

Climate Change and Marine Biology in Southern Patagonia and Antarctica

ENVI-3005 (3 credits)

Argentina: People, Environment and Climate Change in Patagonia and Antarctica

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

This course examines how climate change affects the biodiversity of Southern Patagonia and Antarctica, with a particular emphasis on marine and coastal ecosystems. Students explore the natural and dynamic components of the Beagle Channel, the Southern Ocean, and Antarctica, focusing on the region's coastal and marine biology. The course includes site visits to a range of ecological locations selected to represent the exceptionally unique biodiversity of Southern Patagonia and Antarctica. Through the lens of climate change, students analyze how the region's biodiversity reflects geological, evolutionary, and biogeographical processes, gaining a deeper understanding of the impacts of climate change and other environmental dynamics.

This course runs concurrently with the Environmental Research Methods and Ethics seminar. Instruction by faculty members and researchers is provided both in the classroom and during field excursions. The seminar includes an academic visit to an atmospheric monitoring station that is part of a global network operating under the World Meteorological Organization's Global Atmosphere Watch (GAW) Programme, where long-term measurements of pollutant gases (including CO₂), reactive gases, and ozone are conducted using tools such as radiosonde balloons to study the upper atmosphere. The program also includes a two-day field trip to the eastern coast of the Beagle Channel, with visits to Puerto Almanza—a fishing settlement with artisanal and gastronomic production—and to Estancia Harberton, the first ranch established in Tierra del Fuego. Activities at Estancia Harberton include peat bog excavation, a visit to the Acatushún Museum, which houses a collection of cetacean bones and other seabirds and marine mammals, and a visit to the Magellanic and gentoo penguin colony on Isla Martillo. Throughout these excursions, students deepen their understanding of climate change and coastal-marine biology.

A ten-day expedition from Ushuaia to Antarctica provides a unique opportunity to further examine the region's environment and the impacts of climate change. Traveling aboard the 90-passenger ice-strengthened polar vessel Ushuaia, operated by Antarpplly Expeditions, an IAATO member company, students visit one of the world's last pristine regions. The expedition

team guides students during shore excursions, assists with wildlife identification, and facilitates observations of whales, seals, penguins, and seabirds. On board the vessel, students participate in lectures and structured reflection sessions that complement field-based learning.

Learning Outcomes

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

- Interpret geologic and ecological patterns, as well as key conservation concerns for species in southern Patagonia and Antarctica, using field-based observations and course materials;
- Describe the recent geological history, biodiversity, and ecosystems of southern Patagonia and Antarctica, with particular attention to the impacts of climate change on these environments;
- Analyze the effects of climate change on marine and coastal ecosystems in southern Patagonia and Antarctica through written assignments, field observations, and experiential learning;
- Explain the role of Antarctic ice systems in climate regulation and their influence on marine biodiversity;
- Communicate biological, ecological, and cultural information effectively through short oral presentations and structured field notebook entries

Language of Instruction

This course is taught in Spanish. Students will be exposed to vocabulary related to course content through in-country expert lectures and field visits to 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.

Assignments and Evaluation

Assignment Descriptions and Grading Criteria

1) Weekly Assignments (35%)

Weekly assignments are short written activities designed to integrate and reinforce the content of each module. These assignments assess students' understanding of key concepts, promote reflection on course material, and support continuous engagement with themes related to climate change, biodiversity, and marine and coastal systems throughout the course.

2) Trip Topics Presentation (20%)

For each excursion, students are required to complete a short Trip Topic oral presentation. Each presentation focuses on a selected plant or animal species, ecosystem, or cultural or historical feature and includes a biological or ecological description, relevant background information, and key aspects such as distribution, notable characteristics, and conservation status. Presentations are approximately five minutes in length and are assigned by SIT staff prior to each excursion. Students are expected to document all relevant research materials—such as notes, drawings, diagrams, or graphs—in their field notebook in preparation for the presentation.

3) Field Notebook / Excursion Log (30%)

Students are required to maintain a field notebook throughout the course excursions. More than a simple record of observations, the field notebook serves as a tool for meaningful learning, critical thinking, and reflection. It documents ecological, biological, conservation, and sustainability observations developed through direct engagement with the environment, guided sessions, field activities, and independent observation. Through writing, sketching, and reflective entries, students are encouraged to explore human–nature interactions, natural history, and cultural contexts, creating a vivid and thoughtful account of each excursion that captures not only factual information but also questions, insights, and personal reflections that emerge during the learning process.

5) Participation (5%)

Participation is assessed based on students' preparation, attendance, and attitude in all lectures, discussions, and excursions. Students are expected to actively contribute to periodic group meetings and to complete all assigned written work in a timely manner. Evaluation also includes culturally respectful behavior, flexibility, punctuality, and enthusiasm, as well as constructive engagement with peers and instructors, in order to support a collaborative learning environment.

