Cyberinfrastructure to Support Large Scale Collaborative Water Research

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USU Spring Runoff Conference

4-10-2013

Support:
EPS 1208732

innovative Urban Transitions and Aridregion Hydro-sustainability (**iUTAH**)

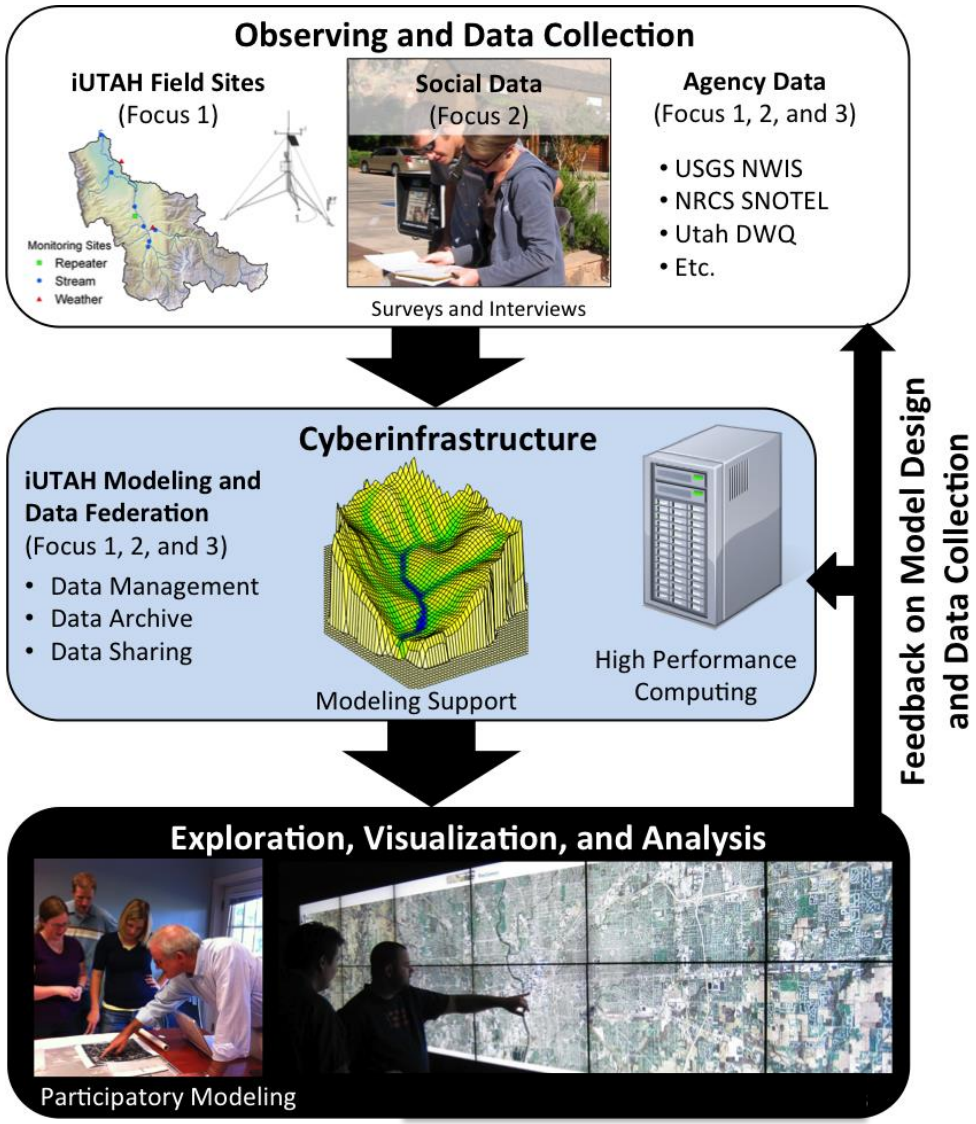
- Statewide effort
- $20 million competitive award from NSF EPSCoR
- Research capacity building
- Interdisciplinary and multi-institution
- Focused on sustainable management of Utah's water resources

