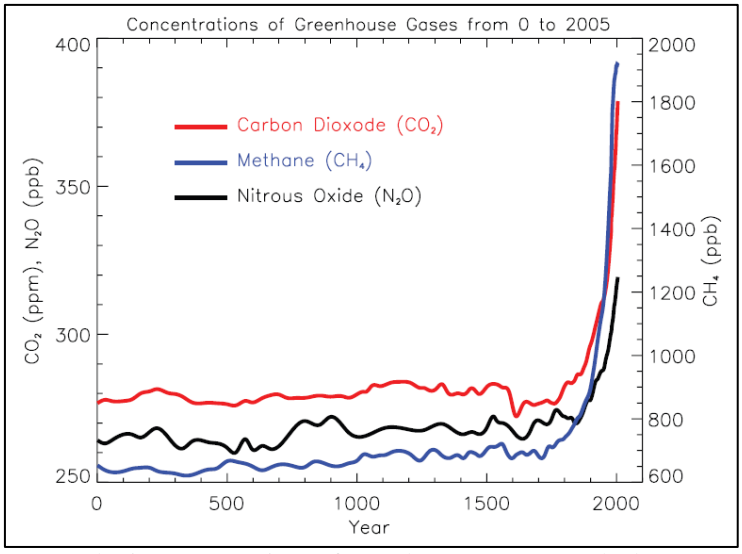
Climate Change

(GARP 0239, 3 credits, Tu/Th 14:15 – 15:30, Wilson Auditorium A)

The United Nations Framework Convention on Climate Change (UNFCCC) defined "Climate Change" in 1992 as *"…a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods."* Article 2 of the UNFCCC then called for *"stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."* (Note: the U.S. signed and ratified the UNFCCC)

Question: What constitutes a "dangerous anthropogenic interference"?



Atmospheric concentrations of greenhouse gases over the last 2,000 years. Increases since ~1750 are attributed to human activities in the industrial era. (IPCC 2007 WG I FAQ)

In this course, we will explore climate change from a wide variety of angles. We begin by investigating the basics of our climate system, including the physics of the greenhouse effect and mechanisms (so-called forcings), both natural and human, of climate change. The second part of the course focuses on climate change observed in the past, today, and in the future, including methods of (past) climate reconstruction and (future) climate prediction. In the third part of the course we will extend our discussions beyond the scientific basis and into questions of impacts, vulnerabilities, and adaptation/mitigation strategies (So what? Now what?). Each of the three parts ends with a relevant "focus theme":

Focus Theme 1:	What caused the Ice Ages?
Focus Theme 2:	The IPCC 4th Assessment Report 2007 (www.ipcc.ch)
Focus Theme 3:	Energy beyond Carbon

➔ This course requires continuous active participation through reading, writing, in-class discussions, and presentations.

Your Instructor

Dr. Carsten Braun cbraun@wsc.ma.edu 413.572.5595 Bates 06
Office Hours: MWF 12:15 to 13:15 (or anytime by appointment)

The basic objective of this course is to untangle scientific facts from personal opinions and scientific uncertainty from political, moral, or ethical bias. Does uncertainty justify inaction? How much uncertainty justifies inaction? What types of action are justified or necessary today? The public discourse about climate change and "Global Warming" is highly polarized and thus often fails to foster pragmatic, "no-regrets" approaches and solutions. This course cannot offer simple answers, but we will separate scientific facts from personal/religious/special-interest opinion and engage in nuanced and informed discussions of what we can/should/must do/not do about these climate change.

➔ **If you feel that you are not progressing as well as you hoped, please feel free to talk to me during my office hours or a mutually convenient time – the sooner the better!**

Required Textbooks

- Archer, D., 2007, Global Warming – Understanding the Forecast. Blackwell Publishing, ISBN 978-1-40514093-3, 194 pp., ~$50. (http://forecast.uchicago.edu/)
- Kolbert, E., 2006, Field Notes from a Catastrophe – Man, Nature, and Climate Change. Bloomsbury USA, ISBN 978-1596911307, 240 pp., ~$12 as paperback.

Assessment

1. Three tests (15 percent each). All three tests will be either take-home format and/or short paper format (~5 pages) with a selection of several pre-defined topics. Note: the test dates on the schedule denote the "out" date – the due dates for Test #1/#2 is one week thereafter. The due date for Test #3 is Tuesday (13 May 2008) at 14:30.

