



# **Waterhackweek Information Session**

Jan 3, 2020 10:00 am PST  
Christina Bandaragoda @dr\_cband

**Application deadline:  
Sunday, January 5, 2020 to  
join the March 23-27, 2020  
workshop University of  
Washington, Seattle**

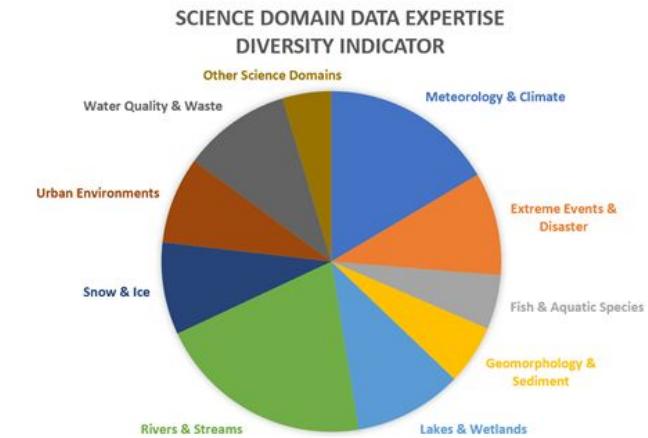
# The goal for today

Address question: What is Waterhackweek?

One Inclusive answer:

“...A participant-driven interactive learning experience.”

Jenny Byrd's Physics PhD friend's synopsis of my 5-min description at the CUAHSI booth at AGU Fall Meeting 2019



# The goal for today

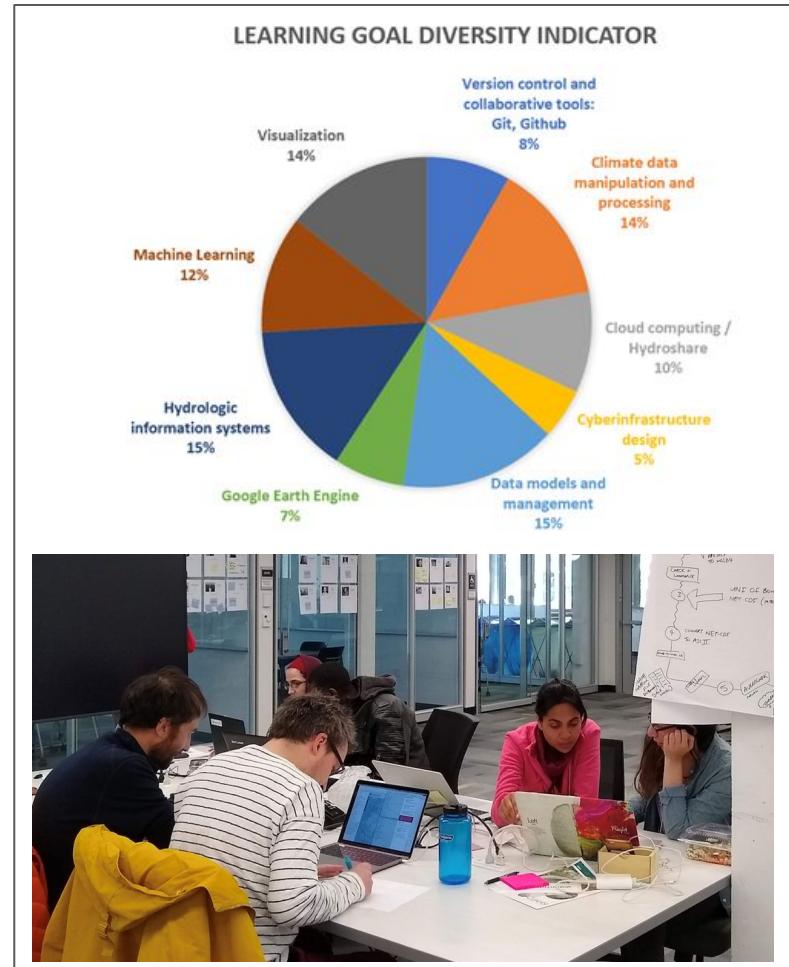
Address question: What is Waterhackweek?

Diverse answers (next slides):



1. Waterhackweek 2019 Community
2. Frontiers of data science and cyberinfrastructure training opportunity
3. Community Leaders: NSF CyberTraining Program; CUAHSI Project; UW eScience Institute Hackweek

Invitation to Connect, Participate, Lead





# Who are we?

- Professors
- Research Scientists
- Undergrad Students
- Graduate Students (50%)
- Data Scientists
- Software Developers
- Education Evaluator
- University Staff

NICOLETA CRISTEA  
RESEARCH SCIENTIST  
ESCIENCE & CIVIL AND  
ENVIRONMENTAL ENGINEERING

CHRISTINA BANDARAGODA  
SENIOR RESEARCH SCIENTIST  
CIVIL AND ENVIRONMENTAL  
ENGINEERING

ANTHONY ARENDT  
PRINCIPAL RESEARCH SCIENTIST  
ESCIENCE & APL

LILY MCGILL  
PHD STUDENT  
UW QUANTITATIVE ECOLOGY &  
RESOURCE MANAGEMENT

JIM PHUONG  
PHD STUDENT  
BIOMEDICAL INFORMATICS AND  
MEDICAL EDUCATION

JULIA HART  
COMMUNICATIONS SPECIALIST  
UW FRESHWATER INITIATIVE

BART NIJSSEN  
PROFESSOR  
CIVIL AND ENVIRONMENTAL  
ENGINEERING

RACHAEL MURRAY  
PROGRAM SPECIALIST  
ESCIENCE

EMILIO MAYORGА  
RESEARCH SCIENTIST  
APL

ANTHONY CASTRANOVA  
HYDROLOGIC SCIENTIST  
CUAHSI

ELIZABETH TRAN  
COMMUNITY-RELATIONS SPECIALIST  
CUAHSI

JILL KLEIN  
SENIOR MANAGER  
CIVIL AND ENVIRONMENTAL  
ENGINEERING

SAI S. NUDURUPATI  
PHD STUDENT  
UNIVERSITY OF WASHINGTON

AMANDA MANASTER  
PHD STUDENT  
UNIVERSITY OF WASHINGTON

YIXIN MAO  
DATA SCIENTIST  
SALESFORCE

AMANDA TAN  
DATA SCIENTIST  
UNIVERSITY OF WASHINGTON

BRANDI JAMES  
ORGANIZER  
UNIVERSITY OF WASHINGTON

JEFF KECK  
ORGANIZER  
UNIVERSITY OF WASHINGTON

VERONICA SMITH  
EDUCATION EVALUATOR  
DATAINSIGHT

ORIANA CHEGWIDDEN  
PHD STUDENT  
UNIVERSITY OF WASHINGTON

DIANA GERGEL  
PHD STUDENT  
UNIVERSITY OF WASHINGTON

SHAY STRONG  
DIRECTOR OF DATA SCIENCE AND  
MACHINE LEARNING  
EAGLEVIEW

VALENTINA STANEVA  
DATA SCIENTIST  
UNIVERSITY OF WASHINGTON

TONY CANNISTRÀ  
PHD STUDENT  
UNIVERSITY OF WASHINGTON

JACOB DEPPEN  
ORGANIZER  
UNIVERSITY OF WASHINGTON

LANDUNG (DON)  
SETIAWAN  
SOFTWARE DEVELOPER  
UNIVERSITY OF WASHINGTON

MADHAVI SRINIVASAN  
ORGANIZER  
UNIVERSITY OF WASHINGTON

YIFAN CHENG  
PHD STUDENT  
UNIVERSITY OF WASHINGTON

ANDREW BENNETT  
PHD STUDENT  
UNIVERSITY OF WASHINGTON

MATTHEW BONNEMA  
PHD STUDENT  
UNIVERSITY OF WASHINGTON

OWEN FREED  
COMMUNICATIONS SPECIALIST  
UNIVERSITY OF WASHINGTON

ROHIT KHATTAR  
PHD STUDENT  
BRIGHAM YOUNG UNIVERSITY

SCOTT BLACK  
SOFTWARE ENGINEER  
CUAHSUTLA STATE UNIVERSITY

CUAHSI  
universities allied for water research

FRESHWATER INITIATIVE  
UNIVERSITY of WASHINGTON



eScience Institute  
ADVANCING DATA-INTENSIVE DISCOVERY IN ALL FIELDS



# Learn Emerging Technology

“This week has been really eye opening on all the tools. The library module out there that can be used is something that I’m interested in ... I can see a lot of occasions to use those tools for the problem that I am looking into ... At the beginning it was a little bit daunting. **It is a quite a steep learning curve; but, now I am really enjoying using the Jupyter Notebook.**

