SYLLABUS: IDS 4930 (section 1485) – CLIMATE CHANGE SCIENCE AND SOLUTIONS

Spring 2015, Meeting: MAEB 229, Thursday 6th-7th period (12:50-2:45 pm)

INSTRUCTORS

Lead Instructor: Dr Andrew Zimmerman, Department of Geological Sciences
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TA: Julie Emminger Office ARC313
Office Hours: Tues. 1:50 – 2:45 pm (or by appt.) e-mail: jcemminger@ufl.edu

COURSE DESCRIPTION

Uses the issue of climate change to deepen student's understanding of science and its role in society. Working individually and collaboratively, students will integrate information and insights from a wide variety of natural sciences and engineering/design disciplines to develop holistic approaches to climate change adaptation and mitigation.

Prerequisites: none **Credits:** 3 **Course Fee:** none

Course Objectives
It is the aim of this course that by the end, students will be able to:

- Understand the basic facts and uncertainties regarding climate change, the role of humans in causing it, and its possible effects on a variety of natural and human systems.
- Understand how science has shaped and is shaped by our modern society.
- Apply the process of scientific inquiry in discovering, understanding, and addressing the challenges of climate change.
- Develop hypothesis-driven solutions to climate change through critical evaluation and teamwork.
- Effectively communicate multi-disciplinary scientific challenges and strategies for addressing them.

Course Structure
The course will require both on-line and in-class participation. Prior to class each week, students will explore content provided on-line (1-2 hours total) that will include:

1) Completion of a 'Spark' Discussion (by Monday 11:59 pm)
2) Readings and on-line lectures
3) A quiz on the on-line materials (completed by Wednesday 5:00 pm)
4) Sometimes exercises relating to the material viewed on-line that week

In class each week students will complete discussion/activities, often as a group, that deepen their understanding of the material presented on-line that week.

In addition, students will work on a semester-long group project, both in and outside of class that will develop a novel approach to addressing one or more climate change-related issues. Students are required to bring a laptop or other web-enabled device to each class meeting and are also required to participate in an all-day field trip on one Saturday of the semester.

COURSE WEBSITE and COMMUNICATION

Course Website
The course will run via **Canvas** through the UF e-learning website; go to http://lss.at.ufl.edu/ and click on the Canvas Login button. The course site will be used to post relevant announcements, reading, lecture materials, links, assignments and quizzes, etc. You are responsible for checking this site for updates, announcements and to

verify that your grades are recorded correctly. We recommend you adjust settings so that Announcements are sent to phone or email.

Questions and Comments on course logistics (e.g. assignments, grading etc.) and on content (e.g. science or policy questions directed toward any of the course instructors) should be posted in two respective discussion boards within the course website. Questions of a personal nature (e.g. medical emergency, legal, documented disability accommodation, etc.) should be sent to the TA via e-mail who will forward these to the appropriate faculty instructor as necessary.

Required Textbook

Dire Predictions: Understanding Global Warming, by Mann and Kump, 2009, Prentice Hall ($15 new on Amazon or at bookstore for about $37)

In addition, there will be numerous selected readings posted or linked through the course website weekly.

ASSESSMENTS AND GRADING

Final Grade Calculation

30% Homework:
- 10% 12 Discussions (2 lowest dropped) [1% each]
- 20% 12 Quizzes (2 lowest dropped) [2% each]

30% In-class Activities (some individual, some group work), expect about 12 assignments, lowest 2 will be dropped [3% each]

20% Final Project
- 5% Initial proposal (Group Assessment)
- 5% midterm presentation (Group Assessment)
- 4% final presentation (Group Assessment)
- 4% final grade (Group Assessment)
- 2% Individual Assessment

20% Mid-term exam (No Final Exam)

Final Grade Scale

A = ≥93%, A- = 90-92.99, B+ = 87-89.99, B = 83-86.99, B- = 80-82.99, C+ = 77-79.99, C = 73-76.99, C- = 70-72.99, D+ = 67-69.99, D = 63-66.99, D- = 60-62.99, E < 60

***Note:** An earned grade of 'C-' grade or below does not qualify for major, minor, Gen Ed, or college basic distribution credit.

For further information on UF's Grading Policy, consult:
https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

Discussions

Students have from the end of class (Thursday 5 pm) till Monday 11:59 pm to complete the on-line 'Spark' Discussion. Each student should make one substantive original comment and one substantive response to the comment of another student. That is, students must read what has been said before and add something more than a few words of agreement or disagreement. No credit will be given for late submissions.

