

Using CUAHSI HIS to Support Large Scale Collaborative Research in Utah

Jeffery S. Horsburgh

Amber Jones, Stephanie Reeder, James Patton, Juan Caraballo,
Mauriel Ramirez, Nate Mouzon

CUAHSI HIS Cyberseminar
5-1-2013

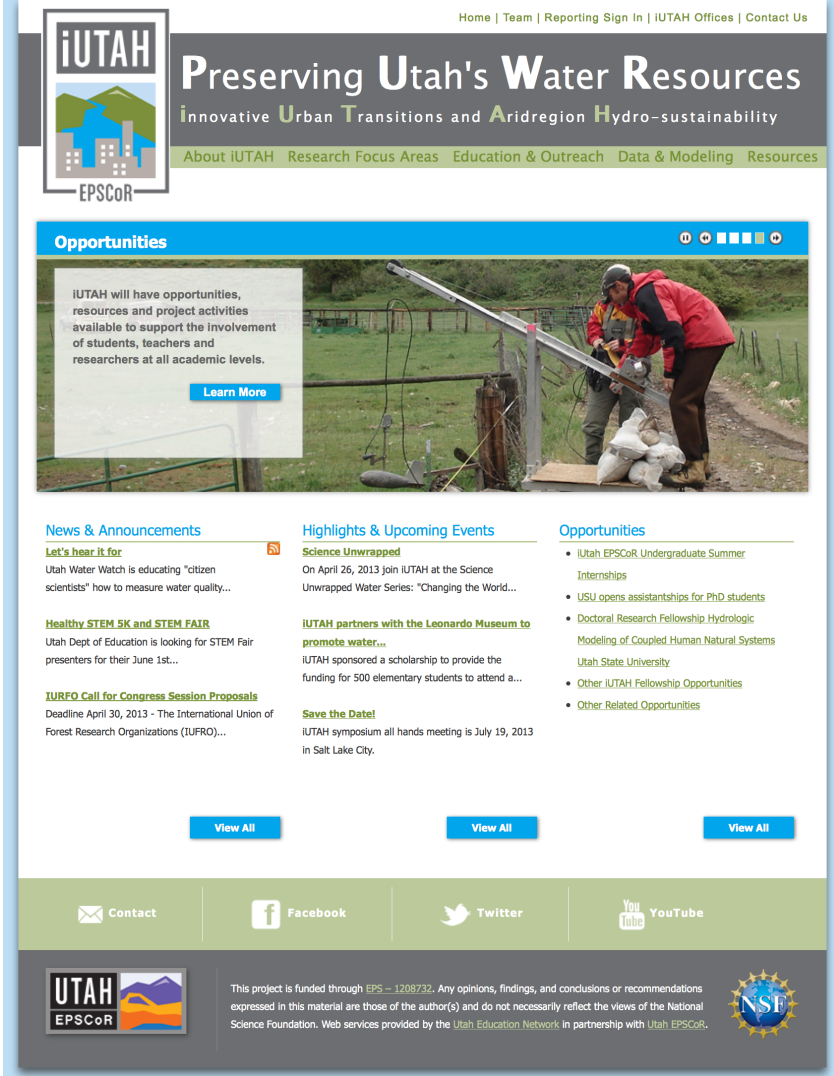
innovative Urban Transitions and Aridregion Hydro-sustainability (iUTAH)

- Statewide effort
- \$20 million competitive award from NSF EPSCoR
- Research capacity building
- Interdisciplinary and multi-institution
- Focused on sustainable management of Utah's water resources



Support:
EPS 1208732

<http://www.iutahepscor.org>



The screenshot shows the iUTAH website with the following content:

- Header:** iUTAH logo, navigation links (Home | Team | Reporting Sign In | iUTAH Offices | Contact Us), and the main title "Preserving Utah's Water Resources" with the subtitle "innovative Urban Transitions and Aridregion Hydro-sustainability".
- Sub-navigation:** About iUTAH | Research Focus Areas | Education & Outreach | Data & Modeling | Resources.
- Opportunities Section:** A blue banner with the text "Opportunities" and a "Learn More" button. Below it, a photo shows two people in a field with water measurement equipment. Text overlay: "iUTAH will have opportunities, resources and project activities available to support the involvement of students, teachers and researchers at all academic levels."
- News & Announcements:** Includes "Let's hear it for Utah Water Watch" (educating citizens on water quality), "Healthy STEM 5K and STEM FAIR" (looking for STEM presenters), and "IUFRO Call for Congress Session Proposals" (deadline April 30, 2013).
- Highlights & Upcoming Events:** Includes "Science Unwrapped" (April 26, 2013), "iUTAH partners with the Leonardo Museum to promote water..." (scholarship for 500 elementary students), and "Save the Date!" (symposium July 19, 2013).
- Opportunities List:** Includes "Utah EPSCoR Undergraduate Summer Internships", "USU opens assistantships for PhD students", "Doctoral Research Fellowship Hydrologic Modeling of Coupled Human Natural Systems Utah State University", "Other iUTAH Fellowship Opportunities", and "Other Related Opportunities".
- Footer:** Social media links (Contact, Facebook, Twitter, YouTube), a disclaimer about funding (EPS-1208732) and opinions, and the NSF logo.

iUTAH Research Focus Areas

1. Eco-hydrology

- Expand Utah's capacity in the natural sciences through instrumentation of 3 watersheds

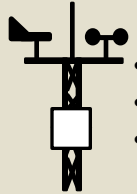
2. Social and Engineered Water Systems

- Studying demographic characteristics, water use behaviors, water infrastructure, and other measures of urban form

3. Interdisciplinary Modeling and Visualization

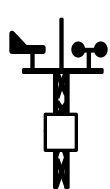
- Development of interdisciplinary models of socio-eco-hydrological systems to determine how changes in water availability and use alter water quantity and quality

iUtah Field Sites



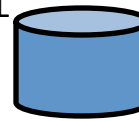
- Little Bear River
- Red Butte Creek
- Provo River

Utah Field Station Network



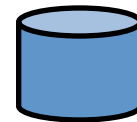
Agency Data

- USGS NWIS
- NRCS SNOTEL
- Utah DWQ
- Etc.



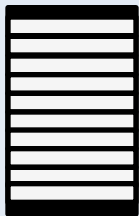
National Science Data Networks

- CUAHSI HIS
- DataONE

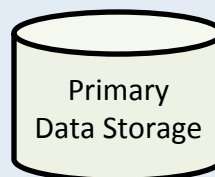


iUTAH Modeling and Data Federation

HPC@USU



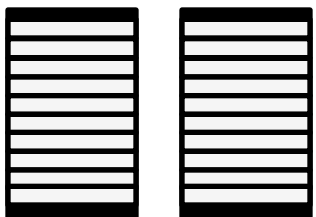
- Primary data organization and storage
- Data sharing, publication, and archival
- Data integration and synthesis
- Integrated modeling and CI Support
- HPC support



USU

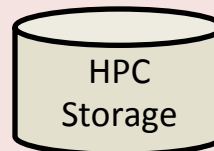
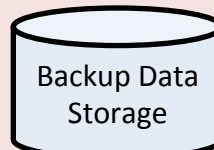
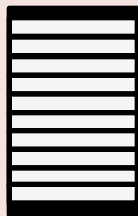
Research@UEN Network

UWyoming (EPSCoR CI Track 2) and National HPC Centers



- Redundant data storage
- HPC support
- Modeling and simulation
- Collaboration technologies

UU Center for High Performance Computing



UU

Research@UEN Network

UEN Network

UEN Network

Fulton Supercomputing Lab

BYU

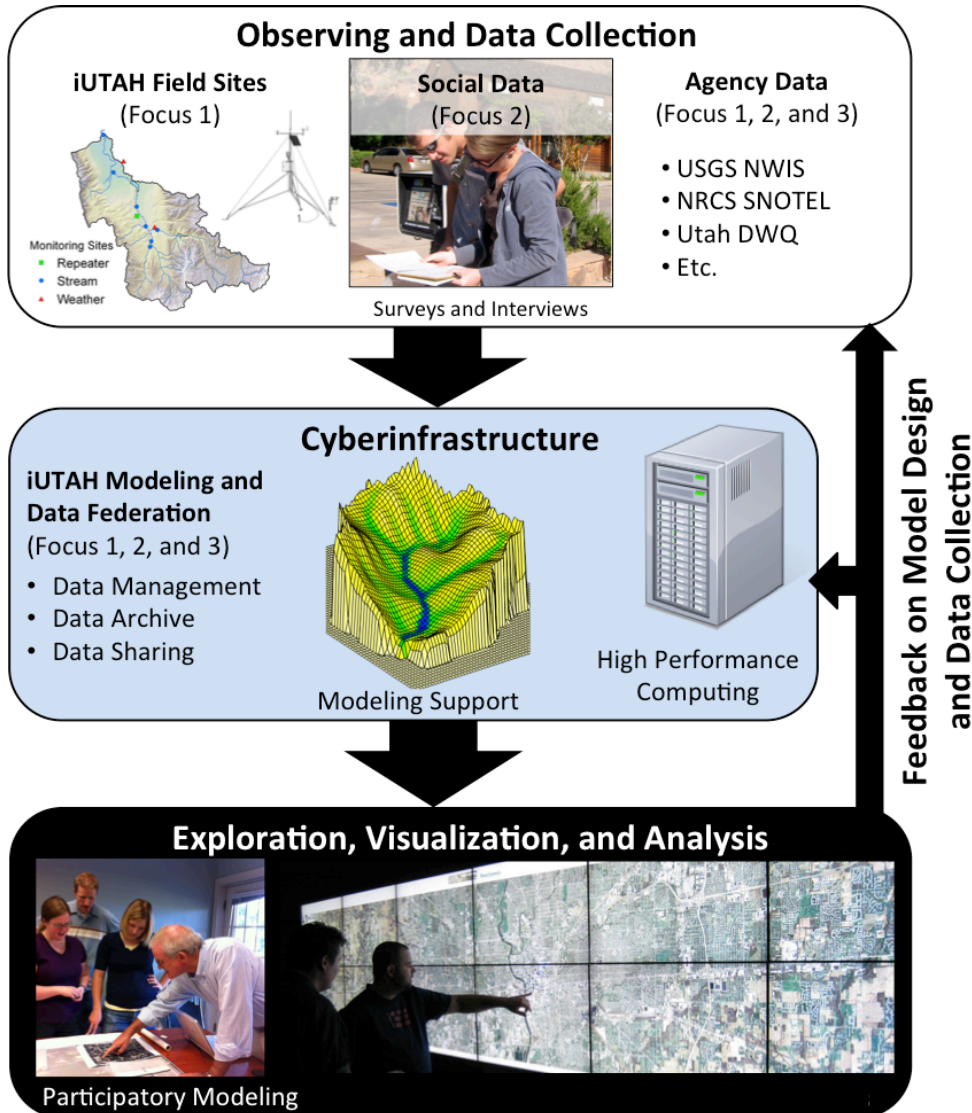
UVU

Intermountain Network Node

UEN and K-12 Sites



iUTAH MDF – Information Flow



- Field sites and other data (e.g., agencies)
- iUTAH Modeling and Data Federation
- Modeling, visualization, and analysis

iUTAH MDF Focus Areas

1. Data management support for data from iUTAH facilities
 - GAMUT – Gradients Along Mountain to Urban Transitions
 - GIRF – Green Infrastructure Research Facility
2. Support for data discovery and access
 - iUTAH facility and investigator data
 - Agency data
 - National data networks
3. Support for integrated modeling
4. Data/model/resource sharing and collaboration

How can we create a hardware platform that supports the diverse cyberinfrastructure needs of iUTAH?

iUTAH CI Development Approach

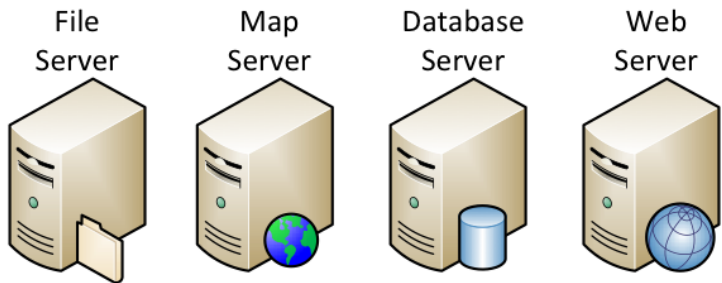
- Where possible, leverage and adopt existing cyberinfrastructure components
- Collaborate with other CI development activities to get needed functionality
- Develop pieces that we need

Required Functionality

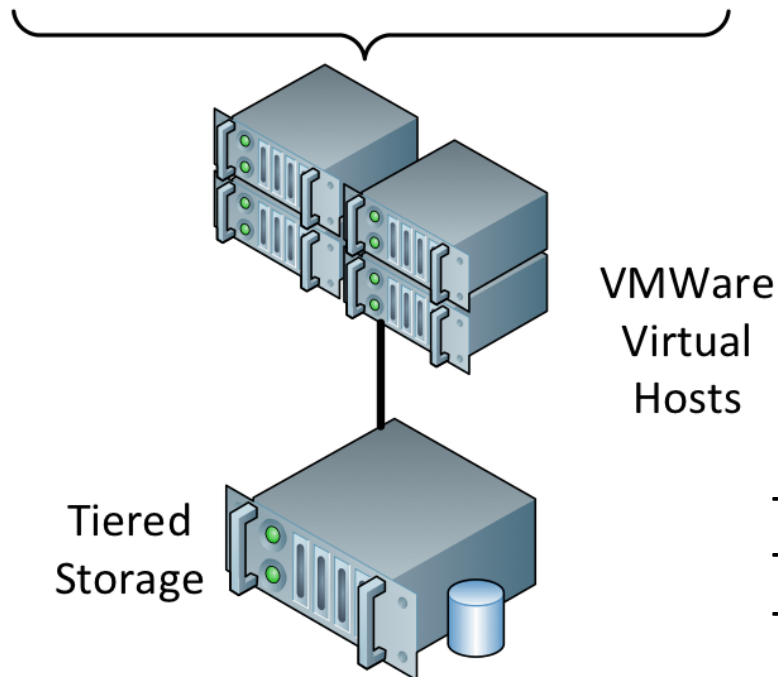
- Research platform
 - Development, prototyping, and testing of servers, software applications, and services on multiple platforms (e.g., Windows, Linux)
 - Host machines allocated for modeling, analysis, and computational tasks
- Production data service and application hosting platform
 - Web servers
 - Data web services
 - Web applications
 - Database servers
 - Map servers
 - File servers
 - Data harvesters and automated data processing applications

