Course Syllabus
ATM 656/456 Climate and Climate Change (3 Credits)
Atmospheric Science Program, CNSM
University of Alaska Fairbanks
Fall 2009 (Sept.-Dec. 2009)

Instructor: U. Bhatt (474-2662, usbhatt@alaska.edu), IARC 307
When: T-Th 9:45-11:15PM, IARC Room 407
Office Hours: T-Th – 12:00-1:00PM and by appointment (send email)
Course Web page: **http://www.gi.alaska.edu/~bhatt/Teaching/ATM656.fall2009/atm656.fall09.html**
Registration information: ATM 456/656 CRN: 86289 / 86310
Course Prerequisite: Graduate level: ATM 601 or equivalent or permission of instructor, and basic computer skills. Undergraduate level: ATM 401 or equivalent or permission of instructor, basic computer skills.

Course Description:
This course covers the basics concepts of climate variability and change. We will cover the topics from Chapters 1-12 of Hartmann and supplement these topics with chapters from the 2007 IPCC report, various advanced climate texts, and current journal literature. A detailed schedule of topics is available on the course web page under 'Course Calendar'.

Materials Needed:
Recommended Text: Global Physical Climatology (The International Geophysics Series, Vol 56) by Dennis Hartmann, Academic Press, 1994, ISBN: 012328530-5. List Price: $83.95. Available at the UAF bookstore.

Other Tools:
- IPCC Report: Climate Change 2007: The Scientific Basis, downloadable free
- Ruddiman, W. F., 2001, "Earth's Climate: Past and Future", Freeman Press, 465 pp.
- Books on reserve in Mather Library (see below)
- R. Pierrehumbert text in progress: 'The Climate Book' is available on his web page at http://geosci.uchicago.edu/~rtp1/ClimateBook/ClimateBook.html .
- J. Marshall and A. Plumb, 2007: Atmosphere, Ocean and Climate Dynamics, Volume 93: An Introductory Text (International Geophysics).

Course Goals:
Students will gain a fundamental knowledge of key processes in the Climate System (Climate Dynamics).

Student Learning Outcomes:
Students who take this class, participate, do the homework, and attend regularly are

expected to have the following skills:

- Understand basic concepts in climate such as: Global energy balance, Surface energy balance, Hydrological cycle, Atmospheric and Oceanic general circulation as related to climate, Past climate, climate feedbacks, and Natural and Anthropogenic climate variability/change
- Be able to read climate papers in mainstream climate research literature
- Be able to critically discuss current climate change issues
- Apply concepts from this class to their research (if applicable)

Pass the Climate and Climate Change Comprehensive Exam (if applicable).

Instructional methods: This course is based on lectures, which will cover the major topics, emphasizing and discussing the important points. They are not sessions to regurgitate material already written in the text (though they sometimes may be!). Your personal participation is important, and it is will help you learn more efficiently to read the assigned material before lecture. There will be homework, two exams to cover the lectures and a final project.

The class overheads will be available for download from the course web page. They will contain key figures that we discuss in class. Text explaining the material will be left off of these slides so that you can write your own notes from the class lecture.

Course Policies:

Homework: Homework will consist of problem sets, oral explanations of climate topics, and written/oral critiques of journal articles.
Late problem sets will have grade lowered by 10% per day late.

Exams: Exams 1 and 2 will cover class lecture material.

Complaints and Concerns: You are always welcome to talk to me to express complaints and concerns about the class. I will listen, though I do not guarantee that I will change the way I am doing things.

Plagiarism etc: Plagiarism and cheating are matters of serious concern for students and academic institutions. This is true in this class as well. The UAF Honor Code (or Student Code of Conduct) defines academic standards expected at the University of Alaska Fairbanks, which will be followed in this class. (Taken from the UAF plagiarism web site, which has many links with good information about this topic).

Evaluation: The course grade will consist of the following components.

	ATM656	ATM456
Attendance/Participation	10%	10%
Homework	15%	20%
Exam 1	25%	25%
Exam 2	25%	25%
Final Project	25%	20%

Final letter grades for ATM 656 will be based on the scale below while final letter grades for ATM 456 will be based on an adjusted scale.

Grade	ATM656	ATM456
A+	98-100%	96-100%
A	93-97%	89-95%
A-	90-92%	86-88%
B+	87-89%	83-85%
B	83-86%	79-82%
B-	80-82%	76-78%
C+	77-79%	72-75%
C	73-76%	69-71%
C-	70-72%	66-68%
D+	67-69%	60-65%
D	63-66%	56-59%
D-	60-62%	50-55%
F	<59%	<50%

Additional References:

Basic Climate Texts (Overviews)

Peixoto, J. P. and A. H. Oort, 1992:" Physics of Climate", AIP Press, 520 pp.

