GEOL 170 Climate Science

Instructor:
Prof. Jessica Kleiss
Office: Olin 226B
Email: jkleiss@lclark.edu
Campus phone: x7368
office hours: Mon, Weds Thurs 1-2pm

Lectures:
MWF 11:30am-12:30pm in Howard 242
Laboratory:
Fri 2-5pm, typically in Dubach computer labs
Credits:
5 credits graded

Textbooks:

- *Climate Studies: Introduction to Climate Science. American Meteorological Society*
- *Investigations Manual; Climate Studies*

Course Description:
Over the past 50 years, the study of the Earth's climate has transformed from a sleepy sub-discipline of Meteorology to a controversial, cutting-edge, politicized debate. Discussion of climate change has become part of our national dialogue, and is regularly encountered in news media, political platforms, and regional planning boards. This course seeks to explore and explain the Earth's climate system from a physical perspective. We will discuss the physics of the Earth that create the current climate conditions, and the interaction of earth systems, including the atmosphere, ocean, cryosphere, geosphere, and biosphere. We will put the present day climate in context by considering paleoclimate, and examine the climate model forecasts for the future. What can we do? We will discuss some approaches to adaptation, mitigation, and geoengineering, as well as the challenges of international policy adoption.

Learning Outcomes:
By the end of the semester, students should be able to:

- Thoroughly understand the difference between weather and climate
- Appreciate the spatial and temporal variation of climate forecasts, especially temperature and sea level rise.
- Understand the radiative balance through the earth's atmosphere
- Appreciate prehistoric climate change on earth, and what that implies for today's climate
- Gain a facility of working with satellite observational data of the earth's climate and perform simple climatological analysis
- Understand the role of feedback in the climate system
- Understand the physical mechanisms behind El Nino and other climate indices, and why they are considered "climate variability."
- Gain a facility of working with educational climate models. Appreciate how the different parameters, forcing, and assumptions input to the models cause differences in model output.

- Understand the causes and consequences of ocean acidification
- Examine the impact of projected climate change on food production and water availability
- Learn about the proposed options of geoengineering, to "fix" this problem
- Think critically about the cause-and-effect of the earth's climate system, especially in the context of the climate debate, and skeptical arguments.

Online Class materials

The AMS Climate textbook and investigations manual comes with an online presence the provides links to weekly news, answer keys for the laboratory assignments, and online links and resources. To log in to the online content, go to

http://amsedu.ametsoc.org/amsedu/login.cfm
Login ID: ***
Password: ***

I will also be heavily using a Moodle page to manage course material. It is the usual page (GEOL-170). Note that the top link is "Course Schedule" that contains a tabular view of reading assignments, and additional assignments.

Class / Lecture.
There will be a reading assignment prior to each class, generally from the AMS textbook. Prior to one hour before lecture (ie. 10:30am MWF), you should

1) Complete an online (Moodle) reading quiz corresponding to the assigned text.
2) Send an email to ClimSci@gmail.com with two comments:
    a. What you found most interesting in the reading.
    b. Any questions, uncertainties, or confusion you have.

I will have some slides prepared that cover the text, but I think that most of the time I will focus on your questions from the reading, and delve a little deeper into the areas you found most interesting.

Climate in the News.
Every week on Wednesday and Friday, groups of 1-2 students will lead a class discussion about some climate in the news. A wide range of possible news topics will be made available as a starting point. A couple slides with images are encouraged. You can expect to lead 2 discussions of Climate in the News.

Weekly Lab
This class includes a weekly 3-hour lab. The majority of the time we will meet in the Dubach computer lab to work with climate models and satellite data. We will sometimes have "physical" labs, one to observe the spectral emission of the earth

and sun, and to tour the Portland NWS weather station, and one to explore the chemistry of ocean acidification.

Field Trip
We have a field trip scheduled for Friday afternoon, March 15th. (The date may change.) I'm hoping to depart at our normal lab time of 2pm, so we do not conflict with other courses or commitments that students have on campus. We will be traveling up to the Portland National Weather Service Forecast office, to see current meteorology in action, and get a tour. This is a required field trip for the course. If you have a scheduling conflict or other concern, please notify the instructor as soon as possible.

Midterms and Final
The midterms and final will draw upon the (Moodle) reading quizzes, the investigations manual, and the laboratory exercises.

Grading:

Climate in the News (2):	15%
Reading quizzes and class participation:	10%
Midterm 1:	15%
Midterm 2:	15%
Final exam:	20%
Laboratory write-ups:	25%

Schedule:

Week 1 (Jan 22):
Today's Climate Science
LAB: Inv 1A & 1B, and NASA time machine writing exercise.

Week 2: (Jan 28): (Chapter 3)
Earth's Energy Budget
LAB: Inv 3A & 3B: Solar spectrometer lab, and Archer "full spectrum" exercises

Week 3 (Feb 4): (Chapter 2)
Monitoring Climate
LAB: Inv 2A & 2B: Tour of Olin weather station, and exercises using the NWS climate record data.

Week 4 (Feb 11)
Climate, Heat, and Temperature
LAB: Inv 4A & 4B: Archer orbit model and full spectrum model. Quantitative thinking practice problems

Week 5 (Feb 18):
Global Water Cycle
LAB: Inv 5A & 5B: Archer infrared spectrum model.

Week 6 (Feb 25): **Midterm exam #1**
Global Atmospheric Circulation
LAB: Inv 6A & 6B: Exercises with adiabatic heating and cooling, planetary-scale circulation, and Coriolis effect.

Week 7 (Mar 4):
Regional Circulations
LAB: Field trip to Portland NWS station! (and write-up assignment)

Week 8 (Mar 11):
Air/Sea Interaction
LAB: MyGIS El Nino exercise

Week 9 (Mar 18):
Paleoclimates
LAB: Inv 9A & 9B

SPRING BREAK (Mar 25)

Week 10 (Apr 1):
Natural Climate Change
LAB: Climate Skeptics creative writing assignment

Week 11 (Apr 8):
Cloud effects, Aerosol direct and indirect effects
LAB: exercises about clouds and aerosols

Week 12 (Apr 15): **Midterm exam #2**
Anthropologic Climate Change
LAB: : Inv 12A & 12B, and ocean acidification (in the Chemistry lab!)

Week 13 (Apr 22):
Responding to climate change
LAB: ClimateInteractive UN summit on international emissions commitments. Role-playing.

Week 14 (Apr 29):
Climate change and public policy
(No LAB)

Week 15:
Final exam Thursday, May 9th, 1-4pm