Graduate Certificate in Climate Science (GCeCS)

The UW Program on Climate Change (PCC; pcc.uw.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, attracting those from the PCC physical science departments (Oceanography, Atmospheric Sciences, and Earth and Space Sciences), and from numerous other units from across UW (including Civil and Environmental Engineering, School of Marine and Environmental Affairs, School of Environmental and Forest Sciences, Evans School of Public Policy and Governance, School of Aquatic and Fishery Sciences, School of Public Health, Biology, and more).

In order to formally recognize 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, seminars, and capstone project all provide learning opportunities.

B. Requirements

Eligibility: Students must first be admitted to a graduate program or maintain a non-matriculated status at the University of Washington. For a graduate student matriculated in a UW department other than ATM S, OCEAN, ESS, or SMEA we also require a letter of concurrence from that student’s advisor, Graduate Program Advisor, or Graduate Program Coordinator. 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 highlighting 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. UW graduate non-matriculated students that meet the above coursework requirements will be considered for admission.

To apply email the GCeCS adviser (uwpcc@uw.edu) the following: (1) undergraduate and graduate transcripts highlighting 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; (2) a statement of interest in pursuing the GCeCS, including your name and UW student number.

Components. The GCeCS consists of coursework, two seminars, one on current research in climate science, another on science communication, and a capstone project. In the formal courses, students investigate climate science
from rigorous interdisciplinary perspectives and participate in group discussions of recent research. In the research seminar, 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 (Three Options)

Fundamentals of Global Warming Science (ATM S/ESS/OCEAN 587, 3 credits, Au)

or

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

or

Climate Dynamics (OCEAN 569/ESS 590/ATM S 591, 3 cr, alt Wi)

(2) The Global Carbon Cycle and Greenhouse Gases

(ATM S/ESS/OCEAN 588, 3 credits, Wi, includes application of undergraduate chemistry and computer programming)

(3) Applications of Climate Science

Many options are listed on the GCeCS webpage, check with the GCeCS adviser to explore other options.

(4) Current Research in Climate Change Seminar (ATM S/ESS/OCEAN 586, 2 credits, Au, Wi and/or Sp quarters)

Includes a weekly seminar by a distinguished speaker, preceded by relevant readings and a student-led discussion.

(5) Science Communication Seminar

Communicating Climate Science Seminar (ATM S/ESS/OCEAN 593, 1 credit). A weekly seminar by both 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. Contact the GCeCS adviser for current offerings.

Or

Other Science Communication Skill Based Course or Workshop

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. See https://pcc.uw.edu/education/graduate-certificate/gcecs-curriculum for recently offered course options. Confirm your choice with the GCeCS advisor.

D. Capstone Requirements and Guidelines

The capstone project (120-150 hours) provides hands-on experience in communicating climate science to other scientists and professionals, policymakers, advocates, the public and students of all levels. Students register for ATM S/OCEAN/ESS 596 with a faculty mentor in ATM S, ESS, or OCEAN, with the GCeCS Adviser, or with the PCC Director during the quarters they are working on the capstone. Projects are most often completed across three quarters, but there are many options.

Project Examples

The capstone communication targets a particular audience and focuses on specific goals. Many projects continue once the capstone is complete.

There are many pathways for completing the capstone project, and we provide two examples to get you started.

Curriculum design builds on the PCC history of working with formal science educators. One student developed and implemented a curriculum on radiation balance in the context of geoengineering. Michael Diamond (ATM S), the capstone student, worked with Lisa Neshyba, a science teacher at Sammamish High School and longtime PCC partner. They found a format and appropriate content and created pre and post knowledge tests to evaluate learning and accomplishment of communication project goals. The project was developed from scratch as a GCeCS capstone and is now a recurring unit taught at Sammamish High School with input from UW Atmospheric Sciences graduate students.

Presentations and workshops can extend a student’s thesis research or be built from scratch. James Lee (SMEA) investigated deploying artificial “floating wetlands” in the Lower Duwamish River as part of SMEA thesis work. James then designed and led a workshop for leaders and residents of the Lower Duwamish to (1) expand understanding of
restoration strategies in the Duwamish, (2) address whether learning about novel ecosystem restoration techniques would help make climate change more readily understandable to this audience, and (3) determine whether this understanding could also motivate and inspire people to act on climate change. The effectiveness of this workshop was evaluated using surveys with Likert scale statements that examined attitudes and thoughts of study participants, as well as free-response questions.

