GEOG 475B – The Arctic Climate System

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Office hours: Wednesday 11:30 – 1:30

*Please note that I am an adjunct faculty member in the Department of Geography and Environmental Management. My substantive position is with Environment Canada in Toronto. I will be on campus all day every Wednesday during term. Contact me by email (Chris.Derksen@ec.gc.ca) if a timely response is needed.

Course Description

High latitude environments are the focus of increasing scientific attention because of their role in forcing and responding to global change. The impact of changes in the extent and thickness of sea ice, the extent and water equivalent of snow cover, and the potential release of high latitude stores of soil carbon on global climate are difficult to quantify, but have far-reaching implications. This course will provide a comprehensive assessment of the high latitude climate system. Topics that will be covered include: the Arctic energy budget, Arctic atmospheric circulation, the hydrologic cycle in the Arctic, Arctic ocean-sea ice-climate interactions, modeling the Arctic climate system, the application of remote sensing to Arctic climate studies, an evaluation of recent climate variability and trends, and the future state of the Arctic.
Course Goal and Student Learning Outcomes

**Goal:** The goal of this course is to provide students with a comprehensive understanding of (1) high latitude climate system processes, (2) the past variability and current state of the Arctic cryosphere and how this relates to the Arctic climate system, and (3) the tools necessary to understand and predict future changes to the Arctic (i.e. climate models).

**Student Learning Outcomes:** By the end of the course, students should be able to:

- Understand the key components and processes of the Arctic climate system;
- Understand the elements of the cryosphere, and how they relate to global climate;
- Critically assess and synthesize key literature on the Arctic climate system in the preparation of an in-depth term paper, and present the results to the class.

**Prerequisites**

GEOG 209; GEOG 309

**Class Meetings**

Wednesday 8:30 – 11:00
Arts Lecture 210

**Evaluation**

3 assignments @ 10% 30%

Term Project
  Paper 30%
  Presentation 10%

Final Exam 30%

Note: Assignments are to be handed in during the class period on the specified dates. No late assignments will be accepted. Consultation and discussion of course material with classmates is acceptable but all course work is to be completed individually.

**Textbook**

Term Project

Students are required to write a term paper (10-20 pages) on a topic of their choice relevant to the course (30% of grade) and make a presentation to the class (10% of grade). Students must first have their topic approved by the instructor.

Some potential topics of interest include:
The northern carbon balance
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 budget
Role of snow in the terrestrial energy budget
Role of lakes ice in the climate system
Role of sea ice in the climate system
Snow metamorphosis in northern environments
The Arctic oscillation
Arctic versus Antarctic warming
Cryosphere evidence for climate change in northern environments
Factors driving variability in sea ice extent
The influence of ice sheets and glaciers on sea level change
The freshwater budget of the Arctic
The future of Arctic sea ice from model predictions

Lecture Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Readings</th>
<th>Assignments</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Course details</td>
<td>Serreze &amp; Barry 2005 Ch1 &amp; Ch2</td>
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<tr>
<td></td>
<td>Introduction</td>
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<td>2</td>
<td>Arctic energy budget</td>
<td>Serreze &amp; Barry 2005 Ch3</td>
<td>#1 assigned</td>
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<td>3</td>
<td>Atmospheric circulation</td>
<td>Serreze &amp; Barry 2005 Ch4</td>
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<tr>
<td>4</td>
<td>Surface energy budget</td>
<td>Serreze &amp; Barry 2005 Ch5</td>
<td>#1 due; #2 assigned</td>
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<td>5</td>
<td>The hydrologic cycle</td>
<td>Serreze &amp; Barry 2005 Ch6</td>
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<td>6</td>
<td>Climate regimes of the Arctic</td>
<td>Serreze &amp; Barry 2005 Ch8</td>
<td>#2 due; #3 assigned</td>
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<td>7</td>
<td>Arctic ocean-sea ice-climate interactions</td>
<td>Serreze &amp; Barry 2005 Ch 7</td>
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<td>8</td>
<td>Modeling the Arctic system</td>
<td>Serreze &amp; Barry 2005 Ch 9</td>
<td>#3 due</td>
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<td>9</td>
<td>Remote sensing of the Arctic cryosphere</td>
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<td>10</td>
<td>Recent variability, trends, and the future</td>
<td>Serreze &amp; Barry 2005 Ch 11</td>
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<td>11</td>
<td>Student presentations</td>
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<tr>
<td>12</td>
<td>Student presentations</td>
<td>Term paper due</td>
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<td>Review</td>
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Academic Integrity

To create and promote a culture of academic integrity, the behaviour of all members of the University of Waterloo is based on honesty, trust, fairness, respect and responsibility.

Grievance

A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70 - Student Petitions and Grievances, Section 4, http://www.adm.uwaterloo.ca/infosec/policies/policy70.html

Discipline

A student is expected to know what constitutes academic integrity, to avoid committing academic offenses, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course professor, academic advisor, or the Undergraduate Associate Dean. When misconduct has been found to have occurred, disciplinary penalties will be imposed under Policy 71 – Student Discipline. For information on categories of offenses and types of penalties, students should refer to Policy 71 - Student Discipline, http://www.adm.uwaterloo.ca/infosec/Policies/policy71.html

Appeals

A student may appeal the finding and/or penalty in a decision made under Policy 70 - Student Petitions and Grievances (other than regarding a petition) or Policy 71 – Student Discipline if a ground for an appeal can be established. Read Policy 72 – Student Appeals, http://www.adm.uwaterloo.ca/infosec/Policies/policy72.html

Accommodation for Students with Disabilities

Students who anticipate needing accommodations should contact as early as possible The Office for Persons with Disabilities (OPD) at ext. 5082.

Religious Observances

Students need to inform the instructor at the beginning of term if special accommodation needs to be made for religious observances that are not otherwise accounted for in the scheduling of classes and assignments.
University of Waterloo LEARN Course Environment

This course uses the LEARN course environment for course material dissemination and information exchange. LEARN is a web-based course management system that enables instructors to manage course materials (posting of lecture notes etc.), interact with their students, and provide feedback. YOU NEED TO ENSURE THAT YOU CAN ACCESS LEARN. Note that lecture slides are posted on LEARN the day prior to each lecture. Assignment materials are also distributed through LEARN.

Logging Into LEARN
Since LEARN is a web-based system, you will need a browser. Once you have started up your browser, you can access LEARN via:
http://learn.uwaterloo.ca

Checking Your Userid and Password
Your password can be checked by going to: http://ego.uwaterloo.ca/~uwdir
If your password check fails, you can unlock your password and receive a new one by going to: http://ego.uwaterloo.ca/~uwdir/UnLock.html
If you still cannot get on after checking and resetting your password, please confirm with your instructor that you are on the class roster.

Getting Help
Documentation for LEARN is available at:
http://av.uwaterloo.ca/uwace/training_documentation/index.html