



# CUAHSI

universities allied for water research

# Annual Report 2011

Consortium of Universities for the Advancement of Hydrologic Science, Inc.

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# Table of Contents

CUAHSI Mission.....	3
CUAHSI Vision .....	3
Statement from the President.....	4
1. Introduction.....	5
2. CUAHSI’s Strategic Plan.....	6
3. Community Outreach and Governance .....	6
4. CUAHSI HIS and Informatics Services .....	8
5. Instrumentation Services .....	12
6. Education and Outreach .....	16
7. Service Development .....	19
8. Financial Overview .....	21
9. The Consortium .....	24
10. CUAHSI Governance.....	25
11. CUAHSI Staff.....	27

# CUAHSI Mission

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CUAHSI enables the water science community to advance understanding of the central role of water to life, Earth, and society. CUAHSI focuses on water from bedrock to atmosphere, and from summit to sea.

CUAHSI will support the community to advance water science and to improve societal well-being by:

- developing, supporting, and operating research infrastructure
- improving access to data, information and models
- articulating priorities for community level water-related research and observations
- facilitating interactions among the diverse water research community
- promoting interdisciplinary education centered in water science
- translating scientific advancements into effective tools for water management and policy.

# CUAHSI Vision

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We envision a diverse and dynamic scientific community, enabled by shared infrastructure, that is developing an integrative understanding of interactions among water, earth, ecosystems, and society and the science necessary to achieve the sustainable management of water.

# Statement from the President

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Dear Colleagues,

I am pleased to transmit to you this Annual Report of CUAHSI's activities during 2011. Much progress has been made, but much work remains to be done. As you can appreciate in this time of tight federal budgets, planning new activities is particularly challenging. Nonetheless, we have to continue to develop consensus on community priorities for infrastructure investment even though future funding is uncertain, because funding opportunities come and go quickly.

A good example of this is the EarthCube initiative announced by NSF in August. Because of the work that has been done on data services by the CUAHSI HIS project led by David Maidment (University of Texas) and the Community Hydrologic Modeling Platform (CHyMP) workshops led by Jay Famiglietti (University of California, Irvine), Larry Murdoch (Clemson University), and Venkat Lakshmi (University of South Carolina), we were in a position to have multiple representatives at the recent charrette with a clear vision for the kinds of investments that will benefit the water science community.

At the tenth anniversary of the incorporation of CUAHSI, it is also an opportune time to review some history and re-visit the rationale for CUAHSI's existence. The premise for CUAHSI's existence is that water science cannot achieve its potential without substantial investment in community infrastructure. Hydrologic science—and earth-surface processes in general—have had much lower infrastructure investment than other areas of geosciences. In part, that difference arose because our community could conduct science 'in our backyard' unlike oceanography or seismology which required community infrastructure much earlier in its development. To attract support from NSF, however, the community must achieve a consensus on what infrastructure investments are needed as well by making a strong scientific justification. The initiation of the Critical Zone Observatory (CZO) program is an example of the result of persistent community insistence on increased investment. It is likely that future NSF funding will be dedicated to growing and developing the CZO program, and our community has the opportunity to influence how this development occurs. How do you think new funding for CZOs should be allocated? Should new sites be instituted at the same support level or should existing sites be supported to make them a more effective community resource (for example, by collecting common data across sites or by improving support for outside scientists to conduct research at CZOs). CUAHSI can provide a forum for the community to debate such issues and to advise NSF of our opinion. This annual report includes the progress that we have made in the areas that the community has identified as its top priorities. We continue to seek opportunities to advance this agenda with NSF and other funding agencies.

As always, we need your engagement in CUAHSI to truly speak for the community. Your ideas are needed and your enthusiastic support is absolutely required to make progress. Please feel free to contact me at any time to discuss your ideas and concerns.

With warm regards,



Rick Hooper, President

# 1. Introduction

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As an NSF-funded consortium, CUAHSI supports the university water research community. The premise behind CUAHSI is that advancing water science requires new tools and approaches, multi-scale investigations, and interdisciplinary cooperation that can best be realized through a community approach. CUAHSI supports and enhances investigator-led research in many ways – from forging collaborations between the university community and federal agencies, to organizing community initiatives around cutting-edge science questions, to advocating for, piloting and operating support services and infrastructure that facilitate academic research.

Over the past few years, a major priority has been to develop and maintain search services for diverse sources of water data through the Hydrologic Information System (HIS), a web-based system for publishing, discovering and accessing hydrologic data. This year, a number of activities supported further maturation of this system. These included building and supporting a user community through user groups and web resources, and initiating the planning for a CUAHSI Hydrologic Data Facility, which will provide data-archiving services for university researchers as well as the search services.

This year also saw the completion of the Community Hydrologic Modeling Platform (CHyMP) design workshops, and the development of more coordinated instrumentation activities with the U.S. Geological Survey, including an instrumentation development workshop on optical water quality sensor networks, and new opportunities for CUAHSI members to access USGS equipment and laboratory services.

CUAHSI also continues to expand education and outreach services that help train and support the next generation of water scientists and communicate key results from academic water science research to the public. These include web resources on educational approaches for professors, our research cyberseminar series that disseminate cutting-edge research talks to the community, and graduate student services such as Pathfinder fellowships to support research and information on water science graduate programs.

CUAHSI has also sought to connect the USGS Powell Center, which hosts synthesis working groups, with the National Science Foundation. The USGS and NSF recently concluded a Memorandum of Understanding and a funding mechanism for academic researchers to propose synthesis working groups that can be hosted at the Powell Center. A pilot project for 2012 and 2013 is underway; NSF will be looking closely at the number of proposals received by the Powell Center to assess demand for synthesis working groups, which have long been sought by the CUAHSI community.

CUAHSI has instituted new mechanisms for expanding and deepening member and earth science community engagement with the Consortium, including issuing formal solicitations for input on new initiatives and instrumentation workshops, and expanding representatives from one to three per

university member. CUAHSI encourages community members to serve on its standing committees, and will continue to explore new methods for documenting and soliciting community input on our activities.

## 2. CUAHSI's Strategic Plan

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In 2010, CUAHSI undertook an important community strategic planning process that went about answering some fundamental questions about the Consortium –

*Who are we as a consortium?*

*Whom do we serve?*

*What do we do?*

*How do we do it?*

This process was achieved by actively engaging the CUAHSI Board of Directors, membership, and the broader water science community and resulted in the adoption of the Strategic Plan by the CUAHSI Board of Directors. This strategic plan guides CUAHSI activities and communicates CUAHSI's goals and strategies with funding agencies and the larger scientific community. The strategic plan is available to the community on the CUAHSI website ([doi:10.4211/stratplan.201012](https://doi.org/10.4211/stratplan.201012)).

## 3. Community Outreach and Governance

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A main function of a community consortium is to foster communication and develop community priorities. CUAHSI is in a unique position to integrate and serve its core constituency of academic scientists and engineers in water science through building community, diversifying and engaging the membership.

Community Outreach programs include a website and a monthly newsletter that help keep the university community informed of what's happening at CUAHSI and in water science. Additionally, a central role of the Consortium is to assess, represent and communicate the needs of the water science research community.

