

INSTRUCTOR:	Dr. Joann Mossa, Professor
CONTACT INFORMATION:	mossa@ufl.edu , (352) 294-7510
COURSE HOURS:	T3, TH3-4 (mix of synchronous and asynchronous, see Canvas)
OFFICE HOURS:	MW 1-3 PM Through Zoom, TBA and by appointment
COURSE WEBSITE:	http://elearning.ufl.edu

REQUIRED OR RECOMMENDED TEXTBOOKS: *No textbooks required. Readings embedded in Canvas, e-learning.*

MATERIALS AND SUPPLIES FEES: *None*

PREREQUISITE KNOWLEDGE AND SKILLS: Sophomore standing, some background in earth or environmental science, geography, or sustainability recommended. Be willing to read, reflect, analyze, discuss, write, and present.

COURSE DESCRIPTION: *Examines droughts, particularly hydrologic droughts and drying rivers, and declining water resources. We examine the biophysical, socio-economic consequences when the quantity or quality of water is limited and/or decreasing through case studies in different environments (rivers, lakes, groundwater, etc.) and countries through data analysis, and projects. The goals for this course are as follows:*

COURSE GOALS AND/OR OBJECTIVES:

- Identify basic terms and concepts related to drought, water resources, and water scarcity
- Learn about national and international sources of water and climate data
- Retrieve, analyze, and synthesize data from multiple reliable sources
- Analyze flow regime, trends and spatial variations regarding droughts water scarcity
- Communicate scientific information regarding droughts water scarcity using graphs, maps, and comparative synthesis
- Interpret the two-way relationship between water resources and human society
- Synthesize scientific and social information about drought, water scarcity and its relation to other concerns (e.g. fire, ecosystem problems, migration, poverty, child marriage, etc.)

INSTRUCTIONAL METHODS: *In this course, much of the learning is done through assignments and discussions that involve data analysis, critical thinking, and synthesizing information.*

HOW THIS COURSE RELATES TO THE STUDENT LEARNING OUTCOMES IN THE GEOGRAPHY MAJOR: *Extreme Droughts is a course that provides content learning in environmental geography for our majors' Student Learning Outcomes. We conduct Critical Thinking through article reviews and evaluating water conflicts in readings, movies, and data analysis of real-world data on droughts and drying water bodies. We develop graphical Communication Skills through assignments such as the streamflow stripes and streamflow heat map. We develop oral communication skills through presenting article reviews, exhibiting a poster that synthesizes several studies relating droughts to another topic, and compiling and narrating a case of a drying river to a hypothetical community.*

COURSE POLICIES:

ONLINE LEARNING COMMENTARY: By now, you already know the basics of how to increase your chances of staying healthy during the semester. Because we are online, this class will not put you at increased risk. However, some things will probably go wrong with technology during the semester on either end of our communications, including Zoom outages and low bandwidth problems here and there. Please be understanding of problems on my end and I will be understanding of issues on your end. Expect glitches to happen.

ONLINE RECORDING DISCLOSURE: Our class sessions may be audio-visually recorded for students in the class to access later and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate verbally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

ATTENDANCE POLICY: When we have synchronous meetings, please do your best to attend and participate in the course throughout the duration of the term. If the internet connectivity is a problem, we will find alternative ways for you to participate. Communicate with the instructor when there is a problem. All assignments will be listed in the course schedule, and specific due dates can be found in the calendar. Requirements for class attendance and assignments in this course are consistent with university policies that can be found in the current [UF Undergraduate Catalog](#)

LATE WORK AND MAKE-UP POLICY: Clemency is granted for late work with valid excuse, including the possibility of COVID-related problems this term. Please communicate with the instructor regarding any problems with *assignments submissions or discussions*. *Please document your problems as best possible (doctor's or ER slip, obituary, etc.)*

COURSE TECHNOLOGY: Access to and on-going use of a computer is required for all students. Competency in the basic use of a computer is required although the instructor will provide help for spreadsheet work. Course work will require use of a computer and a broadband connection to the Internet. For additional information on UF College of Liberal Arts and Sciences policy regarding computer requirements you can visit: <http://it.clas.ufl.edu/policies/student-computer-requirement/>

For technology related issues the UF computing help desk can be reached at:

- <http://helpdesk.ufl.edu>
- (352) 392-HELP - select option 2

DISCUSSION/PEER REVIEW POLICY: Students should adhere to professional etiquette/netiquette standards (see UF Policies below) in all posts and to engage in CONSTRUCTIVE dialogue. Posts should be thoughtful, detailed responses in full sentences with specificity. In most cases, discussions require some research prior to their initial post. Follow-up posts are typically required. Please check the course Calendar for the specific due dates.

