

**GEOL 499: Sustainability Practicum-Visualizing Climate Change**

**Spring 2025, T/TH 1:00-2:50 pm**

**4 units**

**Location: ZHS 200**

**Instructor: Dr. Lowell Stott**, Professor, Earth Sciences

**Preferred Pronouns:** he/him

**Office:** ZHS 235

**Office Hours:** Tuesday, 10:00 am to 12:00 pm or by appointment

**Email:** [stott@usc.edu](mailto:stott@usc.edu)

**This class is intended for students in both Earth Sciences and Environmental Studies. Students from other majors are also welcome.**

**Goal and Objectives:** The course will give students hands on experience working with global environmental observations from published databases and model simulations that are being used by governments and public sector entities who are increasingly in need of employees with skills that enable critical evaluation and thinking about environmental and sustainability issues. Working in teams, students will gather, visualize and evaluate the climate data. Writing reports and giving presentations on your observations and your evaluations will be practiced. Biweekly written reports and oral presentations will be supported by your own data visualization and analyses. This is intended to build communication skills.

There are no prerequisites in math, chemistry and physics. Students will learn to use software-based tools for plotting and evaluating data. You will practice asking questions, posing hypotheses and testing hypotheses. Your peers will provide feedback.

As your instructor I will provide the training and guidance in the use of visualization tools and guide students in identifying and understanding patterns of variability and change (both temporally and spatially).

Students will read published papers that describe and discuss climate data.

A final research project conducted collaboratively in teams will entail a fully developed report on a chosen topic that was previously approved by the instructor. You can think of this as an assignment from your employer who is expecting a rigorous assessment and an accessible report that a non-specialist can read and understand.

**Course modality:** There is no textbook. I will provide background information about climate variables and their relevance to the assessment of climate variability and change on both spatial and temporal scales. You will be assigned readings that illustrate how climate variables are used for climate change assessments. This will include real-time observations, archived observations and paleo-observations (proxies that extend observations beyond the short instrumental period). I will provide in class instruction in the use of visualization tools. In class we will collaboratively discuss best practices for data visualization, evaluation and presentation.

### **Grading and evaluation.** 400pts total

1. 25% (100pts) Team Visualizations. Grade is based upon clarity and descriptions.
2. 25% (100pts) Team Reports and Presentations. Grade is based on clarity, description, ideas raised, and questions/ideas raised from your analysis.
3. 25% (100pts) Lab book. Grade is based on completeness, organization and utility to you and team members.
4. 25% (100pts) Final Research Project. Grade is based on thoughtfulness of questions raised, approach taken to answer the question(s) and quality and clarity of final report and presentation.

### **Classroom ground rules**

- Share responsibility for including all voices in a conversation
- Listen respectfully to your classmate's and your instructor's viewpoints
- Be open to changing your perspectives based on what you learn from others
- Understand that we are bound to make mistakes in this space
- Take group work during class and outside of lecture seriously
- Understand that your classmates may have different experiences from your own
- You will get to know your classmates
- Understand that there are different approaches to solving problems.
- Teamwork and collaboration are essential skills to develop

### **Class Schedule.**

#### **Week 1 (January 13) The Scientific Method**

Day 1. **Lecture.** Scientific Method. Observations, Questions, Hypotheses, Tests

- Examples

**Homework:** Watch video about using the **OSF digital Notebook**

<https://youtu.be/dLElhJESIQA>

Day 2. **In Class Assignment:** In teams of 2

Create and organize a digital Notebook for this class. Setup at <https://osf.io/>

Your digital notebook will contain 6 Components for “**visuals**,” “**data**,” “**observations**,” “**questions**,” “**ideas**,” “**reports**”.

**Week 2** (January 20 Holiday) **How would you describe Earth’s Climate today without any knowledge of the past?**

Day 1. **Lecture.** How do scientists make climate observations and collect data?

The Essential Climate Variables “**ECVs**” in a modern spatial perspective

Day 2 **Lecture.** Climate Forcings. What controls the mean state of the climate?

Greenhouse forcing, albedo, gravity, Coriolis, pressure gradient

- **Homework**, assigned reading

**Team Homework (assigned in class).** Find online visuals (map view) of a regional atmospheric ECVs (average value for January and August) in 2 Northern Hemisphere and 2 Southern Hemisphere countries). Upload visuals to your notebook “**visuals**” Component.

Record your observations in your notebook’s “**observations**” Component. Discuss with teammate your observations including magnitude, spatial heterogeneity, and contrasts between countries and between hemispheres. Each observation is a short description (a few words or a few sentences).

