



OAC-1664061  
OAC-1664018  
OAC-1664119  
2017-2021

ACI-1148453  
ACI-1148090  
2012-2017

# What it takes to achieve water data sharing: lessons learned from CUAHSI HydroShare

Access these slides in HydroShare  
by searching for “niehs2020”

David Tarboton, Jeffery S Horsburgh, Daniel P Ames, Jonathan L Goodall, Alva Couch, Pabitra Dash, Hong Yi, Christina Bandaragoda, Anthony Castronova, Bart Nijssen, Richard Hooper, Shaowen Wang, Mohamed Morsy, Scott Black, Chris Calloway, Jerad Bales, Martin Seul

HydroShare is operated by CUAHSI with ongoing development through a collaborative project among Utah State University, Brigham Young University, CyberGIS Center University of Illinois, Tufts, University of Virginia, and RENCI University of North Carolina.



<http://www.hydroshare.org>



# Grand Challenges in Hydrology and Water Resources



Better forecast, plan for and mitigate the effects of floods.



Ensure sufficient water resources in times of shortage.

From <https://ca.water.usgs.gov/california-drought/>



Provide access to clean water

From <https://uwrl.usu.edu/research/newsletter>

Advancing understanding and generating knowledge in water research depends on collaboration and data sharing

- Open data
- Integration of information from multiple sources
- Easy to use generally accessible shareable computing
- Working as a team and community



# Grand Challenges in Hydrology and Water Resources



Advancing understanding and generating knowledge in water research depends on collaboration and data sharing

- Open data

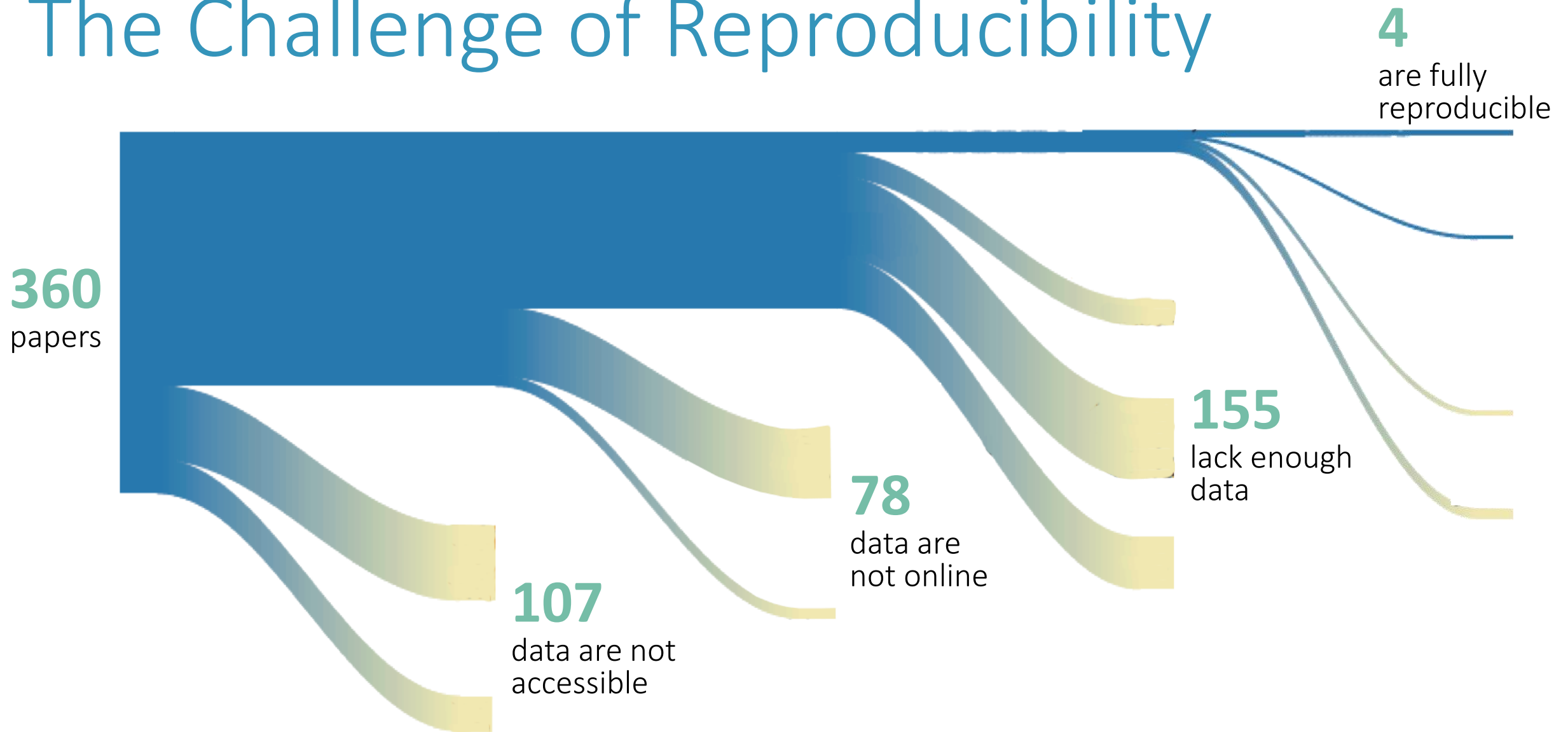
Water Research is a team sport

Information from multiple

computing

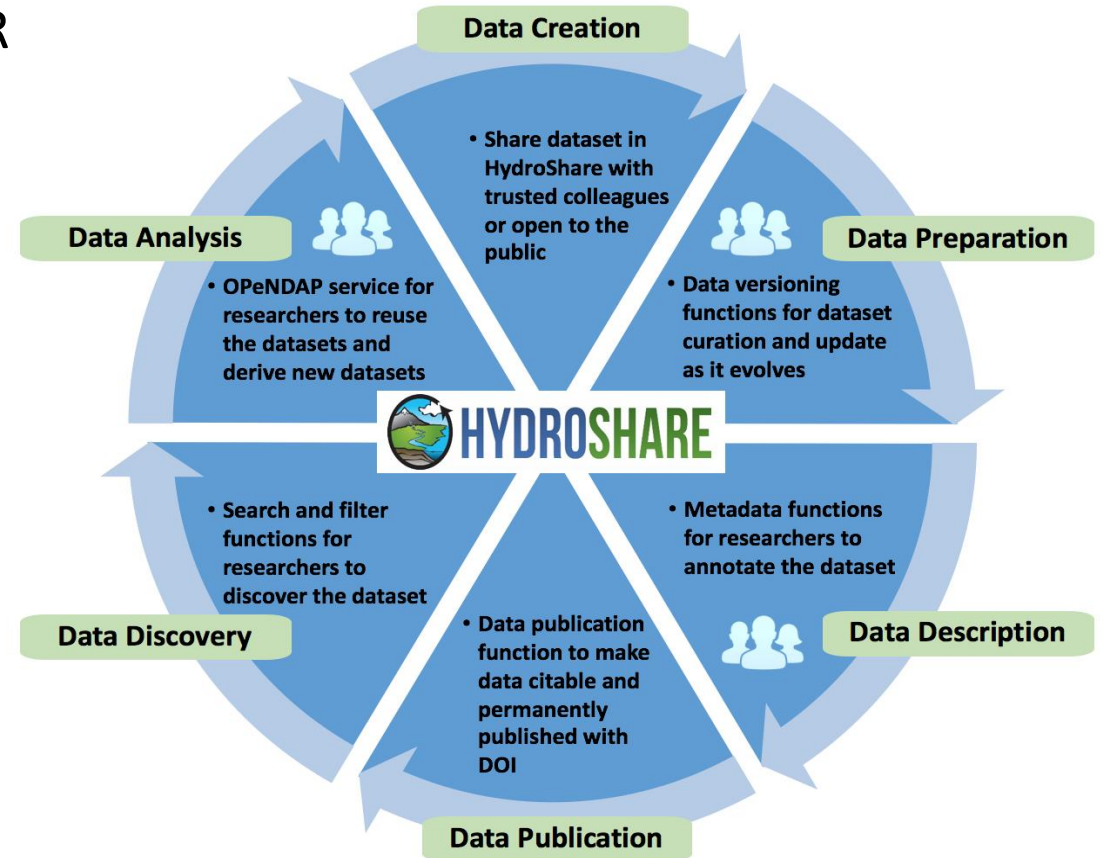
- Working as a team and community

# The Challenge of Reproducibility



# The take home message

- Fulfilling the open data mandate and achieving FAIR data and reproducible trustworthy scientific research requires establishing and advancing information, data and model sharing systems that are easy to use and simplify and facilitate data management through the full data lifecycle
- CUAHSI HydroShare is our effort to achieve this for the Hydrology and Water Resources Research community
- Consider using HydroShare if your data are Water related
- Consider ideas from and approaches developed by HydroShare in other information and data sharing systems and repositories



Gan et al. 2020, <https://doi.org/10.1016/j.envsoft.2020.104706>

# HydroShare is a platform for sharing **Hydrologic Resources** and **Collaborating**

- File Storage
- Meta Data Descriptions
- Data Access API
- Web Apps
- Social Functions
- DOI Data Publication

DropBox-ish Functionality

Value Added Functionality





# HydroShare is a platform for sharing Hydrologic Resources and Collaborating

- File Storage

DropBox-ish Functionality

- Meta Data Descriptions


- Data Access API

- Web Apps

Value Added Functionality

- Social Functions

- DOI Data Publication



The goal of HydroShare is to advance hydrologic science by enabling the scientific community to more easily and freely share products resulting from their research - not just the scientific publication summarizing a study, but also the data and models used to create the scientific publication.

