CE7372 WATER, CLIMATE, AND DISASTERS (SPRING 2025)

5:30 PM - 7:50 PM Wed
Ingram Hall 4106

This course introduces the interactions between water and climate systems and their relationship with occurrences, magnitude, and frequencies of natural disasters with a focus on climate impacts on hydrology, water resources, and extreme events (e.g., floods, drought, heat waves, landslides, and wildfires). This course covers disaster risk management and adaptation strategies for a sustainable and resilient natural environment and human society against weather and climate extreme disasters.

Instructor

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Communication

Office hours are available by appointment. Please email me if you have any questions. I respond to emails within 24 hours during the work week. You are welcome to visit my office as often as you like!
Course announcements will be on Canvas.

Prerequisites

NA

Objectives

This course prepares students to:
• Demonstrate the fundamentals of hydrological and climate processes and present to future patterns of hydroclimatic disasters
• Analyze diagnostics and attribution regarding the influence of hydroclimatologic variables and phenomena on land surface hydrology and its related extreme events
• Assess engineering design values for water infrastructure using computational languages

Instructional Methodologies

1) Lectures of the fundamental concepts of hydroclimatology and extreme disaster events and disaster risk management and adaptation strategies
2) Writing computational languages (**R**, MATLAB, Python, or a suitable equivalent) to analyze climate data and develop engineering design values during regular homework assignments.
3) A literature-based survey of present and future hydroclimate extremes.
4) Scientific writing and accurate summaries to communicate with a wide audience (e.g., heatwaves, floods, drought, and wildfires)
5) Develop your own unique idea related to individual research topics and address research questions
*It is critical to attend, mentally engage, actively participate, and take notes (research has shown that taking notes increases retention)
*Each class is associated with a module on Canvas. Modules provide materials from the class

Readings

Readings are critical parts and supplement the materials presented in class

There are no required textbooks for this course. All of the required and supplemental reading is available for free on Canvas

The recommended (not required) textbooks:

Hydroclimatology: Perspectives and Applications, Cambridge University Press, By Marlyn L. Shelton, 2009. ISBN:9780521848886

Statistical Methods in Water Resources, Editors: Dennis R. Helsel, Robert M. Hirsch, Karen R. Ryberg, Stacey A. Archfield, and Edward J. Gilroy, 2020, https://pubs.usgs.gov/tm/04/a03/tm4a3.pdf

IPCC (2012) Summary for Policymakers. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. 19 p. https://www.ipcc.ch/site/assets/uploads/2018/03/SREX_Full_Report-1.pdf

USGCRP, 2023: Fifth National Climate Assessment. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA. https://doi.org/10.7930/NCA5.2023

Relevant Articles:

Tiedmann, H. R., Spearing, L. A., Castellanos, S., Stephens, K. K., Sela, L., & Faust, K. M. (2023). Tracking the post-disaster evolution of water infrastructure resilience: A study of the 2021 Texas winter storm. Sustainable Cities and Society, 91, 104417.

NOAA (National Oceanic and Atmospheric Administration). 2022. Heat stress datasets and documentation. Provided to EPA by NOAA in February 2022.

England et al. (2019) Guidelines for determining flood flow frequency—Bulletin 17C, U.S. Geological Survey Techniques and Methods, 148 p.

Udall and Overpeck (2017). The twenty-first century Colorado River hot drought and implications for the future. Water Resources Research 53, 2404–2418.

USGCRP (U.S. Global Change Research Program). 2017. Climate science special report: Fourth National Climate Assessment, volume I. Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.). https://science2017.globalchange.gov. doi:10.7930/J0J964J6.

Sarofim, M.C., S. Saha, M.D. Hawkins, D.M. Mills, J. Hess, R. Horton, P. Kinney, J. Schwartz, and A. St. Juliana. 2016. Chapter 2: Temperature-related death and illness. In: The impacts of climate change on human health in the United States: A scientific assessment. U.S. Global Change Research Program. https://health2016.globalchange.gov.

Slater and Villarini (2016) Recent trends in U.S. flood risk. Geophysical Research Letters, 43, 12,428–12,436.

Gariano, S. L., & Guzzetti, F. (2016). Landslides in a changing climate. Earth-Science Reviews, 162, 227-252.

Hirsch and Archfield (2015) Flood trends: Not higher but more often. Nature Climate Change 5, 198–199.

Milly et al. (2008) Stationarity is dead: Whither water management? Science 319, 573-574.

