

GEOG 191: Natural Climate Solutions

Instructor: Yue Li (yli@geog.ucla.edu)

Teaching Assistant: TBA

Class Schedule: LECTURE Wed and Fri

Course Website: <https://bruinlearn.ucla.edu/courses/184858>

Office Hours: TBA

Location: TBA

Time: 12:30pm – 1:45pm, PST

Course Description

To tackle the climate crisis, how many solutions do we have in addition to ending fossil fuels? This course provides a learning opportunity of solutions that aim to use multiple nature-based approaches to remove carbon dioxide from the air through reductions in carbon emission and increases in carbon uptake from ecosystem protection, management, and restoration. The first five weeks will focus on natural ecosystems that contribute to carbon dioxide emissions and sequestration, with highlights on the complexity of terrestrial ecosystem interactions with climate. For the remainder of the course, we will go through the socio-economy, socio-environmental system, and policy dimensions that are associated with natural climate solutions. Students will be able to gain a deeper understanding of the socio-economic trade-offs and co-benefits of natural climate solutions and their implications for human society.

Students will attend the twice-weekly lectures, including one mid-term discussion and the final project presentations. For each lecture, there will be one or two in-class quizzes that facilitate students to actively discuss. An inclusive and respectful learning environment will be promoted. There will be weekly quizzes and four short assignments for students to carry out independently. Students will also collaborate and present for the mid-term discussion and final project.

Student Learning Objectives

After taking this class, you will:

- (1) have a fundamental understanding of what natural climate solutions are, why understanding the uncertainty of terrestrial ecosystem in absorbing carbon dioxide is important, and what the societal implications of natural climate solutions are.
- (2) gain reading and writing skills through course assignments, learn how to collaborate and present by working together towards a final course project.
- (3) be able to learn and use a wide array of natural climate solutions toolboxes that have been developed to support decision making.

Prerequisites

There is no prerequisite for this course.

Textbook

There is no textbook for this course. Course contents will be based on two lectures each week.

Grading and Assignments

In this course, you will be asked to complete a number of small assignments, including 8 weekly quizzes, 4 short assignments, a mid-term discussion paper reading, and a final project. Specific assignments and their weights to your final grade are listed below.

First, each week you will complete a quiz on Canvas. The quizzes consist of a series of selection questions, which reflect the lecture contents each week. Each of the quizzes should never take you more than 10-15 minutes to complete. There are **eight** quizzes in total but only five of your highest scores will be counted toward the final grade. In other words, you're allowed to miss three quizzes without it impacting your grade. Or, if you take them all, your lowest three scores will be automatically dropped. **Each of these quizzes is worth 3% of your grade, 15% in total.**

Second, there will be four short assignments from which you will learn reading and writing skills. A typical assignment is a response paper (1 page single-spaced) to a piece of reading materials. The reading materials depend on the lecture contents and the newest advances of the course topic. **Each of these short assignments will be worth 5% of your grade, 20% in total.**

Third, this course needs your attendance, preparation, and involvement. Course slides will be provided on the course website, but these slides would only be helpful and useful if you actively engage in class attendance. I can be flexible, and students are allowed to miss two classes for any reason—you will not need to inform me or the TA. We understand that everyone can have an emergency. Except for the mid-term and two final project classes, there will be a remainder of 15 classes. **Each of them counts for 1% of your grade, 15% in total.**

To complete the mid-term discussion, students will be asked to read a recent research article and write a response paper (1 page single-spaced). Alternatively, students volunteering to lead a 15-min discussion in class are exempt from writing the response paper. During Week 6, the second class would be a mixture of students' presentations and instructor's lecture, with a focus on the research paper being assigned for the mid-term. **This counts for 20% of your grade.**

Finally, students will work together with some of their classmates to finish a group project. Detailed checkpoints will be released as the class is going. During Week 10, all groups will present to the class. The entire grade does not completely depend on final presentation since teamwork is highlighted by this course. For example, two group meetings discussing and working on your final project may weigh a substantial portion of your final grade. **All checkpoints and the final presentation weight 30% of your final grade.**

Grading Scale:

A+	95.0 – 100%
A	90.0 – 94.9%
A-	88.0 – 89.9%
B+	85.0 – 88.9%
B	82.0 – 84.9%
B-	80.0 – 81.9%
C+	75.0 – 79.9%
C	72.0 – 74.9%
C-	70.0 – 71.9%
D+	65.0 – 69.9%
D	62.0 – 64.9%
D-	60.0 – 61.9%

