Global Change Biology, BIOL 26

Professor: Caitlin Hicks Pries (LSC 349), Office hours Wednesdays 2:00-3:15 pm & by appt.

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Class: Spring 2024, MWF 12:50-1:55, LSC 205
X-hours (Tuesdays 1:20-2:10, will be used to learn data analysis skills and as a time for group work).

Learning objectives

Mission Statement: Understand how humans are reshaping the processes of nature in the Anthropocene, articulate the repercussions of those changes for ecology, evolution, and human health; use global change datasets to answer biological questions; and be able to evaluate solutions that might mitigate the consequences of global change.

By the end of this course, you will be able to:

- Describe the myriad of ways humans are altering earth's atmosphere, land, and water.
- Understand how global change is fundamentally altering the way species interact with their environment and with other species (including humans).
- Apply the concepts and theory of ecology and evolution to case studies detailing the effects of global change on species, species interactions, human health, carbon balance, and nutrient cycling.
- Understand, summarize, and critically evaluate primary scientific literature on global change biology including how scientists use gradients, experiments, and models to investigate global change.
- Develop and answer scientific questions by using R to access, organize, and visualize actual data sets.
- Articulate the pros and cons of potential solutions to global change issues and to be able to defend your position on potential solutions.

We want you to come away from this course with the ability to evaluate new technologies and policies for their potential impact on ecosystems and sustainability.

Course description

We are currently living in the Anthropocene era where humans are having an outsize effect on the Earth's environment through the burning of fossil fuels, the large-scale conversion of land for agriculture, the modification of water courses for flood control and energy, and the use of fertilizers, to name a few. These changes have major consequences for both ecosystems, individual species, and species interactions. Through this course, you will apply fundamental ecological principles to the Anthropocene by reading and discussing the primary literature and working with long term ecological datasets. Through reading and data exploration you will investigate how humans have altered the environment and what the consequences have been for biogeochemical cycling, species' phenology, and species' distributions. You will also evaluate solutions for mitigating these consequences and restoring ecosystem functions.

Course structure

Each week will be dedicated to studying the effects of a global change factor such as climate change, increased concentrations of carbon dioxide in the atmosphere, land use change, excessive fertilizer use, invasive species, and air, noise, and light pollution. Generally, the first class of each week will be a mix of lecture and class activities to orient the students to a different aspect of global change, its causes, and the biological concepts needed to understand its repercussions. The second class of each week will be a discussion of two papers from the scientific literature describing biological consequences of a global change factor. The third class of each week will consist of a data exercise. Data exercises will include exploration of actual long-term observational and experimental datasets. The last week of class will be dedicated to student presentations evaluating solutions for mitigating the consequences of global change and how they would test their efficacy. Students will have to defend their ideas to the broader class community. This class will have a couple quizzes and a term-long project.

Course expectations

This is an active learning course. As such, you are expected to attend live classes and to participate in class activities and discussions. We firmly believe that you need to engage with this course and the material to master it. This means taking notes, answering questions, and, perhaps most importantly, asking questions.

Technological expectations

We will make *extensive* use of the Canvas system in all aspects of this course. Please check Canvas regularly for announcements, assignments, readings, R tips, quizzes, and assignment information and due dates.

You will need a laptop that has R and R Studio installed on it for this course.

Artificial intelligence
We recognize that ChatGPT and other AI large language models can be useful for completing your assignments. However, AI has some major limitations when it comes to using them for writing– mainly that they make mistakes, can make up data, and use sources without citation. We ask you to use and cite the primary literature in your data projects, which you cannot do with AI. More importantly, writing is thinking–the act of writing helps you reflect, clarify your thoughts, analyze your logic, and integrate concepts. Thus, all the writing you produce for this class should be your own work. Using AI for writing in this course will be considered a violation of the honor code.

On the other hand, AI generators are getting very good at coding. We have not used AI to help us code in R yet, but we are curious about how it might be useful. Thus, we are allowing the use of AI generators for completing the R data assignments. If you use AI to code, please let us know which AI tool you used and how you used it, including the successful prompt you gave it. You are still responsible for making sure your code works properly.

Lastly, AI can be helpful for some stages of the research process. You can use AI to find primary literature sources or datasets, just as you would use a search engine. You could use AI to brainstorm ideas or refine your research questions. If you use AI for these purposes, again please let us know that you did and how you used it at the end of your assignment.