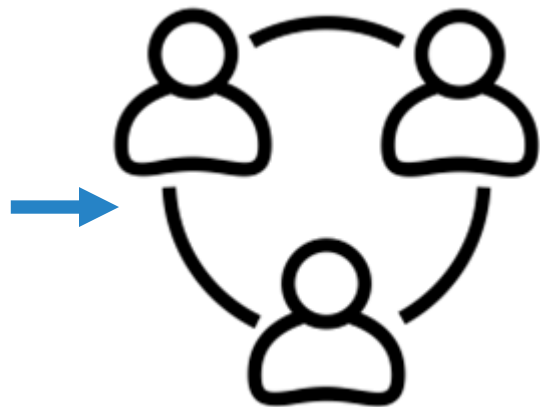


# HYDROSHARE

enables transparency



User creates dataset  
and uploads to  
Hydroshare



Research team  
iterates  
collaboratively



Final version is  
published and  
assigned DOI



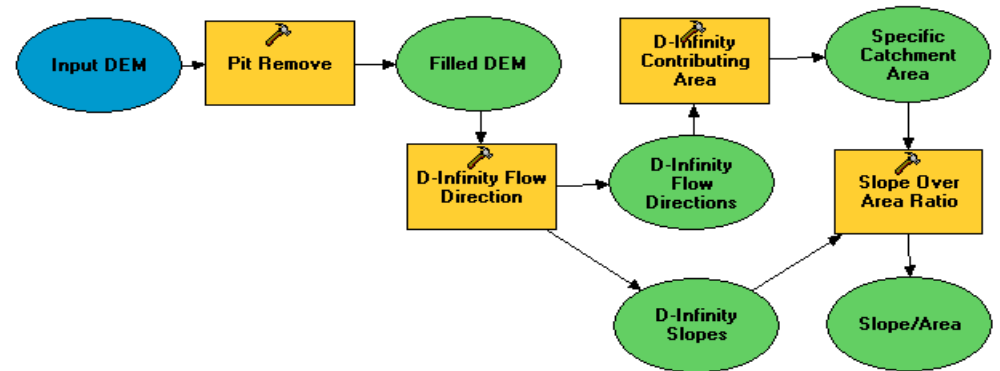
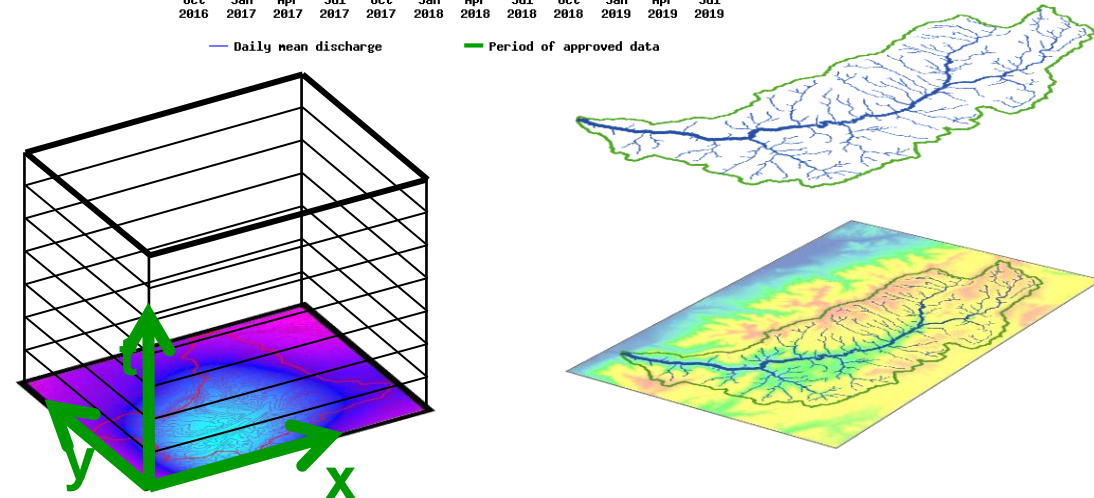
User cites  
dataset in  
paper



# HydroShare founding Principles

- Data and models are first-class products of research and should be shared
- Data and models become **social objects**
- Data and models are stored in and become shareable “Resources” in HydroShare
- Research data management should start at the beginning of a project
- Resources should be created and systematically managed through the full research life cycle and include analysis and modeling workflows

USGS 10109000 LOGAN RIVER ABOVE STATE DAM, NEAR LOGAN, UT



# HydroShare Components

## Resource exploration

- Discover content
- Organize and annotate your Resources
- Group Collaboration
- Manage access

Moving towards fully web based hydrologic innovation environment

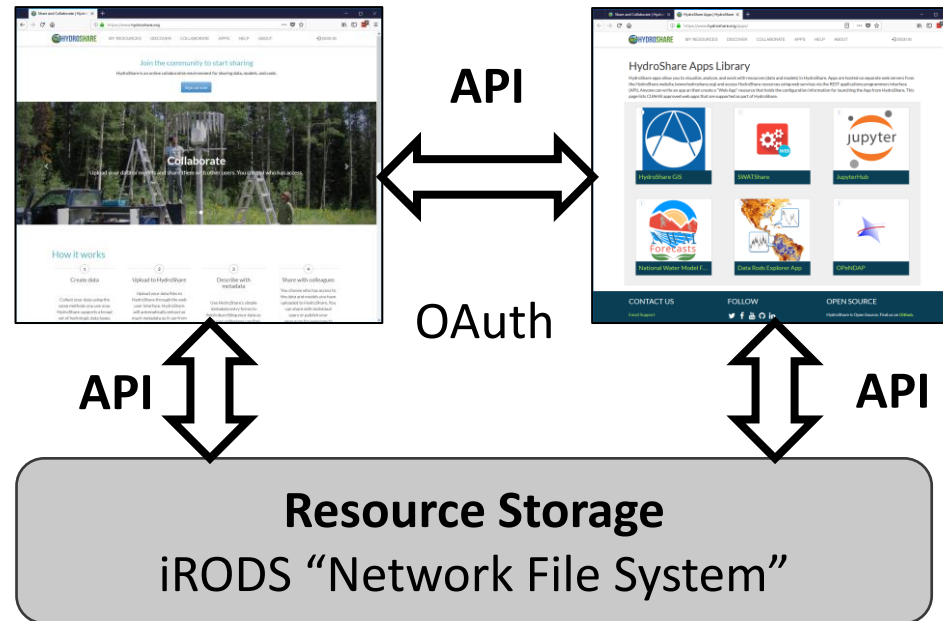
## Distributed file storage

Resource data model concepts



Django Website

HydroShare Apps



## Actions on Resources

- Web software to operate on content you have access to (Apps)
- Computation
- Extensibility through user applications

Anyone can set up a server/app platform (software service) to operate on HydroShare resources through iRODS and API

- JupyterHub and CyberGIS
- Jupyter for Water
- MATLAB Online
- Unidata – THREDDS
- SWATShare (Hubzero)
- ...

# Data and Model Repository (Django Website)

- Manage data (and models and workflows) throughout research life cycle
- Share data, models, and other products
- Create and edit metadata, some of it automatically
- Permanent publication of data and models with citable digital object identifiers (DOIs)
- Fulfill Findable, Accessible, Interoperable, Reusable (FAIR) open data mandate



The screenshot displays the HydroShare website interface. At the top, there is a navigation bar with links for HOME, MY RESOURCES, DISCOVER, COLLABORATE, APPS, and HELP, along with a SIGN IN button. Below the navigation bar, a banner image shows a snowy landscape with a stream and trees. The text "Discover" is overlaid on the banner, followed by the description: "Discover content shared by your colleagues and other researchers. Access a broad range of data types used in hydrology." Below the banner, there is a section titled "How it works" with a numbered list starting with "1 Create data" and the text "Collect your data using the same methods you use now. HydroShare supports a broad set of hydrologic data types." To the right of the banner, there is a detailed resource page for "TW Daniels Experimental Forest (TWDEF) Lidar". This page includes a table of metadata:

<b>Authors:</b>	Michaela Teich   David G. Tarboton	<b>Sharing Status:</b>	Published
<b>Owners:</b>	Michaela Teich	<b>Views:</b>	251
<b>Resource type:</b>	Generic	<b>Downloads:</b>	11
<b>Storage:</b>	The size of this resource is 5.4 GB	<b>+1 Votes:</b>	Be the first one to +1 this. (You need to be logged in to rate this.)
<b>Created:</b>	Nov 17, 2016 at 9:11 p.m.	<b>Comments:</b>	No comments (yet)
<b>Last updated:</b>	Nov 30, 2016 at 6:53 p.m. Michaela Teich		
<b>DOI:</b>	10.4211/hs.36f314971a547bc8bc72dc60d6bd03c		
<b>Citation:</b>	<a href="#">See how to cite this resource</a>		

Below the metadata table, there is an "Abstract" section with the following text: "This resource contains lidar data, collected at the TW Daniels Experimental Forest (TWDEF) on six separate flights in 2008 and 2009 measuring surface and canopy properties during snow-on and snow-off conditions. It was collected for the purposes of obtaining a digital elevation model (DEM) to characterize the area for snowmelt modeling, and by differencing between snow-on and snow-off observations to characterize the spatial distribution of snow depth. Canopy lidar returns also characterize the vegetation. The data was collected by the Utah State University (USU) Lidar-Assisted Stereo Imaging (LASSI) laboratory. The data was initially processed at USU shortly after collection and additionally processed by the Space Dynamics Laboratory (SDL) in support of iUtah lidar efforts in 2016. The metadata report (sdl16-1363-.pdf) gives details about the hardware used for data collection, the flight plans and resulting data, the data processing steps, and a brief error analysis. Zip files are named by the collection date and contain: - Terra Scan Binary Files - LAS Files (one for each flight line and the combined file) - KML Files (one for each flight line) - ASC DEM file (1 m resolution) - PNG Hillshade file A complete list can be found on pp. 17-22 of the metadata report." Below the abstract, there is a "Subject Keywords" section with a search bar and several keywords: "TW Daniels Experimental Forest", "TWDEF", "Lidar", "DEM", and "Snow Depth". At the bottom of the page, there is a "Resource Level Coverage" section with a map of the TW Daniels Experimental Forest area in Utah, showing the spatial extent of the data. The map includes coordinates and a scale bar.



