CATALOG DESCRIPTION

GEOS F477 O Ice in the Climate System

3 Credits
GEOS F477 O Ice in the Climate System
Offered Spring Odd-numbered Years

Earth's cryosphere includes seasonal snow, permafrost, sea ice, mountain glaciers, and ice sheets. This course will cover the formation of each of these forms of snow and ice and their response to changing environmental conditions. Interdisciplinary perspectives allow study the role snow and ice plays within the Arctic system (including atmosphere, ocean, and ecosystems), with an emphasis on Alaska. The cryosphere will also be placed in context of the global climate system. Oral intensive will include instructor and peer feedback. Special fees apply. Prerequisites: PHYS F103X and MATH F200X or instructor permission. (2+3)

Ice in the Climate System
GEOS F477 Syllabus

INSTRUCTOR: Erin Pettit
email: pettit@gi.alaska.edu (email is best way to contact me)
Offices: 338 Reichardt and 410 B Elvey (GI)
Office hours: **by appointment**
you are welcome to drop by my office anytime after noon *for short questions, I am glad to help if I have time. For longer questions, please make an appointment.*

COURSE LOGISTICS:

Time: We will meet Tuesdays 12 to 2pm and Thursdays from 12 to 3 pm.

Place: Reichardt 229

PREREQUISITES:
PHYS F103X or higher AND **MATH F200X** or higher; **permission of instructor**

COURSE MATERIALS:

Book: There will be one required textbook:

The Cryosphere by Shawn Marshall, 2012, Princeton University Press.

Course Reading I will provide course readings, outlines, assignments on Blackboard and the course website, some will be handed out in class.

Field Notebook You will need one *Rite in the Rain* notebook for notes during our outdoor explorations. A variety of online sellers have these. I recommend: Level, Spiral Notebook, 4 5/8" x 7" which has 32 pages. If you write large you may go to a larger size or a version with more pages. You may get any page line pattern you prefer (lines, grids, or plain). *Do not get anything smaller than 4 5/8" x 7".* You may purchase one from the instructor if you bring cash ($8) to the second meeting.

Field Clothing You must have boots and clothing capable of keeping yourself warm for several hours at temperatures as low as -30F. It is possible to rent plastic mountaineering boots for the afternoon from Outdoor Adventures for a small cost. I also recommend toe warmers and hand warmers for the coldest days. We will discuss types of clothing on the first day and options for borrowing items you don't own.

Recommended additional books (we will read selections from some of these, they also provide additional background information for activities and projects). These books will be on reserve at the Geophysical Institute Mather Library or available for loan from me.

1. *Life in the Cold* by Marchand
2. *Glaciers and Glaciation* by Benn and Evans
3. *The Climate Crisis* by Archer and Rahmstorf
4. *The Cryosphere and Global Environmental Change* by Slaymaker and Kelly
5. *On Sea Ice* by Weeks

6. *Dynamics of Snow and Ice Masses* by Colbeck
7. *Glaciers* by Hambrey and Alean
8. *The Little Ice Age* by
9. *Physics of Glaciers* by Cuffey and Paterson
10. *Earth's Climate: Past and Future* by Ruddiman
11. *Glaciers of North America* by Ferguson
12. *Avalanche Handbook* by McClung and Schaerer
13. *Glacier Science and Environmental Change* by Knight
14. *Sea Ice* by Thomas and Dieckmann

COURSE DESCRIPTION:

Snow, permafrost, sea ice, glaciers, and ice sheets (the cryosphere) play a major role in both local and global climate an ocean system. In this course will will use an interdisciplinary perspective to study how snow, permafrost, sea ice, glaciers, ice sheets respond to changes in climate climate and environmental conditions and how the local environment responds to changes in snow and ice. We will emphasize Alaska and the Arctic, but also study the global interactions between ice and the climate system. As a geophysics course, we will emphasizes the physical processes involved; however, we will also emphasize the interdisciplinary nature of this subject through course assignments which will allow students from other disciplines (such as oceanography, chemistry, biology, or math) to highlight those connections. The course will combine readings, discussions, in-class activities, hands on data collection and analysis, homework assignments, exams, and weekly oral presentations.

After taking this course, you will be able to:

1. describe the formation processes and evolution of snow, sea ice, permafrost, glaciers, and ice sheets
2. recognize the importance of these forms of ice in the Arctic system, particularly with respect to their interactions with climate, weather, ecosystems, ocean, and landscapes.
3. apply basic concepts in physics to processes in the natural world, such as heat flow and mass conservation
4. confidently express concepts, ideas, and conclusions in an oral format with a varying amount of preparation and visual aids.

In order to succeed in this course you will need to have

1. some background in physics and calculus and be willing to try applying those concepts to natural processes
2. an interest in Arctic landscape (biological and physical)
3. a willingness to explore the snow and ice on our campus (we will spend time outside!)

