Course Change Request

New Course Proposal

Date Submitted: 04/20/25 4:16 pm

Viewing: CLIM 625 : Unlocking Past Climate: Models & Proxies

Last edit: 10/03/25 6:31 am

Changes proposed by: bklinger

Are you completing this form on someone else's behalf?
No

Effective Term: Fall 2025

Subject Code: CLIM - Climate Dynamics

Course Number: 625

Bundled Courses:

Is this course replacing another course? No

Equivalent Courses:

Catalog Title: Unlocking Past Climate: Models & Proxies

Banner Title: Paleoclimate Models & Proxies

Will section titles vary by semester? No

Credits: 3

Schedule Type: Lecture

Hours of Lecture or Seminar per week: 3

Repeatable:

In Workflow

1. **AOES -Curriculum Committee**
2. **AOES Chair**
3. **SC Curriculum Committee**
4. SC Assistant Dean
5. Assoc Provost-Graduate
6. Registrar-Courses
7. Banner

Approval Path

1. 04/20/25 4:23 pm Barry Klinger (bklinger): Approved for AOES - Curriculum Committee
2. 05/01/25 1:40 pm Mark Uhen (muhen): Rollback to AOES -Curriculum Committee for AOES Chair

May be only taken once for credit, limited to 3 attempts (N3)

Max Allowable Credits: 9

Default Grade Mode: Graduate Regular

Recommended Prerequisite(s):

BS or MS in physical or natural sciences, or permission of instructor. Some background in computer programming languages & statistical analysis is desirable.

Recommended Corequisite(s):

None.

Required Prerequisite(s) / Corequisite(s) (Updates only): None.

Registrar's Office Use Only - Required Prerequisite(s)/Corequisite(s):

And/Or	(	Course/Test Code	Min Grade/Score	Academic Level	)	Concurrency?

Registration Restrictions (Updates only):

Registrar's Office Use Only - Registration Restrictions:

Field(s) of Study:

Class(es):

Level(s):

Degree(s):

School(s):

3. 10/03/25 6:32 am Barry Klinger (bklinger): Approved for AOES - Curriculum Committee
4. 10/03/25 7:16 am Mark Uhen (muhen): Approved for AOES Chair

Catalog Description:

Numerical models and proxy observations illuminate paleoclimate from millions to hundreds of years ago, providing insight into future climate change. This course covers concepts in understanding and using proxies and in applying climate models to paleoclimate. It explores the integration of models and proxy data to test models and improve estimates of past climate states.

Justification:

This course bridges climate dynamics and geology, making it appealing to students from either disciplines. This course is designed to equip students with foundational methods and tools, including paleoclimate modeling and proxy data analysis—including paleoclimate modeling and proxy data analysis—to investigate past climate change and how it informs our understanding of present and future climate challenges.

By integrating numerical models with geological records, this course complements other AOES courses, such as Paleoclimatology, which explores the evolution of Earth's climate, and Earth System Modeling, which develops the technical and scientific skills needed to run climate models and apply them to future projections.

This course may also attract students from other departments by providing interdisciplinary insights relevant to climate-related policy and decision-making.

Does this course cover material which crosses into another department? No

Learning Outcomes:

1. Understand the principles and components of climate models and their application on paleoclimate studies.
2. Gain familiarity with key paleoclimate proxies and understand their advantages and limitations.
3. Learn methods for data-model comparison and proxy-model syntheses.
4. Develop hypotheses about past climate changes and design model experiments/select appropriate model outputs to assess them.
5. Assess and effectively communicate uncertainty in paleoclimate model simulations and paleoclimate records.
6. Apply insights from past climate studies to understand the present and future climate change.

Will this course be scheduled as a cross-level cross listed section? Yes

Please use the Additional Attachments button to attach two syllabi for review, one undergraduate and one graduate, preferably as separate documents. These should be provided in order to demonstrate the difference in expectations and assessments for undergraduates and graduates taking the course.

Attach Syllabus sylCLIM425proxymodel.pdf
sylCLIM625proxymodel.pdf

Additional Attachments

Staffing: Instructor: Xiaojing Du

Relationship to Existing Programs: This course bridges climate dynamics and geology, making it appealing to students from both disciplines. It is suitable for undergraduate students majoring in Atmospheric Sciences or Geology, MS students in Climate Science and Earth System Science, as well as PhD students in the Climate Dynamics Program and Geology & Earth Sciences Program.

Relationship to Existing Courses: This course focuses on the tools and methods used to study past climate change. It introduces the fundamental concepts and applications of both numerical climate models and geological records in a paleoclimate context.

The course complements other AOES courses. For example, GEOL 332 Paleoclimatology reviews the evolution of Earth's climate but does not delve into the scientific methods used to reconstruct past climates. CLIM 679 Earth System Modeling focuses on the technical and scientific skills needed to run climate models and apply them to future projections, but does not cover their application to paleoclimate studies.

Have you reached out to the Libraries to determine whether there are adequate resources to support your course? If not, please email Meg Meiman, Associate University Librarian for Learning, Research, and Engagement at mmeiman2@gmu.edu.

