

Dryland Ecohydrology and Vegetation Dynamics

WS M / RNR / ECOL / HWRS 452/552.
Falls 2021. 4 Credits.

Locations and Times

Mondays and Wednesdays; 9:30-10:45 Mon and 9:30-11:50 Wed;
Environment and Natural Resources 2, Room S210

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Joint with Department of Ecology and Evolutionary Biology
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See COVID19.arizona.edu for updates

Course information:

Desire2Learn (D2L): D2L is a web-based course management system that allows "anytime, anywhere" access to syllabi, grading, readings, communication, etc. Steps for logging into D2L:

1. Open up an Internet browser (i.e., Internet Explorer, Firefox, Safari)
2. Go to <http://d2l.arizona.edu>
3. Click on the NetID button in the upper left corner of the screen
4. Log in using the same information you use for UA Webmail

Class Format and Teaching Methods This class will focus on a learning-centered rather than teacher-centered approach. We will explore the topics together. The Instructor will provide direction and some supplemental lectures. Each class will include periods of discussion where students are expected to contribute and strive to think synthetically. Students will be expected to frequently break into small groups and then report back to class. Students will also be expected to share writing assignments with one another in discussions.

Description of Course Climate change effects permeate dryland ecosystems and will affect management options and decisions. Dryland ecosystems are highly water limited, producing sparse vegetation cover in diverse systems that include arid and semiarid grasslands, shrublands, savannas, woodlands, and forests. Ecological and hydrological processes are tightly interrelated in these ecosystems, with vegetation affecting hydrological response, and hydrologic partitioning of the water budget altering vegetation dynamics, and climate change having direct and indirect effects on these interrelationships. This course focuses on dryland ecosystem dynamics and how they are impacted by climate change, building on perspectives linking ecology and hydrology to focus on the emerging, interdisciplinary area of ecohydrology. The course specifically examines climate change impacts as related to a more ecologically meaningful perspective of the water budget and associated dryland ecosystems ecology. The concepts and principles discussed in the class will have broad applications ranging from site-specific land management to global responses.

Required/Recommended Knowledge Students should enter the class with completion of a course in ecology or discuss with the instructor their previous exposure to environmental science.

Course Objectives

- Develop an understanding of current and projected climate change impacts as related to dryland ecosystems ecology.
- Develop an understanding of dryland water budgets, including major sources of uncertainty from ecological as well as hydrological perspectives
- Develop an understanding of how water budgets and the climate change impacts on them drives dryland ecosystems dynamics in conceptual and predictive models
- Develop an understanding of feedbacks between ecological and hydrological processes in the context of climate change
- Develop an appreciation of how applied issues of climate change relate to dryland ecosystems ecology and associated issues of land use and pollution
- Develop skills in oral and written synthesis of concepts with a focus on climate change and dryland ecosystems ecology
- Develop skills in working on research and synthesis in a team context

Undergraduate Student Expected Learning Outcomes

- Demonstrate knowledge of and ability to communicate key climate change risks and their relevance in dryland ecosystems to science, policy making and/or public groups
- Read new scientific literature and demonstrate ability to integrate that information into existing knowledge and conceptual frameworks
- Effectively synthesizing information from different sources in writing
- Demonstrate ability to avoid the dual traps of following dogma vs. paralysis from too much uncertainty
- Work effectively as part of a team to produce team summaries that are presented orally

Graduate Student Expected Learning Outcomes

In addition to the above learning outcomes for undergraduate students, graduate students will:

- Synthesize information from different sources in writing at a level that produces a draft manuscript suitable for publication with additional editing
- Develop project timelines and budget for a group proposal
- Develop a compelling problems statement and design for a proposal

Grading Scale and Policies This course will use Regular Grades (A, B, C, D, and E).

400-level Course Work – Total 100 pts

1. Homework (25 points)

There are homework assignments due for most classes. There are 19 assignments in total; the lowest grade on any one assignment will be dropped. Homework assignments are designed to prepare students for classroom discussion and must be completed and entered into D2L prior to the start of class on the due date for the given assignment. Homework assignments are one of five types:

Types of Homework Assignments Homework assignments are one of four types, specified in Dropbox (on some dates you will additionally need to submit a project proposal or a new figure or table related to your project):

Interests: Provide a brief description of your professional background and interests and of your interests and goals associated with this class. Limit your description to 300 words. Please double space your text and include your name in both the file name and the text.

Climate change concepts: Without looking up any information, list three concepts related to climate change that you think will be relevant to dryland ecosystems,

1 Liners: Provide a one-sentence summary of each of the readings assigned for the class that matches the date that that particular homework is due. Please double space your text and include your name in both the file name and the text.