Hardware

VMWare Virtual Machines



Required servers and software stacks implemented on virtual machines



Many virtual machines can be hosted on a single virtual host server

Tiered storage
Tier 1 and 2: Databases and operating systems
Tier 3: Lower demand file storage and access

Hardware Capabilities

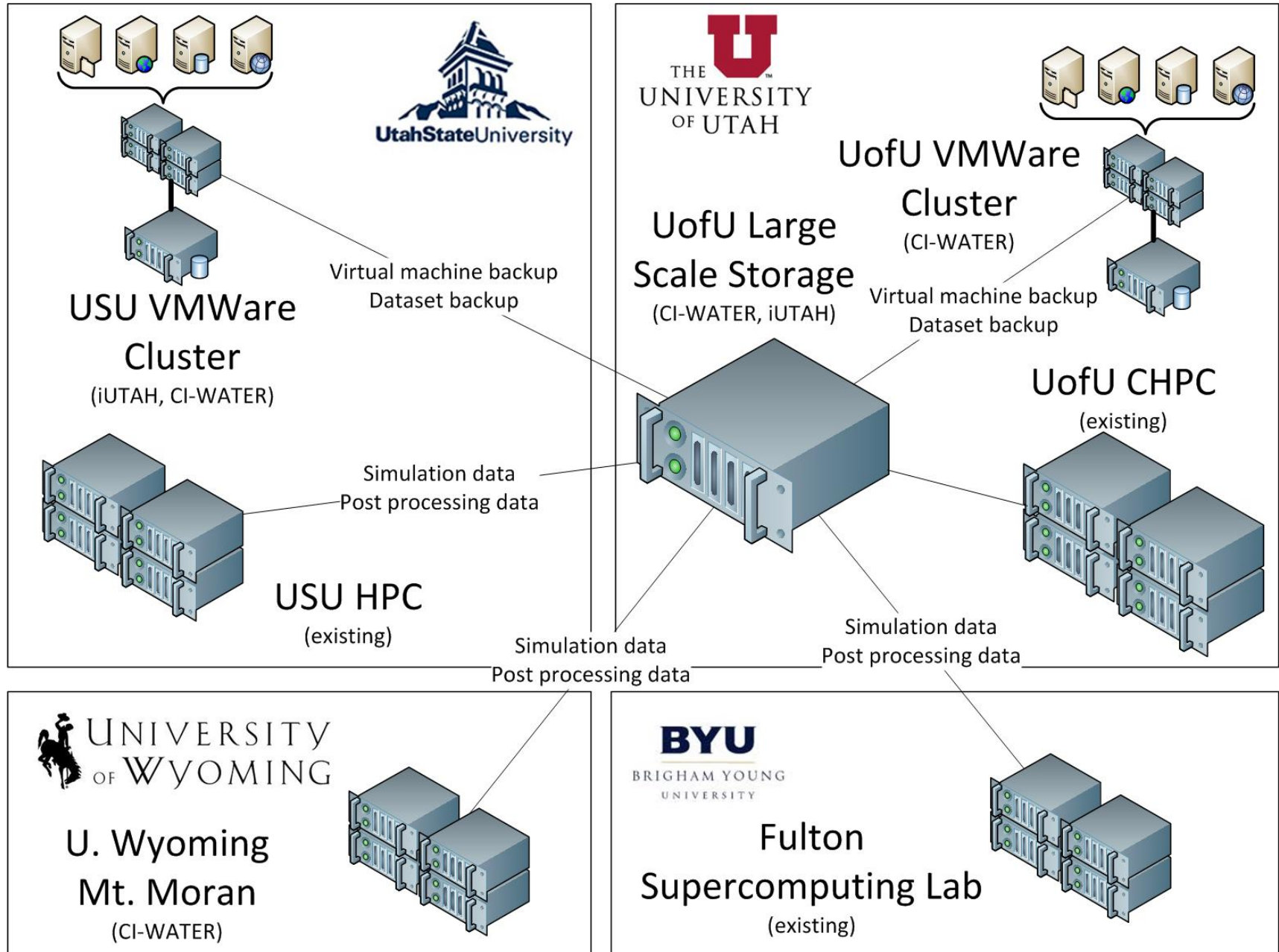
- Quickly spin up virtual machines that implement different operating systems and platforms (e.g., Windows, Linux)
- Use shared computational and storage resources rather than requiring a physical machine for each purpose
- Create and manage both development and production servers using shared hardware
- Hot-swap virtual machines across physical host machines using virtualization software
 - Ensure failover for production virtual servers
 - Efficiently allocate resources to multiple machines

Initial Specifications

- 3 virtual host servers using shared storage arrays
 - Dual 8 core processors
 - 128 GB RAM
- 7.2 TB high performance shared storage array
 - Virtual machine operating systems
 - Relational databases
- 72 TB high capacity shared storage array
 - File storage
 - Archival
- Integrated with USU Central IT VMWare infrastructure and enterprise data center

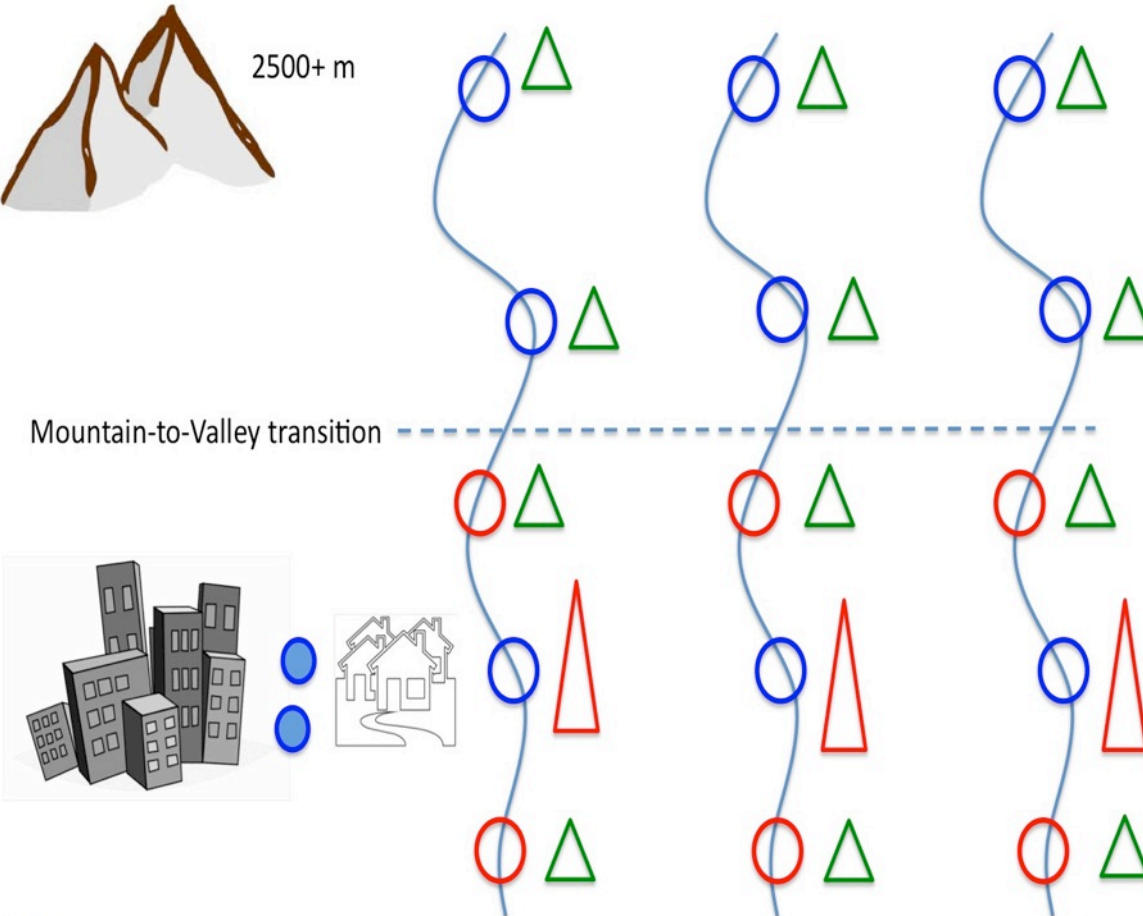
Available storage will be expanded in subsequent years

The Larger Utah EPSCoR Cyberinfrastructure Picture

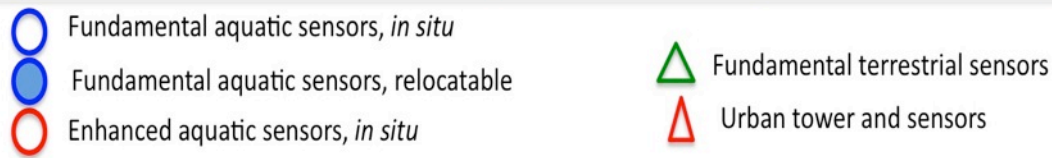


What is the design of a cyberinfrastructure that enables standardized data collection and management for a network of aquatic and terrestrial monitoring sites managed by a consortium of disparate organizations?

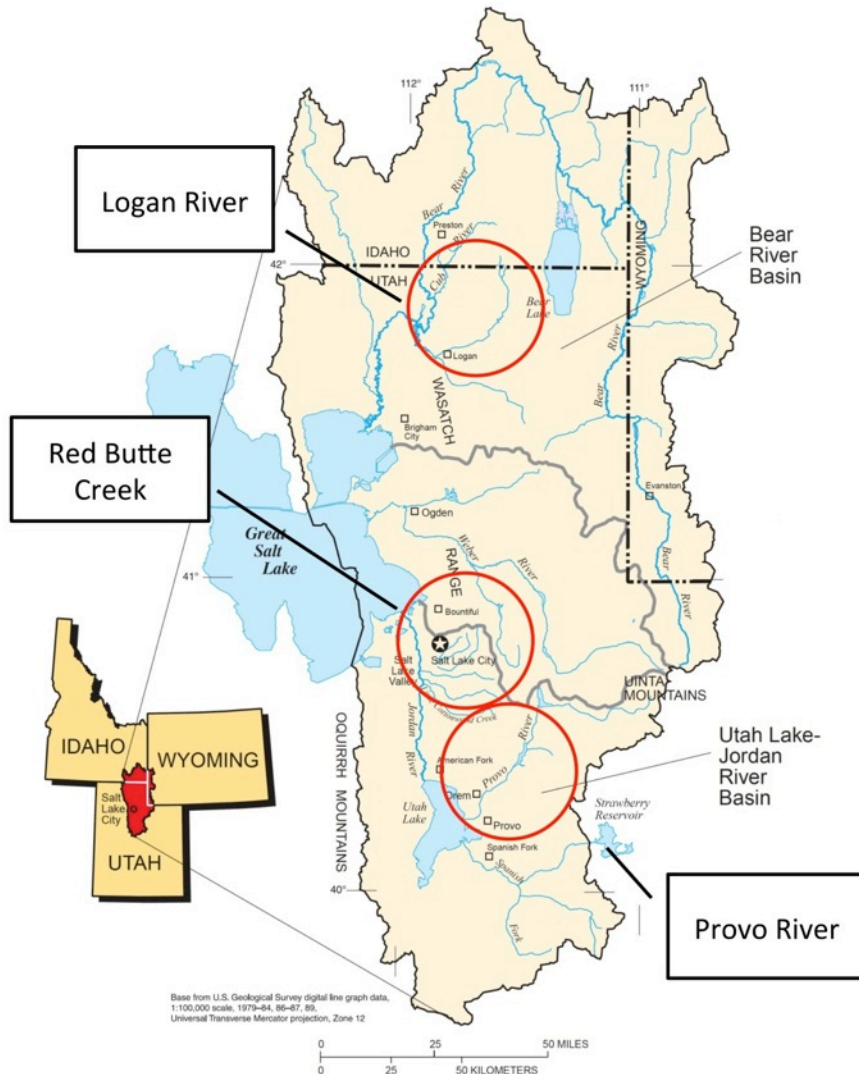
Gradients Along Mountain to Urban Transitions (GAMUT) Network



- Sensor network developed between USU/UofU/BYU
- Mix of aquatic and terrestrial *in situ* and re-locatable sensors
- Measure aspects of water inputs and outputs and water quality over gradient
- Deployed in three watersheds



Gradients Along Mountain to Urban Transitions (GAMUT) Network



- 3 watersheds have similar water source (high elevation snow) but different land use transitions
- Logan River: irrigated agriculture transitioning to moderate density urban at moderate pace
- Red Butte Creek: highly urbanized
- Provo River: irrigated agriculture transitioning to low density urban at rapid pace

	Fundamental Suite	Enhanced/Urban Suite
Terrestrial Sensors	Barometric pressure Wind speed and direction Air temperature Relative humidity Precipitation Snow depth Soil temperature, moisture, conductivity Solar radiation (net radiation and PAR)	Barometric pressure Wind speed and direction Air temperature Relative humidity Precipitation Snow depth Soil temperature, moisture, conductivity Solar radiation (net radiation and PAR)
Aquatic Sensors	Stream stage Temperature Electrical Conductivity pH Dissolved oxygen Turbidity	Stream stage Temperature Electrical Conductivity pH Dissolved oxygen Turbidity Total algae (chlorophyll a + phycocyanin) fDOM Nitrate

Challenges to Managing Sensor Data

- Volume of data
- Data heterogeneity
- Multiple watersheds
- Multiple institutions
- Scale
- Synchronize timing, data access, equipment tracking
- Standardize data QA/QC

