



FALL 2018

CUAHSI VIRTUAL UNIVERSITY
CUAHSI SPECIALIZED ONLINE HYDROLOGY MODULES

Overview

The Consortium of Universities for the Advancement of the Hydrologic Sciences Inc. (CUAHSI) has organized these inter-university courses to enhance the depth and breadth of graduate course offerings at universities across the nation, increase the rate of uptake of new research, and facilitate networking among our hydrologic community.

The format of the course is designed to give you flexibility to select the three¹ topics most relevant to you from a list of modules that are being offered by leading faculty in these specialized research niches from across the country. Each module, which is equivalent to one-third of a semester course, is designed to facilitate interaction among the instructor and students and contain some evaluation elements (problem sets, projects, presentations, exams etc.). The instructor at each student's home university will assign a grade based on the student scores and class distribution provided by the module instructor.

The course will run from September to November with each module being conducted for 4 weeks.

Instructors

Indiana University

Adam Ward | adamward@indiana.edu
Course Number: SPEA-E 710

Kent State University

Anne Jefferson | ajeffer9@kent.edu
Course Number: GEOL 60095

Michigan State University

David Hyndman | hyndman@msu.edu
Anthony Kendall | kendal30@msu.edu
Course Number: GLG 893

University of California-Santa Barbara

Naomi Tague | ctague@bren.ucsb.edu
Course Number: ESM 595NT

University of Delaware

Holly Michael | hmichael@udel.edu
Course Number: GEOL 667

University of Nevada-Reno

Scott Tyler | styler@unr.edu
Course Number: GEOL 702Z

University of Washington

Jessica Lundquist | jdlund@u.washington.edu
Course Number: CEWA 599

University of Wisconsin-Madison

Steven Loheide | loheide@wisc.edu
Course Number: CEE 619

Module Dates and Times

	Sept 4-Oct 1	Oct 1-30	Nov 1- Dec 3
M/W 3:30-5:00 p.m.	Coastal Hydrogeology and Land-Sea Water Exchange	Snow Hydrology: Focus on Modeling	Hydrologic Modeling for Hypothesis Generation and Scenario Development: Tools in R
M/W 5:00-6:30pm		Ecohydrology of Groundwater Dependent Ecosystems	Best Practices in Stream Solute Tracer Measurements and Modeling
T/Th 3:30-5:00 p.m.	Urban Watershed Hydrology and Stormwater Management	Global Change, Crop Production, and Impacts on Hydrology	Advances in Drone-based Remote Sensing for Hydrologic Applications

¹ As University of California-Santa Barbara and University of Washington are on the quarter semester system, students must select two topics from the October and November choices. For other universities, if you have an extenuating circumstance where you need to take fewer credits, you must speak with your home university instructor.

How to Register

To register for the CUAHSI Virtual University modules, students must follow these steps:

1. Register with your university during the normal registration period for the course number listed for your university (e.g. CEE 619 for University of Wisconsin-Madison).
 - a. Registration is limited to 15 students per university.
2. CUAHSI will handle student registration for individual modules across universities. Fill out [Google Form](#) to register with CUAHSI for the Virtual University.
 - a. Module sign up is also limited and will be accommodated on a first-come, first-served basis. Registration for a module will close when capacity is met. Each module is limited to 45 students.
 - b. As University of California-Santa Barbara and University of Washington are on the quarter system, students must select two topics from the October and November choices. UCSB and UW students may sign up for a third module during the September time block as an auditor. For other universities, if you have an extenuating circumstance where you need to take fewer credits, you must speak with your home university instructor.
3. Each student will be notified when a Canvas account is established for them. Canvas is the online learning management system that will be used for CUAHSI Virtual University.

Benefits to Students

- Access to national experts in specialized sub-disciplines of hydrology
- Wider selection of course offerings with greater depth than typically available at a single university
- Networking and collaboration with students and faculty nationwide
- Greater collaboration and community awareness of research activities

Goals

- Evaluate the literature, theory, and/or models associated with three distinct advanced topics within hydrology
- Network and effectively collaborate virtually with peers across the country
- Share data and resources across the hydrologic community
- Specific learning objectives will be provided in the syllabus for each module

Requirements

- Participate in on-campus organization, synthesis, and debriefing sessions held by instructor at home university.
- Register for and complete 3 modules². Each module will have an individual syllabus that outlines the expectations and requirements for that component of the course.