ASSIGNMENT POLICY: Each module has assignments associated with it. Due dates are specified on the course calendar, and timely submission is expected. Assignments must be submitted to Canvas via the assignment page and any instructions detailed therein. Assignments will be graded within a week after submission unless there are extenuating circumstances.

UF POLICIES:

UNIVERSITY POLICY ON ACCOMMODATING STUDENTS WITH DISABILITIES: "Students with disabilities requesting accommodations should first register with the [Disability Resource Center](#) (352-392-8565) by providing appropriate documentation. Once registered, students will receive an accommodation letter that must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester."

UNIVERSITY POLICY ON ACADEMIC CONDUCT: UF students are bound by The Honor Pledge as follows: "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in

doing this assignment." [The Honor Code](#) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor of this class.

CLASS DEMEANOR OR NETIQUETTE: Class members must follow rules of common courtesy in all discussions/ electronic communication. Consequences for violating UF netiquette guidelines include zeroes or reporting. See info at <http://teach.ufl.edu/wp-content/uploads/2012/08/NetiquetteGuideforOnlineCourses.pdf>.

U MATTER WE CARE: Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

GETTING HELP:

For issues with technical difficulties for Canvas, please contact the UF Help Desk at:

- <http://helpdesk.ufl.edu>; (352) 392-HELP (4357); Walk-in: HUB 132

Any requests for make-ups due to technical issues MUST be accompanied by the ticket number received from the Help Desk when the problem was reported to them. The ticket number will document the time and date of the problem. You MUST e-mail your instructor within 24 hours of the technical difficulty if you need to resubmit.

EVALUATIONS:

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

ASSIGNMENT TYPES:

Discussion Postings

- Detailed commentary on a thought-provoking comic/cartoon that can be interpreted different ways. Provide respectful responses to other people's comments, where you disagree or expand on their comments

Video Worksheets

- Fill out pages given in class with information from the movie. Some videos will be broken up over multiples classes, so bring in last sheet each class

Article Reviews

Your main goal is to review the topic, summarize everything and present a clear understanding of the topic. It involves:

- Cite journal or report with author, date, title, journal, volume, or website according to a standard convention (APA)
- For each article, compose a very basic two sentence summary to get the major thrust of the paper: "The author's purpose in writing the article was..." "The author concluded..."
- List what struck you as being the four or five most important points in the article using your own words. Go beyond the author's conclusions or the abstract. News articles should have three points.
- Find one thought-provoking quote from the article that will generate discussion; followed by a brief response, statement, or question of your own about the quote to provoke discussion.
- Select an important figure or table from the article. Briefly state, and be prepared to discuss in class, why you think the figure or table is especially meaningful or interesting. If your news article does not have one, write N/A
- What is the theoretical and applied significance of this article? What (if anything) was interesting or innovative about the paper? News article might only have information on applied significance.
- Come up with one thought-provoking question related to each article for your classmates. Be prepared to express your own thoughts about this question.
- We will review journal articles and news articles that I have characterized as O-overview studies, H-historical & C-case studies in the Canvas Readings repository. Undergraduates will review a minimum of three journal articles (1O-1H-1C or 2O-1H-0C

or 2O-0H-1C). For the two remaining, students can choose from journal articles or news articles (1O-0H-1C or 1O-1H-0C).

- The current repository has a few hundred articles from which readings can be chosen. Students can start there to select articles for review or find readings outside of the repository and review with instructor permission. We will continue to add to the repository over the semester.
- Two students should not review the same article, so students will declare selection in Canvas posting when an article is assigned

Mini Assignments

- Adding to the repository of articles and figures, explain why
- Working with USGS streamflow, groundwater and/or climate data to examine trends and identify droughts
- Google Earth Tours, calculations, and evaluations (calculating changing areas of shrinking lakes)
- Peer review of draft final project
- Preparing a public education brochure or billboard
- Working with e-flows software in the hydrolearn.org Droughts and Drying Rivers module
- Developing different types of flow duration curves
- Creating streamflow stripes graphics using hydrolearn.org
- Creating streamflow heat maps using hydrolearn.org

Mid-term Project: Narrated Drying River Case study (see Mod. 2 for details)

- I co-created a module on Hydrologic Droughts and Drying Rivers for an NSF-funded project called Hydrolearn. In there are several assignments involving working with streamflow data and evaluating hydrologic droughts.
- You will apply several of the techniques learned in the mini-assignments where you work with streamflow data to develop a presentation of a drying river. You can use some of the graphics created in the mini-assignments for this.
- You will narrate that presentation to convince stakeholders in that community of the problem and suggest ideas to promote water conservation

