



Ecohydrology and Biometeorology

GEO 371T/391

Spring 2018

COURSE SYLLABUS

Course description and objectives

Dr. Ashley M. Matheny

In this course, we will study the terrestrial biosphere and way plants and soil influence the hydrologic cycle. We will learn about water, carbon, and energy fluxes within the Earth system from a hands-on experimental approach and through exposure to land-surface and climate models.

We'll do all of this in stages, as we work through four course modules:

1 - Plant hydrodynamics:

How water is acquired, transported, used, and lost by vegetation. How energy, carbon, and water are coupled at the plant level.

2 - Canopy & boundary layer biophysics:

Theory, observation, and modeling of evapotranspiration and carbon and energy flux at the ecosystem level. How to choose the right model for your needs.

3 - Ecohydrology at the regional and global scale:

Feedbacks between vegetation and climate, population expansion, and land use and land cover change.

4- Student presentations:

Students will work independently (graduate students) or in teams (undergraduate students) on a special interest project throughout the semester and will present their work to the class during the last week of the semester.

Goals and Objectives

- 1- Develop a fundamental understanding of boundary layer processes involving the exchange of water, carbon, and energy between the land and the atmosphere.
- 2 - Generate a basic tool-box of measurement and modeling skills that help us as scientists observe and predict ecosystem function.
- 3 - Create awareness of the dynamic role vegetation plays in land-atmosphere exchange, and particularly in the hydrologic cycle.



Eddy covariance

Ed Swiatek of Campbell Scientific demonstrates an eddy covariance measurement system for observing atmospheric CO₂ and H₂O exchange at high frequencies. (Logan, UT 2016)



Boreal forests

In northern forests where permafrost is beginning to thaw, ecosystems are becoming destabilized. Once-solid soil is now turning into a wetland resulting in tree mortality. These historically forested ecosystems are shift to wetland ecosystems (*Picea mariana*, Saskatchewan, Canada, 2016).



Prerequisites:

Enthusiasm and willingness to learn are the only prerequisites for this course. We will cover a broad variety of topics spanning hydrology, Earth science, ecology, and climatology but will work together to build expertise from the ground up.

Questions:

I strongly encourage you to ask questions and speak up in class and on our Canvass Discussion Section.

Field Component:

This course has an associate field component in Dripping Springs. Several field opportunities will be available throughout the semester. Each student will be required to attend a minimum of one field visit.

Collaboration:

- Undergraduate students are expected to work together to complete their course projects. However, everyone is expected to contribute equally.
- Graduate students are expected to prepare their project reports individually, but are encouraged to discuss material

and engage with other students as they do so.

Devices:

Because class participation is mandatory, personal/social calls and messages during class are prohibited. Feel free to use devices to supplement and enhance your learning, but do so while keeping in mind that it must be course-relevant.

Texts:

There are two required texts for this course. Both of which are available for free on the course Canvass page. Supplemental readings may also be uploaded to the Canvass page.

- **Ecological Climatology: Concepts and Applications** by G. B. Bonan (2008)
- **Plant Physiological Ecology** by H. Lambers, F.S. Chapin III, and T. P. Pons (2008)



YOUR INSTRUCTOR:

Dr. Ashley M. Matheny

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↑ Email is the best way to reach me

Office hours: Tu 4pm-5pm, W 3-5 pm and by appointment

Expectations

Attendance:

- This class will involve an **active participation component**. Because a large part of your grade is participation based, **attendance is required**.
- It is your job to complete any assigned readings before class. It is okay if you don't completely understand everything in the reading – just do your best. My expectation is that you come to class ready to discuss the material, and to ask questions.

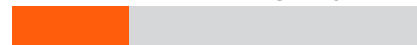


GRADES

Grades are based on:



45% semester-long project



25% classroom participation



15% field experience participation



15% final project presentation

Late work: Late work will be accepted with a penalty of -3% of the total value per day.

Absences: In the case of religious holidays and extenuating circumstances, absences will be considered on a case-by-case basis.

There will not be a final examination for this course.

Semester-long project:



5% initial project idea and abstract



10% project outline and data source



15% data analysis



15% final written report

The semester-long project will consist of several different deliverables throughout the semester to help keep you on track, and to help distribute the 45% of the final grade across smaller "bite-sized" assignments. Note that the yellow bars add up to the 45% of the final grade.

