

## COURSE OUTLINE

Course number and title: SOCR400 “*Soils and Global Change: Science and Impacts*”

Credits: 3 (2 lectures + 1 lab)

Time: MW 10-10.50 Plant Science W01; Lab F 10:00-10.50 Plant Science W01

### **Course Description and Objectives**

The Earth system is undergoing continuous changes, which have profound impacts on soils and soil processes, as well as on the capacity of soils to support demand for food, fibre and energy. Soils and climate change are tightly linked in a series of feedback mechanisms for which understanding is critical to wisely manage the world soils and adapt to and/or possibly mitigate the effects of climate changes.

A successful student will be able to:

- Describe current and projected global changes, their effects on soil, and potential feedbacks.
- Understand and discuss the state-of-the art methods available for the study of the effects of climate and land use change on soils.
- Analyze data from a basic experiment and produce a data report.
- Discuss soil management options for climate change mitigation and adaptation.
- Develop and evaluate conceptual models.
- Read and synthesize scientific literature.
- Write a short scientific paper to articulate and substantiate proposed hypothesis.

Instructor: Dr. M. Francesca Cotrufo, [Francesca.cotrufo@colostate.edu](mailto:Francesca.cotrufo@colostate.edu),  
<http://www.nrel.colostate.edu/cotrufo-home.html>

Text(s): Reading material will be provided to students in the form of articles or book chapters, and posted on Canvas.

Additional Class Material: Pdf files of class notes will be posted for the students on Canvas at least a day before class. Laboratory worksheets will also be posted on Canvas.

Course Topics/Weekly Schedule:

W	Lectures topic	Lab activities	Readings	Students' assignment
<b>SECTION 1: INTRODUCTION TO SOILS AND GLOBAL CHANGE</b>				
<b>1:</b> <b>8/20-24</b>	Introduction to the course: <i>what is Global Change and why it matters to soil?</i> An overview	Conceptual models: learn to structure hypotheses in a flow diagram	IGBP Science 4	Pre-Essay (not graded)
<b>2:</b> <b>8/27-31</b>	Soil Organic Matter dynamics	Demonstration of SOM fractionation methods	Lehman & Kleber, 2015	Lab Essay 1 (A, Quizzes)
<b>3:</b> <b>9/5-7</b>	Soil GHG fluxes: CO <sub>2</sub> , CH <sub>4</sub> and N <sub>2</sub> O	Demonstration of methods to measure soil GHG efflux Conceptual models: learn to structure hypotheses in a flow diagram	Schlesinger, & Andrews, 2000	Lab Essay 2 (B, Data analyses)
<b>4:</b> <b>9/10-14</b>	The Soil Biota: Does loss of biodiversity affect soil processes?	Demonstration of methods to extract and count soil fauna	Wall and Virginia, 1999 Blankinship et al. 2011	Lab Essay 3 (A, Quizzes)
<b>5:</b> <b>9/17-21</b>	Modelling of soil process and their response to changes	Modelling Lab in Simile	Campbell and Paustian, 2016	
<b>SECTION 2: EFFECTS OF GLOBAL CHANGE ON SOIL PROCESSES AND BIOTA: STUDY METHODS</b>				
<b>6:</b> <b>9/24-28</b>	Past-present and future increase in atmospheric CO <sub>2</sub> . Methods of study & effects on soils	<b>Midterm exam (I):</b> group discussion and evaluation of the draft models	Drake et al., 2011	<b>Midterm assignment (I)</b> - Built first draft of conceptual model
<b>7:</b> <b>10/1-5</b>	Current and projected climate changes. Field manipulation experiments	Climate manipulation incubation experiments in the laboratory	IPCC summary reports. Plante & Conant, 2013	
<b>8:</b> <b>10/8-12</b>	Effects of warming - and related feedbacks - on soil processes and biota	Climate manipulation incubation experiments in the laboratory	Wallenstein, 2013	Lab Essay 4 (B, Data analyses)
<b>9:</b> <b>10/15-19</b>	Effects of precipitation changes on soil processes and biota	<b>Midterm exam (II):</b> group discussion and evaluation of the revised models	Cotrufo et al., 2011	<b>Midterm assignment (II)</b> – Build a revised conceptual model
<b>10:</b> <b>10/22-26</b>	Human alteration of the N cycle: Soils and reactive N	Demonstration of methods to extract and measure mineral N		Lab Essay 5 (B, Data analyses)

