Syllabus
Physics of the Global Climate Change
(Physics 2450)
Fall Semester 2015

Instructor: Prof. Jens Oberheide, 102B Kinard Lab, Dept. of Physics and Astronomy, Clemson University, Tel. 864-656-5163, Email: joberhe@clemson.edu

Class Hours: Tu-Th 9:30 – 10:45, 201 Kinard; you may leave class if Prof. Oberheide has not arrived after 15 minutes

Office Hours: Mo 12:00 – 1:00, Th 11:00 – 12:00; students can make appointments outside the regular office hours by email request

Attendance Policy: Attendance is required, since additional material will be presented in class not contained in the textbook. Also in-class exercises and participation in discussions are an important part of this course. Attendance will be checked by short quiz questions at the beginning and end of the class period at the instructor's discretion, which enter into the grade calculation.

Any exam that was scheduled at the time of a class cancellation due to inclement weather will be given at the next class meeting unless contacted by the instructor. Any assignments due at the time of a class cancellation due to inclement weather will be due at the next class meeting unless contacted by the instructor. Any extension or postponement of assignments or exams must be granted by the instructor via email or Blackboard within 24 hours of the weather related cancellation.

Academic Integrity: The Clemson University statement on academic integrity reads: "As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a "high seminary of learning." Fundamental to this vision is a mutual commitment to truthfulness, honor and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating or stealing in any form."

Disability Access Statement: Students with disabilities requesting accommodations should make an appointment with Dr. Margaret Camp (656-6848), Director of Disability Services, to discuss specific needs within the first month of classes. Students should present a Faculty Accommodation Letter from Student Disability Services when they meet with instructors. Accommodations are not retroactive and new Faculty Accommodation Letters must be presented each semester.

Clemson University Title IX (Sexual Harassment) Statement: Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national

origin, age, disability, veteran's status, genetic information or protected activity (e.g., opposition to prohibited discrimination or participation in any complaint process, etc.) in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972. This policy is located at http://www.clemson.edu/campus-life/campus-services/access/title-ix/. Mr. Jerry Knighton is the Clemson University Title IX Coordinator. He also is the Director of Access and Equity. His office is located at 111 Holtzendorff Hall, 864.656.3181 (voice) or 864.565.0899 (TDD).

Scope of Course: Climate change will be, if not already, the environmental issue of the 21st century. This course aims to address the whole complexity of climate change with the focus upon the physics of climate change and impacts on the earth system. Throughout this course, we also study the interrelationships between climate science and society, how the different media communicate controversial issues to the public, and the effects of scientific and public opinion on policymaking. About a third of the material and assignments will focus on Science and Technology in Society (STS) issues in accordance with the General Education requirements.

Some important questions addressed in this course are:

- What is the scientific basis for our understanding of climate change?
- What are the sources of emissions of greenhouse gases?
- What changes in climate might we expect over the coming century and what might be the impacts for human wellbeing?
- What technologies exist or might be developed that could mitigate climate change?
- How do private, national and world economies respond to the challenge?
- How are public opinions formed and how do they vary in time?
- What is the role of scientists in the formulation of strategic goals and policy? What is a scientific consensus?

Objectives: Students will be expected to show mastery of a variety of concepts drawn from the Earth sciences and physics. They would able to explain the relevance of these concepts for our present understanding of human-caused climate change and for the viability of different proposed solutions for adaptation and mitigation. By the end of this course, students will be able to:

- Describe how the Earth's climate system works and summarize general atmosphere circulation patterns, ocean circulation patterns and climate oscillations such as the thermohaline circulation, North Atlantic Oscillation, and the El-Niño-Southern Oscillation.
- Diagram components of the Earth's carbon cycle, quantitatively describe how addition of carbon dioxide to the atmosphere through burning of fossil fuels will influence the climate, and understand the various feedback mechanisms that enter into the modeling of global climate change.

- Explain and evaluate the evidence for human-caused climate change, in the context of historical climate change, as well as the relevant scientific uncertainties and possible evidence to the contrary.
- Explain the natural and human causes of climate change, including the sources of greenhouse gas emissions. Because energy consumption is central to greenhouse gas emissions, students will understand the global energy infrastructure in a historical context. The possible technological options for reducing greenhouse gas emissions would be studied and evaluated.
- Explain and quantify the impacts of climate change on the natural world, and evaluate means by which these impacts can be reduced (adaptation).
- Evaluate the successes and failures of past efforts to address climate change, and evaluate prospects for future mitigation of climate change.
- Summarize and analyze the range of policy issues related to global warming.

Disclaimer: "Students may vary in their competency levels on these abilities. They can expect to acquire these abilities only if they honor all course policies, attend class regularly, complete all assigned work in good faith and on time, and meet all other course expectations of them as a student."

Required Textbook: Archer, David: Global Warming: Understanding the forecast, 2nd ed., Wiley, 2011, ISBN 978-0-470-94341, paperback, ~$40.

Recommended Textbook: Houghton, John: Global Warming: The Complete Briefing, 4th Edition, Cambridge University Press, 2009, ISBN-13: 9780521709163, paperback, ~$40.

Course Outline: The course is 15 weeks with 2 classroom lectures per week. Each week requires about 2-3 additional hours for reading, working a short assignment, and preparing for quizzes and tests. These are the chapter titles from the textbook by David Archer.

1 Humankind and Nature
2 Blackbody Radiation
3 The Layer Model
4 Greenhouse Gases
5 What Holds the Atmosphere Up?
6 Weather and Climate
7 Feedbacks
8 Carbon on Earth
9 Fossil Fuels and Energy
10 The Perturbed Carbon Cycle
11 The Smoking Gun
12 Potential Climate Impacts
13 Decisions, Decisions

Method of Teaching: This is a lecture course based upon a very popular textbook. Students will prepare by reading the chapters and answer included study questions. The main points (including mathematical examples) will be reviewed and discussed in class, along with additional material presented by the instructor. We will also engage in a number of exercises exploring various web-based models and applying the knowledge. Laptop with web access and calculator is required. Students will also be asked to find, present and discuss climate change related news. Many of the assignments are administered through Blackboard.

Course Grades and Weights

- 10% Write two short essays @5% about global climate change – your perspective as to the severity of the global warming problem (pass/fail)
- 10% Answer online questions about lecture material during class, also proof of attendance (count best 80%)
- 20% Successful completion of homework assignments on Blackboard (count best 80%)
- 30% Two Midterm exams @15%
- 30% Final examination (comprehensive)

A: 90-100%; B: 80-89%; C: 70-79%; D: 60-69%; F:<60%