Final Project: Poster Relating Droughts to Another Topic (see Mod. 4 for details)

- Part 1: Proposal, your idea and background resources explained
- Part 2: Draft Presentation of poster, will be peer- and professor-reviewed in order to improve final product
- Part 3: Final presentation, given in class, standing beside a poster and giving a 10-minute presentation, including sources

GRADING BREAKDOWN AND POLICIES:

Assignment Type	Percentage	Examples
Class Discussion and Discussion postings	5%, 50 pts	Class discussion. Share your view, comment on others' viewpoints, reflect on a figure, typically 10 pts each
Video Worksheets	15%, 150 pts	Fill out a worksheet during videos 10-20 pts each
Article reviews	20%, 200 pts	Review 2 news articles and 3 journal articles, many in Canvas repository, 5 total, 20 pts. each
Mini-Assignments	20%, 200 pts	Examples: peer-review, working with water data in spreadsheets and more, supplementing the repository, etc., typically 10-30 pts each
Narrated Case Study of a Drying River (Mid-term project)	20%, 200 pts	As water manager, analyze data for a narrated presentation on a drying river. Opportunity for feedback through draft 10% draft 100 pts., and 10% final 100 pts., Details and rubrics in hydrolearn.org
Topical Poster Presentation, Final Project	20%, 200 pts	3 parts: Page-long proposal & page of preliminary sources, 3% or 30 pts, Draft presentation, 7% or 70 pts; Final class presentation, 10% or 100 pts (rubrics in Canvas)

INFORMATION ON CURRENT UF GRADING POLICIES FOR ASSIGNING GRADE POINTS:

- Grading polices follow the UF Undergraduate Catalog [Grades and Grading Policies page](#).

GRADING SCALE: Grading Scale (& GPA equivalent):

Grade	%	Grade Points		Grade	%	Grade Points
A	≥ 93	4.0		C	70 – 76.9	2.0
A-	90 – 92.9	3.67		C-	68 – 69.9	1.67
B+	87 – 89.9	3.33		D+	66 – 67.9	1.33
B	83 – 86.9	3.0		D	60 – 65.9	1.0
B-	80 – 82.9	2.67		D-	57 – 59.9	0.67
C+	77 – 79.9	2.33		E	< 56	0

Note: A grade of C- is not a qualifying grade for major, minor, Gen Ed, or College Basic distribution credit. For further information on UF's Grading Policy, see:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx#hgrades>

MODULE # 1: OVERVIEW: DROUGHTS, WATER SCARCITY AND THEIR DRIVERS

OBJECTIVES:

- Know terms related to droughts and water scarcity
- Review definitions and perceptions of drought
- Analyze relations between land use, population, and access to fresh water
- Distinguish between direct and indirect water use
- Understand physical and human drivers influencing droughts and water scarcity
- Evaluate possible solutions to anticipated water shortages

SAMPLE READINGS

Dai, A. (2011). Drought under global warming: a review. *Wiley Interdisciplinary Reviews: Climate Change*, 2(1), 45-65.

Dagel, K. C. (1997). Defining drought in marginal areas: the role of perception. *The Professional Geographer*, 49(2), 192-202.

Gleick, P. H. (2003). Global freshwater resources: soft-path solutions for the 21st century. *Science*, 302(5650), 1524-1528.

Hoekstra, A. Y. and Chapagain, A. K. (2007). Water footprints of nations: Water use by people as a function of their consumption pattern. *Water Resources Management*. 21:35–48

Hoekstra, A. Y., Chapagain, A. K., Mekonnen, M. M., & Aldaya, M. M. (2011). The water footprint assessment manual: Setting the global standard. Routledge.

Jackson, R. B., Carpenter, S. R., Dahm, C. N., McKnight, D. M., Naiman, R. J., Postel, S. L., & Running, S. W. (2001). Water in a changing world. *Ecological applications*, 11(4), 1027-1045.

Postel, S. L. (2000). Entering an era of water scarcity: the challenges ahead. *Ecological applications*, 10(4), 941-948.

Postel, S., & Richter, B. (2012). Chapter 1: Where have all the rivers gone? Rivers for life: managing water for people and nature. Island Press.

Savenije, H. H., Hoekstra, A. Y., & van der Zaag, P. (2014). Evolving water science in the Anthropocene. *Hydrology and Earth System Sciences*, 18(1), 319.

Speed, R., Tickner, D., Gang, L., Sayers, P., Yu, W., Yuanyuan, L., ... & Aihua, L. (2016). Chapter 1- Different types of droughts and their impacts, pp. 27-40 in *Drought risk management: A strategic approach*. UNESCO Publishing.