6) General Performance (10%)

General performance is evaluated through a combined assessment of the student's learning achievement, the overall quality, rigor, and consistency of the work produced for the course, and the level of effort demonstrated throughout the term. This includes the student's ability to apply course concepts, engage critically with course materials, meet academic standards, and show sustained commitment to coursework and field-based activities.

Assessment

- Weekly Assignments (35%)
- Trip Topics Presentation (20%)
- Field Notebook / Excursion Log (30%)
- Final Examination (20%)
- Participation (5%)
- General Performance (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 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).
- 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.

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](#), [Accessibility Services](#), [Counseling Services](#), [Title IX information](#), and [Equity, Diversity, and Inclusion](#) resources.

Course Schedule

**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*

The following modules occur during the first three weeks of program time in Ushuaia, Tierra del Fuego and on excursions and site visits.

Module I: Structure and Dynamics of the Environment

This module introduces students to the structure and dynamics of marine and coastal environments in Southern Patagonia, with a focus on the Beagle Channel. Students examine the origin and evolution of the regional landscape, followed by an introduction to physical and biological oceanography. Topics include the geological formation of the region, physical oceanographic processes, and the biological organization of marine systems. Through lectures and discussions, students develop a foundational understanding of how physical drivers shape marine environments and influence biological processes, providing a basis for later discussions on biodiversity and climate change.

Session 1: Origin of the landscape
Session 2: Physical oceanography
Session 3: Biological oceanography

Required Readings

Ponce, J. F. (2025). Los Andes fueguinos: Guía práctica para comprender el paisaje. Independent Edition.

Suggested Readings:

- Almandoz, G.O., Hernando, M., Ferreyra, G., Schloss, I. & Ferrario, M. (2011). Seasonal phytoplankton dynamics in extreme southern South America (Beagle Channel, Argentina). *Journal of Sea Research*, 66(2): 47–57.
- Deppeler, S.L. & Davidson, A.T. (2017). Southern Ocean phytoplankton in a changing climate. *Frontiers in Marine Science*, 4.
- Hoffmeyer, M.S., Sabatini, M., Brandini, F., Calliari, D. & Santinelli, Norma. (eds.) (2018). *Plankton Ecology of the Southwestern Atlantic*. Springer International Publishing, Cham.
- Lutz, V., Segura, V., Dogliotti, A., Garcia, V., Brandini, F., Calliari, D., Ciotti, A., Villafañe, V., Schloss, I., Corrêa, F., Benavides, H. & Vizziano, D. (2018). Overview on primary production in the Southwestern Atlantic. En M.S. Hoffmeyer et al. (eds.), *Plankton Ecology of the Southwestern Atlantic*. Springer International Publishing, Cham.
- Menounos, B., Clague, J., Osborn, G., Davis, P., Ponce, J.F., Goehring, B., Maurer, M., Rabassa, J., Coronato, A. & Marr, B. (2013). Latest Pleistocene and Holocene glacier fluctuations in southernmost Tierra del Fuego, Argentina. *Quaternary Science Reviews*, 77: 1–15.
- Piola A.R. & Rivas, L.R. (1997) Corrientes en la Plataforma continental. En: *El mar argentino y sus recursos pesqueros*, 1:119-132.
- Piola, A.R., Palma, E.D., Bianchi, A.A., Castro, B.M., Dottori, M., Guerrero, R.A., Marrari, M., Matano, R.P., Möller Jr., O.O. & Saraceno, M. (2018). Physical oceanography of the SW Atlantic Shelf: A review. En M.S. Hoffmeyer et al. (eds.), *Plankton Ecology of the Southwestern Atlantic*, pp. 37–56. Springer International Publishing, Cham.
- Ponce, J.F., Coronato, A. & Rabassa, J. (2012). Historia de la plataforma submarina y la costa atlántica argentina durante los últimos 22.000 años. *Revista Ciencia Hoy*, 22(127): 50–56.
- Ponce, J.F. & Rabassa, J.O. (2016). La Isla de los Estados y sus fiordos. *Revista Ciencia Hoy*, 26(152): 49–54.
- Ponce, J.F. & Rabassa, J. (2017). Historia de los glaciares de Tierra del Fuego. Un paisaje modelado por el hielo. *Revista La Lupa*, Año 7: 10.
- Rabassa, J., Bujalesky, G., Meglioli, A., Coronato, A., Gordillo, S., Roig, C. & Salemme, M. (1992). The Quaternary of Tierra del Fuego, Argentina: The status of our knowledge. *Sveriges Geologiska Undersökning*, 81: 249–256.
- Smith, W.O. & Lancelot, C. (2004). Bottom-up versus top-down control in phytoplankton of the Southern Ocean. *Antarctic Science*, 16(4): 531–539.