*-Waterhackweek 2019 participant*



Figure 4. Tony Castronova (CUAHSI) is a PhD Civil Engineer, Hydrologist, and lead software developer on multiple hydrology and cloud related projects that are shaping the frontiers of water research. For example, Want to subset data from the National Water Model? He is making it easier for everyone.



# Build inclusive teams that put diversity to work



Figure 5. There was no work happening when this picture was taken, just strolling through the 100 year old cherry trees in blossom.

“Waterhackweek helped me in areas I never thought it would before coming. These are related to team building and the positive environment that the staff fostered for the participants. It is so different than what I have experienced in graduate school and an absolute breadth of fresh air.”

*-Waterhackweek 2019 participant*



# Water-related Challenges Need Global Perspectives

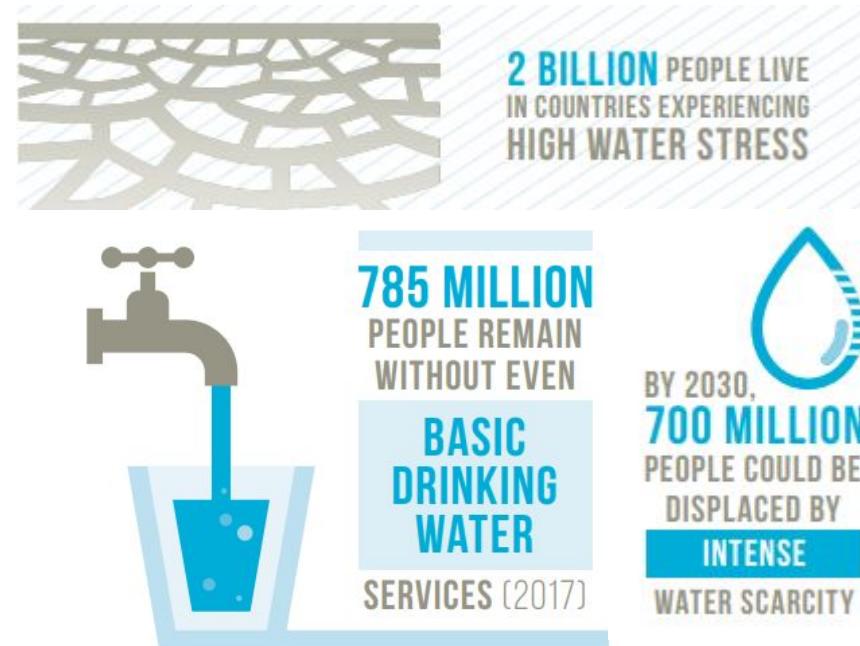


Figure 1. Selected infographics on [water issues related to United Nation Sustainable Development Goals](#). See also [Big Data issues](#), and [Climate Change Issues](#).



# Water-related Challenges Need Global Perspectives

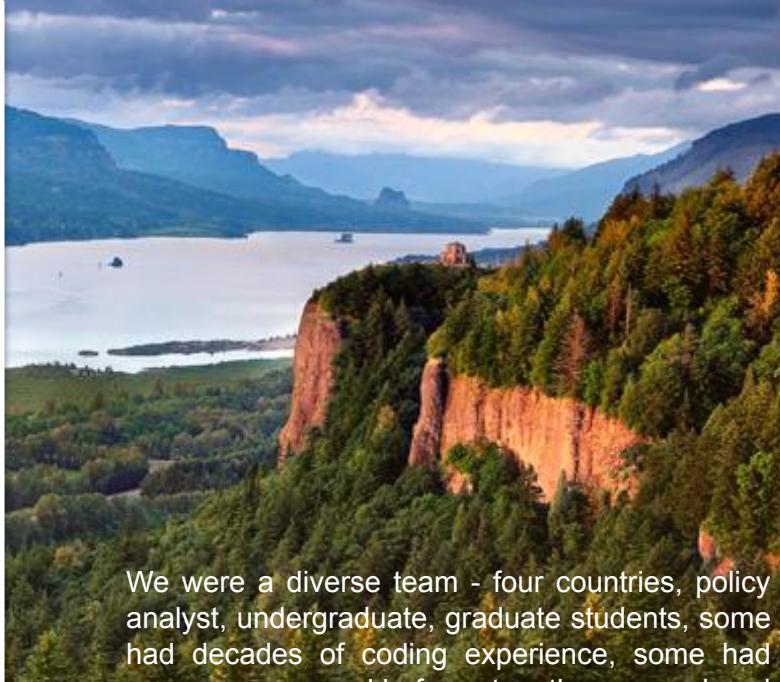
What innovations could emerge if a research workforce that represents the global population worked on these problems?



1. Machine learning with Crowdsourced data for water and food security
2. Mapping infectious disease with climate change
3. Apps for Disaster prevention & response
4. Sensors connected to track access to clean water
5. Satellite and cube imaging of snow, deforestation, lake and land use changes
6. Open source hyper-connectivity of observations, predictions, and physics
7. Critical digital infrastructure standards for ethical and legal translation of data products that are artificial intelligence and public education ready.

# Xtreme Fortune-Telling in the Pacific Northwest

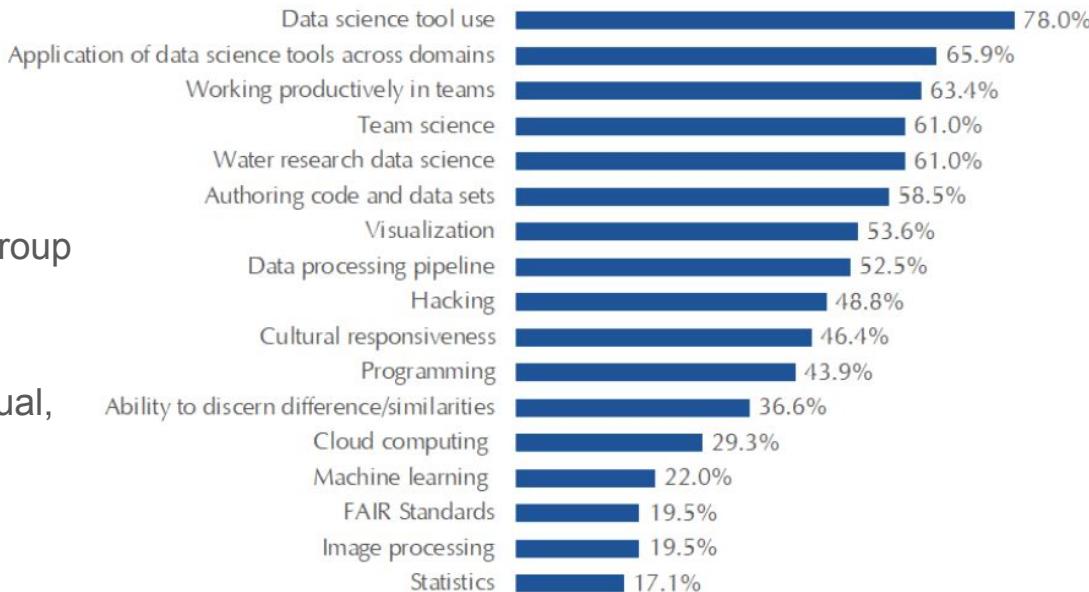
## How will climate change impact floods and droughts?

