UNIVERSITY OF CALIFORNIA SAN DIEGO

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Course Syllabus

SIOC 293: Ocean and Atmosphere Processes and Climate [4 units]
Instructor: Yassir Eddebbar

Quarter: Winter Session, 2020
Time: MW 4:00-5:20 pm, Discussion Th 4:00-5:00 pm
Location: Munk Room (IGPP 303)

Final Exam: Friday Mar 20, 3:00-6:00 pm
Office Hours: Th 2:00-4:00 pm, MESOM 367
E-mail: yeddebba@ucsd.edu

"The maxima of the sea temperature in the eastern and central equatorial Pacific occur as a result of anomalous weakening of the trade winds of the Southern Hemisphere with inherent weakening of the equatorial upwelling. These anomalies are shown to be closely tied to the "Southern Oscillation" of Sir Gilbert Walker." **-** J. Bjerknes

1. Course Overview & Goals

In his 1969 seminal paper on *"Atmospheric Teleconnections From the Equatorial Pacific"*, Bjerknes highlighted a critical aspect of the climate system: the coupling between the ocean and atmosphere. This coupling is integral to most observed variations in weather and climate from daily to millennial timescales. The atmospheric winds drive most of the observed circulation of the upper ocean year around. In turn, the meridional overturning circulation of the ocean exerts a major control on atmospheric carbon and climate on decadal to centennial timescales. Anthropogenic forcing effects on climate are amplified and diminished by ocean and atmospheric feedbacks, some of which have yet to be fully understood and accurately modeled. In this course, we will explore these topics and more, focusing on the following thematic questions:

1) What is the general structure and circulation of the ocean and atmosphere? How do ocean-atmosphere physical and biogeochemical processes influence climate on various timescales?
2) What mechanisms govern El Niño Southern Oscillation (ENSO) and modes of climate variability at high latitudes? What processes drive climate changes on longer timescales?
3) How do ocean and atmospheric processes and feedbacks modulate the climate impacts of anthropogenic greenhouse gases? How are these processes simulated in state-of-the-art climate models?

Each week, we will review an element of the climate system in lectures and reading material from textbooks and review papers as well as discussions of advances in the field from recently published work. Instead of midterms, we will develop familiarity with progress on climate change science through a quarter-long project based on IPCC AR5 documents and in-depth reading of the scientific literature. Through weekly readings, lectures, discussions, in-class presentations, and quarter project assignments, we will:

1) Gain a deeper process understanding of how the coupled ocean-atmosphere-climate system works;
2) Develop multidisciplinary thinking and approaches to understand climate phenomena;
3) Learn to communicate clearly and effectively on climate-related topics in written and spoken forms.

2. Reading (available on course website weekly): Success in this course depends critically on reading, including:

1) **Textbook chapters**: Neelin textbook is required. PDFs of chapters from other textbooks will be provided:
   1) "Climate Change and Climate Modeling", D. Neelin (Print only).
   2) "Descriptive Physical Oceanography", L. Talley et al. 6th Edition. PDFs will be provided.
   3) "Global Physical Climatology", D. Hartmann, (1st Edition PDF; 2nd edition in print only).
2) **Review Papers**: Reviews are excellent resources to gain a general background and catch up on advances.
3) **Short Science Paper:** ~ 1-2 papers per week will be assigned for discussion and presentation by students.

3. Quiz: A 5 min quiz based on reading assignments will be given at 4:00 pm sharp, at the beginning of every class.

4. **Science Paper Presentations:** Each student will conduct a presentation (once/quarter) on a recently published scientific paper during the last 15 minutes of class. Everyone is expected to read and discuss the paper. We will cover instructions on giving a science paper talk during the first week.

5. **Participation:** Participation is a major component of your grade. With such diverse academic and personal backgrounds, your questions and comments are integral to the course. Don't be shy and join the discussion.

6. **The IPCC Project:** Instead of midterms, we will conduct a 3-parts quarter "IPCC Project". This will give you the opportunity to dive into a science topic of your choice and explore the scientific literature in support of your topic review. The quarter project consists of 3 graded milestones with guided instructions to be discussed in class.

7. **Final Exam:** A cumulative final exam will take place on **Friday March 20, 3:00 pm**, and will test you on accumulated knowledge and understanding of material covered throughout the course, including lectures, paper discussions, and readings.

8. **Grading:**
   1. 15% Participation (10% lectures and paper discussion + 5% attendance);
   2. 20% Reading Quizzes;
   3. 5% Paper presentation
   4. 30% Comprehensive Final Exam;
   5. 30% IPCC Project [100%=Proposal 15%, Science Review35%, Science Update 35%, Presentation 15%].

