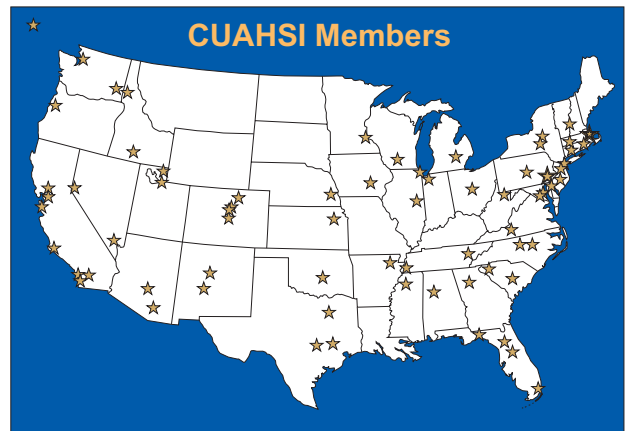


# Advancing Hydrologic Science in the 21st Century

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

## What is Hydrologic Science?

Water is a pervasive substance on, above, and beneath the surface of the Earth that both responds to and modifies its environment by dissolution and precipitation of chemicals, and by physical erosion of the landscape. Water is fundamental to life, but biological processes—such as the evaporation of water through the stomata of plants—are also important regulators of water movement. The study of this complex interaction between water and the physical and living environment is hydrologic science.



*More than 70 universities from across the United States have come together to form the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI).*



### ***Appearances can be deceiving...***

Water seems to flow simply over top of the gravel in this stream. In fact, there is extensive exchange between the visible water, the gravel bed, and the groundwater beneath and adjacent to the stream. This area, known as the "hyporheic zone," is critical in the life cycle of many organisms and for the regulation of nutrients such as nitrate.

—Photo by Michael C. Marshall, Univ. of Wyoming

Hydrologic science incorporates the study of the storage and movement of water on and below the Earth and its transfer between the atmosphere and the Earth, which traditionally has been defined as hydrology. However, hydrologic science further encompasses the interfaces with other Earth and biological sciences that are critically linked with the availability and character of water. For example, hydrologic science interfaces with oceanography in estuaries and at the land's ocean margins to explain how the mixing of fresh and saline waters impacts the environments of these locales. Other crucial interfaces of hydrologic science are ecology, limnology, biogeochemistry, and geomorphology.

## Hydrologic Extremes...

The Potomac River in the drought of 1966



to the flood of 1996.

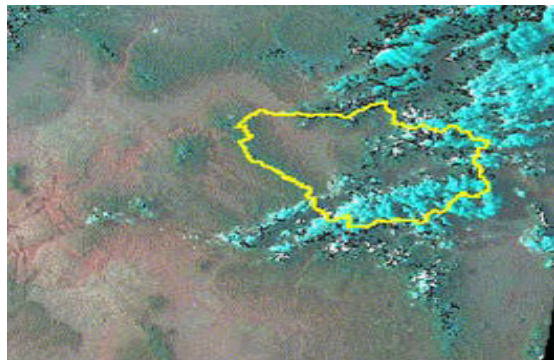


—Photos by Jim Smith, Princeton Univ.

## Why is Hydrologic Science Important to Society?

In many parts of the United States, the water resources have been developed to the extent that all the water is allocated to users. In fact, water use in some areas has exceeded the local resources so that water must be imported from other basins. The competition for water occurs not only in the arid Southwest, but also in humid areas, such as the Piedmont in the Southeastern US where a growing population requires more water for domestic use in Atlanta, GA, reducing water available for transportation in canals in Alabama and maintenance of oyster beds in Apalachicola Bay, Florida. What is the allocation of water that best permits all of these activities to proceed with minimal economic and environmental impact? How will climatic variation affect that allocation decision? Can these activities be managed for more efficient utilization of water? As development approaches the limits of the available resources, the margin of error for any decision declines. We need a better knowledge base to improve the accuracy of predictions for alternate development scenarios. An inadequate knowledge base can lead to serious over- or under-design of infrastructure, to unsustainable expectations, and to other unintended consequences.

Water not only is an essential factor for the existence of humankind and its environment, but its excesses and deficits are the causes of many of society's major disasters in the forms of floods and droughts. Economic damages and loss of life therefrom are recurring problems on a worldwide basis. Improving the knowledge base for hydrologic extremes is one of the most important reasons for the advancement of hydrologic science so that more effective and efficient approaches and schemes to mitigate their associated hazards can be implemented.



Snowfields (bright blue) as seen from satellite. (Photo courtesy of Roger Bales, Univ. of Calif. Merced)

### *A new view of the Earth*

Hydrologic science is poised at the threshold of major advances driven by new and emerging observational technologies. Advances in remote sensing, new sensors enabled by miniaturization coupled with wireless communications and global positioning systems, new geophysical techniques, and leaps in computational ability have combined to provide a comprehensive view of the landscape unimaginable just a few years ago.

