Climate and Climate Change: Focus on the Arctic

ATM 456/656 (3 credits)

University of Alaska Fairbanks

Spring 2016 (Jan.-May. 2016)

9:45-11:15 AM Tues-Thurs (Murie 230)

Course Syllabus (Last Edited: January 13, 2016)

Instructor: Dr. Uma Bhatt, Atmospheric Sciences, 307 IARC, Phone: 474-2662, usbhatt@alaska.edu, office hours TH 11:15-noon or by appointment

Meeting time and location: Course meets 3 hours per week: 9:45-11:15AM on Tues. and Thurs. in Murie 230.

Course Description: This class explores a holistic view of the Arctic climate system. Topics will cover the following components of the Arctic climate system. There will be some flexibility depending on which topics students choose for their projects. We will regularly spend time sharing news about climate and share sources of information.

Course Prerequisites: Graduate or senior standing in Natural Sciences or instructor's permission.

Course Objectives: Students will gain a thorough understanding of Arctic climate, it's key components and how they influence each other.

Instructional / Teaching Methods: This is a lecture/discussion course with mixed activities. Discussion sessions require summary and discussion of assigned readings from the current scientific literature.

Required Texts:

- *The Arctic Climate System* (Cambridge Atmospheric and Space Science Series) Jul 21, 2014, by Mark C. Serreze and Roger G. Barry
- *University of the Arctic BCS 311: Land and Environments of the Circumpolar World Module 7: Climate Change*, Developed by R Boone and US Bhatt, download from my web page at: http://www2.gi.alaska.edu/~bhatt/publications/BCS311Boone_Bhatt_2013.pdf.

Other Useful Texts:

- *Arctic Climate Change: The ACSYS Decade and Beyond* (Atmospheric and Oceanographic Sciences Library) (Volume 43) (2014) Edited by Peter Lemke and Hans-Werner Jacobi
- *Global Physical Climatology* (The International Geophysics Series, Vol 56) by Dennis Hartmann, Academic Press, 1994, ISBN: 012328530-5.
- *IPCC Report: Climate Change 2007: The Scientific Basis*, downloadable from the www for free. This is a good reference if you are looking for some specific information.

Numerous climate books are on reserve at the Geophysical Institute Library in the Akasofu Building (ground floor level). 'Arctic Climate Change: The ACSYS Decade and Beyond' is on reserve at Rasmuson Library.

Student Learning Outcomes:

Students who are successful in this class will learn these things:

- They will gain a basic understanding of how the atmosphere, ocean, cryosphere, and biosphere operate in the Arctic.
- They will become familiar with the basic concepts of climate dynamics including: global energy balance, surface energy balance, hydrological cycle, atmospheric and oceanic general circulation as related to climate, past climate, climate feedbacks, climate models, and natural and anthropogenic climate variability/change.

By the end of this class, students will:

- Be able to read journal articles in the mainstream climate scientific literature.
- Be able to critically discuss current Arctic climate-change issues.
- Apply concepts from this class to their own research where applicable (Pass comprehensive exam in Climate for ATM Ph.D. program

Course Plan:

There will be 1.5-hour meetings on Tuesday and Thursday. The time will be broken up into lectures, discussion, and activities. Several quizzes will gauge student progress. There is a midterm exam, a final exam, and a final project. Class attendance and participation are essential.

Detailed Course Calendar: (Instructor keeps the option to alter this plan)

Week	Date	Class topic
Week 1	(1/14/2016) Thursday	Class 1: Introduction and Basic Arctic
Week 2	(1/19/2016) Tuesday	Class 2: Basic Climate of Arctic
	(1/21/2016) Thursday	Class 3: Basic radiation principles
Week 3	(1/26/2016) Tuesday	Class 4: Earth and Arctic energy budget
	(1/28/2016) Thursday	Class 5: Atmospheric circulation and modes of variability
Week 4	(2/2/2016) Tuesday	Class 6: Atmospheric Circulation and modes of variability
	(2/4/2016) Thursday	Class 7: Surface energy budget wrt snow and ice
Week 5	(2/9/2016) Tuesday	Class 8: Surface energy budget wrt snow and ice
	(2/11/2016) Thursday	Class 9: Climate feedbacks
Week 6	(2/16/2016) Tuesday	Class 10: Precipitation and Arctic hydrology
	(2/18/2016) Thursday	Class 11: Precipitation and Arctic hydrology
Week 7	(2/23/2016) Tuesday	Class 12: Arctic sea ice-ocean-climate interactions
	(2/25/2016) Thursday	Class 13: Climate regimes of the Arctic
Week 8	(3/1/2016) Tuesday	Class 14: Open topics/catch up
	(3/3/2016) Thursday	Class 15: Open topics/catch up
Week 9	(3/8/2016) Tuesday	Class 16: Midterm Exam
	(3/12/2016) Thursday	Class 17: Modeling of the Arctic system
SPRING BREAK WEEK		
Week 10	(3/22/2016) Tuesday	Class 18: Modeling of the Arctic system
	(3/24/2016) Thursday	Class 19: Modeling of the Arctic system
Week 11	(3/29/2016) Tuesday	Class 20: Arctic Oceanography
	(3/31/2016) Thursday	Class 21: Arctic Oceanography
Week 12	(4/5/2016) Tuesday	Class 22: Marine Ecosystem
	(4/7/2016) Thursday	Class 23: Terrestrial Ecosystem
Week 13	(4/12/2016) Tuesday	Class 24: Glaciers, ice sheets and the consequence of a warming climate
	(4/14/2016)	Class 25: Ignite Presentations, Alaska weather/climate
Week 14	(4/19/2016) Tuesday	Class 26: Alaska weather/climate
	(4/21/2016) Thursday	Class 27: Future of the Arctic
Week 15	(4/26/2016) Tuesday	Class 28: Final Student Presentations
	(4/28/2016) Thursday	Class 29: Final Student Presentations
Finals	(5/8/2016) Friday	Final Exam 8-10AM

