

The Arctic: Changing Ecosystems and Resilience

ENVI 3000 (3 credits)

Iceland: Climate Change and the Arctic

This syllabus is representative of a typical semester. Because courses develop and change over time to take advantage of unique learning opportunities, actual course content varies from semester to semester.

Course Description

Gradual and rapid shifts are occurring in ecosystems worldwide. The Arctic, a region of major importance to the world, is changing more rapidly than any other area of the planet. This seminar makes the effects of climate change in this unique part of the world and the rest of the world a subject of discussion. It addresses the conditions of change in the Arctic, spanning ecological, social, and political-economic contexts. The seminar also considers community adaptation to the changing environment. Sessions will take place in different parts of Iceland in cooperation with program partners and working groups of the Arctic Council. Students will learn from experienced scientists, competent instructors, and experts of the Arctic Council.

Learning Outcomes

Upon completion of the course, students will be able to:

- Clarify the physical processes of climate forcings and generate potential feedback loops under various climate scenarios;
- Reflect on the main ways a specific ecosystem or organism is responding to changing global climate.
- Judge the efficacy and limitations of climate-driven ecosystem impact research.

Language of Instruction

This course is taught in English, but students will be exposed to vocabulary related to course content through in-country expert lectures and field visits in a wide range of venues and regional locales.

Instructional Methods

SIT's teaching and learning philosophy is grounded in the experiential learning theory developed by Kolb (1984; 2015) and informed by various scholars, such as Dewey, Piaget, Lewin, among others. Experiential learning theory recognizes that learning is an active process that is not confined to the formal curriculum; "knowledge is created through the transformation of experience" (Kolb, 2015, p. 49). Learning involves both content and process. Learning is holistic and happens through various life experiences upon which students draw to generate

new ways of knowing and being. Learning involves a community and is a lifelong endeavor. Learning is transformational. The suggested four step-cycle of a *concrete experience, reflective observation, abstract conceptualization, and active experimentation* embedded in the experiential learning model is not linear and might not always happen in that specific order, as any learning is highly context dependent. These stages of taking part in a shared experience; reflecting on that experience by describing and interpreting it; challenging their own assumptions and beliefs to generate new knowledge; and ultimately applying new knowledge, awareness, skills, and attitudes in a variety of situations and contexts are important for students to engage in to become empowered lifelong learners.

Course Schedule

Students will be provided a detailed course schedule during orientation on the program. Please be aware that topics and excursions may vary to take advantage of any emerging events, to accommodate changes in our lecturers' availability, and to respect any changes that would affect student safety. Students will be notified if this occurs.

Module 1: Ecosystem impacts in terrestrial systems

This module introduces students to the terrestrial landscape and recent issues related to changing climate. Topics span the range of individual physiological constraints to biome shifts. Different levels of organization are explored across different scales to give a general understanding of major processes at work in terrestrial systems. Major Arctic feedback loops, especially those related to carbon loss from permafrost thaw, will be examined as well.

Site Visits or Excursions: As we travel around Iceland on the Ring Road excursion, we will see firsthand evidence of shifting landscapes as the result of changing climate and changes in land use. We will also investigate the steps being taken to combat the rapid shifts in the landscape.

Required Reading:

Sistla, S. A. et al. (2013). Long-term warming restructures Arctic tundra without changing net soil carbon storage. *Nature* 497: 615-618.

Suggested readings:

Heskel, M. et al. (2013). Differential physiological responses to environmental change promote woody shrub expansion. *Ecology and Evolution* 3: 1149-1162.

Settele, J. et al. (2014). Terrestrial and inland water systems. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 271-359.

Swanson, D. K. (2015). Environmental limits of tall shrubs in Alaska's Arctic National Parks. *PLoS ONE* 10: 1-34.

Tape, K. D. (2016). Range expansion of moose in Arctic Alaska linked to warming and increased shrub habitat. *PLoS ONE* 11: 1-12.

Walker, D. A. (1987). Height and growth rings of *Salix lanata* ssp. *richardsonii* along the coastal temperature gradient of northern Alaska. *Canadian Journal of Botany* 65: 988-993.

Module 2: Ecosystem impacts in freshwater systems

This module addresses consequences of climate variability in fresh waters. Topics will include things like groundwater recharge rates and resource management, nutrient release and eutrophication in northern systems, and impacts from changes in precipitation and snowpack.

