

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

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Office hours: by appointment (email) or catch me after class

Course schedule:

Lectures: Tuesday/Thursday – 10-11 AM (W212 – Plant Science)

Lab: Thurs - 1-4 PM (NR 232 – Natural Resources)

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

Course objectives: Learn to conceive, formulate, construct dynamic process- and ecosystem-models. Use simulation models to develop 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, 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

Spring Break

W9 – Model integration - submodels

W10 – Modeling soil water dynamics I

W11 – Modeling soil water dynamics II

W12 – Modeling soil N₂O emissions

W13 – Sensitivity analysis/validation

W14 – Model uncertainty analysis

W15 – Model integration/testing – full system

W16 – Finals – presentations of modeling projects

Grading: Final (project) 30%, Laboratory projects (models) 70% (each lab weighted equally and graded on a standard numerical basis (90-100 = A, 80-90 = B, etc.)

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 about the processes and phenomena that we’re attempting to model during that week. Relevant papers will be posted on Canvas at the beginning of the week for use in Tuesday lecture giving the science background on each topic. 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 that you’ll do during the laboratory period (and as home work).

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 W7-8
Spring Break	
W9 – Combined SOM and plant model	(no lab report)
W10 – Soil water model	
W11 – “ “ “	Lab report for W10-11
W12 – Soil N ₂ O model	Lab report for W12
W13 – Sensitivity analysis/validation	
W14 – Model uncertainty analysis	Lab exercise - complete
W15 – Model integration – full system	(work toward final)
W16 – Final exam	Write up and presentation

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. 2005 – Modeling Biological Systems – Principles and Applications, Springer (can be downloaded for free from the Library)
Smith, J and Smith P. – Environmental modeling – an introduction. Oxford Press.

Need Help? Rams Take Care of Rams

Reach out and ask for help if you or someone you know is having a difficult time. Always feel free to come and talk to me; I will always make myself available to help connect you with any resources you need. CSU is a community that cares for you. If you are struggling with drugs or alcohol and/or experiencing depression, anxiety, overwhelming stress or thoughts of hurting yourself or others please know there is help available. Counseling Services has trained professionals who can help. Contact 970-491-6053 or go to <http://health.colostate.edu>. If you are concerned about a friend or peer, tell someone by calling 970-491-1350 (or visit <http://safety.colostate.edu/tell-someone.aspx>) to discuss your concerns with a professional who can discreetly connect the distressed individual with the proper resources. Rams take care of Rams!

This course will adhere to the Academic Integrity Policy {Section 1.6} of the Colorado State University General Catalog, the Student Conduct Code, and University Principles of Community.

- *Please refer to [The University Principles of Community](#) found on page 9 of this syllabus.*
- *Please refer to our cheating and plagiarism policy found on the Canvas homepage and page 11 of this syllabus.*
- *Student Conduct Code: <http://www.conflictresolution.colostate.edu/conduct-code.aspx#conduct>*
- *Colorado State University General Catalog: <http://www.catalog.colostate.edu/>*

Principles of Community

In this course we strive to follow and extend Colorado State's University's Principles of Community, and welcome spirited discussion, lively debate and pursuit of knowledge in a manner that respects each of us as individuals.

The Principles of Community support the Colorado State University mission and vision of access, research, teaching, service and engagement. A collaborative and vibrant community is a foundation for learning, critical inquiry, and discovery. Therefore, each member of the CSU community has a responsibility to uphold these principles when engaging with one another and acting on behalf of the University.

- *Inclusion: We create and nurture inclusive environments and welcome, value and affirm all members of our community, including their various identities, skills, ideas, talents and contributions.*
- *Integrity: We are accountable for our actions and will act ethically and honestly in all our interactions.*
- *Respect: We honor the inherent dignity of all people within an environment where we are committed to freedom of expression, critical discourse, and the advancement of knowledge.*

• *Service: We are responsible, individually and collectively, to give of our time, talents, and resources to promote the well-being of each other and the development of our local, regional, and global communities.*

• *Social Justice: We have the right to be treated and the responsibility to treat others with fairness and equity, the duty to challenge prejudice, and to uphold the laws, policies and procedures that promote justice in all respects.*

Title IX: Sexual Assault, Sexual Violence, Sexual Harassment:

CSU's Discrimination, Harassment, Sexual Harassment, Sexual Misconduct, Domestic Violence, Dating Violence, Stalking, and Retaliation policy designates faculty and employees of the University as "Responsible Employees." This designation is consistent with federal law and guidance, and requires faculty to report information regarding students who may have experienced any form of sexual harassment, sexual misconduct, relationship violence, stalking or retaliation. This includes information shared with faculty in person, electronic communications or in class assignments. As "Responsible Employees," faculty may refer students to campus resources (see below), together with informing the Office of Support and Safety Assessment to help ensure student safety and welfare. Information regarding sexual harassment, sexual misconduct, relationship violence, stalking and retaliation is treated with the greatest degree of confidentiality possible while also ensuring student and campus safety.

Any student who may be the victim of sexual harassment, sexual misconduct, relationship violence, stalking or retaliation is encouraged to report to CSU through one or more of the following resources:

-Emergency Response 911

-Deputy Title IX Coordinator/Office of Support and Safety Assessment (970) 491-1350

-Colorado State University Police Department (non-emergency) (970) 491-6425

Please Visit: <http://oeo.colostate.edu/title-ix-sexual-assault> for more information.