Grading Scheme Exams, Assignments and Grading

Component	**Undergraduate**	**Graduate**
Semester long evaluation activities		
Class participation	10%	10%
Homework	10%	10%
Pop Quizzes	5%	5%
Paper Discussion/Summary	10%	10%
Single event evaluation activities		
Exam 1 (Mar 8, 2016)	25%	20%
Exam Final (May 8, 2016)	15%	15%
Ignite presentation	5%	5%
Semester Project	20%	25%

GRADUATE versus UNDERGRAD EXPECTATIONS AND GRADING

1) There will be a 2-tier exam structure in which graduate students will be tested on basic lecture material, but will have an additional in-class exam component. Graduate exams will be graded with different rubric and with higher expectations.
2) Semester project expectations are as follows. Graduate student article reviews will require review of 2-4 journal articles, undergrads will review 1 paper (with instructor guidance). Graduate students will review longer and more sophisticated articles, will have different assignment criteria, and will be evaluated using a different rubric and with higher expectations. Graduate students will give an oral presentation on the state-of-our-knowledge on a mutually agreed upon climate topic that requires reading numerous journal articles and synthesizing the results. This project is 30% of the graduate student's grade.
3) Graduate students are expected to integrate course material into their research and/or contribute perspectives relative to their research in the course discussions.

Course grades will be assigned as indicated at the table below. Course %'s are for THIS course only and may vary with different instructors. Grade point values are indicated on the table as well. Please see "Academics and Regulations" section of UAF 2015-2016 Catalogue.

Grade % GP

A+ 100-97 4.0, A 96-92 4.0, A- 91-90 3.7
B+ 89-87 3.3, B 86-82 3.0, B- 81-80 2.7
C+ 79-77 2.3, C 76-72 2.0, C- 71-70 1.7
D+ 69-67 1.3, D 66-62 1.0, D- 61-60 0.7

Grade Expectations: All grades are determined on an absolute score as above (with no curve) In general, grades will reflect the following about your class performance:
A = 90-100 percent: outstanding work, mastery of topic
B = 80-89 percent: above average work, all assignments completed well
C = 70-79 percent: average, all or most assignments completed, most work satisfactory
D = 60-69 percent: pass, unsatisfactory or missing work
F = less than 60 percent: failure to meet requirements of course

Support and Disabilities Services: The UAF 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. The course instructors will work with the Office of Disabilities Services to provide reasonable accommodation to students with disabilities. Please notify the instructor of any special needs.

Plagiarism etc: Plagiarism and cheating are matters of serious concern for students and academic institutions. 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).

Semester Project Details

Deadlines for Project

- **Week 3 (1/28/2016)**: Project Choice and rough outline 1
  Choose from the list of possible topics below (preferable) or pick a mutually agreed upon topic (We prefer that students explore a topic that is not directly part of their research in order to broaden their knowledge).
- **Week 5 (2/11/2016)**: Project Outline Revised: Week 5
- **Week 7 (2/25/2016)**: Decide on Key Project Papers, give me list: Week 7
- **Week 10 (3/8/2016)**: Provide Presentation Outline: Week 10, revise within a week if necessary
- **Week 14 (4/21/2016)**: Go over Slides with instructors during week before presentation: Implement suggestions by end of week 14.
- **Week 15 (4/26/2016 – 4/28/2016)**: Give Presentations.

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

1. El Niño and PDO links to the Arctic/Alaska
2. The North Pacific Blob
3. Sea ice decline
4. Permafrost thaw and its consequences
5. Snow in the Arctic
6. Arctic Glaciers
7. Greenland Ice sheet
8. Is the Arctic getting wetter or drier?
9. Greening of the Arctic tundra vegetation
10. Alaska and/or Eurasian wildfires
11. Arctic Hydrology

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.

Ignite Presentation Details

Week 13 (4/14/2016): This will be a 5 minute presentation based on the content of your final project. Ignite talks (http://www.ignitetalks.io/) are 5-minute talks with 4 slides a minute that advance automatically. You have to distill your message to convey it in 5 minutes with rapid-fire slides. We will discuss this more but having to give a short talk on your project will force you to think about the key points of your final project. I hope to make this a public event so others may come and learn from your presentations.