Support:
EPS 1208732

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 MDF – Information Flow



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

iUTAH MDF Focus Areas

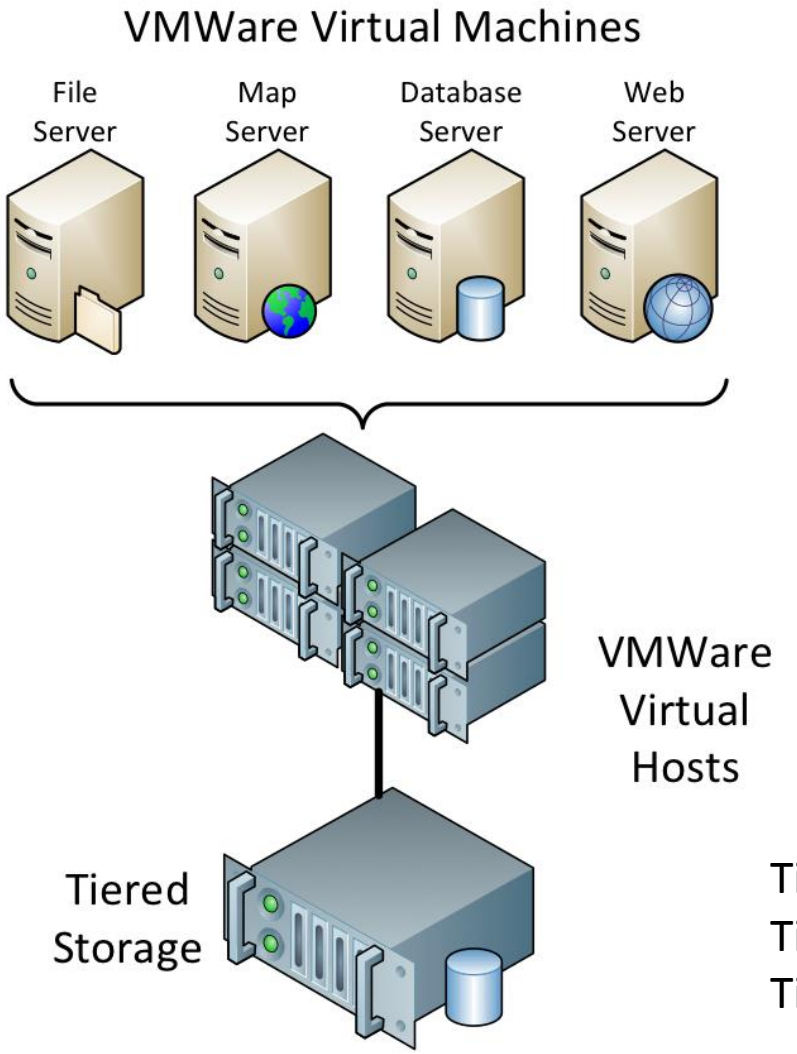
1. Data management support for data from iUTAH facilities
   - GAMUT – Gradients Along Mountain to Urban Transitions
   - GIRF – Green Infrastructure Research Facility
2. Support for data discovery and access
   - iUTAH facility and investigator data
   - Agency data
   - National data networks
3. Support 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?

