



2017 REVIEW OF DATA-DRIVEN EDUCATION ACTIVITIES

FINAL REPORT

Prepared by

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EXECUTIVE SUMMARY

One of the six strategic goals for CUAHSI's Water Data Services program is encouraging and supporting the use of data services in educational settings. Towards fulfilling this objective and as a part of its mission, CUAHSI has supported educational related efforts for more than a decade. In 2017, the CUAHSI Standing Committee on Education and Outreach formed an ad hoc committee to review the consortium's data-driven education activities. CUAHSI requested a review of its data-driven educational activities to identify what activities have been the most useful to the community and provide recommendations for some strategic objectives for the next 3-5 years. This was completed in early 2018 and the results are described herein.

The review committee included seven members, including four from the CUAHSI E&O committee and three additional, external reviewers. All committee members met twice via conference call to come up with a strategy to review the content and to develop a survey for some of the people who have either contributed or used CUAHSI's data-driven educational material. Each committee member reviewed the content and prepared a summary, including their own recommendation of what CUAHSI should do.

Key findings of this review include:

- CUAHSI has created some excellent tools and educational materials through collaboration with other projects and faculty within the membership institutions.
- Overall, CUAHSI's data driven education related efforts and material are not highly visible or easily accessible. For example, many of CUAHSI's data driven education related activities, resources and material are not directly accessible from the "Education" link on its website.
- CUAHSI's role in data driven education, as articulated on its website, is to "support data-driven education by collaborating directly with educators to develop lesson plans and by contributing to educational resources..." Considering the constant changing nature of data format and computational tools, CUAHSI can play a lead role in connecting educators with existing data and modeling resources to create and share hydrology instructional ideas and materials.

The committee recommends the following goals for the next 3-5 years:

- Improve visibility of the community contributions in data driven education through CUAHSI's website and other avenues.
- Develop, maintain, and promote easy-to-use infrastructure and other resources for the community to use data in their hydrology instruction.
- Develop and maintain programs to provide training and recognition to faculty for developing and disseminating data-driven education content.

INTRODUCTION

One of the six strategic goals for CUAHSI's Water Data Services program is encouraging and supporting the use of data services in educational settings. Towards fulfilling this objective and as a part of its mission, CUAHSI has supported education-related efforts in the past 10 years including educational exercises on using data services through software like HydroDesktop and HydroClient, as well as projects like the Shale Network. CUAHSI has also organized workshops and oral/poster presentation sessions at AGU supporting data-driven education. Recent education-related activities include publication of data-driven educational modules on Science Education Resources Center (SERC), HydroShare and HydroLearn. CUAHSI requested a review of its data-driven educational activities to identify what activities have been the most useful to the community and provide recommendations for some strategic objectives for the next 3-5 years.

The review committee included seven members, including four from the CUAHSI E&O committee and three external faculty members. Their names and affiliations are presented in Table 1 below.

Table 1. Review Participants.

Name	Affiliation
Venkatesh Merwade (Chair)	Purdue University, Chair of CUAHSI EO
Ben Ruddell	Northern Arizona University, CUAHSI EO
David Freyberg	Stanford University, CUAHSI EO
Emad Habib	University of Louisiana, CUAHSI EO
Ashok Mishra	Clemson University, External Member
Ted Endreny	State University of New York College, External Member
Ed Maurer	Santa Clara University, External Member
Jon Pollak	CUAHSI

APPROACH

All committee members met twice via conference call to come up with a strategy to review the content and to develop a survey for some of the people who have either contributed or used CUAHSI's data-driven educational material. Each committee member reviewed the content and prepared a summary, including their own recommendation of what CUAHSI should do. The survey was completed by 30 individuals, of which 9 were related to CUAHSI's data-driven education efforts (who contributed content, participated in webinars, workshops or conference sessions) and 21 were from CUAHSI's BOD and standing Committees. After the survey was complete, the committee met via conference call to discuss the survey results and recommendations.

FINDINGS

Key observations from the committee members on CUAHSI's Data Driven Activity are provided below:

1. CUAHSI has created some excellent tools and educational materials through collaboration with other projects and faculty within the membership institutions.
2. Overall, CUAHSI's data driven education related efforts and material are not highly visible or easily accessible. For example, many of CUAHSI's data driven education related activities, resources and material are not directly accessible from the "Education" link on its website.

