AOS 425: Global Climate Processes
Fall 2016 Syllabus

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Lectures: MWF 11-11:50 am (AOSS 1411)
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Course Websites: http://www.aos.wisc.edu/~tristan/aos425.php
(userame: aos425, password: gobadgers)
Learn@UW https://learnuw.wisc.edu/

Required Texts

1. Marshall, J. and R.A. Plumb, 2008, Atmosphere, Ocean and Climate Dynamics: An Introductory Text, Academic Press, New York, 319 pp.
2. Alley, R. 2000, The Two-Mile Time Machine, Princeton Univ. Press, 229 pp.

Reference Materials (Copies have been placed on reserve at the Schwerdtfeger Library)

1. Hartmann, D.L., 1994, Global Physical Climatology, Academic Press, 411pp.
2. Ruddiman, W.F., 2008, Earth's Climate: Past and Future. 2nd Ed. Freeman. 388 pp.

Course Overview

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

Final Exam	25%
Mid-term Exam	15%
Labs and Problem Sets	35%
Climate Modeling Project	25%

Reading Assignments and Problem Sets

- Careful reading of the textbook and related supplemental materials handed out throughout the semester is a very important component of this class. While all key concepts will be covered at a general level in class, we will not have time to cover all sample problems or derivations found in the text. However, class time will gladly be devoted to clarifying any uncertainty you may have regarding any of this reading material so questions are highly encouraged. A suggested reading schedule will be provided at the start of the semester.

- There will be 5 problem sets assigned throughout the semester at approximately 2-week intervals. These problem sets are specifically designed to allow you to dig deeper into the material than can be done in lectures. Unless otherwise stated, problem sets are due in class on the due date. Late problem sets will lose 15% for each day late, and will not be accepted after solutions have been discussed in class.
- 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. List all people (students, other faculty, etc) with whom you discussed each problem in the header of the solution.
- 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 that connect an observation to a mechanistic understanding are encouraged, e.g.:
        - 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
    - <u>Packing as much knowledge into a few words is the goal</u>. More text is not better – either for you to write or for the professor to grade.

Climate Modeling Project (25%)

During the semester you will gain hands-on experience working with a real global climate model. Working with a partner, you will identify a specific climate problem and design, run, and analyze simulations to address it using the EdGCM (edgcm.columbia.edu) software package. EdGCM is based on the first full global climate model that was created at Columbia University in the 1980s. This model and associated visualization packages will be described in a class tutorial in September.

During the first half of the semester, each group will perform a prescribed set of initial simulations and analyses to become familiar with EdGCM. A brief report on these simulations will be due in October. Each group will then decide on a hypothesis they would like to test with EdGCM during the second half of the semester. Each group will write a short (one-page) proposal describing the problem you will address, its importance in climate research, your proposed hypothesis, and a summary of the simulations you intend to perform (three to four) to test it. Since many students are thinking about applying for jobs, graduate school, and fellowships this time of year, we will use this as an opportunity to gain practice in application writing. Each student will submit a CV and an interest statement along with the proposal and seek to convince a mock peer review panel (the rest of the class) to *hire* you to conduct the proposed research. A class will be devoted to exchanging ideas for improving future applications. Groups will then conduct their experiments and present their findings to the class in early December. A final report is due on the last day of presentations.

The EdGCM model is installed on the 1411 computers. You will need to be in Windows in order to use it on these computers. Though very, very fast for a climate model, the model is still computationally intensive for a PC. It requires up to 24 hours to run a 150-year simulation. In 1411, the computers are shared, and thus model cannot be run when another class is using the lab (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). You are also welcome to (encouraged) to install a copy of the software on your own laptop to avoid these restrictions (the software will likely run faster on some newer laptops). Additional guidelines will be provided in class. Projects will be graded as follows:

Part I Report (team)	5%
Proposal and Peer Review	5%
Final presentation (team)	5%
Final paper (individual)	10%

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!