**Faculty of Social Sciences**
**Department of Geography**

University of Victoria

# Geography 491 A02
# ADVANCED TOPICS IN DYNAMICS OF THE CRYOSPHERE
# FALL 2018


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## Course Description

Snow and ice dominate the Canadian landscape. There is virtually no area in Canada which escapes the influence of snow and ice. We skate on frozen ponds, ski down snow laden mountains, drive through snow blizzards and watch how ice jams in rivers cause rivers to swell and floods to occur. The duration and the thickness of snow and ice increase rapidly northwards, and glaciers are found in mountainous areas and in large parts of the Arctic region. Given that snow and ice impact heavily on the Canadian way of life, this course seeks to understand the dynamics of snow and ice in physical, climatological, and hydrological contexts. This course will examine snow properties, snowcover distribution, glacier hydrology, melt runoff, and ice in its many forms (lake ice, river ice, sea ice, and ground ice). The application of remote sensing and other remote observing systems to understanding the cryosphere will be examined. This course will also examine the implications of climate change on the cryosphere in Canada and beyond.

## Class Meetings

Wednesdays 14:30-17:20 CLE C115

## Text and Readings

There is no required text for this course. Readings will be posted on CourseSpaces (http://CourseSpaces.uvic.ca). If necessary, readings may be made available on the course reserve in the main library. If you come to class prepared it will be easier to remain committed to, and engaged with, the course materials throughout the term. This means you should have read and considered the relevant readings before each class meeting.

For project work and the topic review paper you will be expected to make additional use of scientific and policy reports, journal articles, and book chapters in support of your work. Recommended sources will be provided by the course instructor.

**CourseSpaces**

You will be required to access the CourseSpaces site for required readings, important announcements, instructor notes, your grades, and additional information (e.g. discussion topics). Please take the time to familiarize yourself with CourseSpaces if you have not already done so.

**Course Organization**

CLASS MEETINGS

Class meetings will typically comprise discussions around a topic as initiated by the instructor or used for term project work. Topics covered include:

- Components of the cryosphere
- Material properties of water, ice, and snow
- Energy exchanges
- Snow and freshwater ice
- Glaciers and Ice Sheets
- Melt runoff and floods
- Sea ice
- Permafrost
- Climate interactions and climate change

There will also be 1-2 guest speakers at different points throughout the term. They will provide unique and interesting perspectives on cryosphere research, with linkages to industry applications where applicable.

TAKE HOME EXERCISES

Two take home exercises will be given during the course. Further details, including evaluation criteria, will be provided in the class.

TOPIC REVIEW PAPER

Each student is required to conduct a critical review of one peer-reviewed, published, journal article that addresses some aspect of snow and ice hydrology (e.g. techniques or applications). The review will comprise a written component, assessing the article within the context of the literature. It will also comprise a presentation component, where the critical review is presented to the class and followed by a discussion led by the reviewer. You are encouraged to use Power Point or other preferred media to communicate your review

and lead your discussion. Students should consider choosing a journal article and related references which align with their chosen (or anticipated) term project topics. Further details and evaluation criteria will be provided in class.

TERM PROJECT

A group term project (3-4 people) will address an interesting aspect of the cryosphere. Groups are expected to develop a proposal in early September, and to design a scientific experiment which spans the length of the term. Students will have to consider logistical constraints, available data, software and manpower in the design of the project. Guidance and feedback will be provided by the course instructor.

The choice of your topic for your project is up to you and your group but a one page proposal is due in class on September 26, 2018. The final class meeting will be used for term project presentations, to be given in a conference style format. The final term project report is due on the last day of classes for the term.

Required format, evaluation criteria, and suggested topics will be provided in class.

*Sample topics, from which focused projects may be derived.*

*Hydrologic cycle in the Arctic*
*Environmental factors influencing glacier runoff*
*Ice growth and decay*
*Role of climate on the distribution of permafrost*
*Role of permafrost in northern hydrology*
*Northern snow re-distribution and change*
*Role of snow in the northern water budgets*
*Role of snow in the terrestrial energy budget*
*Role of lake ice in the climate system*
*Role of sea ice in the climate system*
*Snow metamorphosis*
*Factors affecting the timing of snowmelt*
*Cryosphere evidence for climate change in northern environments*
*Factors driving the variability in sea ice extent*
*The influence of ice sheets and glaciers on sea level change*
*The relationship between sea ice and ocean current circulation*
*Ocean-ice interactions*
*The Freshwater budget of the Arctic*
*Thermal properties of snow covers*
*Snow water equivalent (SWE) patterns of snowcovers in British Columbia*
*Water chemistry of evolving snowpacks*
*Reflectivity of snow and ice with application to remote sensing*
*Remote sensing approaches*
*Glacier snowline detection*
*Ground based measurements*

*Modeling runoff*

FINAL EXAM

There is no final exam in this course.

