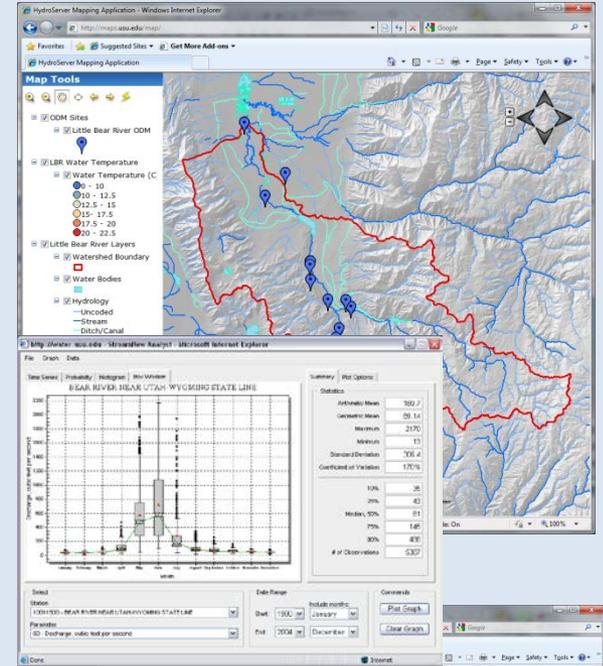
## Ongoing Data Collection



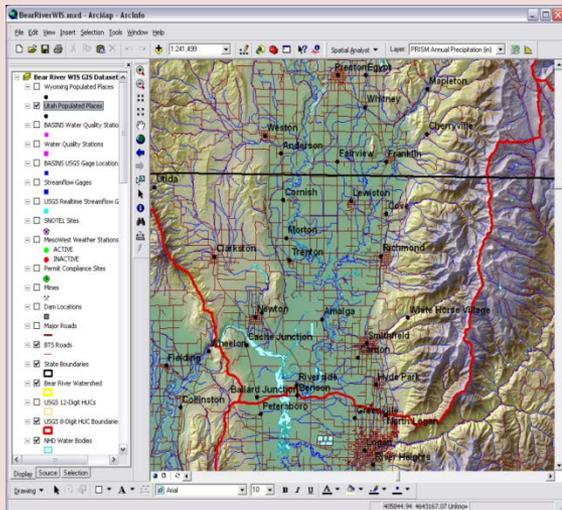
## Historical Data Files



# Internet Applications



# GIS Data

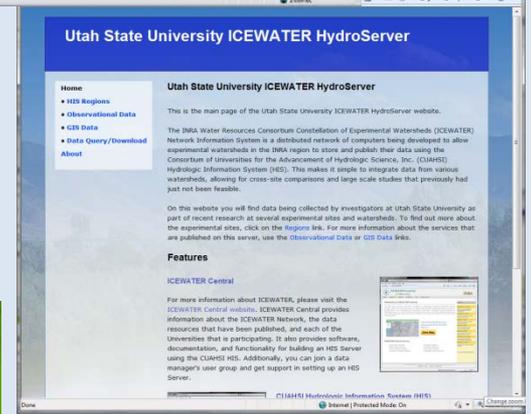


- GetSites
  - GetSiteInfo
  - GetVariableInfo
  - GetValues
- WaterML**
- WaterOneFlow**
- Web Service**

**ArcGIS Server**

# HydroServer

Data presentation, visualization, and analysis through Internet enabled applications