Specific Climate Texts (& Special Topics)

Barry, R. and A.M Carleton, 2001, "Synoptic and Dynamic Climatology", Routledge Press, 620 pp.
Bigg, G., 1996, "The Oceans and Climate", Cambridge Press, 266 pp.
Grotjahn, R. 1993, "Global Atmospheric Circulations: Observations and Theories", Academic Press, 430 pp.
Hastenrath, S., 1991: "Climate Dynamics of the Tropics", Kluwer Academic Publishers, 488 pp.
McGuffie K. and A. Henderson-Sellers, 1997, "A Climate Modeling Primer", 253 pp.
National Research Council Publications:
"Abrupt Climate Change: Inevitable Surprises"
"Natural Climate Variability on Decade-to-Century Time Scales"

Presentation References

Dr. Jim Callen's Preparation of Effective Scientific Talks (Univ. of Wisconsin)

General Advice:

Understanding Climate and Climate Change requires that you pull together all your knowledge in different areas. Climate 'Dynamics' begins the description of a certain phenomena and then works towards understanding the processes are responsible for this variability. Here are some suggestions for how to study climate.

1. Read the material prior to lecture, to familiarize yourself.
2. Listen carefully to the lecture and take notes, ask questions and participate. This is 10% of your grade and could mean the difference between a letter grade in the end. Also, this is a good opportunity for you to practice how science is done.
2. There is a two step process in learning this material well. First you must to some extent memorize climate maps and phenomena and be able to describe them verbally. Then the second step is to understand the physical and chemical basis for why they occur. Some of you may not need to memorize the phenomena because understanding why they occur will help you remember the description of the phenomena.
4. Twenty five percent of your grade will be a class project, which will entail doing 'research' on a topic that you and I have agreed upon. This means finding key papers on the topic and *synthesizing* the results into a coherent story that is presented orally to the class and written up in the form of a short term paper (less than 10 pages).

Disabilities Services:

The Office of Disability Services implements the Americans with Disabilities Act (ADA), and insures that UAF students have equal access to the campus and course materials. We will work with the Office of Disabilities Services (203 WHIT, 474-7043) to provide reasonable accommodation to students with disabilities.

Project Details

Deadlines for Project

- Project Choice and rough outline 1: Week 4
  Choose from the list of possible topics below (preferable) or pick a mutually agreed upon topic (I prefer that students explore a topic that is not directly part of their research to broaden their knowledge).

- Project Outline Revised: Week 5

- Decide on Key Project Papers, give me list: Week 7

- Provide Presentation Outline: Week 10, revise within a week if necessary

- Go over Slides with me during week before presentation: Week 12 or Week 13

and implement suggestions

Project Topics Ideas, will add more depending on number of students in class.

1. El Niño: Air-sea interactions in the tropics and predictability
2. El Niño: Teleconnections to remote parts of the globe
3. Hadley Circulations
4. South Asian Monsoon
5. Impact of Humans on Climate - Early
6. Impact of Humans on Climate - Recent
7. North American Ice Sheets and Climate
8. Sahel Rainfall Variability and Trends
9. Climate variability of the Amazon Basin
10. Abrupt Climate Change – Younger Dryas
11. Atlantic Hurricanes: Trends and controversies
12. Multi-decadal variability of the Atlantic Sector
13. Multi-decadal variability of the Pacific Sector
14. Changes in global mean sea level
15. Geoengineering

Project Requirements

1. Prepare and present a 30-minute for graduate level and 15 minute for undergraduate level (including questions) talk to the class on the chosen topic. 60% of project grade is based on the presentation.
2. Write a term paper on the topic (5 pages undergraduates, 10 pages graduates). 40% of project grade is based on the paper.

Expectations of Undergraduate Level Students for Project

- Summarize the topic based on key classical book chapters/papers (provided by instructor)
- Describe the particular phenomena and display a basic understanding for how the particular phenomena work (i.e. what are the important components of the climate system that impact this phenomena?) based on accepted classical thinking

Expectations of Graduate Level Students for Project

- Satisfy the two steps above for the undergraduate level.
- Present newer views on topic found in literature.
- Present the weaknesses and controversies in the conventional thinking about the phenomena. Provide newer evidence (may be from journal articles or from research done by student) to illustrate where the weaknesses are. This is to strengthen your critical thinking skills.
- Make a statement on what they think the next important step needs to be to further our understanding of this phenomena (e.g. better computer models with higher resolution to resolve clouds) and support it with evidence. This is to strengthen your creativity skills.

