**The Earth’s Climate System (ENVI 140)**

Macalester College – Spring 2010

**Lectures**: MWF 10.50 – 11.50am, Olin-Rice 101

**Labs**: Thurs. 1.20-4.30pm, Olin-Rice 187

**Instructor**: Louisa Bradtmiller lbradtmi@macalester.edu;

**Course description**

The Earth’s climate system is complex and dynamic, and a solid understanding of this system is crucial in order to address concerns about anthropogenic influences on climate.  In this course we examine the basic physical and chemical processes that control the modern climate system, including the role of incoming solar radiation, the greenhouse effect, ocean and atmospheric circulation, and El Niño.  We also look critically at the methods and archives used to reconstruct climate in the past, such as ice cores, marine and lake sediments, and cave deposits.  We explore the possible effects of anthropogenic greenhouse gas emissions on modern and future climate by examining the models used in climate prediction, and discuss the challenges of modeling such a complex system.  Although this course is taught from a primarily scientific perspective, it includes frequent discussions of the roles policy and economics play in the current dialogue on global climate change.

**Course organization**

Class periods will be a mixture of lecture, discussion and group exercises. The latter two will count towards the course participation grade (see below). Lab periods will consist of pair/group work using climate datasets, models, and hands-on experimental materials. Each lab will have an accompanying assignment, due at the beginning of the next week’s lab. Late work (on any assignment) will not be accepted.

**Goals for students**

By the end of this course, students should be able to demonstrate the ability to:

* Analyze data and draw reasonable inferences from it
* Read, comprehend and discuss scientific papers
* Communicate clearly and effectively through written and oral presentations of ideas

**Course Textbook**

Kump, L. R., J. F. Kasting and R. G. Crane. The Earth System, 3rd Edition. San Francisco: Prentice Hall, 2010.

**Moodle**

The class Moodle page (http://moodle.macalester.edu/course/view.php?id=210) will be updated regularly, and should be your first stop for information about readings, assignments, and what to expect in class on any given day. The page is color-coded: anything in green is a reading you should complete before class on the day of the entry, and anything in blue is an assignment due that day. This will require some looking/thinking ahead on your part.

**Grading**

Your final grade for this course will be determined by the number of points you accumulate throughout the semester.

|  |  |
| --- | --- |
| Point distribution | |
| Participation | 40 |
| Homework (4 @ 15 points each) | 60 |
| Website | 90 |
| Labs (11 @ 10 points each) | 110 |
| Exams (3 @ 100 points each) | 300 |
| TOTAL | 600 |

**Attendance**

Attendance in labs is mandatory. Attendance in lecture is at your discretion, although students who attend regularly are likely to receive higher grades than those who do not. The participation portion of your grade will be based on your contributions to classroom discussions/activities and also on any pop quizzes that may turn up…

**Exams**

There will be three exams in this course, spaced roughly evenly throughout the semester. They will cover material from lectures, labs, discussions, and readings assigned at any point before the date of the exam. The format usually consists of a combination of short answer questions and essays. If calculators are allowed/required, I will let you know well in advance. Attendance at exams is required- failure to attend will result in a grade of zero for that exam. I realize that this seems obvious. There are only 3 instances in which you may reschedule an exam: 1) serious illness 2) a family emergency 3) a college sanctioned activity that requires you to be off-campus during the exam. In all cases I will need to see some documentation (ie. a doctor’s note, note from the Dean, etc.), and I ask that you notify me as soon as you know you will miss the exam.

**Homework**

There will be 4 homework assignments to reinforce concepts in lecture. You will have approximately 2 weeks to complete each one from the time it is assigned. I encourage you to work in pairs/groups on these assignments. However, each student must turn in their own assignment, written in their own words. This means you may discuss the answers together, but must write them out yourselves. See me with any questions about what this means- copying will not be tolerated.

**Website**

Being able to communicate facts and ideas through a website is a becoming an increasingly important skill. Your assignment is to choose a topic covered in class, gather more in-depth information than what was covered in lab/lecture, and present that information on a website. There will be more specific information about this assignment as the semester progresses.