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



Required servers and software stacks implemented on virtual machines

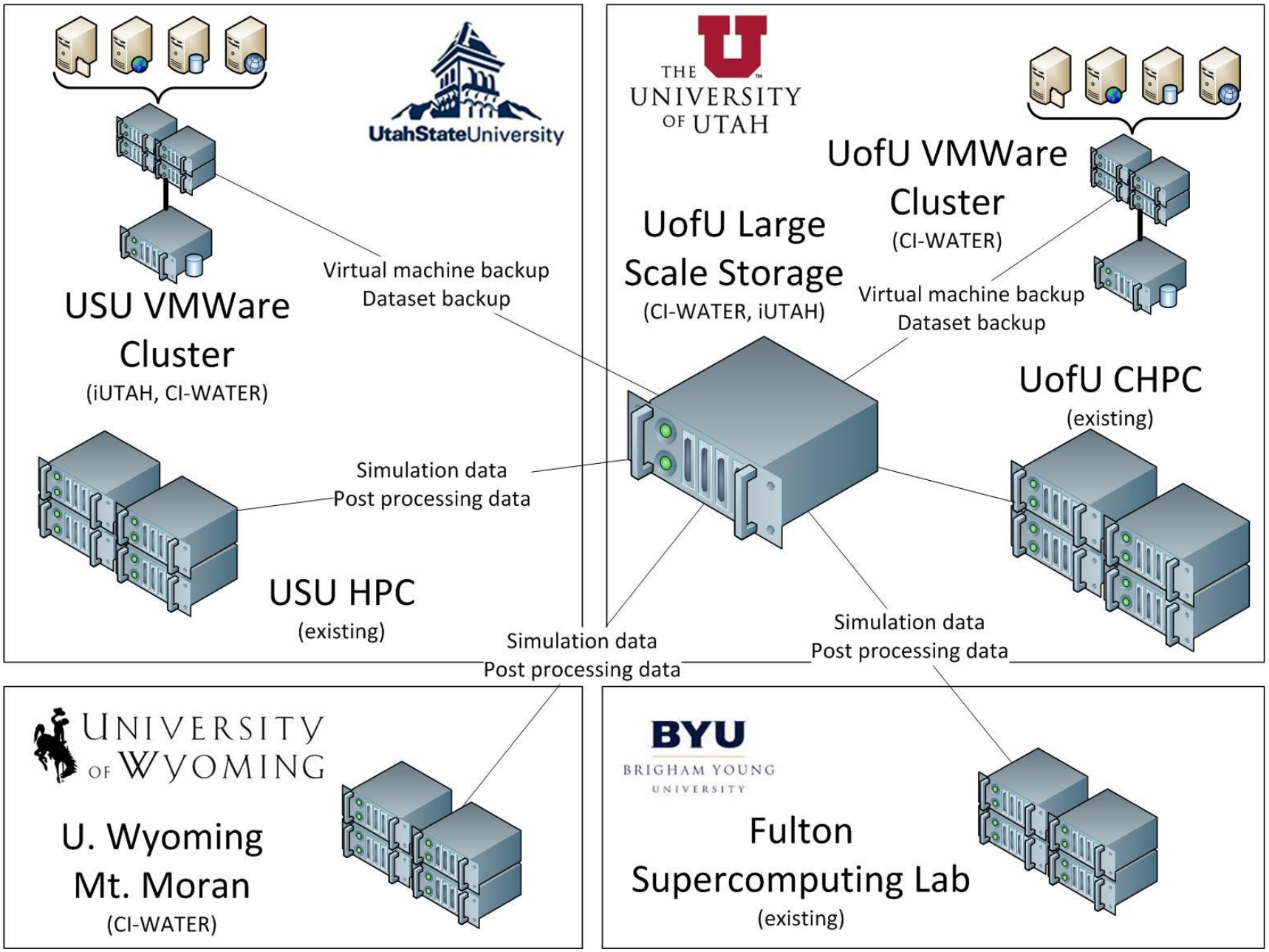
Many virtual machines can be hosted on a single virtual host server

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

The Larger Utah EPSCoR Cyberinfrastructure Picture



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

iUTAH EPSCoR

Modeling and Data Federation

innovative Urban Transitions and Aridregion Hydro-sustainability

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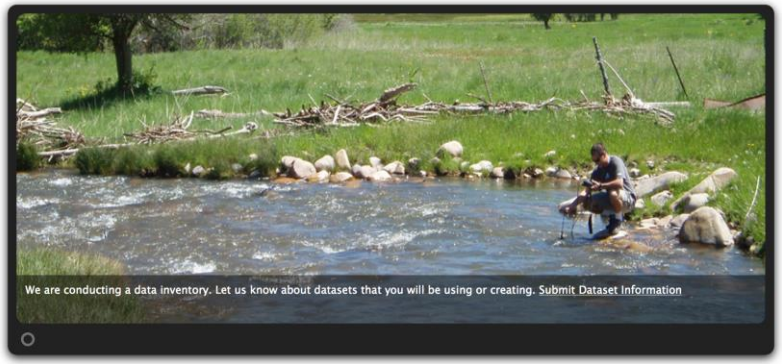

The iUTAH Modeling and Data Federation is an online system for sharing data, models, and other digital resources. Activities of the iUTAH Cyberinfrastructure Team (CI Team) are focused on developing hardware and software systems and tools that improve iUTAH participants' capacity for data collection,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

UTAH EPSCoR

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.

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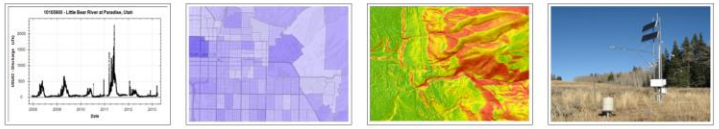
Software Development

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.