Course Calendar Fall 2009

(http://www.gi.alaska.edu/~bhatt/Teaching/ATM656.fall2009/atm656.fall09.calendar.html)

Dates	Tuesday	Thursday
Week 1 Sept 3	Chapter 12 - Pink signifies chapter from Hartmann Chapter 12 - Blue signifies chapter from 2007 IPCC report Chapter 12 - Green signifies chapter from Ruddiman Text	Class #1- *Class Overview & Introduction to Climate* Chapter 1, Summary for Policymakers, Technical Summary, Chapter 1 ROOM 417
Week 2 Sept 8 & 10	Class #2 *Global Energy Balance* Chapter 2 ROOM	Class #3 - *Radiative Equilibrium: Clouds and Climate* Chapter 3, Chapter 2 ROOM
Week 3 Sept 15 & 17	Class #4 *Radiative Transfer: Clouds and Climate* Chapter 3, Chapter 2 ROOM	Class #5 *Radiative Transfer: Clouds and Climate* *Chapter 3, Chapter 2* ROOM
Week 4 Sept 22 & 24	Class #6 *Surface Energy Balance* *Chapter 4* ROOM	Class #7 *Hydrological Cycle* *Chapter 5* ROOM
Week 5 Sept 29 & Oct 1	Class #8 *Atmospheric General Circulation* Chapter 6 ROOM	Class #9 *Finish Atmopheric GC & Ocean General Circulation* Chapter 6-7 ROOM
Week 6 Oct 6 & 8	Class #10 *Ocean general Circulation* ROOM	Class #11 *Past Climate* Chapter 8, Chapter 8-11 ROOM
Week 7 Oct 13 & 15	Class #12 *discuss article and continue with Past Climates* Chapter 8, Chapters 13 &14 ROOM	Class #13 *Exam 1* *Covers material up to Lecture* #12 ROOM
Week 8 Oct 20 & 22	Class #14 *Past Climates* Chapter 8 ROOM	Class #15 *Climate Feedbacks* Chapter 9 ROOM
Week 9 Oct 27 & 29	Class #16 *Finish Climate Feedbacks* Chapter 9 ROOM	Class #17 Climate Modeling Chapter 9 & Chapter 10 ROOM
Week 10 Nov 3 & 5	Class #18 *Natural Variability* Chapter 11, Chapter 3-5 ROOM	Class #19 *Natural Variability* Chapter 11, Chapter 3-5 Discuss Journal Article ROOM
Week 11 Nov 10 & 12	Class #20 *Global Climate Models & Presentation preparation tutorial* Chapter 10, Chapter 3-5 ROOM	Class #21 *Anthropogenic Climate Change* Chapter 12, Chapter 8-11 ROOM
Week 12 Nov 17 & 20	Class #22 *Anthropogenic Climate Change* Chapter 12, Chapter 8-11 ROOM	Class #23 *Anthropogenic Climate Change, Geoengineering* Chapter 12, Chapter 8-11
Week 13 Nov 24	Class #24 *Exam 2* *Covers material up to Lecture #23*	THANKSGIVING HOLIDAY
Week 14 Dec 1 & 3	Class #25 Special Topics	Class #26 Special Topics
Week 15 Dec 8 & 10	Class #27 *Project Presentations* ROOM	Class #28 *Project Presentations* ROOM
Final Exam Week	Tuesday, Thursday 9:45 - 11:15 a.m. classes have final at: 8 - 10 a.m., Thursday, Dec. 17, Remaining Presentations, final paper due.	

ATM 456/656 Course Material Outline

Chapter 1 Introduction to Climate
Chapter 2 Global Energy Balance
Chapter 3 Radiative Equilibrium
Chapter 4 Radiative Transfer
Chapter 5 Surface Energy Balance
Chapter 6 Hydrological Cycle
Chapter 7 Atmospheric General Circulation
Chapter 8 Oceanic General Circulation
Chapter 9 Past Climates
Chapter 10 Climate Feedbacks
Chapter 11 Climate Modeling
Chapter 12 Natural Climate Variability
Chapter 13 Anthropogenic Climate Change
Chapter 14 Geoengineering
Chapter 15 Special Topics