# Operational HydroServers

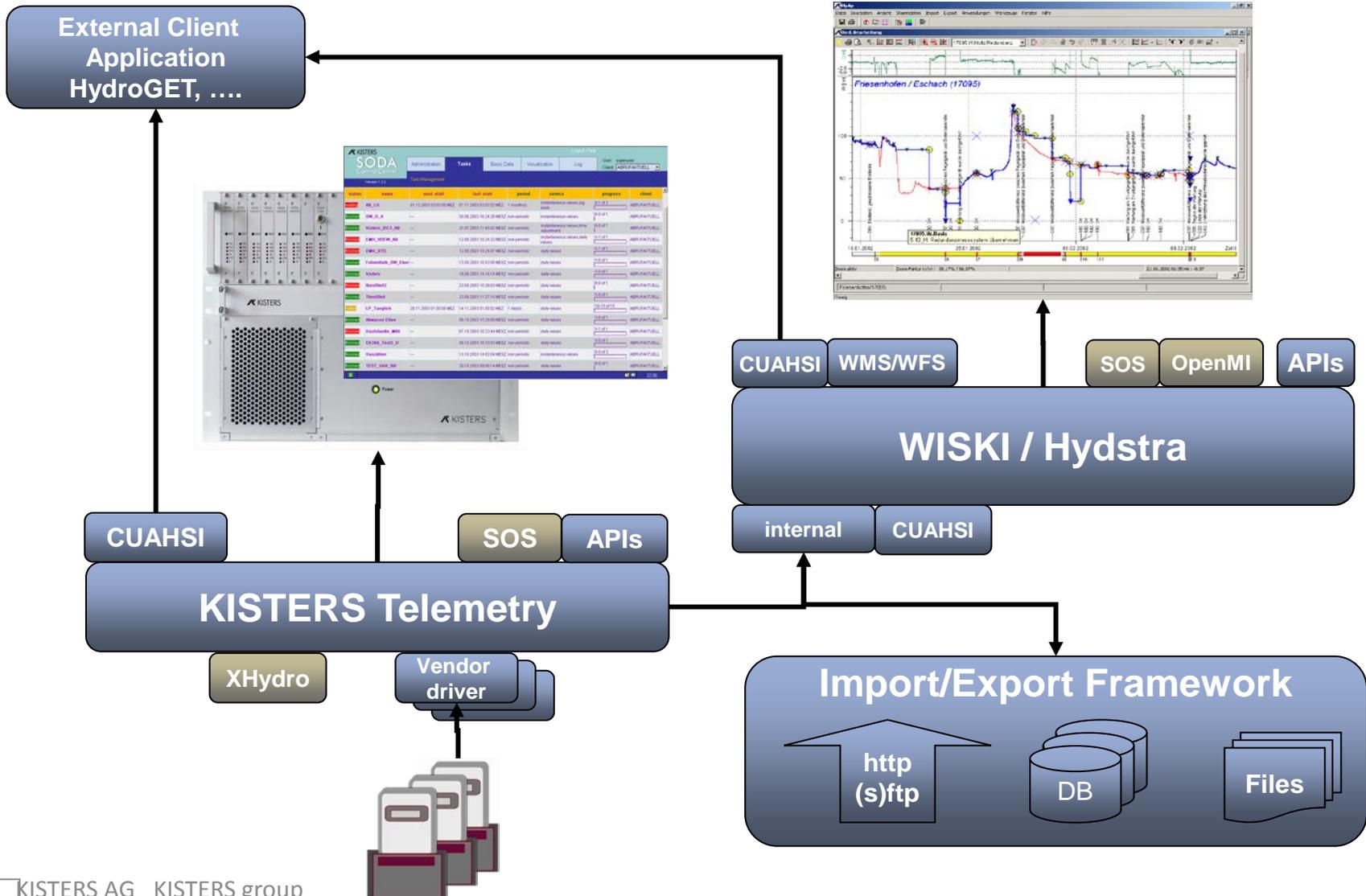
The screenshot shows the homepage of the Utah State University ICEWATER Hydro Server. The header is a blue bar with the text "Utah State University ICEWATER Hydro Server". Below the header is a navigation menu with links: Home, HIS Regions, Observational Data, GIS Data, Data Query/Download, and About. The main content area has a title "Utah State University ICEWATER Hydro Server" and a paragraph explaining that it is the main page of the Utah State University ICEWATER HydroServer website. It describes the SWR Water Resources Consortium Constellation of Experimental Watersheds (ICEWATER) Network Information System as a distributed network of computers being developed to allow experimental watersheds in the SWR region to store and publish their data using the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI) Hydrologic Information System (HIS). It also mentions that on this website, users will find data being collected by investigators at Utah State University as part of recent research at several experimental sites and watersheds. A "Features" section is visible at the bottom, with a sub-section for "ICEWATER Central" and a small screenshot of the ICEWATER Central interface.

<http://icewater.usu.edu/>

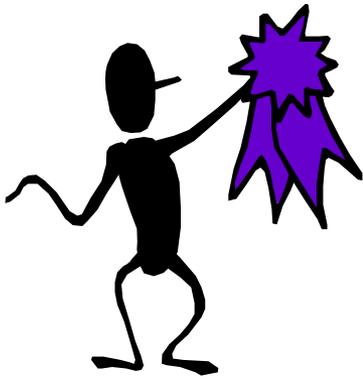
The screenshot shows the homepage of the NPCA Hydrologic Information System. The header is a blue bar with the text "NPCA Hydrologic Information System" and the logo for "NIAGARA PENINSULA CONSERVATION AUTHORITY". Below the header is a navigation menu with links: Home, HIS Regions, Observational Data, GIS Data, Data Query, and About. The main content area has a title "NPCA Hydrologic Information System" and a welcome message: "Welcome to the Niagara Peninsula Conservation Authority Hydrologic Information System Website". A "Features" section is visible, with a sub-section for "CUAHSI Hydrologic Information System (HIS)". It describes that the data hosted on this server have been published using the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI) Hydrologic Information System (HIS). The goals of the CUAHSI Hydrologic Information System (HIS) Project are to unite the nation's water information, to make it universally accessible and useful, and to provide access to the data sources, tools and models that enable the synthesis, visualization and evaluation of the behavior of hydrologic systems. The CUAHSI HIS is a geographically distributed network of hydrologic data sources and functions that are integrated using web services so that they function as a connected whole. The CUAHSI HIS website contains tools for implementing Hydrologic Information Systems. A copyright notice at the bottom reads "© Niagara Peninsula Conservation Authority, 2010".