### **Participation in Community Initiatives**

CUAHSI is in a unique position not only to integrate the academic water science community, but also to promote interactions with other scientific disciplines, government agencies, and policy makers. By participating in or sponsoring community members' participation in meetings and workshops, CUAHSI ensures that the water science research community's needs and perspectives are well represented in various initiatives, and that CUAHSI is well positioned to help respond to those needs. This year

CUAHSI participated in meetings organized by groups such as the Critical Zone Observatories (CZO), the Long Term Ecological Research (LTER) Network, and the Global Energy and Water Cycle Experiment (GEWEX) program. CUAHSI has also played an active role informing, organizing and supporting the water science community's participation in NSF's EarthCube initiative ([earthcube.ning.com](http://earthcube.ning.com)) to integrate data and information for knowledge management across the geosciences.

### **The CUAHSI 2012 Biennial**

Since 2008, CUAHSI has held Biennial Colloquia to explore cutting-edge issues in hydrologic science, biogeochemistry, and environmental engineering that can benefit from the community planning that CUAHSI enables. This year, planning began for the 2012 Colloquium, "Fusing Science and Solutions," which seeks to foster dialogue on how to bridge gaps between research and practice, and how to best use environmental observatories in this effort. The previous Biennial (2010) had 150 attendees, the majority of whom (93% in post-meeting surveys) appreciated the mixed format of plenary talks, sessions, and workshops. The Biennial is a unique opportunity for the water science community to come together in a small, focused setting, and CUAHSI is again planning events such as a graduate student program, software and instrumentation workshops, and sessions on topical events and new hydrologic initiatives, that were well-received in previous years.

### **CUAHSI Website**

CUAHSI maintains a website as the primary source of information about the Consortium, and about important water science community news and activities. The CUAHSI website receives over 30,000 hits each month, and visitors find up-to-date information about CUAHSI services, meetings, and other items of community interest. The website evolves with community input and need. For example, new material added to the site this year includes guidance on writing a data management plan, in response to a new requirement instituted for NSF proposals, current tutorials, downloads, and updates on CUAHSI Hydrologic Information System (HIS) and HydroDesktop software, and resources for students on graduate programs in water science.

### **CUAHSI eNew Brief Newsletter**

The CUAHSI eNews Brief is a monthly newsletter with a distribution of 950 that highlights items of interest to the water science community and the Consortium's services and resources. As a companion to the website, the eNews Brief informs the water science community about new research initiatives, highlights upcoming events and workshops, and news from CUAHSI. A newsletter archive is also maintained on the CUAHSI website.

### **Community Engagement in Governance**

This year, CUAHSI has worked to sustain the community-building and engagement that made the strategic planning process so successful. The CUAHSI membership represents a broad cross-section of the water science community and, in 2010, approved amendments to the CUAHSI Bylaws that expanded

each Member University's voting representation from one to three. Members may appoint whomever they wish as representatives, but the goal is to engage a broader cross-section of the community to actively participate in the governance of the Consortium. Ideally, expanded member representatives will better represent various career stages, disciplines and other underrepresented groups in CUAHSI governance. In 2011, CUAHSI welcomed 81 newly-appointed representatives from academic disciplines as diverse as traditional hydrology and engineering, to geology and geography, to geoscience and earth and environmental science.

CUAHSI also has several other mechanisms for member representatives and the broader community to participate in and guide the direction of the Consortium. CUAHSI supports six standing committees (Education and Outreach, Informatics, Instrumentation, Observational Strategies, Research Applications, and Synthesis) that advise the Board on their respective areas of expertise. CUAHSI has improved the compositional diversity of the standing committees by appointing early career and newly tenured faculty. CUAHSI solicited two-page prospectuses from the water science community defining potential projects or activities viewed as important and appropriate for CUAHSI to pursue for community benefit. In 2011, the standing committees considered 14 prospective new activities and CUAHSI is planning several new pilot initiatives based on the results of this process.

## 4. CUAHSI HIS and Informatics Services

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A major strategic objective for CUAHSI is to develop and deliver services that enhance and enable investigator-led water science research. Under the domain of Informatics, CUAHSI supports information science and technology activities and initiatives that lead to the development of operational services for the community. Most of this work has been centered on developing services relating to accessing, using and managing hydrologic research data.

The most mature of these services is the Hydrologic Information System (HIS), an Internet-based system for sharing hydrologic data. The HIS has been developed under an NSF Geoinformatics grant led by Dr. David Maidment of the University of Texas and involving investigators at several universities (Table 1), in direct response to community needs for the development of a modern information system to improve access to data and to enable better integration of data. The HIS has been built on three components (Figure 1): HydroServer, which enables data publishers to organize and store their research data and make it available to others by registering it with HIS Central; HIS Central, a central catalog which contains copies of metadata of the data services registered to facilitate searches across the HIS system; and clients, such as HydroDesktop, which enables users to search for, retrieve, organize and analyze data from the system. CUAHSI's role in the current HIS project is to articulate the needs of the university community, and provide support to the HIS research and development team. This year is the final year of the current

development grant, and CUAHSI has initiated several steps to ensure a stable and successful transition of the HIS to an operational service maintained by CUAHSI.

Table 1: The Multi-university HIS Project Team

<b>University of Texas at Austin</b>	David Maidment, Tim Whiteaker, Eric Hersh, James Seppi, Jingqi Dong, Fernando Salas, Harish Sangireddy
<b>San Diego Supercomputer Center</b>	Ilya Zaslevsky, David Valentine, Tom Whitenack, Matt Rodriguez
<b>Utah State University</b>	David Tarboton, Jeff Horsburgh, Kim Schreuders, Stephanie Reader, Edward Wai Tsui, Ravichand Vegiraju, Ketan Patul
<b>Idaho State University</b>	Dan Ames, Ted Dunsford, Jiri Kadlec, Yang Cao, Dinesh Grover
<b>University of South Carolina</b>	Jon Goodall, Anthony Castronova

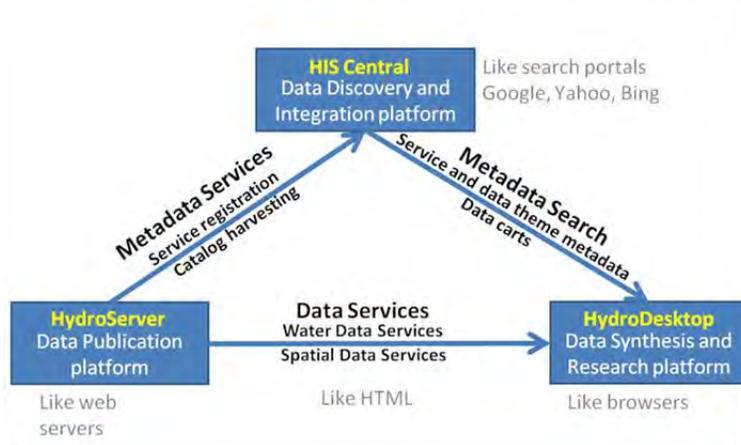


Figure 1: The HIS Service Oriented Architecture

## Building and Supporting the HIS User Community

While the HIS development team continues to advance hydroinformatics and make improvements to the system, one key dimension of CUAHSI’s role in the project is to ensure the system meets user requirements. This includes ensuring stability and documentation for new releases, coordinating user feedback and bug reporting, and fostering communication between users and developers on functionality and user requirements. CUAHSI employs a full time user support specialist, Yoori Choi, to perform standardized testing and documentation of approved releases and coordinate user activities. This year, new activities include establishing an online Users Forum (<http://groups.google.com/group/cuahsi-wds-user-group-forum>), a Google group currently comprising 127 members. Ms. Choi moderates the group, where users and developers can post on any aspect related to HIS – specific questions or bugs, use cases, discussion on future developments, etc. CUAHSI supports an HIS Users Committee to provide feedback and recommendations on current functionality and suggest future developments to the development

team. CUAHSI also maintains online help resources and, this fall, held a series of six webinar tutorials featuring HIS developers covering a broad range of topics focusing on HydroDesktop and key plug-ins (HydroR, Metadata Fetcher, and HydroModeler).