Site Visits: We will be visiting rapidly changing glaciers and seeing the shifts in freshwater storage and transport.

Suggested Readings:

- Hannesdóttir, E. A. et al. (2013). Increased stream productivity with warming supports higher trophic levels. *Advances in Ecological Research* 48: 285-342.
- Jiménez Cisneros, B. E. et al. (2014): Freshwater resources. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 229-269.
- Milner, A. M. et al. (2008). Colonization and development of an Alaskan stream community over 28 years. *Frontiers in Ecology and the Environment* 6: 413-419.
- Reist, J. D. et al. (2006). General effects of climate change on Arctic fishes and fish populations. *Ambio* 35: 370-380.
- Woodward, G. et al. (2010). Climate change and freshwater ecosystems: impacts across multiple levels of organization. *Philosophical Transactions of the Royal Society B* 365: 2093-2106.

Required Reading:

- Winder, M., and Schindler, D. E. (2004). Climatic effects on the phenology of lake processes. *Global Change Biology* 10: 1844-1856.

Module 3: Ecosystem impacts in marine systems

The most visible and informative indicator of climate change in the Arctic is the change in sea ice cover. Arctic sea ice extent has declined over the past decades with far-reaching consequences for ecosystems and humans. In addition to sea ice thickness and extent, there have been rapid changes to salinity, temperature, and pH in several areas of the oceans worldwide. We will look at observed and projected changes to marine ecosystems from myriad perspectives related to global change.

Required Reading:

- Anderson, P. J., and Piatt, J. F. (1999). Community reorganization in the Gulf of Alaska following ocean climate regime shift. *MEPS* 189: 117-123.

Suggested Readings:

- Anthony, M. E., and Richardson, A. J. (2004). Impact of climate change on marine pelagic phenology and trophic mismatch. *Nature* 430: 881-884.
- Beaugrand, G., and Kirby, R. R. (2010). Spatial changes in sensitivity of Atlantic cod to climate-driven effects in the plankton. *Climate Research* 41: 15-19.
- Doney, S. C. et al. (2012). Climate change impacts on marine ecosystems. *The Annual Review of Marine Science* 4: 11-17.
- Perry, A. L. et al. (2005). Climate change and distributional shifts in marine fishes. *Science* 308: 1912-1915.
- Pörtner, H.-O. et al. (2014). Ocean systems. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 411-484.

Module 4: Arctic Resilience and Adaptation

This module broadly examines Arctic biological and physical systems, as well as observed changes and how they will affect those living in the Arctic. This section of the course content is an interdisciplinary mix of topics designed to introduce students to the Arctic. This module is delivered primarily in Akureyri. The Arctic has always undergone change, and Indigenous peoples in the Arctic have depended on and adapted to local environments. Traditional knowledge and unique ways of understanding different surroundings are vital resources for well-being. Adaptation to climate change is a key challenge for Arctic peoples and the world.

Assignments and Evaluation

Papers will be graded on style and structure, depth of analysis, and synthesis of secondary and primary sources.

Assignment Descriptions and Grading Criteria

1) Oral Quiz (10%)

This quiz assesses if students can identify and competently explain climate drivers and create potential feedback loops and their subsequent large- and small-scale ecosystem impacts.

2) Oral Presentation (20%)

Each student will give an oral presentation on a paper of his/her/their choosing that looks at ecosystem impacts of climate change. The paper can focus on any scale from organism to ecosystem. The paper must describe the climate scenarios applied to the study system. Students must have a thorough enough understanding of the impacts and scenarios to build critiques to the study into the presentation and answer audience questions. All papers are approved by the Academic Director in advance.

3) Paper Analyses (3) (60%)

Each student will analyze three peer-reviewed papers. The papers are assigned, and they cover the topics of climate change impacts in terrestrial, freshwater, and marine ecosystems. The analyses are one page, and they consist of four roughly equal sections: summary of the study and findings, broader significance of the paper, strengths, and weaknesses. A discussion of the paper will take place when these ecosystem levels are covered in class.

4) Participation (10%)

This includes active involvement in lectures, readings, discussions, and excursions using the following criteria:

- Attendance - promptness to class and positive presence in class.
- Active Listening - paying attention in class and during field excursions, asking appropriate questions, showing interest and enthusiasm (this includes body language), entertaining contradictory perspectives, taking notes.
- Involvement in Class Discussions - either in small or large groups, sharing knowledge. This means challenging yourself to speak up if you usually don't, and also means allowing others to speak if you are a person who tends to dominate class discussions.
- Group Accountability – positive participation in the group during field excursions and classes; not keeping others waiting.
- Displaying Respect – culturally appropriate interaction with hosts, SIT program staff, SIT lecturers and communities.