<http://www.his.npca.ca/hydroserver/>

# HydroServer Alternatives - KISTERS



# Why Publish Data with HIS



Recognition



Collaboration

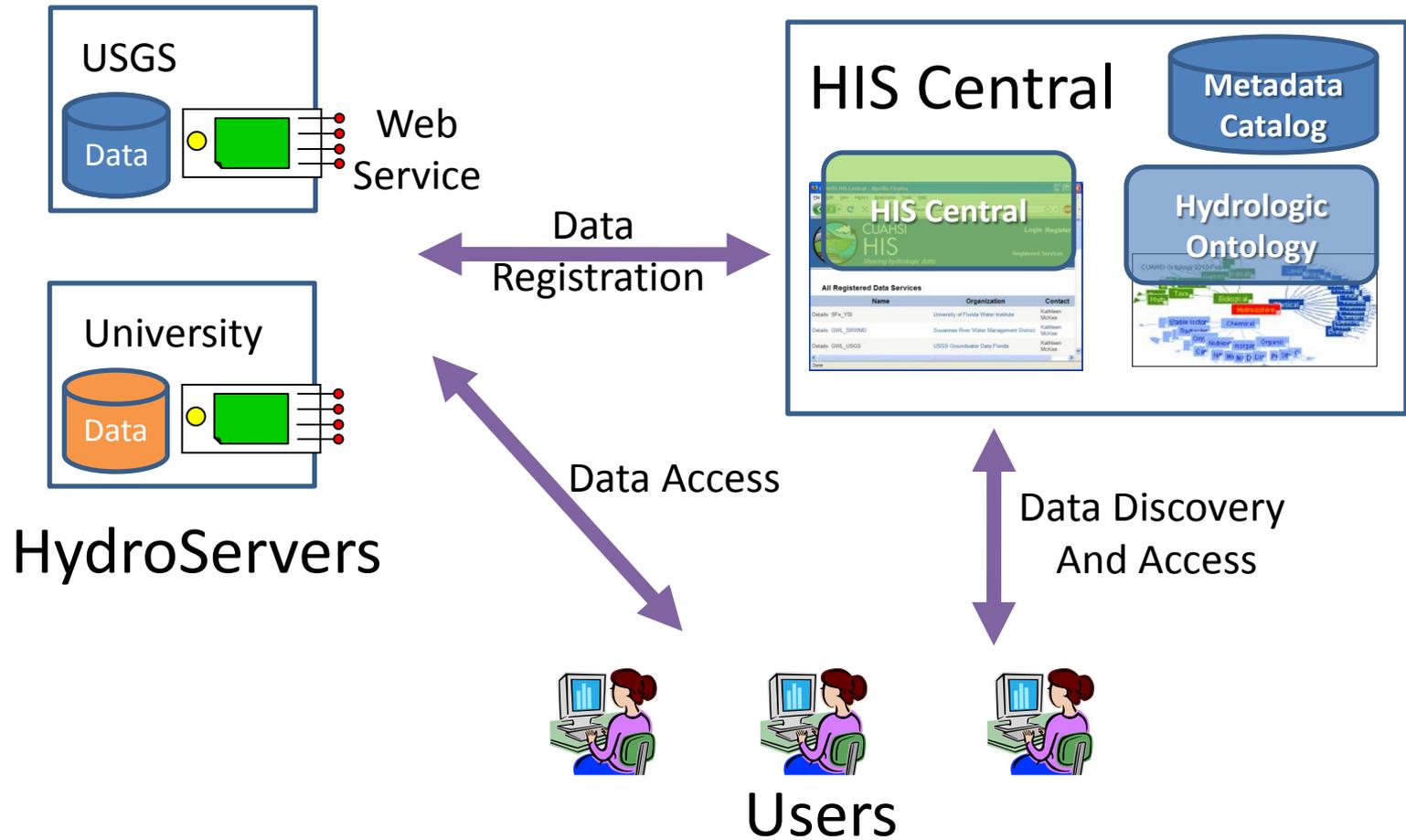


Public service



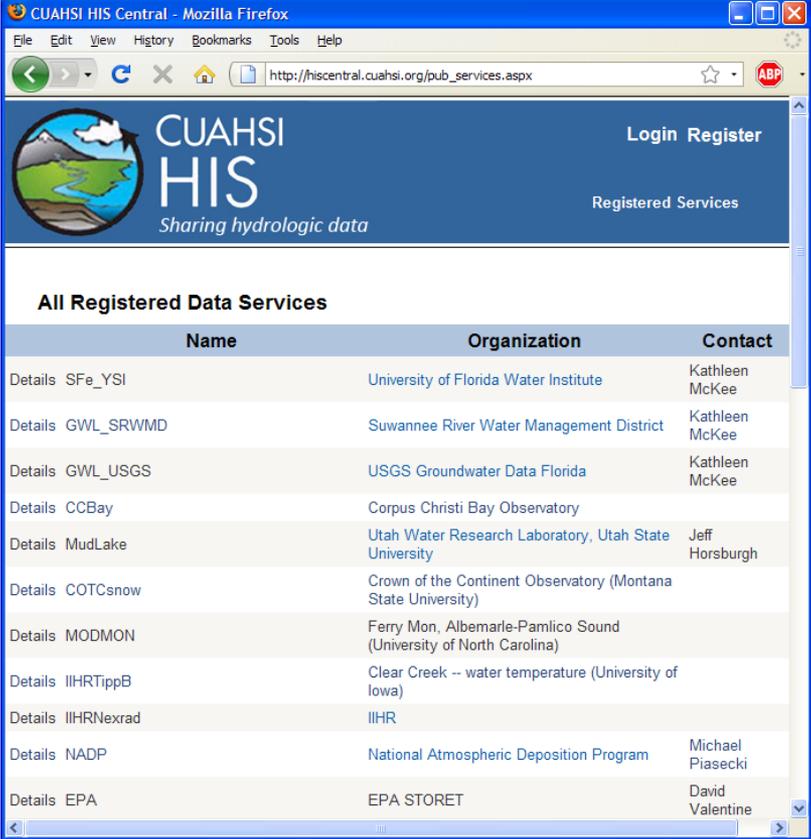
Cost savings

# HIS System – HIS Central



# HIS Central

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



The screenshot shows the HIS Central website interface. The header includes the CUAHSI HIS logo with the tagline "Sharing hydrologic data" and links for "Login Register" and "Registered Services". Below the header, there is a section titled "All Registered Data Services" which contains a table listing various data services.

