GLOBAL ENVIRONMENTAL CHANGE (ERS 201)

Spring 2016
Tuesday 12:30pm-1:45pm and Thursday 12:30pm-5pm
100 Bryand Global Sciences Center

Instructors:
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Office Hours:
Karl, Kat, and Peter have an open door policy – stop by our offices anytime. Making an appointment ensures the most efficient use of your and our time.

Course Description: Global Environmental Change (ERS 201) examines the physical and chemical interactions among the primary systems operating at the Earth's surface (atmosphere, hydrosphere, cryosphere, biosphere, lithosphere) on various timescales throughout geologic history. We will consider internal and external forces that have shaped environmental evolution, including the role of humans in recent geochemical and climatic change. During lecture and laboratory sessions, our goals are to develop critical thinking and writing skills and a scientific approach to the complex array of feedbacks operating at the Earth's surface, as well as an appreciation for how past environmental change informs current societal issues. Course may include field trips during class hours.

General Education Requirements: Satisfies the General Education Lab in the Basic or Applied Sciences, and the Population and the Environment Requirements.

Prerequisites: Any 100-level ERS course.

Course Typically Offered: Spring

Credits: 4

Textbook: The required textbook for the course is: Kump, L.R., Kasting, J.F., and Crane, R.G., The Earth System (third edition), Prentice Hall, 2009, ISBN-10: 0321597796. The textbook is available for purchase at the UMaine bookstore, other retailers, or rented online as an eTextbook (http://www.coursesmart.com/9780321681256?__professorview=false&__instructor=1925278). Reading assignments from the textbook are listed in the class schedule.

Software: We will use two software packages throughout the course: a word processing/ spreadsheet/presentation combination (e.g., Google Docs or Microsoft Office) and isee systems STELLA. Completion of weekly problem sets and the writing prompts will require some combination of these two packages. We strongly encourage you to bring a laptop with software to class every day. Microsoft Office software can be downloaded for free through the UMaine IT Center (https://umaine.edu/it/software/office/), and Google Docs software is available free through Google (https://www.google.com/docs/about/). We will use isee Systems Player

software to run STELLA models; the Player software is available free (http://www.iseesystems.com/softwares/player/iseeplayer.aspx). All of these software packages (including STELLA) are available for student use in the ERS computer cluster (BGSC 205).

Class communication: We will use email and the Blackboard course management software to communicate and share material with you. Once you are enrolled and login to Blackboard, you will see ERS201 Spring 2016 under My Courses. Any announcements will be made either via email or on Blackboard, so please check frequently.

Course Goals and Learning Outcomes

***Course Goals*:** In ERS201: Global Environmental Change, students will:

- Use a systems approach to study the interaction of surface processes linking the atmosphere, hydrosphere, biosphere, lithosphere, and anthrosphere
- Explore Earth system proxy records to appreciate the dynamic range and rates of climate and environmental change
- Investigate the influence of humans on surface processes using geochemical tools
- Use systems models to best explain available geological evidence
- Couple past and present Earth system data with societal trends to evaluate future climate scenarios
- Practice experimental design, data acquisition, uncertainty analysis, data interpretation, and communication in the field, laboratory, and classroom
- Develop evidence-based scientific argumentation skill using data from multiple sources (direct and remote observation, and models)

Course learning outcomes: Upon successful completion of ERS201: Global Environmental Change, students will be able to:

1) Define systems terminology, and use that vocabulary to construct systems diagrams
2) Explain the structure and output of systems models, and contrast equilibrium and non-equilibrium conditions
3) Identify feedback structure in systems diagrams and models, and evaluate Earth system data for the influence of feedback processes
4) Describe quantitative relationships among components in a complex system, and sketch graphs of the behavior of measurable quantities in a system as a function of time
5) Describe the source and graphically display atmospheric CO_2 data from observations and proxy records, and assess data uncertainty
6) Calculate and graphically display atmospheric CO_2 concentration range and rate of change on various temporal and spatial scales
7) Manipulate relevant parameters in short-term and long-term carbon cycle models, and interpret model output with respect to surface, solid earth, and human processes
8) Use stable and radioactive carbon isotope data to fingerprint human vs. natural processes affecting the carbon cycle
9) Analyze stable water isotope ratios in surface samples collected in the Orono area, interpret and communicate results, and assess analytical and sampling uncertainties

10) Use geoscience best practice to record field observations, geospatial information, and other relevant data
11) Apply modern water isotope fractionation processes to paleoclimate proxy temperature reconstructions
12) Define climate sensitivity, and evaluate published literature to choose a representative value
13) Model and predict the magnitude of 21st century warming based on analysis of climate sensitivity and carbon emission trends

Learning assessment

Assessment of course learning outcomes will be based on the following items:

Problem sets: Throughout the course, we will use problem sets that involve some combination of data generation (in a laboratory, in the field, or via database search), system diagraming and/or modeling, data interpretation, and literature exploration. Each problem set is worth 25 points. The topic of each problem set will be tied to our overall goals for the week (and the semester), and in some cases will involve a fieldtrip. Some problem sets will require group work and presentation to the entire class. Results that you submit for grading will require you to demonstrate specific skills in graphical form. These problem sets will be time consuming – *do not* assume you can leave them until the last minute. In most cases you will need to work on them outside of class time either alone or with peers. We encourage you to start working on each problem set as early as possible. You will need to complete each week's problem set by the end of the weekly lab period (i.e., 5 pm on Thursday). We will grade each problem set using the ERS201 Problem Set Rubric, available on Blackboard.

