CUAHSI Virtual University

Fall 2026 Module Catalog

Overview

The Consortium of Universities for the Advancement of the Hydrologic Sciences Inc. (CUAHSI) has organized these inter-university modules to enhance the depth and breadth of graduate course offerings available to students. These modules are taught by faculty from leading research universities across the country and cover a diverse array of advanced topics in hydrologic sciences.

The format of the course is designed to give students flexibility to select up to three topics most relevant to you from a list of modules that are being offered by leading faculty from across the country. The course satisfies graduate credit requirements, but students must register through their home institution.

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

Instructors

University of Arizona
Laura Condon | lecondon@arizona.edu

University of Zurich
Jan Seibert | jan.seibert@geo.uzh.ch

University of Idaho
Meetpal Kukal | mkukal@uidaho.edu

University of Nevada, Las Vegas
Zach Perzan | zach.perzan@unlv.edu

University of Nevada, Reno
Emily Burt | eburt@unr.edu

University of Washington
Erkan Istanbulluoglu | erkani@uw.edu

University of Wisconsin – Madison
Steven Loheide | loheide@wisc.edu

Utah State University
David Tarboton | david.tarboton@usu.edu

Module Dates and Times

Module 1: September 8 through October 5

Module 2: October 7 through November 3

Module 3: November 4 through December 3

	Module 1: Sep. 8 – Oct. 5	Module 2: Oct. 7 – Nov. 3	Module 3: Nov. 4 – Dec. 3
Mon/Wed2:30–4:00 pm ET	**Applying GIS for Terrain and Watershed Analysis in Hydrology** *David Tarboton, Utah State University*	**Reactive Transport Modeling in Hydrologic Systems** *Zach Perzan, Univ. of Nevada, Las Vegas*	**Python-Based Watershed Modeling Using Landlab** *Erkan Istanbulluoglu, Univ. of Washington*

	Module 1: Sep. 8 – Oct. 5	Module 2: Oct. 7 – Nov. 3	Module 3: Nov. 4 – Dec. 3
Mon/Wed 11:00 am - 12:30 pm ET		**Hydrological Catchment Modeling Using Bucket-Type Models** *Jan Seibert, University of Zurich*	**Ecohydrology of Groundwater Dependent Ecosystems** *Steven Loheide, Univ. of Wisconsin – Madison*
Tues/Thurs2:30–4:00 pm ET	**Standardized ET Modeling for Agricultural Applications** *Meetpal Kukal, University of Idaho*	**Stable Isotopes in Hydrology** *Emily Burt, Univ. of Nevada, Reno*	**Integrated Hydrologic Modeling with ParFlow** *Laura Condon, University of Arizona*

ET: Times are given in the US Eastern Time Zone.

Registration and Credit

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. Registration is limited and will be accommodated on a first-come, first-served basis.
2. CUAHSI will handle student sign-up for individual modules across universities. Fill out the sign-up form to register with CUAHSI for the Virtual University. Module sign-up is also limited and will be accommodated on a first-come, first-served basis.
3. Students should sign up for one to three modules based on their learning needs and interests, recognizing that three modules typically equate to a full semester course.
4. The number of university credits given for each module taken will be determined by the home university instructor as credit systems vary among institutions (e.g., quarter vs. semester system).
5. 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 hydrologic sciences
- 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 distinct advanced topics within hydrologic sciences
- Network and effectively collaborate virtually with peers from multiple institutions
- 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 instructors at home university.

- Register for and complete one to three modules. Each module will have an individual syllabus that outlines the expectations and requirements for that component of the course.

Evaluation

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 criteria used to assess the score.

Students with Disabilities

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

Academic Integrity

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

- 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;
- 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.

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

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 related to an individual’s race, color, religion, sex, gender identity, sexual orientation, national origin, age, disability, or veteran status will not be tolerated.

Code of Conduct

All CUAHSI Virtual University participants are expected to adhere to the CUAHSI Code of Conduct. The full Code can be found at cuahsi.org.