	Name	Organization	Contact
Details	SFe_YSI	University of Florida Water Institute	Kathleen McKee
Details	GWL_SRWMD	Suwannee River Water Management District	Kathleen McKee
Details	GWL_USGS	USGS Groundwater Data Florida	Kathleen McKee
Details	CCBay	Corpus Christi Bay Observatory	
Details	MudLake	Utah Water Research Laboratory, Utah State University	Jeff Horsburgh
Details	COTCsnow	Crown of the Continent Observatory (Montana State University)	
Details	MODMON	Ferry Mon, Albemarle-Pamlico Sound (University of North Carolina)	
Details	IIHRTippB	Clear Creek -- water temperature (University of Iowa)	
Details	IIHRNexrad	IIHR	
Details	NADP	National Atmospheric Deposition Program	Michael Piasecki
Details	EPA	EPA STORET	David Valentine

<http://hiscentral.cuahsi.org>



# Metadata Catalog

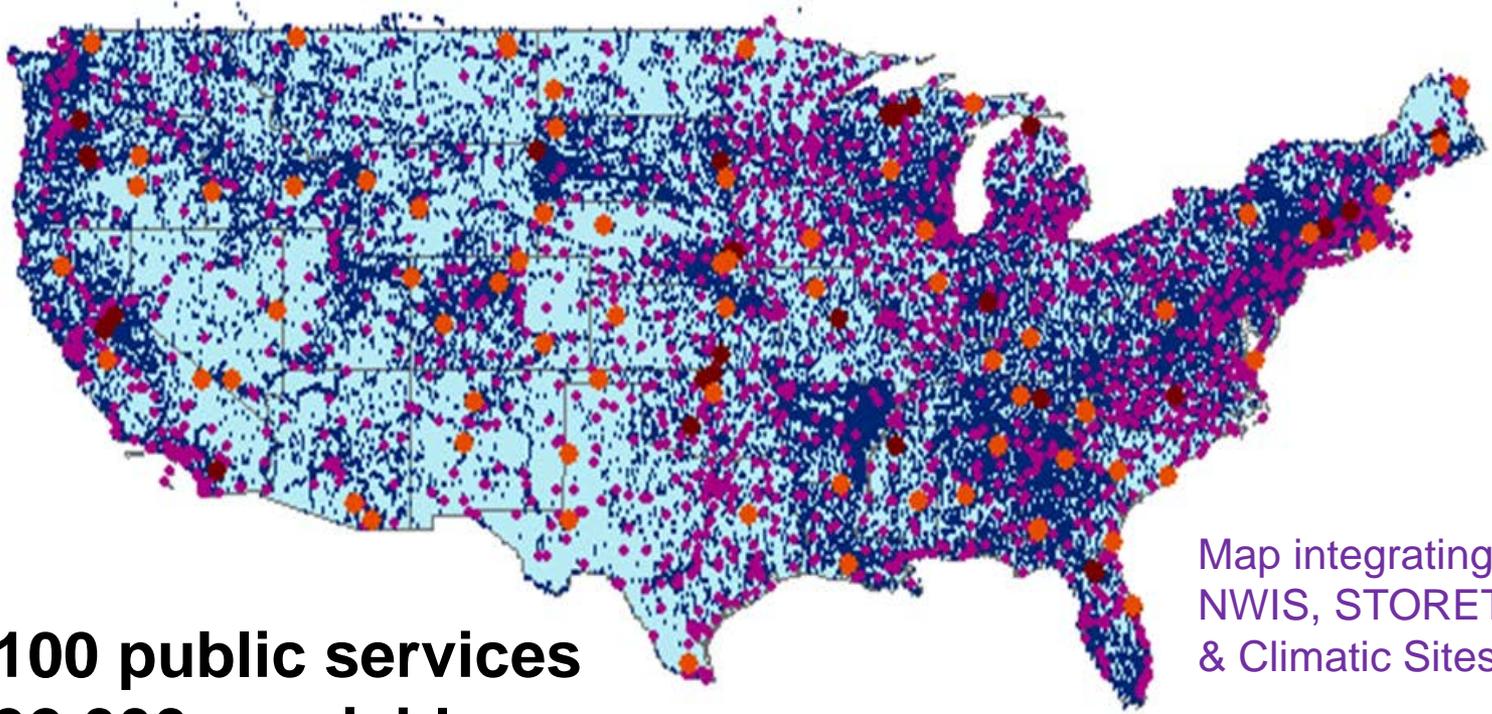
Stores description of time series, e.g.,

*The **USGS** measures **streamflow** at **Waller Creek & Koenig** with data from **7/31/1968** to the **present...***

