

**Geography 6960, Section 002**  
**Seminar: Cryospheric Data Analysis**

Instructor: Summer Rupper

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Office hours: By appointment

***Course Description:***

Chemical constituents and particulates within snow and ice (e.g., solutes, stable water isotopes, dust) provide important environmental and climatic indicators, and can impact snow/ice processes and downstream hydrographs and water quality. In combination with physical observations (e.g., density, bubble morphology and concentration, etc), snow and ice chemistry can help improve our understanding of the physical processes operating within snow and ice. In this course, we will (1) investigate the utility of chemical and physical observations of snow and ice, (2) learn how to measure some of these properties, (3) apply these techniques to a suite of Greenland ice cores and/or perennial snowpack.

***Course Objectives:***

On completion of this course, students will be able to

1. Discuss physical and chemical properties of snow and ice that are used to reconstruct environmental conditions or impact the response of the system to shifts in climate.
2. Apply appropriate sampling and analysis techniques for chemical/physical analysis of ice cores and snowpack.
3. Interpret chemical and physical data from ice cores and snowpack.

***Course Outline:***

*First 1/3 of the semester: Utility of chemical and physical observations*

The first third of the semester will be spent reading papers on chemical and physical properties of snow and ice, how these are measured, and the application of these to understanding components of earth's systems.

*Second 1/3 of the semester: Sampling and instrument training*

Students will be trained in sampling ice cores and perennial snow for laboratory analysis, on imaging ice cores for stratigraphic analysis, on operating instruments for isotopes, anions, and black carbon (Picarro CRDS, Absorption Photometer, Ion Chromatograph). Students will also be introduced to ICP-MS, scintillation spectrometer, and CVAFS.

*Final 1/3 of the semester: Analyze snow and ice samples*

Students will image ice cores using a light table, measure and cut the core using appropriate clean environment techniques, melt and decant core sections, and measure stable water isotopes, major anions, and black carbon in the samples. Students will then analyze the data and reconstruct environmental and climatic changes in the SW portion of Greenland over the period of significant anthropogenic change. Students will present the results in written and oral reports.

**\*\*Note:** Students can choose to sample and analyzed Wasatch perennial and/or seasonal snowpack in place of Greenland ice cores during semester sections 2 and 3.

***Course Grading:***

Readings, discussions, and literature review	25%	
Instrument training and certification	25%	
Snow/Ice laboratory analysis and data quality		25%
Extended abstract and oral presentation	25%	

Attendance is expected and much of your grade will come from participation during class/labs. There are no make-ups for these, so please make every effort to be there. Please coordinate with me ahead of time if you have to miss class, and make sure you get missed materials from a peer.

Grade scale is as follows: A: 93-100, A-: 90-92, B+: 87-89, B: 83-86, B-: 80-82, C+: 77-79, C: 73-76, C-: 70-72, D+: 67-69, D: 63-66, D-: 60-62, E: 0-59

Note that final grades will be rounded to the nearest percent prior to applying the letter grade. For example, 92.3 is an A- (92%), 92.8 is an A (93%).

Assignment deadlines and grades will be posted through Canvas. It is your responsibility to check often.

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***Student Wellness:***

Personal concerns such as stress, anxiety, relationship difficulties, depression, cross---cultural differences, etc., can interfere with a student’s ability to succeed and thrive at the University of Utah. For helpful resources contact the Center for Student Wellness at [www.wellness.utah.edu](http://www.wellness.utah.edu) or 801-581-7776.

***Accommodations:***

The Americans with Disabilities Act. The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in this class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, (801) 581---5020. CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability Services.

***Office of Equal Opportunity:***

Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801---581---8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, SSB 328, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).

***Campus Safety:***

The University of Utah values the safety of all campus community members. To report suspicious activity, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit [safeu.utah.edu](http://safeu.utah.edu).