This course will be taught with an interdisciplinary emphasis. This means that if, for example, you come from a physics background, you will be expected to work closely with students from a biology background, for example, and learn from each other the interactions between biological and physical processes. During most activities, you will work on interdisciplinary teams.

COURSE GOALS: The goal of this course is to build students foundational knowledge in the cryospheric components of the global climate system, with a particular emphasis on the Arctic. After this course, the students will be able to discuss knowledgeably many aspects of Alaskan landscapes with other scientists or science students. This course will use a student-driven learning environment that builds their confidence in making observations, framing questions, and designing experiments in order to understand physical processes.

STUDENT LEARNING OUTCOMES:

Content

Students will be able to:

1. Classify ice masses (land and sea ice) based on their formation, morphology, temperature,
2. Understand the basics of global energy balance,
3. Explain what a positive and negative feedback is and provide examples of feedbacks between the cryosphere and the global climate system,
4. Describe what the mass balance of a glacier, ice sheet, or sea ice is and how climate affects the mass balance for each,
5. Summarize the movement and dynamics on seasonal, decadal, and longer timescales of various forms of ice (glaciers, ice sheets, permafrost, sea ice) and the role dynamics plays in terms of its response to climate change.
6. Discuss the Milankovitch cycle and the theory of the ice ages.
7. List linkages between the physical, chemical, biological processes active in Arctic Landscapes
8. Identify methods for determining past climates and explain in more detail how ice cores record past climate.
9. Discuss the possible future changes in Alaskan icy landscapes under various climate scenarios

Skills

The students will be able to:

Numerical:

1. convert units,
2. make an order of magnitude calculation in one's head,
3. go from a verbal or visual description of an earth process to an equation (in algebra or trigonometry, not calculus)

Spatial Relationships:

1. internalize a map of the earth with continents, oceans, major mountain ranges and major ice bodies in the correct places (be able to sketch from memory),
2. plot positions and measure distances on a map using lat and long,
3. use the concept of scale in describing earth processes (e.g. different properties of ice at microscopic and macroscopic scales)

Time and Changes Through Time (rate):

1. discuss and visualize a specific earth process occurring on a variety of timescales (for example: changes in the mass balance of glaciers over seasonal to multi-millennial time scales)

Critical Thinking:

1. identify and articulate assumptions;
2. assemble a logical chain of reasoning from cause to proximal effect to distal effect;
3. articulate the difference between cause-effect relation and correlated data sets;
4. assemble a logical chain of reasoning from observation to inference;
5. detect flaws in other people's chains of reasoning;
6. recognize a testable hypothesis;
7. given a set of observations, formulate a potentially testable hypothesis to explain those observations

Communication:

1. make a lucid, *unrehearsed*, short oral presentation of a geoscientific observation, process or chain of reasoning using appropriate professional vocabulary;
2. make a lucid *rehearsed* oral presentation describing a geoscientific observation, process or chain of reasoning using appropriate professional vocabulary;
3. provide useful visual aids for an oral presentation
4. use a simple plotting program for figures and diagrams
5. use email (with appropriate level of formality for the content and receiver(s));

INSTRUCTIONAL METHODS and COURSE FORMAT:

This course will consist primarily of hands on activities and group discussions/activities. There will be minimal traditional lecturing. You will be expected to read the materials *before* each class and use the knowledge from the reading during the class discussions.

Tuesday: We will meet for two hours for discussion of reading material, group and individual problem solving and short answer questions, group discussion, oral presentations, and exams.

Thursday: We will meet for a three hour block that will typically be used for group projects involving making observations of the snow and ice on campus, setting up experiments, discussing the processes we observe, collecting data, and preparing oral presentations. This time will also be used, for example, to visit the CRREL Permafrost Tunnel.

Outdoor activities: *We will spend at least half of the Thursday afternoon block time out of doors.* We will go outside regardless of the weather, we will discuss what you should wear the first day of class. If you do not come prepared to be out of doors, the same policy applies as if you had missed class.

Blackboard: In addition to the course packet, the digitally available readings will be posted on Blackboard, this provides a secured place to put copyrighted material. We will also hold on-line discussions on Blackboard.

Prezi: We will use spatial presentation software Prezi (prezi.org) for concept maps as well as to display visual aids for oral presentations. You will need to use your alaska.edu

email account to create a FREE prezi educational account for yourself. Please take time to familiarize yourself with prezi.

COURSE POLICIES:

I make the course policies regarding late assignments or missed classes flexible enough to accommodate reasonable amount absence for illness, emergencies, or required university sponsored absence. It is up to you to decide if and how to use the flexibility I have built into the course. Because of this built in flexibility and the hands-on nature of this course, I do not generally make additional accommodations.