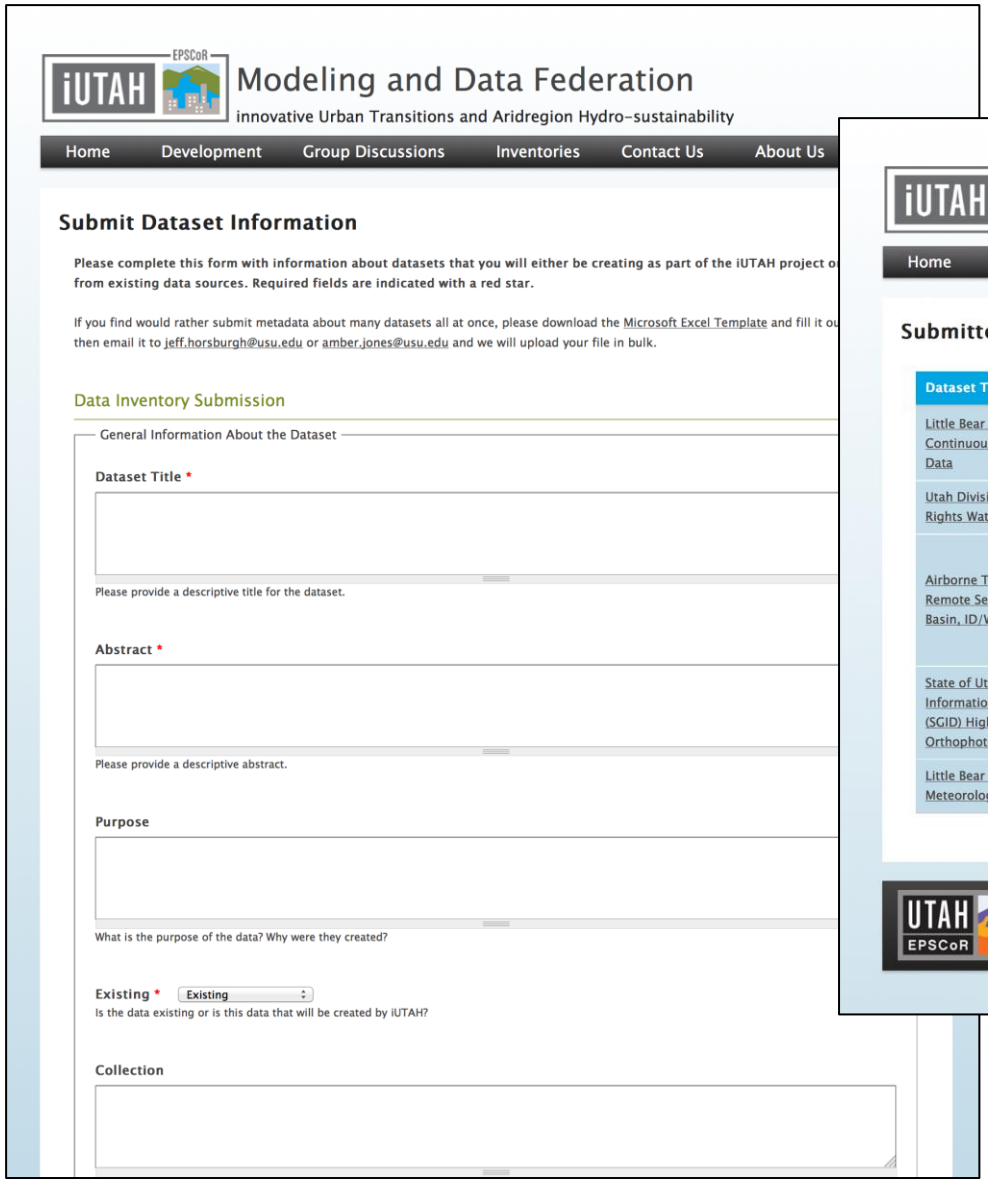


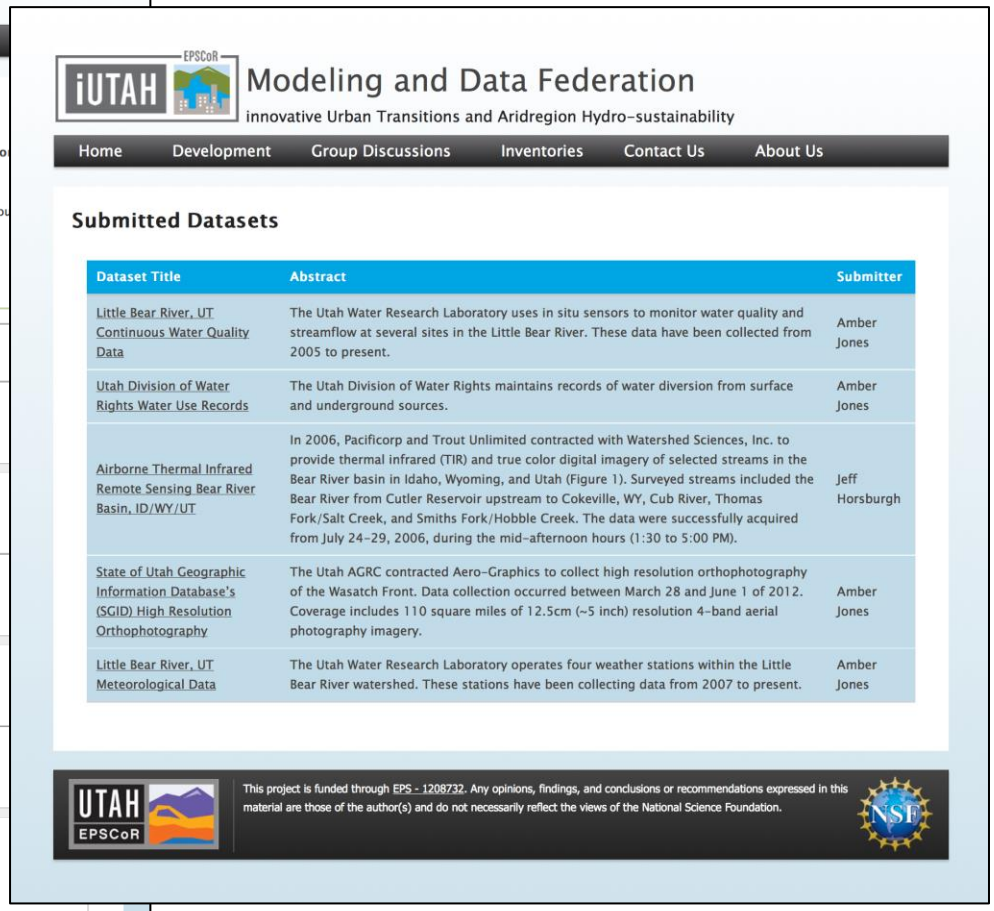
Sensor Data Management

