FALL 2020

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 three 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 and takes place in Eastern Daylight Time

Instructors

Boise State University
H.P. Marshall | hpmarshall@boisestate.edu
Course Number: GEOPH 597

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

Kent State University
Anne Jefferson | ajeffer9@kent.edu
Course Number: GEOL 60095-002

Tulane University
Ehab Meselhe | emeselhe@tulane.edu
Course Number: RCSE 6900

University of Nevada – Reno
Scott Tyler | styler@unr.edu
Course Number: GEOL 765

University of Washington
Christina Bandaragoda | cband@uw.edu
Course Number: CEWA 599 B,D

University of Washington
Erkan Istanbulluoglu | erkani@uw.edu
Course Number: CEWA 599 A,C

University of Wisconsin-Madison
Steve Loheide | loheide@wisc.edu
Course Number: CivEngr 619

Utah State University
David Tarboton | David.tarboton@usu.edu
Course Number: CEE 6930

Module Dates and Times

	Sept 2-30	Oct 2-29	Nov 4-Dec 3
M/W 3:30-5:00 p.m. EDT / 12:30-2:00 p.m. PDT	Ecohydrology of Groundwater Dependent Ecosystems	Stream Solute Tracers: What, Why & How?	Microwave Radar Remote Sensing: Theory and Applications
M/W 5:00-6:30 p.m. EDT / 2:00-3:30 p.m. PDT		Advances in Drone-based Remote Sensing for Hydrologic Applications	Digital Water: Emerging Data Science and Research Software
T/Th 3:30-5:00 p.m. EDT / 12:30-2:00 p.m. PDT	Geographic Information Systems in Water Resources	Urban and Stormwater Hydrology	
T/Th 5:00-6:30 p.m. EDT / 2:00-3:30 p.m. PDT		Introduction to Open Channel Modeling	Modeling Watershed Dynamics Using Landlab

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. SPEA-E 710 for Indiana University).
    a. Registration is limited to 15 students per university.
2. CUAHSI will handle student registration for individual modules across universities. Fill out this 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 Washington is on the quarter system, students must select two topics from the October and November choices. 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 modules. 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.

Evaluation

Your grade[1] 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[i] professor.

[1] 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 (in alphabetical order)

Advances in Drone-based Remote Sensing for Hydrologic Applications

Course Number: GEOL 765
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.

Digital Water: Emerging Data Science and Research Software

Course Number: CEWA 599 B,D
Christina Bandaragoda, University of Washington

Learn how to use digital infrastructure to publish, manage, and operate software to translate your research between science domains for research, policy development, and decision-making using observations and models. Discover data, generate and test hypotheses, and ethically cooperate on reproducible research with online platforms, modeling frameworks, and open source software for interactive science focusing on water data and translation tools.

Prerequisites: None. Additional resources will be provided for those not familiar with Python. Students new to programming should anticipate extra time for completing assignments.

Ecohydrology of Groundwater Dependent Ecosystems

Course Number: CivEngr 619
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. Data processing experience (Matlab will be the preferred platform; R can be used but without instructor support).

Geographic Information Systems in Water Resources
Course Number: CEE 6930
David Tarboton, Utah State University

Application of Geographic Information Systems (GIS) in Water Resources. Digital mapping of 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.

Prerequisites: 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 2.5 hour free Getting Started with ArcGIS Pro 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 or student licenses valid for 1 year.

Introduction to Open Channel Modeling
Course Number: RCSE 6900
Ehab Meselhe, Tulane University

This course introduces the basics of numerical modeling techniques for open channels and discusses the strengths and limitations of these techniques. This introductory modeling course will provide a general overview of the basics of numerical modeling, model development, and applications; hands-on training on model applications to streams and large rivers. This course will cover the following topics: modeling terminology; selection of the appropriate modeling tool; design of the model domain and setting up boundary conditions; sensitivity analyses; and model performance assessment (calibration, validation)

Prerequisites: Undergraduate course in hydraulics or hydrology.

Microwave Radar Remote Sensing: Theory and Applications
Course Number: GEOPH 597
Hans-Peter Marshall, Boise State University

Remote sensing can cover large spatial scales, but typically does not directly measure the earth property (e.g. soil moisture, snow, albedo, rain, temperature) that we want. Optical remote sensing has the advantage of being more intuitive, because as humans, we have a lifetime of experience interpreting reflected light at optical frequencies; however clear skies are required. Microwave radar has the advantage of penetrating clouds and observing the earth surface regardless of weather, in addition to high spatial resolution capability. The relationship between the radar observations (phase, amplitude, polarization) and the surface or atmospheric properties of interest, however, is much more complex. This course will provide an overview of microwave radar theory, along with hands-on exercises using microwave radar data from ground, airborne, and satellite platforms, for the specific case of estimating snow properties. Many of the concepts can be applied to remote sensing of other properties of interest for hydrologists.

Prerequisites: Programing experience in Matlab or R or Python, calculus-based physics, linear algebra, statistics

Modeling Watershed Dynamics Using Landlab
Course Number: CEWA599 A,C
Erkan Istanbulluoglu, University of Washington

This course will present key processes that shape watershed ecohydrologic and geomorphic response and their interactions using Landlab, a Python-based modeling toolkit for building, coupling, and exploring two-dimensional numerical models of Earth-surface dynamics (http://landlab.github.io/#/). We will first review the model structure of Landlab, and its raster and network model grid classes with examples. In each lesson, we will introduce theory and give examples of watershed hydrologic, ecologic and geomorphic processes and their implementation in Landlab. Examples will include routing of surface overland flow, mapping soil moisture, and evapotranspiration, ecohydrologic simulations of vegetation dynamics using cellular automation rules for plant competition, mapping landslide risk, and landscape evolution modeling. Model forcing of climate will be retrieved from existing gridded data sets using Landlab utilities, local weather stations, or through stochastic storm generation. Homework assignments will utilize Landlab models in examples that will require some basic code manipulation to incorporate additional process loops and data input and output.

Prerequisites: Undergrad course in hydrology/environmental sciences and some basic python skills.

Stream Solute Tracers: What, Why, & How?
Course Number: SPEA-E 710
Adam Ward, Indiana University

This module will prepare students to design and interpret solute tracer studies at their own field sites. Lecture topics include dilution gauging, experimental design, interpretation of time series data, and modeling. This course reviews key background to understand solute tracer experiments and analyses. Upon completion of the courses, students will:

(1) Have contracted their own “toolbox” to analyze and interpret solute tracer studies;
(2) Understand how to interpret state-of-the-science analyses of solute tracer data; and
(3) Know how to design a solute tracer experiment, avoiding pitfalls that may complicate interpretation of results

Prerequisites:

(1) A background in hydrology of hydraulics, such as one introductory course;
(2) Ability to work with time series of data and perform numerical integration. Past students have used Excel, Matlab, R, or Python.

Urban and Stormwater Hydrology
Course Number: GEOL 60095-002
Anne Jefferson, Kent State University

This module explores the consequences or urbanization on the hydrologic cycle, and we will evaluate the utility of impervious surface cover as the dominant paradigm for understanding the effect of urbanization on hydrologic processes. We will discuss the ways that manage stormwater approaches alter water balances and flow regimes, and we will make comparisons among various types of stormwater control measures. Historical and contemporary approaches to urban hydrology. Students will be exposed to the techniques used to evaluate urban hydrology and gain experience working with simple SWMM models.

Prerequisites: undergraduate course in hydrology, basic experience with R may be helpful but it is not required.

Questions?

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

For general questions, please contact Ainsley Brown at abrown@cuahsi.org.