Applied Environmental Time Series Analysis (ESCI167/OCEA267)

Course website: https://canvas.ucsc.edu/courses/53325

Instructor: Claudie Beaulieu (she/her), E&MS A443, clbeauli@ucsc.edu
Lectures: M/W 09:00-10:35AM E&MS D236
Office Hours: M 10.40-11.40AM (A443), W 1-2PM (Zoom)

Teaching assistant: JB Novak (he/him), jobnovak@ucsc.edu
Discussion: TBD
Office Hours: TBD

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."*

LEARNING STATEMENT

Your success in this class is important to me. We all learn differently and we may all be impacted differently in these times of uncertainty. If there are aspects of this course that prevent you from learning or exclude you, please let me know as soon as possible. Together we can develop strategies to meet both your needs and the requirements of the course.

THE COURSE

Description: This course takes an empirical approach to quantify and explain changes in the Earth system over time. You will learn how to analyze time-series data and answer questions about environmental change and variability. You will acquire the theoretical basis of the statistical approaches, experience at interpreting and discussing the results and debating your method choice. As such, you will gain a critical understanding of the underlying assumptions and limitations of the methods discussed. This class will be hands-on and utilizes a suite of observational datasets and outputs from Earth system models.

Prerequisite(s): Students are expected to be familiar with R, Matlab or Python and to have some statistics background. Examples of OS and EPS classes fulfilling this requirement are (but not limited to) ESCI160, EART225, OCEA/EART260. Please contact the instructor before enrolling if you are unsure.

Learning outcomes:
1. Apply a range of graphical and statistical tools to summarize, visualize and decompose an environmental time series
2. Test and quantify long-term environmental trends and their uncertainty
3. Select and fit time series models to produce forecasts
4. Select and fit extreme value distributions

5. Discuss and present the results of statistical analysis of an environmental time series problem
6. Critically evaluate and debate statistical applications for environmental time series analysis

LOGISTICS

This class is in-person.

What you can expect from us: The course is designed 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, in case of weather-prohibiting situations, or if we experience illness or need to self-isolate, we will alter the format. This includes moving in-person sessions onto Zoom. Also, we reserve the right to move select classes online if web-based modalities are deemed more desirable for delivering content, as long as the expectations and timing are communicated to students in advance. We will communicate clearly with you via Canvas announcement about any changes that occur. If you have questions about the changes, please reach out to me so we can answer them.

What we expect from you: If you experience an illness or exposure that requires you to miss class sessions, please communicate with us as soon as possible. We will provide links to recordings of class sessions so you can continue making progress in the class.

Masking: As of April 10th, the mask mandate will be released indoors on campus. For a variety of reasons, some people in our community remain particularly vulnerable to or apprehensive about COVID transmission. Out of courtesy for them, I will be wearing a mask in class. I would urge you all to consider doing the same.

I will be offering both in-person and remote office hours this quarter. I ask that you wear a mask when meeting with me in person. If you prefer to meet without a mask, please come to my remote office hours.

Communication: We welcome questions/concerns/comments in five ways:

1. During the Monday/Wednesday lectures;
2. During discussion sections;
3. During office hours;
4. On Ed Discussion. There is a Q&A Forum within the Canvas course, especially catered to get help from classmates, the TAs and the professor. You should use it for both administrative/logistic questions, as well as for clarifying concepts covered in lectures. We suggest that you post your questions as public messages, because many students might have a similar question;
5. Canvas message. If you wanna talk to us about something private or ask a question in private, you can send us a message on Canvas. On the left side, click “Inbox,” then on top, click “Compose a new message.”

Please do NOT post solutions and answers to assignments (in whole or in part) on Ed Discussion/Discord, ever, for any reason. It is, however, acceptable and encouraged to discuss homework ideas in general terms. If you do post solutions, this can be considered a violation of the UCSC academic integrity policy and may lead to consequences as outlined by that policy:

https://registrar.ucsc.edu/navigator/section1/academicintegrity.

Withdrawal: By May 6th. Other key dates for registration and enrolment can be found here: https://registrar.ucsc.edu/soc/key-dates-enrollment.html

COURSE MATERIAL

All materials needed for this course are presented online through the course Canvas website. You need access to a laptop/desktop computer with R installed (graduate students may instead use Python/Matlab). Note that programming instructions and example codes will be given in R only.

TOPICS

Week 1: Exploratory methods. Time Series Decomposition. Smoothing.
Week 2: Least square linear regression and assumptions. Trend detection. Transformations. Theorem central limit.
Week 3: Autocorrelation and partial autocorrelation functions. Stochastic trends. Autoregressive (AR) models. Moving-average (MA) models. Model selection. Box Jenkins method.
Week 4: Forecasting with ARMA models. Causality
Week 5: Nonparametric trends. Nonlinear trends. Changepoints.
Week 6: Generalized least squares.
Week 7: Block-maxima. Extreme value theorem. Fitting extreme distributions.
Week 8: Return periods. Trends in extremes.
Week 9: Frequency domain. Fourier transforms. Periodogram.
Week 10: Project presentations.

ASSESSMENTS & GRADING

Problem sets: There will be six problem sets that together count for 60% of your final grade. Each problem set typically contains some data analysis plots, calculations and interpretation. Copy of the code generated to answer questions will have to be submitted as part of the problem set.