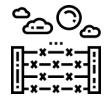


We were a diverse team - four countries, policy analyst, undergraduate, graduate students, some had decades of coding experience, some had never programmed before - together we analyzed 3.5 billion days of streamflow data to distill answers to these important questions.

# What to Expect at Waterhackweek

- Exposure to a wide array of scientific software, tools, and libraries.
  - Github, HydroShare, Jupyter, SUMMA, LandLab, Observatory, Pandas, NumPY, AWS, etc.
- Collaborative research with a diverse group of professionals.
  - 40.5% Women, 40.5% people of color, 40.5% bilingual or multilingual, 2.4% LGBTQ
- Networking and Relationship Building
  - Build your research network: 10 scientific disciplines, 47.6% graduate students





# What to Expect: Curriculum & Learning Goals

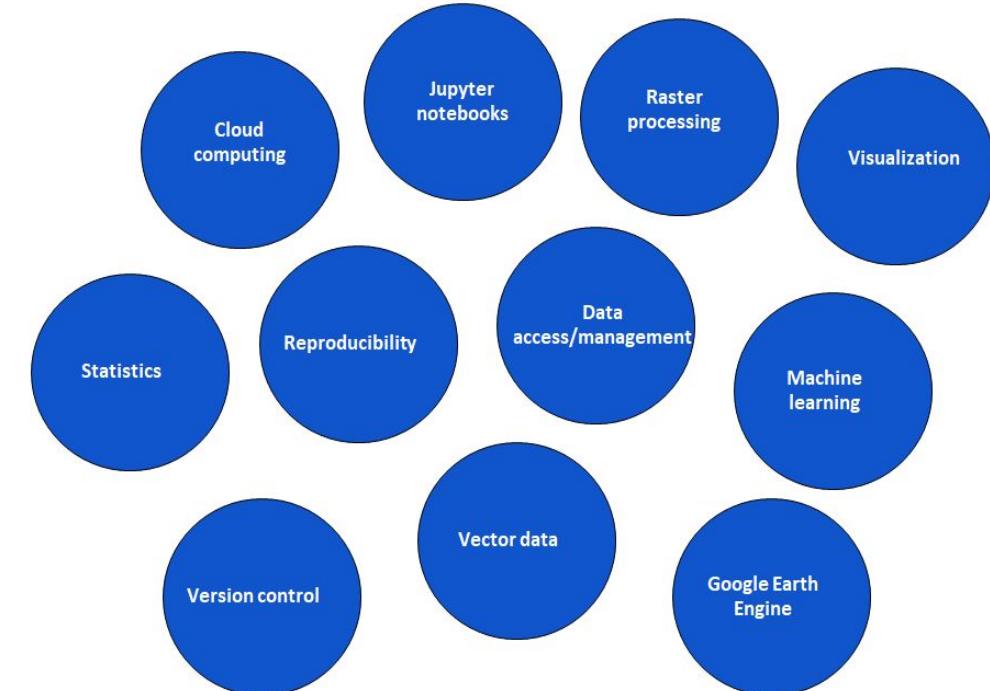
- View schedule on [waterhackweek.github.io](https://waterhackweek.github.io)
- Cyberseminars
- March 23-27: 9 - 5 pm

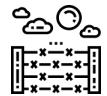
Morning: Interactive Tutorials  
Afternoon: Team Project

Evenings: Fun ++

Welcome Reception  
Community Mixer  
Trivia, Climate Knitting, etc.  
Team Building: e.g. indoor climbing

## Proposed Tutorials WHW 2020





# What to Expect: Projects



Figure 12. Be Yourself. During the Monday afternoon project pitch, any participant who wants to lead a project is invited to recruit other participants to join the team. You could decide Monday at lunch to lead a project and build a team. You could plan for two months and organize all the data ahead of the event. It's self-organized and driven by your interests and learning objectives, that's why it's critical to Be Yourself (which may include yawning, since that increases oxygen to the brain).

“At first I thought, why [are] they [letting] us choose the topic of our project? ... then I figured out that this was part of us learning how to interact with each other ... in different aspects of education and culture ... it’s very helpful.”

*–Waterhackweek 2019 participant*



# What to Expect: Projects

“ I try to encourage everyone in my team to ... put forward their learning goals and expectations ... early on ... I pass that on to my data science lead so that could kind of start highlighting and kind of teaching and integrating those concepts **so that people felt more fulfilled during their experience** ... made sure that everybody ... introduced themselves and their expertise so ... clear to all of the team members that **everyone is an expert in something and that level of expertise and knowledge, whether it's in data or in a subdomain, should be respected** ... I think it's been going well so far.”

*–Waterhackweek 2019 project lead*



# Project & Team Examples

## 2019 Projects (9)

- Climate change and ecohydrologic response using Landlab
- Civil digital infrastructure for real-world health impacts
- Mapping Co-Occurrence of Geogenic Groundwater Contaminants of Concern
- Climate change and ecohydrologic response using Landlab
- Effects of wildlife on Tundra hydrology and lake change
- Tuolumne snowmelt during rain on snow events
- Meteorological forcing data for NWM/WRF-Hydro
- How will climate change affect hydrologic extreme events in the Pacific Northwest

[Link to 2019 Freshwater Community Mixer Lightning Talks](#)

README.md

Repository Name: whw2019\_Mapping\_Groundwater\_Contaminants

Project Title: Mapping Co-Occurrence of Geogenic Groundwater Contaminants

Collaborators on this Project

- Project Lead - Katya Cherukumilli
- Data Science Lead - Rohit Khattar
- Team Member - Allan Jones
- Team Member - Zhen Han
- Team Member - Kevin McGee
- Team Member - Tristan Weiss

HydroShare Resource - [Datasets](#)

The Problem

300 million people worldwide are at risk of irreversible crippling disorders, internal cancers, and early mortality due to consumption of groundwater containing naturally occurring ("geogenic") arsenic and fluoride. In recent years, there has been increasing public interest to appropriately manage and protect high-quality groundwater aquifers for drinking water and irrigation in drought-stricken regions (e.g., Western U.S., India, etc.). Our project aims to map the co-occurrence of multiple contaminants since most maps currently focus on an individual contaminant.