# Example

## Water Resources Research

### RESEARCH ARTICLE

10.1029/2019WR024837

#### Key Points:

- Comparison of flood inundation mapped using Height Above Nearest Drainage (HAND) to inundation observed by Planet high-resolution imagery
- Improvements in HAND flood inundation mapping by conditioning the underlying digital elevation model using high-resolution hydrography
- Potential to use satellite observed inundation to infer distributed hydraulic roughness parameters for HAND-based hydraulic routing

## Terrain Analysis Enhancements to the Height Above Nearest Drainage Flood Inundation Mapping Method

Irene Garousi-Nejad<sup>1</sup> , David G. Tarboton<sup>1</sup> , Mahyar Aboutalebi<sup>1</sup> , and Alfonso F. Torres-Rua<sup>1</sup> 

<sup>1</sup>Department of Civil and Environmental Engineering, Utah Water Research Laboratory, Utah State University, Logan, UT, USA

**Abstract** Flood inundation remains challenging to map, model, and forecast because it requires detailed representations of hydrologic and hydraulic processes. Recently, Continental-Scale Flood Inundation Mapping (CFIM), an empirical approach with fewer data demands, has been suggested. This approach uses National Water Model forecast discharge with Height Above Nearest Drainage (HAND) calculated from a digital elevation model to approximate reach-averaged hydraulic properties, estimate a synthetic rating curve,

In an effort to make this study reproducible, the data and computational scripts used to produce the study results have been saved in HydroShare (Garousi-Nejad et al., 2019). The code for the flow direction conditioning tool is part of TauDEM and is available from the TauDEM GitHub repository (<http://github.com/dtarb/taudem>).

Garousi-Nejad, I., D. Tarboton, M. Aboutalebi, A. F. Torres-Rua (2019). Data for terrain analysis enhancements to the height above nearest drainage flood inundation mapping method, *HydroShare*, <https://doi.org/10.4211/hs.7235a0d6a18343078b2028085b7d8018>

# Data For Terrain Analysis Enhancements to the Height Above Nearest Drainage Flood Inundation Mapping Method

[Open with...](#)

**Authors:** [Irene Garousi-Nejad](#) | [David Tarboton](#) | [Mahyar Aboutalebi](#) | [Alfonso Faustino Torres-Rua](#)

**Sharing Status:** Published

**Owners:** [David Tarboton](#) | [Irene Garousi-Nejad](#)

**Views:** 846

**Resource type:** Composite Resource

**Downloads:** 618

**Storage:** The size of this resource is 4.0 GB

**+1 Votes:** 1 other +1 this (You need to be logged in to rate this.)

**Created:** Aug 19, 2019 at 7:35 p.m.

**Comments:** [No comments \(yet\)](#)

**Last updated:** Sep 03, 2019 at 5:50 a.m. [Irene Garousi-Nejad](#)

**DOI:** [10.4211/hs.7235a0d6a18343078b2028085b7d8018](https://doi.org/10.4211/hs.7235a0d6a18343078b2028085b7d8018)

**Citation:** [See how to cite this resource](#)

**Content types:** [Geographic Feature Content](#) [Geographic Raster Content](#)

## Abstract

This resource contains the data and scripts used for: Garousi-Nejad, I., D. G. Tarboton, M. Aboutalebi and A. F. Torres-Rua, (2019), "Terrain Analysis Enhancements to the Height Above Nearest Drainage Flood Inundation Mapping Method," Water Resources Research, <http://doi.org/10.1029/2019WR024837>.

## References

### Related Resources

The content of this resource serves as the data for: [Garousi-Nejad, I., D. G. Tarboton, M. Aboutalebi and A. F. Torres-Rua, \(2019\), "Terrain Analysis Enhancements to the Height Above Nearest Drainage Flood Inundation Mapping Method," Water Resources Research, <http://doi.org/10.1029/2019WR024837>.](#)

## Credits

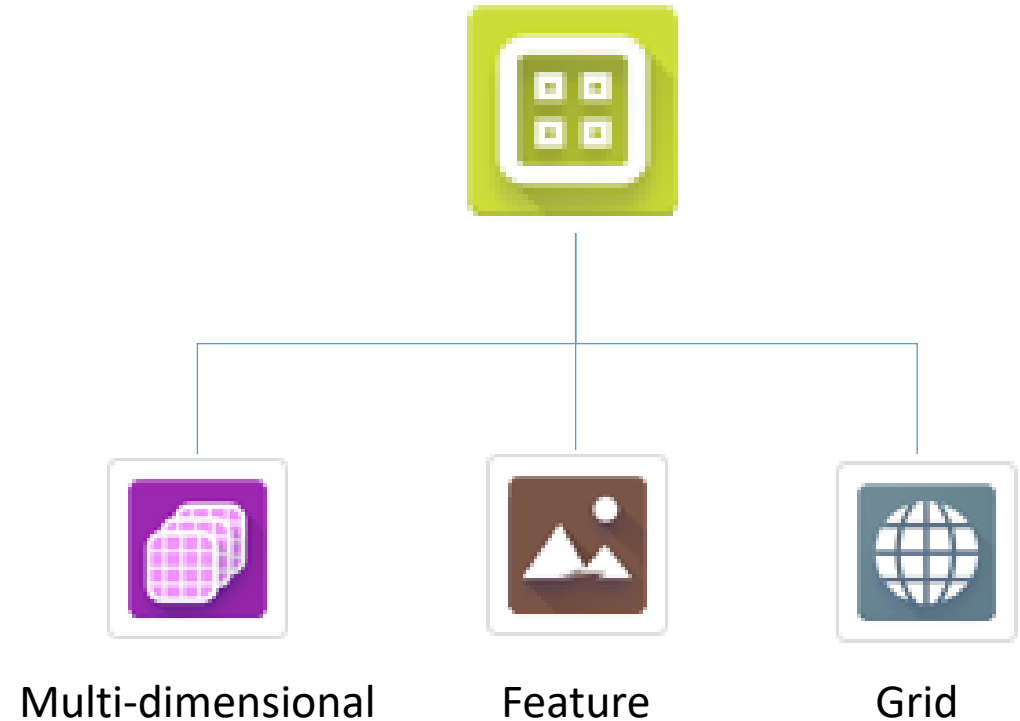
### Funding Agencies

This resource was created using funding from the following sources:

Agency Name	Award Title	Award Number
<a href="#">National Science Foundation</a>	Scalable Capabilities for Spatial Data Synthesis	1443080
<a href="#">Utah Water Research Laboratory</a>	Graduate Student Research Assistantship for I Garousi-Nejad	

# HydroShare OAI-ORE standard based Resource Data Model

- A **resource** can hold multiple content aggregations
  - Managed as one discoverable resource
  - One unique identifier
  - One set of resource level metadata
  - One set of access controls (Owners, Editors etc.)
  - May be private, shared with others (users and groups), public, or permanently published to encourage early creation and addition of information through full data lifecycle
- A **content aggregation**
  - Can hold one or multiple files that comprise a single logical object
  - Each being a different type of data
  - One set of aggregation level metadata
  - Content aggregations are automatically created and metadata generated when a recognized file type is uploaded



**Schema.org + Dublin Core machine readable metadata to make data in HydroShare FAIR**



# Resource Landing Page










Create



## Logan 10 m Terrain Analysis

Open with... ▾

<b>Authors:</b>	<a href="#">David Tarboton</a>	<b>Sharing Status:</b>	Public
<b>Owners:</b>	<a href="#">David Tarboton</a>	<b>Views:</b>	227
<b>Resource type:</b>	Composite Resource	<b>Downloads:</b>	43
<b>Storage:</b>	The size of this resource is 54.7 MB	<b>+1 Votes:</b>	Be the first one to <span>+1</span> this.
<b>Created:</b>	Feb 12, 2017 at 5:36 p.m.	<b>Comments:</b>	<a href="#">No comments (yet)</a>
<b>Last updated:</b>	Feb 16, 2019 at 5:37 p.m. <a href="#">David Tarboton</a>		
<b>Citation:</b>	<a href="#">See how to cite this resource</a>		
<b>Content types:</b>	<span>Geographic Feature Content</span> <span>Geographic Raster Content</span>		

Metadata header with view and download statistics

Content types

### Abstract

Results from Hydrologic terrain analysis performed on Logan River Basin Digital Elevation model using TauDEM

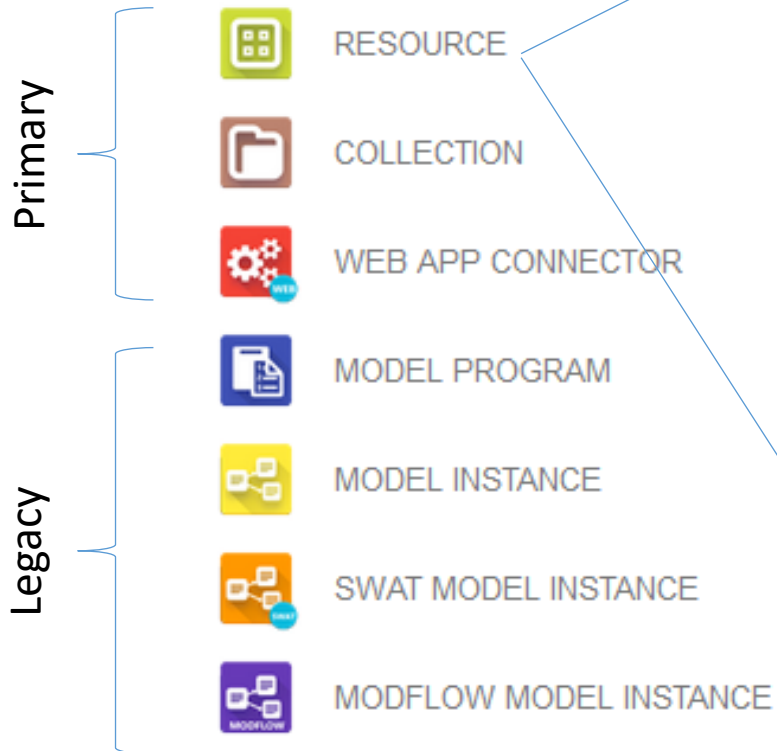
The input digital elevation model (DEM) is Logan.tif.

