

**EARS 86 – Earth’s Past, Present, and Future Climate
Winter 2009**

- Instructor:** Erich Osterberg, 205 Fairchild Hall, 646-1096
- Meeting Times:** Tues, Thurs, 2-3:50 pm (2A)
- Office Hours:** Tues, Thurs 4-5 pm, and any other time my door is open
- Class Web Site:** <http://blackboard.dartmouth.edu>
- Required Text:** *Earth’s Climate: Past and Future* (Ruddiman), 2nd Edition
Intergovernmental Panel on Climate Change (IPCC) selections

Course Objectives: This course investigates the characteristics and causes of short- (1 yr) to long-term (>1 million yrs) climate change over the past ~400 million years and ~1000 years into the future. Future climate change is currently an active topic of discussion in the scientific community and public policy arena. In order to make informed predictions about Earth’s climate and informed decisions about our society’s response, it is essential to understand how and why Earth’s climate has changed in the past. We will investigate the climate system and its forcing mechanisms over three broad timescales: the tectonic timescale (millions of years), the orbital timescale (6,000-400,000 years), and the sub-orbital timescale (1-1,000 years). We will see that the climate has always been changing due to processes such as plate tectonics and changing geography, variations in the amount of solar energy absorbed in the climate system, and complex interactions and feedbacks between the ocean, atmosphere, lithosphere, biosphere, and cryosphere – many of which are only partially understood. We will then use this understanding to make reasonable (hopefully!) predictions of future climate under various scenarios.

Much of our understanding of the climate system and its forcing mechanisms comes from analyzing past changes in climate at particular locations and times using data from the instrumental (~100 years), historical (~500 years), and paleoproxy (~500 million years) records. We will therefore seek to understand where these data come from, the techniques used to collect them, their strengths, and their limitations and/or biases. We will also use the recent scientific literature to discuss four case studies in class as a means to focus on particular aspects of the climate system or climate change history.

A major component of this course will be to research and write a ~2500 word paper on a particular topic of interest to you. This is intended to develop your ability to find information, reconcile potentially-conflicting results, and communicate effectively through writing. There will be progressive deadlines to encourage you to work on this project throughout the term (see below). You will also submit a first draft for comments and revisions to help you improve your writing skills. The final draft of the paper is due on the day of the final exam.

Course Requirements and Grading:

Homeworks (10% of grade): There will be 2 homework problem sets during the term. You will have ~1 week to complete each.

Class Participation (10% of grade): Includes attending classes prepared and promoting class interaction, particularly during case-studies and literature discussions.

Abstracts (15% of grade): You will write three abstracts for three of the four case studies that we will conduct during the course. More information about the specific format for these abstracts will be handed out with the first case study.

Research Paper (25% of grade): You will write a ~2500 word (~10 pages double-spaced) research paper on a related topic of your choice (with approval). You will have progressive deadlines throughout the term (including submitting a topic and 3 sources, submitting an outline with 6+ sources, first draft, and final draft) to encourage you to spread out your research and writing. You will only be graded on the final draft, but points will be deducted if you do not meet each progressive deadline. This assignment is intended to develop your research, critical reading, and writing skills. Your grade will also be based on the quality of your oral presentation of your paper on the last day of classes.

Midterm Exam (20% of grade)

Final Exam (20% of grade)

Learning Disabilities: I encourage students who may need disability-related classroom accommodations to meet with me at the beginning of the term to discuss appropriate solutions. All conversations will remain confidential, although the Student Accessibility Service Office may be consulted to discuss appropriate accommodations.

Religious Observances: If you have a religious observance that conflicts with your participation in this course, please meet with me at the beginning of the term to discuss appropriate accommodations.

Academic Honor Principle: You should be aware of and conform to the Dartmouth Honor Code as expressed in the ORC. For this course, this means:

Homeworks: You may discuss the homework problems with each other and work together towards solutions, but you must write up your solutions in your own words showing your thinking and work where appropriate.

Research Paper: You must appropriately cite work and ideas that are not your own.

Exams: All work on exams is your own.

Tentative Syllabus

Date	Topic	Required Reading	Assignments
Tu 1/6	Course mechanics, into to Climate System Radiation and Heat Transfer	Ch 1	
Th 1/8	Overview of Climate Archives, Data, Models CO ₂ and Long-Term Climate	Ch 2 Ch 3	
Tu 1/13	Plate Tectonics and Climate Case Study #1: Snowball Earth and the Earth's "Thermostat"	Ch 4 Assigned papers	Abstract #1 due
Th 1/15	Greenhouse Climate	Ch 5	
Tu 1/20	Greenhouse to Icehouse	Ch 6	Paper topic and 3 sources due
Th 1/22	Astronomical Control of Solar Radiation, Monsoons, Ice Sheets	Ch 7, 8, 9	
Tu 1/27	Orbital Control of Greenhouse Gases, and Climate Feedbacks	Ch 9, 10, 11	Abstract #1 Rewrite due
Th 1/29	Climate Feedbacks, The LGM World	Ch 11, 12	
Tu 2/3	Deglaciation and Sea-Level Rise Case Study #2: The Younger Dryas	Ch 13 Assigned Published Papers	HW #1 Due Abstract #2 due
Th 2/5	Millennial Climate Oscillations and Forcing	Ch 14	
Tu 2/10	MID-TERM EXAM		
Th 2/12	Holocene Climate and Human Evolution	Ch 15	Outline of Paper and 6+ sources
Tu 2/17	Climate over the Last 1000 Years Case Study #3: Medieval Warm Period?	Ch 16 Assigned Papers	Abstract #3 due
Th 2/19	Climate Since 1800	Ch 17	
Tu 2/24	Causes of 20 th Century Climate Change	Ch 18	Paper 1 st draft
Th 2/26	Impacts, Adaptations and Vulnerability to Climate Change	IPCC Readings	
Tu 3/3	Climate Models and Future Climate Change Class Discussion: Global Warming Debate	Ch 19 Assigned Papers	Homework #2
Th 3/5	Mitigation of Climate Change Class Summary/Overview	PCC readings	
Tu 3/10	Class Presentations		
3/14 3:00	FINAL EXAM		Paper Final Draft