# Project Roles

## Project Lead (1 per project)

- Project management
- Coordinate with leadership to support team and individual learning objectives
- Formulate project idea prior to WHW event and pitch idea on Monday afternoon

## Data Science Lead (1-2 per project)

- Expertise in data tools and methods used in project

## Team Member (2 - 4) per project

- Member of the project contributing to shared goals while focused on individual learning objectives

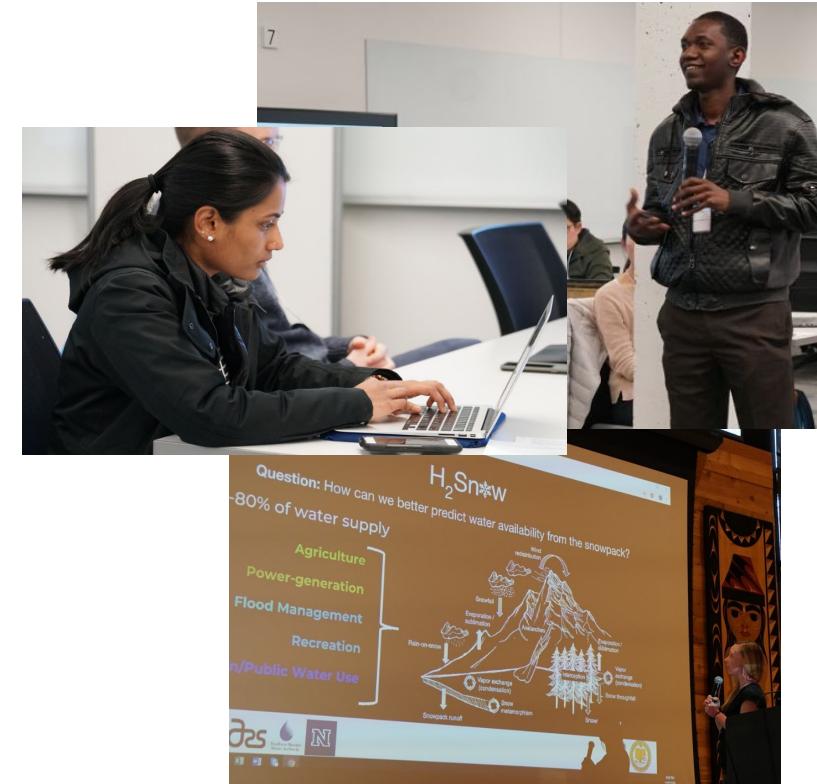
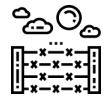


Figure 15. Team members work on their individual learning objectives and shared project goals. This could include presenting ideas in the Active learning classroom to all participants, presenting the team project in a Lightning Talk at the Community Mixer, or no public speaking at all.



# User Ecosystem and Training Experience

- Github Code Repository: [www.github.com/waterhackweek](https://www.github.com/waterhackweek) with Github User ID
- HydroShare Data Repository: [www.hydroshare.org](https://www.hydroshare.org); Collaborate; Join Waterhackweek Group
- Slack Community: By email invitation
- OrCID: suggested platform for managing profile
  
- Cloud - Online - Cyber Tools (options)
  - CUAHSI JupyterHub Server
  - AWS, Azure, Google Collab
  - XSEDE
  - Google Earth Engine
- Open Source Software Libraries (options)
  - Jupyter Notebooks, Binder, SUMMA, LandLab, Observatory, Pandas, NumPY, ++



Figure 16. We work hard and move fast. We also take breaks and encourage everyone to sleep, eat, and take care of themselves. Waterhackweek is not a competitive environment or a race. We are in it for the long run to mobilize a learning community advancing critical water research using cyberinfrastructure.



# CyberSeminar Series

January 23rd - March 12th Thursdays 10:00 am Pacific/1:00 pm Eastern

**“ I learned the most through the opportunities to practice, struggle with, and apply techniques introduced in the seminars to focused problems. The seminars were highly instructive and interesting ... They also broadened my understanding of the available tools for research in water sciences, especially in those areas outside my research niche. However, my personal practice with the demonstrated skills and learning from my mistakes were the times I learned the most.”**

*-Waterhackweek 2019 participant*



Seminars (and signup) will be posted on the CUAHSI website soon! <https://www.cuahsi.org/education/cyberseminars/>

# CyberSeminar Series

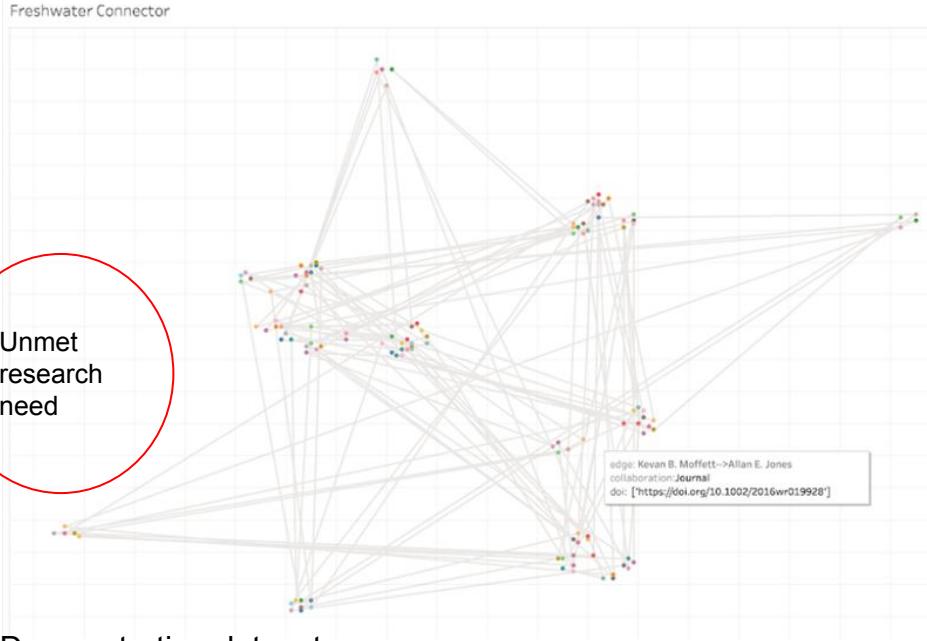
January 23rd - March 12th Thursdays 10:00 am Pacific/1:00 pm Eastern

2019 series are available as Learning Resources and on the CUAHSI archive.  
2020 will be theme-based, linked to optional preparation training activities, and offer Diverse Panel perspectives.

- Jan 23: Collaboration with Teams, Users & Stakeholders
- Jan 30: Publishing Data and Research
- Feb 6: Community Repositories
- Feb 13: Publishing Interactive Code
- Feb 20: Modeling and Big Compute
- Feb 27: Scaling climate data and hydrologic processes
- March 5: Big Research Needs & Waterhackweek Projects
- March 12: Waterhackweek Tutorial Pitch (sign up here for 5 min to introduce your software, toolkit, or curriculum)



# Waterhackweek Learning Connections



Demonstration dataset:

- 1.OrcID or Bibtex file: five citations each
- 2.Waterhackweek 2019 HydroShare Group resources
- 3.Waterhackweek Github organization repositories

**Learning Community  
connections BEFORE  
Waterhackweek:**

journal publications (DOI) linking  
participants and coauthors (dots)



Hi there!