The sequence in the script script.py performs a TauDEM analysis that does the following

- Remove pits (by filling them)
- D8 Flow direction
- D8 Contributing area

# Resources and content aggregations

## Resources



To be implemented as type aggregations within a composite resource

## Composite resource contents

### Content type aggregations

- Single File (with external reference as URL as a special case)
- Geographic Feature
- Geographic Raster
- Multidimensional
- Time Series (ODM2 format)
- Referenced Time Series (JSON))
- File set (Folder with files)

- |  |                          |
|--|--------------------------|
|  | Flowdata.txt             |
|  | project_web_page.url     |
|  | GreatSaltLake            |
|  | logandem                 |
|  | Snow_time                |
|  | Temperature              |
|  | Streamflow.json          |
|  | GreatSaltLakeLevelVolume |

### Files

- Single File
- Folder
- Readme (markdown or txt) that renders on landing page

- |  |                     |
|--|---------------------|
|  | The Budget.xlsx     |
|  | GreatSaltLakeFolder |
|  | README.md           |

# Web based Gateway to computing (Apps and JupyterHub)

- Provide immediate value
  - What can I do now that I may not be able to easily do on my PC
- Model input data preparation
- Model execution
- Visualization and analysis (best of practice tools)
- Reduced needs for software installation and configuration (platform independence)
- Teaching
- Write and execute code in a Jupyter Notebook, acting on content of HydroShare resources and saving results back to HydroShare Repository
  - Collaboration
  - Access to enhanced computation (HPC, Big data)
- Enhanced trust in research through transparency, replicability and reproducibility



A screenshot of a HydroShare resource page titled "Introduction to TauDEM". The page includes metadata such as "Authors: David Tarboton", "Owners: David Tarboton", "Resource type: Composite Resource", "Storage: The size of this resource is 54.2 MB", "Created: Dec 08, 2019 at 12:17 a.m.", "Last updated: Dec 08, 2019 at 3:52 p.m. David Tarboton", "Citation: See how to cite this resource", and "Content types: Geographic Feature Content, Geographic Raster Content". It also shows "Sharing Status: Public", "Views: 69", "Downloads: 28", and "+1 Votes: Be the first one to +1 this resource". A red box highlights the "Open with..." dropdown menu, which lists several applications: HydroShare GIS, CUAHSI JupyterHub, OPeNDAP, CyberGIS-Jupyter for Water, and MATLAB Online.

A screenshot of the JupyterHub file browser interface. The browser shows a directory structure: "Downloads / 18984997bf8f44dd99a246d4fbec903 / 18984997bf8f44dd99a246d4fbec903 / data / contents". A red box highlights a file named "TauDEM.ipynb", which is currently in a "Running" state. Other files listed include "logan.tif" (56.8 MB) and "logan.vrt" (1.73 kB).

A screenshot of a Jupyter Notebook interface. The notebook title is "Hydrologic Terrain Analysis Using TauDEM". The text in the notebook reads: "The purpose of this notebook is to introduce **Terrain Analysis Using Digital Elevation Models (TauDEM)** software for Hydrologic Terrain Analysis in Jupyter. TauDEM is a free and open source set of Digital Elevation Model (DEM) tools for the extraction and analysis of hydrologic information from topography as represented by DEM. This software is developed at Utah State University (USU) for hydrologic digital elevation model analysis and watershed delineation." The interface includes a menu bar with "File", "Edit", "View", "Insert", "Cell", "Kernel", "Widgets", and "Help", and a toolbar with various icons for file operations and execution.



# JupyterHub

The image shows a browser window with two pages. The top page is a HydroShare resource page titled "Terrain Processing - TauDem Example". It features a navigation bar with "HOME", "MY RESOURCES", "DISCOVER", "COLLABORATE", "APPS", and "HELP", along with a "Create" button and a user profile. The resource details include authors (Anthony Castronova), owners (Anthony Michael Castronova), a composite resource type, and a size of 6.3 MB. A "Sharing Status" of "Public" is also shown. A "Open with..." dropdown menu is open, listing "HydroShare GIS", "CUAHSI JupyterHub" (highlighted with a red box and a blue circle labeled "1"), and "OPeNDAP".

The bottom page is the JupyterHub interface, showing the URL `https://jupyter.cuahsi.org/user/demo/hs-pull?id=4a7ba3bc84`. It includes a "CUAHSI" logo, "Logout", and "Control Panel" buttons. A message states: "Loading resources before sending you to `tree/notebooks/data/4a7ba3bc84ca4c2c8c1de17b1200c0ac/4a7ba3bc84ca4c2c8c1de17b1200c0ac/data/contents/...`". Below this, a blue progress bar indicates "Sync finished, redirecting..." with a "Click to see more details" link.

1 Web app connector launches external App

2 NBFetch used to retrieve contents of resource into JupyterHub to be able to immediately open Notebook and act on resource content files

Implemented through collaboration with Martin Hunt, Science Gateways Community Institute Consultant

# JupyterHub

CUAHSI universities allied for water research

Logout Control Panel Welcome demo

Files Running Clusters

Select items to perform actions on them. Upload New ↕

0 / notebooks / data / 4a7ba3bc84ca4c2c8c1de17b1200c0ac / 4a7ba3bc84ca4c2c8c1de17b1200c0ac / data / contents File size

	Name ↓	Last Modified	
<input type="checkbox"/>	..	seconds ago	
<input type="checkbox"/>	logan	seconds ago	
<input type="checkbox"/>	taudem_logan.ipynb	seconds ago	17.3 kB

Open Notebook

3

CUAHSI universities allied for water research

taudem\_logan (unsaved changes) Python 2.7

Logout Control Panel Welcome demo

File Edit View Insert Cell Kernel Widgets Help Not Trusted Python 2.7

Run C Markdown Appmode

### 1. Script Setup and Preparation

Before we begin GIS processing, we must import several libraries into the notebook. The **hs\_utils** library provides functions for interacting with HydroShare, including resource querying, downloading and creation. The **taudem** library provides functions for simplifying the TauDEM GIS commands, workspace maintenance, as well as visualization. Finally, the `%matplotlib inline` command tells the notebook server to place plots and figures directly into the notebook.

**Note:** You may see some matplotlib warnings if this is the first time you are running this notebook. These warnings can be ignored.

```
In [ ]: # import required libraries for geoprocessing
import os
from utilities import hydroshare, taudem
%matplotlib inline
```

Analysis in JupyterHub

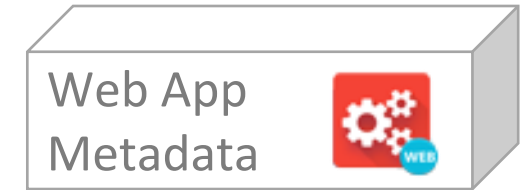
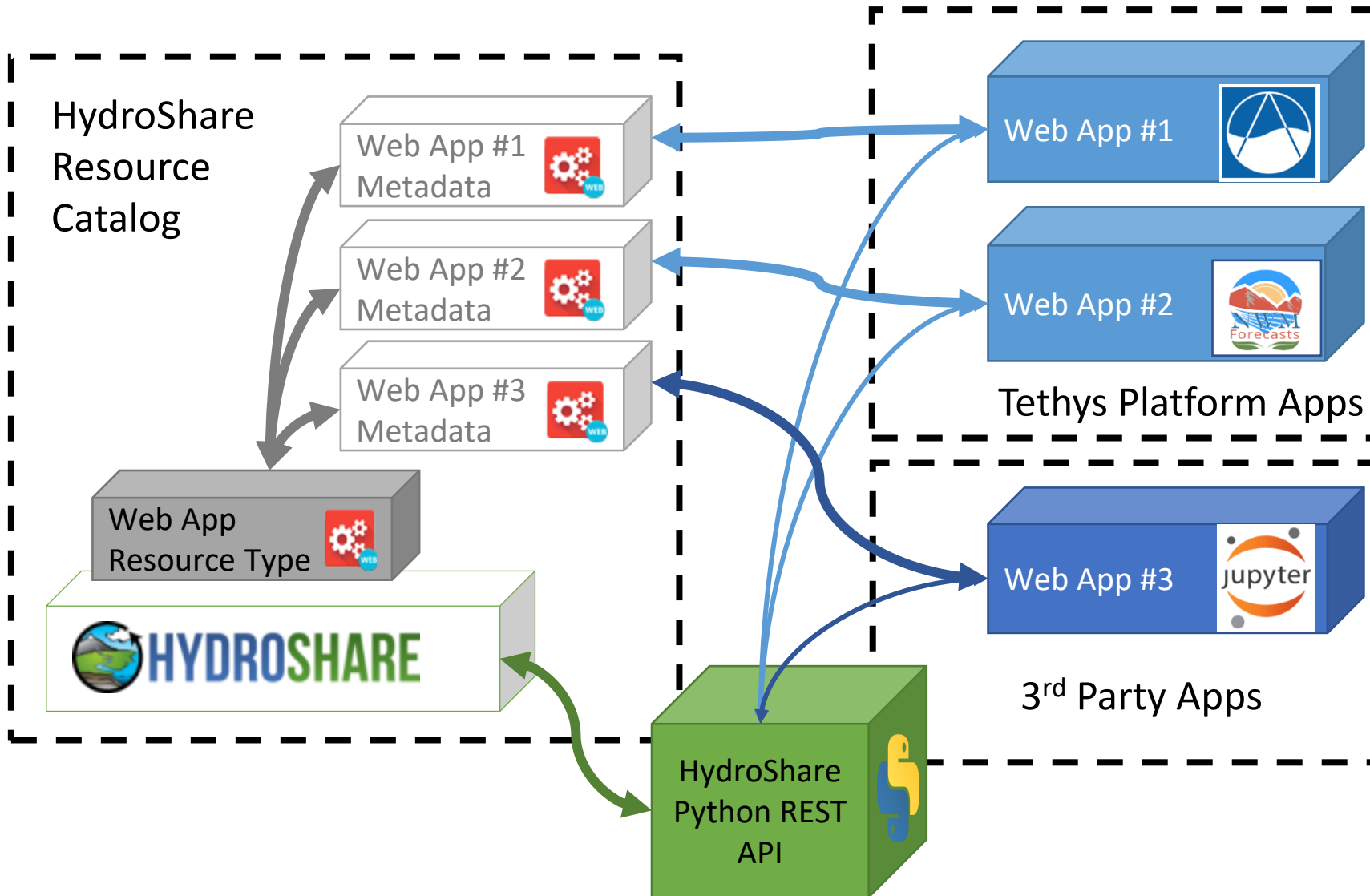
4

Save Results back to HydroShare

5

# Web App Connector

Anybody can create a web app on any web server and configure a web app Connector for it to be launched from HydroShare



Predefined URL Launch Parameters:  
Resource ID:  $\${HS\_RES\_ID}$   
Resource Type:  $\${HS\_RES\_TYPE}$   
HydroShare username:  
 $\${HS\_USR\_NAME}$

Examples:

[https://apps.hydroshare.org/apps/hydroshare-gis/?res\\_id=\\${HS\\_RES\\_ID}](https://apps.hydroshare.org/apps/hydroshare-gis/?res_id=${HS_RES_ID})