Abstract: Develop a 1 paragraph synthetic abstract that relates concepts from three papers. Usually these are the three readings assigned for the class that matches the date that that particular homework is due, unless there are not three readings for class date, in which case use the readings from that date and prior readings to cover three total. Seek to create a new synthetic insight, rather than just restating the points of the papers. Length should be at least 270 words but no more than 300 words. Double space your text and make sure your name is on the paper.

Methods Application: Develop a 1 paragraph synthetic abstract that discusses an ecohydrological method of interest to you.

2. Exams (25 points)

There will be two **exams [October 4 and November 17]** and a **final exam**. All exams will be cumulative. Topics covered in class and in the assigned readings will be fair game. The format will be mixed and may include: matching, fill-in, multiple choice, short answer, and essay. Be prepared to synthesize ideas, rather than just regurgitate information. There will be no make-up exams. Only two of the exams will be used in the exams portion of grading, so any one of the three exams can be dropped. During exams, you will not be able to use notes or other sources of information. Undergraduate exams will differ from those for graduate students; for example, easiest questions will be worth more points, or essay questions will require fewer references to support points made.

The final exam will be December 14, 10:30-12:30.

See the University of Arizona's Final Exam

Regulations <https://www.registrar.arizona.edu/courses/final-examination-regulations-and-information> and Final Exam Schedule <http://www.registrar.arizona.edu/schedules/finals.htm>

3. Class Discussion (20 points for undergraduates, as opposed to 10 points and higher expectations for graduate students). Each student is expected to contribute actively to discussion regularly throughout the course, as evident in participating in small group discussion, in reporting out from small groups to the whole class, and in adding to whole class discussion with both comments and questions.

4. Research Project – Written Report (20 points)

Written reports are due **December 6 before class**. The individual research project should present new ideas that result from synthesis of an area within the realm of dryland ecohydrology and vegetation dynamics. The paper should focus specifically on relevant processes. The goal is to develop new insights rather than simply a summary of other research findings. This will be a very difficult challenge. You will need to dive into the relevant literature, summarize it for yourself, and then ponder carefully what new insights might be gained and how any such insights compare or contrast with existing paradigms in the field. You will need to reflect carefully on "What are these results collectively telling us?" and "What do we really assume about this topic currently?" You will probably be most effective at this if you describe your initial insights to others and solicit feedback. You should keep in mind that the goal extends beyond developing a specific paper for this class to developing skills in synthesizing ideas that you can apply over the rest of your educational experience and professional career. My goal is for each of you to look back on this class a decade from now and say "That is where I really learned critical skills on how to pull ideas together in new and synthetic ways."

Critical criteria for the paper include:

- Does the topic clearly include both ecological and hydrological aspects and associated feedbacks between the two areas, where appropriate?
- Does the paper strategically and effectively define a "hole" (the problem statement) that is then effectively addressed?
- Does the paper provide more than a summary of existing information?
- Does the paper effectively use tables and figures to summarize and synthesize information?

Additional factors to consider in developing an outstanding paper:

- ~~Is the title clear and compelling?~~
- ~~Does the paper start with a statement of broad interest?~~
- ~~Are the objectives of the paper clearly stated?~~
- ~~Does the paper follow the structure of the target journal? (See below.)~~
- ~~Is the paper well referenced?~~
- ~~Do ideas transition smoothly from section to section?~~
- ~~Do ideas flow well within a section?~~

Your **Project Proposal** for your research topic, **due September 20**, should include:

- ~~A title on the proposed topic (13 words or less). This is the area of interest that you plan to investigate. It does not need to, nor should it, include your new insights at this point.~~
- ~~A summary (300 words or less) describing the proposed topic. Be explicit about noting both ecological and hydrological aspects of proposed topic. Focus on processes. You may include new data, but this paper should focus primarily on pulling together previously published results in a new and compelling way.~~
- ~~List 2 references that you expect to include in the synthesis.~~

You should also pick an example journal and follow its' format. See the instructions to the authors on the web site associated with the journal. Possible journals that you might want to consider include:

- ~~*Ecohydrology*~~
- ~~*Ecology*~~
- ~~*Ecological Applications*~~
- ~~*Frontiers in Ecology and the Environment*~~
- ~~*Hydrological Processes*~~
- ~~*Water Resources Research*~~
- ~~*Oecologia*~~
- ~~*Landscape Ecology*~~

You will present your progress orally later in the semester (see below). Your colleagues and I will provide you with feedback. A draft version of your paper is due following your oral presentation after some time for revision, at which time you will receive additional feedback that will not be graded but to aide you in improving your paper. The final version of your paper counts as 20% of your grade and there will be a high standard for quality.

