

Upper level course

ATMOS/GEOG/GEOL 397E "MODELING THE EARTH SYSTEM"
3 hours or 1 unit

Wednesday 7-10 pm (given the late hour, rides will be available for students after class) Room 219 Atmospheric Sciences Building.

ONLY EAST ENTRANCE TO BUILDING WILL BE UNLOCKED AT 7.

Optional open lab: Tuesday, 3-5 pm, Room 219 Atmospheric Sciences Bldg

Instructors

Prof. Thomas Anderson, Department of Geology, 234 Natural History Building
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Prof. Walter Robinson, Department of Atmospheric Sciences, 110 Atmospheric Sciences Building, 333-2292, robinson@atmos.uiuc.edu

Teaching assistant

Mr. Geoff VanDyke, Department of Geography, 124 Davenport Hall
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Geoff will be at the Tuesday open lab sessions

Texts (required)

Donella H. Meadows, Dennis L. Meadows, Jørgen Randers, *Beyond the Limits: Confronting Global Collapse, Envisioning a Sustainable Future*
 Arthur A. Few, *System Behavior and System Modeling*

Welcome to ATMOS/GEOG/GEOL 397E, "Modeling the Earth System". In this course you will build and use models of global climatic, hydrologic, geochemical, and human systems, explore the basic concepts of systems modeling, use models to test hypotheses, and find out about the assumptions and approximations that must be made in modeling. Your models will be constructed using the STELLA® modeling software on Macintosh computers. STELLA offers an intuitive approach to modeling, so that prior experience with computer modeling is *not* a prerequisite for this course.

Why bother to learn about models and modeling? First, because models have become the primary research tool in trying to understand and make predictions about global systems. Many of you will use models in your future research. At the very least your research will be motivated by and informed by results from models. Secondly, because decision-makers use models, and their decisions affect directly how you, and everyone else, lives their lives.

In the past, in various courses, the instructors of this course have described models and presented results from models. Modeling, is, however, only learned by doing. So, this is a course where you will spend most of your time building and

using models. The goals are several:

- ◆ to understand how models are constructed and used, what assumptions must be made, which results are robust and which are deserving of skepticism...
- ◆ to grasp the fundamental systems concepts that underlie all models: fluxes and reservoirs, positive and negative feedbacks, open and closed systems...
- ◆ to gain basic modeling skills that can be applied in your own research...
- ◆ to learn about the basic principles that govern the systems we model here: the climate, the hydrologic cycle, biogeochemical cycles, and the sustainability of human activity on the earth.

Organization and grading

Throughout the semester you will work in small groups. Initially these will comprise just two or three students. Because of the widely varying backgrounds, modeling experience, and computing expertise students bring to this course, these groups will be assigned by the instructors, and they will change over the course of the term. For the first 3 sections of the course, hydrology, climate, and biogeochemical cycles, your group will be asked to keep a lab notebook, describing your models and the experiments conducted with them. For the final section, global sustainability, you will formulate questions to pose to the "World3" model, and then present your results to the class. Grades will be assigned on the basis of these notebooks and presentations.

Use of the texts

There are two required texts. The first of these, Arthur Few's *System Behavior and System Modeling*, will be most useful early in the semester. You should read through the brief (48 pages) of the body of the text during the first week of the semester. The remainder of the book is a "Quick Help Guide" for STELLA (starts on page 88) which may be of use throughout the semester, and a STELLA tutorial (pages 58-82). The deer population model you construct in this tutorial is a simpler example of the overshoot and collapse dynamics that are at the core of the most alarming predictions of the World3.

Beyond the Limits, by Donella Meadows, Dennis Meadows, and Jørgen Randers, introduces the ideas behind the World3 model, and goes on to describe what this model tells us about the future of human society. This is a very readable book, and it is essential that you read it before the final section of the course begins in April. You are *not* required to agree with the book. In fact, as you read, you should be thinking about which of the authors' assumptions you question. Such doubts can motivate your later experiments with World3.

Additional readings may be assigned during the semester.

Schedule

Date	Topic	Principal instructor
Jan 22	Intro. to course, modeling and STELLA	Robinson
Jan 29	Hydrology models	Robinson
Feb 5	" "	" "
Feb 12	" "	" "
Feb 19	Climate models	Robinson
Feb 26	" "	" "
Mar 5	" "	" "
Mar 12	Biogeochemical cycles	Anderson
Mar 19	" "	" "
Apr 2	" "	" "
Apr 9	" "	" "
Apr 16	Global sustainability	Isard
Apr 23	" "	" "
Apr 30	" "	" "
May 7	" "	" "