SOCR670

TERRESTRIAL ECOSYSTEMS ISOTOPE ECOLOGY

3 Credits course

Offered every odd year –in the spring semester

Course schedule: Spring Semester 2013, Lectures: Tuesday / Thursday 10:00 -11:00, Plant Science Room W01; Lab: Thursday: 1:30-3:30 pm Room W001 (or NESB A119)

Instructor: M. Francesca Cotrufo, NESB B250, tel. 491-6056 e_mail: cotrufo@nrel.colostate.edu

Target audience: Graduate students in Soil and Crop Science, GDPE, Botany, Zoology, FRWS, Atmospheric Sciences, Fish Wildlife and Conservation Biology.

Description of the course: This course is meant to bring together students from different backgrounds who share the common interest of exploring new methods for their research. In fact, it will guide students to think "isotopically" and provide them with basic practical skills to apply isotope methods in their research. In the first part of the course, during lectures, students will learn about isotopes and isotope notation, principle of mass spectrometry, isotope fractionation, mixing and enrichment. In parallel, during lab, students will gain experience with handling isotope data, convert from one unit into another, build and solve mass balance equations and keeling plots. This phase will terminate with a midterm exam, in the form of a short questions assignment to be taken at home, closed book, during week 7. In the second part of the course, during lectures students will learn how isotopes distribute naturally in the biogeochemical cycles, and will be presented with several different areas of study, with a focus on biosphere-atmosphere interactions in terrestrial ecosystems, where isotope methods can be applied. This part of the course will mainly present case studies and, in addition to the instructor lectures, guest lectures and recitations of published relevant work will be used to expose students to the state-of-the art knowledge in isotope research. During labs, we will do a field trip to the Shortgrass steppe where students will have the chance to sample plant, soil and air samples. Following, at the CSU stable isotope laboratory, students will analyse the samples by Isotope Ratio Mass Spectrometry (IRMS) and learn, hands on, methods of lab and data analyses. The overall course will stimulate students to develop their ideas on how to incorporate isotope approaches in their research. This will be further achieved by the assignment, as final exam, to write a research proposal on their area of interest, where isotope methodologies are used.

Learning Objectives: Think "isotopically". Gain a general knowledge in isotope ecology. Think outside the boundary of defined research areas. Learn to generate hypotheses and design experiments based on isotopic methods. Handle isotope data and apply mass balance approaches. Gain confidence with basic stable isotope analytical methods and IRMS.

Text: There is not a single text that covers all the contents of the course. However, reading is strongly suggested of specific (#1,2,5,6,7) chapters from Fry B., 2006 "Stable Isotope Ecology", Springer. Additionally, before each lecture, notes will be provided in PDF format, that also report a reference list of the publications used to prepare the lecture, and selective reading of those publications (on the basis of specific students' interest) is suggested. A time-guideline of suggested reading is provided below.

Prerequisites: There are no absolute requirements to follow this course. It is designed for graduate students who are actively engaged in planning or conducting their research and are interested in learning more about isotope techniques.

Class Schedule

Week	Lecture topic	Lab	Suggested Reading
1/22-24	Introduction to the course, what are isotopes? Isotope notations	Student introductions. Numerical exercises to calculate δ and unit conversion	Fry B. 2006. Stable Isotope Ecology. Springer Chap. # 1,2
1/29-31	Measuring stable Isotope	Visit to the CSU Isotope lab and introduction to the IRMSs	Fry B. 2006. Stable Isotope Ecology. Springer Chap. # 2
2/5-7	Isotope fractionation	Numerical exercises to calculate fractionation factors	Fry B. 2006. Stable Isotope Ecology. Chap. #7
2/12-14	Isotope mixing	Numerical exercises to build and solve mixing models	Fry B. 2006. Stable Isotope Ecology. Chap. #5
2/19-21	Isotope labelling I: ^{13}C labelling, recitation	Visit to the labelling chamber. Numerical exercises to calculate isotope enrichment amounts	Bird et al., 2003 Soil Sci. Soc. Am. J. 67: 806-816
2/26-28	Isotope labelling II: nutrients and water, recitation	Numerical exercise with the isotope dilution method	Di et al., 2000. AustJSoilRes:38-213-230
3/5-7	Radioisotopes, (guest lecturer: Dr. Eldor Paul)	**Midterm exam**	Gaudinski, J. B., et al. 2000. Biogeochemistry **51**:33-69
3/12-14	Isotopes in the C cycle	Mid-term exam correction. Group discussion & guidelines for final project preparation	Farquhar et al. 1989. Ann. Rev. Plnt Physiol. Plant Mol. Biol. 40:503-53
3/26-28	Isotopes in the N cycle	Collection of plant, soil and air samples	Högberg et al., 1997. Ney Phytologist . 137: 179-203
4/2-4	Isotope in the water cycle	Water extraction line and analyses of ^{18}O in water, by the CO_2 exchange method	Dawson, 1993. Chap 30. In *Stable isotope and Plant Carbon-Water Relations*. Eds. Ehleringer et al. Academic Press.
4/9-11	Partitioning respiration fluxes using isotopes, recitation	Analyses of ^{13}C-CO_2 on soil respiration samples	Pataki et al., 2003. Glob Biogeochem Cycles 17:22-1/13
4/16-18	Isotope in microbial ecology, (guest lecturer: Dr. Karolien Denef)	Demonstration of PLFAs extraction and isotope analyses	Post, 2002. *Ecology* 83: 703-718
4/23-25	Isotopes in food web	Preparation & Analyses of ^{13}C and ^{15}N on solid samples	Dijkstra et al., 2006. Soil Biology and Biochemistry 38: 3257-3266
4/30-5/2	Isotopes in plant ecology and dendroecology	Isotope data analyses and interpretation	McCarroll & Loader, 2004. Quaternary Science Review. 23:771-801
5/3-5	Students presentations of their projects	Research Panel (students will review and comment on each other projects)	
5/10	**Final exam**		