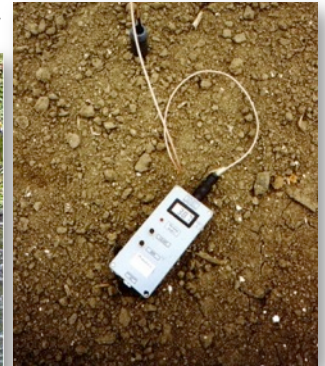
Rainfall and
Meteorology



Water quantity



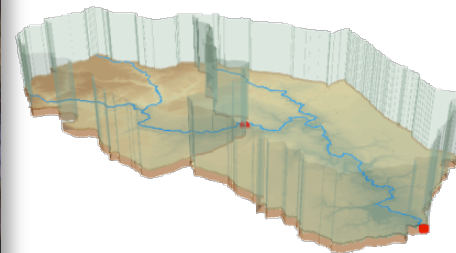
Soil water



Water quality



GIS



Groundwater



Cyberinfrastructure

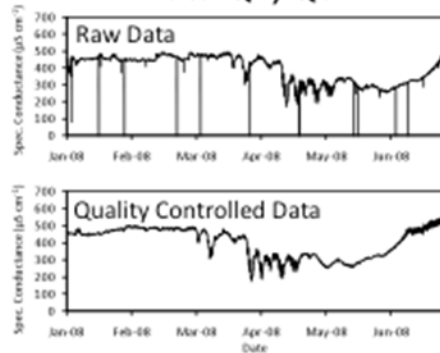
Tier 3: Data Storage, Processing, and Analysis

Data Storage

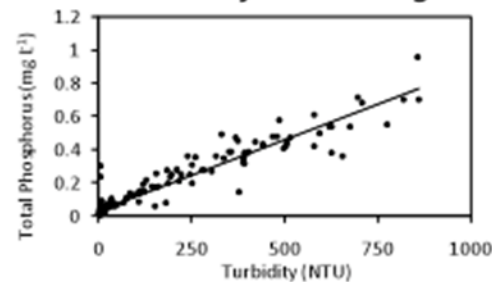
- Data Loading
- Data Manipulation
- Data Publication



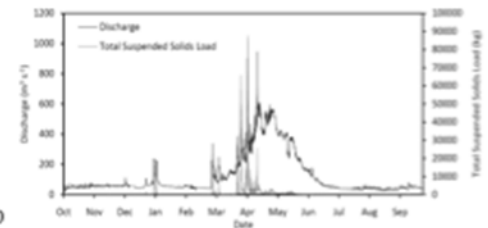
Data QA/QC



Estimation of Discharge and Concentration from Surrogates



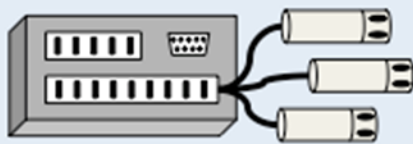
Data Visualization and Analysis



Tier 1: Sensors and Monitoring

Sensor Nodes

- Stream gauging
- Surrogate observations

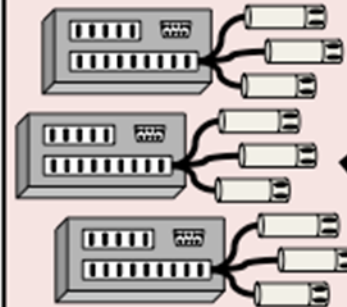


Periodic Monitoring

- Water quality sampling
- Discharge measurements

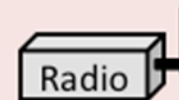


Tier 2: Communication



Sensor Nodes

Telemetry Network



Radio

Base Station Computer



- Monitor Sensor Node Status
- Retrieve Data

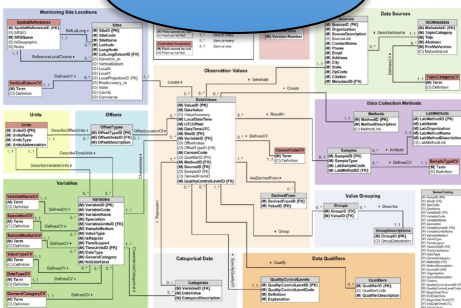
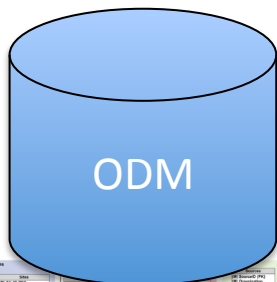
Horsburgh, J. S., A. Spackman Jones, D. G. Tarboton, D. K. Stevens, and N. O. Mesner (2010), A sensor network for high frequency estimation of water quality constituent fluxes using surrogates, *Environmental Modelling & Software*, 25, 1031-1044, doi:10.1016/j.envsoft.2009.10.012.



HydroServer

CUAHSI Open Source Hydrologic Data Tools

Observations
Data Model



ODM Data Loader

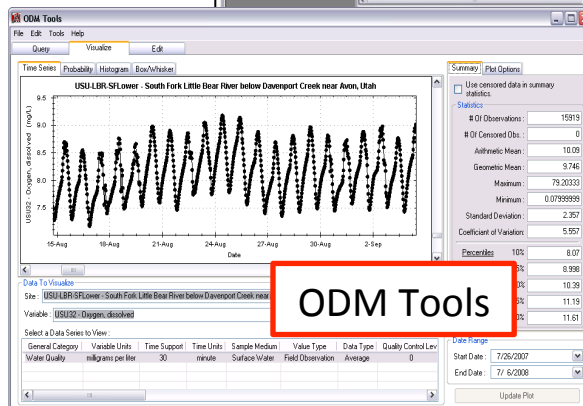
DataValue	LocalDateTime	UTCOffset	Varic	Variable	DataType	Variable	Site Name	Latitude	Longitude	SRS
0.4878	2/16/1998	-5	3	millim...	Incremental	Precipitation	Nexrad1	-82.14	31.45	NAD83
0.4878	2/16/1998	-5	3	millim...	Incremental	Precipitation	Nexrad2	-82.10	31.43	NAD83
0.5169	2/16/1998	-5	3	millim...	Incremental	Precipitation	Nexrad3	-82.07	31.42	NAD83
0.4346	2/16/1998	-5	3	millim...	Incremental	Precipitation	Nexrad4	-82.16	31.42	NAD83
0.3453	2/16/1998	-5	3	millim...	Incremental	Precipitation	Nexrad4	-82.03	31.41	NAD83
0.3857	2/16/1998	-5	3	millim...	Incremental	Precipitation	Nexrad4	-82.12	31.40	NAD83
0.4346	2/16/1998	-5	3	millim...	Incremental	Precipitation	Nexrad4	-81.99	31.39	NAD83
0.5472	2/16/1998	-5	3	millim...	Incremental	Precipitation	Nexrad4	-82.08	31.39	NAD83
0.5169	2/16/1998	-5	3	millim...	Incremental	Precipitation	Nexrad4	-82.17	31.38	NAD83
1.002	2/16/1998	-5	3	millim...	Incremental	Precipitation	Nexrad10	-81.95	31.38	NAD83
1.1571	2/16/1998	-5	3	millim...	Incremental	Precipitation	Nexrad11	-82.04	31.38	NAD83
0.7857	2/16/1998	-5	3	millim...	Incremental	Precipitation	Nexrad11	-82.04	31.38	NAD83
0.6323	2/16/1998	-5	3	millim...	Incremental	Precipitation	Nexrad11	-82.04	31.38	NAD83
0.689	2/16/1998	-5	3	millim...	Incremental	Precipitation	Nexrad11	-82.04	31.38	NAD83

WaterOneFlow
and WaterML

ODM Streaming Data Loader

ID	Server Address	Database Name	File Location Type	File Location	Schedule Period	Schedule Beginning	Last Update
1	local	ModLst400	Local	C:\WorkingPos...	1 hours	7/16/2007 3:00	8/27/2007 10:58
3	local	ModLst400	Local	C:\WorkingPos...	1 hours	7/16/2007 5:00	8/27/2007 11:09
4	local	ModLst400	Local	C:\WorkingPos...	1 hours	7/16/2007 3:00	8/27/2007 11:13
5	local	ModLst400	Local	C:\WorkingPos...	1 hours	7/16/2007 3:00	8/27/2007 11:16
6	local	ModLst400	Local	C:\WorkingPos...	1 hours	8/27/2007 11:00	8/28/2007 12:06
7	local	ModLst400	Local	C:\WorkingPos...	1 hours	8/27/2007 11:00	8/28/2007 12:06

ODM Tools



LittleBearRiver Web Service - Windows Internet Explorer

CUAHSI Web Services for Observations Databases Help Pages

This web page describes CUAHSI WaterOneFlow web services developed to provide access to data from the YOUR SITE HERE at the YOUR SITE HERE for demonstration purposes. These are developmental prototype web services subject to change and should not be relied upon to be static or persistent.

- Installation
- Configuration (restricted to localhost)
- Database Test Page

Service Description.

The service is found at http://hse2.cuahsi.edu/LittleBearRiver/kuahst_1_0.asmx

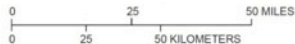
The following operations are supported. For a formal definition, please review the [Service Description](#).

- GetSiteInfo**
Given a site number, this method returns the site's metadata. Send the site code in this format: 'LittleBearRiver:SiteCode' or to retrieve by internal database identifier, send, use 'BYID:siteid'
- GetVariableInfo**
Given a site number, this method returns the site's metadata. Send the site code in this format: 'LittleBearRiver:SiteCode' or to retrieve by internal database identifier, send, use 'BYID:siteid'
- GetVariableInfo**
Given a variable code, this method returns the variable's name. Pass in the variable in this format: 'LBR:VariableCode' or to retrieve by internal database identifier, variableid, use 'BYID:variableid'
- GetVariableInfo**
Given a variable code, this method returns the variable's platform. Pass in the variable in this format: 'LBR:VariableCode' or to retrieve by internal database identifier, variableid, use 'BYID:variableid'
- 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: 'LittleBearRiver:SiteCode' and 'LBR:VariableCode'
- 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: 'LittleBearRiver:SiteCode' and 'LBR:VariableCode'
- GetSiteInfo**
Given an array of site numbers, this method returns the site metadata for each one. Send the array of site codes in this format: 'LittleBearRiver:SiteCode' or 'BYID:siteid' to retrieve by the internal database identifier, send.
- GetSiteInfo**
Given an array of site numbers, this method returns the site metadata for each one. Send the array of site codes in this format: 'LittleBearRiver:SiteCode' or 'BYID:siteid' to retrieve by the internal database identifier, send.



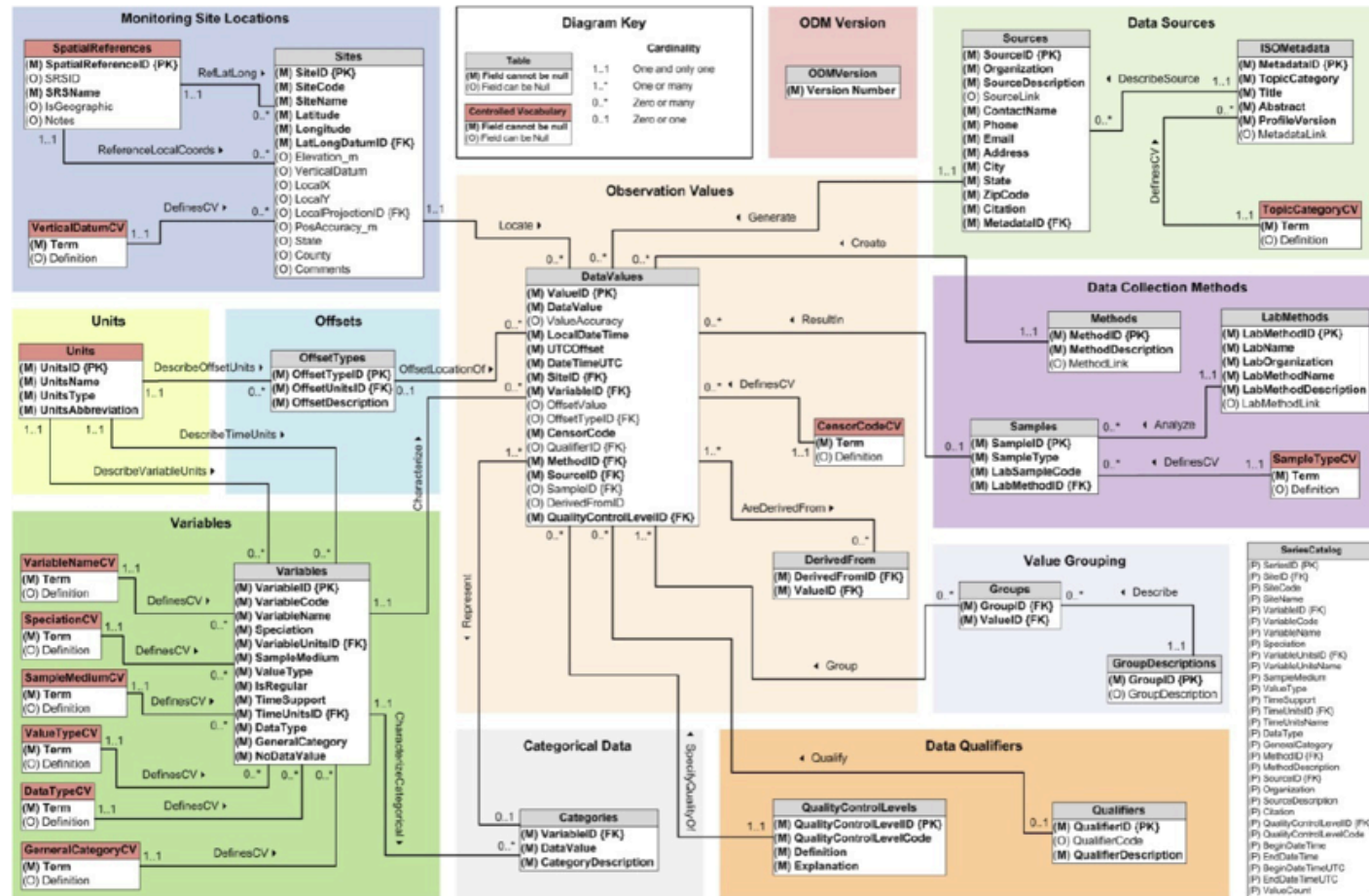
CUAHSI
HIS
Sharing hydrologic data

Base from U.S. Geological Survey digital line graph data,
1:100,000 scale, 1979-84, 86-87, 89,
Universal Transverse Mercator projection, Zone 12