- Create a **PowerPoint** presentation of your ECVs to share with the class. Each team will lead a discussion using your visuals and observations. These should be ~15 minutes. Write a **one-page summary report** of your team’s findings. Your report will be shared with the class. Post your report to your “**reports**” Component.

**Week 3** (February 3) **Skills needed to identify “important” climate observations.**

Day 1. In Class **PowerPoint** presentations of ECVs with class discussion.

Describe Earth’s climate. What stands out?

Day 2. **In class assignment**, Access Zoom Earth Realtime Observations

[zoom.earth.com](https://zoom.earth.com)

Identify regional phenomena in real time. Note relationships between **winds** (speed and direction) and other key ECVs (pressure, precipitation, temperatures). Post your observations and ideas and questions to your “**observations**” and “**ideas**” Component. Post any questions you have to your “**questions**” Component.

**Note: This is a skill building exercise that we will work on together as a class. However, you are expected to build your digital notebook.**

#### **Week 4 (February 10) How to find, access and plot ECVs in 2 dimensions (space and/or time).**

Day 1. **In class instruction.** Accessing Station Data (Realtime and Archived) (Data File Formats)

<https://www.ncdc.noaa.gov/cdo-web/datatools>

- **Team Homework.** In teams, choose an ECV. Load your ECV data into an Excel or Google Sheets file. Save your chosen data files into your “**data**” Component. Plot a timeseries of your ECV. Put your timeseries plots in your “**observations**” Component. Create a PowerPoint presentation to share with classmates. Put your PowerPoint file in your “**reports**” Component.

Day 2. Accessing and visualizing global gridded ECVs Online (Realtime and Archived) (Data File Formats)

<https://www.ncei.noaa.gov/access/monitoring/ghcn-gridded-products/animation/map-blended-mntp/189508-202407>

<https://www.ncei.noaa.gov/products/climate-monitoring>

#### **Week 5 Skills needed to evaluate data in timeseries. What is change and what is variability?**

Day 1. In Class **PowerPoint** presentations of Zoom Earth observations, questions, ideas for class discussion.

Day 2. Further analysis of your timeseries. Trend analysis of time series. Changing means, Calculating anomalies.

#### **Week 6 (February 17 Holiday) What constitutes a Climate Anomaly?**

Day 1. **Instruction and in class assignment.** Calculating and plotting climate anomalies from your ECV files

- **Homework.** Reading assignment about climate anomalies, controversies and realities.

Day 2. Install [Panoply \(NASA\)](#) and produce map-view plots of gridded data

- **Team Homework.** Use Panoply to make a regional map of ECVs from a gridded data set. Post your map to your “**observations**” Component. Post your notes to the “Ideas” Component.

Week 7 (February 24) **netcdf data files. 2D and 3D visualizations.**

Day 1 **In class exercises** using Panoply to produce additional visualizations.

- **Team Homework.** Use Panoply to make plots of ECVs. Analyze your plots. Write a team report and prepare a **PowerPoint** presentation for class.
- **Homework.** Reading, **The theory of Global Warming.**

Day 2 **In class hypothesis development.** We’ll discuss what we’ve learned thus far after 7 weeks. You’ll use that knowledge to pose questions and then formulate hypotheses that you will test.

- **Team Homework.** Outline a question you wish to ask. Outline your strategies (data to use, plotting to use, analysis to use) for testing your hypothesis. Develop a bullet-point chart for presentation using PowerPoint that shows the steps you intend to take to gather, plot and analyze information that can be used to test your hypothesis. This can be refined as we progress.
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Week 8 (February 31) **A little bit of coding for visualization and analysis**

Day 1. **In Class PowerPoint** presentations of Panoply plots with class discussion

Day 2. **In class** Download and Install **Matlab.** Basics of Matlab coding

Week 9 (March 3) **Gaining additional skills**

Day 1 **In class** practice with Matlab. **Homework.** Use the Matlab code that I provide to make a regional map with site locations.

Day 2. **In class** discussion and modification of codes to refine your regional map.

Week 10 (March 10) **Gaining additional skills**

Day 1 **In class instruction.** Matlab plotting data spatially

<https://www.ncdc.noaa.gov/cdo-web/>

Day 2 **In class** Plotting atmospheric variables in time series using Matlab

**-Homework.** Teams plot and analyze a time series variable. Prepare a PowerPoint presentation to share with classmates. Post your presentation to the “**reports**” Component.

