CLIM 312/GGS 312: Physical Climatology; Fall 2024

Catalog Description: Quantitative description of nature and theory of the climate system, dynamics of atmosphere-ocean-land surface, internal interactions and response to external forcing, description of the climate record and simple climate models.

Expanded Description: This course provides a comprehensive introduction to the field of Physical Climatology, focusing on understanding the various climates on Earth, their impacts on plants, animals, and humans, and the application of quantitative physical principles to analyze and explain observed climate patterns.

Course	CLIM 312 and GGS 312: Physical Climatology (3 credits)
Instructor	Timothy DelSole [web profile]
Contact	email: tdelsole@gmu.edu; office: Research Hall Rm112
Prerequisite	CLIM/PHYS 111/112 OR GGS 121, PHYS 243,244
Meeting Times	4:30 pm - 5:45 pm, Tuesdays and Thursdays
Location	Exploratory Hall L505
Required Texts	*The Atmosphere*, 14th Edition, Lutgens, Tarbuck, Herman, & Tasa
	Atmosphere, Ocean and Climate Dynamics, John Marshall and R. Alan Plumb

Learning Outcomes: By the end of this course, students will be able to:

1. **Identify and describe the different climate zones on Earth:** Understand the characteristics, distribution, and classification of major climate zones, including tropical, temperate, polar, arid, and humid climates.
2. **Analyze the impact of different climates on ecosystems and human activities:** Explore how climate influences the distribution and behavior of plants and animals, as well as the implications for agriculture, urban planning, and human health.
3. **Apply quantitative physical principles to climatology:** Use mathematical and physical models to understand atmospheric processes, energy balance, and climate dynamics. Develop skills in data analysis and interpretation related to climatology.
4. **Understand the interactions between the atmosphere, hydrosphere, lithosphere, and biosphere:** Study how these components interact to create and modify climate patterns over time.

Technical Requirements

- This course will be hosted on Canvas. Please ensure you are familiar with accessing and navigating this platform. Resources and support are available at: https://lms.gmu.edu/getting-started-students/ to help you get started. If you have any questions, do not hesitate to reach out to me or contact the ITS Support Center for assistance.
- Students should be able to create simple graphical plots based on equations and include them as part of their homework submissions. For example, generate and submit a plot of cos(x).

Course Overview

- *The Atmosphere*, 14th Edition, Lutgens, Tarbuck, Herman, & Tasa
  - Ch15.1: Climate Classification and Controls
  - Ch15.2: Humid Tropical Climates
  - Ch15.3: The Dry Climates
  - Ch15.4: Mild Midlatitude Climates
  - Ch15.5: Cold Midlatitude Climates
  - Ch15.6: Polar Climates
- *Atmosphere, Ocean and Climate Dynamics*, Marshall & Plumb
  - Ch1: Characteristics of the Atmosphere
  - Ch2: The Global Energy Balance
  - Ch3: The Vertical Structure of the Atmosphere
  - Ch4: Convection
  - Ch5: The Meridional Structure of the Atmosphere
  - Ch10: The Wind-Driven Circulation
  - Ch12: Climate and Climate Variability

Class Schedule

week	dates	Tuesday Class	Thursday Class	reading
1	Aug 27, 29	basic concepts	Mountains & Plants	Lutgens ch1-ch14
2	Sep 03, 05	Review and Cryosphere	Humid tropical (A)	Lutgens 15.2-15.3
3	Sep 10, 12	dry tropical (B)	midlatitude (C & D)	Lutgens 15.4-15.5
4	Sep 17, 19	E & H & Glaciers & Biomes	Science and Box Models	Lutgens 15.6-15.7
5	Sep 24, 26	Heat Capacity	Gases and Liquids	Lecture Notes
6	Oct 01, 03	problem discussion	Gases and Liquids	Lecture/ Marshall ch1
7	Oct 08, 10	problem discussion	mid-term	
8	Oct 15, 17	exam discussion	Global Energy Balance	Marshall ch 2
9	Oct 22, 24	problem discussion	Vertical Structure of Atm.	Marshall ch 3
10	Oct 29, 31	problem discussion	convection part 1	Marshall ch 4.1-4.4
11	Nov 05, 07	no class (Election Day)	convection part 2	Marshall ch 4.5-4.8
12	Nov 12, 14	discussion/submit slides	meridional structure	Marshall ch 5
13	Nov 19, 21	problem discussion	wind-driven circulation	Marshall ch 10
14	Nov 26, 28	student presentations	no class (Thanksgiving)	
15	Dec 03, 05	Climate Variability	TBD	Marshall ch 12

Depending on our progress, the above schedule may be adjusted during the semester to either reduce or expand the number of problem discussion sessions or the range of topics covered.

