

AOS 425

Fall 2011

3 credits

GLOBAL CLIMATE PROCESSES

TTh 9:30-10:45 am AOSS 1411

Professor Ankur Desai

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Office Hours: T Th 11:00 am – 12:00 pm or by appointment

Web page: <https://learnuw.wisc.edu/> (login with your NetID to access course)

Prerequisites

AOS 311, 340, or instructor consent

Required Texts

1. Marshall, J. and R.A. Plumb, 2007, Atmosphere, Ocean and Climate Dynamics: An Introductory Text, Academic Press, 344 pp. ISBN: 9780125586917.
2. Archer, D. and Pierrehumbert, R., 2011. The Warming Papers, Wiley-Blackwell, 432pp. ISBN: 9781405196161.

Recommended References

1. Hartmann, D.L., 1994, Global Physical Climatology, Academic Press, 411pp., ISBN: 9780123285300.
3. Ruddiman, W.F., 2007, Earth's Climate: Past and Future. 2nd Ed. Freeman, 388 pp, ISBN: 9780716784906.
4. Alley, R. 2002, The Two-Mile Time Machine, Princeton Univ. Press, 240pp.. ISBN: 9780691102962.

All books have been requested for reserve in the SSEC Library on the 3rd floor of this building.

Course Description

We develop a mechanistic understanding of the climate system and its capacity for variability and change. Topics considered include: global and local energy balances, atmosphere and ocean general circulations, atmosphere - ocean - land coupling, carbon cycling, climate feedbacks and variability, modeling, and anthropogenic climate change. A climate modeling project with the EdGCM is a key component of the course. This course is highly recommended as an elective for seniors majoring in AOS. Beginning graduate students may also find the course useful.

Grading

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| 1. In-class exams (2) | 30%, equally weighted (15% each) |
| 2. Problem sets (5) | 30%, equally weighted (6% each) |
| 2. Climate literature review paper | 15% |
| 3. Climate modeling project paper | 15% |
| 4. In-class exercises, attendance, and participation | 10% |

Problem Sets and In-class Assignments

- Each student must submit independent solutions for all problems. Discussion is encouraged on problem sets, but copying from any source will be considered as plagiarism (see Academic Honesty below).
- Legible, organized solutions are expected. Problems should be organized in the sequence in which they were assigned.
- When qualitative discussions are requested in a problem, you should be both succinct and illustrative of your understanding.
 - Bullet lists, for example, that connect an observation to a mechanistic understanding are encouraged, for example:
 - “High latitudes have high albedo due to high zenith angle and snow and ice cover
 - Low latitudes have low albedo over the dark, poorly reflective ocean and high albedo where there are high cloud tops”
 - Packing as much knowledge into few words is the goal. More text is not better – either for you to write or for the professor to grade.
- Late problem sets will lose 15% for each day late, and will not be accepted after solutions have been discussed in class.

Literature Review Paper

Using the assigned edited collection by Archer and Pierrehumbert, you will be writing a short (5 page) analysis of classical and current scientific literature on an aspect of climate change to help better acquaint you with how the science of global climate processes has evolved through time. Details will be provided later in the semester. For this assignment, you will have an opportunity to revise your text with the help of Writing Fellows at the UW Writing Center (<http://www.wisc.edu/writing/>). Both the draft paper and meeting with the fellows are required portions of this project. A short presentation will be given by each student during a class session later in the semester.

Climate Modeling Project

Over the course of the semester, you will learning to run and analyze results from a global climate model, the EdGCM (<http://edgcm.columbia.edu>). This model and associated visualization packages will be described early in the semester. In the first half of the semester, everyone will do the same set of initial simulations and analyses. In the second half, you will have a chance to conduct your own research study by formulating a hypothesis you would like to explore with the model, and then designing and executing the appropriate modeling experiments. Each of you will meet with me to discuss your plan prior to starting. Results will be interpreted in a final paper in the form of a 4-5 page extended abstract for an AMS conference. Similar to the literature review paper, we will employ writing fellows to help you revise your paper. You will present your findings to class and submit the final report on the last day of class.

The model is installed on the 1411 computers. You will need to be in Windows in order to use it. Though very, very fast for a climate model, the model is still computationally intensive for a PC. It requires approximately 24 hours to run a 150-year simulation. In 1411, the computers are shared, and thus everyone will have to be careful to not run the model when the lab is being used by another class (AOS 330, 452, 650, 718, 740 -- see the schedule on the door of 1411). You should plan your runs for Friday afternoons and weekends (up to 8:30AM on Mondays). Specific guidelines will be detailed in a later document.

Given the time required for model integrations and the fact that only one experiment can be done at a time on each computer, it will be essential to plan ahead in order to get all experiments completed on time!