Data Loading and Storage

- Observations Data Model (ODM): relational database at the single observation level
- Metadata for unambiguous interpretation
- Traceable heritage from raw measurements to usable information
- Promote syntactic and semantic consistency
- Cross dimension retrieval and analysis



Loading Data Streams



ODM Streaming Data Loader

ID	Server Address	Database Name	File Location Type	File Location	Schedule Period	Schedule Beginning	Last Update
1	(local)	MudLakeOD	Local	C:\Working\Proj...	1 hours	7/18/2007 3:00...	8/27/2007 10:59...
3	(local)	MudLakeOD	Local	C:\Working\Proj...	1 hours	7/31/2007 5:00...	8/27/2007 11:09...
4	(local)	MudLakeOD	Local	C:\Working\Proj...	1 hours	7/18/2007 3:00...	8/27/2007 11:13...
5	(local)	MudLakeOD	Local	C:\Working\Proj...	1 hours	7/18/2007 3:00...	8/27/2007 11:18...
6	(local)	MudLakeOD	Local	C:\Working\Proj...	1 hours	8/27/2007 11:00...	8/28/2007 12:06...
7	(local)						

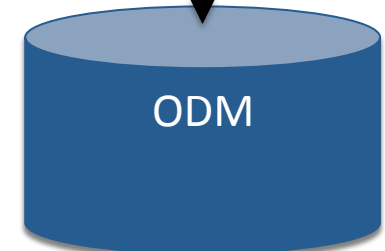
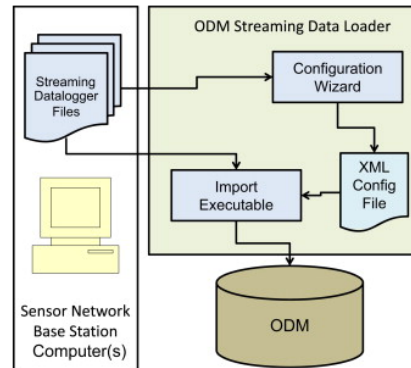
Add New File

TIMESTAMP	RECORD	Bat_Volt_Avg	Turb_Avg	Turb_Vis	Turb_Med	Turb_RES
2007-06-08 13:00	0	13.37478	5.5	0.0963	5.44	5.48
2007-06-08 13:01	1	13.37625	5.26	0.0614	5.23	5.24
2007-06-08 14:02	2	13.30762	5.37	0.0784	5.32	5.33
2007-06-08 14:03	3	13.31814	5.4	0.0722	5.37	5.38
2007-06-08 15:04	4	13.32022	5.62	0.0623	5.57	5.58
2007-06-08 15:05	5	13.37645	5.47	0.064	5.44	5.45
2007-06-08 16:06	6	13.35044	5.55	0.0618	5.54	5.53
2007-06-08 16:07	7	13.35565	5.66	0.064	5.62	5.62
2007-06-08 17:08	8	13.34624	5.47	0.0434	5.44	5.44
2007-06-08 17:09	9	13.36051	5.91	0.1418	5.86	5.86
2007-06-08 18:10	10	13.39325	6.06	0.1145	6.05	6.05
2007-06-08 18:11	11	13.39744	6.09	0.1119	6.08	6.09
2007-06-08 19:10	12	13.25306	6.25	0.0535	6.24	6.24
2007-06-08 19:13	13	13.24299	6.65	0.0905	6.63	6.65

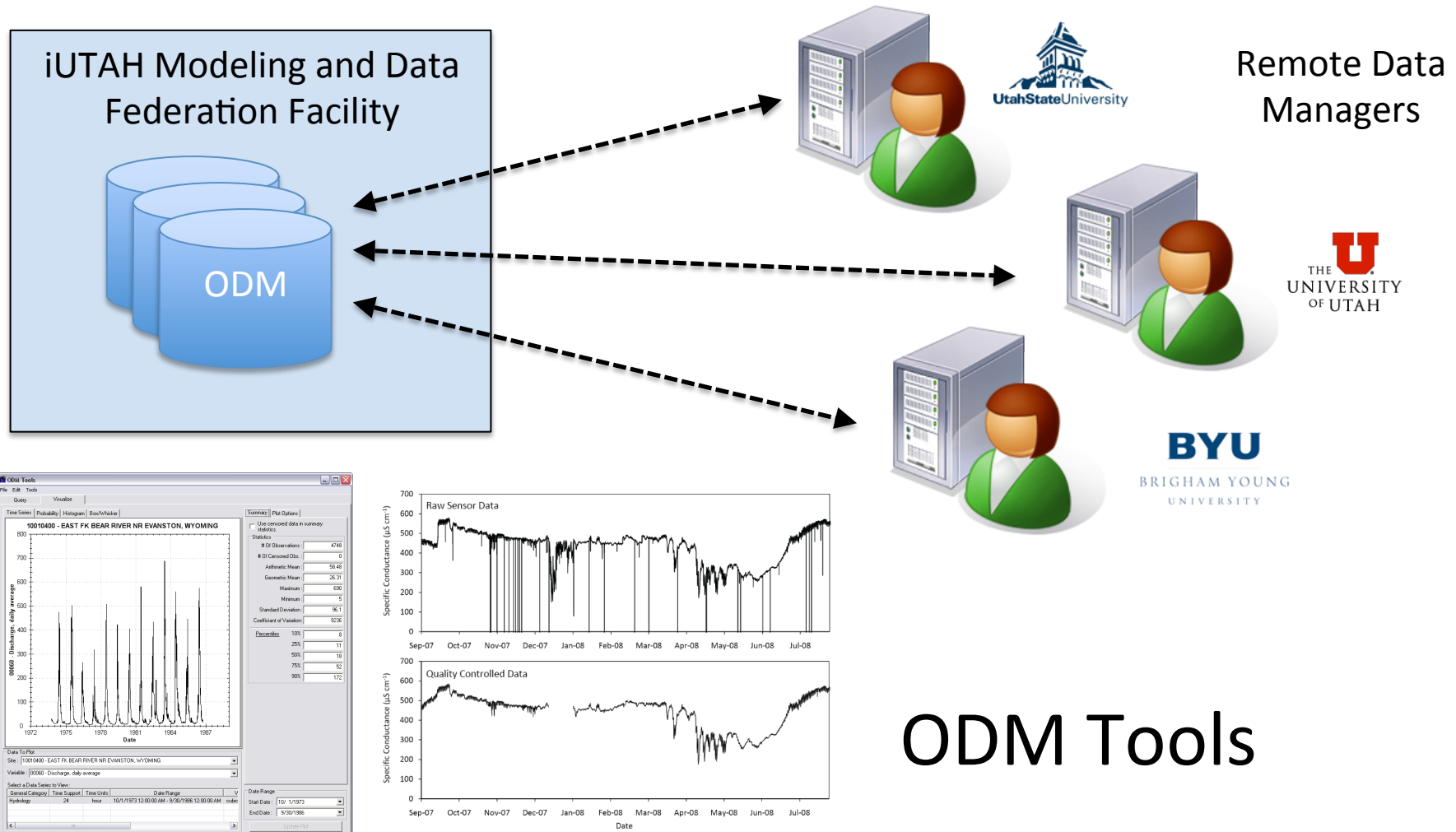
Value Col. S. Val. Offset T. Offset Met. Sou. Quality

Value Col.	S.	Val.	Offset T.	Offset	Met.	Sou.	Quality
Bat_Volt_Avg	2	5	<None>	<None>	5	1	0
Turb_Avg	2	1	<None>	<None>	1	1	0
Turb_RES	2	8	<None>	<None>	8	1	0
Turb_Med	2	3	<None>	<None>	3	1	0
Turb_Med	2	7	<None>	<None>	7	1	0