Course Format

The course is structured to provide both qualitative and quantitative understanding of physical climatology through a combination of readings, lectures, student presentations, and assignments.

Weeks 1-4: Qualitative Understanding of Major Climate Zones

- **Lectures:** The instructor will deliver lectures Tuesday and Thursday, focusing on the qualitative aspects of major climate zones.
- **Reading Assignments:** Students will read the assigned materials and submit comments and questions by the end of the day on Monday and Wednesday. These comments will guide class discussions and help identify challenging concepts. See below for further guidance.
- **Homework Assignments:** Weekly homework assignments will be given out every Tuesday, designed to reinforce the qualitative concepts discussed in the readings and lectures. These assignments are due the following Monday by 5 pm, before the next Tuesday class. The homework will be graded and returned prior to the Tuesday class.
- **Quizzes:** Most Tuesdays there will be a closed-book 10-minute quiz based on the lectures, readings, and homework of the previous week. These quizzes are designed to ensure that students have understood and can apply the concepts covered in the assignments.

Weeks 5-15: Quantitative Interpretation of Climatology

- **Lectures:** The instructor will deliver lectures every Thursday, covering quantitative aspects of climatology such as climate modeling, data analysis, and the application of physical principles.
- **Reading Assignments:** Students will read the assigned materials and submit comments and questions by the end of the day on Wednesday. See below for further guidance.
- **Homework Assignments:** Weekly homework assignments will be given out every Tuesday to reinforce the quantitative concepts discussed in class. The assignments are due the following Monday by 5pm, and will be graded and returned on Tuesday in time for class discussion.
- **Quizzes:** Every Tuesday, there will be a closed-book 10-minute quiz based on the lectures, readings, and homework of the previous week. These quizzes are designed to ensure that students have understood and can apply the concepts covered in the assignments.
- **Student Presentations:** Each Tuesday, students will present a solution to a problem from that week's graded homework. Students are expected to present their solution and be prepared to defend it independently. This exercise will help students develop their problem-solving skills and enhance their ability to communicate complex ideas effectively.

Student Presentations

Near the end of the semester (see calendar), each student will give a 25 minute presentation exploring the intersection between climate and society. This presentation allows students to apply their understanding of climatology to real-world issues and areas of interest. Possible topics:

- Extremes: Droughts, Floods
- Water management
- Soil Erosion
- Climate Measurements (e.g., evapotranspiration)
- Agriculture and Crop production
- Urban planning
- Human health and comfort
- Dust, Aerosols, Air Pollution
- Fog
- Housing Design
- Climate Change
- Paleoclimatology: Inferring Climates of the Past
- Forest Fires and forest management
- Climate and pests

Prior to the presentation (see calendar), students submit a first draft of their slides and meet one-on-one with the instructor to discuss improvements *(early submissions are encouraged)*. The goal is to create a clear, engaging, and well-supported presentation that fits within the time limit and demonstrates understanding of the topic. The following rubric is intended to help guide your preparation.

- **Preparation and Incorporation of Feedback (15%):** The student submits a first draft of their slides on time. Slides are well-organized and visually clear. The student meets one-on-one with the instructor before their presentation to discuss potential improvements. The student incorporates feedback and suggestions from the meeting into the final presentation.
- **Content and Depth of Analysis (30%):** Clearly identifies and explores the connection between climate and a real-world issue (see above list). Demonstrates a thorough understanding of the topic with relevant and accurate information.
- **Citing Sources (10%):** All sources of information and data are properly cited. References are credible and relevant to the topic.
- **Clarity and Simplicity of Language (25%):** Uses clear and simple language throughout the presentation. Avoids jargon or explains any technical terms used in the presentation.
- **Understanding and Explanation of Concepts (20%):** The student demonstrates a strong understanding of the concepts cited in their presentation. The student is prepared to answer questions and explain the concepts in more detail if asked.
- **Presentation Timing:** Two points deducted per minute overtime.