Stockle, C. O. (2001). Environmental impact of irrigation: a review. Washington State University.

UNCCD (2017) Global Land Outlook. Chapter 8 Water Resources, 160-189.

Wilhite, D. A. (2000). Chapter 1 Drought as a Natural Hazard: Concepts and Definitions" (2000). Drought Mitigation Center Faculty Publications. 69. University of Nebraska-Lincoln.

Wilhite, D. A., & Glantz, M. H. (1985). Understanding: the drought phenomenon: the role of definitions. *Water international*, 10(3), 111-120.

MODULE # 2: HISTORICAL AND RECENT DROUGHTS AND DATA ANALYSIS

OBJECTIVES:

- Know some important droughts in history and methods for reconstructing droughts
- Evaluate how misuse and overuse contributes to drying rivers and shrinking lakes
- Apply indicators and measures (e.g. Palmer Drought Index, Stream Drought Index, minimum flow levels)
- Compute minimum environmental flows from data sets using e-flows software
- Developing different types of flow duration curves (regular, comparative, dimensionless)
- Creating streamflow stripes graphics

- Creating streamflow heat maps or strips
- Narrated presentation of a drying river or river using graphics

SAMPLE READINGS

Cook, E. R., Seager, R., Cane, M. A., & Stahle, D. W. (2007). North American drought: Reconstructions, causes, and consequences. *Earth-Science Reviews*, 81(1-2), 93-134.

Fang, K., Davi, N., Gou, X., Chen, F., Cook, E., Li, J., & D'Arrigo, R. (2010). Spatial drought reconstructions for central High Asia based on tree rings. *Climate Dynamics*, 35(6), 941-951.

Fleig, A. K., Tallaksen, L. M., Hisdal, H., & Demuth, S. (2006). A global evaluation of streamflow drought characteristics. *Hydrol. Earth Syst. Sci.*, 10, 535–552.

Gippel, C. J., & Stewardson, M. J. (1998). Use of wetted perimeter in defining minimum environmental flows. *Regulated Rivers: Research & Management*, 14(1), 53-67.

Heim Jr, R. R. (2002). A review of twentieth-century drought indices used in the United States. *Bulletin of the American Meteorological Society*, 83(8), 1149-1166.

Paulo, A. A., & Pereira, L. S. (2006). Drought concepts and characterization: comparing drought indices applied at local and regional scales. *Water International*, 31(1), 37-49.

Poff, N. L., Richter, B. D., Arthington, A. H., Bunn, S. E., Naiman, R. J., Kendy, E., ... & Henriksen, J. (2010). The ecological limits of hydrologic alteration (ELOHA): a new framework for developing regional environmental flow standards. *Freshwater Biology*, 55(1), 147-170.

Speed, R., Tickner, D., Gang, L., Sayers, P., Yu, W., Yuanyuan, L., ... & Aihua, L. (2016). Chapter 2- Lessons learnt, live issues and challenges, pp. 41-60 in *Drought risk management: A strategic approach*. UNESCO Publishing.

Stahle, D. W., Fye, F. K., Cook, E. R., & Griffin, R. D. (2007). Tree-ring reconstructed megadroughts over North America since AD 1300. *Climatic Change*, 83(1-2), 133.

Stahle, D. W., Cook, E. R., Burnette, D. J., Villanueva, J., Cerano, J., Burns, J. N., ... & Szejner, P. (2016). The Mexican Drought Atlas: Tree-ring reconstructions of the soil moisture balance during the late pre-Hispanic, colonial, and modern eras. *Quaternary Science Reviews*, 149, 34-60.

Stewardson, M. J., & Gippel, C. J. (2003). Incorporating flow variability into environmental flow regimes using the flow events method. *River Research and Applications*, 19(5-6), 459-472.

Tennant, D. L. (1976). Instream flow regimens for fish, wildlife, recreation and related environmental resources. *Fisheries*, 1(4), 6-10.

Tharme, R. E. (2003). A global perspective on environmental flow assessment: emerging trends in the development and application of environmental flow methodologies for rivers. *River research and applications*, 19(5-6), 397-441.

Vicente-Serrano, S. M., Beguería, S., & López-Moreno, J. I. (2010). A multiscalar drought index sensitive to global warming: the standardized precipitation evapotranspiration index. *Journal of Climate*, 23(7), 1696-1718.