Homework, Quizzes and Exams

Quizzes each week will be taken by students each week on Canvas by 5 pm of the Wednesday before class and will consist of about 20 multiple choice questions on the lecture and reading material presented on-line that week. It is also possible that an additional on-line homework activity will be assigned which may include a short essay, a few short answer questions etc. In addition, students should bring any questions they may have to class, brought to mind by the online material. Quizzes and homework can be turned in only up to 1 week after they are due but will only receive half credit.

The Midterm Exam must be taken on October 6 or 7, will be on-line, closed book, 2 hour limit The exam will consist of about 50 multiple choice questions (some taken from quizzes, some new). Everything associated with the class up to the point of the exam (Weeks 1-6), including on-line material and in-class discussion/exercises, is fair game on the mid-term exam. If missed, make-ups for this exam will only be given by pre-arrangement or under extraordinary circumstances.

In-Class Activities

There will be a graded activity that will be completed during each class meeting. These may be individual or group assignments and they may sometimes be turned in during class, sometimes after, on paper or on-line, as specified by the instructor. These can generally be turned in up to 1 week after they are due but will receive half credit.

Semester Project

Students, in groups of 4-5, will be asked to work as a team to create and evaluate either a strategy to mitigate climate change, or a strategy to adapt to the predicted effects of climate change. The strategies will range widely, e.g., from a solar-powered bicycle to a change in international law. Each group will quantitatively evaluate the cost and/or potential impacts that would result from the adoption of their strategy (climate, human health, economic, etc.). During the course of the semester, both lectures and sub-assignments will build students' skills and the knowledge base needed for this kind of problem solving. At the end, both an oral and a written presentation will be due. An evaluation rubric for this project is included below.

Extra Credit

No mechanisms for extra credit are available.

COURSE AND UNIVERSITY POLICIES

Attendance and Absence

Students are expected to complete all requirements (quizzes, exams, presentation) on the specified dates and will not be granted an alternate date unless they have an acceptable reason for their absence (e.g., absences due to medical emergency, observance of religious holidays, military obligation) or pre-arranged consent of the instructor. However, you may receive an extension on an assignment by pre-arranged consent of the instructor or in extraordinary circumstances. These requests must be timely and accompanied by all necessary written documentation.

'In-class activities' must be turned in by the end of each class period. They can be turned in only up to 1 week after the class they are due but will receive half credit. Students are expected to complete all requirements (quizzes, exams, presentation) on the specified dates. However, you may receive an extension on an assignment by pre-arranged consent of the instructor or in extraordinary circumstances. These requests must be timely and accompanied by all necessary written documentation.

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found in the online catalog at:
https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

Classroom policy

Students are required to bring to each class meeting a laptop or similar device for use in taking notes, submitting in-class activities, and accessing the internet. However, use of mobile devices and computers during class for purposes other than viewing readings or conducting sanctioned research is not allowed. Cell phones must be turned off during class. Students who receive or make calls or text messages or engage in other disruptive behavior during class will be asked to leave will not be allowed to turn in the assignment due on that day. Students should also bring pen/pencil and paper to each class.

Academic Honesty Policy
Students must conform to UF's academic honesty policy regarding plagiarism and other forms of cheating. This means that on all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The university specifically prohibits cheating, plagiarism, misrepresentation, bribery, conspiracy, and fabrication. For more information about the definition of these terms and other aspects of the Honesty Guidelines, see http://www.dso.ufl.edu/sccr/process/student---conduct---honor---code/. All students found to have cheated, plagiarized, or otherwise violated the Honor Code in any assignment for this course will be prosecuted to the full extent of the university honor policy, including judicial action and the sanctions listed in paragraph XI of the Student Conduct Code. For serious violations, you will fail this course.

Software Use
All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate.

Accommodations for Students with Disabilities
Please do not hesitate to ask for accommodation for a documented disability. Students requesting classroom accommodation must first register with the Dean of Students Office (http://www.dso.ufl.edu/drp/). The Dean of Students Office will provide documentation to the student, who must then provide this documentation to the Instructor when requesting accommodation. Please ask the instructor if you would like any assistance in this process. Please provide this information to your TA within the first two weeks of the semester.

Instructor Evaluation
Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at https://evaluations.ufl.edu. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at https://evaluations.ufl.edu/results/.

Drop/Add/Withdrawal
A student can drop/add during the drop add period with no penalty. After drop/add, a student who drops will receive a W until the date listed in the academic calendar. After that date, the student may be assigned an "E" (fail). Note: it is the responsibility of the STUDENT to withdraw from a course, not the instructor. Failure to participate/complete the class is NOT a drop.