Policies

- **Attendance:** Regular attendance is expected, particularly during student presentations. Please notify the instructor in advance if you need to miss a class.
- **Homework assignments:** No late assignments will be accepted. The lowest individual homework grade will be dropped before calculating the total homework score.
- **Quizzes:** There are no makeup quizzes. Lowest quiz score will be dropped.
- **Academic Integrity:** Students are expected to adhere to the university's academic integrity policy. Plagiarism and cheating will not be tolerated.
- Common University Policies (Including Academic Integrity, Disability Accommodations, Diversity, Title IX, and Student Privacy) [clickable link]

Grades

Grading	
homework assignments	25%
weekly quizzes	10%
student presentation	15%
reading comments	10%
mid-term	20%
Final	20%

Grade Schema	
grade	**percentages**
A+	97.0 - 100
A	93.0 - 96.9
A-	90.0 - 92.9
B+	87.0 - 89.0
B	83.0 - 86.9
B-	80.0 - 82.9
C+	77.0 - 79.9
C	73.0 - 76.9
C-	70.0 - 72.9
D+	67.1 - 69.9
D-	60.0 - 67.0
F	less than 60.0

Reading Assignments and Comments

Students will have 1-2 weekly reading assignments. A PDF document of the reading assignment will be made available on Canvas. Students are expected to submit questions/comments about the material before each lecture (i.e., by midnight on Monday and Wednesday for the first four weeks). Students must submit their comments each week and on time (see Class Format) to receive this course credit. All comments will be consolidated and shared with the rest of the class, with personal identifying information removed.

Submission Instructions

- Insert your comments electronically into the PDF file.
- It is preferable to highlight the precise sentence or paragraph related to your comment.
- All highlights should have a comment from you; do not submit blank comments.
- When submitting comments, name the file either Lutgens[SectionNumber].[LastName].pdf or Marshall[ChapterNumber].[LastName].pdf, as appropriate.
- Ensure you insert comments using the latest version of Adobe Reader (or DC Adobe Acrobat if you have a license), as I use special software to consolidate all comments into a single PDF file. Note that Adobe Reader is free, you do not need special GMU license to use Adobe Reader.
- Do not use Mac Preview!

Comment Guidelines: Comments should indicate where the text fails to aid your understanding. As a senior scientist, I am accustomed to the concepts and may overlook areas that are poorly explained in textbooks. You, coming fresh to the subject, are in the best position to identify these areas. Your comments will drive class discussions, allowing me to focus on the concepts you find challenging.

Types of Comments:

- Provide spontaneous insights into your thought process as a student learning the material.
- Note difficulties as they appear. If something is unclear, indicate that.
- If something later in the text clarifies an earlier confusion, add that to your comments without erasing the original note.
- Use ”I” statements such as ”I’m lost,” ”I do not understand this part,” ”I would like you to discuss this more in class,” etc.
- Do not worry about suggesting fixes; simply highlight where you experience confusion.

By sharing your honest reactions and questions, you will help me tailor our class discussions to better address your learning needs.

Policy on AI tools

ChatGPT can correctly answer most homework problems in this course (I checked). However, if you simply submit answers from ChatGPT without understanding them, you will learn very little (plus you will violate university ethical policies). Effective use of AI tools requires students to take more control of their own education to make wise decisions about how to use these tools to enhance their educational experience. As a teacher, I was initially tempted to ban AI tools completely, but on the other hand, I have a responsibility to train students for future jobs, and use of these tools will likely be very commonplace in your next job. In this course, AI tools are allowed with the following guidelines.

- Definition of AI Tools: AI tools include, but are not limited to, software and online resources capable of generating content, solving problems, or providing data analysis. Examples include language models, data analysis programs, and algorithmic problem solvers.
- Permitted Use of AI Tools:
  - Supplemental Learning: You may use AI tools to enhance your understanding of course material, explore concepts, and engage in self-directed learning.
  - Clarification and Research: AI tools can be used for clarifying complex topics, conducting research, or gathering supplementary information.
- Restrictions on Use:
  - Directly submitting work generated by an AI tool as your own is strictly prohibited. This includes, but is not limited to, written assignments, code, and statistical analysis (if any).
  - Understanding Over Automation: The focus of assignments is your understanding and application of the material. Using AI tools to bypass this learning process undermines the educational objectives of the course. Quizzes and classroom discussions are used to encourage you to understand assignments without reliance on AI.
- Disclosure and Transparency:
  - Mandatory Disclosure: If you use an AI tool to assist with any part of your homework, you must disclose this use. Clearly indicate which portions were aided by AI and provide a brief explanation of how it contributed to your work. If you found errors or could improve over AI tools, mention that too.
  - Ethical Considerations: Consider the ethical implications of using AI in your work. Honesty and integrity are paramount in academic pursuits.
- Academic Integrity Violations: Failure to adhere to this policy will be considered a violation of academic integrity. Consequences will be in line with the universitys academic integrity policy and may include a grade penalty or disciplinary action.
- Encouragement of Skill Development:
  - Focus on Personal Skill Enhancement: While AI tools can be beneficial, the primary goal is to develop your own skills and understanding. The use of these tools should not replace personal effort and intellectual engagement with the course material.