

OCEA90: Fundamentals of Climate

July 25–August 26
Monday and Wednesday, 9am–12:30pm
PBSci 114
Summer Session, 2022

Instructor: Dr. Jonathan Izett (he/him)

Land Acknowledgement

The land on which we gather is the unceded territory of the Awaswas-speaking Uypi Tribe. The Amah Mutsun Tribal Band, comprised of the descendants of indigenous people taken to missions Santa Cruz and San Juan Bautista during Spanish colonization of the Central Coast, is today working hard to restore traditional stewardship practices on these lands and heal from historical trauma.

The land acknowledgement used at UC Santa Cruz was developed in partnership with the Amah Mutsun Tribal Band Chairman and the Amah Mutsun Relearning Program at the UCSC Arboretum.

Overview

The climate of the Earth is undeniably changing. In this course we will explore how interactions between the atmosphere, ocean, cryosphere, biosphere and land surface shape the very nature of the Earth’s climate. The course will comprise five modules that introduce important ideas and concepts about the circulation of the atmosphere and ocean (week 1), atmospheric teleconnection patterns (week 2), the El-Niño Southern Oscillation (week 3), the Pacific Decadal Oscillation and other low frequency modes of natural climate variations (week 4), and greenhouse gas emissions and global warming (week 5). The analysis of climate is inherently statistical in nature—that is, there is no “control experiment” on which we can base the interpretation of Earth observations, so by necessity we are forced to view climate in terms of probabilities. Therefore, in addition to learning about how the climate system works, this course will explore some of the statistical methods that underpin much of what is known about how climate is changing. This class satisfies the Statistical Reasoning (SR) General Education requirement.

The general goals of this course are to:

1. Develop a basic understanding of climate
2. Learn to distinguish natural variations from anthropogenic changes
3. Apply statistical concepts and methods such as correlation and linear regression to analyze climate observations

This course was originally designed by Prof. Andrew Moore, and was subsequently adapted by Dr. Claudie Beaulieu as an online course. The material covered is largely based on their work.

Lectures: Monday and Wednesday, 9am–12:30pm

Room: PBSci 114

Method of Instruction: In Person

Duration: 5 Weeks; July 25–August 26

Course Schedule

The approximate outline of the course is as follows. Please note, however, that some specifics may change as we proceed through the material. I hope that we will be able to get through quickly enough to allow a review session in the final lecture (i.e., shifting the end of Module 5 to Mon Aug. 22). Any updates to readings or other material covered will be posted on Canvas and shared in lecture.

Module #1: Atmospheric Circulation and the Basics of Probability and Statistics

Mon. Jul. 25 Random numbers, probability, Earth's atmosphere, radiation, intro. to R, atmospheric
Wed. Jul. 27 pressure, forces, geostrophic balance
Fri. Jul. 29 **Assignment 1 Due - 5 pm**

Module #2: North American Teleconnection Patterns

Mon. Aug. 1 Solar radiation, heat capacity, teleconnections, the Pacific north American Pattern, the
Wed. Aug. 3 North Atlantic Oscillation
Fri. Aug. 5 **Assignment 2 Due - 5 pm**

Module #3: The El Niño Southern Oscillation

Mon. Aug. 8 Ocean circulation, correlation, ENSO - impacts and forecasting
Wed. Aug. 10
Fri. Aug. 12 **Assignment 3 Due**

Module #4: Climate Variability

Mon. Aug. 15 Covariance, principal component analysis, more teleconnections.
Wed. Aug. 17
Fri. Aug. 19 **Assignment 4 Due - 5 pm**

Module #5: Climate Change

Mon. Aug. 22 Linear regression, hypothesis testing, the greenhouse effect, clouds and
Wed. Aug. 24 feedbacks, detection and attribution of climate change.
Wed. Aug. 24 **Final Exam Becomes Available**
Fri. Aug. 26 **All Materials Due - 11:59 pm**

Important Administrative Dates

July 25 Session 2 Begins
July 28 Last Day to Add Classes
July 29 Deadline to Apply for Graduation (No Fee)
August 1 Drop Deadline (Tuition Reversed)
August 14 Request "W" Grade (No Tuition Reversal)
August 21 Change Grade Option
August 26 End of Session 2 **All Assignments Due by 11:59 pm**
Deadline to Apply for Graduation (w Fee)
Deadline to complete all requirements for degree
September 1 Summer Session Grades Due

Instructor Information

Instructor: Dr. Jonathan Izett (he/him)

E-mail: jizett@ucsc.edu

Office: A147, Earth and Marine Sciences Building

Office Hours: MTWTh, 2–3 pm (In Person or Zoom)
F 2–3 pm (Zoom only)

Please also feel free to schedule a separate appointment with me.