Module Descriptions (in alphabetical order)

Applying Geographic Information Systems for Terrain and Watershed Analysis in Hydrology

David Tarboton, Utah State University

Module 1 (Sep. 8 – Oct. 5)

Monday/Wednesday 2:30 – 4:00 pm ET

Digital mapping of hydrology and water resources information using content from publicly available sources such as the US national map, and other climate and hydrography datasets. Hydrologic terrain analysis using digital elevation models (DEMs) and DEM-based delineation of channel networks and watersheds. Flood hydrology modeling and inundation mapping based on height above the nearest drainage derived from digital elevation models. There will be four detailed computer exercises that introduce (1) Building a watershed basemap using publicly available hydrography and watershed boundary data in the US; (2) Spatial analysis – calculation of slope, land use, and precipitation over subwatersheds; (3) Watershed delineation from digital elevation models; and (4) Basic GIS Programming using Python, using calculation of river hydraulic properties using height above the nearest drainage (HAND) as an example.

Prerequisite(s): This course will use ArcGIS Pro from ESRI. The prerequisite is basic knowledge of GIS through any prior GIS course or self-preparation through the free "Get started with ArcGIS Pro" online lesson from ESRI at https://learn.arcgis.com/en/projects/get-started-with-arcgis-pro/. Arrangements will be made for students to use ArcGIS Pro through their university site license.

Ecohydrology of Groundwater Dependent Ecosystems

Steven Loheide, University of Wisconsin – Madison

Module 3 (Nov. 4 – Dec. 3)

Tuesday/Thursday 5:00 – 6:30 pm ET

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.

Prerequisite(s): Course in hydrogeology or groundwater. Data processing experience (Matlab will be the preferred platform; R can be used but without instructor support).

Hydrological Catchment Modeling Using Bucket-Type Models

Jan Seibert, University of Zurich

Module 2 (Oct. 7 – Nov. 3)

Monday/Wednesday 11:00 am – 12:30 pm ET

Hydrological models are essential tools for decision making at the catchment scale. These models are crucial for forecasting hydrological conditions, ranging from the short-term forecasts of flooding in the coming hours or days to long-term forecasts of hydrological climate change impacts. This module will focus on bucket-type models as a representation of catchment hydrology using the HBV model as an example. After a general overview and motivation, the history of catchment models and a detailed introduction to the HBV model, we will address issues like model uncertainties, automatic model calibration, model-performance measures, multi-criteria calibration, the value of data. Furthermore, we will address the use of models to quantify land-use and climate changes and will discuss how tracer data can be included into this type of models. Hands-on modeling exercises will provide further opportunities to get familiar with typical modeling issues.

Prerequisite(s): Undergraduate course in hydrology. Ability to process data in a computing program (e.g., Matlab, Python, R)

Integrated Hydrologic Modeling with ParFlow

Laura Condon, University of Arizona

Module 3 (Nov. 4 – Dec. 3)

Tuesday/Thursday 2:30 – 4:00 pm ET

This module will introduce integrated groundwater surface water modeling at the water scale using ParFlow. We will discuss: (1) general strategies for model building, initialization and evaluation, (2) the conceptual foundations of groundwater modeling and integrated hydrologic modeling, (3) the basics of solvers and solver settings for PDE based solutions. Students will get hands on experience building and running ParFlow models at the watershed scale. We will discuss modeling workflows, explore data structures and strategies for reproducibility. We will also work with the HydroFrame platform to subset watershed models from the national ParFlow platform directly. Students who complete this module will be able to build and run ParFlow models, and will also have a general understanding for picking up other similar hydrologic modeling tools.

