Course Syllabus

CSU ESS 411: Earth Systems Science

Streaming Lectures (recorded): TBA

Discussion Face-to-Face: Clark A203, MF 3-4:15 (please follow CSU COVID updates for face-to-face at https://covidrecovery.colostate.edu/)

Discussion Online: Friday 3-4:15 (this is an alternative for those who are not participating on the Face-to-Face discussion)

Join Zoom Meeting:
https://zoom.us/j/97258171787?pwd=azc4Tkl0VVVoOGJQSnpnTjkyWnliZz09

Meeting ID:: 972 5817 1787
Passcode: welcome

Professor Daniela F. Cusack

E-mail: Daniela.Cusack@colostate.edu

Office Hours: Friday 1-2pm via Zoom

Join Zoom Meeting
https://zoom.us/j/93741999430?pwd=T3BqeWxpek5penpGTmxES0lVWTV2QT09

Meeting ID: 937 4199 9430
Passcode: DCoffice

TAs

Amanda Longhi Cordeiro

alonghic@rams.colostate.edu

Office hours: Thursday 4-5pm via Zoom. Join Zoom Meeting:

https://us04web.zoom.us/j/75343036266?pwd=Mk1Kb25yeXV5THFvTzNrdFJnSTFiUT09

Meeting ID: 753 4303 6266

Passcode: welcome

Natalie Buchholz, "Bucky"

Pronouns: She/Her

natbuckz@colostate.edu

Office hours: Monday 12-1pm via Zoom.

Join Zoom
Meeting: https://zoom.us/j/93912861284?pwd=UFI1eEU5VFpqVEV3aGQ1cWNORWtsUT0

Meeting ID: 939 1286 1284

Passcode: Bucky

Course Objectives:

The course aims to provide students with:

1) an understanding of how global change is altering Earth systems' structure and function around the world,

2) a basis in the scientific theory of global change biology and thresholds,

3) familiarity with scientific methods used to study ecosystems,

4) experience preparing and writing a formal grant proposal

5) experience presenting and summarizing complex topics in earth systems ecology

Earth Systems students will assess how human activity is altering the energy and material flows through both the living (plants, animals, microbes) and non-living (soils, atmosphere) components of ecological systems. Our goal is to develop a solid understanding of the links between ecosystem structure and function, and examine how global change factors affect these links. We will focus on the logical connections among ideas so that complex processes can be understood from some basic concepts.

The course is divided into sections.

1) Drivers of Global Change & Planetary boundaries (warming, thresholds, tipping points)

2) Trajectories/vulnerability of Earth systems: Water, CNP cycles, soils (microbiota and physio-chem)

3) Spotlight to vulnerable ecosystems: humid tropics, arctic, food systems

4) Climate engineering/mitigation solutions (LCAs, cross-disciplinary assessments)

Also, throughout the course and our large writing activity, we will read about and discuss

5) Science writing and bias in ecosystem research and writing

Course Readings: 1.) Readings include peer-reviewed, scientific papers posted to the course website, and current events articles. Each week we will discuss the content and implications of the material. Also, each week one student per section will select and assign a current even article related to the material (see below)

2.) Chapters from a book on science writing will also be used and read through the course of the semester (available on Amazon): ***Writing Science: How to write papers that get cited and proposals that get funded by Joshua Schimel***

Notes on Hybrid "streaming with face to face components"

Given the global pandemic, this course has been converted from 100% in-person to a hybrid format. Scheduled course timeslots will be used for Discussion/Writing Workshop periods with the TA. These sections will generally include short explanations by the TA, followed by your questions and discussion periods. If you do not wish to attend in-person discussions, there will be a standing Friday zoom discussion group at the same time as the face-to-face. ***You must alert the professor and TAs if you with to switch to the Friday zoom section,*** or if you need to attend it temporarily because you are home sick. All lectures will be given by the professor in a streaming online format. If you cannot attend the live streaming lectures (timing to be announced), you can access the recordings of lecture on the course website. All announcements and assignments during the semester will be posted to Canvas, so please check there regularly.

Course Requirements: (see important dates and deadlines)

Exams

(20% of final grade): Students will be required to take two tests during the course (10% each). Tests will be offered online and timed. Students will be able to log in and take the exam at any time during the week that it is open, but once started the exam cannot be stopped or re-taken. Exam will cover topics from readings.

