



The Graduate Certificate in Climate Science (GCeCS)

The UW Program on Climate Change (PCC; www.uwpsc.washington.edu) fosters cutting-edge interdisciplinary graduate education and research in the science of climate and climate change through a sequence of cross-listed courses and seminars. These courses and seminars are open to all qualified graduate students, drawing mainly from the PCC 'core' departments (Oceanography, Atmospheric Science, and Earth and Space Science), but also from numerous other units that participate in managing the PCC (including Civil and Environmental Engineering, School of Marine and Environmental Affairs, School of Environmental and Forest Sciences, Evans School of Public Affairs, School of Aquatic and Fishery Sciences, School of Public Health, Law School).

In order to recognize formally the climate science training that PCC students gain in addition to their disciplinary degree, PCC offers a Graduate Certificate in Climate Science (GCeCS). The certificate combines the PCC courses, specifically designed to address the cross-linkages in the earth system that disciplinary curricula are not able to do, with a capstone project in Communicating Climate Science.

A. Purpose

The GCeCS provides interdisciplinary training in methods, research issues, and communication of climate science that enhances the scientific breadth and professional employability of awardees.

Learning Objectives

- (1) Certificate recipients will be able to demonstrate an integrated interdisciplinary knowledge of climate science, current methods of research, and of current, past and future climate. They will have an ability to evaluate information about the rapidly changing field of climate science and to appreciate uncertainties in the ability to attribute observed changes and predict future changes in the climate system.
- (2) Certificate recipients will be able to critically analyze new scientific results in the field of climate science.
- (3) Certificate recipients will demonstrate an ability to work in an interdisciplinary team to effectively

communicate climate science to a specific target audience.

The formal courses, the seminar and the capstone project all provide learning opportunities.

B. Requirements

Admission process: Applications showing intent to pursue the GCeCS must be emailed or sent (campus mail Box 355351) to the GCeCS Program Advisor, Miriam Bertram (uwpsc@uw.edu).

Eligibility: Students will be admitted to GCeCS on the basis of strong scholastic performance in relevant undergraduate and graduate courses, and must include undergraduate and graduate transcripts and GRE scores with their application. Prerequisites include either (a) admission to the graduate programs of either Atmospheric Sciences (ATMS), Earth and Space Sciences (ESS), or Oceanography (OCEAN), or (b) admission to a graduate program or non-matriculated status at the University of Washington, and at least six quarters (four semesters) of undergraduate or graduate coursework in geophysical science, chemistry, biology and/or physics, including at least one quarter of chemistry all with an average grade of B (3.0) or above. For a graduate student matriculated in a UW department other than ATMS, OCEAN or ESS, we also require a letter of concurrence from that department's Graduate Program Coordinator. The GCeCS will consider applications from UW graduate nonmatriculated students meeting the above coursework requirements with GRE mathematics, verbal, and analytical scores all at or above the 75th percentile.

Components. The GCeCS consists of coursework, a seminar on science communication, and a capstone project. In formal courses, students investigate climate science from rigorous interdisciplinary perspectives and participate in group discussions of recent research. In the seminar course, the students participate in discussions which focus on a particular area of cutting edge climate science. In the process, they learn to critically analyze primary literature in an interdisciplinary learning environment. In the communication seminar and capstone project, individuals or interdisciplinary teams demonstrate climate science knowledge and effective

communication skills. All aspects of the education program integrate multiple disciplines. These are described in detail in the next two sections.

C. Coursework (12 credits)

(1) Physical climate (offered Autumn Quarter)

Two options:

Fundamentals of Global Warming Science (ATM S/OCN/ESS 587, 3 credits, requires one semester of calculus) **OR**

Advanced Physical Climatology (ATMS 571, 3 credits, requires an undergraduate course in differential equations)

(2) Climate and biogeochemistry (offered Winter Quarter)

Required for all students:

The Global Carbon Cycle and Greenhouse Gases (OCN/ATM S/ESS 588, 3 credits, includes application of undergraduate chemistry and computer programming)

(3) Applications of climate science.

Many options, including:

Option 3a: **Paleoclimatology- Data, Modeling and Theory** (ESS/OCN/ATMS 589, 3 credits, offered alternate years).

Option 3b: **Paleoclimate Proxies** (OCN/ATMS/ESS 554, 3 credits).

Option 3c: **Climate Modeling** (ATMS/ESS 559 and OCEAN 558, 4 credits, offered alternate years in Spring Quarter).