- CUAHSI's role in data driven education, as articulated on its website, is to "support data-driven education by collaborating directly with educators to develop lesson plans and by contributing to educational resources..." Considering the constant changing nature of data format and computational tools, CUAHSI can play a lead role in connecting educators with existing data and modeling resources to create and share hydrology instructional ideas and materials.

Besides the above observations, a summary of responses to the 21 questions is included in Table 2 below.

Table 2. Summary responses.

Question	Response
At what level do you primarily teach?	60% graduate, 30% undergraduate, and 10% other
What subject matter do you teach? Please select all that apply.	Mostly hydrology
What are the typical data sources you use for teaching? Please select all that apply.	Mostly USGS followed by NASA, EPA, NOAA, own data and hypothetical data
How familiar are you with CUAHSI's resources that support education?	On the scale of 1 (not familiar) to 5 (very familiar), the average response is 3.7
Have you contributed to or participated in CUAHSI's educational related activities at any level? Please select all that apply.	7 out of 30 never contributed or participated. Others have participated mostly by presenting a oral/poster, webinar or contributing content
What resources have you used? Please select all that apply.	HydroClient was selected by almost all respondents, HydroDesktop and HydroShare were next.
How easy was it for you to find CUAHSI's tools and data services that can be used for education purposes?	18 responded "somewhat easy", 6 did not use, 2 responded "very easy"
How easy was it for you to integrate the CUAHSI tools with your curriculum?	12 responded "somewhat useful", 10 never used and 4 very useful
In your educational setting, how would you rate HydroClient?	15 never used, 11 responded somewhat useful
In your educational setting, how would you rate the WaterML R Package?	25 never used, 3 somewhat useful
In your educational setting, how would you rate HydroShare?	20 never used, 8 somewhat useful
In your educational setting, how would you rate Jupyter Notebooks?	24 never used, 3 somewhat useful
What's the best way for CUAHSI to improve our Water Data Services to make them more useful in the classroom?	See comments below

Data-driven exercises at the Science Education Resource Center (SERC) (https://serc.carleton.edu/hydrmodules)	15 never used, 7 somewhat useful and 7 very useful
Hydroviz modules (http://www.hydroviz.org/Home)	21 never used, 6 somewhat useful and 1 very useful
What's the best way for CUAHSI to improve our data-driven education material?	See comments below
Cyberseminars or Virtual Workshops on data-driven education topics	10 never participated, 9 somewhat useful, 9 very useful
In-person workshops on how to use CUAHSI tools and data services to adapt or develop data-driven educational material	13 never participated, 9 somewhat useful, 8 very useful
Oral and Poster Sessions at conferences to learn about community data-driven educational developments	13 somewhat useful, 8 very useful, 8 never participated, 2 very useful
What's the best way for CUAHSI to improve our data-driven education related events?	See below
Please provide any additional comments here...	See below

Q. What's the best way for CUAHSI to improve our Water Data Services to make them more useful in the classroom? (Note: The responses below are exact quotes from all the participants who answered this question).

- Tools that are there need to be robust and reliable, especially as you scale in a classroom.
- Easier access and short video tutorials plus some basic classroom exercises
- Virtual lectures, example homework exercises
- I love the assignments that are available through the SERC-CUAHSI partnership, but I wish there were more available such that there was a broader selection
- Provide lesson modules that can be used at the high school level
- Some students do not have the necessary programming skills to perform statistical analysis of data they downloaded from GUI, e.g., HydroClient. Therefore, it would be very helpful if HydroClient can integrate some basic statistics capability, e.g., calculating the mean, moving window averaging, low flow, variance, etc. Some apps in HydroShare are useful, but not very easy to find for students.
- Package things as curriculum materials and lecture guides
- the interfaces to access and search for data are still not very intuitive – better help/manual/documentation materials would facilitate easier integration
- Work with faculty (e.g., via mini-grants, workshops, partnerships with funded outside educational projects) to test/develop/adapt CUAHSI data services in their classrooms
- Show me the value. At R1 schools, there is not a structural incentive to bring data like these into the classroom because research rather than teaching is emphasized. So doing this kind of thing mainly comes from the faculty's own initiative, which means many people don't bother.
- I just need to find the time to see how I might be able to adapt the steps or units into my needs for lab activities
- Need an easier way to navigate to relevant educational material..maybe a 'portal' that includes SERC, but also other 'lessons' etc

Q. What's the best way for CUAHSI to improve our data-driven education material? (Note: The responses below are exact quotes from all the participants who answered this question).