Discussion Responses and Participation

(30% of final grade): Almost half of the course will be dedicated to discussion and understanding the ecosystem responses to global change as presented in the readings. Discussion participation points are gained by attending the “face-to-face” on "zoom discussion" portion of class (2 pts. per week), and turning in reading responses every week (10 pts. per week) through Canvas. Each week starting in Week 3 one student per section will be assigned to find an article about a current event relevant to the course material, and lead a Discussion on the current even with an opening question to the Discussion (30 pts. to lead discussion once per semester). This current event assignment will be graded as part of the overall discussion grade. ***We welcome diverse perspectives and experiences, and respectful exchanges.***

Due dates for reading responses and current events depend on which section you are in. **Reading responses are due the night before your discussion section, and current event readings are due five nights before your discussion section. For clarification:**

Monday Section:

-Online reading responses are due Sunday night before class (question available by Wed.).

-Current event readings are due the Wednesday before class.

Friday Section:

-Online reading responses are due Thursday night before class (question available by Sun.).

-Current event readings are due the Sunday before class.

Presentation

(15% of final grade): During the final few weeks of the semester each student is required to present a brief summary and explanation of a paper addressing a global change effect on an ecosystem type. Groups will be formed during the first weeks of class based on students signing up for an ecosystem of interest. Each student will then select a global change factor of interest, and coordinate with their group to present the topics in a cohesive way. Each student presentation will be 2-3 minutes, and is limited to 1 power point slide. The slide should give the "big picture" of the student's grant proposal topics, and include at least one graph or figure from a cited reference to be explained by the student. The slide should also summarize the proposed study approach. These groups will also form the basis of the discussion groups.

Grant Proposal

(35% of final grade): Students will be required to independently write a formal grant proposal following the guidelines for the National Science Foundation Graduate Research Fellowship. The instructions for formatting and writing this type of proposal can be found at:

https://www.nsf.gov/pubs/2019/nsf19590/nsf19590.htm

The proposal should be for research or a project focused on **global change effects on a terrestrial (natural or managed) ecosystem**. The proposal must be submitted in the format of the NSF Graduate Research Fellowships, and include a bibliography with in-text citations. This proposal should describe the global change factor you are focusing on, describe your ecosystem type, and review the literature on how this ecosystem is being affected. Then you should identify gaps in our knowledge, and propose a study that would increase our understanding, addressing formal hypotheses. More information and an example will be posted on the course webpage.

All components must be entirely original with proper citations for material paraphrased or quoted. 5% of this grade will be based on participation in activities targeted at grant writing throughout the quarter. At least 12 scientific paper references are required. **This will be due on Wednesday at 11:59pm during Finals Week.**

Grading Policy:

Exams are based on lectures and readings. Your grade is computed from your final point total using an *adjusted linear scale* as follows:

> 98.0%A+ 78.0 – 79.9%C+

92.0 – 97.9%A 72.0 – 77.9%C

90.0 – 91.9%A- 70.0 – 71.9% C-

88.0 – 89.9%B+ 68.0 – 69.9% D+

82.0 – 87.9%B 62.0 – 67.9% D

80.0 – 81.9% B-60.0 – 61.9%D-

To compare your raw grade earned to the above grading scale, your raw grade on tests will be divided by an adjustment factor (*A*) calculated as the mean of your class' top three scores. For example, if you score 83% and the mean score of the top three students is 94% (*A*=0.94) then your grade earned is 0.83 / 0.94 = 88% (B+). Note that it is theoretically possible to earn an adjusted test grade of >100% if you are consistently among the three top scores in the class. Note also that the adjustment can only help your grade, not hurt it. Assignments other than tests are not adjusted, and final grades are not adjusted. **Your final scores will be automatically rounded to the nearest 0.1%, and there are no exceptions to the above grading policy.**

Email Communications

I will regularly send out updates and short assignments over email. If you have clarification questions on assignments or materials, I urge you to post these to the course website so that everyone can see the answer. If you have more confidential questions, please email me using "Ecosystem Ecology: XXX" in the subject line of your email. Please allow 24 hours for responses.

