

GEO409-FS2026 (3 credits)

Global Climate Change and Variability

Instructor: Dr. Jiquan Chen
Guest Lectures: Prof. Atul Jain (UIUC), Prof. Geoff Henebry, Prof. Nathan Moore, Dr. Cheyenne Lei, Mr. Moriz Steiner, and Mrs. Carrie Wicker
Office: 213 Geography Building
Contact: jqchen@msu.edu; 517-884-1884 (office)
Class Webpage: <https://lees.geo.msu.edu/course-geo409.html>
Time: 3:00-4:20 pm, Monday & Wednesday
Location: 126 Geography Building
Office Hours: Wednesday, 12:00 – 14:00 h, or by appointment
Textbook: None
Reading Materials: Available on the course webpage & distributed prior to each lecture

Course Goal

By the end of this course, you should have a solid understanding of the physical processes that govern climate and climate change. You should be able to perform basic calculations and make simple projections to illustrate how various climate forcings influence Earth's average temperature. You should also be able to clearly explain to friends and family the distinction between climate and weather, including what scientists understand with high confidence and where important uncertainties remain.

In addition, you should be familiar with the major arguments raised by climate change skeptics and be able to critically evaluate which claims are scientifically supported and which lack credible evidence. An important takeaway from this course is the ability to distinguish long-term climate change from short-term weather variability and individual extreme or unusual weather events.

Perhaps most importantly, you should be prepared to describe the environmental, societal, and economic impacts of climate change; understand the complexities, trade-offs, and competing perspectives involved in developing climate policy in the United States and internationally; and synthesize these concepts into informed, practical, and effective actions at scales ranging from individual households and local communities to the global community.

ACADEMIC INTEGRITY POLICY

Academic dishonesty violates Michigan State University's Academic Integrity Policy and the General Student Regulations. Examples of academic dishonesty include: (1) **plagiarism**, such as presenting someone else's work as your own on a graded assignment; (2) **collusion**, such as unauthorized collaboration between two or more students on a graded assignment; (3) **cheating**, such as copying answers or using unauthorized materials on a graded assignment; and (4) **fraud**, such as misrepresentation or having someone else complete a graded assignment on your behalf. The first offense will result in **zero points for the assignment in question** and the submission of an **Academic Dishonesty Report**. A second offense will result in a **0.0 final grade for the course** and the submission of a second Academic Dishonesty Report. Please see me immediately if you have any questions about what constitutes academic dishonesty or whether a particular form of collaboration or assistance is permitted.

All students are expected to uphold the **Spartan Code of Honor Academic Pledge**:

“As a Spartan, I will strive to uphold values of the highest ethical standard. I will practice honesty in my work, foster honesty in my peers, and take pride in knowing that honor in ownership is worth more than grades. I will carry these values beyond my time as a student at Michigan State University, continuing the endeavor to build personal integrity in all that I do.”

REQUIRED TECHNOLOGY

Mobile devices (e.g., laptop, tablet, smart phone) with high-speed internet required to access class content on D2L (<https://d2l.msu.edu>) and class webpage. I will send weekly e-mail updates to your MSU email account.

COMMERCIALIZATION OF CLASS NOTES & MATERIALS

MSU prohibits students from commercializing class notes & materials without written consent of the instructor.

RESOURCE CENTER FOR PERSONS WITH DISABILITIES (RCPD)

If you have accommodation with RCPD (<https://www.rcpd.msu.edu>), please email me your accommodation letter. Accommodation will not be provided without an RCPD letter.

EXAMS

There will be a midterm examination (**100 points**) on October 21, 2026. The exam will consist of T/F and multiple-choice questions as well as fill-in-the-blank and written response questions. Makeup exams are only allowed in cases where a physician's excuse is presented. If an exam is missed due to a family funeral, a newspaper obituary (with the date of the newspaper issue clearly shown), or other emergencies, the student must be presented to the instructor within **four** class days of the missed exam. In all cases the make-up must be done prior to the regularly scheduled exam. If the student cannot take the make-up exam early, it will be dropped, and the remaining exams will be weighted appropriately.

QUIZZES

Four short, 15-point quizzes (total **60 points**) will be administered throughout the term. Quizzes will consist of T/F and multiple-choice questions. Make-up quizzes will **NOT** be allowed. Since this class is small, we will do these in class.

CLASS ATTENDANCE

There is no university-wide regulation requiring class attendance. However, attendance is an essential and intrinsic element of the educational process. Each unexcused absence will result in a deduction of **2 points (except 8/31, 11/23)**, with a total of **50 points** allocated for attendance.

TERM PAPER & GROUP PRESENTATION

Each student will develop an **independent term paper**, due on **December 17, 2026**. The paper will be evaluated based on the quality of the written work (**100 points**). The term paper should align with the student's anticipated research focus and address a topic related to the **theory, methods, or impacts of global climate change**. Students are encouraged to discuss their proposed topics with the instructor during **Weeks 3–4** of the semester. Guidelines for the term paper and detailed assessment criteria will be provided and discussed in class.