**Labs**

Lab section will meet in Olin-Rice 187 on Thursdays from 1.20-4.30pm. ***Lab will meet for the first time on Thursday, 28 January—you must attend!*** We will use the weekly laboratory time to engage in a variety of activities including experiments, field trips, computer modeling, data analysis, etc. No make-up labs will be available and missing lab will result in a significant loss of points. The lab Moodle page can be found at http://moodle.macalester.edu/course/view.php?id=211. You may work in pairs for lab reports (and turn in one report per two students), and it is your responsibility to make sure that the work is divided equitably. See me with any problems.

**Study help**

Mark Davis, Professor and Chair of Biology, has written several Useful Flyers of Information covering a number of ‘how to’ topics, including reading a scientific paper. These can be found at http://macalester.edu/~davis/MADUFIs.htm. You can also take advantage of the MAX center (and your peers!) for help with math or other areas.

**Academic integrity**

I take all instances of cheating and plagiarism very seriously. It is YOUR RESPONSIBILITY to become familiar with Macalester’s policies on what constitutes each of these offenses and to behave accordingly. Instances of suspected academic dishonesty will be handled as outlined in the policies. **http://www.macalester.edu/academicprograms/integrity.html**

**Disabilities**

I am committed to providing assistance to help you be successful in this course. Accommodations are available for students with documented disabilities. Contact the Associate Dean of Students, Lisa Landreman (696-6220) to make an appointment. Please do this early in the semester to ensure that necessary accommodations are approved so that you can begin the semester successfully.

**Miscellany**

If you have concerns about any aspect of this course, please come see me sooner rather than later. I am always interested to hear about how you think the class could be more interesting, and if there’s a topic you’re just dying to see covered, we’ll see if we can fit it in. I will be as accommodating as possible with respect to religious/cultural observances (with appropriate notice). I will respond to email during ‘normal business hours’. While it is possible that I will check my email at 2am, I probably won’t write you back until the next morning. So, don’t wait until the last minute to email with that question about your lab that’s due tomorrow.

**Schedule of topics:**

|  |  |  |  |
| --- | --- | --- | --- |
| Week | Topic | Lab | Readings |
| 1 | Introduction | Radiation and the Greenhouse Effect | Ch. 1; Ch. 2 (pp18-23) |
|  | Radiation budget |  | Ch. 3 (pp 34-41) |
| 2 | Greenhouse effect | Cloud Forcing | Ch. 3 (pp 41-48) |
|  | Atmospheric convection |  | Ch. 3 (pp 48-53) |
| 3 | Moisture and clouds | Surface Energy and Water Balance |  |
|  | Atmospheric balance, weather |  | Ch. 4 (pp 55-68) |
| 4 | General circulation, climate zones | Structure of the Atmosphere | Ch. 4 (pp 68-82) |
|  | Ocean circulation |  | Ch. 5 |
| 5 | Ocean stratification | Ocean Circulation Simulation | Ch. 5 |
|  | Midterm |  |  |
| 6 | Ocean/Atmosphere coupling | ENSO Impacts |  |
|  | ENSO- Ocean/Atmosphere coupling |  | Ch. 15 (306-312) |
| 7 | ENSO- impacts | The Cryosphere |  |
|  | The cryosphere |  |  |
| 8 | Spring Break, no class |  |  |
| 9 | Earth's carbon cycle | Field Trip to LacCore Lab | Ch. 8 |
|  | Proxies and archives |  | Ch. 14 |
| 10 | Paleoclimate | Abrupt Climate Change | Ch. 10; Ch. 11; Ch. 12 |
|  | Paleoclimate |  | Ch. 15 (289-306) |
| 11 | Midterm | ED GCM |  |
|  | Anthropogenic influence on climate |  | Ch. 16 |
| 12 | Introduction to climate models | ED GCM | Ch. 6 |
|  | General Circulation Models |  | Ch. 6 |
| 13 | Future climate projections- Intergovernmental Panel on Climate Change (IPCC) | Work on Websites | IPCC Fourth Assessment Report (AR4) |
|  | IPCC |  | IPCC AR4 |
| 14 | Impacts of climate change | Work on Websites | IPCC AR4 |
|  | GHG/CC Remediation |  | IPCC AR4 |
| 15 | Present Websites | No Lab (classes over) | IPCC AR4 |
|  | Final Exam |  |  |