### Providing Data Publishing Support for Water Science Researchers

With the institution of NSF’s data management plan (DMP) requirement for proposals on January 18, 2011, CUAHSI has taken an active role in providing information and support for the water science community to help them meet this requirement. CUAHSI developed guidance on creating a DMP for hydrologic data, which is available on the CUAHSI website. The HIS system is one way in which projects can meet the DMP requirements that NSF-funded research data are published and discoverable. CUAHSI User Support works with data providers to help them utilize HIS and provides options for hosting and publishing their data. These services are available to the entire university community on a non-competitive basis. This past year CUAHSI wrote letters of support for several investigators who included HIS services in their research proposals and data management plans. CUAHSI continues to encourage the water science community to take advantage of these services, and often sends out community announcements when new, important research solicitations are announced by funding agencies.

In addition to providing software support for HydroServer and projects that want to maintain their data on-site, CUAHSI maintains a HydroServer to host and publish academic research data. Currently, the CUAHSI HydroServer maintains four water data services, is working with additional groups to publish their data (Table 2), and is actively soliciting new requests from researchers who would like to utilize these hosting services.

Table 2: Water Data Services Maintained on CUAHSI Servers

University/Organization	Project	Status
Northeastern University	Muddy River Water Quality Monitoring Project	Completed
University of North Dakota	Glacial Ridge Project	Completed
Massachusetts Water Resources Research Center	WRRC Acid Rain Monitoring Project	Completed
North Carolina State University	La Selva Hydrologic Data Project	Completed
Ipswich River Watershed Association	IRWA’s active volunteer monitoring program	In progress
University of Potsdam	BIOPORE hydrologic project	In progress
University of Washington	Yosemite Hydroclimate Monitoring Project	In progress

CUAHSI also actively engages the community in exploring new extensions and applications of HIS components and technology. As an example of this, CUAHSI will be a partner on two of the Research Coordination Network (RCN) projects recently announced by NSF as the first grants under its Science, Engineering, and Education for Sustainability (SEES) effort. In the Marcellus Shale Research Network,

under the direction of Sue Brantley (Penn State), HIS will be used to help volunteering water quality monitoring networks share data, while in A Global Water Diplomacy Network (directed by Shafiq Islam, Tufts University), HIS will be deployed to facilitate international partnerships and data sharing with participants from Latin America, the Middle East, Asia, and Africa.

## **Representing the University Community in Geoinformatics Initiatives**

In March of this year, CUAHSI entered into a Memorandum of Understanding with the Open Geospatial Consortium, Inc. (OGC) to study the use of OGC standards and services to support publishing, cataloguing, discovering and accessing water data, the key elements of the HIS. The OGC is a not-for-profit organization founded in 1994, and composed of industry, government and academic members dedicated to advancing interoperability among IT systems that process geo-referenced information. The purpose of the study was to provide the basis for adapting the current HIS system to OGC standards and services to extend the current HIS in a way that makes it more interoperable with a wider variety of hydrologic data and publishers, and to provide recommendations and guidelines to universities and research organizations that collect water data and need to make the data broadly available. The study was completed in July 2011 and resulted in an OGC Public Engineering Report, document 11-013r6 ([http://portal.opengeospatial.org/files/?artifact\\_id=44834](http://portal.opengeospatial.org/files/?artifact_id=44834)). CUAHSI continues to actively participate in the OGC standardization process for hydrologic data.

## **Planning for the Future**

The current HIS project will be ending in January 2012. This represents the completion of the fundamental research phase that has produced the current HIS open-source suite of software tools and services. CUAHSI has contracted with Dr. Alva Couch (Tufts University) to produce an implementation plan that outlines the necessary steps to support HIS for regular “production” use by researchers in hydrology and related disciplines. CUAHSI is planning to propose a CUAHSI Hydrologic Data Facility (HDF) to NSF’s Instrumentation and Facilities program. The facility's mission will be to advance the state of the art in research in hydrology and related disciplines, by empowering academic use of hydrological information sources, and promoting sharing of both hydrological data and software among the diverse research communities that utilize hydrological data. The HDF would maintain the necessary server and client software, host and maintain the metadata catalog, maintain a community-based ontology, and establish agreements with data providers, including agencies and academic institutions. Another envisioned key function of the HDF is to serve as a long-term archive for water data produced by university research projects.

CUAHSI will work to continue and expand the collaboration the HIS team has begun with the federal agencies that has facilitated user access to various agency data through the HIS. CUAHSI’s highest priority is that HIS and its interaction with other water information systems provides research-grade functionality for the academic community. CUAHSI will continue to assist members of the

hydroinformatics research community in pursuing and implementing technology solutions and standards to the HIS that maintain and improve consolidated access to and effective discovery of water data.

### Community Hydrologic Modeling Platform (CHyMP)

CUAHSI undertook a second informatics initiative around hydrologic modeling in 2008. The rationale was a clear need to improve the efficiency of the development of hydrological models, and the use of models to advance understanding. Improved models will lead to more reliable and more precise predictions. CUAHSI organized a series of open workshops to define the scope and requirements of a Community Hydrologic Modeling Platform (CHyMP) to develop, disseminate and support community modeling tools and simulation models. This year, a third and final workshop, A Strategic and Implementation Plan, was held March 15-17 at the Keck Center in Irvine, CA. There were 27 formal participants and 10 additional graduate students and post-docs from University of California, Irvine in attendance at the meeting. A final workshop report was submitted to NSF and is being prepared for community release.

The CHyMP workshops were successful in bringing the water science community together, fostering academic, government and private sectors collaborations, towards scoping, designing and implementing a path toward a community modeling effort (Figure 2). CUAHSI will continue to advocate for activities that support this goal.