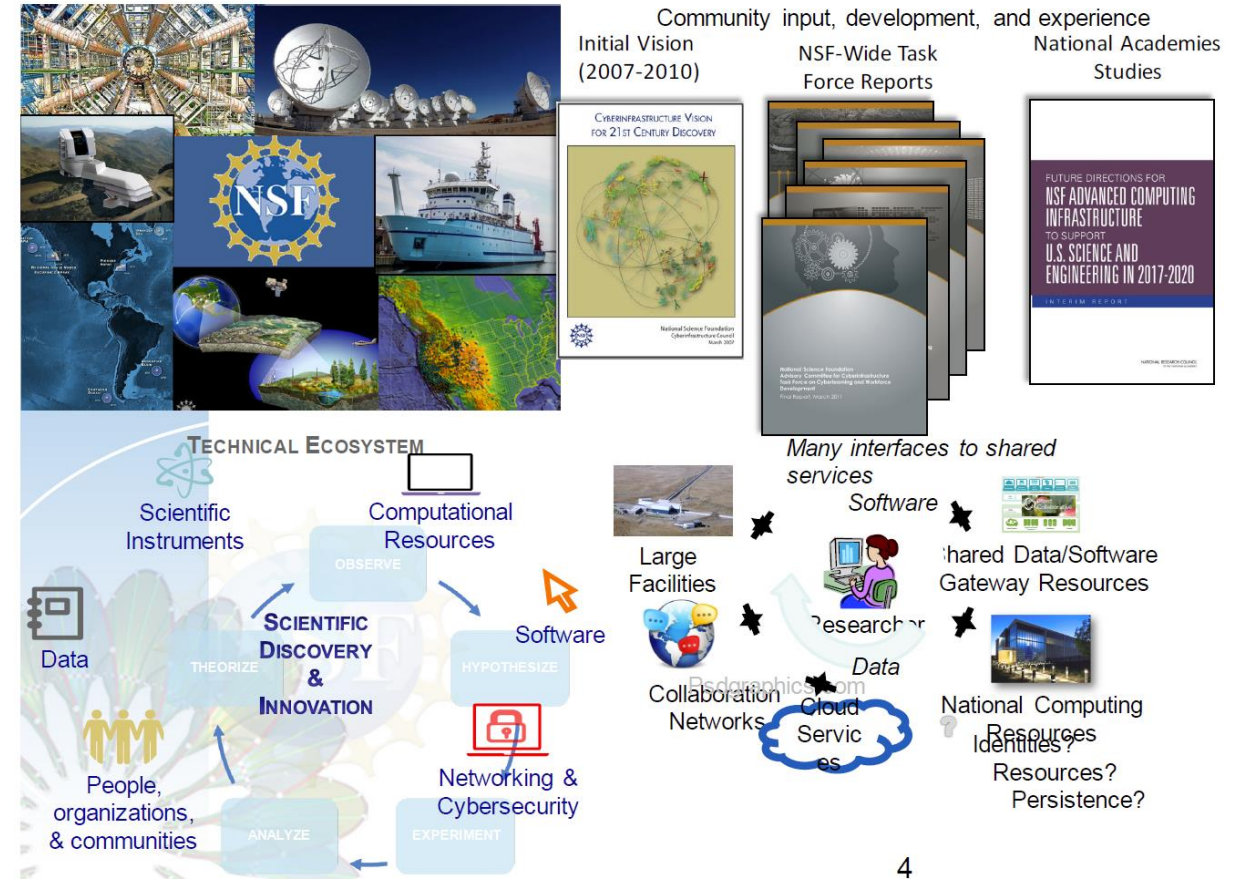
[https://mygeohub.org/.../?res\\_id=\\${HS\\_RES\\_ID}&usr=\\${HS\\_USR\\_NAME}&src=hs](https://mygeohub.org/.../?res_id=${HS_RES_ID}&usr=${HS_USR_NAME}&src=hs)

[http://hyrax.hydroshare.org/opendap/\\${HS\\_RES\\_ID}/data/contents/](http://hyrax.hydroshare.org/opendap/${HS_RES_ID}/data/contents/)



# Interoperability and Software Ecosystems

- A foundation of the web
- No one system can do it all
- Applications programming interfaces (APIs)
- Unique Identifiers that enable linked data (web URI's)
- A cyberinfrastructure ecosystem of many interfaces to shared services
- Personal Cyberinfrastructure
  - Individually managed set of CI tools you assemble and learn to use to do your work



NSF vision for a cyberinfrastructure of many interfaces to shared services [Rajiv Ramnath, NSF Division of Advanced Cyberinfrastructure

<https://doi.org/10.6084/m9.figshare.4676173>]

# [geoserver.hydroshare.org](https://geoserver.hydroshare.org)



username  password  Remember me

- About & Status
  - About GeoServer
- Data
  - Layer Preview
- Demos

## Layer Preview

List of all layers configured in GeoServer and provides previews in various formats for each.

<< < 1 > >> Results 1 to 14 (out of 14 matches from 950 items)

Type	Title	Name	Common Formats	All Formats
	Logan	HS-cd0bc6f5a2e54247927128a85bc10c8a:Logan	OpenLayers KML	Select one
	Loganad8	HS-cd0bc6f5a2e54247927128a85bc10c8a:Loganad8	OpenLayers KML	Select one
	Loganang	HS-cd0bc6f5a2e54247927128a85bc10c8a:Loganang	OpenLayers KML	Select one
	Logandd	HS-cd0bc6f5a2e54247927128a85bc10c8a:Logandd	OpenLayers KML	Select one
	Loganfel	HS-cd0bc6f5a2e54247927128a85bc10c8a:Loganfel	OpenLayers KML	Select one
	Logannet	HS-cd0bc6f5a2e54247927128a85bc10c8a:Logannet	OpenLayers KML GML	Select one
	Loganord	HS-cd0bc6f5a2e54247927128a85bc10c8a:Loganord	OpenLayers KML	Select one
	Loganp	HS-cd0bc6f5a2e54247927128a85bc10c8a:Loganp	OpenLayers KML	Select one

Public Resources with Geographic Content are published on Geoserver using OGC Web Services

<https://geoserver.hydroshare.org/geoserver/HS-cd0bc6f5a2e54247927128a85bc10c8a/wms?request=GetCapabilities&service=WMS>

# HydroShare GeoServer contents in Arcgis.com

The screenshot shows the HydroShare interface for a resource titled "Resource Level Coverage". The page includes a "Spatial" section with the following details:

- Coordinate System/Geographic Projection: WGS 84 EPSG:4326
- Coordinate Units: Decimal degrees
- North Latitude: 42.1108°
- East Longitude: -111.4569°
- South Latitude: 41.6642°
- West Longitude: -111.8177°

A map shows a geographic area with a black rectangle highlighting a specific region. Below the map is a "Content" section with a warning: "This resource contains links to external content. Linked content is NOT stored in HydroShare, and we can't guarantee its availability, quality, or security." Below this is a file browser showing a directory structure:

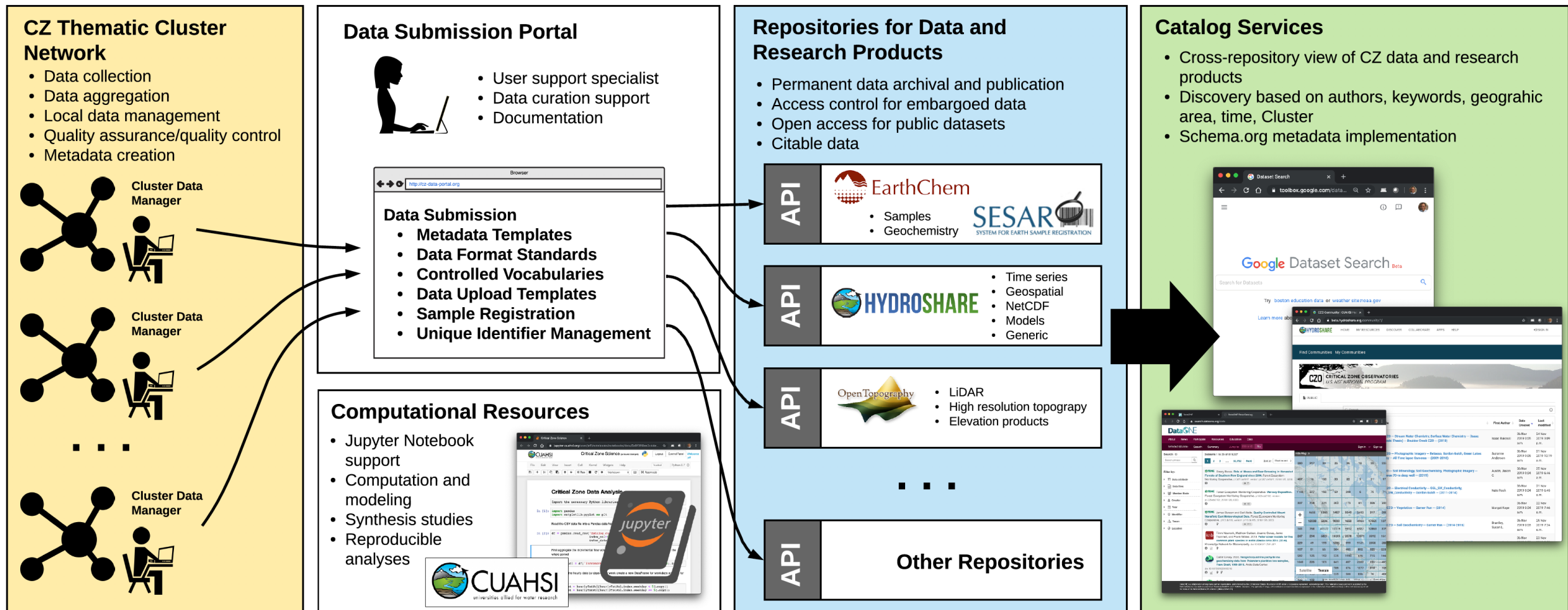
Item	Type	Format	Title
Loganssa	File Folder	GeoRasterL...	
Loganw	File Folder	GeoRasterL...	
Outlet	File Folder	GeoFeature...	Outlet
Logancoord.txt	File		
Logandrp.txt	File		
Logantree.txt	File		
arcgis_online_map...	Single File C...	47 Bytes	
script.py	x-python File	2.1 KB	

A blue callout box with the text "Link to ArcGIS.com web map" points to the "arcgis\_online\_map..." file in the directory list.