Back Finish

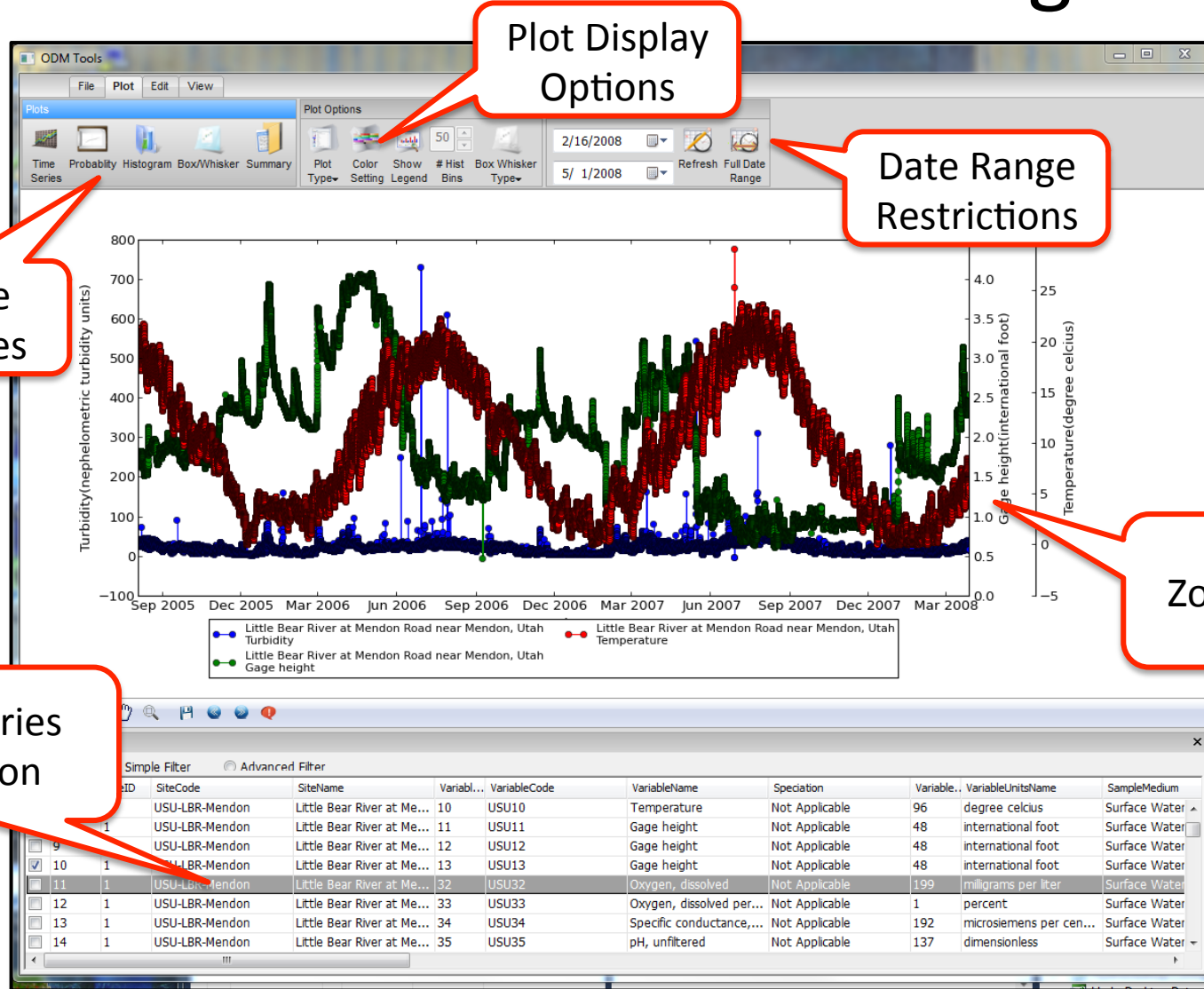


Data Visualization and Management



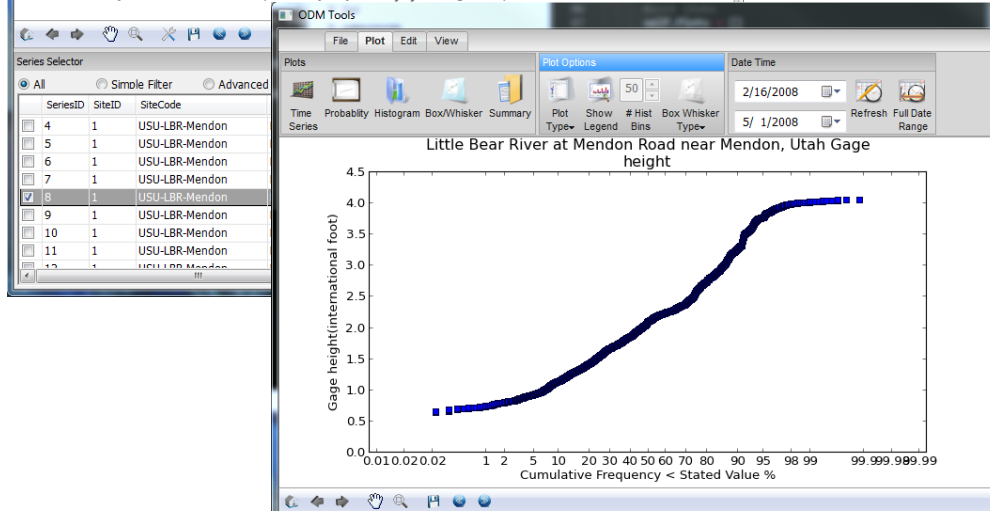
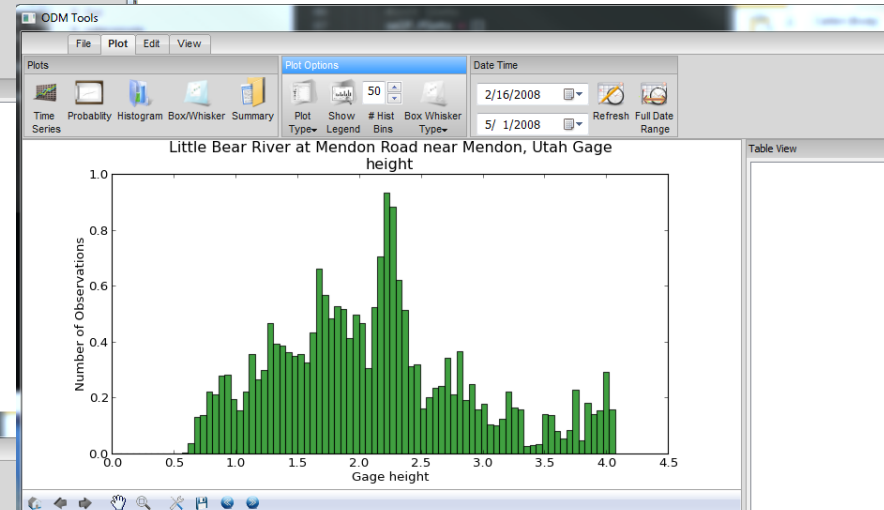
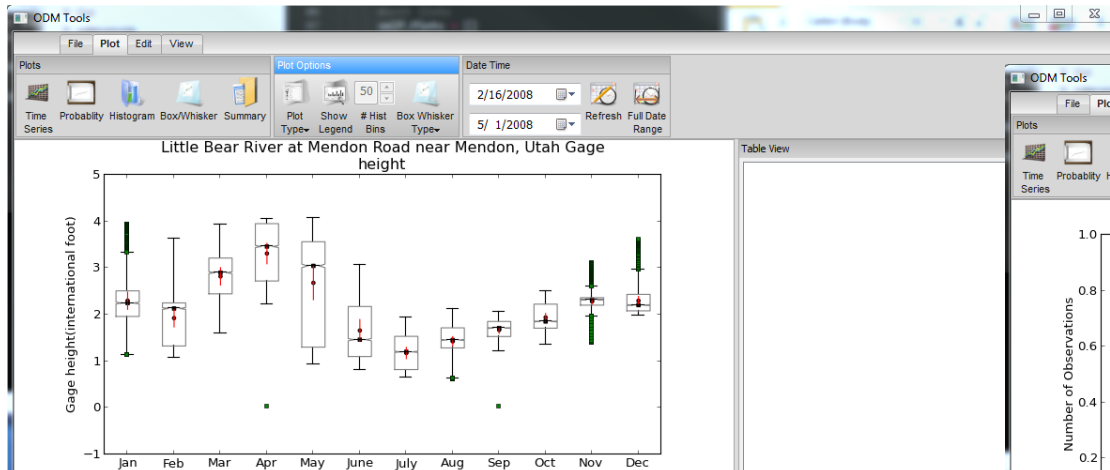
ODM Tools Python

Data Visualization and Management



ODM Tools Python

Multiple Plot Types



Series Selector

☒ All ☐ Simple Filter ☐ Advanced Filter

SeriesID	SiteID	SiteCode	SiteName	VariableCode	VariableName	Speciation	VariableUnits
4	1	USU-LBR-Mendon	Little Bear River at Me...	7	USU7	Turbidity	Not Applicable
5	1	USU-LBR-Mendon	Little Bear River at Me...	8	USU8	Turbidity	Not Applicable
6	1	USU-LBR-Mendon	Little Bear River at Me...	9	USU9	Turbidity	Not Applicable
7	1	USU-LBR-Mendon	Little Bear River at Me...	10	USU10	Temperature	Not Applicable
8	1	USU-LBR-Mendon	Little Bear River at Me...	11	USU11	Gage height	Not Applicable
9	1	USU-LBR-Mendon	Little Bear River at Me...	12	USU12	Gage height	Not Applicable
10	1	USU-LBR-Mendon	Little Bear River at Me...	13	USU13	Gage height	Not Applicable
11	1	USU-LBR-Mendon	Little Bear River at Me...	32	USU32	Oxygen, dissolved	Not Applicable
12	1	USU-LBR-Mendon	Little Bear River at Me...	33	USU33	Oxygen, dissolved	Not Applicable

Series Selector

☒ All ☐ Simple Filter ☐ Advanced Filter

	SeriesID	SiteID	SiteCode	SiteName	Variable...	VariableCode	VariableName	Speciation	Variable...	VariableUnitsName	SampleMedium
<input type="checkbox"/>	4	1	USU-LBR-Mendon	Little Bear River at Me...	7	USU7	Turbidity	Not Applicable	221	nephelometric turbidi...	Surface Water
<input type="checkbox"/>	5	1	USU-LBR-Mendon	Little Bear River at Me...	8	USU8	Turbidity	Not Applicable	221	nephelometric turbidi...	Surface Water
<input type="checkbox"/>	6	1	USU-LBR-Mendon	Little Bear River at Me...	9	USU9	Turbidity	Not Applicable	221	nephelometric turbidi...	Surface Water
<input type="checkbox"/>	7	1	USU-LBR-Mendon	Little Bear River at Me...	10	USU10	Temperature	Not Applicable	96	degree celcius	Surface Water
<input checked="" type="checkbox"/>	8	1	USU-LBR-Mendon	Little Bear River at Me...	11	USU11	Gage height	Not Applicable	48	international foot	Surface Water

ODM Tools Python

Time Series Selection and Filtering

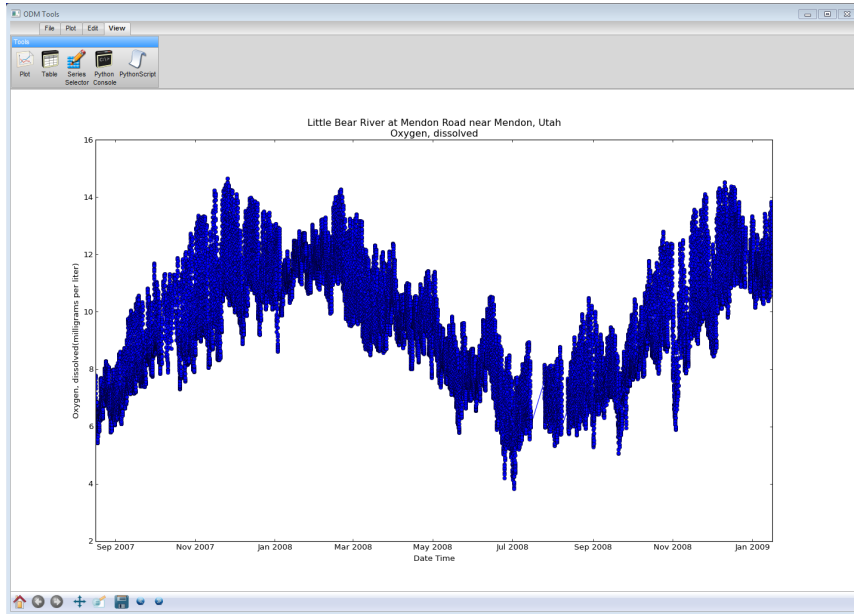
The screenshot displays the ODM Tools Python interface. The main window shows a time series plot titled "Little Bear River at Mendon Road near Mendon, Utah Gage height". The plot shows height in international feet over time from 2006 to 2007. A red callout bubble points to the plot with the text "Filters on Data Series".

A "Query Builder" dialog box is open on the right, showing a list of field names and a query: `SELECT * FROM [Attributes] WHERE [SiteName] = 'Little Bear 11'`. A red callout bubble points to the dialog with the text "Build Query".

A "Series Selector" dialog box is open at the bottom, showing a table of data series. A red callout bubble points to the "Export Data" button with the text "Export Data Series".

SeriesID	SiteID	SiteCode	SiteName	VariableCode	VariableName	Speciation
4	1	USU-LBR-Mendon	Little Bear River at Me...	7	USU7	Turbidity
5	1	USU-LBR-Mendon	Little Bear River at Me...	8	USU8	Turbidity
6	1	USU-LBR-Mendon	Little Bear River at Me...	9	USU9	Turbidity
7	1	USU-LBR-Mendon	Little Bear River at Me...	10	USU10	Temperature
8	1	USU-LBR-Mendon	Little Bear River at Me...	11	USU11	Gage height
9	1	USU-LBR-Mendon	Little Bear River at Me...	12	USU12	Gage height
10	1	USU-LBR-Mendon	Little Bear River at Me...	13	USU13	Gage height
11	1	USU-LBR-Mendon	Little Bear River at Me...	14	USU14	Gage height
12	1	USU-LBR-Mendon	Little Bear River at Me...	15	USU15	Gage height

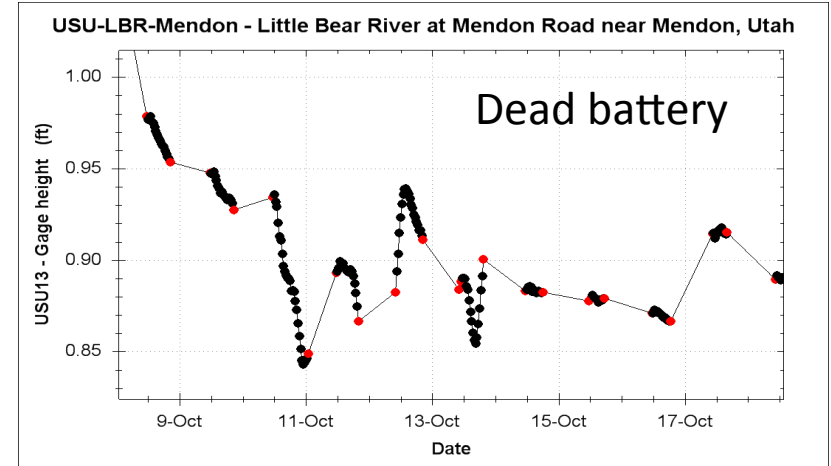
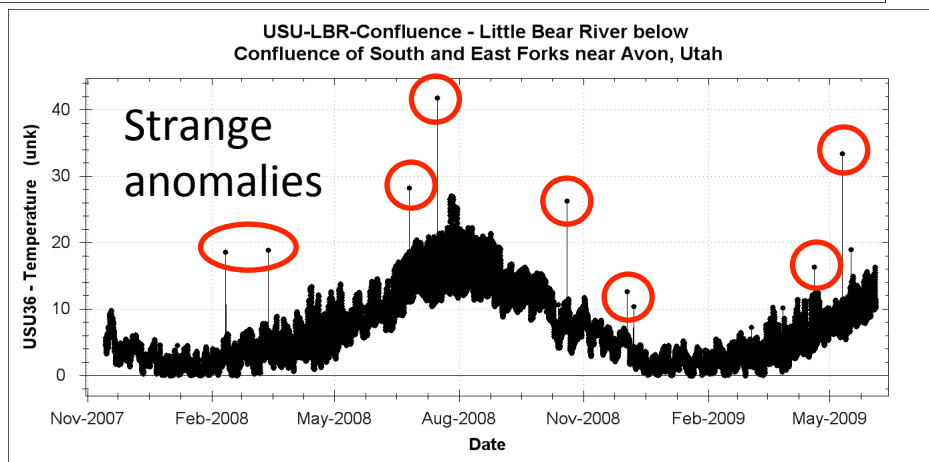
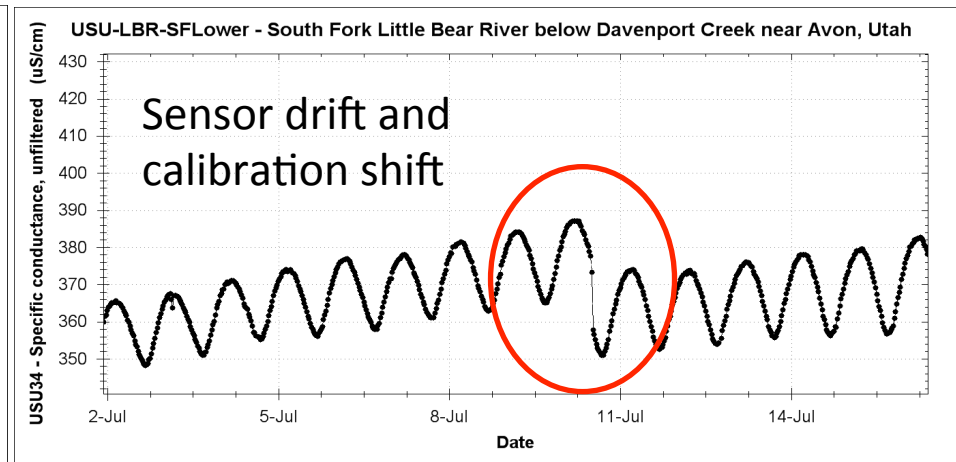
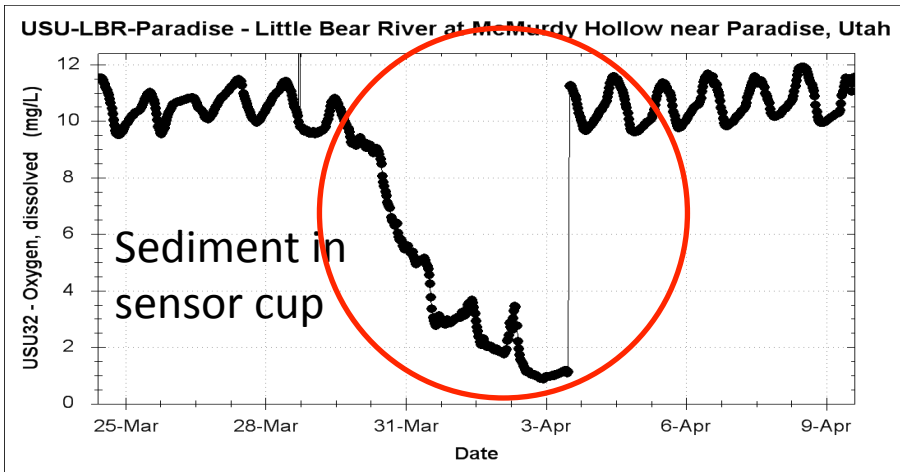
ODM Tools Python Dockable Windows