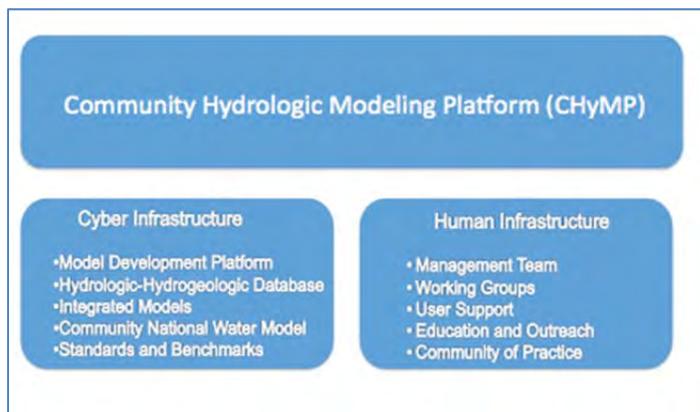


Figure 2: A framework for the major elements of CHyMP

## 5. Instrumentation Services

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Access to advanced instrumentation and the knowledge of how to use such instrumentation can lead to observations that can transform how we perceive and understand the processes that control water and its interaction with the surface earth. Instrumentation services have been identified as a fundamental area for CUAHSI to pursue since its inception. Despite the lack of an instrumentation facility, CUAHSI has

concentrated on improving access to, awareness of, and use of instrumentation by our community through filling niches and leveraging collaborations or other opportunities. One such niche that CUAHSI can fill is to promote training on the use of advanced instrumentation. A number of “hands-on workshops” have been conducted in years past and this remains a core instrumentation activity. This year, CUAHSI pursued additional collaboration with the U.S. Geological Survey on increasing member access to USGS equipment and services, and on bringing academic and agency scientists together to advance instrumentation development. The CUAHSI Virtual Hydrologic Measurement Facility (HMF) also provides distributed access to specialized instrumentation.

### The Virtual HMF Program

CUAHSI’s instrumentation services ran a pilot Hydrologic Measurement Facility program (HMF) from 2004 through 2008. While funding does not currently exist for a central instrumentation facility, CUAHSI has evolved this program into the Virtual HMF concept: a series of distributed nodes (Table 3) – proposed and managed by principal investigators and funded by traditional PI grants from NSF – that provide community access to specialized instrumentation. CUAHSI’s role is to centralize and provide access to information about these nodes to the community, and to assist node PIs with publicity, community oversight if requested, and provide other non-monetary support. CUAHSI encourages investigators submitting to NSF’s Instrumentation and Facilities program to consider joining the Virtual HMF as a way of ensuring community access and broader impacts.

Table 3: CUAHSI’s Virtual HMF Nodes

Center for Transformative Environmental Monitoring Programs (CTEMPs)	Jointly operated by Oregon State University and the University of Nevada, Reno CTEMps provides short and intermediate term project access to five field-deployable Distributed Temperature Sensing (DTS) systems.
HydroGeoPhysics Facility (HGP)	Connecting hydrologists with early career geophysicists to encourage them to write joint proposals to test the applicability of new geophysical methods to hydrologic investigations.
Mobile X-Band Radar	Four University of Iowa mobile X-band polarimetric radars are available to the community for support of hydrologic research.

### The HydroGeoPhysics Node

CUAHSI funding directly supports one node of the Virtual HMF: The HydroGeoPhysics (HGP) Facility, managed by Dr. Ty Ferré (University of Arizona). This node is supported by a three year pilot project. The HGP is different from a traditional instrumentation facility in that it is a seed-funding agent to promote improved integration of geophysics into hydrologic science. The motivation was the recognition that hydrologists can benefit from the imaging and monitoring capabilities offered by geophysics and that geophysics can benefit from the site- and process-specific context provided by close collaboration with hydrologists. The HGP program seeks to connect hydrologists with geophysicists to encourage them to test the applicability of new geophysical methods to hydrologic investigations. The first benefit of this program is the pairing of hydrologists and geophysicists to produce a small grant proposal that satisfies

both hydrologic and geophysical metrics of novelty, originality, and likelihood of success. The second benefit is the production of initial data that are intended to support applications for further funding within and beyond NSF. Particular emphasis is placed on identifying and funding early career geophysicists in an effort to form lasting research partnerships and to establish a hydrogeophysical approach to their science.

Since the HGP was initiated in fall 2010, 11 researchers and/or research groups have proposed work through the HGP. To date, CUAHSI has funded four of these requests (Table 4), and three are still under review. With the exception of the grant to Dr. Lane, which had the intention of training young scientists, all of the grantees can be considered early career. CUAHSI maintains a strong commitment to fostering improved use of geophysics in hydrology research and to introducing young scientists to innovative technologies.

Table 4: Grants Awarded from the HGP: Oct 2010 – Oct 2011

Hydrologist	Geophysicist	Topic
John Selker (Oregon State)	John Lane (USGS)	Adding Geophysics to “International Undergraduate Field Hydrology”
Erich Hester (Virginia Tech)	Kamini Singha, Adam Ward (Penn State)	Streambed preferential flow imaging
Allison Aldous (Nature Conservancy)	Xavier Comas (Florida Atlantic University)	Stratigraphic characterization of groundwater-dependent ecosystems
Steve Loheide (University of Wisconsin-Madison)	Stephen Moysey (Clemson)	Saturated/unsaturated water exchange in a restored floodplain

### Hands-on Workshops

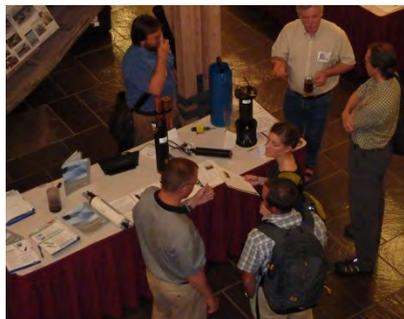
Hands-on workshops provide scientists with the opportunity to learn about new technology and its capabilities in the field. CUAHSI has offered a number of these workshops in years past, and these were often done opportunistically. This year, a new process formalized the solicitation of hands-on workshops (<http://www.cuahsi.org/hmf-hands-on.html>). As a result of this solicitation, CUAHSI is planning a 2012 Hands-on Workshop, Techniques to Quantify Stream-Groundwater Exchange and Shallow Transport, to introduce and train new users to three novel techniques that can be used to investigate stream-groundwater interactions. Participants will learn to apply all three techniques and learn related experimental design, data acquisition, data processing, and analysis issues for stream-groundwater interaction studies. The workshop organizers and instructors are Mike Gooseff and Kamini Singha (Penn State), Roy Haggerty (Oregon State), Christine Hatch (University of Massachusetts), and Adam Ward (University of Iowa), and keynote speaker Judd Harvey (USGS). Workshop information, including registration procedure and cost, will be finalized and available on the CUAHSI website in December.

## USGS CRADA and Joint Activities

In 2010, CUAHSI and the USGS executed a Cooperative Research and Development Agreement (CRADA) that aimed to increase collaboration opportunities for USGS and university scientists through joint activities.

### *Joint USGS–CUAHSI Workshop on Optical Water Quality Sensor Networks*

This year, CUAHSI funded university involvement in what is envisioned as the first in a series of joint CUAHSI-USGS workshops on instrumentation technology and development. The Joint USGS–CUAHSI Workshop on In Situ Optical Water Quality Sensor Networks was held June 8–10 in Shepherdstown, WV, to bring together academic and agency scientists and vendors that had experience with different aspects of the life cycle of sensor networks (i.e., deployment, network design, data transmission and storage, analysis and visualization) to facilitate advancements in sensor technology and assist researchers in designing and deploying these networks. The workshop, originally envisioned at 40 to 50 participants, grew to 63 final participants (Figure 3). A post-workshop survey showed that a majority of the respondents (85%) were “highly satisfied” with the workshop, and that 80% of respondents were “highly likely” or “likely” to “use some of the techniques, instruments, or ideas I learned about at this workshop in the next two years.” Follow-up activities included CUAHSI joining the Aquatic Sensors Work Group (<http://watersensors.org>) and production of a USGS Open File Report workshop summary.