Final project: A final project on a given problem/dataset will count towards 40% of your final grade. Students will come up with their own project (to be approved the instructor) and will conduct data analysis and write a short paper. Students will also conduct a peer-review of a colleagues' paper.

Schedule of assessments:	Due (11.59 pm)
PS1	April 13th
PS2	April 20th
PS3	April 27th
PS4	May 4th
PS5	May 11th

Final project dataset	May 13th
PS6	May 18th
Final paper 1st draft	May 27th (OCEA267)
Peer-review	June 1st (OCEA267)
Final paper responses	June 3rd (OCEA267)
Final paper	June 3rd (ESCI167)

Group work: I strongly encourage you to work in groups in this class, as students can achieve deeper learning through talking with other students. While group work is strongly encouraged, you must turn in your own work using your own words and your own code. Copying someone else's words/code is not allowed and can lead to serious consequences. Please see the following for a description of the UCSC Academic Integrity policy: https://registrar.ucsc.edu/navigator/section1/academicintegrity. I trust you to be honest and turn in your own work that reflects your own understanding.

Grading scale:
As: 100-90%
Bs: 90-75%
Cs: 75-60%
Ds: 60-50%
F: <50%

Late Work: Problem sets are due a week after handed out. Final project papers are due as listed above. Of course, medical emergencies and traumatic events may happen. If you contact me within 24h and provide documentation, I will be happy to give you an extension.

Instructor feedback: We will provide direct comments and feedback on your problem sets. Please click here to learn how to access my comments in Canvas. For major assignments, we will include a grading rubric that will be available to you prior to submitting your work. Please click here to learn how to access grading rubrics for assignments.

Student feedback: We will solicit feedback from you about the course content/delivery on a regular basis via problem sets and via forms. At the end of the quarter you will be asked to complete a Student Experience of Teaching 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 that will help future students learn more effectively.

Student hours for class: This is a 5-credits course, which requires approximately 15-hours of work per week. This includes 3 hours of lectures, 3 hours of reading, 1 hour section and 8 hours of homeworks (exercises, problem sets, projects) per week, approximately.

Tips for success:
1- Showing up: class and discussion sections attendance and participation
2- Planning ahead: Start the weekly problem set BEFORE discussion section, so that you can get help where needed early on
3- Collaborating: I guarantee you that you will achieve deeper learning by discussing with your peers
4- Providing feedback: I will ask you for feedback weekly at the end of each problem sets. If some concepts were less well understood, I will make adjustments to lectures to revisit these concepts.

5- Asking questions: I encourage you to ask questions as soon as you get confused. Because each week's material is built on the previous ones, it is important not to drag concepts less well understood.

Disclaimer: This syllabus is intended to provide guidance on topics to be covered in the class, and I will follow as closely as possible. However, I reserve the right to modify, supplement and make changes as needed if I judge it will benefit your learning.

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. 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.

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: videos, assignment prompts, slides, notes, syllabus, simulations, datasets, discussion threads. Conversely, any materials created solely by you (for example, final project) are your intellectual property and you may use them as you wish.

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, you have the right to have these met. Please submit your Accommodation Authorization Letter from the Disability Resource Center (DRC) to me by email, preferably within the first two weeks of the quarter. I would also like us to discuss ways we can ensure your full participation in the course. I encourage all students who may benefit from learning more about DRC services to contact DRC by phone at 831-459-2089 or by email at drc@ucsc.edu.

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.

ALL-GENDER RESTROOMS

UC Santa Cruz is committed to the well-being of all students and cares about all students feeling safe and welcome, regardless of their gender identity, expression, and/or embodiment. The Lionel Cantú Queer Center has worked with students and campus staff to create more safe and accessible restrooms for transgender and genderqueer students, staff, faculty, alumni, and UCSC visitors. A complete list of all-gender restrooms on campus was compiled and is maintained by the Cantú Queer Center.

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.

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

Slug Support: https://deanofstudents.ucsc.edu/slug-support/program/
If you are facing financial challenges, food and housing insecurity, or other concerns, and you are not sure how to find the resources you need.

Basic Needs: https://basicneeds.ucsc.edu
If you are experiencing challenges related to basic needs, such as food, housing, health & wellness, or financial security, visit the Basic Needs hub for information about food pantries, accessible housing, mental health support, and financial aid options

Student Success: https://studentsuccess.ucsc.edu/resource-centers/index.html
UC Santa Cruz has a variety of resources to support your overall success at UC Santa Cruz, ensure accessible living and learning environments, help you when you're experiencing personal or academic challenges, and support you in building community.

CAPS (Counseling and Psychological Services): https://caps.ucsc.edu/
If you are in distress, managing heightened stress and anxiety, or want to get more support and a counselor's perspective on something you're going through, CAPS provides a variety of services for your needs—including immediate crisis support, scheduled individual appointments, group counseling, and workshops led by peer advisors.

Resource Centers: https://resourcecenters.ucsc.edu/index.html
UCSC Resource Centers offer counter-spaces for students who are queer, trans, nonbinary, womxn, and people of color, as well as impact institutional policies and campus climate. The Resource Centers engage the broader campus on issues and challenges facing our communities, and provide programs, physical spaces, and services to foster student's academic, personal, and professional growth, through community-based leadership development.

Slug HelpTechnology: https://its.ucsc.edu/index.html
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: https://www.ucsc.edu/help/
For all other help and support, including the health center and emergency services, start here.
Always dial 9-1-1 in the case of an emergency.