The screenshot shows the ArcGIS.com web map viewer for "Logan River TauDEM Results". The map displays a terrain analysis of the Logan River watershed, with the watershed boundary highlighted in black and the river network in blue. The map includes a legend, navigation tools, and a search bar. The legend shows "GeoServer Web Map Service" with "nodata" (red X), "values" (black square), and "values" (blue line). The map also shows "Bear Lake National Wildlife Refuge" and "Cache National Forest". A scale bar at the bottom indicates 0, 3, and 6 miles. The Esri logo is visible in the bottom right corner.



# NSF Critical Zone (CZ) Collaborative Network Data Management



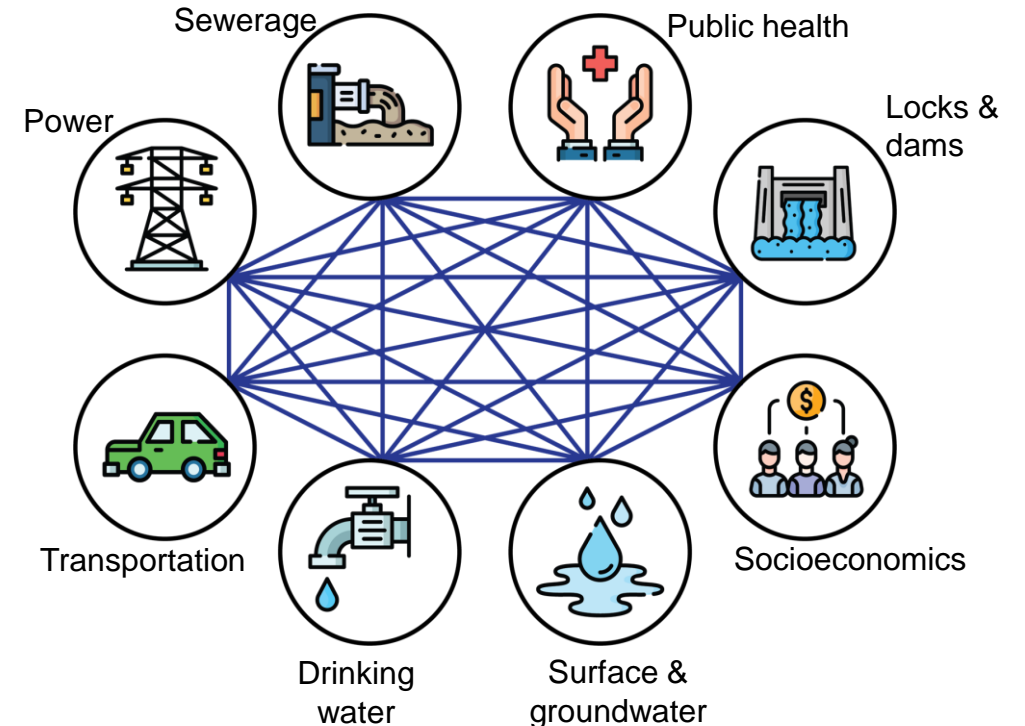


# UF-OKN Urban Flooding Open Knowledge Network

- Delivering flood information to anyone, anytime, anywhere
- Holistic approach for better understanding how floods impact the urban multiplex (water, transportation, power, civic infrastructure networks etc.)
- Knowledge graph to deliver results based on natural language queries



*What areas of my city are at risk?*



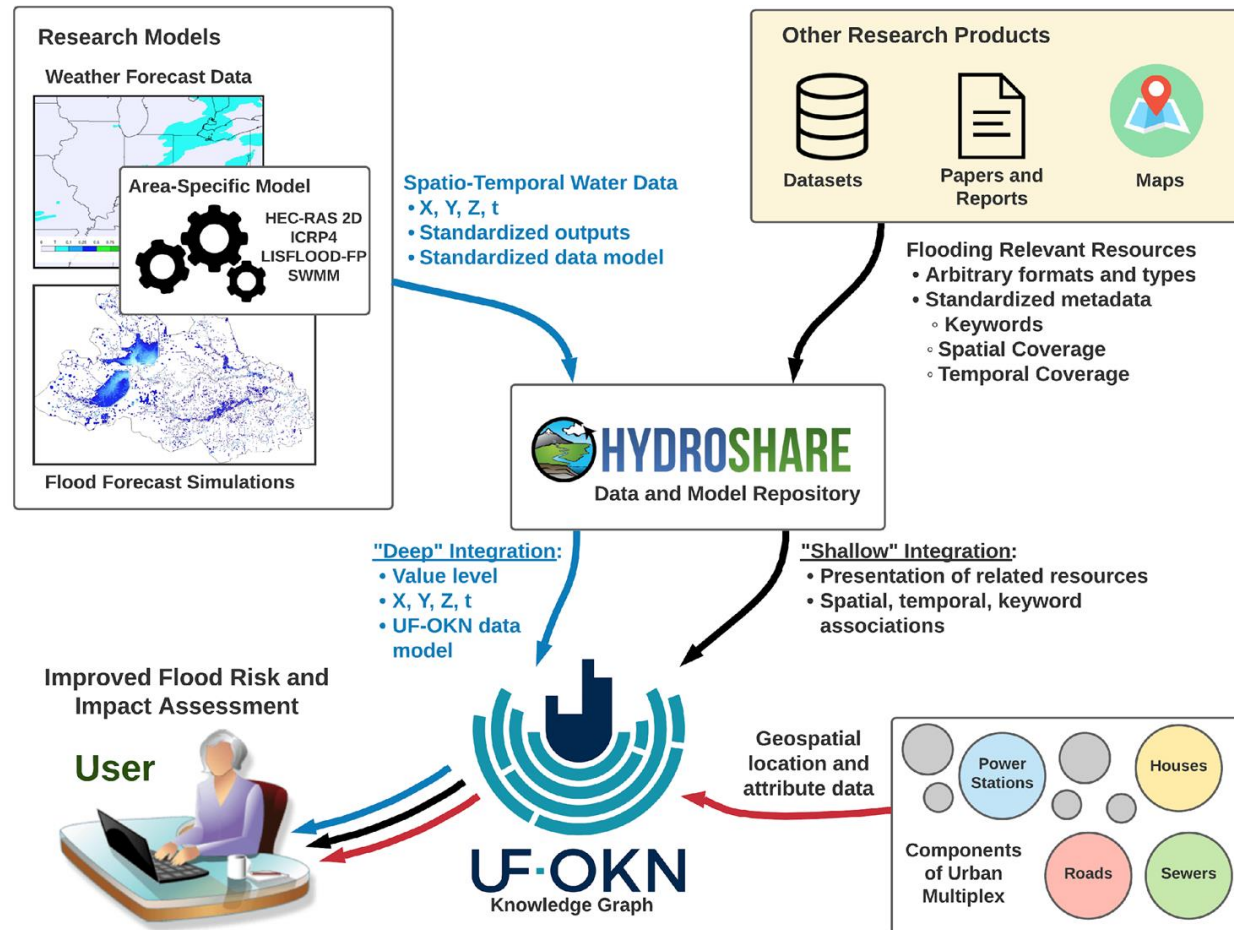
- NSF Convergence Accelerator project

<https://ufokn.com/>



Contact  
[lilit.yeghiazarian@uc.edu](mailto:lilit.yeghiazarian@uc.edu)

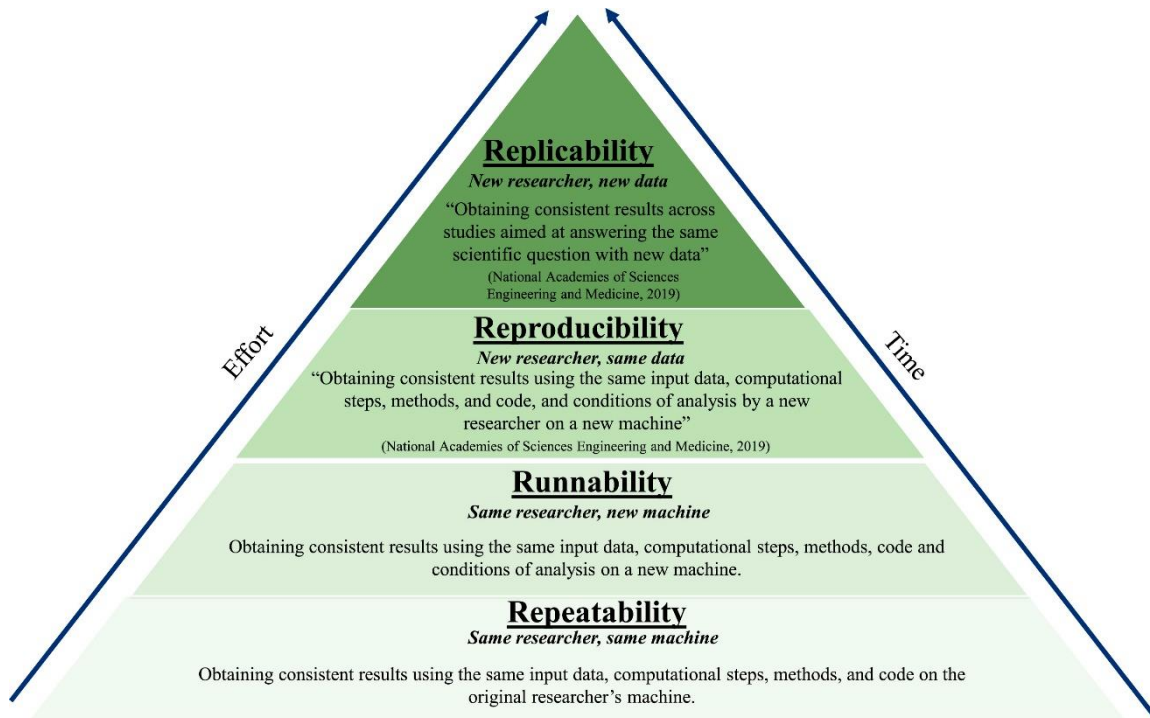
# HydroShare supporting UF-OKN Research Community and Data Integration