Figures 3 and 4: Optical Sensor Workshop Participants included academic, agency scientists and vendors.

### *Other Services for CUAHSI Members via USGS CRADA*

USGS has agreed to provide CUAHSI members access to equipment rental from the USGS Hydrologic Instrumentation Facility (HIF), as well as offering member universities that operate laboratories the opportunity to participate in a round-robin analysis of standard reference samples. This exercise, run by the Branch of Quality Systems of the U.S. Geological Survey, sends out Standard Reference Samples to hundreds of participating labs which each analyze the samples and report their results (confidentially). The participating labs can then get a report to see how their results compared with other labs. Six different standard reference samples are available for inorganic elements and nutrients at different ionic strengths. These round-robins are run twice per year in the spring and the fall.

### *Planned Joint USGS-CUAHSI Sediment Hydroacoustics Workshop*

CUAHSI is actively planning the next joint instrumentation workshop in conjunction with USGS. A workshop on Sediment Hydroacoustics will be held March 20-22, 2012. Workshop information, including registration procedure and cost, will be finalized and available on the CUAHSI website in December.

Similar to the previous workshop, this one will convene scientists, engineers, manufacturers, and managers interested in exploring and extending an important measurement and monitoring technology. Hydroacoustic technology has applications for measuring/monitoring suspended load, bed load, bed material, and related hydrodynamic characteristics in rivers and streams. Dr. Marian Muste (University of Iowa), Dr. Peter Wilcock (Virginia Tech) and Dr. James Chambers (University of Mississippi) are the current academic members on the steering committee. The committee welcomes additional members and is enthusiastic that these technologies will be of interest and value to the hydrologic research community. As Dr. Muste states,

*“Hydroacoustics is the most promising technique for providing data and information on the hydro- and morphodynamics of streams. Sediment transport processes (suspended and bed load) are intrinsically related to local stream hydrodynamics. Acoustic measurements can acquire simultaneously water and sediment data, therefore revolutionizing the investigative capabilities.”*

The joint USGS-CUAHSI instrumentation development workshops provide a unique opportunity to bring together an effective group of people to advance instruments. University scientists typically “push the envelope” in adapting the instruments to field settings; government agencies provide a sufficiently large market to attract instrumentation manufacturers; and the manufacturers see firsthand how scientists are trying to use their products.

## 6. Education and Outreach

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Education and outreach activities focus on providing services, programs and resources that engage and prepare the next generation of water scientists to successfully confront the complexities of future water issues. These services are geared primarily toward resources for undergraduate and graduate water science education, but CUAHSI members are also involved in education at all levels, incorporating their research and encouraging broad interest in environmental science. CUAHSI education and outreach programs support graduate student research and education, through the Pathfinder Fellowship program, undergraduate education through the “Let’s Talk About Water” program, and the Cyberseminar program which produces high-quality presentations on cutting-edge research that reach undergraduate, graduate, and faculty audiences.

## The Pathfinder Fellowship Program

Through the Pathfinder Fellowship program, CUAHSI provides travel support for graduate students to make an extended field site visit to assist in enhancing their research program by moving beyond a traditional “one site, one view” approach common in hydrology. These fellowships support travel to an additional field site to conduct comparative research, to collaborate with a research group using alternate approaches or modeling methods, or to work with researchers on adding an interdisciplinary dimension to a water science research project. CUAHSI awards six grants of up to \$5000 in travel support each year. The 2010 awardees (Table 5) were announced in February 2011 and began their research this past summer. Many of the fellows have completed their research, and report having had successful and rewarding experiences. The 2011 applications were accepted until October 7, 2011, and CUAHSI anticipates announcing six new fellows in conjunction with the CUAHSI Annual Town Hall Meeting (December 6, 2011) at the American Geophysical Union Fall Meeting.

Table 5: 2010 Pathfinder Awardees

<b>Nikolaos Apsilidis</b> , Virginia Tech, Department of Civil & Environmental Engineering	Apsilidis will travel to the Waterways Experiment Station (WES) in Vicksburg, MS to collect data and perform large scale experiments to better understand the physical processes of scouring around bridge piers.
<b>Ricardo González-Pinzón</b> , Oregon State University, Department of Geosciences	Gonzalez-Pinzon will travel to Clear Run in Wilmington, NC to study patterns in nutrient and pollutant retention and respiration by stream microorganisms.
<b>Annelen Kahl</b> , University of California, Santa Barbara, Bren School of Environmental Science & Management	Kahl will travel to the Reynolds Creek experimental watershed in Idaho to broaden the understanding of how elevation, topography, and vegetation affect the patterns of mountain snow and snow water equivalent.
<b>Christa Kelleher</b> , Pennsylvania State University, Department of Civil Engineering	Kelleher will be traveling to University of Montana to collaborate with researchers at the Tenderfoot Creek watershed in Montana, to contrast with the Mahantango Creek (PA) watershed, and examine how well models represent these two different headwater catchments
<b>Avirup Sen Gupta</b> , Utah State University, Department of Civil & Environmental Engineering	Sen Gupta will travel to the Unidata Program Center at Boulder, CO to explore Unidata's approach to data modeling and data publication to benefit his research on developing cyberinfrastructure for hydrology to help manage and provide better access to data, and capability for data analysis.
<b>Hal Voepal</b> , Desert Research Institute, Reno, Hydrologic Sciences	Voepal will travel to the University of British Columbia to utilize their stream site in his work on simulating coarse particle sediment transport in gravel-bed rivers.

## Let's Talk About Water

"Let's Talk About Water" is a film symposium designed to bring together experts and the public to talk about the complex water issues facing society. The format of the event is quite simple: a panel of experts and the audience view a water documentary (such as "FLOW", "Liquid Assets", or "Gasland") together and there is an extended moderated discussion period following the film between the panel and the audience.

This format has been applied at college campuses with a target audience of lower-level undergraduates. Our past events at UC Irvine and at UMass Boston have been successful in attracting large audiences and

have been viewed positively by attendees. This year, CUAHSI continued assisting in the development of LTAW events and documenting and disseminating what we have learned from the experience.

CUAHSI assisted in organizing and moderated at two LTAW events this year. The first was held October 13, 2011 at the New York Public Library for the Performing Arts at Lincoln Center. The event was a public showing of *Gasland* that invited local high school classes, and the general public. Students from John Jay College also attended. This represented a departure from the previous LTAW events focusing on lower-level undergraduates and explored how this formula might translate to different audiences. There were approximately 60 people in attendance.

The second LTAW event was organized with Ferdi Hellweger (Northeastern University) on October 15, 2011 and began an annual rotation of events among Boston universities to form a multiversity event. Initial planning for a fall 2012 event at Tufts University has begun. The event drew close to 200 students and was well-received.



Figure 5: Panel, moderator and audience at the Northeastern University LTAW event (courtesy Ferdi Hellweger)

To expand this successful program, CUAHSI has begun an effort to document and disseminate the LTAW formula. An Eos article entitled “Using Documentaries for Earth Science Education” appeared in the October 18, 2011 issue, and a web resource with additional content is also available (<http://www.cuahsi.org/ltaw.html>).