ValueID	DataValue	Val...	LocalDateTime	UT...	DateTimeUTC	Sit...	Va...	Of...	O
8607706	4.00045970149		2008-07-02 07:30:00	-7.0	2008-07-02 14:30:00	1	32		
8615287	4.25681459701		2008-07-01 07:30:00	-7.0	2008-07-01 14:30:00	1	32		
8616334	4.23571177612		2008-07-02 05:30:00	-7.0	2008-07-02 12:30:00	1	32		
8619129	4.33288192537		2008-07-02 01:30:00	-7.0	2008-07-02 08:30:00	1	32		
8619782	4.4006091194		2008-07-02 03:00:00	-7.0	2008-07-02 10:00:00	1	32		
8619818	4.4100449403		2008-07-01 05:00:00	-7.0	2008-07-01 12:00:00	1	32		
8620012	4.36762985075		2008-07-02 03:30:00	-7.0	2008-07-02 10:30:00	1	32		
8620220	3.83081343284		2008-07-02 08:00:00	-7.0	2008-07-02 15:00:00	1	32		
8622377	3.89308523881		2008-07-02 06:30:00	-7.0	2008-07-02 13:30:00	1	32		
8622441	4.49635820896		2008-07-01 04:30:00	-7.0	2008-07-01 11:30:00	1	32		
8625349	4.58550746269		2008-07-02 00:30:00	-7.0	2008-07-02 07:30:00	1	32		
8625395	4.59515373134		2008-07-02 00:00:00	-7.0	2008-07-02 07:00:00	1	32		
8625705	4.2038311791		2008-06-25 06:30:00	-7.0	2008-06-25 13:30:00	1	32		
8626475	4.62864941791		2008-07-03 04:30:00	-7.0	2008-07-03 11:30:00	1	32		
8627214	4.66996268657		2008-07-03 04:00:00	-7.0	2008-07-03 11:00:00	1	32		
8627341	4.66188076119		2008-07-03 02:00:00	-7.0	2008-07-03 09:00:00	1	32		
8628198	4.28373167164		2008-07-01 05:30:00	-7.0	2008-07-01 12:30:00	1	32		
8630093	4.78889435821		2008-07-02 10:00:00	-7.0	2008-07-02 17:00:00	1	32		
8630222	4.37667031343		2008-07-02 04:30:00	-7.0	2008-07-02 11:30:00	1	32		
8634141	4.93983449254		2008-06-30 07:30:00	-7.0	2008-06-30 14:30:00	1	32		
8634276	4.48706534328		2008-06-25 05:00:00	-7.0	2008-06-25 12:00:00	1	32		

Series Selector								
<input checked="" type="radio"/> All <input type="radio"/> Simple Filter <input type="radio"/> Advanced Filter								
	SeriesID	SiteID	SiteCode	SiteName	Variabl...	VariableCode	VariableName	Speciation
<input type="checkbox"/>	12	1	USU-LBR-Mendon	Little Bear River at Me...	13	USU13	Gage height	Not Applicable
<input type="checkbox"/>	13	1	USU-LBR-Mendon	Little Bear River at Me...	13	USU13	Gage height	Not Applicable
<input type="checkbox"/>	14	1	USU-LBR-Mendon	Little Bear River at Me...	13	USU13	Gage height	Not Applicable
<input checked="" type="checkbox"/>	15	1	USU-LBR-Mendon	Little Bear River at Me...	32	USU32	Oxygen, dissolved	Not Applicable
<input type="checkbox"/>	16	1	USU-LBR-Mendon	Little Bear River at Me...	32	USU32	Oxygen, dissolved	Not Applicable
<input type="checkbox"/>	17	1	USU-LBR-Mendon	Little Bear River at Me...	33	USU33	Oxygen, dissolved per...	Not Applicable
<input type="checkbox"/>	18	1	USU-LBR-Mendon	Little Bear River at Me...	34	USU34	Specific conductance	Not Applicable

Sensor Data Quality Control



ODM Tools Python

Sensor Data Quality Control

The screenshot displays the ODM Tools Python interface, which is used for sensor data quality control. The interface is divided into several sections:

- Data Editing Tools:** A toolbar at the top left contains icons for editing data points, including 'Filter Points', 'Change Value', 'Interpolate', 'Flag', 'Add Point', 'Delete Point', and 'Record'.
- Dynamic Data Editing Display:** A plot titled 'Little Bear River at Paradise, Utah Gage height' showing 'Gage height(international foot)' on the y-axis (ranging from 4 to 10) and 'Date Time' on the x-axis (ranging from Dec 22 2007 to Apr 12 2008). The plot shows a series of data points with a sharp increase in gage height around March 1, 2008, reaching a peak of approximately 9.5 feet.
- Python Code Console:** A window on the right side of the interface showing a list of active points and their corresponding timestamps. The console output includes a list of points with their timestamps and gage heights, such as:

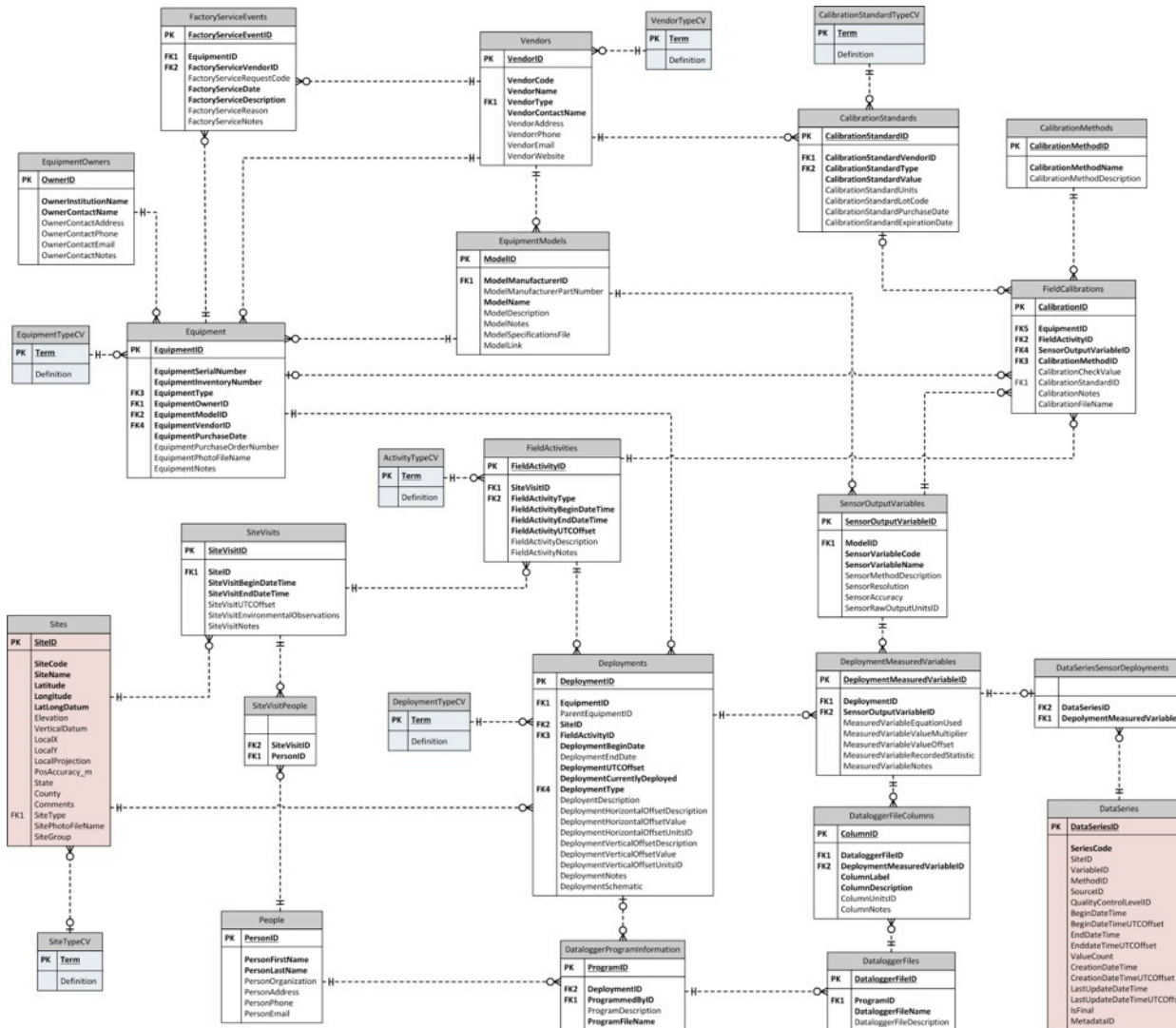
```
>>> series.get_active_points()
[(2766974, 9.04, datetime.datetime(2008, 3, 2, 11, 30)), (
2766975, 9.04, datetime.datetime(2008, 3, 2, 11, 45)), (2766976
, 9.04, datetime.datetime(2008, 3, 2, 12, 0)), (2766977, 9.04,
datetime.datetime(2008, 3, 2, 12, 15)), (2766978, 9.04,
datetime.datetime(2008, 3, 2, 12, 30)), (2766979, 9.04,
datetime.datetime(2008, 3, 2, 12, 45)), (2766980, 9.04,
datetime.datetime(2008, 3, 2, 13, 0)), (2766981, 9.04, datetim
e.datetime(2008, 3, 2, 13, 15)), (2766982, 9.05, datetim
e.datetime(2008, 3, 2, 13, 30)), (2766983, 9.06, datetim
e.datetime(2008, 3, 2, 13, 45)), (2766984, 9.06, datetim
e.datetime(2008, 3, 2, 14, 0)), (2766985, 9.08, datetim
e.datetime(2008, 3, 2, 14, 15)), (2766986, 9.09, datetim
e.datetime(2008, 3, 2, 14, 30)), (2766987, 9.1, datetim
e.datetime(2008, 3, 2, 14, 45)), (2766988, 9.1, datetim
e.datetime(2008, 3, 2, 15, 0)), (2766989, 9.1, datetim
e.datetime(2008, 3, 2, 15, 15)), (2766990,
9.1, datetim
e.datetime(2008, 3, 2, 15, 30)), (2766991, 9.1,
datetim
e.datetime(2008, 3, 2, 15, 45)), (2766992, 9.09,
```
- Python Script Editor:** A window at the bottom right showing a script for editing data points. The script includes the following code:

```
1 from odmservices.edit_service import EditService
2 series = EditService(series_id= 171,
3 connection_string = "mssql+pyodbc://ODM:odm@(local)/Lit
4 series.filter_value(8, '>')
5
```

The bottom of the interface features a 'Series Selector' table with columns for SeriesID, SiteID, SiteCode, SiteName, VariableCode, VariableName, Speciation, VariableUnitsName, and SampleID. The table lists various data series for the Little Bear River at Paradise, Utah, including temperature, phosphorus, solids, gage height, and discharge.

SeriesID	SiteID	SiteCode	SiteName	VariableCode	VariableName	Speciation	VariableUnitsName	SampleID
165	11	USU-LBR-Confluence	Little Bear River below...	USU36	Temperature	Not Applicable	96 degree celcius	Surfa
166	11	USU-LBR-Confluence	Little Bear River below...	USU39	Phosphorus, total as P	P	199 milligrams per liter	Surfa
167	11	USU-LBR-Confluence	Little Bear River below...	USU40	Phosphorus, total as ...	P	199 milligrams per liter	Surfa
168	11	USU-LBR-Confluence	Little Bear River below...	USU41	Solids, total Suspended	Not Applicable	199 milligrams per liter	Surfa
169	12	10105900	Little Bear River at Pa...	USU42	Gage height	Not Applicable	48 international foot	Surfa
170	12	10105900	Little Bear River at Pa...	USU43	Discharge	Not Applicable	35 cubic feet per second	Surfa
171	12	10105900	Little Bear River at Pa...	USU42	Gage height	Not Applicable	48 international foot	Surfa

Equipment Management



- Track physical infrastructure: sensors, data loggers, batteries, etc.
- Track events: deployments, calibrations, site visits, factory servicings, etc.
- Connects to ODM where streaming data is stored
- Web interface

Sites
Manage Sites

Site Visits
Manage Visits

Equipment
Manage equipment

Reports
Generate Reports

Equipment Details | [View full equipment details](#)

[Edit Description](#)

[Delete](#)

Equipment Description

Equipment ID: 99999999999

Serial Number: 9999999999

Model Name: DTS-12

Description: Forest Technology Systems DTS-12 Digital Turbidity Sensor

Purchase Date: 1/20/2013

Notes: Measures water turbidity and water temperature.

Link: <http://www.ftsenvironmental.com/products/sensors/dts12/>

Owner Institution: Utah State University

Owner Contact: Michelle Baker

Owner Address: 5305 Old Main Hill, Logan, UT 84322-5305

Owner Phone: 1.435.797.7131

Email: michelle.baker@usu.edu



Manufacturer

Vendor Name: Forest Technology Systems

Contact Name: Someguy Thatworksthere

Address: 1123 Fir Avenue, Suite C., Blaine, WA, 98230
Phone: 1.800.548.4264

Email: sales@ftshydrology.com

Web Address: <http://www.ftsenvironmental.com/>

Vendor

Vendor Name: Forest Technology Systems

Contact Name: Someguy Thatworksthere

Address: 1123 Fir Avenue, Suite C., Blaine, WA, 98230

Phone: 1.800.548.4264

Email: sales@ftshydrology.com

Web Address: <http://www.ftsenvironmental.com/>

[View Deployment History](#)

[View Factory Service History](#)

[View Calibration History](#)

Sites
Manage Sites

Site Visits
Manage Visits

Equipment
Manage equipment

Reports
Generate Reports

Site Visit Details | [View full site visit details](#)

[Edit Description](#)
[Delete](#)
[View Full Site Visit History for this Site](#)


Site Visit Location

Site Code: USU-LR-UWRL

Site Name: Logan River at the Utah Water Research Laboratory

Latitude: 43

Longitude: -111

Elevation: 4355 m

Site Visit Description

Crew: Jeff Horsburgh, Amber Jones

Begin Date Time: 2/22/2013 1:00 PM MST

End Date Time: 2/22/2013 2:00 PM MST

Environmental Observations: The weather was sunny. The river was low. Water was clear.