Issues? Let us  
know at  
<https://github.com/waterhackweek/freshwater-connect>

**Madhavi Srinivasan**  
madhasri

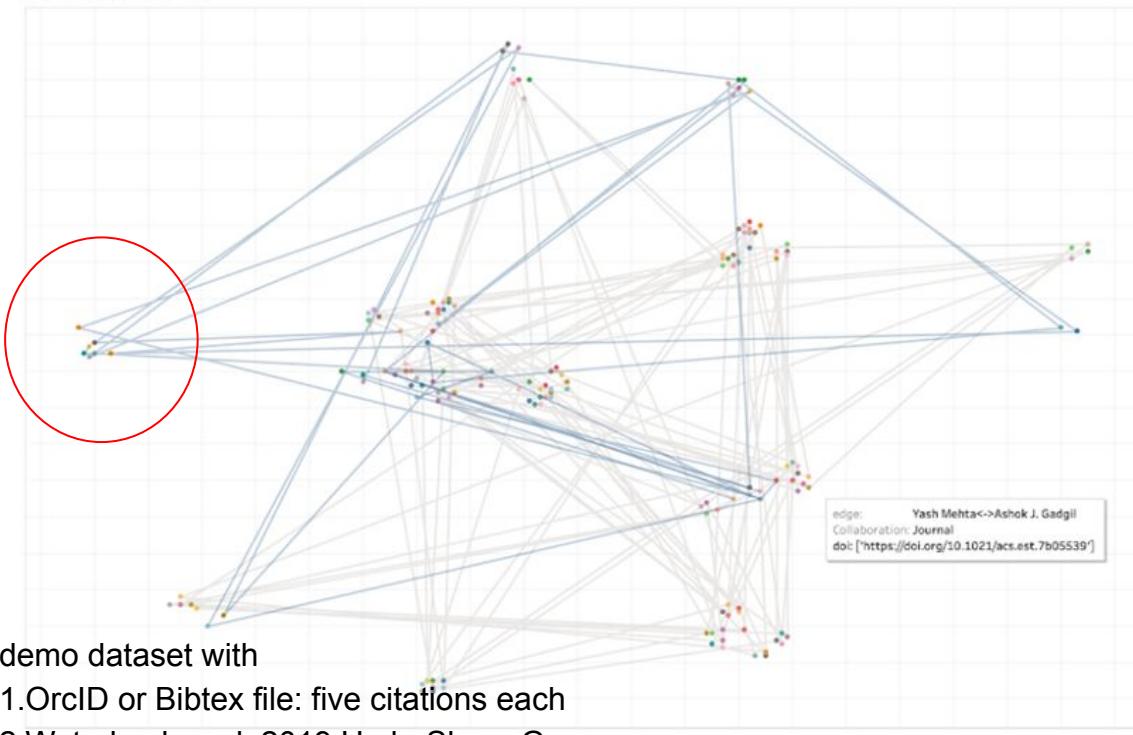
Follow

Scuba Diving with Data | Data Storyteller  
Seattle



# New Waterhackweek Learning Connections

Freshwater Connector



Collaboration

 Github Hydroshare Journal

Collaboration

 Github Hydroshare Journal

Find a person

Highlight Name

**Learning Community connections AFTER Waterhackweek**  
journal+Github+HydroShare publications linking participants and coauthors (dots) leads to new connections (red circle)

Issues? Let us know at  
<https://github.com/waterhackweek/freshwater-connect>



# National Science Foundation CyberTraining Project

## Data Streams, Model Workflows, and Educational Pipelines for Hydrologic Sciences

UW Award: #1829585 CUAHSI Award: #1829744

**Program: Training-based Workforce Development for Advanced Cyberinfrastructure (CyberTraining)**  
**sponsored by Office of Advanced Cyberinfrastructure (OAC)**



Christina Bandaragoda (Principal Investigator)  
Anthony Castronova (PI)  
Bart Nijssen (Co-PI)  
Erkan Istanbulluoglu (Co-PI)  
Anthony Arendt (Co-PI)  
Emilio Mayorga (Senior Research Scientist)  
Nicoleta Cristea (Research Scientist & Project Coordinator)  
Owen Freed (Communications Manager)  
Madhavi Srinivasan (Data Scientist)  
Jane Koh (Project Manager)



# How does the NSF CyberTraining Team participate?

- Dream up new ways to experiment on our projects, our teams, and our learning capacity
- Fix problems and debug research software that does not operate as expected.
- Coordinate with Sponsors and Contributors
- Develop and test new research software with participants.
- Bring scientists, students, and staff and project resources to participate in projects and tutorials
- Cooperatively own new software tools with friends

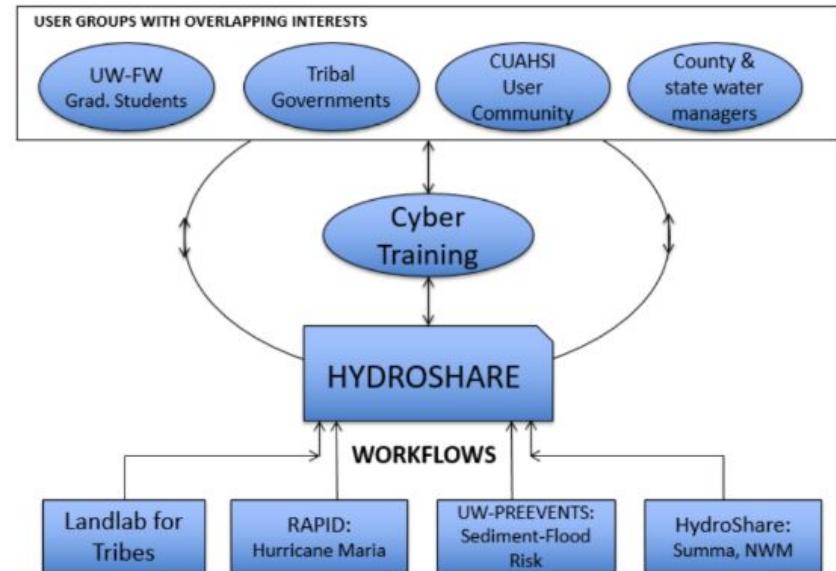


Figure 1. Using CyberTraining on HydroShare to connect user groups with shared scientific, data or research interests with academic and applied project workflows published on HydroShare.



COLLEGE OF THE ENVIRONMENT  
COLLEGE OF ENGINEERING



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**Our community advances  
students to the leading-edge  
of freshwater research**

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**Reinventing water  
research**

Freshwater “flows” across many disciplines. Today’s freshwater issues are complex, and no single discipline can tackle them alone. That’s where we come in. The Freshwater Initiative promotes community interaction and facilitates new and creative applications of freshwater research in the water science and engineering communities.

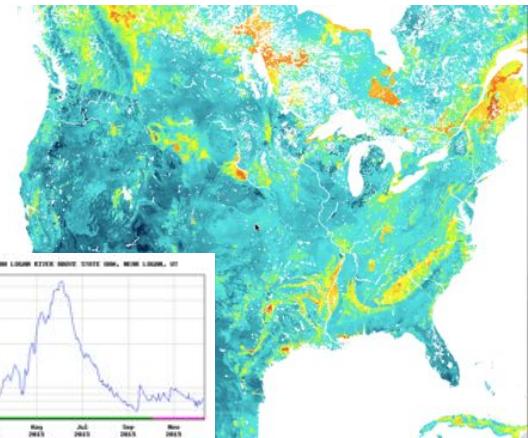
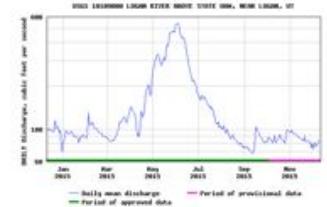
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Consortium of Universities for the Advancement of Hydrologic Science, Inc. is  
sponsored by the [National Science Foundation](#)



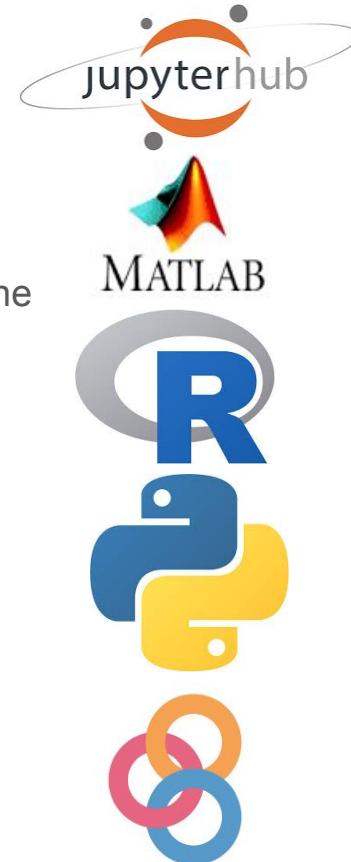
- CUAHSI (COO-WAH-see) - Consortium of Universities for the Advancement of Hydrologic Science Inc.
  - *Strengthening interdisciplinary collaboration in the water science community,*
  - *To empower the community by providing critical infrastructure, and*
  - *To promote education in the water sciences at all levels*
- Community Services - Resources and training to build capacity and extend capabilities
- Data Services - Access to data and models to facilitate research and education.