Grade	Cutoff
A	94%
A-	90%
B+	87%
B	84%
B-	80%
C+	77%
C	74%
C-	70%
D	65%
F	<65%



Innovative field measurement

Ecohydrology can require some creative field work! In the uppermost photo, students are using a “canopy access lift” to measure water content in leaves at the top levels of the forest. In the second photo, students are using a “portable canopy LIDAR” to create a map of the vertical structure of the rainforest in Panama.



Mosses!

While easily overlooked in comparison to trees and shrubs, mosses and lichen can contribute significantly to ecosystem function along with carbon, water, and energy exchange. In boreal forests, like the one pictured here, mosses help to insulate the permafrost and retain soil moisture.

Student Rights & Responsibilities

- You have a right to a learning environment that supports mental and physical wellness.
- You have a right to respect.
- You have a right to be assessed and graded fairly.
- You have a right to freedom of opinion and expression.
- You have a right to privacy and confidentiality.
- You have a right to meaningful and equal participation.
- You have a right to learn in an environment that is welcoming to all people. No student shall be isolated, excluded, or diminished in any way.

With these rights come responsibilities:

- You are responsible for taking care of yourself, managing your time, and **communicating with me if things start to feel out of control or overwhelming.**
- You are responsible for acting in a way that is worthy of respect and always respectful of others.
- Your experience with this course is directly related to the quality of the energy that you bring to it, and your energy help shape the quality of your peers’ experiences.
- You are responsible for creating an inclusive environment and for speaking up when someone is excluded.
- You are responsible for holding yourself accountable to these standards, holding each other to these standards, and holding the teaching team accountable as well.

Personal Pronoun Preference

Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender, gender variance, and nationalities. Class rosters are provided to the instructor with only the student’s

legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records.

University Policies

Academic Integrity

Each student in this course is expected to abide by the University of Texas Honor Code: **“As a student of The University of Texas at Austin, I shall abide by the core values of the University and uphold academic integrity.” Plagiarism is taken very seriously at UT and in my classroom.** Therefore, if you use words or ideas that are not your own, you must cite your sources. Otherwise you will be guilty of plagiarism and subject to academic disciplinary action, including failure of the course. You are responsible for understanding UT’s Academic Honesty and the University Honor Code which can be found here:

http://deanofstudents.utexas.edu/sjs/acint_student.php

Q Drop Policy

If you want to drop a class after the 12th class day, you’ll need to execute a Q drop before the Q-drop deadline, which typically occurs near the middle of the semester.

Under Texas law, you are only allowed six Q drops while you are in college at any public Texas institution. For more information, see:

<http://www.utexas.edu/ugs/csacc/academic/adddrop/qdrop>



University Resources for Students

Your success in this class is important to me. We will all need accommodations because we all learn differently. If there are aspects of this course that prevent you from learning or exclude you, please let me know as soon as possible. Together we'll develop strategies to meet both your needs and the requirements of the course. There are also a range of resources on campus:

Services for Students with Disabilities

This class respects and welcomes students of all backgrounds, identities, and abilities. If there are circumstances that make our learning environment and activities difficult, if you have medical information that you need to share with me, or if you need specific arrangements in case the building needs to be evacuated, please let me know. I am committed to creating an effective learning environment for all students, but I can only do so if you discuss your needs with me as early as possible. I promise to maintain the confidentiality of these discussions. If appropriate, also contact Services for Students with Disabilities, 512-471-6259 (voice) or 1-866-329-3986 (video phone). <http://ddce.utexas.edu/disability/about/>

Counseling and Mental Health Center

All of us benefit from support during times of struggle. You are not alone. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner

rather than later is often helpful.

If you, or anyone you know, experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. <http://www.cmhc.utexas.edu/individualcounseling.html>

The Sanger Learning Center

Did you know that more than one-third of UT undergraduate students use the Sanger Learning Center each year to improve their academic performance? All students are welcome to take advantage of Sanger Center's classes and workshops, private learning specialist appointments, peer academic coaching, and tutoring for more than 70 courses in 15 different subject areas. For more information, please visit <http://www.utexas.edu/ugs/slc> or call 512-471-3614 (JES A332).