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





iUTAH
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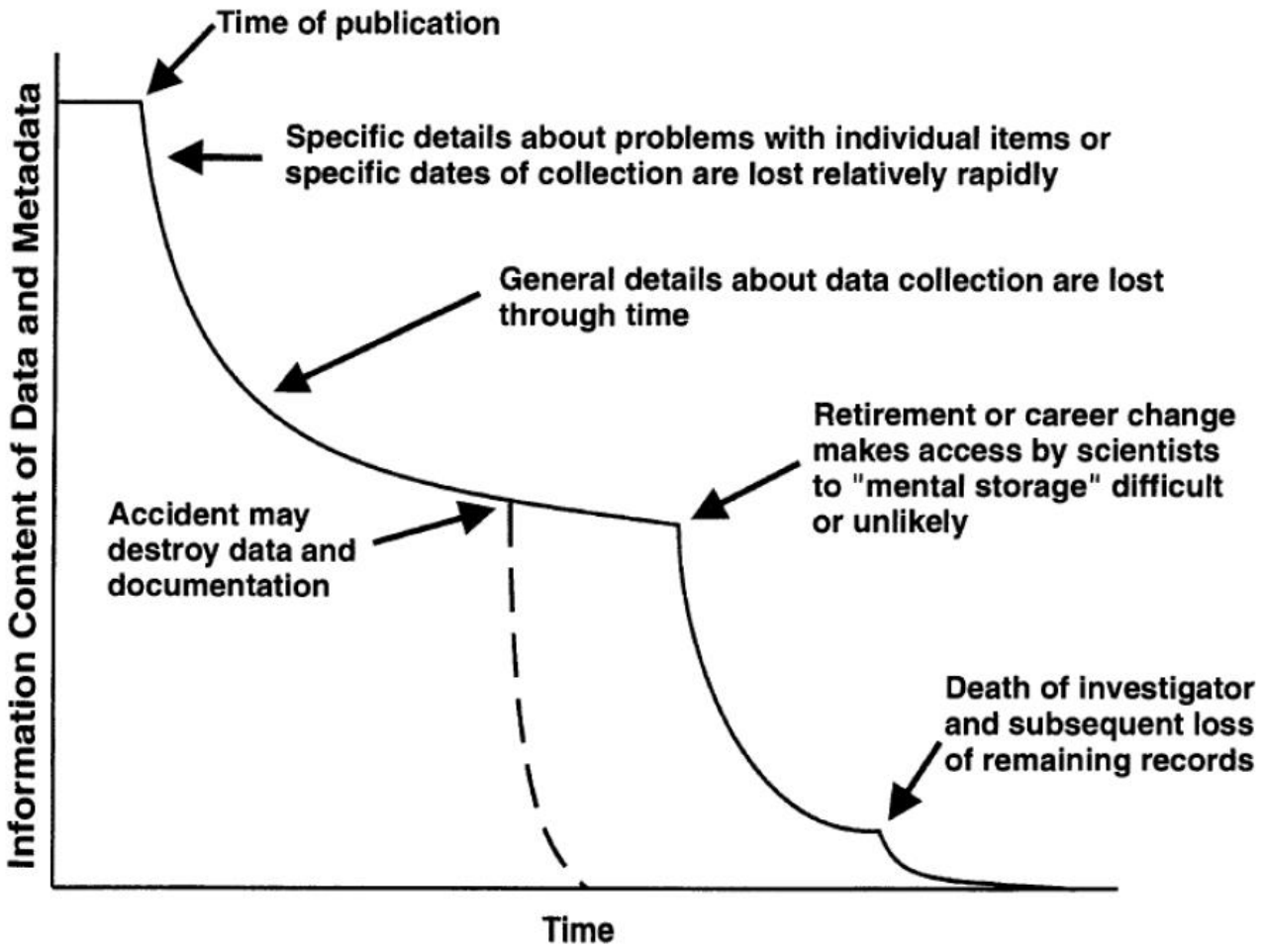