Course Policies

- (1) *Attendance and Participation Policy:* Class presence is necessary as most content will be delivered verbally and class discussions are keys to success for this course. But anyone can have emergency in life, so students are allowed to miss two classes for any reason—you will not need to inform me or the TA. As described in the grading and assignments above, 15% of your grade depends on class attendance. Attending mid-term discussions and the final project presentation during Week 10 are necessary. If students can't attend either one of them, they need to contact the instructor or the TA. Absences from the mid-term and final week will be treated case by case.
- (2) *Academic Honesty Policy:* Students are not permitted to copy others' answers, assignments, projects, or any other work for their own sake. If you're unclear about specific behaviors, – don't take chances, don't just take your well-intentioned friend's advice – ASK your TA or your Professor. Remember, getting caught cheating affects more than just your GPA. Please check specific explanations for academic dishonesty behaviors like cheating, plagiarism, multiple submissions, facilitating academic dishonesty, and fabrication at <https://deanofstudents.ucla.edu/file/4b995724-f033-476a-bccc-f6103528d959>.
- (3) *General Course Expectation:* This course aims to improve students' capability to have a big picture of this emerging subject—natural climate solutions. Quantitative tasks will be reduced to the minimum, but writing, critical thinking, class involvement, and presenting skills are highlighted, especially for an upper-division undergraduate course. Students could benefit from this course from a Geography perspective to improve their global scope of climate change and natural ecosystems, and their connections to human society.
- (4) *Late Assignments:* In general, this course does not allow late submission of assignments or quizzes. However, due to unexpected situations (e.g., family emergencies), you need to notify me or the TA to let us know what happens.

Course topics

More topics will be updated after the course starts

- (1) Definition, Concept, Objectives
 - a. Definition of Natural Climate Solutions
 - b. Carbon sink
 - c. Carbon source
- (2) Fossil Fuel Emissions
 - a. Atmospheric CO₂ concentration
 - b. Energy sectors
 - c. Carbon-climate relationship (TCRE, carbon-climate feedback)
- (3) Land use Emissions
 - a. Deforestation
 - b. Agricultural
 - c. Fire emissions
 - d. Geographical Distribution
- (4) Carbon sink
 - a. Climate & CO₂ drivers of carbon sink
 - b. Geographical Distribution
- (5) Trade-off & Co-benefits (ecosystem function)
 - a. Biodiversity
 - b. Climate co-benefits
 - c. Benefits for public health
 - d. Trade-off for water
- (6) Ocean & Coastal Carbon sink
 - a. Coastal carbon sink
 - b. Ocean carbon sink estimation
- (7) Global Carbon Budget
 - a. Land
 - b. Ocean
 - c. Potentially weak carbon sink
- (8) Carbon and Socio-economic/Socio-environmental System
 - a. Economy trade-off of decarbonization
 - b. Co-benefits of decarbonization with public health
 - c. Carbon and local community
- (9) Carbon neutral & future decarbonization
 - a. Future Californian socio-economy scenarios
 - b. SSP scenarios
 - c. Net zero emissions

Course Schedule

Week 1

Lecture 1 Introduction to Natural Climate Solutions (NCS): Course introduction and why we should care. NCS's relationship to natural ecosystems, society, and climate change.

Lecture 2 Carbon Emissions and Carbon Sinks: Why is carbon central to proposing NCS? Why is atmospheric CO₂ measurement our only observation? What is the current global carbon budget? What are the major components?

Assignment #1: Writing assignment, guidelines, prompt, and submission deadline (1 week)

Week 2

Lecture 3 Fossil Fuel Emissions: How do we estimate fossil fuel emissions? What are the main components of energy infrastructure for fossils? What is the relationship between carbon emission and climate change (TCRE)?

Lecture 4 Land Use Emissions: What is deforestation, and how does it go nowadays? How do agricultural demands drive deforestation? What are the climate consequences of deforestation? How does fire contribute to land use emissions?

Assignment #2: Writing assignment, guidelines, prompt, and submission deadline (1 week)

Week 3

Lecture 5 Global Vegetation Response to Climate Change: Why does land surface carbon sink have large uncertainties? What are the main measurement approaches (inversion, process-based model)? What do we see from global greening? What are the main drivers, and why does this have implications for global carbon sink?

Lecture 6 Global Vegetation Response II: Geography distribution of vegetation response to environmental factors in boreal: temperature driven, interactions with Arctic warming and fires; temperate: human forest management, history and what we have learned; tropics: nutrient limitation and drought impacts on carbon.

Assignment #3: Reading assignment, guidelines, prompt, and submission deadline (1 week)

Week 4

Lecture 7 Vegetation Feedback to Climate and Carbon: What is the causality of vegetation-climate relationship? What are the biophysical climate effects of vegetation dynamics? The basic mechanism of carbon, water, and energy exchange.

Lecture 8 Vegetation Feedback II: How is this feedback to climate geographically distributed? Boreal: positive warming feedback via albedo; Temperate: complex interaction, trade-off with hydrological cycle; Tropics: strong coupling with rainfall.