## Cyberseminars

CUAHSI’s Cyberseminars are PowerPoint presentations shown over the web in conjunction with a conference call for narration by the presenter. CUAHSI began its Cyberseminar program in fall 2003, and has built an extensive archive of high-quality research presentations from a diverse group of scholars across the water and earth sciences communities. Live presentations are advertised via the CUAHSI website and include a question and answer session, and the recordings are then posted to the CUAHSI website and other outlets for viewing and reference.

CUAHSI’s Spring 2011 Cyberseminar series highlighted a broad range of research talks spanning hazard and resource topics. Live participation ranged from 10 to more than 40 sites during the seminars. Often,

one site will represent several participants (i.e., classes or research groups viewing the presentation together). This fall, CUAHSI initiated a year-long (fall 2011 and spring 2012) series entitled “Earth Observatories for Interdisciplinary Science: Reports from Critical Zone Observatories and Water, Sustainability and Climate Studies.”

## 7. Service Development

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In addition to its currently funded programs, CUAHSI continues to engage the community in exploring and prioritizing new services for the water science community. CUAHSI serves as a conduit between the water science community and NSF, to document and transmit community needs and consensus, and to provide methods to incubate the conceptualization and development of new initiatives and services. CUAHSI supports standing committees in alignment with core community needs (Education and Outreach, Informatics, Instrumentation, Observational Strategies, Research Applications, and Synthesis) and continues to push for investment and new opportunities for our community. For the three core areas without dedicated program funding, the input of the community is especially critical to demonstrate the need for continued investment. CUAHSI supports service development in these areas by advocating for community priorities, leveraging opportunities from other funding sources, and developing proposed initiatives based on community input.

### Observational Strategies

CUAHSI has adopted an observational strategy that keeps the grand vision of establishing networked hydrologic observatories as a long-term goal, while also pursuing observation strategies that yield community products in the near-term. CUAHSI supports a standing committee on Observational Strategies to evaluate progress toward these objectives, and to review strategies toward achieving these goals.

One near-term objective outlined in CUAHSI’s strategic plan is to improve community accessibility to existing observational networks. CUAHSI is achieving this by highlighting the Critical Zone Observatories as community resources. The 2011-2012 Cyberseminar series will focus on the experimental and research design of these important NSF investments and explicitly highlight how external researchers can conduct research or access data from these sites. Additionally, CUAHSI has proposed to NSF that CUAHSI assemble a catalog of field sites as a resource to the water science community. CUAHSI would host a catalog of experimental field sites that consists of outlines of study area (typically watersheds or aquifers) along with a limited amount of metadata, such as contact information, study affiliation, and website for further information. Some continental (or global) scale coverages, such as political outlines, watershed outlines, physiographic provinces and other polygon coverages will be available as context. This site will be driven by a map interface that would allow the user

to see all registered sites (if for North America, a point coverage of sites; if globally, a spinning globe with points like in Google Earth); however, as the user zooms into a location, a tiled map server (e.g., ESRI Hydrobase map) would display increasing detail and, ultimately, the point would be replaced with the outline of the study area. Users could download these outlines for further GIS analysis.

CUAHSI would seed the site by working with the NSF networks (LTER and CZO) to get the outline polygon coverages and with federal agencies such as USGS and USDA. The intent, however, is that the catalog will attract voluntary contributions from sites around the world. CUAHSI would create an interface to attract contributions to the site. Such a catalog could encourage cross-site comparisons and network-level analyses of data collected at such field sites. The registered sites become a greater community resource because they can be more easily discovered.

## Research Applications

Part of CUAHSI's stated mission is to advance water science and improve societal well-being by translating scientific advancements into effective tools for water management and policy. As part of its strategic planning process, CUAHSI developed a translational science approach to meet these aspects of its mission. CUAHSI supports a standing committee on Research Applications to evaluate progress toward the objectives outlined in the strategic plan and CUAHSI's engagement with the practitioner community, and to review strategies and activities achieving these goals.

In the coming year, CUAHSI is proposing to undertake a scientific national survey of water managers, regulators, practitioners, and scientists to determine the needs and opportunities for translational research in the water sciences. This survey would serve to inform our community about current gaps and funding opportunities in addressing translating academic water science research to practice. This activity arose from the community input process, and is aligned directly with CUAHSI's stated strategic objectives.

## Synthesis

Since its inception, CUAHSI has been committed to advancing water science synthesis and advocating for support of synthesis activities. Because water science cuts across a wide swath of disciplines, synthesis is essential to obtain comprehensive understanding of freshwater systems and to evaluate critical societal issues involving water. In recent years, pilot efforts funded by NSF and new synthesis centers in federal agencies, such as the USGS John Wesley Powell Center, have been important results of this process.

Thanks to the efforts of USGS and NSF, there is now an important opportunity to elevate interaction between academic and government scientists in water science synthesis. In August, USGS and NSF Division of Earth Sciences announced an agreement to co-sponsor a small number of working groups hosted at the Powell Center to work on synthesis projects. This is an important opportunity for the academic community and represents the kind of activity that will accelerate advancement in earth system science. We are hopeful that this will be the start of a larger collaboration and the beginning of sustained

synthesis efforts within the water science community. CUAHSI will continue to advocate for synthesis opportunities and will continue to support the water science community in applying for these opportunities.

## 8. Financial Overview

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The Consortium of Universities for the Advancement of Hydrologic Science, Incorporated (CUAHSI), is a 501(c)(3) nonprofit consortium of universities established in 2001 to focus on common needs of scientific hydrology and address common infrastructure needs and the overall research and education agenda. CUAHSI is incorporated in the District of Columbia. A complete copy of CUAHSI’s financial statements and auditor’s reports are available from CUAHSI by contacting [busmgr@cuahsi.org](mailto:busmgr@cuahsi.org).

### 2011 CUAHSI Budget

Core Program Budgets\*

Program	FY2010 Budget
CUAHSI Data Federation (CUAHSI HIS)	304,941
Community Outreach	132,593
Community-Wide Meetings (CUAHSI Biennial)	5,063
Instrumentation	78,682
CHyMP	56,538
Education and Outreach	63,342
Strategic Planning	76,060
Indirect Costs	428,422
<b>TOTAL</b>	<b>1, 145,641</b>

*\*Core Program Budgets are those funded by the Cooperative Agreement from NSF Earth Sciences Division Hydrologic Sciences Program.*

### Additional Funding

In 2011, CUAHSI received a grant of \$30,000 from the Johnson Family Foundation to develop pilot online educational materials that build upon CUAHSI's core Let's Talk About Water program.

In 2011, CUAHSI received a subaward of \$50,000 from the University of Texas (Austin) to execute the CUAHSI Conference on Hydrologic Data and Information Systems.

## Overview of Program Budgets

### *CUAHSI Data Federation (CUAHSI HIS)*

Funding for CUAHSI HIS is used to fund our User Support Specialist, and staff management of the HIS project, staff travel to participate in meetings and hold trainings, publication of HIS advertising and training materials, and software and hardware maintained at the CUAHSI office. This budget also includes professional services contracts and subawards to develop the implementation plan for the HIS transition. Funding is also used for staff support of the Informatics Standing Committee.

### *Community Outreach*

The Community Outreach budget funds community activities such as CUAHSI's exhibitions and events at professional meetings such as the AGU and GSA annual meetings, CUAHSI's website and newsletter, and costs associated with the CUAHSI Board of Directors.