Communication: Aside from coming to my office hours, the best way to reach me is via e-mail. Please send any emails with “OCEA90” in the subject to help me identify them better. I will do my best to respond as quickly as possible within the hours of 8–5 pm M–F. If I have not replied to you within 2 working days, please follow up.

Bio: I am a postdoctoral scholar working with Prof. Chris Edwards in the Ocean Sciences Department. I grew up in Canada and have a background in earth and ocean sciences (BSc Physics and Ocean Sciences; MSc Oceanography; PhD Atmospheric Science). My current research focuses on using computer simulations to model the coastal ocean and the interaction between physical (e.g., currents, temperature) and biogeochemical (e.g., phytoplankton growth) processes. My favourite part about climate science is its multi-disciplinary nature.

Reader: Julia Baer

Bio: I am a PhD student working with Dr. Raphe Kudela in the Ocean Sciences Department. In my home state of Maryland, I completed a B.S. in Biology and Chemistry. I study factors that influence the molecular dynamics of harmful algal blooms to determine how things like coastal pollution and climate change might impact these toxic events. I’m excited to assist in this class because understanding and communicating climate science is so important for anyone seeking to make an impact on the future of climate change

Required Materials, Textbooks & Technology

Course readings will come from “Introduction to Climate Science” by Andreas Schmitter. This is a free, open textbook available at <https://open.oregonstate.education/climatechange/>. It encourages you to download the PDF on your computer.

Some of the assignments are based on the open source statistical software package R (<http://www.r-project.org/>), which is a free software environment for statistical computing and graphics. You can download it here: <https://ftp.osuosl.org/pub/cran/>. R is also available on all Mac and Win/PC Labs on campus if you don’t have a laptop/desktop or are unable to install it on your machine. For more detailed instructions on installing/accessing R see the ‘Installing R’ page in Module 1 in Canvas.

All additional materials needed for this course are presented online through the course Canvas website. Lecture slides will be posted on the afternoon following a given lecture (so that I can compile all of the slides that were actually used in class and any additional notes that may be generated during the lecture).

Assessment

The following shows the breakdown of grades for this course.

Attendance	5%
Quizzes	15% or 0%
Assignments	50%
Final Exam	30% or 45%

Attendance

Attendance will contribute 5% to your overall grade. This does not mean you must be physically present for each lecture; I understand that things may come up and that it will not always be possible for you to be present. Instead, points will be awarded for either attending each of the 10 lectures in person, or actively reaching out to arrange for a hybrid option (e.g., live stream over Zoom or to obtain a recording of the lecture after the fact) whenever you cannot make a given class. The grade will be assigned as:

$$\text{Attendance} = \frac{\# \text{ Lectures Attended or Alternative Arranged}}{10} \times 5\%$$

Quizzes

Each module will be accompanied by a short online quiz (5 questions each) designed to help you review the material. Once started, you will have 10 minutes to complete the quiz. The quiz will become available on Canvas following the lecture in which the module is completed and due by 11:59 pm on August 26. Completing the quizzes before the end of the session will allow for you to receive feedback before the final exam. Each quiz will contribute 3% to your overall grade in the course (summing to 15% of the total grade). In the case that the final exam score is better than the average of all quizzes, then the quiz score will be replaced by that of the final exam.

Assignments

You will be asked to complete five assignments throughout the quarter. Each assignment will correspond to one of the five primary modules covered by the course and will each be worth 10% of the total grade (summing to 50% of the final grade for the course). Assignments will be released at 9 am each Monday and due by 5 pm on Friday of the week in which they were given. Assignments are to be submitted via Canvas, or email to Dr. Izett. I recommend you plan to spend between 2–3 hours to complete each assignment. If you find that it's consistently taking you longer than 3 hours to complete the assignments, come talk to me so that we can figure out why.

