Climate Change: An Interdisciplinary Approach to Problem Solving (3 Credits)

Instructor:
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Meeting Time and Location:
Tuesday and Thursday 10:00 – 11:30
For Winter 2023 the course is remote and classes will be held by Zoom.
Narrative Introduction:

We are unique in history. Through sound scientific investigation we are presented with the knowledge that the Earth's climate is warming and that the climate will warm for generations to come.

We know that past changes of Earth's climate, small in comparison to those which we will experience, caused great changes in society. These past changes were sometimes positive, for example agricultural prosperity, and sometimes negative, for example agricultural failures, famines, and migrations.

The change we are experiencing today is large and rapid. Already we are experiencing disruptions from rising sea level, more extreme precipitation, and more extreme drought. We are only at the beginning of these changes; they will grow and persist.

Climate change provides personal, regional, national and global challenges to ourselves, our children, and our grandchildren. Adaptation to an always-changing climate will be required. With the knowledge that we hold, and the improved knowledge that we are generating, we have the luxury of choice. Do we invest today, pro-actively, in developing resilience and adaptation strategies, or do we simply, like our ancestors, react to changes in the climate?

This course explores the intersections of the science of climate change with society: policy, business, economics, public health, energy, ecosystems, environmental engineering, information science, journalism, religion, etc. The problem is approached from the perspective that there are communities with heterogeneous interests that are vested in both adapting to and mitigating climate change. There are also communities actively resisting any actions to address climate change. The course will expose students to the fundamental factual and contextual elements of climate change and the interface of climate change to societal interests. In order to facilitate effective participation in the response to realized and predicted climate change, this knowledge is framed in a structured approach to complex problem solving.

Course Structure and Requirements:

Faculty lectures and student-organized and student-led discussions: A comprehensive series of lectures and readings on the scientific basis of climate change is provided. Then, lectures and readings are provided to introduce special topics. In groups, students will investigate a use case in climate action planning.

1. ***Class preparation, attendance, and participation:*** The course is discussion-intensive course.

   Therefore, attendance and participation are mandatory and vital to the student's success of the course. This includes coming to class prepared and having listened to the recorded lectures or read the readings.

2. ***Reading and Response:*** During the course, you are required to produce responses of roughly one page (single-spaced) to readings, key figures, and recorded lectures.

   The responses do not need to be elaborate, but they should do more than summarize the reading. They should be used to refine your questions and insight from the source materials and enhance the class discussion. They must be submitted via Canvas at least two hours before the start of lecture for the relevant readings.

3. ***Student work time and facilitated discussions:*** Class time will be reserved for students to work individually and collectively to analyze their knowledge base and synthesis the material.

   Response questions will be provided, and each student will be expected to generate their own questions. During facilitated discussions students will be expected to answer each other's questions.

4. ***Outside-Class Event:*** You are to attend some sort of climate – change lecture or event outside of our class.

   You will need to provide a short writeup of the event. Also, if you miss class more than one class, I ask you to attend a second event. Your participation in the MUSE conference and/or the Climate Blue Symposium can count for the outside-class event.

5. ***Grading Guidelines:*** This is an upper-level course. Students are assumed to take the material seriously, and therefore, grades are expected to good.

   I anticipate that students will be doing A work. A+ students make extra efforts in assignments, perhaps bringing in more material than assigned, and A- students represent less effort. To make a B grade would be missed classes, inattention to assignments, but still making a credible effort. To make below a B would require not taking the course seriously – it happens. I expect students to give serious attention to the papers, lectures, and other resources. They are not very long, but they require thinking. I want students to discuss what they have gotten from the resources, because making statements is part of thinking, and each student is likely to have different perspectives and insights. Multiple ways to communicate are provided, written and oral, so students have a choice of communication styles. I expect students to come to class. I realize that all of us experience events that alter schedules, and I expect students to balance priorities in a professional way. I like to know if students are going to miss class, and if students have to miss more that 2 of the classes,

then we should talk about the specifics. For the written responses, the questions are designed to guide you to important issues. I am not looking for long answers. I want to see what points students bring out, and I also want to understand if students are finding the material accessible. The responses are graded on a 5 point scale, which is described in the class announcements.