Attendance/makeup policy:

1. Attendance will be counted as part of the Discussion section, with most points awarded for turning in written responses to thereadings, and leading a current events topic once during the semester. There is no formal attendance requirement for lectures, which will be streaming and available in recorded form afterward. The lectures will focus on the reading materials, and so **students who watch lectures are likely to score higher on exams.**
2. Exams will be available for you to log in and take during one full week, providing ample

time for you to take the test when it is convenient. No missed exams will be made up*WITHOUT A DOCTOR'S MEDICAL NOTE SENT TO PROFESSOR CUSACK NO LATER THAN 5:00 PM ON THE LAST EXAM DAY*

Late assignments (Discussion responses, grant proposals) will drop grades as follows:

First day late: 5% grade reduction;

Second day late: 10% grade reduction;

Third day late: 20% grade reduction

No assignments accepted after third day late.

ACADEMIC HONESTY: All work must be the student's own work. **Any clear incidents of copying or grouping up / use of electronic devices during exams or plagiarism on papers or discussion reports will be automatically and directly forwarded to the Dean of Students**. Please familiarize yourself with the CSU rules and regulation on academic honesty to ensure that you do not plagiarize in your paper writing:

https://resolutioncenter.colostate.edu/academic-integrity/

Accommodations will be made for students with special needs, including extra time on assignments and access to internet materials. Please alert the instructor to arrange in advance of due dates.

Weeks Topics

Drivers of Global Change & Planetary boundaries (warming, thresholds, tipping points)

1-2 Drivers of Global Change

Reading: Raupach et al 2007: Drivers of increased CO2 emissions (full document)

3 Planetary Boundaries and Resilience

Reading: Steffen et al 2018: Anthropocene (full document)

Focus on Science Writing and Research Week

4 Science Writing and Bias in Research/Writing

Reading: J. Schimel Book: How to Write Science: Chapters 1, 2 & 4

Reading: M. Carey PHG 2016: Bias in Science (full document)

***Grant proposal/presentation topic and 2 draft hypotheses due*

Trajectories/vulnerability of Earth systems (Water, CNP cycles, soils)

5-6 Trajectories of Global Water Cycle

Reading: Abbott et al 2019: Water Cycle Domination (full document)

Milley et al 2008: Water Management in the Future (full document)

***Grant proposal introduction paragraph with 3 cited references and bibliography due*

7 Trajectories of Soils: Fertility, health, and carbon storage

Reading: Chapter 3 from Global Change and Forest Soils 2019

8 Trajectories of Nutrient Cycles: Nitrogen and Phosphorus

Reading: Townsend et al. 2012: Agriculture and N&P (full document)

Wieder et al 2015: N&P limit NPP with Climate Change (full document)

***Week 8 – *Midterm Test (Readings on sections I. and II.)*

Spotlight to vulnerable ecosystems: humid tropics, arctic, food systems

9 Vulnerable Ecosystem: Humid Tropics

Reading: Cusack et al. 2016: Global Change Feedbacks from Rainforests (pp.1-4 Abstract, Intro, and Intro to 2.1, p.43 Intro to 2.2, p.62-70 Recommendations, and ALL FIGURES)

10 Vulnerable Ecosystem: Arctic

Reading: Schuur et al. 2015: Permafrost climate feedback (full document)

Reading: J. Schimel Book: How to Write Science: Chapters 11 & 12

***Grant proposal background section with 5 new cited references and bibliography due**

11 Vulnerable Ecosystem: Food Systems

Readings: Poore et al. Science: warming effects of different foods (full document)

Foley et al. Nature: cultivated planet (full document)

Climate engineering/mitigation solutions (LCAs, cross-disciplinary assessments)

12 Climate Engineering

Reading: Cusack et al. 2014: Climate engineering strategies (full document)

13 Natural Climate Solutions

Reading: Griscom et al.2017: Land stewardship (full document)

Website: https://drawdown.org/ *(peruse the website, look around at the different topics and recommendations to discuss)*

14 Sustainable Development Goals (SDGs)

Reading: Sachs 2012: Sustainable economic development (full document)

15 Student Presentations (Zoom during scheduled class time)

***** Final Test during Finals Week (readings sections III. and IV.)***

***** Full NSF-style Grant Proposal due FINALS WEEK, WEDNESDAY 11:59pm***