No

Additional Comments:

Reviewer Comments

Mark Uhen (muhen) (05/01/25 1:40 pm): Rollback: Please consider adding prerequisites and adding more distinction between the graduate and undergraduate versions of the course.

Key: 19027

Syllabus
CLIM 625 Unlocking Past Climate: Models & Proxies

Credits: 3

Instructor:
Dr. Xiaojing Du
Dept. of Atmospheric, Oceanic, & Earth Sciences
https://sites.google.com/view/xiaojing-du/
Email: xdu5@gmu.edu
Office Hours: See Section Canvas Calendar for appointment options

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Course Objectives:
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Recommended Course Materials:
- Gettelman, A. and Rood, R.B., 2016. *Demystifying Climate Models: A User's Guide to Earth System Models* (274 pp.). Springer Nature.
- Goosse, H., 2015. *Climate System Dynamics and Modeling*. Cambridge University Press.
- Ivany, L.C. and Huber, B.T., 2012. Reconstructing Earth's Deep-Time Climate. *The Paleontological Society Papers, 18*.

Tentative Class Schedule:
Week 1: Introduction to Paleoclimate Studies
- Why study past climate change?

- Overview of Earth’s climate history
- Key drivers of past climate change
- Introduction to the final project (expectations, grading criteria, and possible topics)

Week 2: Overview of Climate Models
- Basics of climate modeling: components and processes
- Introduction to General Circulation Models (GCMs)

Week 3: Paleoclimate Simulations I: Introduction
- Using models to simulate past climates
- TraCE-21ka and the Paleoclimate Modeling Intercomparison Project (PMIP)

Week 4: Paleoclimate Simulations II: CESM model
- Introduction to CESM 1.2
- Modifying boundary conditions and testing the impact of external climate forcing

Week 5: Paleoclimate Proxies
- Physical and chemical proxies: ice cores, marine and lake sediments, speleothems
- Biological and geological proxies: tree rings, pollens, corals, and foraminiferal
- In-class group discussion and brainstorming for final project topics

Week 6: Proxy Age Control
- Dating methods (e.g., radiocarbon, Uranium-thorium dating, layer counting)
- Age-model development and uncertainties
- Submit a brief topic description (200-300 words)

Week 7: Data-Model Comparison I: data process and visualization
- Downloading and working with Trace-21ka simulation
- Downloading and working with proxy data
- Submit a project proposal (1 pages)

Week 8: In Class Work on Final project
- In-class peer review of project proposals in pairs
- Troubleshooting with instructor/ classmates
- Collecting and downloading data for the final project

Week 9: Data-Model Comparison II: statistical techniques
- Analyzing time series data
- Identifying spatial patterns

Week 10: Data-Model Comparison III: tools and techniques
- Introduction and motivation
- Approaches to comparing proxy data and model outputs
- Methods for evaluating model performance
- Submit 1-2 key figures for the final project

Week 11: Proxy Forward Models
- Introduction and motivation
- Climate proxy system modeling tools (e.g., PRYSM)

Week 12: Case Studies in Paleoclimate Data-Model Synthesis
- Mid-Holocene climate
- Last Glacial Maximum
- Submit a draft of the final project

Week 13: Paleoclimate and Future Climate Change
- Lessons from past climates for future projections
- Paleoclimate constraints on climate sensitivity
- In-class peer review of final project drafts

Week 14: Student Presentations and Discussions
- Students present their research project
- Reading and discussions on challenges and opportunities in paleoclimatology
- Final project due by the final exam week

Assessment:
1. **In-class quizzes/participation (15%)**:
   - In-class quizzes to test understanding of key concepts.
   - In-class peer review of final project proposals and drafts.
2. **Homework (40%)**
   - Weekly homework on lecture materials and final projects
3. **Final Project (35%)**:
   - A final project must involve original data-model synthesis or model experiments conducted by you on a chosen paleoclimate topic.
4. **Final project oral presentation (10%)**
   - A formal presentation summarizing the final project findings.
   - Evaluation based on clarity, depth of analysis, and effectiveness of communication.

Late Homework Policy
Weekly homework is due by the end of Sunday (11:59pm) each week. After this time, homework turned in one week late will receive a 25% penalty, homework turned in after this will receive a 50% penalty.

AI Policy
AI tools may be used to support your learning, but all submitted work must be your own original thinking and demonstrate your own understanding. Substantial use of AI must be acknowledged.

George Mason University Policies
Please refer to the GMU guidelines at https://stearnscenter.gmu.edu/home/gmu-common-course-policies/ for information about
- Academic Standards
- Accommodations for Students with Disabilities
- FERPA and Use of GMU Emails
- Title IX Resources and Required Reporting

Grading Scale:

Grade	Letter Grade	GPA
96-100	A+	4.0
93-95	A	4.0
90-92	A-	3.67
86-89	B+	3.33
83-85	B	3.00
80-82	B-	2.67
60-79	C	2.00
<60	F	0.0

* This grading scale follows the university-wide system for grading graduate courses.