In short, you cannot use AI to write, but you can use AI to code or find sources. If you use AI, please let us know how you used it.

Readings

Readings for this course will be from the primary literature, select chapters from books, and reports from both governmental and non-governmental organizations. The readings will be available as links or to download as pdf files from the course's Canvas website.

Assessment

Your learning and understanding will be assessed throughout the course, through a final presentation in which you will evaluate solutions to a global change problem of your choice, and a term-long project in which you will use publicly available data and the scientific literature to answer a global change related question of your choice.

There will be in class activities or discussions almost every day. Participation will be 15% of your grade. Each week, we will discuss papers from the primary scientific literature you are expected to come prepared to these discussions and fill out the reading assignment. We will use class time to learn R and explore actual datasets. Some of these activities may be completed in a class or two while others will need work outside of class before they are turned in. These data activities will be 15% of your grade. In lieu of midterms and a final, there will be 2 quizzes, roughly at the middle and end of the term. These will be taken via Canvas, open book, and are timed. They will be posted on Friday afternoon to be completed by Monday at 11:59 EST and will contribute 15% to your grade. The quizzes will not be cumulative and will test the previous 4-5 weeks. At the end of the term you have to present a potential solution for a global change problem, which will contribute 15% to your grade. The largest proportion of your grade (40%), will be a data analysis project which consists of analyzing and presenting scientific data with figures and discussing the findings in the context of global change. The data analysis project will be "ungraded" (see assignment for details).

Participation in class (activities, discussions)	15%
Data analysis assignments	15%
Solutions Presentation	15%
Quizzes (2)	15%
Final data analysis project	40%

Collaboration and academic integrity:

This course involves several group projects. However, when specified, certain assignments, such as the quizzes and reading responses, are to be completed independently. For further information, please consult the Dartmouth College Academic Honor Principle.

Learning Accommodations:

Students requesting disability-related accommodations and services for this course are required to register with Student Accessibility Services (SAS; Getting Started with SAS webpage; student.accessibility.services@dartmouth.edu; 1-603-646-9900) and to request that an accommodation email be sent to Professor Caitlin in advance of the need for an accommodation. Then, students should schedule a follow-up chat with Professor Caitlin to discuss an implementation plan. This process works best for everyone when completed as early in the quarter as possible. If students have questions about whether they are eligible for accommodations or have concerns about the implementation of their accommodations, they should contact the SAS office. All inquiries and discussions will remain confidential.

You may also wish to contact or visit the Academic Skills Center or the Research Center for Writing and Information Technology.

Religious Holidays:

Some students may wish to take part in religious observances that occur during this academic term. If you have a religious observance that conflicts with your participation in the course, please meet with one of us before the end of the second week of the term to discuss appropriate accommodations.

Mental Health:

We recognize that the academic environment at Dartmouth is challenging, that our terms are intensive, and that classes are not the only demanding part of your life. There are a number of resources available to you on campus to support your wellness, including: the Counseling Center which allows you to book triage appointments online, the Student Wellness Center which offers wellness check-ins, and your undergraduate dean. The student-led Dartmouth Student Mental Health Union and their peer support program may be helpful if you would like to speak to a trained fellow student support listener. If you need immediate assistance, please contact the counselor on-call at (603) 646-9442 at anytime. We encourage you to use these resources, to take care of yourself throughout the term, and to feel free to come talk with us when needed.

Title IX:

At Dartmouth, we value integrity, responsibility, and respect for the rights and interests of others, all central to our Principles of Community. We are dedicated to establishing and maintaining a safe and inclusive campus where all have equal access to the educational and employment opportunities Dartmouth offers. We strive to promote an environment of sexual respect, safety, and well-being. In its policies and standards, Dartmouth demonstrates unequivocally that sexual assault, gender-based harassment, domestic violence, dating violence, and stalking are not tolerated in our community. The Sexual Respect Website (https://sexual-respect.dartmouth.edu) at Dartmouth provides a wealth of information on your rights with regard to sexual respect and resources that are available to all in our community.

Please note that, as faculty members, we are am obligated to share disclosures regarding conduct under Title IX with Dartmouth's Title IX Coordinator. Confidential resources are also available, and include licensed medical or counseling professionals (e.g., a licensed psychologist), staff members of organizations recognized as rape crisis centers under state law (such as WISE), and ordained clergy (see https://dartgo.org/titleix_resources).

