How does the internet work?

This is how it got started ..... 

Three key components linked by services and a common language

[Diagram showing the connection between web servers, Mosaic browser, Google, Yahoo, Bing, Firefox, Internet Explorer, and the user.] 

.....this is how it works now 

Metadata harvesting 

Search Services
What has CUAHSI Done?

- Taken the internet services model....
  - Server
  - User
  - Catalog
  - Data
  - HydroServer
    - Data Publication
  - Metadata
  - HIS Central
    - Data Discovery and Integration
  - WaterML
    - GML
    - OGC Services
  - Analysis
    - HydroDesktop
      - Data Synthesis and Research
- .... and implemented it for water data

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## All Registered Data Services

<table>
<thead>
<tr>
<th>Data Service Title</th>
<th>Observation Network Name</th>
<th>WSDL</th>
<th>Created Date</th>
<th>Organization</th>
<th>Contact</th>
<th>Status</th>
<th>Earliest Start Date</th>
<th>Latest End Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>NWIS Daily Values</td>
<td>NW/SDV</td>
<td>WSDL</td>
<td>10/30/2008</td>
<td>USGS</td>
<td>David Valentine</td>
<td></td>
<td>01/01/1861</td>
<td>12/08/2008</td>
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<td>NWIS Instantaneous Irregular Data</td>
<td>NW/ISID</td>
<td>WSDL</td>
<td>10/20/2008</td>
<td>USGS</td>
<td>David</td>
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<td>06/01/1987</td>
<td>12/18/2004</td>
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<td>NWIS Unit Values</td>
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<td>EPA STORET</td>
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<tr>
<td>Chesapeake Bay Information Management System</td>
<td>CIMS</td>
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<td>Mud Lake Idaho</td>
<td>MucLake</td>
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</tbody>
</table>
The CUAHSI Water Data Catalog

47 services
15,000 variables
1.8 million sites
9 million series
4.3 billion data Values

... All the data is accessible in WaterML
Web Services Data Requests per Day

Observations Networks Indexed at HIS Central

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Federal Agency Water Data Services at HISCentral (10/09)

<table>
<thead>
<tr>
<th>Network Name</th>
<th>Site Count</th>
<th>Value Count</th>
<th>Earliest Observation</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>NWISDV</td>
<td>29894</td>
<td>274762525</td>
<td>1/1/1900</td>
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<tr>
<td>EPA</td>
<td>362645</td>
<td>94349967</td>
<td>1/1/1900</td>
<td>SOAP wrapper over WQX services, catalog harvested</td>
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<tr>
<td>NWISUV</td>
<td>11185</td>
<td>77935488</td>
<td>60 DAYS</td>
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<td>NCDC ISH</td>
<td>11555</td>
<td>3000000*</td>
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<tr>
<td>RIVERGAGES</td>
<td>2206</td>
<td>263101295</td>
<td>1/1/2000</td>
<td>WaterML compliant REST services from Army Corps of Engineers</td>
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</tbody>
</table>
MultiSensor Precipitation Estimator MPE for Chesapeake Bay Watershed
Temporal Scale: daily from 2005 – 2008, GeoSpatial Scale: 4*4 km on HRAP grid

Michael Piasecki and Yoori Choi, Drexel University
NCDC Integrated Station Hourly Data

Hourly weather data up to 36 hours ago

13,628 sites across globe

34 variables

Published by National Climate Data Center and populated with weather observations from national weather services

http://water.sdsc.edu/wateroneflow/NCDC/ISH_1_0.asmx?WSDL
USGS Instantaneous Data

- Real time, instantaneous data over the last 60 days
- 11188 sites, nationally for the US
- 80 variables

Published by USGS National Water Information System
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Corps of Engineers Water Observations

Time series at Corps gages

2210 sites, mainly in Mississippi Basin

80 variables

4954 series

Published by Corps of Engineers, Rock Island District to support their WaterML plugin to HEC-DSS

http://www2.mvr.usace.army.mil/watercontrol/soap/WaterML_SOAP.cfc?wsdl
Reynolds Creek Experimental Watershed

Published by USDA-ARS as part of an Idaho Waters project

1 data service
84 sites
65 variables
372 series
17.8 million data

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http://idahowaters.uidaho.edu/RCEW_ODWS/cuahsi_1_0.asmx?WSDL
HydroDesktop

Open Source Project:
www.hydrodesktop.org
HydroDesktop HIS Capabilities

**GIS**
- Add shapefiles to map
- Change symbology and labels
- Print and export map
- GIS toolbox and Modeler

**Hydrology**
- Search for data
- Download data
- Display time series
- Export data

**Space**

**Time**
CUAHSI HIS – looking ahead

• CUAHSI Online - A “social networking” site for hydrologic data (and possibly models)
• Simple and easy to use
• Find, create, share, connect, integrate, work together online
• Value added for scientists
Time Series as Themes

- A time series is like a feature
- Theme – a collection of time series describing a subject and region

Streamflow data provided as WaterML data services by USGS
Mapping Water “Themes”

Nutrients in Florida

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Summary

- **Web services** open possibilities for new modes of collaboration and research
- **Metadata requirements** will be substantial to enable other disciplines to understand data
- **Data sharing** is required to realize the potential but barriers exist
  - Costs versus benefits of data publication
  - Tradition of holding data
CUAHSI Member Universities: North America
CUAHSI Members: Europe
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http://www.cuahsi.org
Corps of Engineers Reservoirs

KawLake Reservoir

CUAHSI Water Data Service:

http://his.crwr.utexas.edu/Corps_Reservoirs/cuahsi_1_0.asmx?WSDL
Corps and USBR Reservoirs
Water Resources Sustainability under Climate Change

Data is fragmented across 39 Corps District Offices and 24 USBR Field Offices.
Building Critical National Datasets

- National Reservoir Operations Dataset
- National Hydrogeologic Dataset
- National River Morphology Dataset