# How does CUAHSI participate?

- Organize Cyberseminars
  - Weekly seminars to prep for the Waterhackweek event in March 2020.
- Provide compute and modeling services
  - JupyterHub: Python, R, MATLAB Online
  - CONUS Model Subsetter.
- Data services
  - Hydrologic Information System, HydroShare
- Attend
  - We bring scientists to participate in projects, host interactive seminars, answer questions, and have fun!
  - Founding sponsor and NSF project collaborator



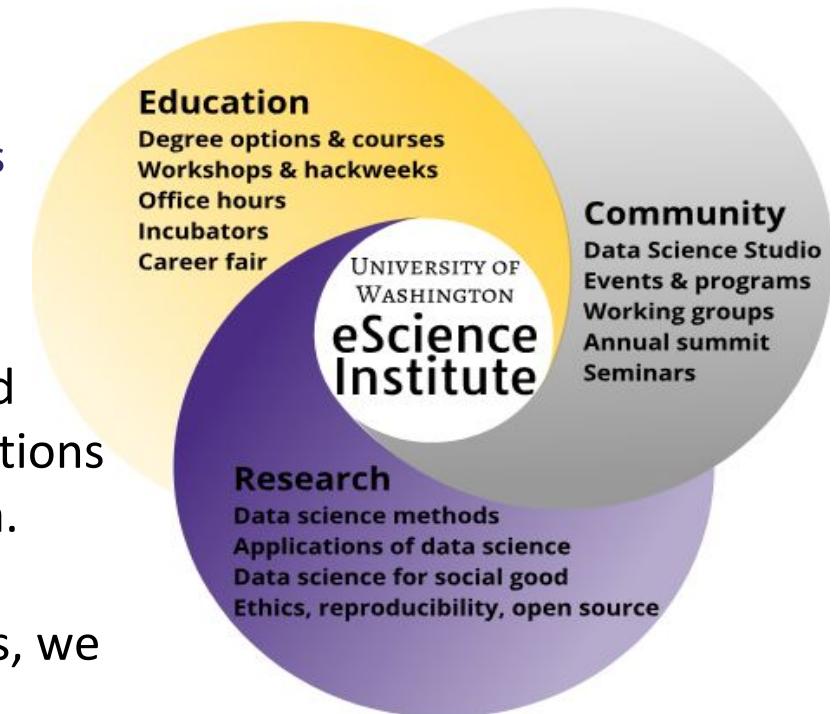
The screenshot shows the HydroShare interface. At the top, there's a navigation bar with links for HOME, MY RESOURCES, DISCOVER, COLLABORATE, APPS, and HELP. Below the navigation is a banner with a photo of a stream and the word "Discover". A sub-section titled "How it works" contains five numbered steps: 1. Create your data (using the same methods you use now; HydroShare supports a broad set of hydrologic data types), 2. Upload to HydroShare (upload your data files through the web user interface; HydroShare supports a broad set of hydrologic data types), 3. Describe with metadata (use HydroShare's simple entry forms to flesh out your data so others can easily extract as much information as possible from the files you upload), 4. Share with colleagues (choose who has access to your data and models you have uploaded to HydroShare; you can share with individual users or groups or make resources public for everyone to access), and 5. Permanently Publish (obtain a Digital Object Identifier (DOI) so your work can be easily cited). Below this are two resource cards: "National Water Model" (with a map of the US showing streamflow paths) and "ParFlow-CONUS" (with a map of the US showing a grid over the Great Lakes).



## Mission:

The eScience Institute **empowers** researchers and students in all fields to answer fundamental questions through the use of large, complex, and noisy data.

As the **hub** of data-intensive discovery on campus, we lead a **community** of innovators in the techniques, technologies, and best practices of data science and the fields that depend on them.



# 10 years!



# How does eScience Institute participate?

- Coordinate hackweek tutorials and activities
- Provide resources for coordinators and tutorial leads
- Building a Hackweek Toolkit (<https://github.com/uwescience/HackWeek-Toolkit>)
- Event Sponsorship: Lunch cards, Welcome Reception, Community Mixer
- Connect participants with Big Data Hubs and other Data Science groups and events
- Provide meeting space and resources for Software Carpentry training sessions
- Attend
  - We bring staff, data scientists, and expertise from other Hackweeks to participate in projects and tutorials
  - Founding sponsor and NSF project collaborator



# What is a hackweek?

## Hack weeks as a model for data science education and collaboration

Daniela Huppenkothen<sup>a,b,c,d,1</sup>, Anthony Arendt<sup>d,e</sup>, David W. Hogg<sup>c,b,f,g</sup>, Karthik Ram<sup>h,i</sup>, Jacob T. VanderPlas<sup>d</sup>, and Ariel Rokem<sup>d</sup>

<sup>a</sup>Institute for Data-Intensive Research in Astrophysics and Cosmology, Department of Astronomy, University of Washington, Seattle, WA 98195; <sup>b</sup>Center for Data Science, New York University, New York, NY 10003; <sup>c</sup>Center for Cosmology and Particle Physics, Department of Physics, New York University, New York, NY 10003; <sup>d</sup>The University of Washington eScience Institute, The Washington Research Foundation Data Science Studio, University of Washington, Seattle, WA 98105; <sup>e</sup>Polar Science Center/Applied Physics Laboratory, University of Washington, Seattle, WA 98105-6698; <sup>f</sup>Max-Planck-Institut für Astronomie, D-69117 Heidelberg, Germany; <sup>g</sup>Center for Computational Astrophysics, Flatiron Institute, New York, NY 10010; <sup>h</sup>Berkeley Institute for Data Science, University of California, Berkeley CA 94720; and <sup>i</sup>Berkeley Initiative in Global Change Biology, University of California, Berkeley CA 94720

Edited by Russell A. Poldrack, Stanford University, Stanford, CA, and accepted by Editorial Board Member Marlene Behrman July 9, 2018 (received for review September 29, 2017)

Across many scientific disciplines, methods for recording, storing, and analyzing data are rapidly increasing in complexity. Skillfully using data science tools that manage this complexity requires training in new programming languages and frameworks as well as immersion in new modes of interaction that foster data sharing, collaborative software development, and exchange across disciplines. Learning these skills from traditional university curricula can be challenging because most courses are not designed to evolve on time scales that can keep pace with rapidly shifting data science methods. Here, we present the concept of a hack week as an effective model offering opportunities for networking and community building, education in state-of-the-art data science methods, and immersion in collaborative project work. We find that hack weeks are successful at cultivating collaboration and facilitating the exchange of knowledge. Participants self-report that these events help them in both their day-to-day research as well as their careers. Based on our results, we conclude that hack weeks present an effective, easy-to-implement, fairly low-cost tool to positively impact data analysis literacy in academic disciplines, foster collaboration, and cultivate best practices.