Written arguments*:* Using knowledge gained in the weekly problem sets, you will provide an argument for the following questions (each argument is worth 250 points). In each case, you will submit a first draft which we will assess using the ERS201 Writing Prompt Rubric (on Blackboard). We will not record a grade for your first draft (although submission is mandatory), but that feedback should be used to revise and submit your final draft.

Question 1: Is modern atmospheric CO_2 anomalous in Earth history?

Question 2: What will the global mean temperature be in 2100 AD?

Projects: We will do two small projects during the semester (each project is worth 100 points). The first involves evaluation of CO_2 emission projections for the 21st century, and the second is an analysis of possible environmental impacts of those emissions. For each project, you will work to develop, deliver, discuss, and submit a Powerpoint (first project, in a group) and poster (second project, individually) presentation. Grading will be based on the Powerpoint file and presentation, the poster, and written question responses for each presentation using the rubrics on Blackboard.

Discussion: Throughout the course, we will ask you to write short discussion pieces (e.g., a summary of your carbon footprint, homework based on in-class discussion, synopsis of textbook

reading, your thoughts on a particular journal article, media piece, topic, course component, the course overall, metacognition, etc.) and turn them in. These will not be graded and returned; rather, we will simply keep track of participation and use that as a basis for awarding up to 125 points.

Grading summary:	Problem sets (7 x 25 points each)	175 points
	Written arguments (2 x 250 points each)	500 points
	Projects (2 x 100 points each)	200 points
	Discussion	125 points
		1000 points total

A = 900 – 1000 (or more) points
B = 800 – 899 points
C = 700 – 799 points
D = 600 – 699 points
F = 599 points or less

Course Policies: Attendance at all lecture and laboratory sessions is required. Students are responsible for all material presented in class as well as in the required readings. By turning assignments in on time, you are eligible for full credit. Late assignments forfeit the right to any credit; any partial credit for late assignments will be up to the instructor's discretion.
We expect appropriate use of electronic devices during class.

Academic Integrity Statement: Academic dishonesty includes cheating, plagiarism and all forms of misrepresentation in academic work, and is unacceptable at the University of Maine. As stated in the University of Maine's online undergraduate "Student Handbook," plagiarism (the submission of another's work without appropriate attribution) and cheating are violations of the University of Maine Student Conduct Code. Any breach of this code during class will be referred to the Dean's office (NSFA) for evaluation and disciplinary action.

Disabilities (ADA) statement: If you have a disability which requires accommodation, please contact Sara Henry, Director of Disabilities Services, 121 East Annex, 581-2319, as early as possible in the term.

Course Schedule: The following schedule is based on the Spring 2016 semester. We may deviate slightly due to new events that offer learning opportunities, extended discussions, etc. In the event of extended campus interruption (e.g., flu outbreak, natural or manmade disaster) we will provide instruction through Blackboard on how to complete assignments remotely.

Week	*Date*	*Topic*	*Textbook Reading*	*Assignments*
1	Jan. 19	Course introduction	Ch. 1	
	Jan. 21	Atmospheric CO_2 and your carbon footprint		*Problem Set 1*
2	Jan. 26	CO_2 variability	Ch. 2	
	Jan. 28	What is a system? (InTeGrate Unit 1)		*Problem Set 2*
3	Feb. 2	Picturing complexity (InTeGrate Unit 2)	Ch. 8, 7, 12	
	Feb. 4	*Field trip - Caribou Bog*		*Problem Set 3*
4	Feb. 9	Modeling a system (InTeGrate Unit 3)	Ch. 8, 3, 14, 15	
	Feb. 11	Feedbacks in a system; modeling the carbon cycle (InTeGrate Unit 4)		*Problem Set 4*
5	Feb. 16	Modeling the carbon cycle	Ch. 5, 8, 7, 12, 14, 15	
	Feb. 18	Carbon tracing with isotopes		*Problem Set 5*
6	Feb. 23	Analyzing complexity (InTeGrate Unit 5)	Ch. 3, 15, 16	
	Feb. 25	*Field trip- Caribou Bog*		
7	Mar. 1	Project - Representative Concentration Pathway (RCP) evaluation	all previous	*Written argument 1 first draft*
	Mar. 3	Presentation - RCP evaluation		*RCP Project*
SPRING BREAK				
8	Mar. 22	Earth's energy balance	Ch. 4, 5	*Written argument 1 final draft*
	Mar. 24			*Problem Set 6*
9	Mar. 29	Temperature reconstruction	Ch. 6	
	Mar. 31	*Field trip - Water collection*		
10	Apr. 5	Temperature reconstruction	Ch. 14	
	Apr. 7			*Problem Set 7*
11	Apr. 12	Climate sensitivity	Ch. 14,12, IPCC	
	Apr. 14	Writing workshop		
12	Apr. 19	Project - environmental impacts of CO_2 emissions	all previous	*Written argument 2 first draft*
	Apr. 21			
13	Apr. 26	Project - environmental impacts of CO_2 emissions	all previous	
	Apr. 28	Poster presentation- environmental impacts		*Impacts Project*
14	May 3	Systems thinking synthesis (InTeGrate Unit 6)	all previous	
	May 5	Course wrap up - evaluations, reflection, post-course assessment		*Written argument 2 final draft*
15		*Finals week - no ERS201 final*		