9. **Format & Rules:**
   1. **Class consists of:** i) ~ 5 min reading quiz, ii) ~ 45-60 min lecture and discussion, and a iii) ~ 15-20 min paper presentation and discussion.
   2. **Discussion** will be conducted throughout lecture. All students should be ready to discuss the reading.
   3. **Lecture slides and reading** will be made available on course website for each respective week.
   4. **Class attendance** is recorded through quiz participation. The course builds on cumulative knowledge from lectures and discussions. Skipping class will drastically impact your progress and grade.
   5. **Late assignments** are not accepted. Please plan ahead of deadlines accordingly.
   6. The class will be conducted in an environment of **mutual respect, inclusion, and integrity**. Please avoid disruptions (e.g. chatter, texting/cellphone use, arriving late, leaving early, skipping class, etc.) that directly affect everyone's progress in the class.
   7. **Phone usage** is highly distracting to everyone, and is thus not tolerated in class. If you have an emergency or phone related issue, please inform me ahead of time.
   8. **Deadlines** for adding, dropping, or changing grade types and other class related matters can be found on the UCSD website: https://blink.ucsd.edu/instructors/courses/enrollment/calendars/2019.html

10. **Academic Integrity:** Academic integrity stands for principles of honesty, originality, and self reliance in every aspect of academic life. Student are expected to follow UCSD policy on academic integrity, including, but not limited to: "*No student shall complete examination or assignment for another person; or knowingly allow any examination or assignment to be completed for himself or herself by another person; plagiarize or copy the work of another person and submit it as his or her own work; use aids excluded by the instructor in undertaking course work or in completing any exam or assignment; alter graded class assignments or examinations and then resubmit them for regrading; submit substantially the same material in more than one course without prior authorization.*" as outlined by the UCSD Policy on Integrity of Scholarship, found here http://senate.ucsd.edu/Operating-Procedures/Senate-Manual/Appendices/2. Non-compliance with UCSD academic integrity policy and other misconduct will lead to disciplinary action. All submitted material will be screened for plagiarism on **turnitin.com** and are thus subject to their terms of agreement.

Course Schedule*		
Wk	**Date**	**Topics**
1	M: Jan 6	Course Overview: Ocean-Atmosphere Processes & Climate
	W: Jan 8	Paleoclimate: Earth History & Ice Age Theories
2	M: Jan 13	Atmospheric Composition and Structure
	W: Jan 15	Atmospheric Circulation & Climate
3	*M: Jan 20*	***MLK Holiday***
	W: Jan 22	Ocean Circulation & Climate: The Wind Driven Circulation **IPCC Project Proposal Part I Due Thursday Jan 23, 11:59 pm 11:59 pm PST**
4	*M: Jan 27*	Ocean Circulation & Climate: The Thermohaline Component
	W: Jan 29	Ocean-Atmosphere Interactions & Climate Across Time & Space
5	*M: Feb 3*	ENSO: Observations, Mechanisms, and Predictions
	W: Feb 6	ENSO: Teleconnections, Impacts, and Projections
6	M: Feb 10	Climate Variability Beyond ENSO: Decadal Variability and Climate Modes at High Latitudes
	W: Feb 12	The Crysophere & Climate: Polar Amplification and Ice/Ocean/Atmosphere Interactions
7	*M: Feb 17*	***President's Day***
	W: Feb 19	The Hydrological Cycle & Climate: Cloud-climate feedbacks, Extremes Events, and Attribution **IPCC Project Part II Due Thursday February 20, 11:59 pm PST**
8	M: Feb 24	Sea Level and Climate: Observations, Drivers, Projections, & Uncertainties **Guest speaker: Mark Merrifield**
	W: Feb 26	Ocean Biogeochemical Cycles and Climate: Carbon, Oxygen and Productivity
9	*M: Mar 2*	Modeling the Climate System I: Model Structure, Advances, and Parameterizations
	W: Mar 4	Modeling the Climate System II: Model Projections, Biases, & Limitations
10	M: Mar 9	Geoengineering & Climate: Proposals & Consequences **Final IPCC Project Part III Due Monday Mar 9, 11:59 pm PST**
	W: Mar 11	**IPCC Project Presentations**
	Th: Mar 12	**IPCC Project Presentations**
	F: Mar 20	**Finals 3:00-6:00 pm**

* Schedule, assignment due dates and readings are subject to change upon course instructor's notice