2. Reading assignments and/or data analysis exercises (20 percent), given approximately weekly. These assignments and exercises are designed to formalize the readings and to lay the foundation for in-class discussions. You can't discuss what you haven't read! Assignments typically involve writing in connection with the assigned weekly reading, but will also include quantitative problem solving.

3. Semester-long individual research project (35 percent). Here you get choose your own topic, conduct the research, and present your research as a scientific paper and poster at the end of the semester (6 May 2008) as a poster presentation. A few details:

    - About 10-15 pages text (figures, tables, and bibliography extra).
    - Follow the scientific method and standard scientific paper structure.
    - The project proposal and project draft are mandatory and part of the overall project evaluation.
    - In addition to the paper, you will create a large-format color poster (24 by 36 inches) for display and presentation on 6 May 2008.

➔ **More detailed and specific instructions will be provided over the course of the semester.**

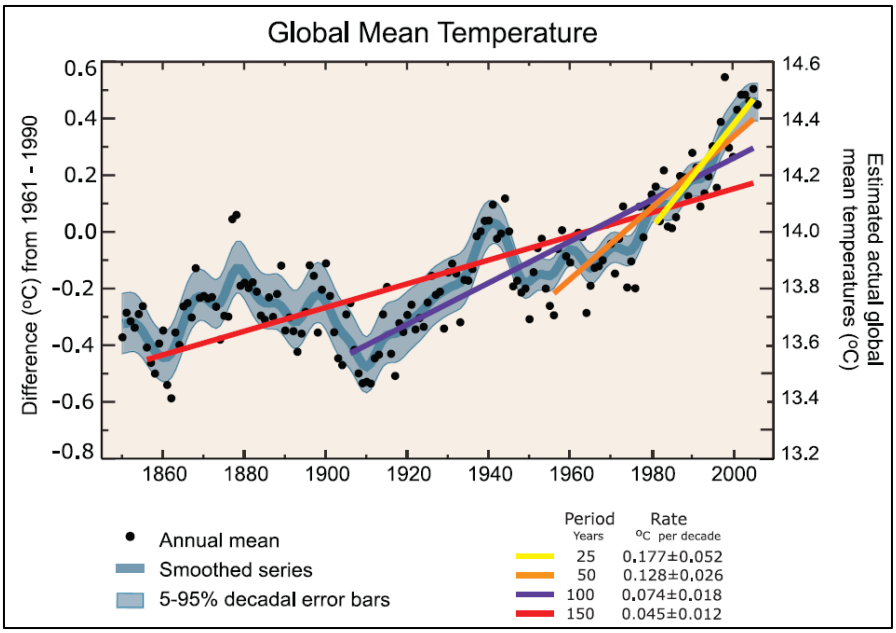
Course Schedule GARP 0239 (Spring 2008)			
	Theme/Topic	**Reading**	**Comments**
Week 1 (01/22, 01/24)	Course Overview Climate Change vs. Global Warming	Archer Ch.1 Kolbert preface	
Week 2 (01/29, 01/31)	The Basics of the Climate System: Atmosphere, Temperature, Wind, etc.	Archer Ch.6	
Week 3 (02/05, 02/07)	The Physics of the Greenhouse Effect, Greenhouse Gases	Archer Ch.2/3/4 Kolbert Ch.2	
Week 4 (02/12, 02/14)	Mechanisms of Climate Change: Forcings, Feedback, and Tipping Points	Archer Ch.7	Test #1 out
Week 5 (02/19, 02/21)	**Focus Theme 1:** What caused the Ice Ages?	Hand-outs	Research Project Proposal due
Week 6 (02/26, 02/28)	Studying Past Climates: Methods of Paleoclimatology	Hand-outs Kolbert Ch.1	
Week 7 (03/04, 03/06)	Climates Change in the Past: The last 650,000 years	Hand-Outs Kolbert Ch.3	
Week 8 (03/11, 03/12)	Spring Break		
Week 9 (03/18, 03/20)	Climates Change in the Present: The last 1,000 years	Archer Ch.11	
Week 10 (03/25, 03/27)	Climates Change in the Future: The next 100 years according to models	Archer Ch.12 Kolbert Ch.5	Test #2 out
Week 11 (04/01, 04/03)	**Focus Theme 2:** The IPCC 4th Assessment Report 2007	IPCC 2007 SPM	Research Project Draft due
Week 12 (04/08, 04/10)	Climate Change Today: Impacts and Vulnerability	Archer Ch.13 Kolbert Ch.6	
Week 13 (04/15, 04/17)	Climate Change: Mitigation Strategies and Cost(s)	Archer Ch.8 Archer Ch.9	
Week 14 (04/24)	Climate Change: Adaptation Strategies	Hand-outs Kolbert Ch.7/8	
Week 15 (04/29, 05/01)	**Focus Theme 3:** Energy Beyond Carbon	Hand-outs Kolbert Ch.9/10	Research Project due
Week 16 (05/06)	Research Project Poster Presentations		Test #3 out