# Why CUAHSI?

Exploiting the current opportunities for the advancement of hydrologic science will require large investments of time and money as well as teams of scientists from many disciplines. To accomplish this effort, the university hydrologic science community, with the aid of the US National Science Foundation, has organized a not-for-profit corporation, CUAHSI, to gain efficiencies in the pursuit of these opportunities and to leverage investments in hydrologic science from across the nation made by government agencies. CUAHSI will facilitate the design and operation of a *network of hydrologic observatories* to collect coherent, multidisciplinary data sets; a *hydrologic information system* to store, process, visualize and analyze this complex data set; a *hydrologic measurement technology facility* to bring cutting-edge technology to bear on these problems; and a *hydrologic synthesis center* to develop new theories that cut across disciplinary boundaries.

These facilities are essential to developing the hydrologic knowledge needed to:

- Mitigate the effects of flood and drought
- Understand the hydrologic, ecological and sociological consequences of regional water allocation decisions (e.g., the Apalachicola Bay problem described above)
- Understand the implications of long-term hydroecological restoration projects (e.g., the \$8 billion Everglades restoration)
- Understand the possible geographic redistribution of water resources due to climate and land-use change (e.g., deforestation of the Amazon or desertification of Africa)
- Understand the ecological and sociological consequences of the development of alternative water supplies (e.g., balancing the beneficial effects on freshwater wetlands from reduced groundwater pumping with the impact on Tampa Bay of a large desalinization plant )

## **A multi-faceted resource**

Collecting data about water requires making observations in the atmosphere, on the land surface, in the water, and under the land surface. Often, teams of scientists with widely differing training are required to pursue scientific research.

Measuring the flux of water vapor above a tree canopy.



—Photo by Jim Gosz, Univ. of NM

Determining groundwater movement using a well field.



Photo by Laura Toran, Temple Univ.

# CUAHSI Member Universities

(as of June 6, 2003)

<b>Alabama:</b>	University of Alabama	<b>Michigan:</b>	Michigan State University
<b>Alaska:</b>	University of Alaska Fairbanks	<b>Minnesota:</b>	University of Minnesota
<b>Arizona:</b>	Arizona State University University of Arizona	<b>Mississippi:</b>	University of Mississippi
<b>Arkansas:</b>	Arkansas State University	<b>Nebraska:</b>	University of Nebraska
<b>California:</b>	Stanford University University of California Berkeley University of California Davis University of California Irvine University of California Los Angeles University of California Riverside University of California Santa Barbara	<b>Nevada:</b>	University of Nevada Las Vegas University of Nevada Reno
<b>Colorado:</b>	Colorado School of Mines Colorado State University University of Colorado Boulder Univ. of Colorado Colorado Springs	<b>New Hampshire:</b>	Dartmouth College
<b>Connecticut:</b>	University of Connecticut	<b>New Jersey:</b>	Princeton University Rutgers University
<b>Delaware:</b>	University of Delaware	<b>New Mexico:</b>	New Mexico Institute of Mining and Technology University of New Mexico
<b>Florida:</b>	Florida State University University of Central Florida University of Florida University of Miami	<b>New York:</b>	Columbia University Cornell University State University of New York - ESF
<b>Georgia:</b>	Georgia Institute of Technology	<b>North Carolina:</b>	Duke University The Univ. of North Carolina System
<b>Idaho:</b>	Boise State University University of Idaho	<b>Ohio:</b>	Ohio State University
<b>Illinois:</b>	Northwestern University University of Illinois	<b>Oklahoma:</b>	University of Oklahoma
<b>Indiana:</b>	University of Notre Dame	<b>Oregon:</b>	Oregon State University
<b>Iowa:</b>	University of Iowa	<b>Pennsylvania:</b>	Drexel University Pennsylvania State University Temple University
<b>Kansas:</b>	University of Kansas	<b>Rhode Island:</b>	University of Rhode Island
<b>Maryland:</b>	Johns Hopkins University University of Maryland	<b>South Carolina:</b>	Clemson University University of South Carolina
<b>Massachusetts:</b>	Harvard University Mass. Institute of Technology Tufts University University of Massachusetts	<b>Tennessee:</b>	University of Memphis University of Tennessee Knoxville
		<b>Texas:</b>	Texas A&M University University of Texas Arlington University of Texas Austin
		<b>Utah:</b>	University of Utah Utah State University
		<b>Virginia:</b>	Virginia Institute of Technology
		<b>Washington:</b>	University of Washington Washington State University
		<b>West Virginia:</b>	West Virginia University
		<b>Wisconsin:</b>	University of Wisconsin

  
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