<b>11: 10/29- 11/2</b>	Fire: Pyrogenic carbon dynamics & effects on soils, soil biota.	Discussion on PyC analytical methods - Video	TBD	Work on final project
<b>12: 11/5-9</b>	Impacts and feedbacks of global change in Polar and Tropical soils	Recitation	TBD	Work on final project
<b>SECTION 3: ADAPTATION AND MITIGATION OPTIONS</b>				
<b>13: 11/12-16</b>	Biochar: is it a sustainable solution to mitigate climate change and improve soil fertility?	Biochar lab	Lehmann et al., 2011	Work on final project
<b>14: 11/19-23</b>	FALL BREAK			
<b>15: 11/26-30</b>	Forestry and Grassland Management for Mitigation and Adaptation to Climate Change	Recitation	Houghton, 2013.	Work on final project
<b>16: 12/3-7</b>	Agricultural Management Options for Mitigation and Adaptation to Climate Change	Demonstration of CometFarm	Paustian, 2016	<b>Final project due</b>
<b>17: 12/10-14</b>	Finals			

Instructional Methodology: The class will meet as a single group two days a week for lectures and one for laboratory activities. An inquiry-based lecturing method will be used, and student input will be solicited throughout lectures.

Mode of Delivery: *Lectures* will be delivered as interactive presentations, and will include activities complying with the inquiry-based learning approach. *Laboratory* classes will consist of hands-on experiences and possibly visits to several field sites, which will enable students to explore state-of-the art research approaches and interact with expert scientists.

Methods of Evaluation: Students will be evaluated based on their critical thinking, knowledge of the subject, ability to synthesize knowledge in conceptual models and to evaluate these models. Students will be evaluated through the following assessments:

- 1) *Lab papers* –A (quizzes): A quiz related to the lab objective and procedure will be posted on Canvas. Students will be required to submit short answers to the quizzes. B (Data analyses): A data set related to the laboratory experience will be posted on Canvas, students will have to analyze the data and present results in graphic form. Quizzes, or data will be posted on the Friday morning and the papers will be due the subsequent Monday at 10am.
- 2) *Midterm exam* (I and II) - students will join in a group of max three, and work to the

midterm and final exams as a group. They will have to synthesize their knowledge to construct a conceptual model on how a global change (e.g., N deposition, warming, etc.) would affect soil processes in a particular ecosystem. Each group will present their model in .ppt to the class, and we will dedicate two lab classes to the group discussion and evaluation of the conceptual models.

- 3) *Final Exam* will consist in a paper (max 5 pages + reference list) in which the conceptual model is discussed in the context of the literature and the knowledge acquired during the course. The paper should be structured in a brief introduction presenting the system and the global change of interest, followed by the scope and the hypotheses represented in the conceptual model. In the discussion section students will need to analyze each of the hypotheses in the context of the literature and current understanding. Finally main conclusions should be reported in bullet points. All the cited literature will need to be reported in alphabetical order in a list at the end of the paper.

### Rubric used to grade all class assignments

Level 1 (< 25%)	Level 2 (25-50%)	Level 3 (50-75%)	Level 4 (75-100%)
<b>Consistently does the following:</b>	<b>Does most of the following:</b>	<b>Does most of the following:</b>	<b>Consistently does the following:</b>
Misinterpret the problem. Demonstrate wrong factual knowledge.	Misinterpret the problem. Demonstrate incomplete factual knowledge.	Is able to interpret the problem. Demonstrate factual knowledge.	Accurately interpret the problem. Demonstrate complete factual knowledge.
Identify incorrect approaches to address the problem	Fails to identify correct approaches to address the problem	Identifies correct approaches to address the problem	Identifies correct approaches to address the problem
Analyze the data incorrectly	Analyze the data incorrectly	Analyze the data correctly	Thourroulgy and competently analyze the data
Draws fallacious conclusions	Draws fallacious conclusions	Draws non-fallacious conclusions	Draws non-fallacious conclusions
Does not provide justification of results or procedures	Seldomly provide justification of results or procedures	Justifies few results or procedures, explains reasons when applicable	Justifies key results or procedures, explains assumptions and reasons when applicable

**Grading:** Class participation (presence and engagement): 10 points; Lab papers: 50 points (10 points per paper), Mid-term exams: 40 points (20 points per exam); Final paper: 50 points.

Major criteria utilized for student evaluation are: 1) knowledge of the subject matter, 2) critical thinking, 3) ability and clarity of exposition.

### Library & Research Help

The CSU Libraries Help Desk provides both research (970-491-1841) and technical (970-491-7276) support. Virtual assistance is also available via the Libraries' Ask Us chat and email services (Links to an external site.)Links to an external site. <http://lib.colostate.edu/help/ask-us> (Links to an external site.). Renae Newhouse is the librarian supporting Agriculture and this course. Contact her for assistance at [Renae.Newhouse@colostate.edu](mailto:Renae.Newhouse@colostate.edu) or (970) 491-5338.

### 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 plagiarism. 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

<http://catalog.colostate.edu/general-catalog/policies/students-responsibilities/#academic-integrity>

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."*

### 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:
  - o Emergency Response 911
  - o Deputy Title IX Coordinator/Office of Support and Safety Assessment (970) 491-1350
  - o Colorado State University Police Department (non-emergency) (970) 491-6425

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