

GPHY 819: MODELING THE EARTH SYSTEM

(Queen's University, Winter 2012)

Instructor

Dr. Neal Scott

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Meeting location: Mac-Corry E216, Tuesday 8:30-11:30 (room may change during semester)

Course Description

Earth System Science involves understanding complex interactions and feedbacks, e.g. between biological systems and physical factors such as temperature and moisture. To facilitate our understanding of dynamic systems, simulation models can help organize our thinking about system interactions, point to critical knowledge gaps, and test key hypotheses when field experimentation is not possible. Without models, researchers are often left speculating about causality in their own research. This course will take students through the process of developing, testing, and validating system models. It will start by introducing students to the philosophy of modeling, different types of modeling approaches, and basic model development and structure. We will then explore, using the literature, various modeling approaches involving systems of interest to the students and/or online versions of various models. Over the last half the course, much of the time will be spent by students developing their own model, ideally one directed towards their own research. Students do NOT need to have their own data to take (and benefit from) this course.. Model development will be done using the modeling software STELLA (developed by *isee systems*), and will learn to utilize the software to construct and analyze their models (including uncertainty analysis and model validation)

Course activities

Throughout the term, we will have a combination of lectures and hands-on tutorials during our scheduled class time. For most weeks early in the term, roughly half of the class will be dedicated to lecture/discussion and half to hands-on work. Initially, I will be providing some modeling exercises from Richmond 2005. These either need to be completed during lab time, or you can complete them outside of class time. Completed exercises **MUST** be turned in to me the week after they are assigned.

For the second half of the course, we will spend much more time talking about your own process of model development. This will include class discussions of each person's modeling framework, objective statements, etc. As a class, we will go through all the stages of model development as they relate to your own experience building a systems model. I will give some lectures on a few topics of special interest in terms of Earth System Models.

Evaluation:

- Literature review project: 25%
- Assignments: 10%
- Final project presentation: 15%
- Individual modelling project: 40%
- Participation in discussions of reading assignments and seminars: 10%

Reading material:

Grant, W.E., E.K. Pedersen, and S.L. Marin. Ecology and Natural Resource Management: Ssystems Analysis and Simulation. John Wiley and Sons, Inc. New York, NY. 373 pp.

Richmond, B. 2005. An Introduction to Systems Thinking. Isee Systems. 165 pp

Fisher, D.M. 2005. Modeling Dynamic Systems: Lessons for a First Course.

Hannon, B., and M. Ruth. Dynamic Modeling. Springer Verlag

STELLA Software Reference Guide.