Prerequisite(s): - A course in hydrogeology or groundwater
- Familiarity with Python

Python-Based Watershed Modeling Using Landlab

Erkan Istanbulluoglu, University of Washington

Module 3 (Nov. 4 – Dec. 3)

Monday/Wednesday 2:30 – 4:00 pm ET

Watershed hydrologic, ecologic, and geomorphic processes respond to spatial patterns in soils, vegetation, and weather forcing. In this module you will learn how to use a modular python-based earth surface dynamics modeling library called Landlab (https://landlab.csdms.io) for coupled modeling of watershed processes. We will first review the model structure of Landlab, and its raster and network model grid classes, visualization tools and a python-based data pipeline for gathering distributed watershed and weather data from online resources for a given shape file. In each lesson, we will introduce theory and give examples from watershed eco-hydrologic and geomorphic processes and their implementations in Landlab. Examples will include surface and subsurface flow generation and routing; coupled soil moisture, evapotranspiration, and leakage dynamics; and an optional example on mapping landslide and soil erosion risk or landscape evolution. Students will have the option of working on a class project individually or in two-person groups to explore Landlab at a specific site or complete short weekly assignments.

Prerequisite(s): Course in hydrology and hydraulics; some exposure to programing in Python or MATLAB.

Reactive Transport Modeling in Hydrologic Systems

Zach Perzan, University of Nevada, Las Vegas

Module 2 (Oct. 7 – Nov. 3)

Monday/Wednesday 2:30 – 4:00 pm ET

This module introduces reactive transport as a framework for understanding the coupled physical, chemical, and biological processes that control water quality in natural environments. The course will introduce the fundamentals of solute transport, equilibrium chemistry, and reaction kinetics, with an emphasis on providing an introduction to each topic rather than covering them in detail. Assignments will consist of a series of hands-on modeling exercises with a widely used reactive transport code and will include example applications to surface water nutrient cycling, soil carbon transformations, and groundwater contaminant transport. Overall, this module is designed to provide practical modeling skills that can be applied to a wide range of research problems in hydrology.

Prerequisite(s): An undergraduate-level course in hydrogeology is recommended, but not required. For assignments, students will modify parameter values and run Python scripts, so familiarity with Python, R, Matlab, or a similar programming language may be helpful, but not required.

Stable Isotopes in Hydrology

Emily Burt, University of Nevada, Reno

Module 2 (Oct. 7 – Nov. 3)

Tuesday/Thursday 2:30 – 4:00 pm ET

Stable isotopes of oxygen and hydrogen in water molecules have been used as tools to understand movement of water through landscapes since the 1960s. This module begins with an exploration of water isotope systematics and foundations of stable isotopes in hydrology, progressing to water isotope applications such as hydrograph separations, young water fractions, and water transit time modeling. We'll cover how water isotopes have been used to study soil water transit and the origin and uptake of water in plants. Students will gain hands on experience calculating a variety of commonly used metrics in isotope hydrology using their own (or published) data, and engage in discussion about interpretation of results.

Prerequisite(s): An undergraduate course in hydrology; some coding experience will be helpful but isn't strictly required.

Standardized ET Modeling for Agricultural Applications

Meetpal Kukal, University of Idaho

Module 1 (Sep. 8 – Oct. 5)

Tuesday/Thursday 2:30 – 4:00 pm ET

This module will educate students on the standardized approaches to simulate water use in irrigated agriculture, which is usually the largest and most uncertain component of the hydrologic budgets in many ecosystems. The module will start with an overview of hydrologic budgets in agricultural fields and how they are impacted by variation in soils, environment, and management. Next, each student will select a field of interest and obtain open source datasets of soils (Web Soil Survey) and weather (Climate Engine) for their sites. They will simulate hydrologic budget components for their sites, including effective precipitation, evapotranspiration, and deep percolation under different water management regimes and stress conditions. We will use recently published OpenET data and eddy covariance data collected by the instructor to compare students' simulations of crop evapotranspiration. To maximize reach, the simulations will be carried out using both spreadsheet models as well as Python-based tools. The intent of the module is that the students understand soil-crop-atmospheric relationships and its relationships with typical management practices on an agricultural field.

Prerequisite(s): None. All physical processes will be explained with sufficient detail in class. As for coding skills, these are not required. There will be an option to use spreadsheets to model the hydrological budgets, as well as Python-based coding to achieve the same.

Questions?

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

For questions related to specifics about your institution (such as grading policies), contact the CVU instructor at your home institution.

For general questions, please contact commgr@cuahsi.org.

Generative AI was used to support the formatting of this document, and was reviewed by Julia Masterman