Final Exam

The final exam will be an open-book test in the form of a Canvas quiz. It will become available following the final lecture and can be completed any time that is convenient for you, though must be finished by 11:59 pm on August 26. You will have 90 minutes to complete the exam. Should you require additional time, please contact me before starting the exam. The final exam will count toward 30% of your total grade. Should you perform better on the final exam than the average of your quizzes, the quiz score will be replaced by the final exam, making it count for 45% of your grade.

Grading Policy

Please submit all course material by 11:59 pm on August 26. This will allow us to submit grades in a timely manner. I ask that contact me as early as possible if this deadline is unattainable so that we can work together to find a solution. This may include agreeing on an extension, or assigning an incomplete per UC Santa Cruz policy. Without alternative arrangements, any material not submitted by 11:59 pm on August 26 will be graded as 0.

The weekly deadlines for the assignments are provided in order to help you manage a balanced workload throughout the course and also allow time for feedback to be given in advance of the final exam. If the assignment is submitted on time, we will have it returned to you by Wednesday of the following week. Up to two weekly assignments are eligible for full credit if received within one week of the original deadline. Otherwise, the maximum possible score will decrease by 10% at 9am every Monday that the assignment is late. Please speak to me at any point if you are struggling to complete an assignment on time and we will work together to help find a strategy for success.

There may be events outside our control that arise during the term. I understand how difficult these times are. Should such an event arise, please contact me as soon as possible so that we can adjust any deadlines accordingly and work together to find a solution that will enable you to learn effectively and meet your goals in this course.

Student Feedback

Please feel free to give me feedback on the course, including where I need to spend more time on a given topic, if things are unclear, or even things that work well! You can always speak to me in person, or send me an email. To further facilitate feedback, I invite to submit questions and comments following lectures using this anonymous Google Form: <https://forms.gle/dna4AjKZH9AyvFCL6>. I will aim to then address topics in the following lecture and/or in a review scheduled during the final lecture.

At the end of the quarter you will be asked to complete a Student Experience of Teaching (SET) survey for this course. SETs provide an opportunity for you to give valuable feedback on your learning that is honest and constructive. This anonymous feedback will help me consider modifications to the course and my teaching style that will help future students learn more effectively.

Additional Information

COVID-19

For updated campus news and policies related to COVID-19, please refer to the SlugStrong website (<https://slugstrong.ucsc.edu/>).

What we can expect from each other:

Each individual at UC Santa Cruz should act in the best interests of everyone else in our community. Please take care to comply with all university guidelines about masking, performing daily symptom and badge checks, testing as required by the campus vaccine policy, self-isolating in the event of exposure, and respecting others' comfort with distancing. If you are ill or suspect you may have been exposed to someone who is ill, or if you have symptoms that are in any way similar to those of COVID-19, please err on the side of caution and stay home until you are well or have tested negative after an exposure. Let me know that you're not feeling well and I'll respond about how best you can keep learning. If you are uncomfortable with any of the protocols in place, please contact me so we can work together and find a solution.

Based on an anonymous pre-course survey, your peers have expressed they would feel most comfortable if masks are worn in the classroom. As such, I kindly ask that you wear a well-fitting (preferably N95) mask at all times when possible. I also ask that you wear a mask during in-person office hours. Masks can be obtained from several locations on campus, including the Bay Tree Bookstore, Science and Engineering Library, and several of the colleges. I will also try to have some with me for those who need one.

A compilation of COVID-19 FAQs can be found at: <https://healthcenter.ucsc.edu/services/covid-19/covid19-faq.html>

What you can expect from me:

I have designed our course following campus guidance and with current public health guidelines in mind. However, these guidelines may change in accordance with shifting infection rates or the emergence of new variants. If updated public health recommendations and university requirements make our current course format unfeasible, or if I experience a need to self-isolate, I will alter the format. This may include moving in-person sessions onto Zoom. I will communicate clearly with you via email or Canvas announcement about any changes that occur. I will provide as much advance warning as possible and give you all the information you need to transition smoothly to the new format. If you have questions about the changes, please reach out to me so that I can answer them.