*...and you can get the data from [here](#).*

Registered services harvested weekly

# Metadata Catalog, October, 2012



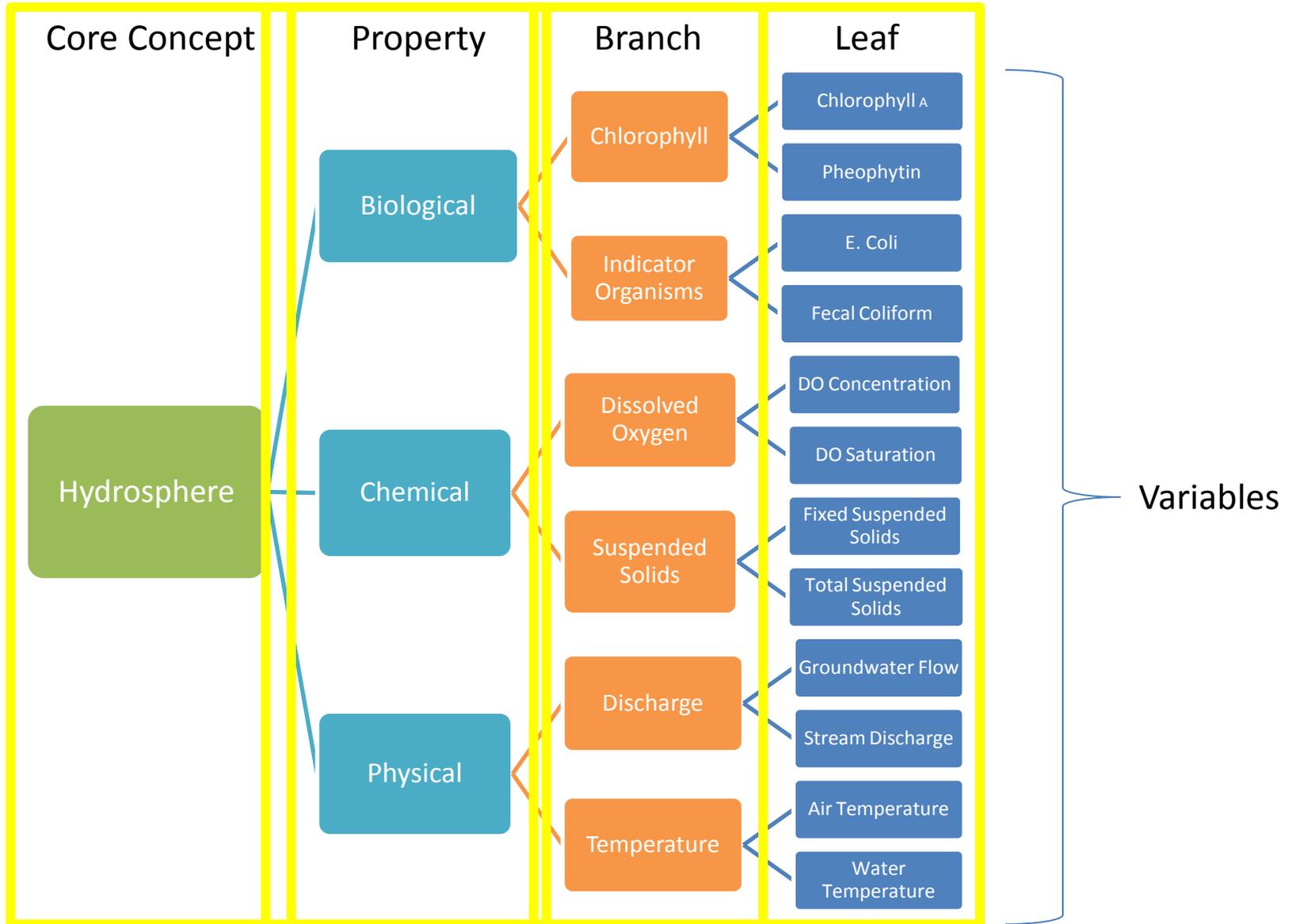
Map integrating  
NWIS, STORET,  
& Climatic Sites

**100 public services**  
**32,000+ variables**  
**2.79 million sites**  
**33.9 million series**  
**Referencing 18+ billion data values**