Option 3d: **Governmental Responses to Climate Change** (SMEA 521, 3 credits, offered in Autumn Quarter)

Additional options are found on the GCeCS webpage, and are modified or augmented, as appropriate new courses are initiated.

(4) PCC seminar: **Current Research in Climate Change** (OCN/ESS/ATMS 586, 2 credits, Autumn, Winter and/or Spring Quarters)

The Autumn Quarter seminar topic is chosen to match the PCC's annual theme and includes a weekly seminar by a distinguished speaker, preceded by relevant readings and a student-led discussion. A Winter Quarter seminar is often offered that includes an in-depth student led discussion of current literature on a special topic in climate science.

(5) Science Communications Seminar

Two options:

Communicating Climate Science Seminar (OCN/ATMS/ESS 593, 1 credit, Winter Quarter). Includes a weekly seminar by UW faculty and non-UW professionals who share their knowledge and experiences with climate communication in different settings, including communicating uncertainty, public perceptions and misconceptions, and personal stories about effective communication. The goal of the seminar is to broaden student perspective on scientific outreach, discussing issues and different communication media, styles and situations. OR

Students may choose to deeply investigate a targeted area of communications, developing expertise in policy, education, media etc. by selecting one of the science communications courses offered across campus. Examples include:

COM 597 Special Topics in Communication: Science Communication (5 credits)

PB AF 595 Topics in Environmental Policy and Management: Ethics and Practice of Climate Change Communication and Community Engagement Strategies (4 credits)

PB AF 595 Communicating Climate Change (4 credits)

OCEAN 592 Communicating Ocean Sciences (4 credits)

ENVIR 500A Science Communication & the Media (2 credits)

ENVIR 500 Graduate Seminar in Environmental Studies : Science Writing for Impact (2 credits)

CENV 500: ENGAGE Seminar: Communicating Science to the Public Effectively (3 credits).

D. Capstone project (ATMS/OCN/ESS 596, 5 credits) requirements and guidelines.

The capstone project (100-150 hours) provides hands-on experience in communicating climate science to other scientists and professionals, policy-makers and advocates, the public and to students of all levels. It may span more than one quarter, and a grade is given by either a faculty mentor in a PCC core department (ESS, OCEAN, ATMS) or the PCC Director (LuAnne Thompson).

Identify a project. The first step is to choose a project and find partners or sponsors and a faculty mentor. Examples of capstone projects are listed below. Consult with the GCeCS Program Advisor (Miriam Bertram) or the PCC Director (LuAnne Thompson) for additional ideas, examples and expectations as you start this process.

Submit a proposal. Describe your project with attention to the following key points:

- (1) What are the objectives, timeline, partners or sponsors, target audience, and (if any) tangible deliverables? Include a statement of support from any partners or sponsors. A faculty mentor should also be identified; by default the PCC Director, LuAnne Thompson can serve as faculty mentor.
- (2) The capstone project should be firmly grounded in climate science and the bulk of the material communicated should consist of some aspect of the physical climate system, climate impacts and/or adaptation. Topics covered in IPCC Working Group I (*The Physical Science Basis*) and WGII (*Impacts, Adaptation and Vulnerability*) are suitable. Topics in WGIII (*Mitigation of Climate Change*) may also be acceptable.
- (3) The capstone project should provide an opportunity to demonstrate mastery of multidisciplinary or interdisciplinary material. For example, a graduate student in oceanography could design a project that includes aspects of atmospheric sciences.
- (4) To facilitate greater understanding of the area of climate science integral to the capstone project, we strongly encourage students from non-physical science departments to collaborate with a student or faculty member from Earth and Space Sciences, Atmospheric Sciences or Oceanography. The GCeCS Program Advisor or PCC Director can help you identify possible partners.
- (5) An important component of your capstone is to assess the effectiveness in educating the target audience. For example, if the project is intended to train teachers in climate science, a before-and-after quiz could evaluate whether their knowledge of the science improved after training (see *Evaluate Communication Effectiveness* for additional detail).
- (6) The proposal should reflect an awareness of the target audience, and describe how the proposer intends to account for the audience's motivations, interests, and level of education. For example, a lab for high school classrooms might include a

presentation and hands-on data lab; the proposal could state that each component would be piloted with high school teachers.

- (7) Final proposal approvals (e-mail is fine) are needed from your faculty mentor, off-campus project partner(s), the GCeCS Program Advisor (Miriam Bertram) and PCC Director (LuAnne Thompson).

Carry-out the project. Create communication materials, engage an audience, and evaluate effectiveness of communication.