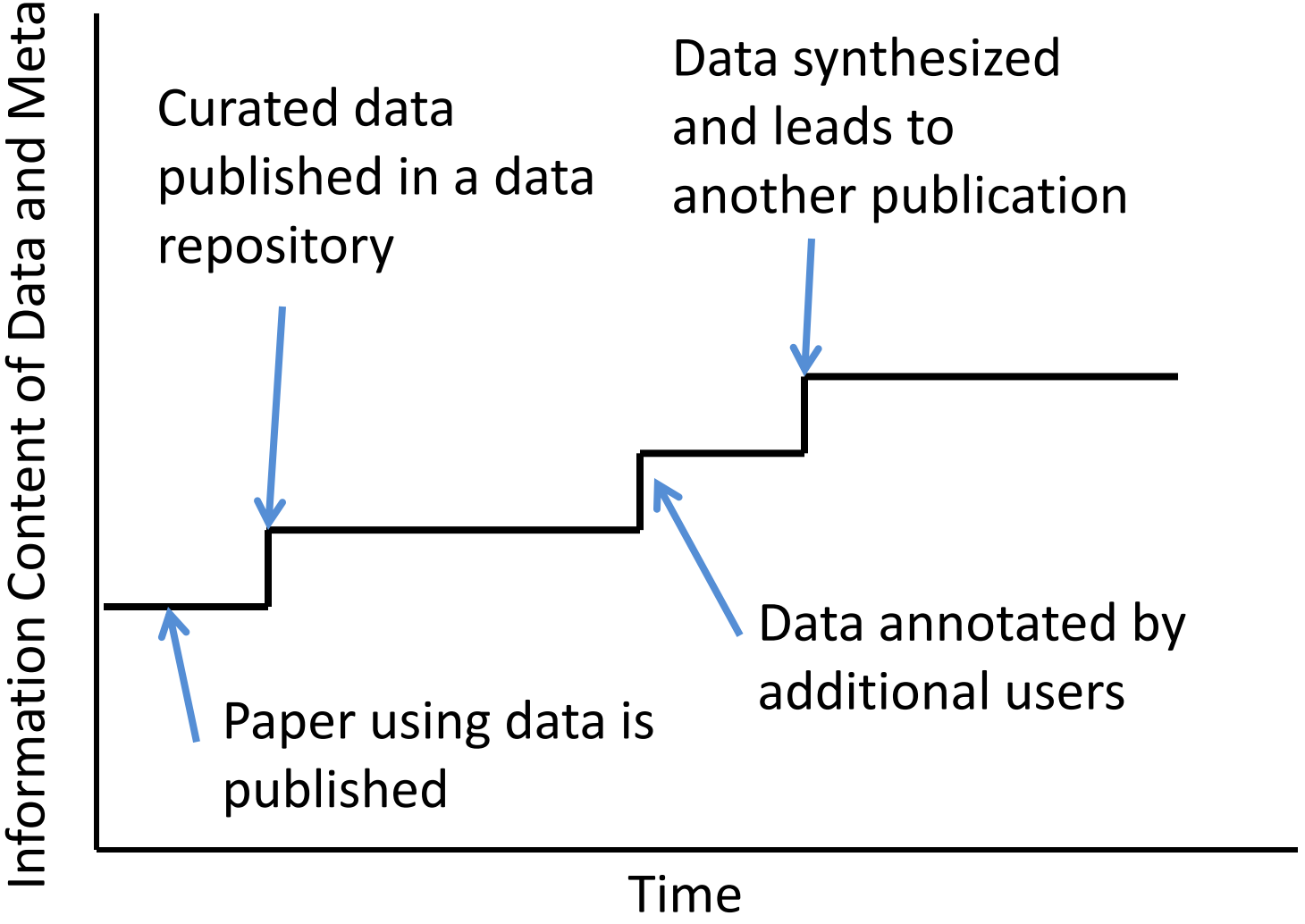
Information Entropy



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?