Other more specific guidance includes:

- ~~The paper should be 8-10 pages for undergraduate students double-spaced text, not including abstract and title page, references, tables, figure legends and figures.~~
- ~~The paper should include 3-6 tables and/or figures, at least one of which clearly presents new insights.~~
- ~~The paper should have 15+ references for undergraduate students with at least half of those coming from the primary literature.~~

5. Research Project – Oral Presentation (15 points – UPDATED from 10)

Each student will present an oral progress report on the research project in preparation for the written version of the research project (detailed above). The oral presentations will be between 8 and 10 minutes each. The rubric for presentations is: ~~Organization and effectiveness of presentation: 50%; Compelling problem statement: 25%; Effective synthesis (as evident in new tables and/or figures and associated concepts): 25%.~~ Organization and clarity of main message (6-8 minutes): 25%; Professional slides: 25%; Discuss ecohydrological processes, including both directions (Ecology ↔ Hydrology): 25%; Effective figure or table that is new and tied to the literature and related to your main message: 25%.

500-level Course Work – Total 100 pts

Graduate students enrolled in RNR 532 will be expected to meet the learning outcomes described above for 400-level students, and go beyond those expectation to demonstrate a higher level of cognitive

learning. This will be demonstrated in more in depth comments in class discussion and higher level of professionalism in written assignments. Graduate students will also develop and present a proposal. Differences from 400 level students include:

- **Exams** will be graded differently; for example easiest questions will be worth fewer points, essay questions will be expected to be developed in greater depth and supported with a specified greater number of points and supporting references.
- **Class Discussion** will count 10 points for graduates (as opposed to 20 points for undergraduates), yet will be graded based on the expectation of a higher level of insight and demonstration of integration of concepts in thinking relative to 400-level students.
- **Research Project – Oral Presentation** will be graded based on a higher level of standards for Organization and professional development, equivalent to that expected at a professional society meeting.

Group Proposal (10 points): Graduate students will work in small groups to develop a proposal in ecohydrology and with relevance to management in dryland ecosystems and that considers climate change. Each group will present the proposal orally together on November 29. Specifics include:

- 12-15 minute presentation
- Present the motivation, the objectives, the design, the timeline, the budget and the expected products.
- Topic: an aspect of ecohydrology that will enable improved water resources management in the Southwest
- Slides on budget and timeline can be more detailed than would normally be used in a talk to highlight the project has been thought out in detail.
- Budgeting:
 - \$300k for up to 3 years
 - 50% overhead: applies to everything
 - \$34k / year for a student for 0.5 FTE (this is full time support for a graduate student and includes the tuition remission)
 - \$100k / year for a Prof includes fringe
 - 1 week min of a prof
 - 1 week min of each team member
 - Travel: to site; to meetings
 - Publication costs (\$1k each)
 - Equipment
- Include a timeline

The rubric for the Graduate Proposal is as follows: Compelling problem statement: 20%; Solid approach: 20%; Match to team skills set: 10%; Budget: 15%; Timeline: 15%; Effective presentation and team effort: 20%

Summary of 400- and 500-level grading:

	452	552
Homework Assignments (19, with lowest grade dropped)	25%	25%
Exams (2 best scores from Exam 1, Exam 2, and Final)	25%	25%
Class Discussion	45%	25%
Research Project – Oral Presentation	15%	15%
Research Project – Written Report		
Group Proposal	NA	10%
TOTAL	100%	100%

All grading will be done separately for undergraduate and graduate students and portions of the exams will be different. Graduate students must complete an additional Group Proposal. Assignment of final grades is not based on any preconceived thresholds for letter grades, but roughly follows: >90% = A; 80-89% = B; 70-79% = C; 60-69% = D; <60% = E.