Submit a final report. This document should include updated elements of the proposal including a final timeline showing actual time spent, summary of project, deliverables (e.g. powerpoint presentations, labs, briefs), final evaluation tool, summary and interpretation of evaluation results and self-evaluation. The self-evaluation should include a discussion of one or more of: (1) what aspects were the most and least successful (2) suggested future work, and (3) how well your capstone accomplished one or more of the learning objectives listed above.

Final reports require the approval of your faculty mentor, the GCeCS advisor (Miriam Bertram) and PCC Director (LuAnne Thompson).

Evaluate Communication Effectiveness. The evaluation component of the project is critically important, as it provides opportunities to gauge effectiveness of communication. During project development, regularly scheduled discussions with the GCeCS Program Advisor (Miriam), the faculty mentor, and/or a meeting of GCeCS candidates where content and presentation is discussed will aid students in creating an effective presentation. These meetings provide a venue where students present their projects and other students provide feedback and constructive advice including stating what worked and what could be improved in the presentation and content.

The second step in the evaluation process is developing an evaluation tool to assess audience learning. In creation and evaluation of the capstone project, the proposer will develop a specific rubric for evaluation. It will include the knowledge base and learning goals of the project; it will evaluate whether that knowledge has been translated effectively, and whether the project is tied to the needs of the proposed audience. A post-assessment should be completed to see whether the communication project was successful. We **strongly** encourage a brief consultation with Dr. Angela C Davis-Unger <acd2@uw.edu> at the Office of Educational

Assessment as you develop your assessment strategy and materials.

Examples of potential and completed capstone projects include:

(1) Curriculum Development for Formal Education Settings.

Develop and lead a 1-quarter seminar/discussion that connects climate science to your field, e.g. “Public health risks of climate change”;

Develop and implement a lab for a high school classroom.

(2) Research News

Develop a rapid response capability for newspaper opinion pieces or blogs, and place several responses;

Intern with a science writer to write several articles about emerging issues in climate science.

(3) Communication materials for the general public that explains the underlying climate science.

Develop presentation materials for local health departments to use to explain climate-related health risks and mortality, including projections for the future;

Plan and teach a short course on climate science for the general public, which could, for example, be taught through a university extension office;

Update and enhance the PCC outreach slide library, give an outreach talk using the new materials.

(4) Physical and non-physical scientists collaborate to address a societal problem.

Develop a research brief on the impacts of future climate change on crops in Africa.

Proposal and Final Report Examples are available upon request from the GCeCS Program Advisor

Time-Line. Students must complete their capstone projects prior to graduating to be awarded the GCeCS. Capstone projects are often conducted over multiple quarters and students may register for capstone credits (ATMS/OCEAN/ESS 596) with their faculty mentor (if in ESS, OCEAN or ATMS) in one or more quarters, not to exceed 5 credits total. Grades are issued upon completion of the final report.

Students planning to complete the capstone within 1 quarter should identify a project and draft a proposal within the first 2 weeks of the quarter. Evaluation materials should be submitted for approval by the 6th

week of the quarter, and the final project submitted prior to the final day of the quarter. Capstone credits and grade are awarded upon completion of the final report.

Possible model for completing the capstone in two consecutive quarters

Prior to starting the capstone project:

1. Submit GCeCS Application Showing Intent to Participate to PCC office, submit transcript showing that prerequisites have been met or how they will be met.
2. While taking required coursework and communications seminar, brainstorm possible capstone projects with peers and advising team.
3. Quarter 1: Register for 2-3 credits of ATMS/OCN/ESS 596 with your capstone advisor if they are in ESS, OCEAN or ATMS (you may also register for all 5 capstone credits in the second quarter). If your capstone advisor is not in ESS, OCEAN or ATMS, register for credits with the PCC Director. Finalize capstone ideas with advising team (one or more of the following: any off-campus project partners, faculty mentor, PCC Director, and GCeCS Program Advisor) and draft proposal. Contact Dr. Angela C Davis-Unger <acd2@uw.edu> at the Office of Educational Assessment to discuss evaluation plan. Finalize proposal which includes timeline for completion, learning or communication goals, and tool for assessing communication. Submit proposal for final approvals. Begin developing presentation materials.
4. Quarter 2: Register for balance of ATMS/OCN/ESS 596 capstone credits. Complete presentation materials, pilot presentation and get feedback, refine. Give final presentations and complete pre and post assessment. Complete final report by the last day of the quarter. Obtain final approval of written report from faculty mentor, GCeCS Program Advisor and PCC Director.