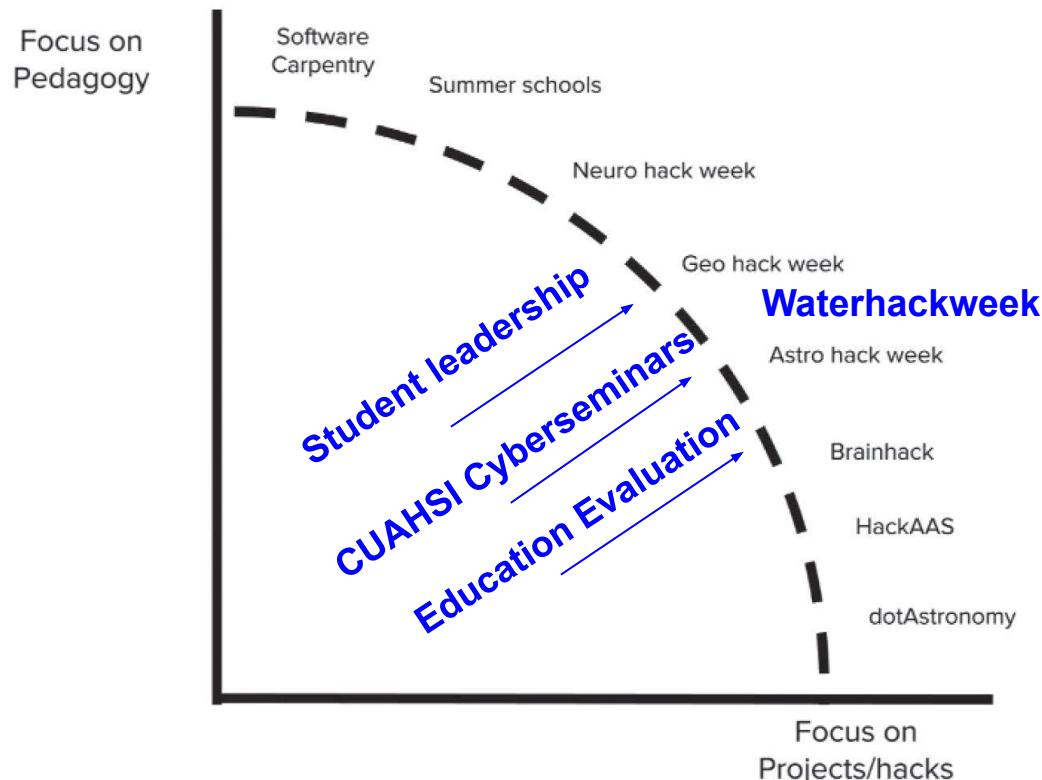
data science | education | interdisciplinary collaboration | reproducibility

event (Fig. 1). Pedagogically focused events follow a classic academic model where novices learn new skills from experts. This model tends to focus on a one-way flow of information from instructor to student and is usually targeted toward participants in the training phase of their career. On the other end of the spectrum, project-focused workshops emphasize collaborative activities using existing skills, leading to the common perception that they are designed for technical experts. This may limit their audience. To bridge this gap, we describe here a model that we have implemented: “Hack Weeks” that aim to capitalize on the advantages of each of these models. These week-long events combine structured periods focused on pedagogy (often with an emphasis on statistical and computational techniques) and less structured periods devoted to hacks and creative projects, with the goal of encouraging collaboration and learning among people at various stages of their career.

We have run eight such hack week events: four focused on astronomy and two each focused on neuroscience and geoscience. Here we share the philosophy behind the hack week model, results from surveys of participants, practical lessons we have learned in organizing these events, and recommendations for future hack weeks. *SI Appendix* provides additional details on the practical aspects of organizing these events.



# Hackweeks & the Learning Continuum





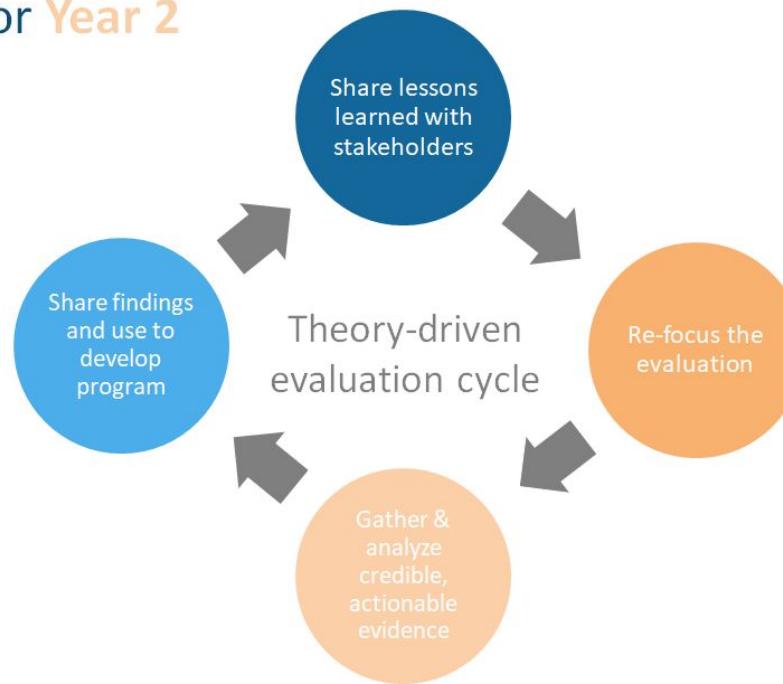
# Independent Education Evaluation

Led by Evaluation Data Scientist Veronica Smith



**data2insight**  
Find wisdom in information

Preparing for **Year 2**





# How you can join the Waterhackweek Community?

1. **Apply** by January 5 for Waterhackweek 2020
2. **Attend** Join Cyberseminars Jan-March 2020
3. **Sponsor** Add Waterhackweek event and participant travel support to your funded proposals
4. **Follow** HydroShare, Github, Twitter #waterhackweek during and after March 23-27
5. **Connect** Opt in to the Connector, submit abstract for session at AGU 2020 Fall Meeting, submit to Open Water special edition
6. **Repeat** Apply for Waterhackweek 2021
7. **Advise, Promote, Sustain** PhD student co-directors: apply using Instructor application. Nominate for Board of Advisors January 31, 2020: contact Christina Bandaragoda, [cband@uw.edu](mailto:cband@uw.edu). Promote and share community news: contact Owen Freed, [ofreed1@uw.edu](mailto:ofreed1@uw.edu)

# Opportunity! Waterhackweek Student Co-Directors

Self-nominate and [Apply by](#)  
[using the Instructor](#)  
[application.](#)



# WATERHACKWEEK 2019

## THANK YOU TO OUR SPONSORS



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FOUNDATION



# Credits and References to Content Contributors

Bandaragoda, C., Arendt A., Castranova, A., Nijssen B., Istanbulluoglu E., Cristea, N. and V. Smith. 2018, December. Data Streams, Model Workflows and Educational Pipelines for Hydrologic Sciences. ED23D-0945 at American Geophysical Union Fall Meeting, Washington, D.C., 10-14  
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Cristea, N.C., Smith, V., and C. Bandaragoda. 2019, December. Waterhackweek, workshop on water data science: structure, topics and evaluation. ED12A-07 at American Geophysical Union Fall Meeting, San Francisco, CA. 9-13 Dec,  
<https://agu.confex.com/agu/fm19/meetingapp.cgi/Paper/611390> available at  
<https://www.hydroshare.org/resource/e6f80e35639f48ec8cf4831a4d2fa9f3/>

Castranova, Anthony M., Christina Bandaragoda, and Danielle Tijerina. "Cloud-based Learning in the Water Sciences using HydroShare and Jupyter Notebooks." In AGU Fall Meeting 2019, San Francisco, CA



“Waterhackweek is an opportunity for hydrologists and others interested in water to discover emerging technologies in the field and how to harness the power of data science in their work.”

“Waterhackweek is the chance to develop data science skills, whatever your background, to work on a real-life project with people who you would normally never get the chance to interact with.”

# END

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A few more slides follow with more details.

## Testimonials from 2019 Participants



### Katya Cherukumilli

"At Waterhackweek, I was introduced to a unique and powerful network of data scientists passionate about water issues. I was also encouraged to push my own intellectual boundaries and to learn new methods that will greatly contribute to my future research and humanitarian work."

### Zahra Sharifnezhadazizi

"The diverse milieu of the workshop in terms of both culture and science, and the welcoming nature of Seattle let me have this notion that [the] organizers are not only proficient in technology, but also experts in social sciences."