Assessment

Instructions and rubrics will be provided for all assignments.

Oral Quiz - 10%

Oral Presentation - 20%

Paper Analyses (3) - 60%

Participation - 10%

Attendance and Participation

Due to the nature of SIT Study Abroad programs, and the importance of student and instructor contributions in each and every class session, attendance at all classes and for all program excursions is required. Criteria for evaluation of student performance include attendance and participation in program activities. Students must fully participate in all program components and courses. Students may not voluntarily opt out of required program activities. Valid reasons for absence – such as illness – must be discussed with the academic director or other designated staff person. Absences impact academic performance, may impact grades, and could result in dismissal from the program.

Late Assignments

SIT Study Abroad programs integrate traditional classroom lectures and discussion with field-based experiences, site visits and debriefs. The curriculum is designed to build on itself and progress to the culmination (projects, ISP, case studies, internship, etc.). It is critical that students complete assignments in a timely manner to continue to benefit from the sequences in assignments, reflections and experiences throughout the program.

Example: Students may request a justified extension for one paper/assignment during the semester. Requests must be made in writing and at least 12 hours before the posted due date and time. If reason for request is accepted, an extension of up to one week may be granted at that time. Any further requests for extensions will not be granted. Students who fail to submit the assignment within the extension period will receive an 'F' for the assignment.

Grading Scale

94-100%	A
90-93%	A-
87-89%	B+
84-86%	B
80-83%	B-
77-79%	C+
74-76%	C
70-73%	C-
67-69%	D+
64-66%	D
below 64	F

Program Expectations

- Show up prepared. Be on time, have your readings completed and points in mind for discussion or clarification. Complying with these elements raises the level of class discussion for everyone.
- Have assignments completed on schedule, printed, and done accordingly to the specified requirements. This will help ensure that your assignments are returned in a timely manner.
- Ask questions in class. Engage the lecturer. These are often very busy professionals who are doing us an honor by coming to speak.
- Comply with academic integrity policies (no plagiarism or cheating, nothing unethical).
- Respect differences of opinion (classmates', lecturers, local constituents engaged with on the visits). You are not expected to agree with everything you hear, but you are expected to listen across difference and consider other perspectives with respect.
- Storing Your Work: Keep several copies of your work as back up and keep one copy accessible to you through an online forum, such as an attachment in your email, the course learning management system, or cloud-based storage. This way your work will always be available to despite technical issues. Lost files, deleted drives, or computer crashes are not excuses for late, missing work.
- Personal Technology Use: Cell phones and other personal electronics can be used for taking notes and other class activities. Off-task usage is not acceptable. You may be marked as absent for habitually using them for something other than classroom activities.
- Content Considerations: Some texts and activities you will encounter in this course delve into sensitive topics that may be emotionally and intellectually challenging. Our classroom is a space where we can engage with challenging ideas, question

assumptions, and navigate difficult topics with respect and maturity. As possible, I will flag content and activities that are especially graphic or intense, so we are prepared to address them soberly and sensitively. If you are struggling to keep up with the work or participate in the course because of the nature of the content and activities, you should speak with me and/or seek help from counseling services.

- Classroom recording policy: To ensure the free and open discussion of ideas, students may not record classroom lectures, discussion and/or activities without the advance written permission of the instructor, and any such recording properly approved in advance can be used solely for the student's own private use.

SIT Policies and Resources

Please refer to the [SIT Study Abroad Handbook](#) and the [Policies](#) section of the SIT website for all academic and student affairs policies. Students are accountable for complying with all published policies. Of particular relevance to this course are the policies regarding: academic integrity, Family Educational Rights and Privacy Act (FERPA), research and ethics in field study and internships, late assignments, academic status, academic appeals, diversity and disability, sexual harassment and misconduct, and the student code of conduct.

Please refer to the SIT Study Abroad Handbook and SIT website for information on important resources and services provided through our central administration in Vermont, such as [Library resources and research support](#), [Disability Services](#), [Counseling Services](#), [Title IX information](#), and [Equity, Diversity, and Inclusion](#) resources.