Module II: Marine Biodiversity - Regional Biodiversity

This module focuses on marine and regional biodiversity in Southern Patagonia and adjacent sub-Antarctic environments. Students study biological resources, marine birds, and marine

mammals, as well as the structure and functioning of marine food webs. Emphasis is placed on species interactions, trophic dynamics, and the ecological roles of key taxa. Instruction combines classroom-based learning with field-based observations during excursions, allowing students to contextualize biodiversity patterns within the region's marine ecosystems and to understand their relevance for conservation and sustainable resource use.

Session 4: Biological resources

Session 5: Marine birds and marine mammals

Session 6: Trophic webs

Required Readings:

Scian, M., Riccialdelli, L., & Marina, T. I. (2025). Food web structure and species' role in the sub-Antarctic Marine Protected Area Yaganes. *Polar Biology*, 48(2), 49.

Diez, M.J & Sotelano, P. (2011). Viviendo entre mareas en el canal Beagle. *Revista La Lupa*, Año 1: 1.

Suggested Readings:

Bruno, D.O. & Fernández D. (2016). Bosques de cahichuyo. Nursery para larvas de peces que habitan el Canal Beagle. *Revista La Lupa*, Año 6: 9.

Forcada, J., & Trathan, P. (2009). Penguin responses to climate change in the Southern Ocean. *Global Change Biology*, 15(11), 2574-2587.

Scioscia, G., Raya Rey, A.N., & Schiavini, A.C. (2016). Breeding biology of Magellanic Penguins (*Spheniscus magellanicus*) at the Beagle Channel: interannual variation and its relationship with foraging behaviour. *Journal für Ornithologie*, 157(3), 7-20

Plön, S., Andra, K., Auditore, L., Gegout, C., Hale, P. J., Hampe, O., Ramilo-Henry, M., Burkhardt-Holm, P., Jaigirdar, A. M., Klein, L., Maewashe, M. K., Müssig, J., Ramsarup, N., Roussouw, N., Sabin, R., Shongwe, T. C. & Tuddenham, P. (2024). Marine mammals as indicators of Anthropocene Ocean Health. *NPJ Biodiversity* 3(1):24.

Riccialdelli, L., Newsome, S.D., Fogel, M.L., & Fernández, D.A. (2017). Trophic interactions and food web structure of a subantarctic marine food web in the Beagle Channel: Bahía Lapataia, Argentina. *Polar Biology*, 40(4), 721-733.

Module III: Climate Change

The final module examines climate change in Southern Patagonia and Antarctica from an interdisciplinary perspective. Students explore atmospheric processes through a visit to the Global Atmosphere Watch (GAW) monitoring station in Ushuaia and analyze the impacts of climate change on marine species, including ocean acidification. Geological perspectives on climate change are addressed through the study of peatlands and glaciers, complemented by a field excursion focused on these environments. Additional topics include blue carbon, Antarctic climate systems, and the role of sea ice and glaciers in shaping Antarctic ecosystems. Throughout the module, students integrate scientific observations, field experiences, and discussions with researchers to deepen their understanding of climate change processes and impacts.

Session 7: Visit to the Global Atmosphere Watch (GAW) Station, Ushuaia
Session 8: Climate change and marine species: ocean acidification
Session 9: Climate change from a geological perspective: peatlands and glaciers
Session 9*: Field excursion: climate change from a geological perspective (peatlands and glaciers)
Session 10: Blue carbon
Session 11: Climate change and Antarctica

Required Readings:

Bergagna, L., Riccialdelli, L., Lovrich, G., Morán, G. A., Schejter, L., Palomo, G., & Sahade, R. (2026). Deeper Waters, More Calcifiers: Spatial Variation in Benthic Assemblages Highlight Conservation Challenges in Sub-Antarctic Marine Protected Areas. *Marine Environmental Research*, 107889.

Suggested Readings:

Bergagna, L., Lovrich, G., Riccialdelli, L. & Sahade, R. (2024). Blue carbon storage in a sub-Antarctic marine protected area. *Scientific Reports*, 14(1): 20642.

Croxall, J.P. (1992). Southern Ocean environmental changes: Effects on seabird, seal and whale populations. *Philosophical Transactions of the Royal Society B*, 338(1286): 319–335.

Dlugokencky, E.J., Miller, J.B. & Staehelin, J. (2010). La Vigilancia de la Atmósfera Global: historia de una contribución al control del clima. *Boletín de la OMM*, 59(1): 1–7.

Lattuca, M.E., Boy, C.C., Vanella, F.A., Barrantes, M.E. & Fernández, D.A. (2018). Thermal responses of three native fishes from estuarine areas of the Beagle Channel, and their implications for climate change. *Hydrobiologia*, 808(1): 235–249.

Ponce, J.F., Coronato, A., Fernández, M., Rabassa, J. & Roig, C. (2014). Las turberas de Tierra del Fuego y el clima del pasado. *Ciencia Hoy*, 24(141): 29–35.