Accommodation Policy

Campus policy: “We believe in the right of all students who are enrolled at the University of Wisconsin-Madison to full and equal educational opportunity. Disability should not be the basis for exclusion from educational programs. All students are entitled to an accessible, accommodating, and supportive teaching and learning environment. ... Students are expected to inform faculty, in a timely manner, of their need for special instructional accommodations.” Students requiring class accommodations due to a learning or physical disability must present documentation from the McBurney Disability Resource Center (<http://www.mcburney.wisc.edu/> ; 608-263-2741, Middleton Bldg, 1305 Linden Dr) no later than the second week of class. Students who require temporary accommodations due to medical or psychological reasons should acquire documentation from University Health Services. Counseling is available from Counseling Services, University Health Services (<http://www.uhs.wisc.edu/>).

Academic Honesty

Since there is significant written and collaborative work required in this course, you should familiarize yourself with the University academic misconduct policy. Minor instances of academic misconduct will be treated with requirement to repeat the offending assignment with a reduced grade. Major instances will lead to automatic failure for the course. The University policy, excerpted below, is at:

<http://www.wisc.edu/students/saja/misconduct/UWS14.html>

“Academic honesty requires that the course work (drafts, reports, examinations, papers) a student presents to an instructor honestly and accurately indicates the student's own academic efforts. UW-Madison [...] defines academic misconduct as follows:

Academic misconduct is an act in which a student:

- seeks to claim credit for the work or efforts of another without authorization or citation;
- uses unauthorized materials or fabricated data in any academic exercise;
- forges or falsifies academic documents or records;
- intentionally impedes or damages the academic work of others;
- engages in conduct aimed at making false representation of a student's academic performance;
- assists other students in any of these acts.

Examples include but are not limited to: cutting and pasting text from the web without quotation marks or proper citation; paraphrasing from the web without crediting the source; using notes or a programmable calculator in an exam when such use is not allowed; using another person's ideas, words, or research and presenting it as one's own by not properly crediting the originator; stealing examinations or course materials; changing or creating data in a lab experiment; altering a transcript; signing another person's name to an attendance sheet; hiding a book knowing that another student needs it to prepare an assignment; collaboration that is contrary to the stated rules of the course, or tampering with a lab experiment or computer program of another student. If you are accused of misconduct, you may have questions and concerns about the process. If so, you should feel free to call SAJA”

Plagiarism

“Plagiarism means presenting the words or ideas of others without giving credit. You should know the principles of plagiarism and the correct rules for citing sources. In general, if your paper implies that you are the originator of words or ideas, they must in fact be your own. If you use someone else's exact words, they should be enclosed in quotation marks with the exact source listed. You may put someone else's idea in your own words as long as you indicate whose idea it was (for example, "As Jane Smith points out, . . ."). If you are unsure about the proper ways to give credit to sources, ask your instructor or consult the Writing Center at 6171 Helen C. White Hall (phone: 608/263-1992, e-mail: writing@wisc.edu) for a copy of their handout "Acknowledging, Paraphrasing, and Quoting Sources,"”

Course Calendar, Readings, and Due Dates

<u>Week 1</u>	9/6 9/8	Introduction to Global Climate Processes Global Energy Balance (M&P Ch. 1-2)	
<u>Week 2</u>	9/13 9/15	Introduction to EdGCM and Climate Modeling GEB: Greenhouse Effect	MARK CHANDLER LECTURE
<u>Week 3</u>	9/20 9/22	GEB: Surface Processes GEB: Convection and Clouds (M&P Ch. 3-4)	ASSIGNMENT #1 DUE
<u>Week 4</u>	9/27 9/29	GEB: Energy transport (M&P Ch. 5) GEB Review	ASSIGNMENT #2 DUE
<u>Week 5</u>	10/4 10/6	Exam 1 – GEB Atmospheric Circulation (M&P 6-8)	EXAM 1
<u>Week 6</u>	10/11 10/13	AC: Hadley cell and thermal wind AC: Mid-latitudes	REVIEW PAPER DRAFT DUE
<u>Week 7</u>	10/18 10/20	Ocean Circulation (M&P 9-10) OC: Ekman Processes	ASSIGNMENT #3 DUE
<u>Week 8</u>	10/25 10/27	OC: Wind Driven OC: Abyssal and heat transport (M&P 11)	REVIEW PAPER FINAL DUE
<u>Week 9</u>	11/1 11/3	Circulation Review Presentations	IN-CLASS PRESENTATION
<u>Week 10</u>	11/8 11/10	Climate feedbacks (A&P p.154-190) CF: Ice-albedo	ASSIGNMENT #4 DUE
<u>Week 11</u>	11/15 11/17	CF: Carbon cycle NO CLASS	
<u>Week 12</u>	11/22 11/24	Exam 2 – AC, OC, CF NO CLASS THANKSGIVING	EXAM 2
<u>Week 13</u>	11/29 12/1	Climate variability – ENSO (M&P 12) CV: Paleoclimate	PROJECT PAPER DRAFT DUE
<u>Week 14</u>	12/6 12/8	NO CLASS NO CLASS	
<u>Week 15</u>	12/13 12/15	CV: Anthropogenic climate change (IPCC SPM) Final review, presentations, evaluations	ASSIGNMENT #5 DUE PROJECT PAPER FINAL DUE

NO FINAL