Academic Integrity

All members of the UCSC community benefit from an environment of trust, honesty, fairness, respect, and responsibility. You are expected to present your own work and acknowledge the work of others in order to preserve the integrity of scholarship. Academic integrity includes: following exam rules, using only permitted materials during an exam, viewing exam materials only when permitted by your instructor, keeping what you know about an exam to yourself, incorporating proper citation of all sources of information, submitting your own original work

Academic misconduct includes, but is not limited to, the following: disclosing exam content during or after you have taken an exam, accessing exam materials without permission, copying/purchasing any material from another student, or from another source, that is submitted for grading as your own, plagiarism, including use of internet material without proper citation, using cell phones or other electronics to obtain outside information during an exam without explicit permission from the instructor, submitting your own work in one class that was completed for another class (self-plagiarism) without prior permission from the instructor.

Violations of the Academic Integrity policy can result in dismissal from the university and a permanent notation on a student's transcript. For the full policy and disciplinary procedures on academic dishonesty, students and instructors should refer to the Academic Misconduct page at the Division of Undergraduate Education.

Accessibility

UC Santa Cruz is committed to creating an academic environment that supports its diverse student body. If you are a student with a disability who requires accommodations to achieve equal access in this course, please affiliate with the DRC. I encourage all students to benefit from learning more about DRC services to contact DRC by phone at 831-459-2089 or by email at drc@ucsc.edu. For students already affiliated, make sure that you have requested Academic Access Letters, where you intend to use accommodations. You can also request to meet privately with me during my office hours or by appointment, as soon as possible. I would like us to discuss how we can implement your accommodations in this course to ensure your access and full engagement in this course.

Intellectual Property

The materials in this course are the intellectual property of their creators. As a student, you have access to many of the materials in the course for the purpose of learning, engaging with your peers in the course, completing assignments, and so on. You have a moral and legal obligation to respect the rights of others by only using course materials for purposes associated with the course. For instance, you are not permitted to share, upload, stream, sell, republish, share the login information for, or otherwise disseminate any of the course materials, such as: video and audio files, assignment prompts, slides, notes, syllabus, simulations, datasets, discussion threads. Conversely, any materials created solely by you (for example, your videos, essays, images, audio files, annotations, notes) are your intellectual property and you may use them as you wish.

Religious Accommodation

UC Santa Cruz welcomes diversity of religious beliefs and practices, recognizing the contributions differing experiences and viewpoints can bring to the community. There may be times when an academic requirement conflicts with religious observances and practices. If that happens, students may request the reasonable accommodation for religious practices. The instructor will review the situation in an effort to provide a reasonable accommodation without penalty. You should first discuss the conflict and your requested accommodation with your instructor early in the term. You or your instructor may also seek assistance from the Dean of Students office.

Principles of Community

The University of California, Santa Cruz expressly prohibits students from engaging in conduct constituting unlawful discrimination, harassment or bias. I am committed to providing an atmosphere for learning that respects diversity and supports inclusivity. We need to work together to build this community of learning. I ask all members of this class to:

- be open to and interested in the views of others consider the possibility that your views may change over the course of the term
- be aware that this course asks you to reconsider some “common sense” notions you may hold
- honor the unique life experiences of your colleagues
- appreciate the opportunity that we have to learn from each other
- listen to each other’s opinions and communicate in a respectful manner
- keep confidential discussions that the community has of a personal (or professional) nature
- ground your comments in the texts we are studying.

Title IX/Care Advisory

UC Santa Cruz is committed to providing a safe learning environment that is free of all forms of gender discrimination and sexual harassment, which are explicitly prohibited under Title IX. If you have experienced any form of sexual harassment, sexual assault, domestic violence, dating violence, or stalking, know that you are not alone. The Title IX Office, the Campus Advocacy, Resources & Education (CARE) office, and Counseling & Psychological Services (CAPS) are all resources that you can rely on for support.