- make accessible to wider audience like High School, citizen science, and other researchers (Gov Agencies).
- Workshops, webinars, or professional development courses to introduce teachers to the materials and tools
- make it accessible to broader community, workshops, webinars and professional development
- I have not made the effort to use them (but I should, they look useful), so I don't have any feedback. The link to hydroviz is broken, though.
- increased breadth and depth
- Especially for SERC stuff, improve the interfaces and UI, and package things as polished lecture/curriculum materials. And increase the volume of content! Get young faculty to package and publish their class materials this way.
- Develop avenues by which faculty can be engaged in using data services from CUAHSI (see previous comment)
- More content for undergraduate student audiences; I use SERC material a lot
- I still need to spend more time on this before I can comment.

Q. What's the best way for CUAHSI to improve our data-driven education related events? (Note: The responses below are exact quotes from all the participants who answered this question).

- I would love to participate in a cyberseminar or virtual workshop. I hadn't realized that these were offered. It might be helpful to have a separate listserv for CUAHSI educational material announcements.
- Separate listserv for educational purposes
- Get the word out, there is quality material, need to drive people to it
- Bring it front and center at the Biannual and wherever you set up a booth. Make it a #1 or at least co-equal top priority for advertising and visibility.
- Just having more of them - maybe outreach to other meetings, involvement in AGU technical committees,...not sure but there still needs to be wider familiarity

Please provide any additional comments here... (Note: The responses below are exact quotes from all the participants who answered this question).

- This survey brought my attention to some resources I hadn't realized existed! Thank you for supporting so many wonderful educational initiatives.
- I am not helpful since I have not tried any of these activities. I would like to use them in the future, though, after taking a look at them.
- I just learned about some of the details behind the educational materials while going through this survey. I will definitely be looking over some of the materials before I teach watershed hydrology again next fall.
- Again, I am just getting started with these tools. They look highly useful. I will work to integrate them into my graduate Hydrology course this spring.

RECOMMENDATIONS

Based on the committee members' personal observations and the survey results, the committee recommends the following strategic and tactical goals for CUAHSI for the next 3-5 years:

1. Improve visibility of the community contributions in data driven education through CUAHSI's website and other avenues.
 - a. Highlight data-driven education content by (1) posting success stories on the CUAHSI website, (2) including data-driven education related resource/activity in the newsletter, and (3) posting information and/or videos of how CUAHSI's data tools are well suited for data driven education.

- b. Work with faculty to disseminate data-driven education efforts at AGU and other meetings by convening oral and/or poster sessions.
 - c. Perform annual or bi-annual survey of member institutions to assess the impact of CUAHSI's data driven education efforts
 - d. Access to water is one of the grand challenges, and organizations such as National Academy of Engineering (NAE) and United Nations are encouraging students to undertake research on grand challenges. Explore partnership with NAE to advertise data driven water education and research.
2. Develop, maintain, and promote easy-to-use infrastructure and other resources for the community to use data in their hydrology instruction.
 - a. Work with faculty to create curated datasets that demonstrate specific hydrologic science concepts/events/phenomena.
 - b. Develop and/or promote easy-to-use "quick tools" that can interact with CUAHSI's data services to compute simple statistics (e.g., mean, variance, etc), perform time series analysis, and plot data.
 - c. Develop and promote the Education Module Resource type for HydroShare. Advocate the use of data served via the CUAHSI portal, or other common data sources for this resource.
 - d. Partner with and promote the efforts of members who are engineering and maintaining next-generation cyberinfrastructures and programs that further hydrology instruction.
3. Develop and maintain programs to provide training and recognition to faculty for developing and disseminating data-driven education content.
 - a. Create videos or offer workshops to demonstrate the use of CUAHSI' data services and other data driven educational products for hydrology instruction
 - b. Incentivize faculty for contributing to data driven education by (1) giving awards, (2) publication credit, or (3) subsidizing participation at CUAHSI events.
 - c. Incentivize faculty for utilizing existing educational modules or tools by featuring their name and/or work in success stories, workshops, newsletter and CUAHSI reports.
 - d. Track usage of data driven educational resources to assess and show the impact of contributing faculty.
 - e. Host a webinar series on odd years to highlight ongoing data driven education efforts in the community.
 - f. Host a data-driven education workshop at the Biennial on even years; provide support to students and faculty to develop and share curriculum materials as part of this workshop. Target graduate students and early career faculty.