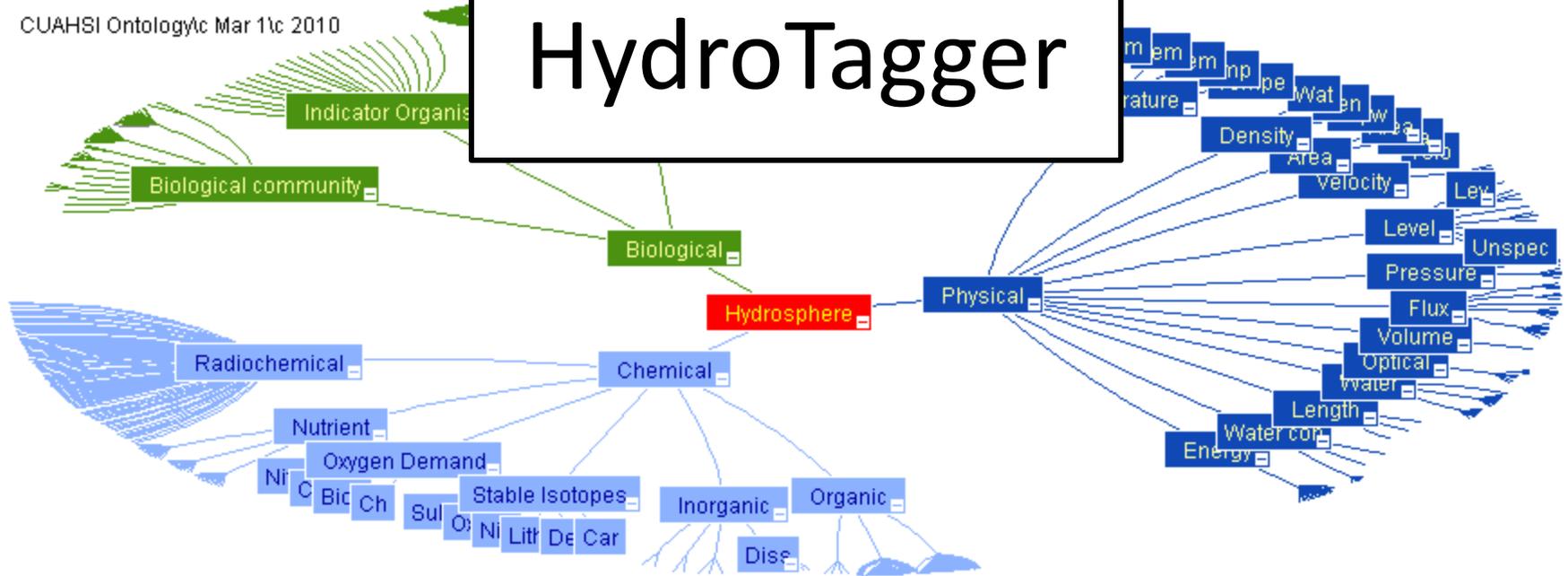
# Ontology: Conceptual Framework

- **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



Star Tree™ created with Inxight VizServer™



Variable Name	Code	Medium	Variable:	Variable	Keyword	
sampling depth, feet	nwisuv:00003	unknown	Temperature, Water, Degree	gage height, feet	water depth, stream	delete
sample accounting number	nwisuv:00008	unknown	Mapping:	discharge, cubic feet per second	discharge, stream	delete
location in cross sectio...	nwisuv:00009	unknown	Temperature, water	barometric pressure, not corrected to sea level, millibars	atmospheric pressure	delete
temperature, water, degr...	nwisuv:00010	unknown	Map!	acoustic signal strength, units		delete
temperature, water, degr...	nwisuv:00011	unknown				

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

# HIS Central Web Page



**CUAHSI  
HIS**  
*Sharing hydrologic data*

[Login](#) [Register](#)

[Home](#) [All Data Services](#)

### All Registered Data Services

Data Service Title	Observation Name
<a href="#">Baltimore Precipitation</a>	BaltPrecip
<a href="#">Baltimore Ecosystem Study Stream Chemistry Data</a>	BESOD
<a href="#">Baltimore Ecosystem Study Soils Data</a>	BESSoil
<a href="#">Baltimore Waters Test Bed Ground Water Level Data</a>	BaltimoreGW
<a href="#">Beacon Institute for River and Estuary</a>	BEACON_IBM
<a href="#">Dry Creek Experimental Watershed, SW Idaho</a>	ODMDCEW2
<a href="#">Chesapeake Bay Information Management System</a>	CIMS



**CUAHSI  
HIS**  
*Sharing hydrologic data*

[Login](#) [Register](#)

[Home](#) [All Data Services](#)

## Dry Creek Experimental Watershed, SW Idaho

**Boise State University, Hydrologic Sciences Department**  
ODMDCEW2  
[http://cewater.boisestate.edu/dcew2dataservices/cuahsi\\_1\\_0.asmx?WSDL](http://cewater.boisestate.edu/dcew2dataservices/cuahsi_1_0.asmx?WSDL)

**Contact:** Pam Aishlin  
pamaishlin@boisestate.edu  
208-426-2220

Service Statistics:		
<b>Sites:</b>	68	
<b>Variables:</b>	24	<b>Geographic Extent:</b>
<b>Values:</b>	4738590	43.74071
		-116.1788
		43.68834
Last Harvested on 7/25/2010 1:12:50 PM		

**Abstract**

Dry Creek Experimental Watershed was established by Dr. Jim McNamara in 1998 as an outdoor laboratory for student and faculty research toward improving understanding of hydrologic processes in semi-arid mountainous terrain and testing and improving data integration and hydrologic modeling. Continuous and discrete data collection includes climate, surface water, groundwater and soil



<http://hiscentral.cuahsi.org>

**Citation**

Boise State University, Hydrologic Sciences Dept,  
Dr. Jim McNamara

# HIS Central *Web Service*

- Programmatic methods to query the national metadata catalog
- Search by:
  - Location
  - Variable (concept)
  - Date Range
  - Data source (WaterOneFlow service)