**Grading Scheme**

| | |
|---|---|
| Exercises (2 at 10% each) | 20% |
| Topic Review Paper | 10% |
| Project Presentation | 10% |
| Project Report | 60% |

**Late Assignment Policy**

**Late lab assignments are subject to significant penalties: 5% for each 12 hour period following the due date and time.** Exceptions are not permitted except for circumstances involving medical or compassionate reasons. Written verification as proof may be requested at the discretion of the instructor.

**Grade Scale**

| A+ | A | A- | B+ | B | B- | C+ | C | D | F |
|---|---|---|---|---|---|---|---|---|---|
| 90-100% | 85-89% | 80-84% | 77-79% | 73-76% | 70-72% | 65-69% | 60-64% | 50-59% | 0-49% |

**Possible Field Trip**

Depending on student interest and the occurrence of ideal conditions, we may augment our course experience with a short (2 day maximum) field trip. The field trip would include a demonstration of snow sampling protocols and examination of the influence of forcing mechanisms on snow pack properties. The field trip would occur outside of the normal course schedule. More details will be provided at the commencement of the course.

**Tentative Course Schedule**

| Week | | Activity |
|---|---|---|
| 1 | 05 SEP | COURSE INTRODUCTION. |
| 2 | 12 SEP | PROJECT SCOPING. |
| 3 | 19 SEP | PROJECT DISCUSSION. TOPIC. |
| 4 | 26 SEP | TOPIC. EXERCISE 1 DUE. PROJECT PROPOSAL DUE. |
| 5 | 03 OCT | TOPIC. PROJECT WORK. |
| 6 | 10 OCT | TOPIC. PROJECT WORK. |
| 7 | 17 OCT | TOPIC REVIEW PAPER DUE. DISCUSSION ABOUT TOPIC REVIEWS. |
| 8 | 24 OCT | TOPIC. PROJECT WORK. |
| 9 | 31 OCT | PROJECT WORK. EXERCISE 2 DUE. |
| 10 | 07 NOV | PROJECT WORK. |
| 11 | 14 NOV | PROJECT WORK. |
| 12 | 21 NOV | PROJECT WORK. |
| 13 | 28 NOV | PROJECT WORK. |
| 14 | 05 DEC | PROJECT PRESENTATIONS. FINAL REPORT DUE. |

**Course Experience Survey (CES)**

I value your feedback on this course. Towards the end of term you will have the opportunity to complete a confidential course experience survey (CES) regarding your learning experience. The survey is vital to providing feedback to me regarding the course and my teaching, as well as to help the department improve the overall program for students in the future. When it is time for you to complete the survey, you will receive an email inviting you to do so. If you do not receive an email invitation, you can go directly to http://ces.uvic.ca. You will need to use your UVic NetLink ID to access the survey, which can be done on your laptop, tablet or mobile device. I will remind you nearer the time, but please be thinking about this important activity, especially the following three questions, during the course.

1. What strengths did your **instructor** demonstrate that helped you learn in this course?
2. Please provide specific suggestions as to how the **instructor** could have helped you learn more effectively.

3. Please provide specific suggestions as to how this **course** could be improved.

**Academic Integrity**

Academic integrity requires commitment to the values of honesty, trust, fairness, respect and responsibility. It is expected that students, faculty members and staff at the University of Victoria, as members of an intellectual community, will adhere to these ethical values in all activities related to learning, teaching, research and service. Any action that contravenes this standard, including misrepresentation, falsification or deception, undermines the intention and worth of scholarly work and violates the fundamental academic rights of members of our community. Students are advised to consult the university's Policy on Academic Integrity in the University Calendar. The instructor reserves the right to use plagiarism detection software programs to detect plagiarism in term papers.

*The University of Victoria is committed to promoting, providing and protecting a positive and safe learning and working environment for all its members.*