Syllabus AOSS/NRE 480

Course: Climate Change: An Interdisciplinary Approach to Problem Solving

Instructor:
Prof. Richard Rood
e-mail: rbrood@umich.edu
phone: (734) 647-3530 / Cell 301-526-8572
office: Space Research Building (SRB), room 2525

Expert Guest Lecturers

Meeting Time and Location:
Tuesday and Thursday from 10:00-11:30 am
1024 Dana Building

Course Description:
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 rapidly 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 changes were sometimes positive, for example agricultural prosperity, and sometimes negative, for example agricultural failures, famines, and migrations. Climate change provides personal, regional, national and global challenges to our selves, 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. 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 practiced in real-world projects

Course Structure:
2 Weekly Lectures with Discussion

Lecture Schedule:

The Science of Climate Change

1 (1/8/15) **Introduction**: Course Outline; Student Backgrounds; Introduction to a Warming Planet

2 (1/13/15) **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

3 (1/15/15) **Knowledge Systems and 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

4 (1/20/15) **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

5 (1/22/15) **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

6 (1/27/15) **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.

7 (1/29/15) **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.

8 (2/3/15) **Observations of Earth's Climate**: Methods and quality of observations; Causes the climate variability; How does the climate vary in the absence of human interference?

9 (2/5/15) **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

10 (2/10/15) **Coherent and Convergent Evidence**: Observations of physical climate and ecosystems; The power of correlated information; Alignment of observations and model projections

11 (2/12/15) **How Do We Know?** Attribution of observed warming to fossil-fuel emissions. The signal and the noise

12 (2/17/15) **Scenario Modeling and Analysis:** Shelie Miller, School of Natural Resources and Environment.

Responses to Climate Change

13 (2/19/15) **Existing Energy Systems**: Energy sources, energy infrastructure, energy uses; Scale of what needs to be changed; Barriers to change

14 (2/24/15) **Future Energy Systems:** Mark Barteau, Director, University of Michigan Energy Institute

15 (2/26/15) **International Policy Response:** United Nations Framework Convention on Climate Change: dangerous, stabilization, language of international response; Policy evolution Kyoto to Paris to 2020; National responses to international efforts

16 (3/10/15) **Policy TBD:** Barry Rabe, Ford School of Public Policy

17 (3/12/15) **Politicization of Climate Change**: Paul Edwards, School of Information and Department of History

18 (3/17/15) **Corporate Enterprise:** Andy Hoffman, Holcim (U.S.) Professor of Sustainable Enterprise, Ross School of Business

19 (3/19/15) **Regulation and Litigation**: David Uhlmann, Michigan Law, Director, Environmental Law and Policy Program

20 (3/24/15) **Wealth, Poverty, Ethics**: Ethical considerations problem solving; How does wealth frame responses? How does wealth relate to vulnerability? Climate winners and climate losers?

21 (3/26/15) **Design as engaging and responding to climate, environment, economic, energetic and systemic issues:** Geoff Thun, Taubman College of Architecture and Urban Planning

22 (3/31/15) **Urban water infrastructure and climate change**: Nancy Love: Civil and Environmental Engineering

23 (4/2/15) **Local Urban Planning for Resilience in the Face of Climate Change: Great Lakes Cities** Richard Norton, Chair, Urban and Regional Planning Program

24 (4/7/15) **Approaches and Challenges to Climate Adaptation – the role of boundary organizations**: Don Scavia, Graham Family Professor of Sustainability and Director, Graham Sustainability Institute

25 (4/9/15) **Strategic Approaches to Addressing Climate Change**: Mitigation wedges; No regrets mitigation and adaptation; Structured problem solving – how to organize complex, trans-disciplinary problems

26 (4/14/15) (TBD) **Entrepreneurial Opportunities**, Steve Skerlos, Professor, Mechanical Engineering; Professor, Civil and Environmental Engineering; Arthur F. Thurnau Professor, Mechanical Engineering

27 (4/16/15) **Managing Earth's Climate**: Avoiding greenhouse gas emissions; Removing greenhouse gases; Geo-engineering; Looking beyond warming: precipitation, extremes, ocean acidification, nitrogen fertilization

28 (4/21/15) **Class Synthesis, Discussion, Evaluation**

Course Requirements:

1. ***Class preparation, attendance, and participation.*** The course is discussion-intensive course. Therefore attendance and participation are mandatory and vital to the success of the course. This includes coming to class prepared and having read the assigned readings for the lecture.
2. ***Reading Responses.*** During the course you are required to produce responses of roughly one page (single-spaced) to readings and recorded lectures. The responses do not need to be elaborate, but they should also not summarize the reading. Their should be used to refine your questions and insight from the source materials and enhance the class discussion. They must be submitted via CTools at least two hours before the start of lecture for the relevant readings.
3. ***Group Project.*** You will work in multi-disciplinary teams on projects, determined by clients and instructors, to analyze current real-world problems and to develop strategies to address those problems. Final project presentations will stand in lieu of final examinations.