

GEOB 408 – The Changing Cryosphere

Term 1, 2019/2020

Schedule: Wednesdays, 9 AM – 12 PM
Room: Jack Bell Building (SOWK) rm 224

Pre-Reqs: GEOB 305, GEOB308,
Phys 101/107

Instructor: Michele Koppes
Room: 141 Geography
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Office Hrs: Tuesdays 2-3 pm or by
appointment

Acknowledgement

UBC's Point Grey Campus is located on the traditional, ancestral, and unceded territory of the xwməθkwəyəm (Musqueam) people. The land it is situated on has always been a place of learning for the Musqueam people, who for millennia have passed on in their culture, history, and traditions from one generation to the next on this site.

Course Outline

This course contains a variety of topics on the role of snow and ice in the Earth system from a physical perspective, with special emphasis on their physical and mechanical properties and relationship to ongoing climate change. The treatment will be both descriptive (distributions, forms and features, qualitative treatment of processes) and technical (examination of governing equations, quantitative treatment of processes). This course is aimed at students with an interest in gaining an in-depth understanding of how snow, glaciers and ice sheets operate within the Earth system.

Course schedule

Week 1. Introduction to the changing cryosphere

Week 2. The Geography of Ice

Reading: IPCC Summary of Ch.4 Observations of the Cryosphere
Assignment 1: Changes in the Cryosphere

Week 3. Physical and thermal properties of snow and ice

Reading: Benn and Evans, Ch. 2
Stillbeck, 1980, Water Revisited
Box et al., 2012
Assignment 2: Thermal properties of ice

Week 4. Ice-climate interactions and feedbacks

Reading: Bliss et al., 2014
Oerlemans, 2005

Week 5. Formation and metamorphism of snow

Reading: The Avalanche Handbook, Ch. 2-3
Sturm et al., 1997
Assignment: Snowpack properties

Week 6. Mass balance and surface energy budgets of ice masses

Reading: Benn and Evans, Ch. 2, 5
IMBIE (2018)
Hock, 2003
Assignment: Surface energy balance

Week 7. Glacier deformation and flow

Reading: Benn and Evans, Ch. 4

Moon et al., (2012)

Assignment: Glacier Flow

Week 8. Glacier sliding and surging

Reading: Benn and Evans, Ch. 5.5, 5.7

Meier and Post, 1969

Bevington and Copeland, 2014

Week 9. Snow and glacier hydrology and meltwater resources

Reading: Huss and Hock, 2018

Baraer et al., 2012

Week 10. Ice – ocean interactions, tidewater glaciers, sea ice

Reading: Benn and Evans, Ch. 8

Rignot et al., 2010

Week 11. MIDTERM

Weeks 12-13. Final project presentations

Resources

Website: On Canvas and at ibis.geog.ubc.ca/courses/geob408

username: geob408

password: glaciology (Note: all are case sensitive)

Class outlines, problem sets, readings and videos will be posted on Canvas and on the course website. Also check for updates on exam and research papers.

Textbooks (recommended, not required):

The Avalanche Handbook by D. McClung & P. Schaerer (4th edition, 2010)

Glaciers and Glaciation by D. Benn and D.J.A. Evans (2nd edition, 2008).

Treatise on Geomorphology, vol. 8, J. Shroder (ed.) (2013)

Other reference texts:

Glacial Geologic Processes by D.J. Drewry

Physics of Glaciers, 4th ed. by K. Cuffey and W.S.B. Paterson

Glaciers of North America by S. Ferguson

Course Evaluation

Problem assignments: 20%

Midterm exam: 25%

Research paper + proposal: 30%

In class presentation of research: 10%

Class participation and discussion facilitation: 15%

Lectures and readings:

Lecture notes will be posted on the course website in Canvas after each class. Note that these are simple outlines and do not substitute for class attendance (see below). You will be responsible for summarizing the key aspects of one of the prior lectures (see below). Readings should be completed prior to the class for which they are scheduled. Student pairs will present summaries of particular readings. You may be asked to prepare one or two questions and answers in response to particular readings to stimulate class discussion. On occasion, 3-minute reading response papers will be scheduled, for the lecture in which the reading is assigned.