Additional Resources
Students facing difficulties completing the course or who are in need of counseling or urgent help may contact the Counseling and Wellness Center: http://www.counseling.ufl.edu/cwc/Default.aspx, 392-1575; or the University Police Department: 392-1111 or 9-1-1 for emergencies.
Other Resources available on-campus for students include:

a. Student Mental Health, Student Health Care Center, 392-1171, personal counseling;
b. Sexual Assault Recovery Services (SARS), Student Health Care Center, 392-1161, sexual counseling;
c. Career Resource Center, Reitz Union, 392-1601, career development assistance and counseling.

Disclaimer
This syllabus represents the current plans and objectives; however, schedules, requirements, and assignments may change throughout the semester as the need arises. Such changes, communicated clearly, are not unusual and should be expected.

COURSE SCHEDULE

Meeting Day Spring 2015	Week	Module	Fundamental Science Topic	Framework Topic	Other Activities	Reading in '*Dire Predictions*', pages
8-Jan	1	Intro to climate and CC	Disciplines of climate change	Interdisciplinary Science		
16-Jan	2		Climate Drivers/Feedbacks	Scientific Method		6-31
22-Jan	3		Climate History	How science is done		32-33, 40-43
29-Jan	4		Evidence for Climate Change	Uncertainty/Consensus		34-46
5-Feb	5		CC and the Weather	Research and Big Data	Intro. Semester Project (2nd hr)	47-62
12-Feb	6		CC Projections	Models		63-105
19-Feb	7	Problems and Solutions	Ecological Impacts of CC	Team Science	Midterm Exam – Feb 16 or 17	107-127
26-Feb	8		Human/Population, Consumption	Ethics	Semester Project (2nd hour)	128-139, 190-191
12-Mar	9		Agriculture/ Land Use	Communicating Science to the Public	Field trip – March 14	141-153
19-Mar	10		Energy	Science Funding/ Fueling Technology		155-165
26-Mar	11		Built Environment	From the Lab to the Real	Midterm project evaluation	166-179
2-Apl	12	CC Policy	Environmental Policy: Climate Change	Science in the public realm		180-197
9-Apl	13		Climate Change and Sea Level Rise (Capstone)	Science in the public realm		
16-Apl	14		Project Presentations		Final project presentation	

GENERAL EDUCATION

This course fulfills a Physical Science (P) General Education requirement

General Education Objectives

General education physical science courses provide instruction in the basic concepts, theories and terms of the scientific method in the context of the physical sciences. Courses focus on major scientific developments and their impacts on society, science and the environment, and the relevant processes that govern physical systems. Students will formulate empirically-testable hypotheses derived from the study of physical processes, apply logical reasoning skills through scientific criticism and argument, and apply techniques of discovery and critical thinking to evaluate outcomes of experiments.

Accomplishment of General Education Objectives

The general education objectives will be accomplished through the examination of the issue of climate change; climate science, climate change impacts, and approaches to finding solutions to the 'wicked problem' of climate change. Each week, students will study on-line material on a 'hard science' climate change (Fundamental) topic and a 'doing science' or 'science and society (Framework) topic'. Then, in class meetings each week, the two topics will be brought together and reinforced by doing critical thinking and application exercises and discussions.

General Education Student Learning Outcomes

The general education student learning outcomes describe the knowledge, skills and attitudes that students are expected to acquire while completing a general education course at the University of Florida. The SLOs fall into three areas: content, communication and critical thinking.

- Content: Students demonstrate competence in the terminology, concepts, methodologies and theories used within the discipline.
- Communication: Students communicate knowledge, ideas, and reasoning clearly and effectively in written or oral forms appropriate to the discipline.
- Critical Thinking: Students analyze information carefully and logically from multiple perspectives, using discipline specific methods, and develop reasoned solutions to problems.