Site Visit Notes: None.

Field Activities Performed (click the activity type to view details)

Activity Type	Begin Date/Time	End Date/Time	Description	Notes
Calibration	2/22/2013 1:00 PM MST	2/22/2013 1:10 PM MST	Sensor Calibration	None
Deployment	2/22/2013 1:30 PM MST	2/22/2013 2:00 PM MST	Sensor Deployment	None



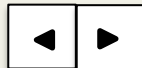
Sites
Manage Sites

Site Visits
Manage Visits

Equipment
Manage equipment

Reports
Generate Reports

Calendar | Click on activities to view details



February ▼

2013 ▼

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
			Logan River Site1			
	Red Butte Creek Site3	Logan River Site2	Red Butte Creek Site1			
			Provo River Site1	Logan River Site3		
	Red Butte Creek Site2		Provo River Site1			

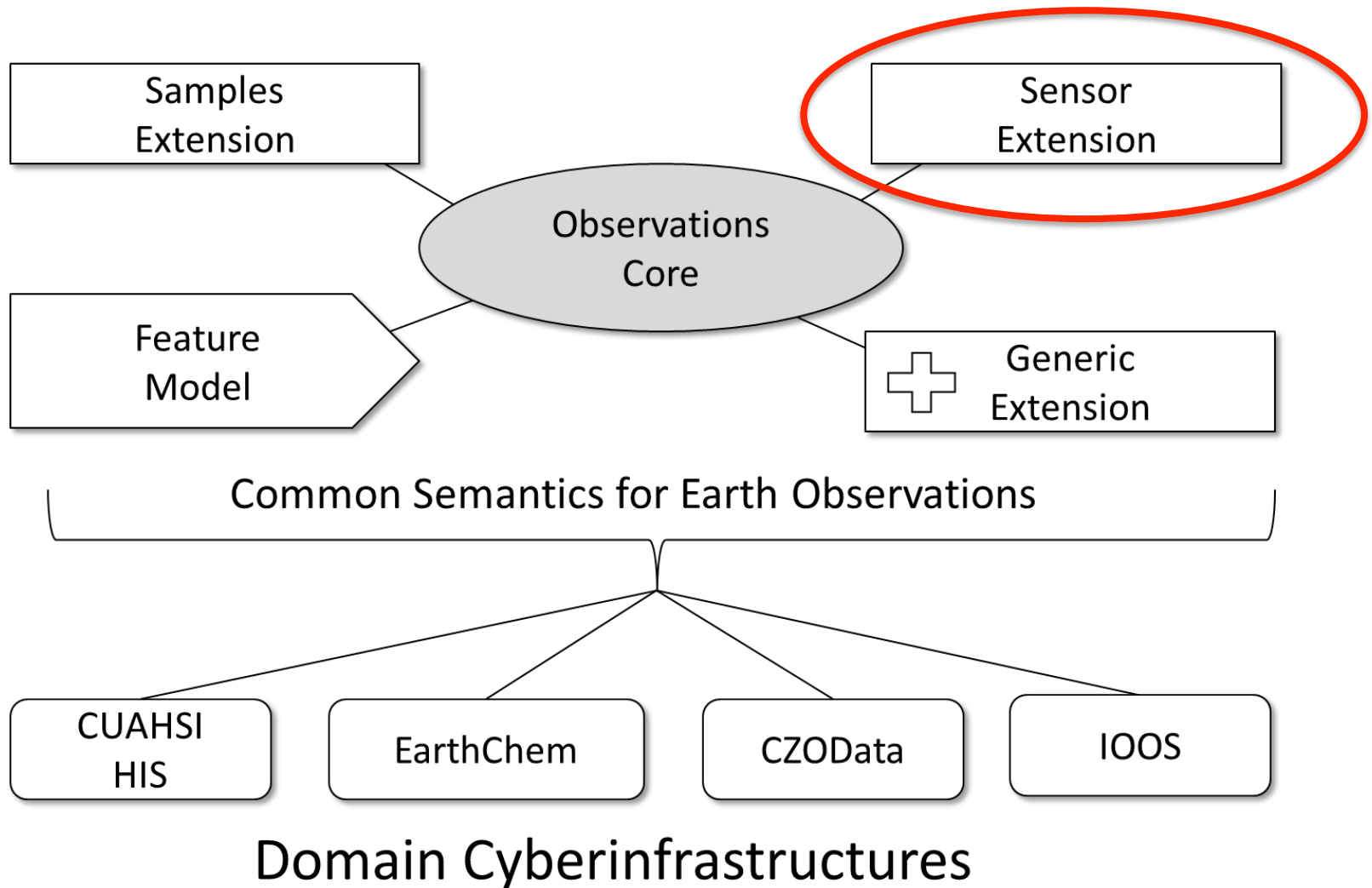
Display: ☒ Site Visits ☐ Factory Service Events

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This material is based upon work supported by the National Science Foundation (NSF) under Grant No. XXXXXXXX.

Any opinions, findings, conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the NSF.

ODM2



How can we enable and increase collaborative research and sharing of data and models through the innovative use of cyberinfrastructure?

iUTAH Modeling and Data Federation

data.iutahepscor.org



Modeling and Data Federation

Innovative Urban Transitions and Aridregion Hydro-sustainability

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The iUTAH Modeling and Data Federation is an online system for sharing data, models, and other digital resources. Activities of the iUTAH Cyberinfrastructure Team (CI Team) are focused on developing hardware and software systems and tools that improve iUTAH participants' capacity for data collection, organization, management, sharing, synthesis to higher-level products, and integration with models.

Announcements

Data Inventory: As an initial step in developing the iUTAH Modeling and Data Federation, we are conducting a survey of existing and planned datasets.

[Click here](#) to submit dataset information to the iUTAH data inventory or view the list of datasets that have been submitted.

Model Inventory: We are collecting information about models from a variety of disciplines that may be of interest to your iUTAH-related research. [Click here](#) to submit model information to the iUTAH data inventory or view the list of models that have been submitted.

[iUTAH Homepage](#)

[Utah EPSCoR](#)

[CI-WATER EPSCoR](#)

[Data Inventory](#)

[Model Inventory](#)

[Year 1 Scope of Work](#)

[About](#)

[Hardware Development](#)

[Software Development](#)



This project is funded through EPS - 1208732. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.



Modeling and Data Federation

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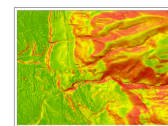
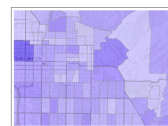
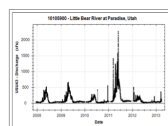
Software Development

UTAH Modeling and Data Federation

The beginnings of the iUTAH Modeling and Data Federation have been implemented at <http://data.iutahepscor.org>. This website will continue to be fleshed out as we develop new functionality of the next couple of years.

Data and Model Inventories

The iUTAH research teams will be developing new datasets and models to support iUTAH's research goals. However, there will also be extensive reuse of existing data resources and models from many different sources. The CI Team is developing tools that will help facilitate the process of identifying existing datasets and models that may be useful to the iUTAH efforts. For example, we are compiling a database of metadata describing existing and planned data resources. iUTAH participants can access an online metadata submission form via <http://data.iutahepscor.org> to submit metadata describing datasets that they know about. Users can also view details of datasets that have been submitted by others. The database of metadata that we compile will enable us to both prioritize efforts for providing access to specific datasets through the iUTAH Modeling and Data Federation and will serve as an initial corpus of data that we can use to develop data discovery and access services needed by iUTAH partners.



Sensor Data Management

One of the immediate goals of the iUTAH CI team is to support management of the streaming sensor data from the iUTAH aquatic and terrestrial monitoring sites that will be installed as the GAMUT network is built. The CI Team is assisting in the planning for telemetry connections to each of the iUTAH monitoring sites as well as implementing tools that will facilitate the automated loading of the streaming sensor data into relational databases where they can be more easily managed by the iUTAH watershed technicians and ultimately and shared on the Internet. Much of the required sensor data management functionality is being implemented using existing tools from the CUAHSI Hydrologic Information System.



Extended Data Models

Model and Data Inventories



Modeling and Data Federation

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Submit Dataset Information

Please complete this form with information about datasets that you will either be creating as part of the iUTAH project or from existing data sources. Required fields are indicated with a red star.

If you find would rather submit metadata about many datasets all at once, please download the [Microsoft Excel Template](#) and fill it out then email it to jeff.horsburgh@usu.edu or amber.jones@usu.edu and we will upload your file in bulk.

Data Inventory Submission

General Information About the Dataset

Dataset Title *

Please provide a descriptive title for the dataset.

Abstract *

Please provide a descriptive abstract.

Purpose

What is the purpose of the data? Why were they created?

Existing *

Is the data existing or is this data that will be created by iUTAH?

Collection



Modeling and Data Federation

innovative Urban Transitions and Aridregion Hydro-sustainability

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Submitted Datasets

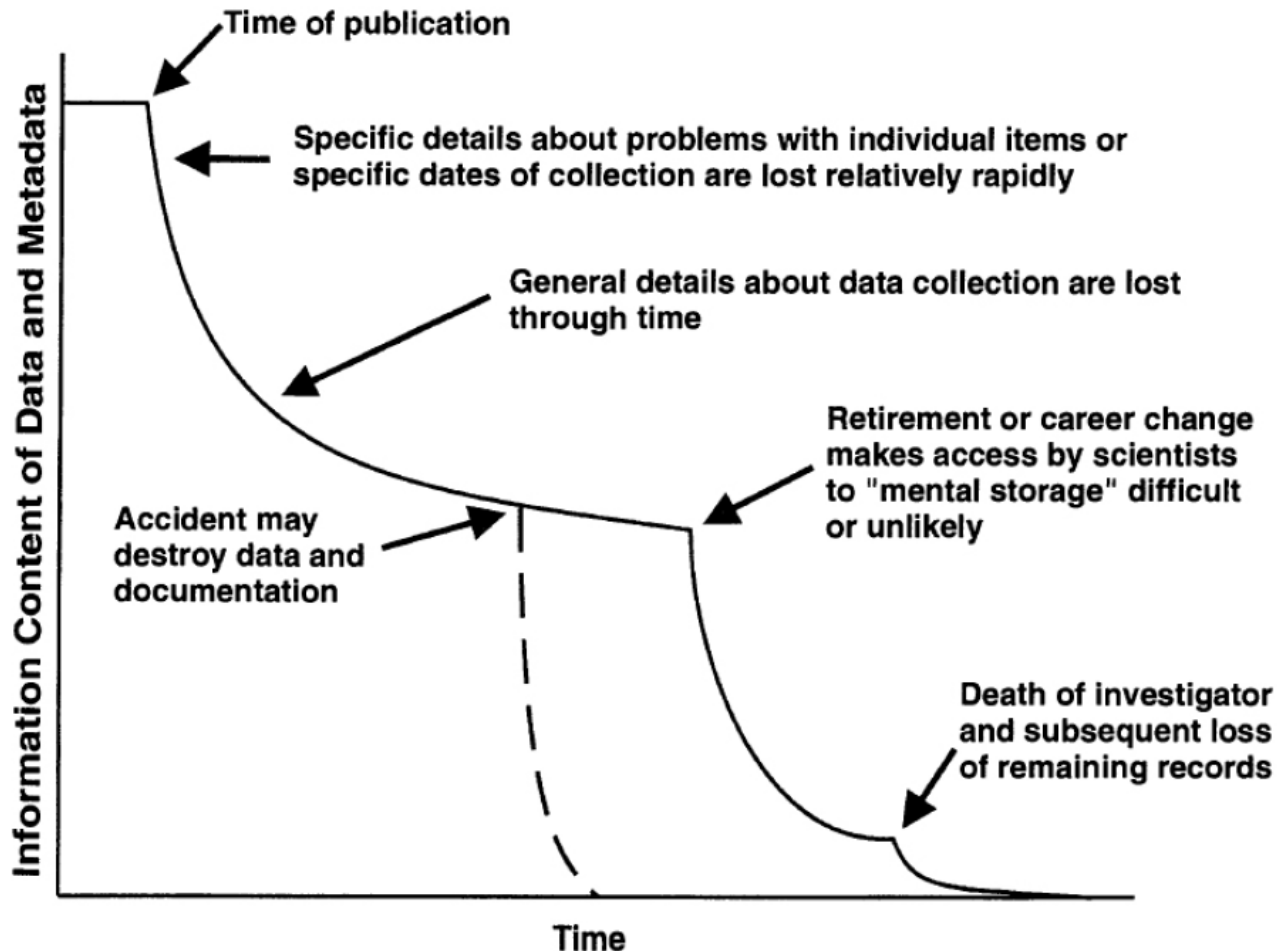
Dataset Title	Abstract	Submitter
Little Bear River, UT Continuous Water Quality Data	The Utah Water Research Laboratory uses in situ sensors to monitor water quality and streamflow at several sites in the Little Bear River. These data have been collected from 2005 to present.	Amber Jones
Utah Division of Water Rights Water Use Records	The Utah Division of Water Rights maintains records of water diversion from surface and underground sources.	Amber Jones
Airborne Thermal Infrared Remote Sensing Bear River Basin, ID/WY/UT	In 2006, Pacificorp and Trout Unlimited contracted with Watershed Sciences, Inc. to provide thermal infrared (TIR) and true color digital imagery of selected streams in the Bear River basin in Idaho, Wyoming, and Utah (Figure 1). Surveyed streams included the Bear River from Cutler Reservoir upstream to Cokeville, WY, Cub River, Thomas Fork/Salt Creek, and Smiths Fork/Hobble Creek. The data were successfully acquired from July 24–29, 2006, during the mid-afternoon hours (1:30 to 5:00 PM).	Jeff Horsburgh
State of Utah Geographic Information Database's (SGID) High Resolution Orthophotography	The Utah AGRC contracted Aero-Graphics to collect high resolution orthophotography of the Wasatch Front. Data collection occurred between March 28 and June 1 of 2012. Coverage includes 110 square miles of 12.5cm (~5 inch) resolution 4-band aerial photography imagery.	Amber Jones
Little Bear River, UT Meteorological Data	The Utah Water Research Laboratory operates four weather stations within the Little Bear River watershed. These stations have been collecting data from 2007 to present.	Amber Jones



This project is funded through EPS - 1208732. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.