1. **Absence:** If you miss a class, you will be required to make up the work with assistance from your group members or you will have to complete an alternative assignment. Please contact me by email as soon as you know you will miss a class (even if it is just one hour before the class).

   Tuesday Classes: You may miss one (1) Tuesdauy classes without significant impact on your grade if you make up the work before the following Thursday or Tuesday.

   Thursday Block Class: You may miss one (1) Thurs Block class without significant impact on your grade if you work with your group to make up the work promptly. Making up work on Block days will take substantial more effort and will require you working closely with other students. You will still be required to be a contributor to group projects; for example, if you miss a day of data collection, you will be required to take more a of a lead on the analysis of the data. In some cases you may need to complete an alternative assignment.

2. **Late Assignments:**
   (a) You will make approximately one oral presentation per week (thirteen total). Because this is an oral intensive course, these generally cannot be given late. I will drop the lowest oral presentation score (which means you can miss one presentation without penalty). The dates for the graded Oral Presentations are listed in the left column on the schedule as *Oral #1*.
   (b) There are 10 written short answer/problems (due dates on left column of schedule as *Written #1*). These are due in Tuesday classes. You may turn them in on Thursday for 5% off of the grade or the following Tuesday for 15% off of your grade. Because these are for immediate feedback for your learning I do not accept them later than one week after their due date. I will drop your lowest homework grade (or you may not turn in one).

	Attendance (5 pts per week)	70
	Written Assignments (40 pts each)	360
	Oral Assignments (40 pts each)	480
ASSESSMENT:	Completion of Outline/Notes from Readings	100
	Written Final	120
	Oral Final	120
	Contributions to Activities and Discussions (5 pts per week)	70
	Total Possible	**1320**

1. **Attendance:** You receive two points for each Tuesday Class and three points for each Thursday Class you attend and participate. As written above, you may miss one Tuesday and one Thursday class without penalty (it is good to save this for a day you are sick or have an emergency).
2. **Written Assignments:** Written assignments include both short answer, short essays (paragraphs), and problems. There will be 10 assignments total, I will drop your lowest score.
3. **Oral Assignments:** This is an oral intensive course: there are 13 oral assignments, worth 40 pts each. Two of the oral assignments will have two parts (each worth 40 pts). I will drop your lowest score. Most of the oral assignments will be 2-5 minutes.
4. **Completion of Outline/Notes from Readings:** I will check completion of written outline and notes from the readings (using the guided outline I provide) during the first week and then several random checks throughout the semester. If a random check happens on a day you are absent, you will be asked on another day (not necessarily the day following). Each incomplete outline will result in deduction of up to 15 pts.
5. **Written Final:** The written final will be similar to the written assignments and may include short answer, short essay and problem solving.
6. **Oral Final:** The oral final will consist of a video of yourself giving a prevention.
7. **Contributions to Activities and Discussions:** This includes being cooperative in working in your groups, contributing to group discussion (without my having to ask or remind you to contribute), being helpful in preparing for hands on activities, offering thoughtful ideas and asking questions, providing peer feedback as requested, and volunteering to help others in the class. These points will be earned through a combination of my observations and interactions with you and through anonymous peer feedback. I will provide written feedback in the 4th and 10th week of the semester on your progress and offer suggestions for improvement if necessary. You are welcome to request additional feedback.

Your final grade will be calculated as a percentage of the total number of points possible.

Minimum Points Required:

A+ (97-100%)	=1280
A (93-96.9%)	=1228
A- (90-92.9%)	=1188
B+ (87-89.9%)	=1148
B (83-86.9%)	=1096
B- (80-82.9%)	=1056
C+ (77-79.9%)	=1016
C (73-76.9%)	=964
C- (70-72.9%)	=924
D+ (67-69.9%)	=884
D (63-66.9%)	=831
D- (60-62.9%)	=792
F (0-59.9%)	=0

DISABILITY ACCOMMODATION: 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. UAF is committed to equal opportunity for all students. If you have a documented disability, please let us know AS SOON AS POSSIBLE, and we will work with the Office of Disabilities Services to make the appropriate accommodation(s). If you have a specific undocumented physical, psychiatric or learning disability, you will benefit greatly by providing documentation of your disability to Disability Services in the Center for Health and Counseling, 474-7043, TTY 474-7045. (For example: procrastination issues, dyslexia, ADHD...)

If you are the first in your family to attempt a four-year college degree, and/or eligible for Pell grants, you have opportunities for tutorial and other forms of support from the office of Student Support Services. We will collaborate with the Office of Disabilities and/or the Office of Student Support Services to make your educational experience in our class as positive as possible. Check the following website for further information:
`http://www.uaf.edu/advising/learningresources/`