General Education Student Learning Outcomes Assessment

- Content: Mastery of discipline-specific science-related content (terminology, concepts, theories etc.) will be assessed through weekly on-line quizzes that will be taken by students after viewing weekly on-line materials as well as in the mid-term exam. (total 50% of final grade)
- Communication: In weekly class meetings, students will be required to participate in open-ended thoughtful discussions regarding the climate change topics and policy implications, the process of scientific discovery, ethics, and applications. Students will communicate their ideas to their peers while working in groups to communicate to generate creative solutions of a scientific nature and also present these final projects formally to the larger group. (total 20% of final grade)
- Critical Thinking: Each week, students will complete exercises, sometimes individually and sometimes in groups, which require them to synthesize and interpret scientific data, and lead them to support or reject existing scientific hypotheses. Hypothesis testing is most explicitly addressed in week 2 of the course in which students formulate their own scientific hypotheses regarding drivers of climate and experiments to test those hypotheses, and in week 4, in which students will critically evaluate data proposed to support established hypotheses. (total 30% of final grade)

For each activity, students will be provided with specific instructions for completing the activity and a grading rubric. The grading rubrics are designed to evaluate the student's mastery of specific content and their ability to produce bodies of work within the guidelines specified in the instructions.

Semester Project Evaluation Rubric

Proposal (5% of Final Grade)

a. Written summary is clear and complete – 25/100 points
b. Oral presentation is clear and complete – 25/100 points
c. Concepts clearly address either adaptation or mitigation – 50/100 points

Midterm Presentation (5% of Final Grade)

a. Proposed strategy is clearly articulated – 20/100 points
b. The potential benefit of the strategy is clear – 20/100 points
c. The population who will benefit from the strategy is clear - 10/100 points
d. Visual resources have been incorporated in the strategy presentation - 10/100 points
e. Scientific data have been incorporated in the presentation and inform either the concept or how it will be implemented - 20/100 points
f. A method(s) of assessing the effectiveness/impact of the strategy is described - 20/100 points

Final Presentation (10% of Final Grade)

a. Suggestions from the midterm presentation are incorporated into the strategy and its presentation. – 10/100 points
b. Proposed strategy is clearly articulated – 20/100 points
c. The potential benefit of the strategy is clear – 10/100 points
d. The population who will benefit from the strategy is clear - 10/100 points
e. Visual resources are incorporated in the strategy presentation - 10/100 points
f. Scientific data are incorporated in the presentation and inform either the concept or how it will be implemented - 20/100 points
g. The effectiveness/impact of the strategy is assessed - 20/100 points

Selected Examples of 'Spark Discussions' to be used (These are discussion done before viewing any on-line content, meant get the thought juices flowing and preconceptions realized and shared)**:**

1. Relate an interesting scientific experiment you did (either as a child or recently, in school or informally). If you really draw a blank, you can tell about a famous one you may have heard about (not already mentioned by another student). Tell what your hypothesis was if you had one, method and the results. (about 4 sentences). Make 1 substantive comment about someone else's experiment.

2. The U.S. government distributes about $50 million each year for paleoclimate research, study of climates in Earth's past (hard to give an exact number since this money comes from a variety of separate programs at NSF, NOAA, NASA, operation of a deep sea drilling ship). What do you think of when you think of Earth's past climate? Why do you think it would be so important to understand climates of the past?

3. Let's define anthropogenic global warming (AGW) as the theory that human beings are responsible for increasing atmospheric GHG, which has contributed to recent (last 50-100 years) warming of the Earth and other climate changes (that would not have occurred otherwise). Recount an experience you have had where someone expressed to you an argument against or doubts about AGW theory (or why we as a society shouldn't do anything about AGW) - what did they say? A personal experience would be best but if you have none, something you may have read or heard in the media would suffice.

Selected Examples of Readings that will be assigned (in addition to most of the 200 page textbook):

Peer Reviewed Research

Fudge, D., Fifty years of J. R. Platt's strong inference. The Journal of Experimental Biology (2014) 217, 1202-1204 doi:10.1242/jeb.104976.

Monnin et al., 2010. Atmospheric CO2 Concentrations over the Last Glacial Termination. Science. 291: 112-114. DOI: 10.1126/science.291.5501.112.

Hites, R.A. How To Give a Scientific Talk, Present a Poster, and Write a Research Paper or Proposal, Environ. Sci. Technol. 2014, 48, 9960−9964. dx.doi.org/10.1021/es503552t.

Teigen, K.H., When very likely is not so likely. NATURE CLIMATE CHANGE , 4: 2014.

Doran and Zimmerman, 2009. Examining the Scientific Consensus on Climate Change, Eos, VOLUME 90 NUMBER 3. DOI: 10.1029/2009EO030002.

Curry, JA and PJ Webster, 2013: Climate change: no consensus on consensus. CAB Reviews, v8.

Kitchn., R., Big Data, new epistemologies and paradigm shifts. Big Data & Society 2014 1. DOI: 10.1177/2053951714528481.