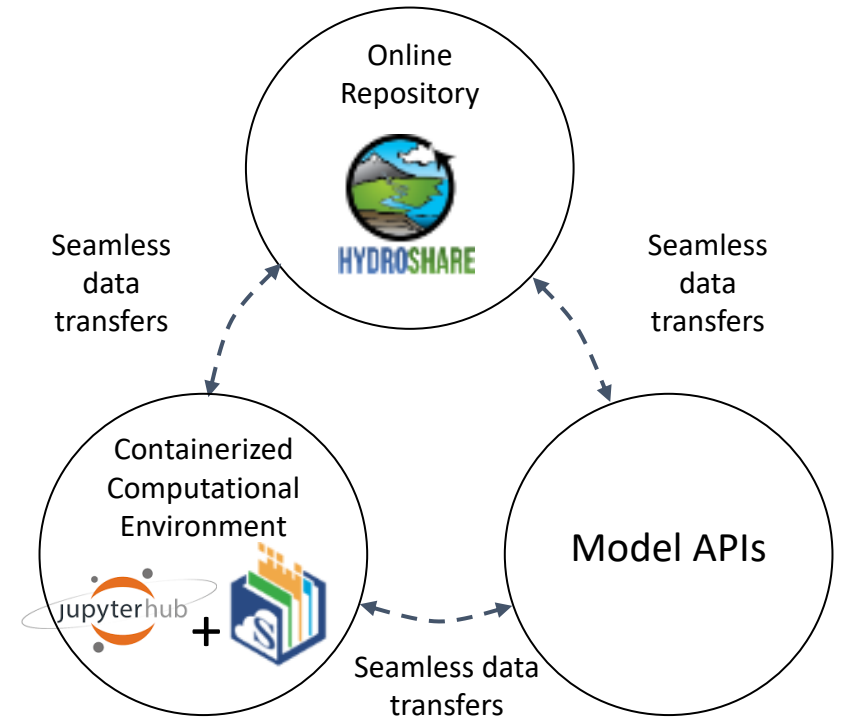
# Reproducibility



## What it means to be reproducible



## EarthCube Reproducibility Workbench



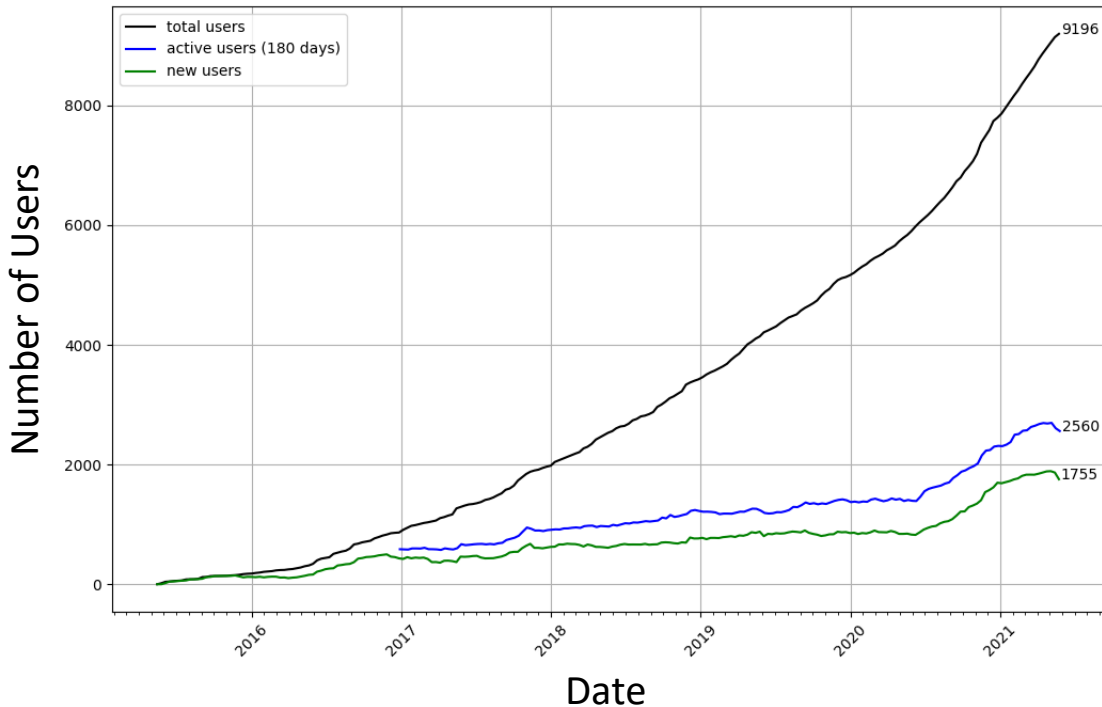
Essawy, et al., 2020, A taxonomy for reproducible and replicable research in environmental modeling, *Environmental Modelling & Software*, 134:104753, <https://doi.org/10.1016/j.envsoft.2020.104753>

Choi, et al., 2021, Toward open and reproducible environmental modeling by integrating online data repositories, computational environments, and model application programming interfaces, *Environmental Modelling & Software*, 135:104888, <https://doi.org/10.1016/j.envsoft.2020.104888>

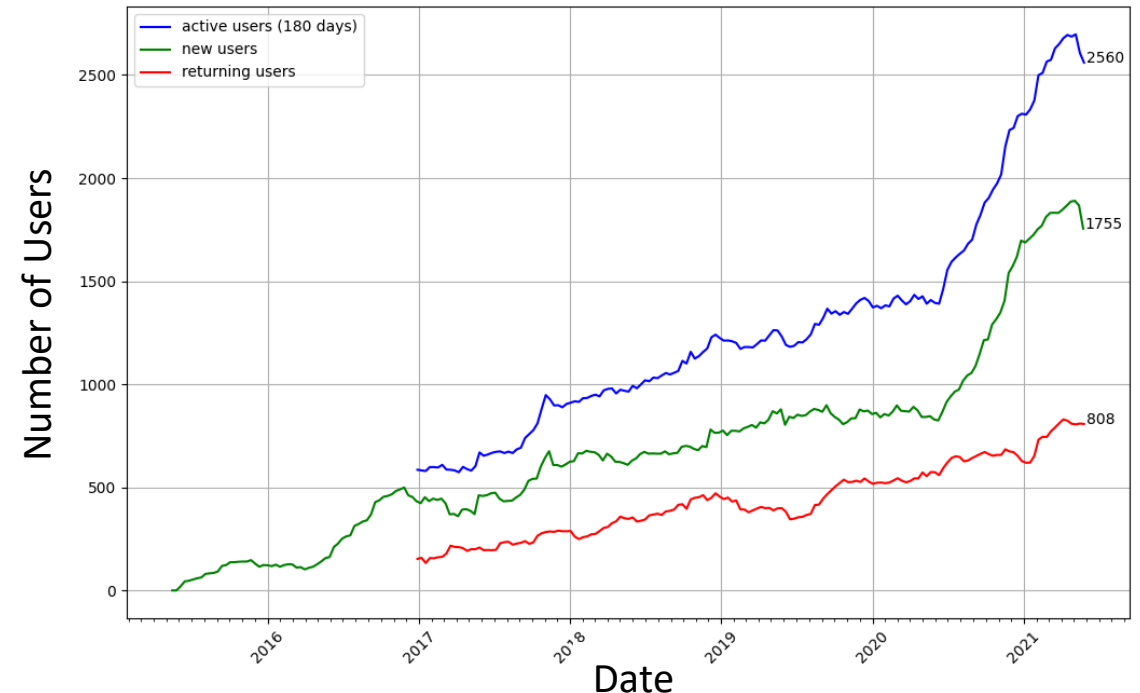
# Audience and Use

Primary audience is US Hydrologic Research community (NSF funding) but open to international use and use by water resource professionals, educators and citizen scientists

## Overall User Accounts



## Active User Accounts



Returning users are users who returned to use (logged in to) HydroShare in the last 180 days after having created their account prior to the last 180 days

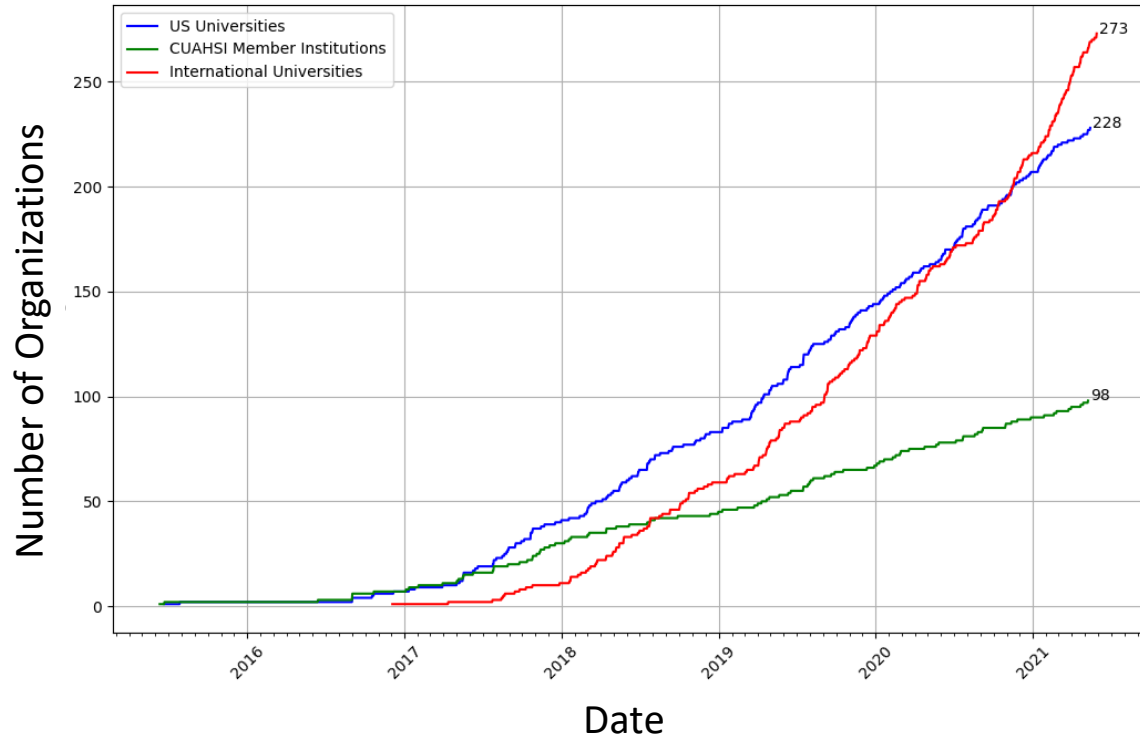
Data from: <http://public.cuahsi.org/metrics-report/>