Week 11 (March 17 Spring Break) No Classes

Week 12 (March 24) **Visualizing Ocean ECVs**

Day 1. **In class presentations** of your Matlab plots with class discussion

Day 2. **Install** Ocean Data View <https://odv.awi.de/>

- A. Ocean Observations- [GLODAP](#)
- B. World Ocean [Database](#).

Week 13 (March 31) **Ocean Observations using Ocean DataView**

Day 1. **In class skill building.** Plotting Ocean ECVs, The GLODAP database

Day 2. **In class plotting** World Ocean data.

- **Homework.** Teams produce transect plots (one from each ocean) of ocean ECV. Describe your observations and post these to your “observations” Component. Make notes of your observations and post them to your “notes” Component. Prepare a PowerPoint presentation to share with your classmates.

Week 14 (April 7) **Pre-Instrumental Records “Proxies”**

Day 1. **In class presentation and discussion** of ocean ECVs and transects.

- Homework, write a report of our in-class discussion and conclusions about the **ocean** ECVs and post this to your “**reports**” Component.

Day 2. **Lecture.** Paleoclimate/Paleo -ocean proxies and observations.

Week 15 (April 14) **Pre-Instrumental Records “Proxies”**

Day 1. **Install** and use **PaleoDataView**

- **Team Homework.** The Antarctic Ice Core CO<sub>2</sub> and temperature data. Use a visualization tool to plot the proxy data. Post your plots to the “observations” Component. And write a short report that describes your proxy. Post your questions and/or ideas to your Components.

Day 2. In class discussion of pre-historic observations relative to modern

Week 16 (April 21 Easter Monday) **Model Simulations**

Day 1. **Lecture.** Climate Models, Present day

Day 2. **In class** Climate Models, Future simulations (CMIP) Future Scenarios.

- **Team Homework.** Teams will be assigned a CMIP simulation (scenario) and will analyze the results to identify how, where, when climate ECVs change under each scenario. Your team will produce a written report on your analysis that includes illustrative figures. You will also prepare a PowerPoint presentation of your findings to share with the class.

Week 17 (April 28 Last Week of Classes)

Day 1. **In class presentations.** Model results and class discussion.

Day 2. Outline your research topic for the class

Final Project and Final presentation. Your team will present your research findings and post a final report to your notebook that all students in the class can access.

## Statement on Academic Conduct and Support Systems Academic integrity

Academic dishonesty is far-reaching and is considered a serious offense against the university. All incidences of academic misconduct will be reported to the Office of Academic Integrity and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university. For details, see [the student handbook](#) or the [Office of Academic Integrity's website](#), and university policies on [Research and Scholarship Misconduct](#).

## Students and Disability Accommodations

USC welcomes students with disabilities into all of the University's educational programs. [The Office of Student Accessibility Services](#) (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at [osas.usc.edu](https://osas.usc.edu). You may contact OSAS at (213) 740-0776 or via email at [osasfrontdesk@usc.edu](mailto:osasfrontdesk@usc.edu).

## Student Financial Aid and Satisfactory Academic Progress

To be eligible for certain kinds of financial aid, students are required to maintain Satisfactory Academic Progress (SAP) toward their degree objectives. Visit the [Financial Aid Office webpage](#) for [undergraduate](#)- and [graduate-level](#) SAP eligibility requirements and the appeals process.

## Support Systems

[Counseling and Mental Health](#) - (213) 740-9355 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

[988 Suicide and Crisis Lifeline](#) - 988 for both calls and text messages – 24/7 on call

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States.



The Lifeline consists of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

[Relationship and Sexual Violence Prevention Services \(RSVP\)](#) - (213) 740-9355(WELL) – 24/7 on call Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

[Office for Equity, Equal Opportunity, and Title IX \(EEO-TIX\)](#) - (213) 740-5086

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

[Reporting Incidents of Bias or Harassment](#) - (213) 740-2500

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

[USC Campus Support and Intervention](#) - (213) 740-0411

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

[Diversity, Equity and Inclusion](#) - (213) 740-2101

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

[USC Emergency](#) - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

[USC Department of Public Safety](#) - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7  
*on call* Non-emergency assistance or information.

[Office of the Ombuds](#) - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

A safe and confidential place to share your USC-related issues with a University  
Ombuds who will work with you to explore options or paths to manage your concern.

[Occupational Therapy Faculty Practice](#) - (323) 442-2850 or [otfp@med.usc.edu](mailto:otfp@med.usc.edu)

Confidential Lifestyle Redesign services for USC students to support health promoting  
habits and routines that enhance quality of life and academic performance.