Assignments and Examinations: Schedule/Due Dates

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I. DRYLAND ECOSYSTEM DYNAMICS AND CLIMATE CHANGE	Assignments Due:
Class 1. Mon Aug 23: Introduction	None
Class 2. Wed Aug 25: Water Budget	Homework 1: Interests
Class 3. Mon Aug 30: Climate Change	Homework 2: 1 Liners
Class 4. Wed Sep 1: Perspectives on ecohydrology	Homework 3: 1 Liners
Class 5. Wed Sep 8: Ecosystems and plant functional types	Homework 4: 1 Liners
Class 6. Mon Sep 13: Dryland conceptual models	Homework 5: 1 Liners
Class 7. Wed Sep 15: Thresholds, feedbacks & nonlinearities	Homework 6: Abstract
Class 8. Mon Sep 20: Climate change assessments and land use	Homework 7: 1 Liners + Project Proposal
Class 9. Wed Sep 22: Fire, pest and pathogens and die-off	Homework 8: 1 Liners
Class 10. Mon Sep 27: Desertification and encroachment	Homework 9: Abstract
Class 11. Wed Sep 29: Review	None
Class 12. Mon Oct 4: EXAM I (On I)	EXAM I
II. ECOHYDROLOGICAL WATER BUDGET	
Class 13. Wed Oct 6: Precipitation and interception	Homework 10: 1 Liners
Class 14. Mon Oct 11: Infiltration, runoff and runoff	Homework 11: 1 Liners + Draft Project Fig or Table
Class 15. Wed Oct 13: Soil evaporation	Homework 12: Abstract
Class 16. Mon Oct 18: Plant water use and hydraulic redistribution	Homework 13: 1 Liners
Class 17. Wed Oct 21: Evapotranspiration partitioning	Homework 14: Abstract
Class 18. Mon Oct 25: Methods - Part I	Homework 15: Methods Application + Revised Project Fig or Table
Class 19. Wed Oct 27: Methods - Part II	Homework 16: Methods Application
Class 20. Mon Nov 1: Riparian systems, recharge and groundwater	Homework 17: 1 Liners
Class 21. Wed Nov 3: INDIVIDUAL PRESENTATIONS – 1	None – Presentation if assigned
Class 22. Mon Nov 8: INDIVIDUAL PRESENTATIONS – 2	None – Presentation if assigned
Class 23. Wed Nov 10: INDIVIDUAL PRESENTATIONS – 3 / Grad Project Introduction	None – Presentation if assigned
Class 24. Mon Nov 15: Review	
Class 25. Wed Nov 17: EXAM II (On I and II)	EXAM II
III. APPLICATIONS AND IMPLICATIONS	
Class 26. Mon Nov 22: Modeling	Homework 18: 1 Liners
Class 27. Wed Nov 24: Optional Grad Student Project WorkiSession	None
Class 28. Mon Nov 29: Grad Proposals / Biogeography and biogeochemistry	Grad Student Group Proposals
Class 29. Wed Dec 3: Wind and water erosion / Course evaluation	Homework 19: 1 Liners
Class 30. Mon Dec 6: Restoration and Action Ecology	
Class 31. Wed Dec 8: Synthesis / Paths forward for Future Application	None
FINAL EXAM (on I, II and III): Tues Dec 14, 10:30-12:30	FINAL EXAM

Absence and Class Participation Policy

The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at: <http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop>

The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable, <http://policy.arizona.edu/human-resources/religious-accommodation-policy>.

Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. See: <https://deanofstudents.arizona.edu/absences>

Participating in the course and attending lectures and other course events are vital to the learning process. As such, attendance is required at all lectures and discussion section meetings. Students who miss class due to illness or emergency are required to bring documentation from their health-care provider or other relevant, professional third parties. Failure to submit third-party documentation will result in unexcused absences.

Required texts or readings

All required readings will be available on D2L; there are no required texts.

Makeup Policy for Students Who Register Late

Students who register after the first class meeting may make up missed assignments within 1 week of registering.

Course Communications

Online communication will be conducted D2L.

Final Examination or Project

The Final draft of the paper is due Mon Dec 26 before class.

Classroom Behavior Policy

To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.).

Threatening Behavior Policy

The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See <http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students>.

Accessibility and Accommodations

At the University of Arizona we strive to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability or pregnancy, you are welcome to let me know so that we can discuss options. You are also encouraged to contact Disability Resources (520-621-3268) to explore reasonable accommodation.

If our class meets at a campus location: Please be aware that the accessible table and chairs in this room should remain available for students who find that standard classroom seating is not usable.

Code of Academic Integrity

Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort

unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See:

<https://deanofstudents.arizona.edu/policies/code-academic-integrity>

The University Libraries have some excellent tips for avoiding plagiarism, available at <http://new.library.arizona.edu/research/citing/plagiarism>.

Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor's express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA e-mail to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement.

UA Nondiscrimination and Anti-harassment Policy

The University is committed to creating and maintaining an environment free of discrimination; see <http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>

Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.

Additional Resources for Students

UA Academic policies and procedures are available at <http://catalog.arizona.edu/policies>

Student Assistance and Advocacy information is available at <http://deanofstudents.arizona.edu/student-assistance/students/student-assistance>

Confidentiality of Student Records

<http://www.registrar.arizona.edu/personal-information/family-educational-rights-and-privacy-act-1974-ferpa?topic=ferpa>

Subject to Change Statement

Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at <http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete> and <http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal> respectively.

Dispute of Grade Policy: A dispute of a grade must be made within 1 week of receipt of the grade; grade reevaluations will be with respect to an entire paper, project, or exam, rather than for a single question or aspect and can result in increases or decreases in the overall grade, depending on the outcome.