Lectures and Classes

1. ***Introductory Material***
    1. Course Outline: Student Backgrounds; Introduction to a Warming Planet / Student Special Interests
    2. Framing the System: Glimpse into the climate change problem using observations and projections; How is science-based knowledge generated? Relation of climate change to global issues: energy, economics, population, consumption; Organizing our response to global warming: Mitigation – Adaptation; Assessment and the United Nations; Discussion of climate "precipice" and the "next 10 years
2. **Scientific Study of Earth's Climate**
    1. Balance and Changing the Balance: The Earth-Sun-Space system in energy balance, role of the atmosphere and role of carbon dioxide in the atmosphere and climate; Past variability and historical context; Carbon dioxide budget
    2. The Conservation Principle: Balancing the Budget: The conservation of energy and mass, role of atmosphere, ocean, ice, and land; The Earth System; Modeling as budget and accounting, relation to scientific method
    3. Response to Heating, Feedbacks: How does the Earth's climate respond to an increase of carbon dioxide? If the Earth's surface warms a little bit, does the Earth respond by cooling or by enhancing the warming? Role of ice, ocean, and the Arctic, abrupt climate change
    4. Particles in the Atmosphere, Aerosols: The role of particulate matter (aerosols) in the atmosphere: heating, cooling; Air quality and climate change; Changes in the Earth's energy balance changes since the Industrial Revolution.
    5. Observations of Earth's Climate (1): Methods and quality of observations
    6. Observations of Earth's Climate (2): Causes of climate variability; How does the climate vary in the absence of human interference?
    7. Organization of Earth's Climate: The role of weather in climate and climate change: transporting energy and water, how humans experience climate; Why is weather organized the way it is organized: physical geography, rotation of planet, role in framing climate response and human impacts
    8. Coherent and Convergent Evidence: Observations of physical climate and ecosystems; The power of correlated information; Alignment of observations and model projections
    9. How Do We Know? Attribution of observed warming to fossil-fuel emissions. The signal and the noise.
3. **Problem Solving**
    1. Usability of Climate Science in Planning and Management: Knowledge system theory, Science usability theory, Communications, Engagement, Framing, Uncertainty management, Decision analysis and decision making (Problem Solving)
    2. Knowledge Systems and Structured Problem Solving: The gap between knowledge generation and knowledge use, the usability of science-based knowledge in problem solving: Structured problem solving, analysis tools, scenario analysis (Problem Solving)
    3. Wealth, Poverty, Ethics: Ethical considerations in problem solving; How does wealth frame responses? How does wealth relate to vulnerability? Climate winners and climate losers

4. Communication, Rhetoric, Argumentation: Communication is, perhaps, the most important issue of complex, multi-constituent, multi-jurisdictional, problem solving. This is more about communication with each other than letting the world know what you know.
5. Energy considerations: Energy sources, energy infrastructure, energy uses; Scale of what needs to be changed; renewables and alternative energy systems; what is possible; what are the barriers? What have we done?
6. Strategic Approaches to Addressing Climate Change: Mitigation wedges; No regrets mitigation and adaptation; Structured problem solving – how to organize complex, trans-disciplinary problems. Uncertainty management.
7. Policy Response: United Nations Framework Convention on Climate Change: dangerous, stabilization, language of international response; Policy evolution Kyoto to Paris to 2020; National and sub-national responses.
8. Managing Earth's Climate: Avoiding greenhouse gas emissions; Removing greenhouse gases; Geo-engineering; Looking beyond warming: precipitation, extremes, ocean acidification, nitrogen fertilization

4. **Other**