U Colorado

Senior
UCO Global environmen

Global Environmental Modeling
GEOL 4700/5700, EPOB 4460/5460

Class time: T-Th 9:30-10:50. Room 285, Benson Earth Sciences Building

Instructors: Alan Townsend (EPOB) alan@nalu.colorado.edu
INSTAAR office 116 RL-1, 492-6865,
Julia Cole (Geological Sciences) coleje@spot.colorado.edu
INSTAAR office 153 RL-1, 492-0595 (preferred #)
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Teaching Assistants: Alex Robertson, 492-7808, aroberts@stripe.colorado.edu
Ken Mack, 492-7739, mack@colorado.edu

Text: No text for this class; readings assigned from the literature.

Office hours: to be determined for instructors and TA's

If you have a learning disability that requires accomodation, please see one of the instructors early in the semester so we can help you make appropriate arrangements.

Welcome!

Overview: Modeling of Earth and ecological systems offers environmental scientists an important and probably unique tool to anticipate how these systems respond to natural or anthropogenic perturbations and how they interact with each other. In this course, we aim to teach you how to translate a basic understanding of a scientific phenomenon into a quantitative representation – a model – of that system. We will construct simple models of environmental systems, use them to explore the behavior of these systems through time and under modified input conditions, and combine them to develop more complex models. This background will enable us, later in the class, to apply and diagnose existing complex models of global climate, ecological, and biogeochemical systems. This course will target topics related to the subject of global change (Earth's energy balance, climate, biogeochemistry, ecological systems), and students will design and apply numerical models to explore the possible consequences associated with past and future environmental change scenarios.

We expect that at the end of this class, you will have developed the ability to construct simple models of simple systems, develop more complex models using these simple modules and varying input and boundary parameters, evaluate models' performance based on their construction and inputs, and discern whether conclusions drawn from a modeling study are appropriate or inappropriate based on an understanding of the model. These skills will be important whether you are doing science or simply reading about the latest computer model projections of global warming in the newspaper.

Expected student background: This class is aimed at advanced undergraduates with a natural sciences major and at beginning graduate students in the natural sciences, particularly Geological Sciences, EPO Biology, and Geography. You should be familiar with basic computing in a PC environment (Mac users should have no trouble either), including simple data manipulation and internet use. The first half of the class will require you to become familiar with the modeling program Stella; we assume no prior knowledge of this software. The latter part of the class will require you to download large files from the Web and import these into programs for analysis. We will be happy to provide tutorials if any of these are unfamiliar skills.

The format of the class will include both lecture, group and individual presentation, guest lectures, and hands-on computer work. The hands-on portions will meet in the Benson computer classroom. We envision mostly classroom work on Tuesdays, and split classroom and computer work on Thursdays, although this will vary from week to week.

Grading and Assignments: We have not selected a text for this class; readings will be derived from many sources, mostly the primary scientific literature. We will assign modeling exercises weekly, and these will comprise 50% of the total class grade. They will be due on time, with 10% penalty weekly for late assignments and no assignments accepted after 3 weeks beyond the due date (unless other arrangements are made). A midterm will comprise 20% of the final grade, and a final project will be worth 30%. There will be no final exam. Many of the homework assignments, and potentially the final project, will incorporate group activities. We will outline separate expectations for graduate students (revolving primarily around the final project) early in the semester.

Approximate Course Outline:

1. Introduction to modeling with Stella: (6 weeks)
    - Lake system
    - Ecosystems
    - Radiative balance and greenhouse gases
    - Global carbon cycle and anthropogenic perturbations
2. General circulation models of climate (2.5 weeks)
    - Diagnosis and evaluation of modern simulations
    - Simulations of past and future: what to trust, what to question?
3. The CENTURY model of biogeochemical and ecological systems (2.5 weeks)
    - Biome-climate relations
    - Nitrogen fertilization and carbon uptake
4. Guest lectures: what's state-of-the-art in modeling complex environmental systems? (1.5 weeks)
    - Inverse modeling
    - Coupled ocean-atmosphere GCMs and their predictions for the future?

Earth system models?
Predictive ecosystem models?

5. Student presentations of final projects (1.5 weeks)