### *Community Wide Meetings*

This program supports staff time in planning for the 2012 Biennial meeting.

### *Instrumentation*

Funding for Instrumentation is used for staff support of the Virtual HMF and the instrumentation standing committee, execution of Hands-On Workshops, and includes a subaward to the University of Arizona for the HydroGeoPhysics Facility.

### *CHyMP*

Funding for CHyMP was used to fund staff participation in the planning, execution and reporting of the Third CHyMP workshop.

### *Education and Outreach*

Funding for the Education and Outreach programs supports the Pathfinder Graduate Student fellowships, the production of the Cyberseminar series and archives, and staff participation in the Let's Talk about Water program. Funding is also used for staff support of the Education and Outreach standing committee.

### *Strategic Planning*

The Strategic Planning budget is used to fund staff time supporting activities that implement the CUAHSI strategic plan. These include aspects of governance (supporting activities of the Board of Directors), coordination and communication with NSF, managing mechanisms for community input, and supported unfunded standing committees (Research Applications, Observational Strategies, and Synthesis).

### *Indirect Costs*

Costs include corporate administration and business staff salaries; audit, human resources and legal services; office expenses at the CUAHSI Administrative office (Washington, DC) and the Program Office (Medford, MA); and insurance.

# 9. The Consortium

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## Member Universities

**AK** University of Alaska - Fairbanks  
**AL** Auburn University  
University of Alabama  
**AR** Arkansas State University  
University of Arkansas  
**AZ** Arizona State University  
Northern Arizona University  
University of Arizona  
**CA** Stanford University  
University of California – Berkeley  
University of California - Davis  
University of California - Irvine  
University of California - Los Angeles  
University of California – Merced  
University of California – Riverside  
University of California - Santa Barbara  
**CO** Colorado School of Mines  
Colorado State University  
University of Colorado  
**CT** University of Connecticut  
**DE** University of Delaware  
**FL** Florida International University  
Florida State University  
University of Central Florida  
University of Florida  
University of Miami  
University of South Florida  
**GA** Georgia Institute of Technology  
University of Georgia  
**IA** Iowa State University  
University of Iowa  
**ID** Boise State University  
Idaho State University  
University of Idaho  
**IL** Northwestern University  
Southern Illinois University  
University of Illinois  
**IN** Purdue University  
University of Notre Dame  
**KS** Kansas State University  
University of Kansas  
**KY** Murray State University  
University of Kentucky  
**LA** Louisiana State University  
**MA** Harvard University  
Massachusetts Institute of Technology  
Northeastern University  
Tufts University  
University of Massachusetts

University of Massachusetts – Boston  
Woods Hole Oceanographic Institution  
**MD** Johns Hopkins University  
University of Maryland – Baltimore County  
University of Maryland – College Park  
**MI** Michigan State University  
**MN** University of Minnesota  
**MS** University of Mississippi  
**MT** Montana State University  
University of Montana  
**NC** Duke University  
University of North Carolina – Chapel Hill  
University of North Carolina – Charlotte  
University of North Carolina – NCSU  
**ND** University of North Dakota  
**NE** University of Nebraska  
**NH** Dartmouth College  
University of New Hampshire  
**NJ** Princeton University  
Rutgers University (SUNJ)  
**NM** New Mexico State University  
New Mexico Tech  
University of New Mexico  
**NV** University of Nevada - Las Vegas  
University of Nevada - Reno  
**NY** City College New York  
Clarkson University  
Columbia University  
Cornell University  
State University of New York – Buffalo  
State University of New York – ESF  
**OH** Ohio State University  
**OK** Oklahoma State University  
University of Oklahoma  
**OR** Oregon State University  
Portland State University  
**PA** Carnegie Mellon University  
Drexel University  
Pennsylvania State University  
Temple University  
University of Pennsylvania  
University of Pittsburgh  
**RI** University of Rhode Island  
**SC** Clemson University  
University of South Carolina  
**SD** South Dakota State University  
**TN** University of Memphis

University of Tennessee  
**TX** Texas A&M University  
Texas State University - San Marcos  
University of Texas - Arlington  
University of Texas - Austin  
University of Texas - El Paso  
University of Texas - San Antonio  
**UT** Brigham Young University  
University of Utah  
Utah State University  
**VA** George Mason University  
Virginia Tech University  
**VT** University of Vermont  
**WA** University of Washington  
Washington State University  
**WI** University of Wisconsin  
**WV** West Virginia University  
**WY** University of Wyoming

## Affiliate Members

**IL** Eastern Illinois University  
**MA** Smith College  
**MD** Smithsonian Environmental Research Center  
**NC** RTI International  
**NH** Plymouth State University  
**NV** Desert Research Institute  
**OH** Cleveland State University

## International Affiliates

**Australia** CSIRO  
Queensland University of Technology  
University of Queensland  
**Canada** Dalhousie University  
University of British Columbia  
University of Calgary  
University of Quebec  
University of Waterloo  
**Denmark** University of Copenhagen  
**Italy** CIMA Research Foundation  
University of Padova  
University of Trento, Italy  
**Korea** Yonsei University  
**Slovenia** University of Ljubljana  
**Sweden** Swedish Hydrological Council  
**UK** Centre for Ecology and Hydrology

## Corporate Affiliates

Aquatic Informatics™ Inc.  
KISTERS

# 10. CUAHSI Governance

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## **Board of Directors**

### **Term expires 12/31/2011**

Larry Band, University of North Carolina - Chapel Hill  
Jay Famiglietti, University of California - Irvine  
Tissa Illangasekare, Colorado School of Mines  
Jennifer Jacobs, University of New Hampshire  
Scott Tyler, University of Nevada - Reno

### **Term expires 12/31/2012**

Robyn Hannigan, University of Massachusetts - Boston  
Carol A. Johnston, South Dakota State University  
Witold Krajewski, University of Iowa  
Larry Murdoch, Clemson University  
Aaron Packman, Northwestern University

### **Term expires 12/31/2013**

David L. Freyberg, Stanford University  
Brian McGlynn, Montana State University  
Jim McNamara, Boise State University  
Todd Rasmussen, University of Georgia  
Ying Fan Reinfelder, Rutgers University

## **Current Officers**

President: Rick Hooper, CUAHSI  
Secretary: Chris Graham, Pennsylvania State University  
Treasurer: Rina Schumer, Desert Research Institute  
Chair: Larry Murdoch, Clemson University  
Past-Chair: Larry Band, University of North Carolina - Chapel Hill  
Chair-Elect: Witold Krajewski, University of Iowa

## **Executive Committee of the Board of Directors**

**Chair:** Larry Murdoch, Clemson University  
**Chair-Elect:** Witold Krajewski, University of Iowa  
**Past-Chair:** Larry Band, University of North Carolina - Chapel Hill  
Robyn Hannigan, University of Massachusetts - Boston  
Jennifer Jacobs, University of New Hampshire

## **Standing Committees**

### **Education and Outreach Standing Committee**

**Chair:** Benjamin Ruddell, Arizona State University - Polytechnic

**Board Liaison:** David Freyberg, Stanford University

**Members:** Tony Berthelote, Salish Kootenai Tribal College; Diana Dalbotten, University of Minnesota/NCED; Mark Green, Plymouth State University; Beverley Wemple, University of Vermont