Please be aware that if you tell me about a situation involving Title IX misconduct, I am required to share this information with the Title IX Coordinator. This reporting responsibility also applies to course TAs and tutors (as well to all UCSC employees who are not designated as “confidential” employees, which is a special designation granted to counselors and CARE advocates). Although I have to make that notification, you will control how your case will be handled, including whether or not you wish to pursue a formal complaint. The goal is to make sure that you are aware of the range of options available to you and that you have access to the resources you need.

Confidential resources are available through CARE. Confidentiality means CARE advocates will not share any information with Title IX, the police, parents, or anyone else without explicit permission. CARE advocates are trained to support you in understanding your rights and options, accessing health and counseling services, providing academic and housing accommodations, helping with legal protective orders, and more. You can contact CARE at (831) 502-2273 or care@ucsc.edu.

In addition to CARE, these resources are available to you: If you need help figuring out what resources you or someone else might need, visit the Sexual Violence Prevention & Response (SAFE) website, which provides information and resources for different situations. Counseling & Psychological Services (CAPS) can provide confidential counseling support. Call them at (831) 459-2628. You can also report gender discrimination and sexual harassment and violence directly to the University’s Title IX Office, by calling (831) 459-2462 or by using their online reporting tool. Reports to law enforcement can be made to the UC Police Department, (831) 459-2231 ext. 1. For emergencies, call 911.

Difficult Conversations

Climate change can be a difficult topic to discuss. The history of earth science, and equity issues related to unequal impacts of climate change will also present challenges. In our in-class and online discussions and dialogues, we will have some opportunity to explore challenging, high-stakes issues and increase our understanding of different perspectives. Our conversations may not always be easy. We sometimes will make mistakes in our speaking and our listening. Sometimes we will need patience or courage or imagination or any number of qualities in combination to engage our texts, our classmates, and our own ideas and experiences. We will always need respect for others. Thus, an important aim of our classroom interactions will be for us to increase our facility with difficult conversations that arise inside issues of social justice, politics, economics, morality, religion, and other issues where reasonable people often hold diverse perspectives. This effort will ultimately deepen our understanding and allow us to make the most of being in a community with people of many backgrounds, experiences, and positions.

Report an Incident of Hate or Bias

The University of California, Santa Cruz is committed to maintaining an objective, civil, diverse and supportive community, free of coercion, bias, hate, intimidation, dehumanization or exploitation. The Hate/Bias Response Team is a group of administrators who support and guide students seeking assistance in determining how to handle a bias incident involving another student, a staff member, or a faculty member. To report an incident of hate or bias, please use the following form: Hate/Bias Report Form.

Student Services

Counseling and Psychological Services

Many students at UCSC face personal challenges or have psychological needs that may interfere with their academic progress, social development, or emotional wellbeing. The university offers a variety of confidential

services to help you through difficult times, including individual and group counseling, crisis intervention, consultations, online chats, and mental health screenings. These services are provided by staff who welcome all students and embrace a philosophy respectful of clients' cultural and religious backgrounds, and sensitive to differences in race, ability, gender identity and sexual orientation.

Student Success and Engagement Hub

The Division of Student Success provides campus-wide coordination and leadership for student success programs and activities across departments, divisions, the colleges, and administrative units.

Tutoring and Learning Support

At Learning Support Services (LSS), undergraduate students build a strong foundation for success and cultivate a sense of belonging in our Community of Learners. LSS partners with faculty and staff to advance educational equity by designing inclusive learning environments in Modified Supplemental Instruction, Small Group Tutoring, and Writing Support. When students fully engage in our programs, they gain transformative experiences that empower them at the university and beyond.

Slug Support Program

College can be a challenging time for students and during times of stress it is not always easy to find the help you need. Slug Support can give help with everything from basic needs (housing, food, or financial insecurity) to getting the technology you need during remote instruction. To get started with SLUG Support, please contact the Dean of Students Office at 831-459-4446 or you may send us an email at deanofstudents@ucsc.edu.

Slug Help/Technology

The ITS Support Center is your single point of contact for all issues, problems or questions related to technology services and computing at UC Santa Cruz. To get technological help, simply email help@ucsc.edu.

On-Campus Emergency Contacts

For all other help and support, including the health center and emergency services, Click here to go to UCSC's Emergency Services page. Always dial 9-1-1 in the case of an emergency.