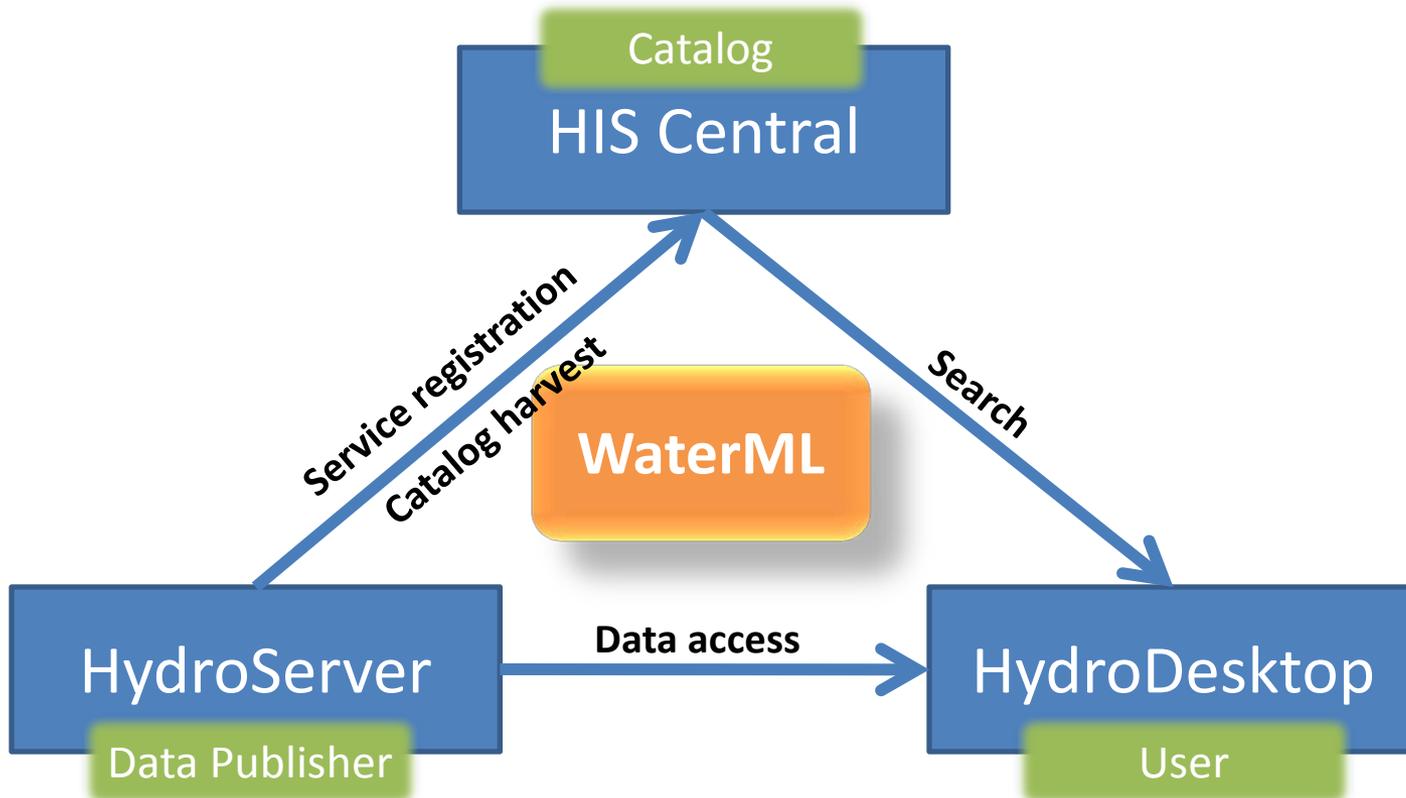
## hiscentral

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>

# Services-Oriented Architecture for Water Data

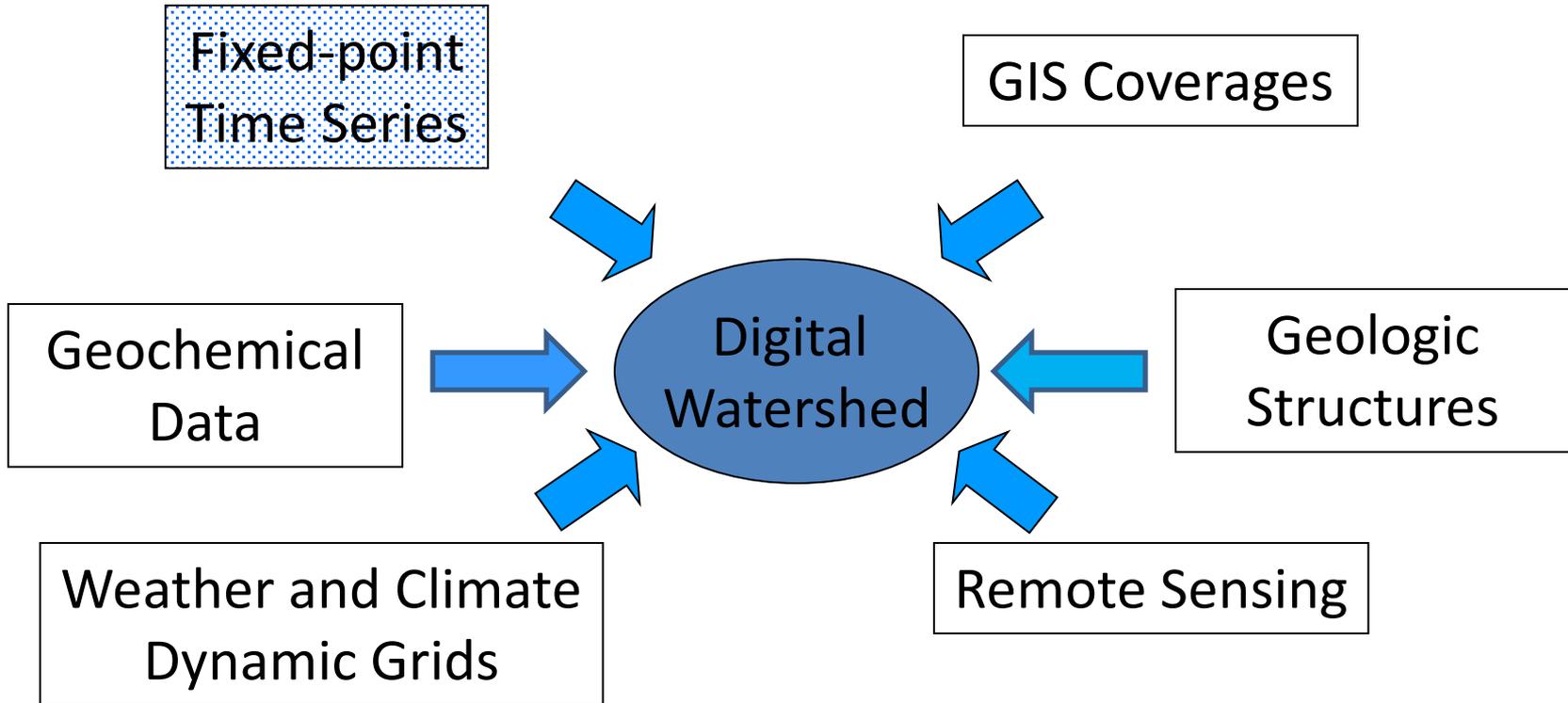




# The Road Ahead – WaterML 2.0

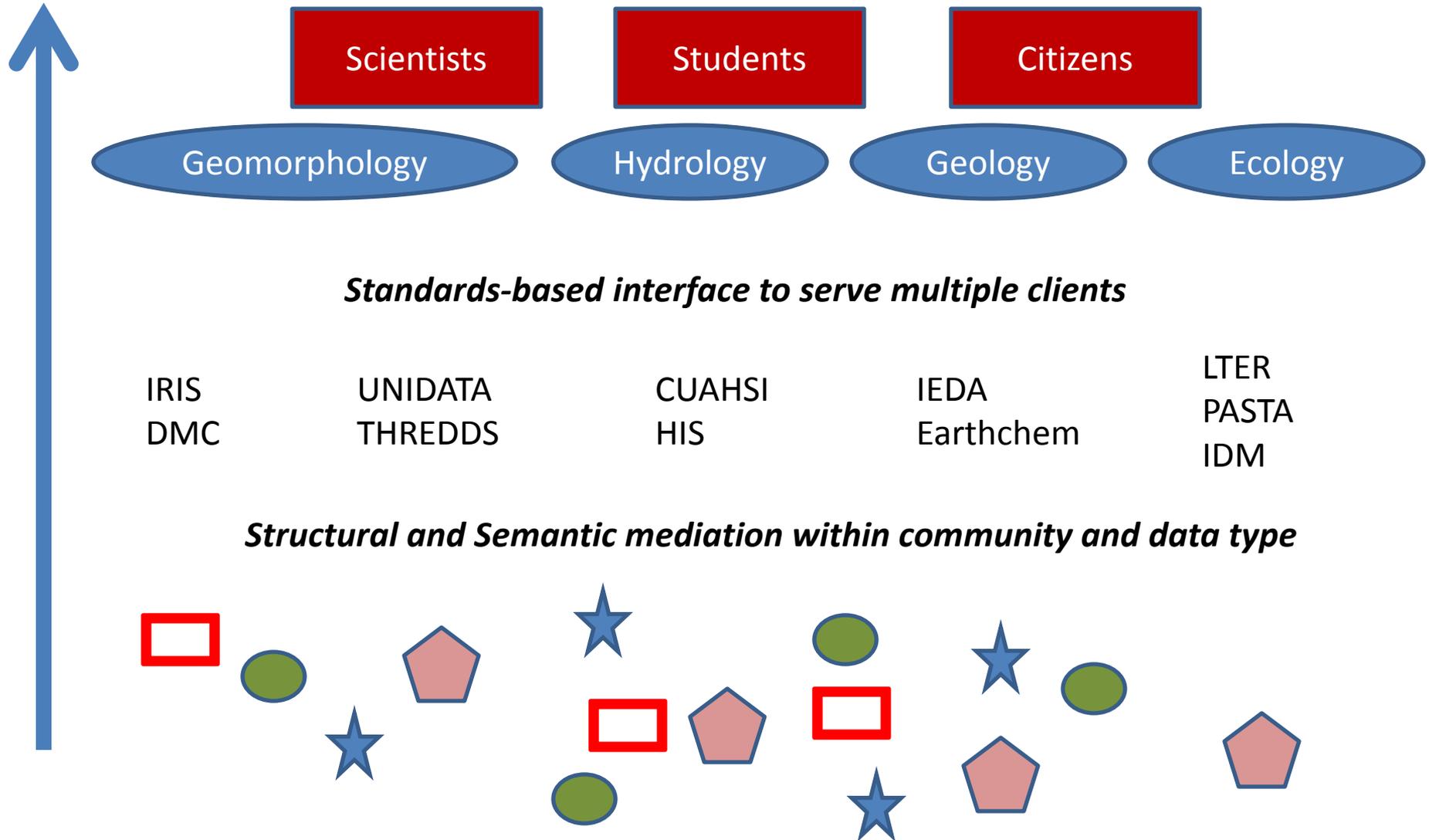
- CUAHSI Water Data Center
  - Recommended for funding at NSF
  - \$800K/yr for 3 yr start-up
- Broader collaboration
  - Hydrology Domain Working Group
    - World Meteorological Organization
    - Open Geospatial Consortium (OGC)
- Towards an international standard
  - OGC standard adopted, July, 2012
  - WMO initiate process to accept as standard Nov., 2012

# Data Integration

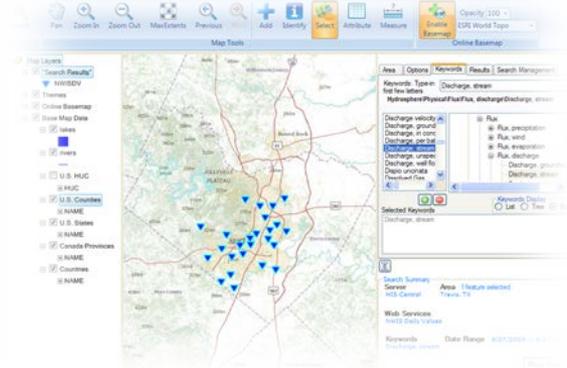


*Currently, the focus is on data from monitoring sites at point locations.*

# Multiple Services, Multiple Clients within a Standards-Oriented Environment



# Start Using HIS!



- HIS Website
  - [his.cuahsi.org](http://his.cuahsi.org)
- Hydrodesktop
  - [www.hydrodesktop.org](http://www.hydrodesktop.org)
- User Support available through CUAHSI
- Contribute to software development