Problem sets:

Problem sets will be assigned during the weekly lecture time, and posted on Canvas and the course website. Time during lecture will be set aside to introduce the assignment. Most assignments will be due in class the following week. Unless otherwise indicated, assignments should be completed and submitted individually, although group discussion is encouraged.

Research paper:

The research paper is a maximum 7 written pages in length, not including figures. A range of different topics will be made available during the lectures, dependent upon individual interests. Prior to beginning your research, in week 6, you will submit a brief proposal for informal, formative feedback. The research proposal should include:

- a draft title indicating the proposed topic,
- a clear and concise statement of the research question and objectives,
- a brief overview of the importance of the topic, datasets and methods you are going to pursue,
- a list of at least five bibliographic references that you have identified to date (up to 2 of the 5 references may be to a textbook or website).

The proposal should be no more than 1 page, typed, double spaced, not including the list of references. It is worth 5% of the total evaluation and is designed to get you thinking early about your research paper topic, the feasibility of doing it, and allow for feedback.

The deadline for the research paper will be the last day of class, and includes an oral presentation of your findings to the class in the last two weeks of term. The oral presentation will be assessed by your peers.

Please note: Late work will incur a 5% per day penalty, including weekends. See me early (i.e. *before* the deadline) if you will have trouble handing in work on time. I realize that sometimes life events may disrupt the best laid plans, but I cannot be of help if you do not alert me as soon as you know your timelines and/or expectations cannot be met.

Class participation:

This is a 4th year class, and active participation in class discussions is expected. Your participation in the lectures, including summarizing lecture material and current events and leading discussions of readings, is important and will be evaluated as part of your final participatory mark. You will be asked to lead **three** components over the course of the term:

1. Provide a brief summary of the key points from the last lecture at the start of class (5 min)
2. Provide a brief overview of a current event or topic found in the media related to the cryosphere (5-10 min)
3. Provide a brief summary (5 min) and facilitate a class discussion of the weekly readings

Midterm exam:

The midterm exam will be held on *November 13* during the lecture period. The exam will cover all subject matter discussed in the lectures and readings. Additional details, including a list of study topics and tips, will be provided on Canvas two weeks before the exam.

Attendance:

You should plan on attending all lectures. Let me know if you will be absent. There will be weekly in-class active learning activities, often dealing with particular readings or topical issues. In some cases, you will be assigned to a group with which to formulate and exchange your ideas. These activities will be logged in your Participation grade.

Moreover, my lecture slides are not intended to be distance-learning tools, nor a substitute for complete lecture notes. Students who attend classes have a better understanding and enjoyment of their courses than those with weak attendance, and tend to achieve better outcomes. Students are also responsible for announcements or changes to the syllabus made while they are absent. It is your responsibility to review any topics you may have missed in lecture.

University Policies

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions.

Details of the policies and how to access support are available on the UBC Senate website, <https://senate.ubc.ca/policies-resources-support-student-success>

Other considerations

Provisions will be made for students requiring learning support, including administration of exams. Please see me if you need additional assistance. In particular, if you find you are falling behind in the course, notify me at once so that I can help you early in the process.

Academic integrity

Students are responsible for academic integrity and for honest and individual completion of assignments and other work. In the case of group work, ***each student must contribute to the ideas, research, and writing or presentation of the final product.*** Examples of academic misconduct and dishonesty include, but are not limited to: cheating on a test, exam, or assignment, copying the work of another person or erroneously referencing another person's work, or presenting another person's work as one's own.

Email policy

Please make every effort to **ask questions in person** during **lecture or office hours**. If you need to ask questions over email, please follow these instructions:

- Place GEOB 408 in the subject header and sign your message with your full name. You may use the email system within Canvas or email me directly
- Email is a formal and public method of communication. Do not write anything that you do not want on the permanent, public record.
- I will try my best to reply within 24-48 hours during weekdays. I do not read email on weekends and holidays. Do not send emails at the last minute!