Should you have any questions, please feel free to contact Dartmouth's Title IX Coordinator or the Deputy Title IX Coordinator for the Guarini School. Their contact information can be found on the sexual respect website at: https://sexual-respect.dartmouth.edu

Course Schedule:

Week	Date	Topic	Class	Who leads class	Reading	Assignments Due
1	25-Mar	Global Change	Global Change Introduction	Caitlin	Anthropocene Debate news articles	
	26-Mar		Introduction to Data Project	Caitlin		
	27-Mar		*Anthropocene Discussion*	Caitlin	Lewis and Maslin 2015; Zalasiewicz 2020	Reading Responses
	29-Mar		Intro to Data Science in R I	Caitlin		Come with R and R Studio installed on your laptops
2	1-Apr	Species' Responses to Climate	Phenology and Range shifts	Caitlin	IPCC report chapters	
	2-Apr	Change	R Breakout Groups	Caitlin		R Practice Activity I
	3-Apr		*Species Response to Winter Changes*	Caitlin	Papers TBD	Reading Responses
	5-Apr		Intro to Data Science in R II	Caitlin		
3	8-Apr	Climate Change Feedbacks	Lecture and C Cycle Activity	Sophie	NASA Carbon Cycle	
	9-Apr		R Breakout Groups	Sophie		R Practice Activity II
	10-Apr		*Tipping points discussion*	Sophie	Russil 2015, McKay et al. 2022	Reading Responses
	12-Apr		Graphing in R Activity	Sophie		**Project Proposals DUE**
4	15-Apr	Increased Atmospheric CO2	Lecture on Photosynthesis and Ocean Acidification	Caitlin		
	16-Apr		R Breakout Groups	Caitlin		R Graphing Activity
	17-Apr		*Coral Reef Calcification Discussion*	Caitlin	Papers TBD	Reading Responses
	19-Apr		Mapping in R Activity	Caitlin		
5	22-Apr	Air pollution	Acid Rain and Hubbard Brook, Ozone	Sophie	Original Acid Rain papers	
	23-Apr		R Breakout Groups (*Optional R Raster lesson*)	Sophie		R Mapping Activity
	24-Apr		*Human Health Consequences and Equity Discussion*	Sophie	Papers TBD	Reading Responses
	26-Apr		Data Activity: Long term data at Hubbard Brook	Sophie		**QUIZ over the weekend**
6	29-Apr	Urbanization	Cities as Ecosystems	Caitlin	Urban evolution, ecology, and equity	
	30-Apr		R Breakout Groups	Caitlin		**Project Preliminary Graphs DUE**
	1-May		*Noise and light pollution discussion*	Caitlin	Papers TBD	Reading Responses
	3-May		Data Activity: Long term data at Hubbard Brook Part 2	Caitlin		Mini group presentations on HBEF data
7	6-May	Water Pollution	Eutrophication, Salt, PFAS, and Plastics	Sophie		
	7-May		R Breakout Groups	Sophie		
	8-May		*Discussion TBA; Excursion?*	Sophie	Papers TBD	Reading Responses
	10-May		Data Activity: Ocean Plastics	Sophie		**Solutions Outline DUE**
8	13-May	Land Use Change	Consequences of Land Use Change	Sophie		
	14-May		R Breakout Groups	Sophie		Ocean Plastics Activity
	15-May		*4 Permille initiative discussion*	Sophie	Papers TBD	Reading Responses
	17-May		DeFR❄ST Snowmelt Experiment Guest Lecture	Joanna		
9	20-May	Class Choice!	To be determined by class interests	Caitlin		
	21-May		Project Help	Caitlin		
	22-May		*Discussion TBD*	Caitlin	Papers TBD	Reading Responses
	24-May		Student Presentations	Caitlin & Sophie		**10 minute Solutions presentation DUE**
10	27-May		NO CLASS: Memorial Day			
	28-May	Solutions	Student Presentations	Caitlin & Sophie		**10 minute Solutions presentation DUE**
	29-May	Solutions	Student Presentations	Caitlin & Sophie		**10 minute Solutions presentation DUE**
Exam Week	**3-Jun**					**Final Project DUE**