# Waterhackweek curriculum 2019

## Cyberseminars

1. *Hydroshare and data sharing tools*
2. *Jupyter notebooks on Hydroshare*
3. Visualization of water datasets
4. Data access and time-series statistics
5. Workflows for gridded climate datasets
6. *Version control git/Github*
7. Landlab modeling framework and use cases -
8. Tools for building Apps: Tethys

## In-person training

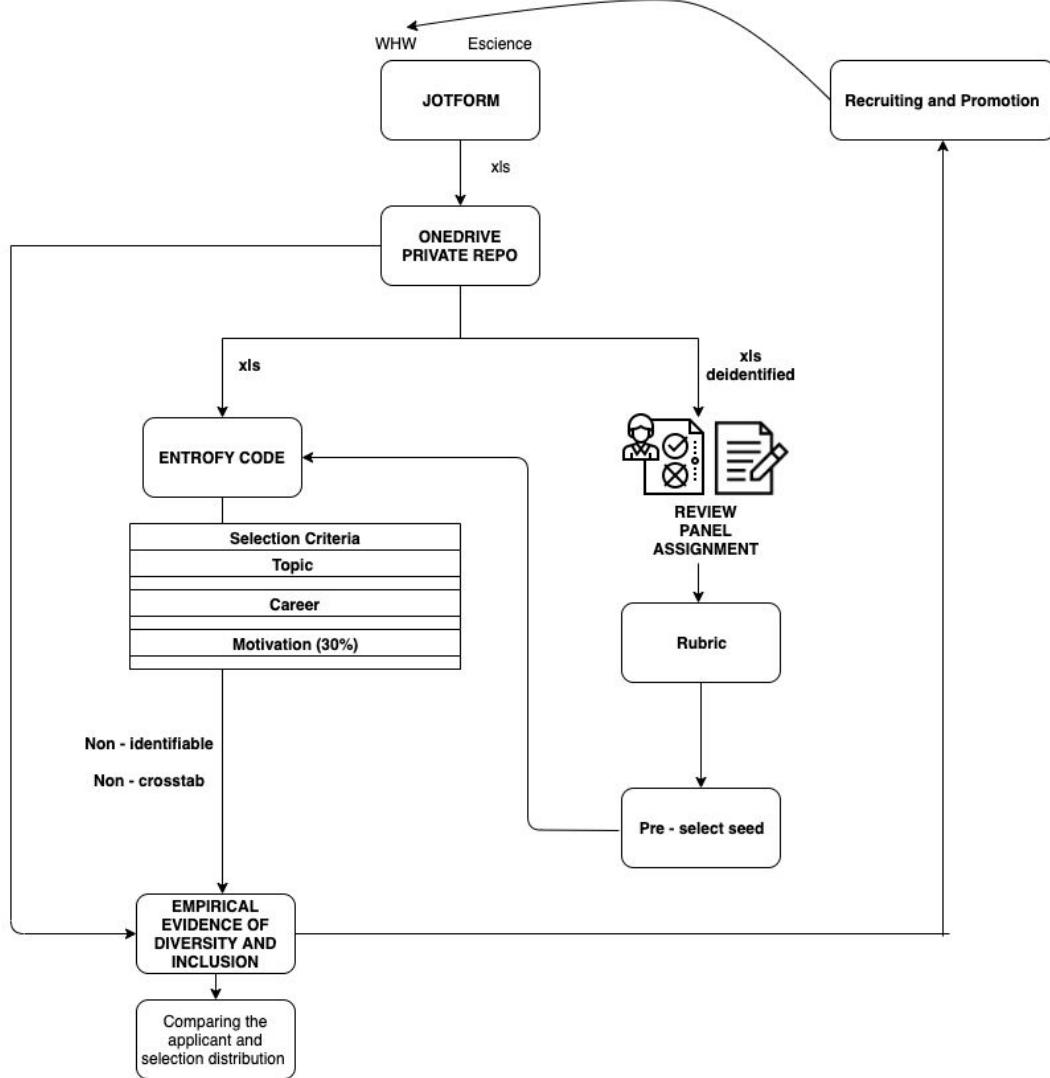
1. *Jupyter notebooks / Hydroshare*
2. *Git/Github*
3. Metsim – meteorological simulations
4. OGH –gridded meteorology
5. Cloud computing
6. Google Earth Engine
7. Machine learning
8. Landlab
9. Reproducibility workflows

## Project work

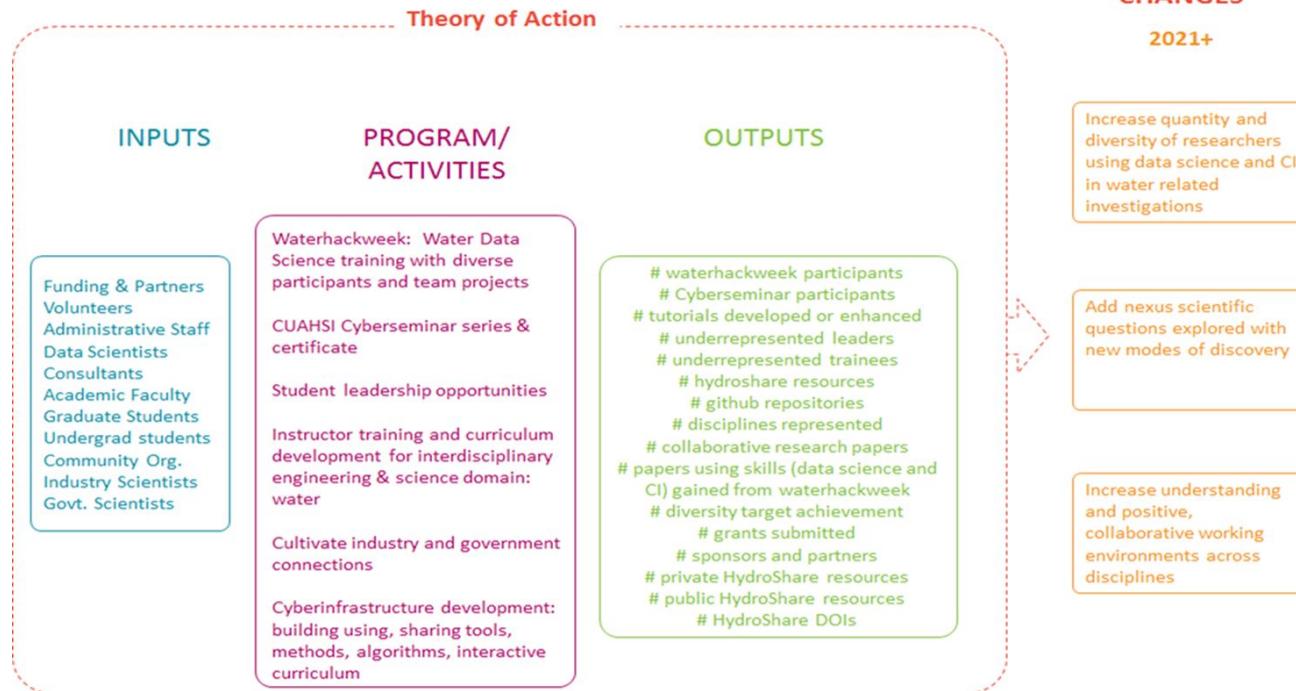
Team project time Noon - 5 and later each day

<https://waterhackweek.github.io/>

# Application Selection Process & Workflow



# Theory of Action



**Figure 1.** The theory of action outlines how a set of contributors (inputs) can support a limited set of funded activities (program) to generate measurable products (outputs). Waterhackweek encompasses interrelated activities with the shared vision (Anchor Changes) that an increase in scientific workforce diversity will generate new nexus science and improved interdisciplinary working environments.

# Open to new Collaborators and Roles

For example, Earth Science in the Arts with Irish Center for Research in Applied GeoSciences or exploring new mediums for presenting local data. ShowYourStripes!

