

## **Modeling Earth Systems (ENVI 294-03)**

### **Macalester College – Fall 2015**

**Class meetings:** T 1:20 – 4:30pm, OLRI 189 (Geology computer lab)

**Instructor:** Louisa Bradtmiller      lbradtmi@macalester.edu; 651.696.6837; Olin-Rice 249D  
Office hours by appointment (Google Calendar)

#### **Course description**

The Earth is full of large, complex systems. Often, these systems involve one or more components that make them impractical to study directly in nature because they are inaccessible (e.g. Earth's core), very slow (e.g. plate tectonics), or simply because they are too large to observe in their entirety (e.g. the climate system, or ocean circulation). One possible solution is to use numerical models to generate and test hypotheses by simulating the processes most important to each system. In this course we will use papers from the scientific literature as the basis for modeling a new system each week. We will create models and run experiments using STELLA, a visually based modeling software package. Topics include (but are not limited to) population growth, Earth's climate, the flow of ice in glaciers, and ocean circulation. For the final project students will spend several weeks designing a model of a system of their own choosing. No previous Macalester courses in math or computer science are required; exposure to calculus may be helpful, but students can be highly successful without it. This course is designed for students with a basic knowledge of systems thinking within any related scientific discipline, and a willingness to experiment.

#### **Course organization**

Each week we'll focus on modeling a different system. Students will be asked to complete a reading before class, and a reading quiz first thing in class. We'll spend a short time introducing and discussing the system together; after this, students will follow a set of instructions to guide them through creating the system model. The model, and answers to questions embedded in the exercise, will typically be due at the beginning of class the following week. About halfway through the course students will start working toward their final project, an independent modeling project on a system of their choosing, due at the final course meeting (see Moodle for complete project assignment description).

#### **Goals for students**

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

- create a model of a dynamic earth system.
- use a model to make a predictive hypothesis and then test that hypothesis through experimentation.
- critique and make judgments about the uses and limitations of models.
- explain the main components, feedbacks, and forcings of the global climate system, including the role of humans as one of the principal forcings.

## **InTeGrate**

This course is part of [InTeGrate](#), a large multi-site NSF-funded project to create interdisciplinary teaching materials about critical problems related to sustainability, systems thinking, and geoscience. As such, there are a few components of the course that may be unusual for you, including some pre- and post- course surveys needed to supplement the data collection. Most of the work you submit in this course will only be seen by the instructor, but there are several notable exceptions; the essay response and final project will both be sent (with student data anonymized) to the project coordinators as part of their assessment efforts. Data collection for this course has been approved by Macalester's IRB, and students will be given the opportunity to (anonymously) opt out of data collection on the first day of class. Please feel free to ask any and all questions you may have about this project!

## **Moodle**

The class Moodle page (<https://moodle.macalester.edu/course/view.php?id=57>) 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	
Surveys (2 @ 5 points each)	10
GLE (2 @ 5 points each)	10
Essay response	30
Reading quizzes (10 @ 5 points each)	50
Modeling exercises (10 @ 30 points each)	300
Final Project	200
TOTAL	600

## **Attendance**

Attendance in weekly course meetings is mandatory; you are free to leave early if you have finished and turned in the assignment for the week. Obviously if you are seriously ill, we'll work something out, but plan to spend the entire class period in class each week. Unexcused absences will result in substantial penalties on that week's assignment.

## **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. All work in this course will be turned in individually; there is no group work. Students are encouraged to collaborate with one another on weekly assignments, but

each student must turn in an assignment written entirely in their own words. Instances of suspected academic dishonesty will be handled as outlined in college 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 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 assignment that's due tomorrow. Cell phone use will not be tolerated- please turn phones all the way off, or put them to sleep (no vibrate!).