Homework

Course concepts and procedures are applied in the homework

Each assignment is posted on Canvas

Upload your submission to Canvas as a PDF file

Feel free to include handwritten work by taking photos or scanning
Late submissions are generally NOT accepted. Exceptions may be made only if you obtain the instructor's permission in advance.
Submissions must be entirely your own individual work, but discussion with others is recommended

Project

You will work in a team of approximately 2 students (we will have five groups)
Topics: Any topics of your current research connected to hydroclimate extreme events and/or climate change such as floods, drought, wildfires, heatwaves etc.
Examples: Heatwaves Impact on Water Quality in Texas
Evaluating the Role of Wildfire-Induced Land Changes on Flooding
Future Infrastructure Design Values in a Warmer Climate
A unique opportunity to develop your skills in data acquisition, analytics, interpretation, and visualization using hydroclimatological data.
Benchmark References (Five most relevant publications) (Jan-29)
Concept/Topic Presentations (Feb-5)
One-Page Plan Submission (Feb-12)
There are mid- and final presentations (Feb-26 and Apr-23, Wed).
The presentations will be evaluated by Dr. Cho as well as **peers**.
Upload your final report to Canvas as a PDF file (by midnight on Apr-30, Wed)

Exams

Mid exam: 5 - 7 PM **Mar-5** (Wed); No final exam
Make-up exams are only given for extreme cases
Notify me as soon as possible if you are unable to take a scheduled exam
Exams are based on the classes and homework
Handouts with key figures and/or tables may be provided if needed
Bring a calculator (you cannot use a calculator on any device with communication capabilities)
Submissions must be entirely your own individual work
Exams are graded within one week

Grading

The following weighting is used to determine course grades:
15% - Attendance/In-class Discussions
20% - Homework/Reading Assignments
20% - Midterm
25% - Presentations (mid: 10% & final: 15%)
20% - One-Page Plan (5%) & Final Report (15%)

Improvement and growth are the keys. The instructor will conduct his/her expert assessment on student performance and will assign grades consistent with the following:
• **A (excellent)** exceptional performance; exceeding the requirements of the course, showing strong academic initiative and independent resourcefulness.
• **B (good)** performance above the norm; accurate and complete; beyond the minimum requirements of the course; work demonstrates marked progress and initiative.
• **C (average)** satisfactory work that adequately meets minimum requirements and

demonstrates satisfactory comprehension, communication skills, and effort; demonstrates little initiative to investigate the problem without substantial prodding of the instructor and/or work shows little improvement.

• **D (inferior)** unsatisfactorily meets minimum requirements; demonstrates minimum comprehension, communication skills, and effort at an inferior level; initiative lacking and/or improvement not noticeable.

• **F (failing)** does not meet minimum requirements; fails to adequately demonstrate comprehension, communication skills, and effort

Course Outline (Subject to Change)

Week 1 topic
Course overview and motivation; Overview of hydroclimatology concept
Week 2 topic
The global hydrologic cycle and water-related disasters
Week 3 topic
Measuring atmospheric components (radiation, temperature, humidity, etc.)
Week 4 topic
Measuring terrestrial components (precipitation, snowfall, soil moisture, streamflow, etc.)
Week 5 topic
The runoff process and streamflow: interception, infiltration, overflow, and reservoirs
Week 6 topic
Engineering design and theory
Week 7 topic
Remote sensing and modeling
Week 8 topic
National Climate Assessment: Texas
Week 9 topic
Flood hazards: the hydrologic extreme of excessive moisture
Week 10 topic
Drought: the hydrologic extreme of deficient moisture
Week 11 topic
Heat Waves: Is the world getting drier?
Week 12 topic
Wildfires & Landslides: the causes and consequences
Week 13 topic
Climate Change: Dimensions in Disaster Risk, Exposure, Vulnerability, and Resilience
Week 14 topic
Reducing Risks Through Adaptation Actions
Week 15 topic
Decision theory and analysis, risk and reliability
Week 16 topic
Final Presentation

Guidance on Using AI Tools (e.g., ChatGPT) in this Course

Artificial Intelligence (AI) tools, such as ChatGPT, can be useful resources for enhancing your understanding of concepts and/or assisting with projects and coding. However, their

use must adhere to ethical guidelines and support your learning rather than replace critical thinking or original work.

Appropriate Uses of AI Tools:

- Concept Clarification: Use AI tools to clarify concepts and/or methodologies.
- Draft Refinement: Obtain suggestions for improving the structure, clarity, or grammar of your written work.
- Coding Assistance: Seek help with basic programming tasks or troubleshooting scripts, while ensuring you understand the methodology.

Inappropriate Uses of AI Tools:

- Academic Misconduct: Do not use AI tools to generate complete answers for assignments, exams, or projects that require original thought and effort.
- Plagiarism: Submitting AI-generated content as your own is a violation of academic integrity policies.
- Uncritical Reliance: Avoid using AI-generated outputs without verifying accuracy and relevance, as these tools may occasionally provide incorrect or incomplete information.

Best Practices:

- Cite Appropriately: If you use AI-generated content as a reference, acknowledge it in your work (e.g., "This explanation was assisted by ChatGPT.").
- Engage Critically: Treat AI outputs as starting points and cross-check them against reputable sources.
- Collaborate with Integrity: If you think unclear, discuss the use of AI tools with me to ensure alignment with course policies.

Notifications

This course adheres to the TXST academic integrity policy as stated in the General Catalog and the Student Conduct Code

Instructors are required by law to notify university officials about any disclosures of interpersonal violence

It is a violation of academic integrity and/or copyright laws to share, post, republish, or repurpose any course materials. All materials are provided only for your personal use.

Resources (see Canvas syllabus for hyperlinks)

Any student who self-identifies with the Student Disability Center (SDC) as having a disability is eligible for support from the SDC

Any student seeking an exemption from attending class or meeting a deadline for a religious observance should submit the Religious Accommodation Request Form to the Division of Student Affairs