MODULE # 3: CASE STUDIES: IMPACTS AND MANAGEMENT OF WATER SCARCITY TO HUMANS AND BIOLOGICAL COMMUNITIES

OBJECTIVES:

- Examine a range of case studies of drought impacts relating to humans and biota
- Evaluate the Disaster Management Cycle in relation to droughts, including preparedness, response, recovery, and mitigation
- Develop management and policy to reduce risk to humans and biological communities

SAMPLE READINGS

Dilling, L., Daly, M. E., Kenney, D. A., Klein, R., Miller, K., Ray, A. J., ... & Wilhelmi, O. (2019). Drought in urban water systems: Learning lessons for climate adaptive capacity. *Climate Risk Management*, 23, 32-42.

Ding, Y., Hayes, M. J., & Widhalm, M. (2011). Measuring economic impacts of drought: a review and discussion. *Disaster Prevention and Management: An International Journal*. Vol. 20 No. 4, pp. 434-446.

Green, P. A., Vörösmarty, C. J., Harrison, I., Farrell, T., Sáenz, L., & Fekete, B. M. (2015). Freshwater ecosystem services supporting humans: Pivoting from water crisis to water solutions. *Global Environmental Change*, 34, 108-118.

Hayes, M. J., Wilhelmi, O. V., & Knutson, C. L. (2004). Reducing drought risk: bridging theory and practice. *Natural Hazards Review*, 5(2), 106-113.

- Lake, P. S. (2003). Ecological effects of perturbation by drought in flowing waters. *Freshwater Biology*, 48(7), 1161-1172.
- Pereira, L. S., Oweis, T., & Zairi, A. (2002). Irrigation management under water scarcity. *Agricultural water management*, 57(3), 175-206.
- Pittock, J., & Lankford, B. A. (2010). Environmental water requirements: demand management in an era of water scarcity. *Journal of Integrative Environmental Sciences*, 7(1), 75-93.
- Richter, B. D., Mathews, R., Harrison, D. L., & Wigington, R. (2003). Ecologically sustainable water management: managing river flows for ecological integrity. *Ecological applications*, 13(1), 206-224.
- Rockström, J., Falkenmark, M., Allan, T., Folke, C., Gordon, L., Jägerskog, A., ... & Postel, S. (2014). The unfolding water drama in the Anthropocene: towards a resilience-based perspective on water for global sustainability. *Ecohydrology*, 7(5), 1249-1261.
- Sivakumar, B. (2011). Water crisis: from conflict to cooperation—an overview. *Hydrological Sciences Journal*, 56(4), 531-552.
- Speed, R., Tickner, D., Gang, L., Sayers, P., Yu, W., Yuanyuan, L., ... & Aihua, L. (2016). Chapter 3 (Drought as a Risk), Chapter 4 (Role of Strategic Drought Risk Management), Chapter 5 (Framework of Strategic Drought Risk Management), Chapter 6 (The Adaptive Process of Strategic Drought Risk Management Planning), Chapter 7 (Measures and instruments), Chapter 8 (Safeguarding and Enhancing Freshwater Ecosystems), Chapter 9 (Enabling Environment and Implementation) in *Drought risk management: A strategic approach*. UNESCO Publishing, 215 pp.
- Wolf, A. T. (2007). Shared waters: Conflict and cooperation. *Annu. Rev. Environ. Resour.*, 32, 241-269.
- Yoffe, S., Fiske, G., Giordano, M., Giordano, M., Larson, K., Stahl, K., & Wolf, A. T. (2004). Geography of international water conflict and cooperation: Data sets and applications. *Water resources research*, 40(5).
- Zamani, G. H., Gorgievski-Duijvesteijn, M. J., & Zarafshani, K. (2006). Coping with drought: Towards a multilevel understanding based on conservation of resources theory. *Human Ecology*, 34(5), 677-692.

Zhang, Q., Han, L., Jia, J., Song, L., & Wang, J. (2016). Management of drought risk under global warming. *Theoretical and applied climatology*, 125(1-2), 187-196.

MODULE # 4: SYNTHESIZING ANALYSIS OF DROUGHTS: STUDENT PROJECTS

OBJECTIVES:

- Link varied aspects of droughts through case studies and projects
- Synthesize studies relating droughts to another topic (water scarcity, adaptation, famines, wildfires, dust storms, teleconnections, desertification, agricultural impacts, biological impacts, navigation problems, dams, health or disease or specific aspect, local or regional conflict, water use policy, industry, poverty/economic inequality, irrigation, fisheries, religion, conservation, increased mortality, children, the elderly, population migration, planning, food scarcity, disaster relief, climate change, communication, tourism, strategic management, specific historic (SW Native American, Mayan, Chinese, South Asian, etc.)

READINGS

Each student will be finding and reading references related to the topic that they are synthesizing and presenting