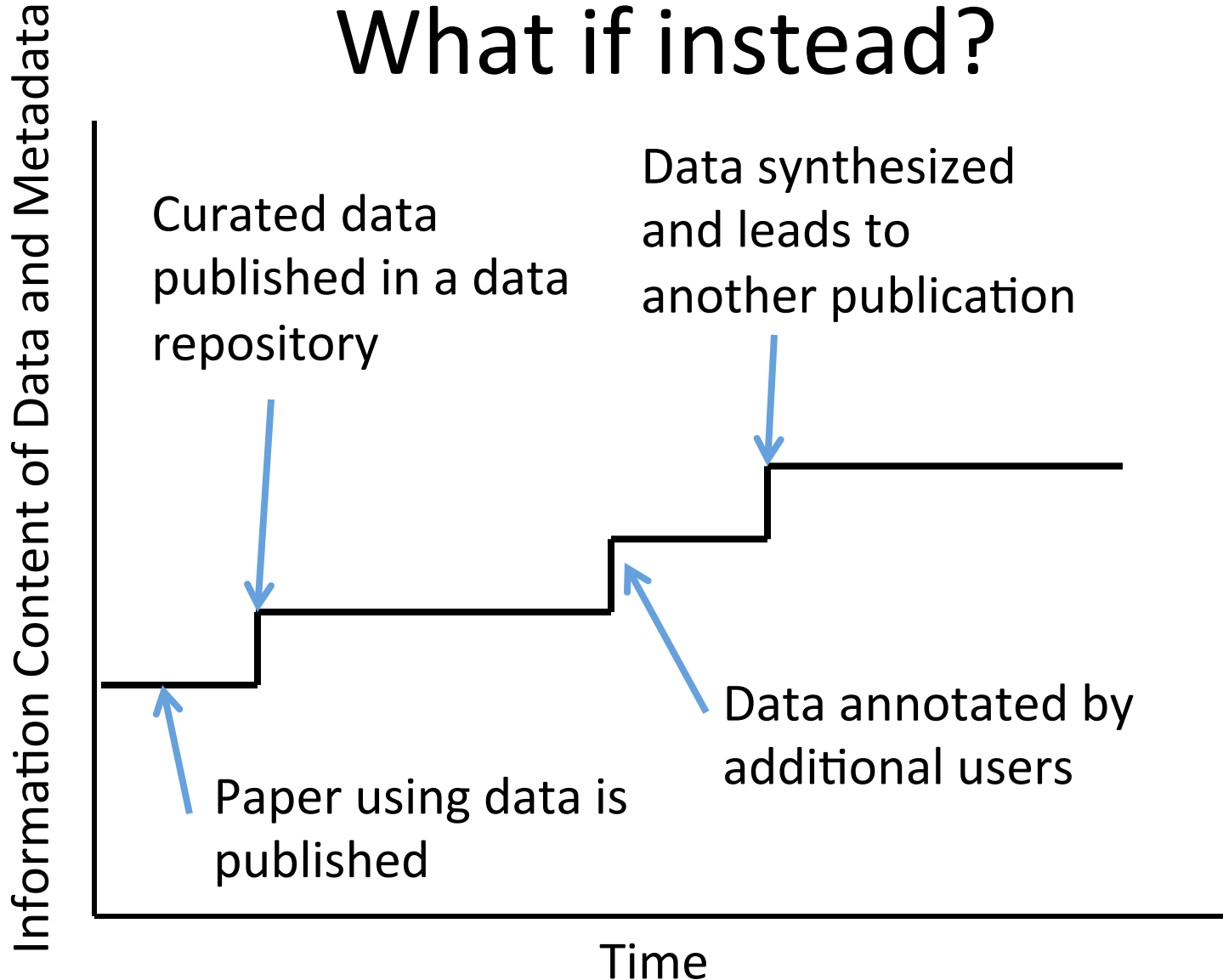
Information Entropy



Example of the normal degradation in information content associated with data and metadata over time ("information entropy").

Michener, W.K. (2006). Meta-information concepts for ecological data management, *Ecological Informatics*, 1(1), 3-7, <http://dx.doi.org/10.1016/j.ecoinf.2005.08.004>.

What if instead?



Support for Sharing and Collaboration

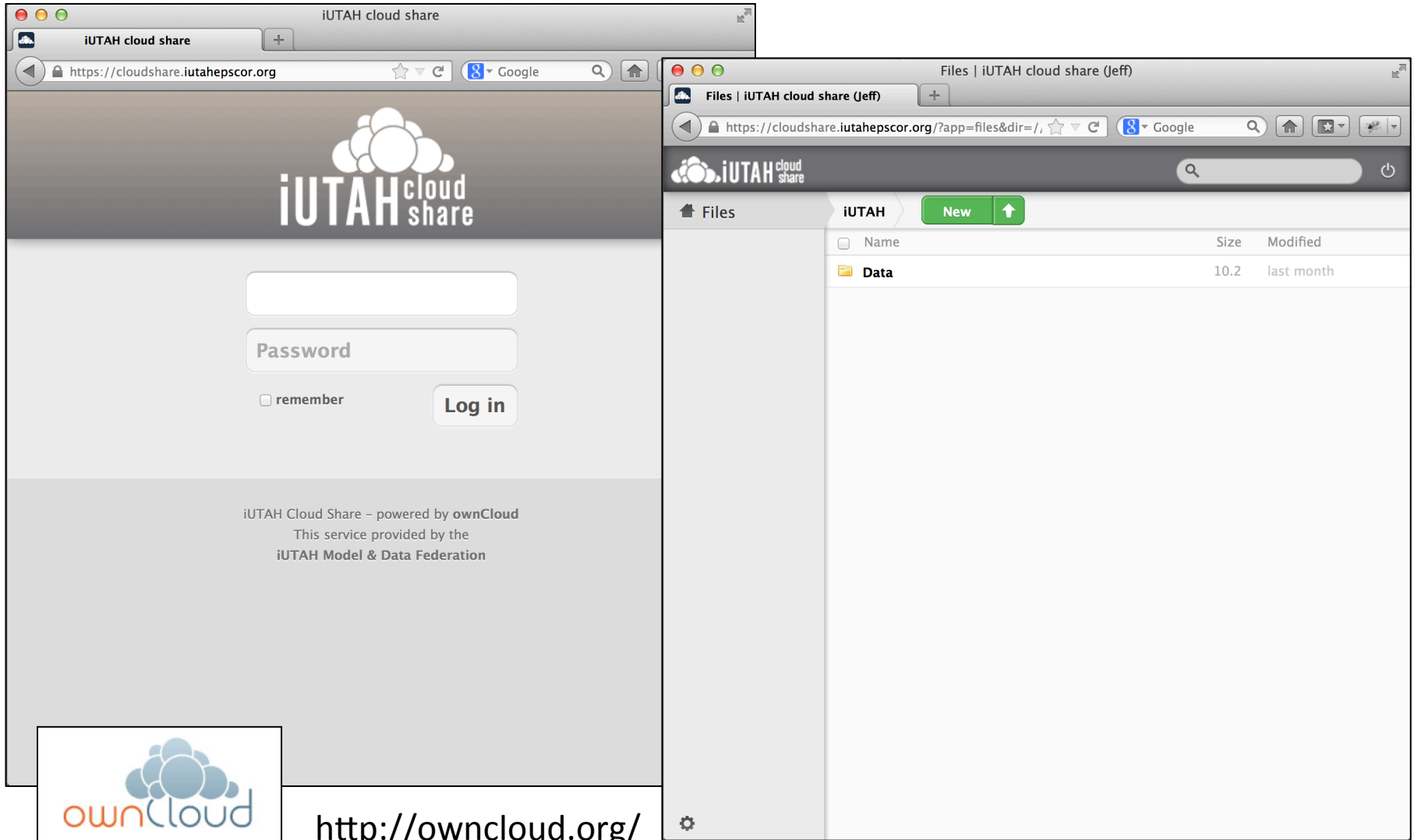
- Collaboration
 - Datasets as shared “social objects”
 - Formation of collaborations
 - Social networking features
- Requirements
 - What data resources are available? (metadata catalog)
 - How do I get them? (search interface)
 - How can I share what I have? (data repository)

Accessing Agency and National Data Networks

- Challenges
 - Multiple sources, websites, systems
 - Multiple data formats, schemas, semantics
 - Building consistent metadata to support data discovery
 - Prioritizing where to allocate our resources
- Solutions
 - **Partnerships!!!**

Collaborative Data Sharing

cloudshare.iutahepscor.org



The image displays two overlapping browser windows from the iUTAH cloud share service. The background window shows the main login page, which includes the iUTAH cloud share logo, a text input field, a password field, a 'remember' checkbox, and a 'Log in' button. Below the login fields, it states 'iUTAH Cloud Share - powered by ownCloud' and 'This service provided by the iUTAH Model & Data Federation'. The foreground window shows the file management interface for a user named 'Jeff'. It features a sidebar with 'Files' and 'iUTAH' tabs, a 'New' button, and an upload icon. The main area contains a table with file information:

Name	Size	Modified
Data	10.2	last month

At the bottom left, there is an ownCloud logo and the URL <http://owncloud.org/>.

Data Publication in National Networks

- Collaboration with:
 - CUAHSI Data Center
 - HydroShare
 - NSF DataONE Network
- Focus: publishing data products in a way that they can be cited and easily accessed



HydroShare: Collaborative Sharing of Data and Models

- Collaboration environment and social media website
 - Social objects – data, models, digital content
 - HydroShare aims to change the way we do science
 - We are working to make collaboration easier
 - Sharing data
 - Sharing models and other research products
 - Providing new communication and social media capabilities
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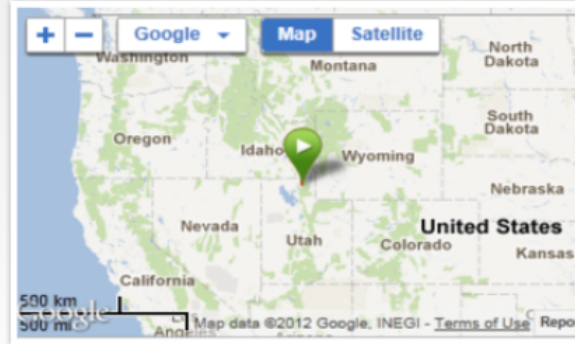
LITTLE BEAR RIVER ODM
Database 6/6/2012

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WATERSHED DELINEATION
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ABSTRACT

Time series of water quality sensor data in the Little Bear River, Utah, USA.

KEYWORDS

Temperature, Dissolved Oxygen, pH, Specific Conductance, Turbidity

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Jeff Horsburgh
Utah State University
jeff.horsburgh@usu.edu

RESOURCES YOU MAY LIKE



LITTLE BEAR RIVER SWAT MODEL
Shared by: David Tarboton



LITTLE BEAR RIVER DEM
Shared by: David Tarboton



LITTLE BEAR RIVER DEM
Shared by: David Tarboton

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<input type="checkbox"/>		Watershed Delineation Workflow	6/6/2012	
<input type="checkbox"/>		Little Bear River SWAT Model	6/6/2012	
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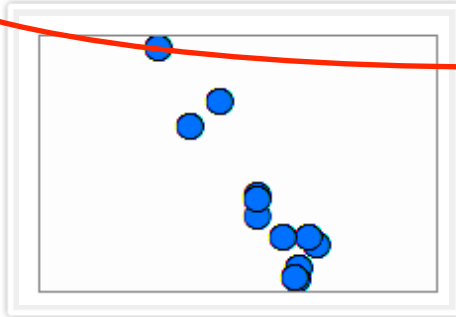
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LITTLE BEAR RIVER MONITORING SITES | Resource Details

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Resource Type: ESRI Shapefile 

Created by: Jeff Horseburgh

Created: 6/10/2012

Keywords: observations catalog, data cart, little bear river, utah, CUAHSI, Water, Utah State University, Continuous Monitoring, Water Quality, Streamflow.

Size: 250 KB

Extent: Left: -111.95 Right: -111.79 Top: 41.73



Resource Description

Abstract: Utah State University is conducting continuous monitoring within the Little Bear River watershed of northern Utah, USA to investigate the use of surrogate measures such as turbidity in creating high frequency load estimates for constituents that cannot be measured continuously. This shapefile contains location of USU's continuous monitoring sites.

Citation: Horsburgh, J. S., D. K. Stevens, D. G. Tarboton, N. O. Mesner, A. Spackman Jones, and S. Gurrero, (2009), Monitoring data collected within the Little Bear River Experimental Watershed, Utah, USA, Utah State University.

COMMENTS



Jeff Horsburgh 11.11.12
This shapefile is really helpful if you want to know where my monitoring sites are located.



Jeff Horsburgh 11.21.12
Have you thought about re-writing the script so that it can access data using web services instead?

SIMILAR RESOURCES



LITTLE BEAR RIVER SITES
Shared by: Jeff Horsburgh



LITTLE BEAR RIVER ODM DATABASE
Shared by: Jeff Horsburgh



LITTLE BEAR RIVER DEM
Shared by: David Tarboton

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Name: [Little Bear River Research Group](#)

Description: This group is studying water quality in the Little Bear River, Utah, USA.

Created by: Jeff Horsburgh



Name: [CUAHSI](#)

Description: This group shares resources related to hydrologic science.

Created by: Rick Hooper



Name: [Little Bear River Research Group](#)

Description: This group is studying water quality in the Little Bear River, Utah, USA.

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Name: [USU Hydrology Group](#)

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Next Steps

- Accessing agency and national datasets
 - Developing tools for automatically accessing data
 - Partnerships with data providers
- Supporting data discovery and access across iUTAH and external data sources
 - Mediating across sources, formats, semantics
- Enhanced tools for collaboration and sharing of models and data
- Data publication within national networks
 - publishing data products in a way that they can be cited and easily accessed



Support: EPS 1208732

Questions?

Jeff Horsburgh

jeff.horsburgh@usu.edu



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