### **Informatics Standing Committee**

**Chair:** D. Scott Mackay, SUNY at Buffalo

**Board Liaison:** Carol Johnston, South Dakota State University

**Members:** Kathy Bower, Eastern Illinois University; Ibrahim Demir, University of Iowa; Ben Domenico, Unidata; Marilyn Kaminski, National Snow and Ice Data Center; Scott Peckham, CSDMS; Christina Tague, University of California, Santa Barbara; Mark Williams, University of Colorado; Peter Williams, IBM

**Agency Reps:** Kristen Gunthardt, EPA; Deborah Hayes, USFS; Katherine Lins, Steve Markstrom (Alternate) USGS; Russ Vose (primary), Glenn Rutledge (alternate), NCDC; Mark Walbridge, ARS

### **Instrumentation Standing Committee**

**Chair:** Klaus Neumann, Ball State University

**Board Liaison:** Robyn Hannigan, University of Massachusetts - Boston

**Members:** Erich Hester, Virginia Tech; Jasmeet Judge, University of Florida; Todd Scanlon, University of Virginia; Bob Poreda, University of Rochester

### **Observational Strategies Standing Committee**

**Chair:** Dave Chandler, Syracuse University

**Board Liaison:** Jim McNamara, Boise State University

**Members:** William Ball, Johns Hopkins University; Paul Brooks, University of Arizona; Wendy Graham, University of Florida; Miki Hondzo, University of Minnesota; Jan Hopmans, University of California, Davis; Henry Lin, Penn State University; Franco Montalto, Drexel University

### **Research Applications Standing Committee**

**Chair:** Allen Bradley, University of Iowa

**Board Liaison:** Todd Rasmussen, University of Georgia

**Members:** Laura Bowling, Purdue University; Kristie Franz, Iowa State University; Stu Schwartz, University of Maryland, Baltimore County; Rich Vogel, Tufts University; Ralph Wurbs, Texas A&M

### **Synthesis Standing Committee**

**Chair:** \*\*vacant\*\*

**Board Liaison:** Aaron Packman, Northwestern University

**Members:** Kevin Bishop, Swedish University of Agricultural Sciences; Beth Boyer, Penn State University; Charles Vörösmarty (Caroline Hermans, alternate), CUNY

# 11. CUAHSI Staff

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## **CUAHSI Locations**

### **Washington, DC Office**

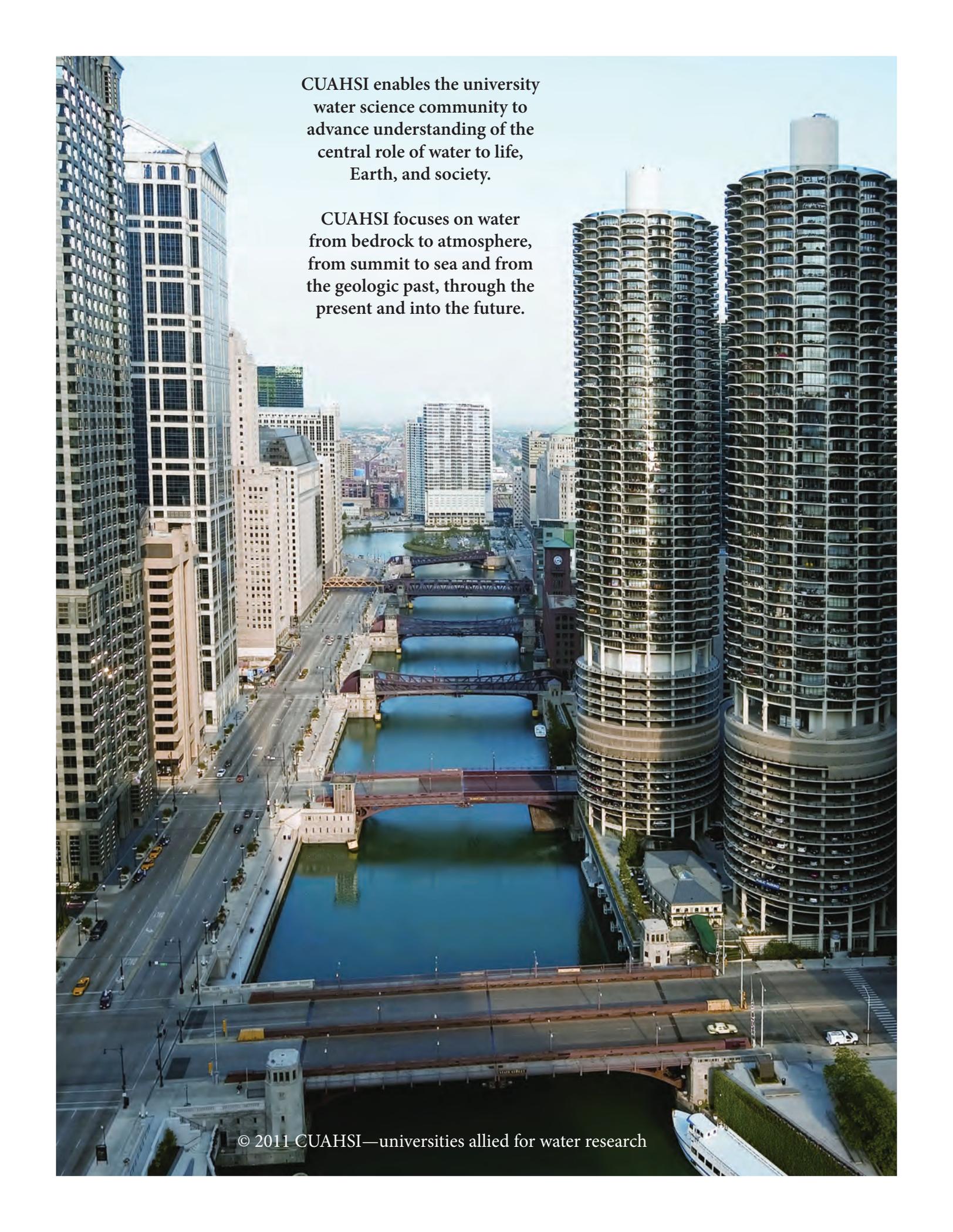
2000 Florida Avenue, N.W.  
Washington, D.C. 20009  
Phone: (202) 777-7306  
FAX: (202) 777-7308

### **Boston, MA Office**

196 Boston Avenue, Suite 2100  
Medford, MA 02155  
Phone: (339) 221-5400

## **CUAHSI Staff**

Richard Hooper, President and Executive Director  
Jessica Annadale, Controller  
Jennifer Arrigo, Program Manager  
Yoori Choi, User Support Specialist  
Lisa Gray, Accounting Assistant  
Conrad Matiuk, Communications Director

An aerial photograph of a city street, likely in Chicago, showing a river (the Chicago River) running through the center. Several bridges cross the river. On the right side, there are two prominent, curved skyscrapers with many balconies. The street is lined with various buildings, and there are cars and a bus visible. The sky is clear and blue.

CUAHSI enables the university  
water science community to  
advance understanding of the  
central role of water to life,  
Earth, and society.

CUAHSI focuses on water  
from bedrock to atmosphere,  
from summit to sea and from  
the geologic past, through the  
present and into the future.