Academic Integrity

The Honor Code is a cornerstone of this course. It is an undertaking of the students, individually and collectively:

1. that they will not give or receive aid in examinations; that they will not give or receive unpermitted aid in class work, in the preparation of reports, or in any other work that is to be used by the instructor as the basis of grading;
2. that they will do their share and take an active part in seeing to it that others as well as themselves uphold the spirit and letter of the Honor Code.

² As University of California-Santa Barbara and University of Washington are on the quarter semester system, students must select two topics from the October and November choices. For other universities, if you have an extenuating circumstance where you need to take fewer credits, you must speak with your home university instructor.

Evaluation

Your grade³ will be based on the following:

- 10% on-campus organization, synthesis, and debriefing sessions.
- 30% Module 1
- 30% Module 2
- 30% Module 3

The evaluation criteria for each module will be outlined in the individual module syllabus. The module instructor will provide a score to each home university instructor for each student as well as the class distribution for their module.

Guidelines for Online Etiquette

The goal of these guidelines is to encourage online interaction in a positive and engaging manner. They will be posted and discussed in greater detail on the course website.

- Participate
- Report glitches
- Help others
- Be patient
- Be brief
- Use proper writing style
- Cite your sources
- Refrain from emoticons and texting lingo
- Respect diversity
- No YELLING!
- No flaming
- You can't un-ring the bell

Students with Disabilities

If you need accommodations for a physical or learning disability, please see instructor at home university.

Non-discriminating Environment

CUAHSI is committed to creating a dynamic, diverse, and welcoming learning environment for all students and has a non-discrimination policy that reflects this philosophy. Disrespectful behavior or comments addressed toward any group or individual, regardless of race/ethnicity, sexuality, gender, religion, ability, or any other difference is deemed unacceptable in this class, and will be addressed by the professor.

³ Your grade will be based on the number of modules you take. This grading scheme is based on 3-credits for 3 modules.

Module Descriptions

Advances in Drone-based Remote Sensing for Hydrologic Applications

Scott Tyler, University of Nevada-Reno

This module focuses on the integration of remote sensing data into groundwater/surface water exchange, specifically addressing recent advances in unmanned aircraft systems (UAS), or drones, to obtain high resolution, repeat imagery. We will begin the course with an overview of remote sensing capabilities and their integration in UAS platforms. We will then explore topographic analysis from photogrammetry and the development of high-resolution Digital Elevation Models (DEMs) to compliment in-stream and groundwater measurements. The module will next focus on infrared sensing, both near-IR for vegetation density and stress, as well as repeated thermal IR for both stream and land surface temperature. Students will have access to photogrammetry and other remote sensing software as well as a suite of data sets.

At the outset of class, students should download a 30-day free trial version of Agisoft PhotoScan at: <http://www.agisoft.com/downloads/request-trial/>

Prerequisites: Undergraduate course in geology.

Best Practices in Stream Solute Tracer Measurements and Modeling

Adam Ward, Indiana University

Stream solute tracers are a common research technique to assess transport and transformation in the environment. Still, execution of a well-conceived field experiment and responsible interpretation of the data remain challenging. This module will cover:

1. design and execution of stream solute experiments, including common pitfalls and challenges;
2. interpretation of recovered field data using time series analyses, water and solute mass balances, ranked Storage Selection interpretation, separation of mass involved in advection-dispersion vs. transient storage mechanisms, and breakthrough curve extension;
3. forward and inverse modeling approaches using the Transient Storage Model, including Monte Carlo extensions to assess parameter identifiability and sensitivity.

Upon completion of the module, participants will be able to successfully conduct a field tracer study and interpret the recovered solute tracer timeseries using state-of-the-science techniques and approaches. The instructor will make field equipment freely available for participants to conduct experiments at their own field sites as needed.

Prerequisites: Comfort working with data in Matlab (several toolboxes and models will be provided to the participants).

Ecohydrology of Groundwater Dependent Ecosystems

Steven Loheide, University of Wisconsin Madison

Ecohydrologic research investigates the effects of hydrological processes on the distribution, structure, and function of ecosystems, and the effects of biotic processes on elements of the water cycle. Groundwater dependent ecosystems are ecosystems that have their species composition and natural ecologic processes determined by groundwater processes. In this class, we discuss and quantify ecohydrologic processes in groundwater dependent ecosystems. We will develop techniques to exploit the signal contained within diurnal watertable fluctuations to quantify the groundwater component of ET. We will explore a variety of approaches for quantitatively describing how groundwater controls vegetation composition. We will integrate the understanding we develop about the ecohydrologic functioning of groundwater dependent ecosystems to simulate coupled hydrologic and ecologic processes for prediction of vegetation patterning.