Additional details on these projects are available in the capstone final reports (available on request) and blog posts (see pcc.uw.edu).

Get Started. The first step is to choose a project that builds on your skills and future career goals. Discuss ideas with the GCeCS Program Advisor and your departmental adviser as you identify partners and a faculty mentor.

Set Communication Goals. All of the GCeCS capstone projects include developing audience awareness of the science of climate change. Many projects include additional goals, including encouraging individual action and political engagement, increasing civil discourse, developing empathy, and amplifying the voices of others. All are valuable and can be part of your capstone project. Work with your advising team as you develop your ideas and plan your evaluation strategy.

Dig in. Once the goals and target audience are defined, proceed to (i) draft a proposal, (ii) gather information, which may be done as part of thesis or other degree requirement, (iii) create and disseminate the communication product, (iv) evaluate the effectiveness of the communication, and (v) draft the final report.

Draft the Proposal. Describe your project paying attention to the following key points:
(1) What are the objectives, timeline, partners or sponsors, target audience, and (if any) tangible deliverables? Project advisers submit an email to uwpcc@uw.edu acknowledging their acceptance of the advising role, and later the proposal and final project.

(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 Atmospheric Sciences, Earth and Space 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 (email is fine) are needed from your faculty mentor, off-campus project partner(s), the GCeCS Program Advisor and PCC Director.

Evaluate Communication Effectiveness. The evaluation component of the project is critically important as a learning opportunity and as a strategy to guide project development. Many projects allow for a pilot presentation, feedback collection, revision, then a final presentation or workshop followed by collection of final evaluations. Throughout the process, plan for several discussions with the GCeCS Program Advisor, the faculty mentor, and/or peers to discuss and strategize.

The evaluation rubric and tool require careful thought, and are informed by audience size, delivery mode (in person or remote), and communication goals. For small audiences, collecting free responses can be very enlightening, but for large audiences, compiling free responses is not practical. The evaluation should include a measure of change in the knowledge base of the audience, and an evaluation of attitude shifts. As you develop your evaluation strategy we...
strongly encourage you to consult faculty with expertise in evaluation or a brief consultation with Dr. Angela C Davis-Unger (acd2@uw.edu) at the Office of Educational Assessment.

Carry out the Project. Create communication and evaluation tools, run a pilot presentation, revise, engage your target audience, and evaluate the effectiveness of the final communication.

Submit a Final Report. The final report includes updated elements of the proposal including a final timeline showing total time spent, summary of project deliverables, if any (e.g., PowerPoint presentations, labs, briefs), evaluation tools, 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 your communication objectives. All communications must include increasing climate science understandings such as those found in IPCC WG I and II.

Final reports require the approval of your faculty mentor, the GCeCS advisor and PCC Director.

Share your project with the PCC Community. Share the project and what was learned from the capstone experience, as well as impact on the audience, through a blog post shared on the PCC website (fewer than 1000 words preferred). If at all possible, present the capstone project to the PCC community at one of the annual events, e.g. the Spring Symposium or Summer Institute.

Credit for Completion

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

GCeCS Certificate: Once the required course work is complete, and the final capstone report and blog post are approved, the GCeCS advisor petitions the graduate school to award the certificate.

The Graduate School requires you print your transcript and document which courses applied to your departmental degree and which to your certificate, showing that no more than 6 credits overlap. Details can be found here.

Capstone Examples:

Curriculum Development for Formal Education Settings
- Develop and lead a one quarter seminar/discussion that connects climate science to your field, e.g., “Public health risks of climate change”.
- Develop and implement curriculum in a K-12 classroom.

Research Briefs
- Intern with a science writer to write several articles about emerging issues in climate science.
- Develop a research brief on the impacts of future climate change on crops for policy makers in Africa.

Presentations and Workshops
- Develop a presentation and for local health departments explaining 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.
- Create a new curriculum and host a workshop to share new climate-science understandings and underlying science with the target audience.
- Conduct research on concerns and priorities of resource managers w.r.t ocean acidification and share these results with representatives of state agencies.

Examples:
- Communicating the Benefits of Novel Restoration Techniques to Promote Climate Change Literacy and Action, James Lee, Marine and Environmental Affairs, University of Washington.

Note: Proposal and Final Reports for past projects are available upon request from the GCeCS Program Advisor, email uwpcc@uw.edu

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