Statistics as of 5/30/2021

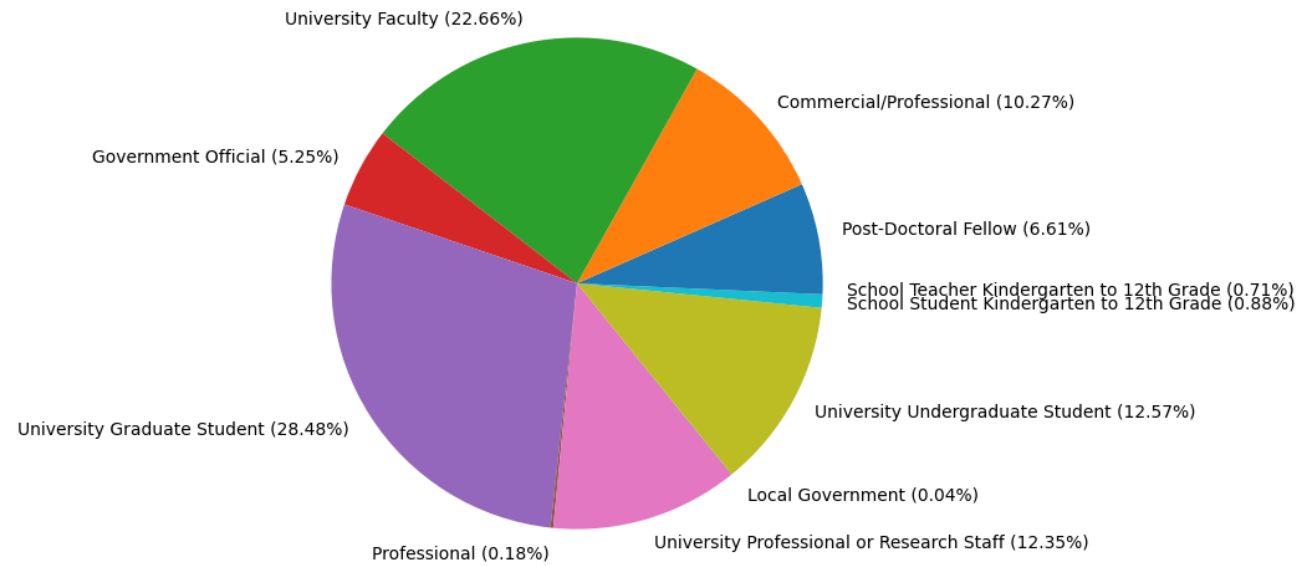




# Organizations and Users by Types



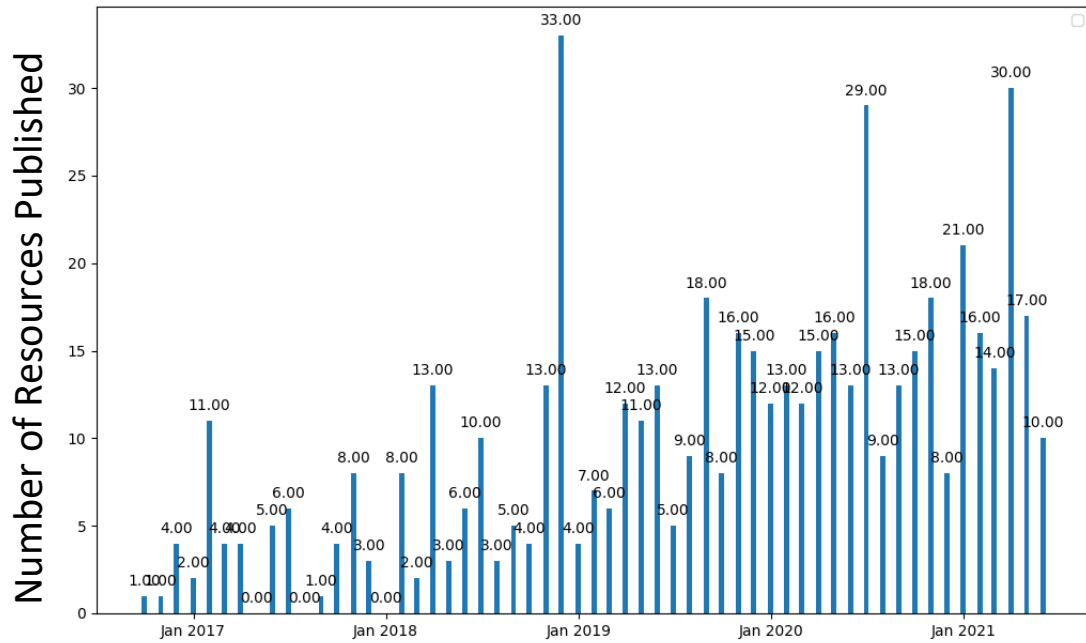
Distinct organizations that users are affiliated with.



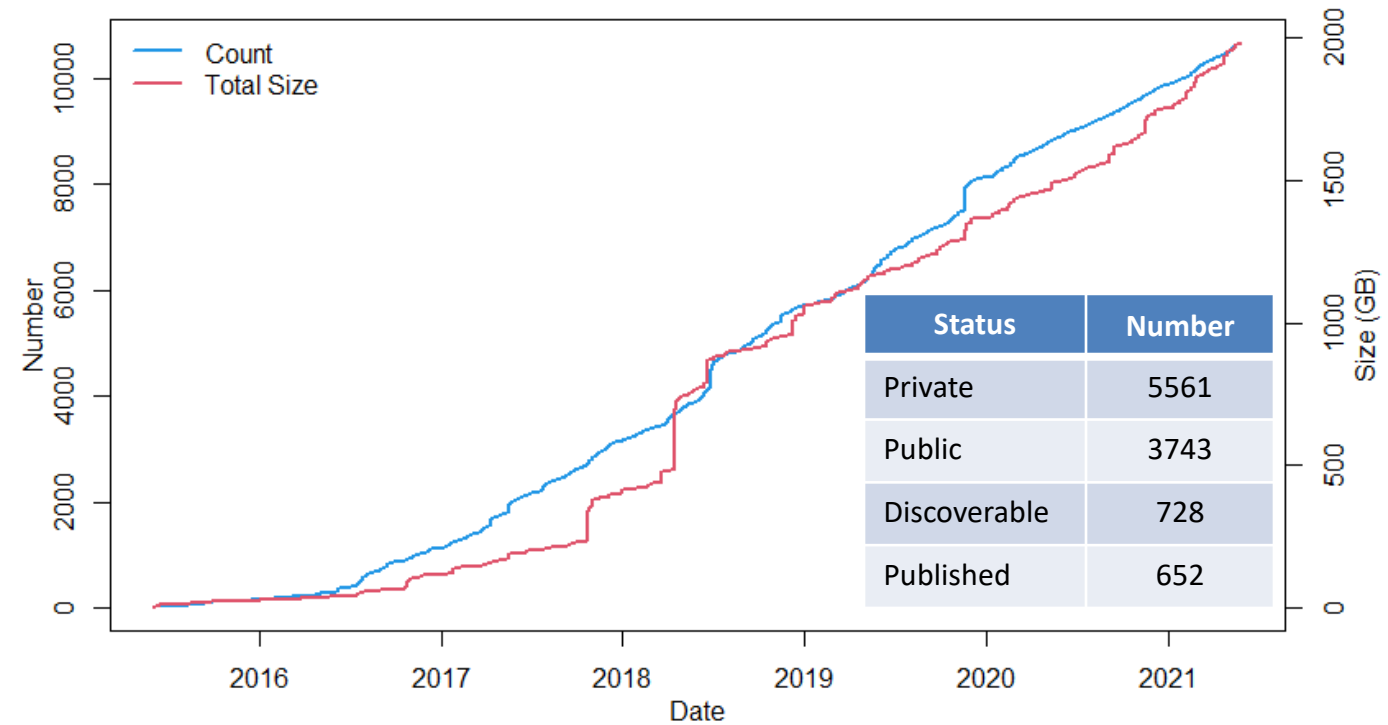
Users by type (from 54 % of users reporting type)

Statistics as of 5/30/2021

# Resources



Number of resources permanently published with digital object identifier (DOI) issued per month



Cumulative number and size of resources in HydroShare

Statistics as of 5/30/2021

# Lessons Learned

- Having a community is critical. Listen and address community needs
- Provide immediate value
  - (fulfilling open data mandate is not immediate value)
  - DOI's for citation and credit
  - Simplified access to computational capacity
- Standards
- Be Interoperable – participate in services oriented architecture Ecosystem
- Partnering to expand use and funding base

# Summary

HydroShare is a web based collaboration environment to enable more rapid advances in hydrologic understanding through data sharing, analysis and modeling

- Sharing and publication of data (DOI)
- Social discovery and added value
- Model and workflow sharing

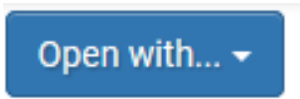
Collaboration, Reproducibility,  
Credit, Transparency



- Model input data preparation
- Model execution
- Visualization and analysis (best of practice tools)

Server/Cloud Computation

- Platform independence
- Big data
- Reproducibility
- Interoperability
- Reduced needs for software installation and configuration







OAC-1664061  
OAC-1664018  
OAC-1664119  
2017-2021

ACI-1148453  
ACI-1148090  
2012-2017

# Thanks to the HydroShare team!

HydroShare is operated by CUAHSI with ongoing development through a collaborative project among Utah State University, RENCI University of North Carolina, CyberGIS Center University of Illinois, Tufts, University of Virginia, Brigham Young University, National Center for Atmospheric Research and the University of Washington.



We are looking for developers. If you are interested email [dtarb@usu.edu](mailto:dtarb@usu.edu)

To learn more

- Publications <https://help.hydroshare.org/about-hydroshare/publish/>
- Online Help <https://help.hydroshare.org/>

Access these slides in HydroShare by searching for "niehs2020"



<http://www.hydroshare.org>



# *What is CUAHSI?*

- **CUAHSI is a 501(c)3 Non-Profit Consortium of about 130 U.S. Academic Institutions, Non-Profits, and International Universities**
- **Mission is to shape the future of water science by:**
  - **Strengthening interdisciplinary collaboration in the water-science community**
  - **Empowering the community by providing research and education services**
  - **Promoting education in the water sciences at all levels**
- **Key Activities**
  - **Community Services, such as workshops, community meeting, training, etc.**
  - **Data and Model Services, including HydroShare and time-series services**