Modeling ecosystem biogeochemistry

SOCR 620
3 credit course: 2 hour lecture + 3 hour laboratory
Target audience: Graduate students in Soil and Crop Sciences, Horticulture, Natural Resources, GDPE, Agricultural Engineering

Instructor: Keith Paustian

Course schedule:
Lectures: Tuesday/Thursday – 10:00-11:00 AM
Lab: Wed - 1-4 PM

Recommended prerequisites: Calculus, Introductory Soil Science (SC 240), Ecology (BY 220, EY 505)

Course objectives: Learn to conceive, formulate and construct dynamic process- and ecosystem-models. Use simulation models to develop and formalize hypotheses and to analyze and interpret experimental or observational data. Gain an understanding of the use and limitations of models. Get an introduction to advanced model analysis procedures, including parameter optimization, sensitivity analysis, validation and uncertainty analysis.

Course overview:

W1 – Course introduction, basic systems theory
W2 – Model elements and model construction
W3 – Modeling litter decomposition
W4 – Modeling N mineralization and immobilization
W5 – Modeling soil organic matter and nutrient dynamics (Century model)
W6 – Modeling soil organic matter and nutrient dynamics II
W7 – Modeling photosynthesis and respiration (Farquhar model)
W8 – Modeling plant growth/biomass partitioning
W9 – Model integration - submodels
W10 – Modeling soil water dynamics I
W11 – Modeling soil water dynamics II
W12 – Modeling soil inorganic chemistry
W13 – Sensitivity analysis/validation
W14 – Thanksgiving
W15 – Model uncertainty analysis
W16 – Model integration – full system
W17 – Finals – presentations of modeling projects

Grading: Mid-term (take home – W 9) 15%, Final (project) 25%, Laboratory projects (models) 60%

Lecture and laboratory interactions

After the first few 'how to do' lectures, the lecture periods will largely function as 'set up' periods to the modeling exercises, to provide some background and general principles on the processes and phenomena that we're attempting to model during that week. Relevant papers will be handed out at the Tuesday lecture to be read and studied before the next Thursday meeting. For the Thursday lecture period we'll go through the model abstraction and design process as a group exercise to lead into the model construction during the laboratory period.

Laboratory exercises

W1 – Self orientation on Simile system	
W2 – Simple flow model	**Lab report for W1-2**
W3 – Litter decomposition models	
W4 – N mineralization and immobilization model	**Lab report for W3-4**
W5 – Soil organic matter model (Century)	
W6 – " " "	**Lab report for W5-6**
W7 – Photosynthesis model (Farquhar model)	
W8 – Whole plant model	**Lab report for W5-6**
W9 – Combined SOM and plant model	
W10 – Soil water model	
W11 – " " "	**Lab report for W10-11**
W12 – Soil P model	
W13 – Sensitivity analysis/validation	
W14 – Thanksgiving	
W15 – Model uncertainty analysis	**Lab report W13-15**
W16 – Model integration – full system	

Textbook: There is **no** required text for the course. However, if you are interested in an introductory text book for further study here are a couple of recommendations:

Haefner, J.W. – Modeling Biological Systems – Principles and Applications, Chapman Hall.

Smith, J and Smith P. – Environmental modeling – an introduction. Oxford Press.