Attendance Policy
This course's attendance policy is the same as what is reflected in the general university catalogue.

Statement Regarding Academic Integrity
(modified from SPCM 201 Fall 2011 Syllabus of Professor Greg Dickinson)

Academic integrity means that no one will use another's work as their own. One part of academic integrity is avoiding plagerism. Plagerism is the unauthorized or unacknowledged use of another person's academic or scholarly work. It is a theft of intellectual property and a violation of an ironclad rule demanding "credit be given where credit is due."
Source: (Writing Guides: Understanding Plagiarism.
http://writing.colostate.edu/guides/researchsources/understandingplagiarism/plagiarismoverview.cfm).
If you plagiarize in your work you could lose credit for the plagiarized work, fail the assignment, or fail the course. Plagiarism could result in expulsion from the university. Each instance of plagiarism, classroom cheating, and other types of academic dishonesty will be addressed according to the principles published in the CSU General Catalog (see page seven, column two: http://www.catalog.colostate.edu/FrontPDF/1.6POLICIES1112f.pdf).
Academic integrity means more than just avoiding plagiarism. It also involves doing your own reading and studying. It includes regular class attendance, careful consideration of all class materials, and engagement with the class and your fellow students. Academic integrity lies at the core of our common goal: to create an intellectually honest and rigorous community. Because academic integrity, and the personal and social integrity of which academic integrity is an integral part, is so central to our mission as students, teachers, scholars, and citizens, we will ask to you sign the CSU Honor Pledge as part of completing the scientific paper. While you will not be required to sign the honor pledge, we will ask each of you to write and sign the following statement on your paper:
"I have not given, received, or used any unauthorized assistance."

Assignments
There will be two main assignments (Mid-Term and Final Exam) for this course. Additionally, there will be a minimum of 3 recitation classes (W 5,6,11). For recitation, students will be given a peer reviewed published paper to read and discuss in class during the Thursday morning lecture. The papers will be distributed a week before discussion is due, together with a list of specific points to debate.
The Midterm exam will consist of 5 questions (each answer not exceeding 1 p), to be taken closed book at home. Questions will be given on Monday of week 7 and will be due by Wednesday of week 7. Performance on the exam will be discussed in the lab class on the Thursday of Week 7.
The Final Exam will consist on a research project proposal (max 10 pages) that students will have to produce individually following specific guidelines. The proposed research has to make use of isotope methods but can span any area of interest (i.e. typically students are encouraged to write on their own research area). Proposals are due by the end of week 14. Additionally students will be arranged in a panel and each of them will have a few of the proposals from other students to review. Finally, each student will give a short (10-20 minutes, depending on the total number of student in the course) oral presentation (in ppt format) of the submitted proposal during classes in week 15, and week 16, while during lab of week 15, students will run the panel evaluation of the projects. Clear guidelines (simplified from NSF) for the preparation of the project proposal, as well as for the presentation and for the review process and panel work, will be given in week 10, in a lab session.

Grading
Mid-term 30%; Course participation/recitations 20%; Project (proposal writing) 35%, oral presentation and review panel 15%.
Grading Scheme: ≥ 90 A; 80-89% B; 70-79% C; 60-69% D; < 60% F
Major criteria utilized for student evaluation are: 1) knowledge of the subject matter, 2) critical thinking, 3) ability and clarity of exposition.