Prerequisites: Course in hydrogeology or groundwater. Familiarity with, or willingness to learn to use basic Matlab functions with quick start tutorial from instructor.

Coastal Hydrogeology and Land-Sea Water Exchange

Holly Michael, University of Delaware

This module explores the physical processes of variable-density groundwater flow in coastal aquifers, seawater intrusion, and coastal groundwater-surface water interactions. Processes considered will span spatial and temporal scales associated with waves, tides, seasons, and glacial cycles. Advancement of understanding through theory, numerical modeling, laboratory experimentation, and field measurements will be discussed. Implications and strategies for management of seawater intrusion and excess nutrient loading to nearshore aquatic ecosystems will be addressed. Parallels to groundwater-surface water exchange in rivers and lakes as well as inland variable-density problems such as brine migration will also be considered.

Prerequisites: Course in introductory hydrogeology or groundwater hydrology.

Global Change, Crop Production, and Impacts on Hydrology

David Hyndman & Anthony Kendall, Michigan State University

This module explores the influence of crop production and global change on fluxes of water sustainability across the surface and through the subsurface. The course will span the interdisciplinary nexus of food, energy, and water in a manner that examines process based models of land surface processes, along with the data that are required to drive these models, and the types of analyses that can be performed. This course synthesizes current research on the likely impacts on hydrologic systems and water use of agricultural systems due to projected global change drivers. Latest generation climate change assessments are surveyed, along with impact studies on various domains of the hydrologic sciences. The impacts of global change on agricultural systems are detailed. Underlying models, data, and assumptions are examined and discussed. Climate data, model outputs, and downscaling are discussed from the standpoint of driving hydrologic and agronomic models.

Prerequisites: Course in hydrogeology or groundwater. Familiarity with, or willingness to learn, basic Matlab, Python, or R functions with tips from the instructor

Hydrologic Modeling for Hypothesis Generation and Scenario Development: Tools in R

Naomi Tague, University of California, Santa Barbara

Eco-hydrology is the study of interactions among climate, hydrology and ecological productivity and biogeochemical cycling. One of the main tools used in eco-hydrology is computer based simulation modeling. These models combine data and theory to understand how plants and water interact and how decisions that people make alter water resources and plant and ecosystem health. This section will provide a brief overview of hydrologic and eco-hydrologic models and their applications. We will then examine, using in class exercise, how ecohydrologic models can be used for testing hypothesis. We will examine how both existing hydrologic models and simple model developed - on the fly - can be used to quantify the implications of multiple controls on eco-hydrologic processes. The course will cover both designing a new model and selecting, calibrating and evaluating existing models. This is a skills based course and we will use R (a data analysis and programming environment

Prerequisites: Familiarity with R, undergraduate course in hydrology (or equivalent).

Snow Hydrology: Focus on Modeling

Jessica Lundquist, University of Washington

Modeling the hydrologic regime in snow-dominated ecosystems requires an understanding of data sources (to drive the model, to update the model, and to evaluate the model's performance); of model architecture (how to set up the model, run the model and make decisions regarding model parameters and model physics); and how to optimally combine data and modeling (data assimilation and model evaluation). The course objective is to learn modeling concepts with hands-on experience, as opposed to being a tutorial on how to run a particular model. We will use a modular modeling framework that incorporates components from most snow models in use today. The class will include hands-on computer laboratory exercises using existing datasets and models. The target audience is people who will benefit from an understanding of snow modeling but who are not already well versed in modeling and data assimilation.

Prerequisites: Familiarity with basic computer programming (e.g., Matlab, R, or Python). Ability to navigate in a command line (e.g., Linux or Unix) work environment.

Urban Watershed Hydrology and Stormwater Management

Anne Jefferson, Kent State University

This module explores the science and management of water in cities and built environments. The course will cover the effects of urban development on hydrologic processes including runoff generation, streamflow, infiltration, and groundwater recharge and flow, and touch upon the consequences of these changes for water quality and ecosystem processes. Historical and contemporary approaches to managing stormwater runoff will be discussed, along with issues of scaling up solutions and barriers to implementation. Students will be exposed to current literature on urban hydrology and will gain experience working with real world datasets and simple models.

Prerequisites: Content knowledge from a course in physical or watershed hydrology is expected. Students are expected to be proficient at using Excel, R, Matlab, or another data analysis program.

Questions?

For questions on the module content, please contact your university instructor.

For general questions, please contact Elizabeth Tran at etran@cuahsi.org.