A **group oral presentation (40 points)** will be given on **December 7** and evaluated by both the

instructor and fellow students. Each group of **three students** will give an **8-minute presentation**, followed by **2 minutes of Q&A**, summarizing the key lessons and insights gained from their individual term papers. All students will participate in evaluating the oral presentations of their peers.

GRADING

Points earned for each assessment will be posted on D2L in a timely manner. Final grades will be based on the total points earned out of a possible **350 points**, according to the breakdown and grading scale provided below. **Grades will not be rounded or curved.** Requests for an **Incomplete (I) grade** will be considered in accordance with the guidance provided in MSU's *Academic Programs*. Extra credit is **not** offered in GEO 409. Except under extreme circumstances, students must earn a minimum of **60% of the total available points (210 out of 250 points)** to pass the course.

- Midterm Exam: 100 points
- Term Paper: 100 points
- Quizzes: 60 points
- Presentation: 40 points
- Attendance: 50 points
- **Total: 350 points**

Detailed Schedule *(Subject to Adjustment as the Course Progresses)*

Date	Topic	File
8/31/2026*	Introduction • Goals, guest lectures, term paper, grading, scheduling, etc. • Brainstorm connections—why this course? • Terminology: weather, climate, WMO, NOAA, NASA, USGS, etc. • Term paper	PDF
9/2/2026	Global climate changes • More terminology & Unit • Unit and conversions Global Climate Change: A few facts • How is global climate change quantified? • Temperature anomalies & spatial variability • NASA video : https://www.youtube.com/watch?v=bk6mCWfVtbw	PDF
9/9/2026	Physical Foundations for Global Climatic Changes • Physical Laws • Radiative processes • Energy balance of the Earth	PDF
9/14/2026	Greenhouse Effects on Global Climate & Change • What is greenhouse effect? • Major Greenhouse Gases (GHG)	PDF
9/16/2026	Albedo Effects on Earth's Climate: Warming and Cooling (Dr. C. Lei) • Albedo of terrestrial ecosystems • Land use and albedo	PDF

	Albedo measurements; GWP	
9/21/2026	Quiz 1; Feedback from Students for Improvement Guidelines for term papers and presentations Major Consequences of Climate Change - I - Sea Level Rise - Severe Storms - Changing Currents - Shrinking Ice Cover (polar bears) - Videos: NASA OCO-2; Sea Level Rising; the Shrinking Aral Sea (https://www.youtube.com/watch?v=UZwLTJroLpE)	PDF
9/23/2026	Major Consequences of Climate Change - II - Bleaching Effect (loss of coral reef) - Hotter Sands - WTO Lead Centre for Annual-to-Decadal Climate Prediction (https://hadleyserver.metoffice.gov.uk/wmolc/)	PDF
9/28/2026	Southern Oscillation (ENSO) El Niño, La Niña and Neutral Phases	PDF
9/30/2026	Other Climate Extremes - Drought, heatwaves, Dzuds, etc. - Limited knowledge	PDF
10/5/2026	Quiz 2 Carbon Removal and Sequestration -- I	PDF
10/7/2026	Carbon Removal and Sequestration -- II	PDF
10/12/2026	Urban Heat Islands (UHI) - Causes and Consequences - Green vs Gray Cities	PDF
10/14/2026	TBD (sole flexible slot)	PDF
10/19/2026	Phenological Changes and Climate (Dr. G. Henebry)	PDF
10/21/2026	Midterm Exam	PDF
10/28/2026	Ecosystem Modeling for Wildlife (M. Steiner) - Zoonotic diseases - Invasive species - Why is it vital for the entire planet, including humans - Why do we model anything? Action must follow. Wildlife conservation is essential but not high on the agenda in capitalistic societies	PDF
11/2/2026	Climate, Ecosystems and People Lessons from Mongolian Plateau	PDF
11/4/2026	Climate Change, Food/Water Security	PDF
11/9/2026	Quiz 3 Term Paper & Group Presentation (synthesis) - Scientific Writing: Key points for a quality manuscript - Tips for Making an Effective Presentation	PDF
11/11/2026	Paleoclimate Reconstructions (Dr. N. Moore)	PDF

	• Ice core, tree rings, Isotopic analysis • USGS Paleoclimate Proxies, https://www.usgs.gov/programs/ecosystems-land-change-science-program/science/paleoclimate-proxies • Paleoclimatology Introduction, https://earthobservatory.nasa.gov/features/Paleoclimatology	
11/16/2026	Earth's Near-Future Climate • Alternative scenarios • Spatial variations	PDF
11/18/2026	Earth System Modeling – ESM (Dr. A. Jain -- zoom); Quiz 4	PDF
11/23/2026*	Group Discussion and Team Presentation (Self-arranged)	PDF
11/25/2026	IPCC Reports, Policies, and Management	PDF
11/30/2026	Adaptation and Mitigation Actions • Societal needs and Differences • Tradeoffs • Contextualization • Climate-and Nature-Based Solutions	PDF
12/2/2026	Visualizing global Climate and Changes (w/ Mrs. Carrie Wicker) @ MSU Museum Group presentations (10 min each; 6 groups)	PDF
12/9/2026*	Group meeting & discussion w/ Dr. J Chen (zoom)	
12/17/2026	Individual term papers are due by 5:00 pm	

* Attendance is encouraged, but optional.