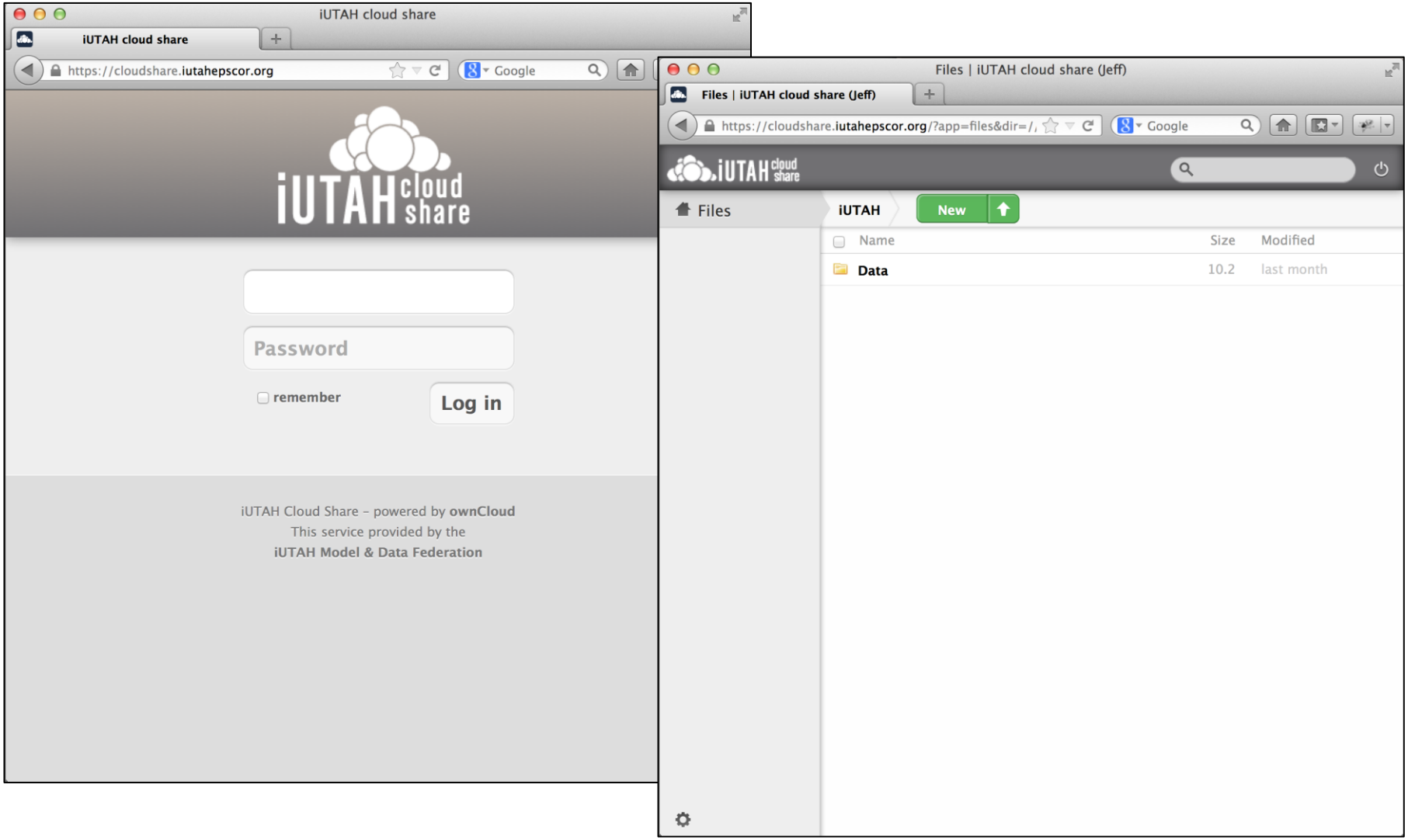


Support for Sharing and Collaboration

- 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)

Collaborative Data Sharing

cloudshare.iutahepscor.org



Data Publication in National Networks

- Collaboration with:
  - CUAHSI Data Center for hydrologic datasets
  - NSF DataONE Network
  - HydroShare

- 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
- 5 Year, $5 Million collaboration among USU, RENCI, BYU, Purdue, U. Texas, San Diego Supercomputer Center, Tufts, U. of North Carolina Chapel Hill, U. of South Carolina

Support:
OCI 1148453

HYDROSHARE

HYDROSHARE
Share and Collaborate

SHARE AND COLLABORATE

Hydroshare is an online collaboration environment for sharing data, models, and code. Join the community to start sharing.