Retchless, D., Frey, N., Wang, C., Hung, L., Yarnal, B. 2014. Climate extremes in the United States: recent research by physical geographers. *Physical Geography*, 35:1, 3-21.

Davidson, E.A. et al., 2012. The Amazon basin in transition. Nature 481, 321-328. doi:10.1038/nature10717.

Costanza et al., 1997. The value of the world's ecosystem services and natural capital. *Nature* 387:253-260.

Twenty Landmark Papers in Biodiversity Conservation. Chapter 6: Twenty Landmark Papers in Biodiversity Conservation. By: Bradshaw, N. S. Sodhi, W. F. Laurance, B. W. Brook. In Research in Biodiversity - Models and Applications (2011).

Ethics and Global Climate Change, Gardiner, S. M. & Hartzell-Nichols, L. (2012) Ethics and Global Climate Change. Nature Education Knowledge 3(10):5.

Chapter 4 "The Perfect Brainstorm" in The Art of Innovation from Kelly, T. (2001). The art of innovation: Lessons in creativity from IDEO, America's leading design firm. New York: Doubleday.

The Popular Press

The Real Scientific Consensus on Climate Change http://www.foxbusiness.com/business-leaders/2014/06/05/real-scientific-consensus-on-climate-change/

The Seven Warning Signs of Bogus Science http://www.quackwatch.com/01QuackeryRelatedTopics/signs.html

NOVA scienceNow video on Tropical Ice Cores Measure Climate, http://www.pbslearningmedia.org/asset/clim10_vid_icecores/

Climate change is an uncertain science by John Howard. *The Telegraph*. 09 Nov 2013.

Government Agencies

Climate Change 2007: Working Group I: The Physical Science Basis, Chapter 1: Historical Overview of CC, http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch1.html

IPPCC Fifth Assessment Report (AR5) Home page. http://www.ipcc.ch/index.htm

Climate Change 2013, The Physical Science Basis, Summary for Policymakers, A report of Working Group I of the IPCC (selected portions; p 4-25, 36-41 and 114-115). http://www.ipcc.ch/report/ar5/wg1/

IPCC Special Report s, CHpater 5, Emissions Scenarios (SRES). http://www.ipcc.ch/ipccreports/sres/emission/index.php?idp=0

IPCC Special Report: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX) Chapter 3: Changes in Climate Extremes and their Impacts on the Natural Physical Environment http://ipcc-wg2.gov/SREX/images/uploads/SREX-Chap3_FINAL.pdf

NASA Earth Observatory Website on Paleoclimatology
http://earthobservatory.nasa.gov/Features/Paleoclimatology_SedimentCores/

Specific sections: Executive Summary p. 111-114, Section 3.2 Requirements and Methods for Analyzing Changes in Extremes 3.2.1 Observed Changes p. 122 – 125 (skip box), Box 3-2 p. 132 ~ 6 pages of reading

NOAA/NCDC report on billion dollar weather and climate events from 1980-2003
http://www1.ncdc.noaa.gov/pub/data/techrpts/tr200301/tr2003-01.pdf

Southeast Climate Consortium's agroclimate website climate fact sheets: Fundamentals of Climate variability and Change
http://agroclimate.org/fact-sheets-climate.php

NOAA National Climatic Data Center: http://www.ncdc.noaa.gov/cag/time-series/us

Academic Resources

On Science: http://undsci.berkeley.edu/article/0_0_0/us101contents_01

Zimmerman, A.R., 2014. How science is *really* done.

SENSE ABOUT SCIENCE, MAKING SENSE OF UNCERTAINTY, 2013.
http://www.senseaboutscience.org/resources.php/127/making-sense-of-uncertainty

Naomi Oreskes on the Merchants of Doubt, https://www.youtube.com/watch?v=wX3y6BQd4LI

Holgate, S.A., 2014. How to Collaborate. *Science*. 10.1126/science.caredit.a1200082

Non-Governmental Agencies

Climate Drivers http://co2now.org/Know-the-Changing-Climate/Climate-System/ipcc-explains-earths-climate-system.html

Selections from Climate Change Reconsidered II – Physical Science. Published for the Nongovernmental International Panel on Climate Change (NIPCC). Heartland Institute. 2013.

Can we live inside the doughnut? Why the world needs planetary and social boundaries: http://blogs.oxfam.org/en/blog/12-02-13-can-we-live-inside-doughnut-why-world-needs-planetary-and-social-boundaries

Southeast Climate Consortium's agroclimate website climate fact sheets. http://agroclimate.org/fact-sheets-climate.php