- **Undergraduate Writing Center:** <http://uwc.utexas.edu/>
- **Libraries:** <http://www.lib.utexas.edu/>
- **ITS:** <http://www.utexas.edu/its/>
- **Student Emergency Services:** <http://deanofstudents.utexas.edu/emergency/>

Important Safety Information:

If you have concerns about the safety or behavior of fellow students, TAs or Professors, call BCAL (the Behavior Concerns Advice Line): 512-232-5050. Your call can be anonymous. If something doesn't feel right – it probably isn't. Trust your instincts and share your concerns.

The following recommendations regarding emergency evacuation from the Office of Campus Safety

and Security, 512-471-5767, <http://www.utexas.edu/safety/>

Occupants of buildings on The University of Texas at Austin campus are required to evacuate buildings when a fire alarm is activated. Alarm activation or announcement requires exiting and assembling outside.

- Familiarize yourself with all exit doors of each classroom and building you may occupy. Remember that the nearest exit door may not be the one you used when entering the building.
- Students requiring assistance in evacuation shall inform their instructor in writing during the first week of class.
- In the event of an evacuation, follow the instruction of faculty or class instructors. Do not re-enter a building unless given instructions by the following: Austin Fire Department, The University of Texas at Austin Police Department, or Fire Prevention Services office.
- Link to information regarding emergency evacuation routes and emergency procedures can be found at: www.utexas.edu/emergency



Course Outline

All instructions, assignments, readings, and essential information will be on the Canvas website at <https://utexas.instructure.com>. Check this site regularly and use it to ask questions about the course schedule.

This is a living document and changes may be made at my discretion if circumstances require. It is your responsibility to note these changes when announced (although I will do my best to ensure that you receive the changes with as much advanced notice as possible).

Week	Date	Class Topic	Readings	Assignments due
1	1/16	Syllabus, Course Intro		
1	1/18	Overview of biosphere exchange	Bonan Ch 1	
2	1/23	Photosynthesis and plant function	PPE Ch 2A: (at least Sections 2-4)	
2	1/25	Photosynthesis 2	Bonan Ch 9.1-9.4	
3	1/30	Plant hydraulics 1	PPE Ch 2A, section 5, PPE Ch 3	Project ideas/abstracts due
3	2/1	Group discussion of projects	Keep reading PPE Ch 3	Bring your Laptops!
4	2/6	Independent Project Work	Bring your Laptops!	
4	2/8	Guest lecture – Vadose zone processes	Keep reading PPE Ch 3	
5	2/13	Plant hydraulics 2	PPE Ch 3	
5	2/15	MATLAB Tutorial	Bring your laptop to class, have MATLAB installed!	Project outline due
6	2/19	Root hydraulics and soil properties	Bonan 6.7, PPE Ch 6	
6	2/22	Water limitation and excess	PPE Ch 2A Section 5, review Ch 3	
7	2/27	Plant-scale measurements	PPE Ch 5	
7	3/1	Diurnal and seasonal cycles	Bonan 12.2 and 2.5	
8	3/6	Micrometeorology/Biometeorology	Bonan Ch 2.1-2.3 and 2.7	

8	3/8	Surface energy balance	Bonan Ch 2.1-2.4	
9	3/13	Spring break!		
9	3/15			
10	3/20	Turbulent fluxes & Eddy covariance	Bonan Ch 7	
10	3/22	Canopy structure and light	PPE Ch 4A	
11	3/27	Sensor theory and construction	This class will be held with Geophysical Measurement Methods at our normal class time but in room JGB 3.116	
11	3/29	Models for evapotranspiration 1	Bonan Ch 7	
12	4/3	Guest Lecture: Dr. Todd Halihan	This class will be held in JBG 4.102 (Barrow Conference Room)	
12	4/5	Partitioning T and E from ET		
13	4/10	Urban and Agro-ecohydrology	Bonan Ch 14	
13	4/12	Watershed scale ecohydrology	Bonan Ch 8.4-8.6	
14	4/17	Biogeochemistry	Bonan Ch 10.4.4	
14	4/19	Disturbance and land use change	Bonan Ch 13.1-13.6	Data processing due
15	4/23	Regional and global ecohydrology	Bonan Ch 10, PPE 10.B2 and 10.B4	
15	4/26	Ecohydrology and climate	Bonan Ch 4.4-4.5	
16	5/1	Student Presentations		
16	5/3	Student Presentations		Final project due online

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