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KEYWORD: Search Activities Show Filters

UPLOAD DELETE SHARE CREATE MASHUP EXPORT

	Type	Title	Date	Abstract
☐		Little Bear River ODM Database	6/6/2012	
☐		Little Bear River Sites	6/6/2012	
☐		Watershed Delineation Worflow	6/6/2012	
☐		Little Bear River SWAT Model	6/6/2012	
☐		Little Bear River DEM	6/6/2012	
☐		Little Bear River Excel File	6/6/2012	
☐		Little Bear River Word .doc	6/6/2012	

Results 1 - 10 of 100 << 1 2 3 4 5 6 7 8 9 10 >>

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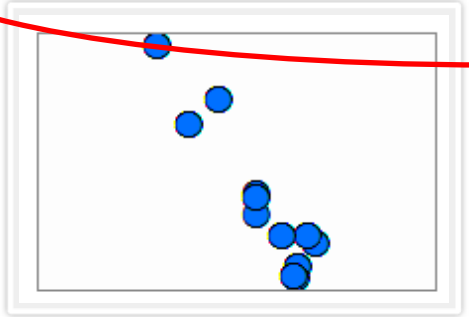
LITTLE BEAR RIVER MONITORING SITES | Resource Details

OPEN | SHARE | EXPORT | EDIT | DELETE



Resource Type: ESRI Shapefile

Created by: Jeff Horsburgh

Created: 6/10/2012

Keywords: observations catalog, data cart, little bear river, utah, CUAHSI, Water, Utah State University, Contnuous 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?

SIMALAR 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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EXPLORE | Discover and access resources published by others

KEYWORD: Little Bear River

Search | Hide Filters

Resource Type: Geospatial dataset

Date: 1.1.2012 – 6.12.2012

Sort by: Relevance | Title | Owner | Rating | Date

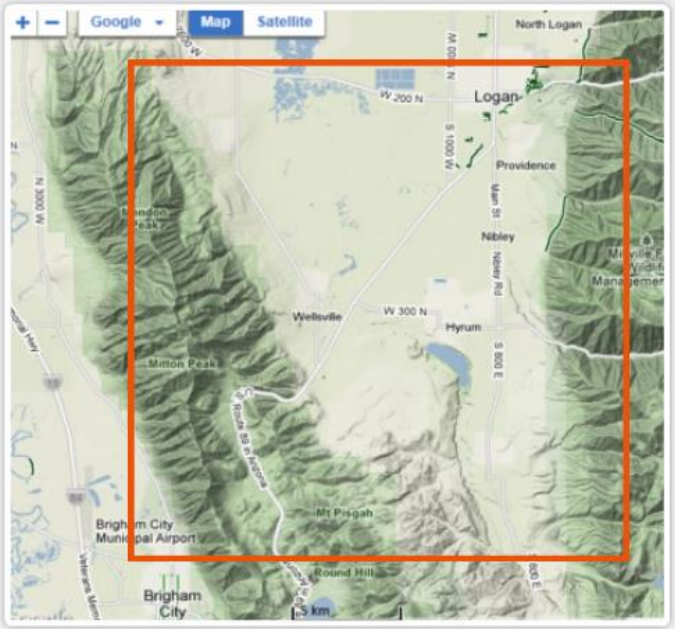
Title: Little Bear River Sites — 6.6.2012
Shared by: Jeff Horsburgh

Title: Little Bear River DEM — 6.10.2012
Shared by: David Tarboton

Title: National Land Cover Dataset — 6.10.2012
Shared by: United States Geological Survey

Title: National Elevation Dataset — 6.10.2012
Shared by: United States Geological Survey

Results 1 - 10 of 100 << 1 2 3 >>



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CREATE GROUP +

SEARCH GROUPS:

By Keyword

Groups You Created | Results

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.
Created by: Jeff Horsburgh

GROUPS YOU MIGHT BE INTERESTED IN

Name: USU Hydrology Group
Created by: David Tarboton
View Group

Name: Little Bear River Junkies
Created by: Jeff Horsburgh
View Group

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Next Steps

- Accessing agency and national datasets
  - Developing 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

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EPS 1208732

Questions?

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