Notes

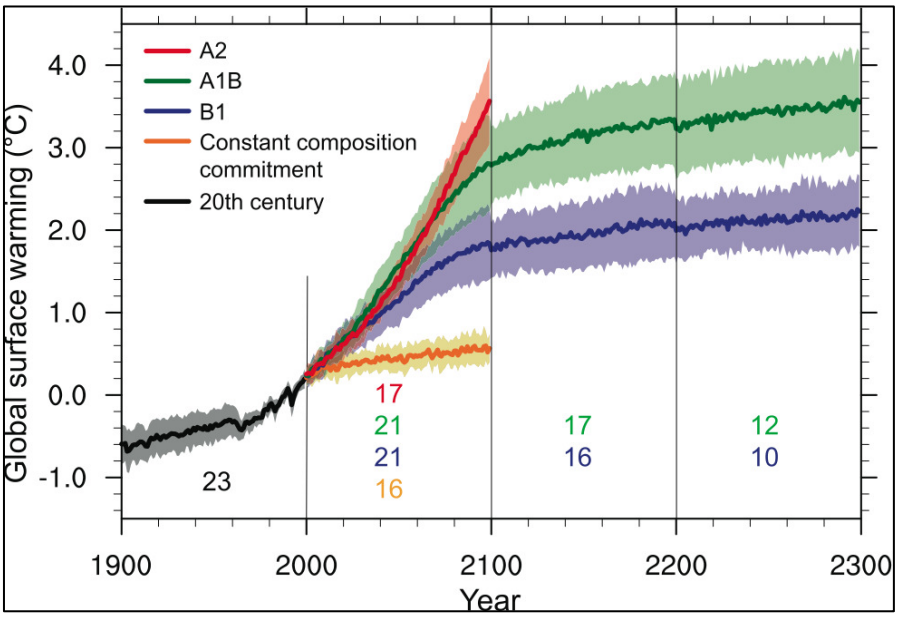
- Adjustments to the course schedule may be necessary to account for unforeseeable or unavoidable situations during the semester.
- I will try to invite guest speakers at appropriate times during the semester. However, the precise timing also depends on their schedule and may require some adjustments.
- Attendance is mandatory. If you have to miss a class…inform me in advance.
- It is your responsibility to keep up with the material, hand-outs, due dates, projects, etc. over the course of the semester.
- It is your responsibility to seek additional help and support as needed.
- Late tests/assignments/project: minus 10 points for each day late; "skipped" = zero.

Grade Conversion Table

Letter	Points	Letter	Points	Letter	Points
A	93 to 100	B–	80 to 82	D+	67 to 69
A–	90 to 92	C+	77 to 79	D	63 to 66
B+	87 to 89	C	73 to 76	D–	55 to 62
B	83 to 86	C–	70 to 72	F	<55



Annual global mean observed temperatures1 (black dots) along with simple fits to the data. The left hand axis shows anomalies relative to the 1961 to 1990 average and the right hand axis shows the estimated actual temperature (°C). Linear trend fits to the last 25 (yellow), 50 (orange), 100 (purple) and 150 years (red) are shown. Note that for shorter recent periods, the slope is greater, indicating accelerated warming. The blue curve is a smoothed depiction to capture the decadal variations. (IPCC 2007 WG I FAQ)



Multi-model means of surface warming (relative to 1980–1999) for the scenarios A2, A1B and B1, shown as continuations of the 20th-century simulation. Values beyond 2100 are for the stabilization scenarios (see Section 10.7). Lines show the multi-model means, shading denotes the ±1 standard deviation range of individual model annual means. (IPCC 2007 WG I Fig. 10.4). The predicted warming in 2090-2099, relative to 1980-1999, is between 1.8°C and 4.0°C depending on the specific emission scenario used in the prediction.