Announcement of Mid-Term Paper Reading & Discussion Guidelines and Formats.

Week 5

Lecture 9 Ocean Carbon Sink: What is the role of ocean biogeochemistry? What is blue carbon? How do we estimate the ocean's carbon sink? What is the trend of the recent ocean carbon sink?

Lecture 10 Coastal Ecosystems Carbon Exchange: Why does coast ecosystem matter for natural climate solutions? What is the geography of coastal ecosystem carbon storage?

Week 6

Lecture 11 NbCS: Protection, Management, and Restoration: Do we have any other option for Carbon Dioxide Removal (CDR) techniques or initiatives? Why is STOP THE FOSSIL not the only solution?

Mid-Term Discussion

Week 7

Lecture 12 Trade-off of Decarbonization: How much of our GDP will change if we speed up decarbonization? How much of our agricultural products rely on land use/deforestation? Can we rely on non-photosynthesis products?

Lecture 13 Cascading, Tipping of Our Natural and Societal System: Why do we still need to perform NCS Policy (biodiversity, continued climate warming impacts on Amazonia Forest die off and potential tipping)? Compound climate hazards are a lack of understanding, potentially causing cascading impacts that increase the difficulty of adaptation.

Assignment #4: Video assignment, guidelines, prompt, and submission deadline (1 week)

Announcement of Final Project Presentation, Guidelines, Prompt, and Format

Week 8

Lecture 14 NCS and Societal Public Health: What are the consequences of climate extreme on Society. Aerosol emissions from carbon. What are the co-benefits of NCS and decarbonization on public health in terms of heatwaves and wildfires?

Lecture 15 NCS and Indigenous/Local Community: Land tenure impacts on deforestation in Brazil); Local Community, UCLA Carbon Neutrality, and Environmental Justice

Week 9

Lecture 16 Agriculture, Grassland and Peatland: Food Demand, Population change and geography, livestock, and challenges from ecosystems other than forests.

Lecture 17 Net Zero Emission in the Future, Carbon Neutral, Policy: COP28, main findings and what we have learned and what we will do. Future shared socio-economic scenarios. How possible will the carbon market become a failure?

Week 10

Final Project Presentation

Campus Resources

- (1) Center for Accessible Education (<https://cae.ucla.edu/>). The mission of the Center for Accessible Education (CAE) is to create an accessible, inclusive, and supportive learning environment. Students need accommodation can register for accommodations and support from CAE by filling out an application and begin the accommodation process on the website. Questions can be reached out to CAE via caeintake@saonet.ucla.edu.
- (2) Title IX Office/Sexual Harassment Prevention (<https://sexualharassment.ucla.edu/>). Title IX prohibitive conduct includes Sexual Harassment, Sexual Violence, Relationship Violence, Stalking, Gender discrimination, Gender identity discrimination, Gender Expression discrimination, Sexual Orientation discrimination, Pregnancy discrimination, Retaliation, Indecent Exposure, Statutory rape, Invasion of Sexual Privacy, and Failure to Comply with an Order. How to Report? <https://sexualharassment.ucla.edu/filing-a-report>.
- (3) LGBTQ Campus Resource Center (<https://lgbtq.ucla.edu/>). The center provides a comprehensive range of education and advocacy services supporting intersectional identity development as well as fostering unity, wellness, and an open, safe, and inclusive environment for UCLA's LGBTQ community.
- (4) Counseling and Psychological Services (<https://counseling.ucla.edu/>). Your mental health matters! To make an appointment with CAPS, you need to speak with a Triage Clinician over the phone following steps as described in <https://counseling.ucla.edu/services/make-an-appointment>.
- (5) Supportive Services for Students. UCLA's Student Affairs Guidebook gathers key resources for students (<https://www.studentaffairs.ucla.edu/guidebook>). Students can always consult the Student Care Managers program website for information about supportive services, including information about confidential one-on-one consultation: <http://www.studentincrisis.ucla.edu/Who-can-Help>.
- (6) UCLA Equity, Diversity & Inclusion Campus Resources: <https://equity.ucla.edu/campus-resources/>.

Land Acknowledgement

As a class event physically hosted at UCLA, we respectfully acknowledge our presence on the traditional, ancestral, and unceded territory of the Gabrielino/Tongva peoples.

Equity, Diversity, Inclusion (DEI)

DEI is highly valued in this class. Following the classroom agreements that we set up together, all students, TA, and the instructor are important and equal partners in this education process regardless of racial/ethnic, cultural, gender, age, social class, caste and other kinds of human difference. We highlight the importance of inclusivity and respect for all students and their contributions. The course contents aim to explore a broad range of diverse contributions to the discipline.