ATS 743 Interactions of the Ocean and Atmosphere – Fall 2023

Instructors
Eric Maloney Eric.Maloney@colostate.edu 125 ATS West
Office Hours: Email me to arrange a time.

Maria Rugenstein Maria.Rugenstein@colostate.edu 407 ATS Main
Office Hours: preferably right after class
* Please direct questions about the class (auditing, credits, homework, missing classes) at Maria.

Web
Class webpage is available on Canvas. Class notes, homework instruction, and discussion papers will be posted there.

Class Schedule
Class meets in 212B ACRC 1from 10 a.m.-11:15 a.m. Monday and Wednesday.

Format
The format of the class will be around 2/3 lectures and 1/3 paper discussions of both classical and very recent papers.

Student Learning Goals and Objectives
The successful student will gain a graduate level process-oriented understanding of the coupled ocean-atmosphere physical climate system, including the mean state, ENSO, decadal variability, and climate change.

Textbooks
No textbook will be required. Lectures and discussion will be drawn from published research papers and other sources.

Grading:
Participation in class discussion: 18%
Homework in week 2: 16%
Leading one and participating in paper discussions: 33%
Final Project: 33%

Homework in week 2: Part 1 You will recap/read-up on Ekman transport in response to a wind stress from given notes, as well some applications of Ekman transport. *Part 2* You will answer the following questions: How does your research involve ocean-atmosphere interactions? What are the most relevant open questions about ocean-atmosphere interactions around your broader research subject? You will have 2 slides and 5min in class to present the answers. The goal is to get to know each other and potentially make the rest of the class more geared toward your questions.

Paper Discussion: Each student will be required to lead one 50-minute discussion of a journal article. Papers (and with that the given week) will be assigned during the first week of class. The papers to be discussed are listed below. All other students are required to read the paper in depth, participate fully in the discussion, and ask at least one question per paper.

Final Project; due December 15: The class will cover a large range of subjects, and for some this implies we cannot go into the depth you or we would like to. At the end of a subject, we will lay-out issues we *could not cover but might be of interest to you*. You will pick one of these issues and develop *your own class segment* on that subject. That class segment will be 20-30min and you will submit a deck of slides and a recording of the class (both will be part of the grading). Since your fellow students might be also interested in the subject, you may use Monday 12/11 and Wednesday 12/13 to actually teach your 20-30min segment in-person (and record it). If you're attending AGU (as Eric and Maria will do) you can just submit a recording. The idea of the project is motivated by the saying "You only fully understand something once you taught it."

Covid/absence:
Please stay at home if you're sick and also if you're in doubt about having been in contact with sick people or if you don't feel comfortable in the classroom (in the latter case let us know).
If you are sick, please let us know and we will accommodate you with access to course materials.

Statement on Academic Integrity:
This course will adhere to the CSU Academic Integrity Policy as found in the General Catalog (http://catalog.colostate.edu/general-catalog/policies/students-responsibilities/#academic-integrity) and the Student Conduct Code (https://resolutioncenter.colostate.edu/conduct-code/). At a minimum, violations will result in a grading penalty in this course and a report to the Conflict Resolution Services and Student Conduct Services.

CSU Atmospheric Science promotes inclusive community:
CSU Atmospheric Science is a leading global institution, and as such, all members of our community regardless of race, ethnicity, culture, religion, sexual orientation, gender identity and expression, physical ability, age, socioeconomic status or nationality are welcome as equal contributors. We value and appreciate diversity, and we believe that diversity on our campus strengthens our entire scientific community.

Course Outline:

Date	W	Monday	Wednesday
08/21-08/27	1	Coupled circulations in the time mean	Coupled circulations in the time mean
08/28-09/03	2	Homework discussion	Coupled circulations in the time mean
09/04-09/10	3	Labor Day, no class	*Paper discussion coupled circulation.*
09/11-09/17	4	Ocean heat uptake in a forced climate	*Paper discussion ocean heat uptake*
09/18-09/24	5	The pattern effect	*Paper discussion pattern effect*
09/25-10/01	6	Madden-Julian Oscillation	Forcing of the ocean by the MJO
10/02-10/08	7	El Nino-Southern Oscillation	El Nino-Southern Oscillation
10/09-10/15	8	El Nino-Southern Oscillation	*Paper discussion ENSO*
10/16-10/22	9	El Nino-Southern Oscillation	ENSO Teleconnections/Atmospheric Bridges
10/23-10/29	10	ENSO Teleconnections/Atmospheric Bridges	*Paper discussion ENSO Teleconnections*
10/30-11/05	11	Teleconnections of the extra-tropics into the Tropics	*Paper discussion extra-tropical teleconnections into the tropics*
11/06-11/12	12	Mid-Latitude Ocean-Atmosphere Interactions	Mid-Latitude Ocean-Atmosphere Interactions
11/13-11/19	13	Buffer /probably on ENSO	*Paper discussion ENSO*
11/20-11/26	14	Fall break, no class	Fall break, no class
11/27-12/03	15	Pacific Decadal Oscillation	*Paper discussion on PDO*
12/04-12/10	16	Internal Variability of ocean heat uptake/hiatus	*Paper discussion hiatus*
12/11-12/17	17	Finals/AGU/ student-led class/recording	Finals/AGU/ student-led class/recording

Paper discussions

Week 3:
Bjerknes, J., 1966: A possible response of the atmospheric Hadley circulation to equatorial anomalies of ocean temperature. *Tellus,* **18**, 820–829.
Bjerknes, J., 1969: Atmospheric teleconnections from the equatorial Pacific. *Monthly Weather Review*, **97**, 163–172.

Week 4:
Armour et al. 2016: Southern Ocean warming delayed by circumpolar upwelling and equatorward transport. Nature Geoscience, https://www.nature.com/articles/ngeo2731

Week 5:
Dong et al. 2019: Attributing Historical and Future Evolution of Radiative Feedbacks to Regional Warming Patterns using a Green's Function Approach: The Preeminence of the Western Pacific. Journal of Climate, https://journals.ametsoc.org/view/journals/clim/32/17/jcli-d-18-0843.1.xml.

Week 8:
Meinen and McPhaden, 2000: Observations of warm water volume changes in the equatorial Pacific and their relationship to El Niño and La Niña. *J. Climate*, **13**, 3551–3559.

Week 10:
Alexander et al., 2002: The atmospheric bridge: The influence ENSO teleconnections on air-sea interaction over the global oceans. J. Climate, 15, 2205-2231. https://journals.ametsoc.org/view/journals/clim/15/16/1520-0442_2002_015_2205_tabtio_2.0.co_2.xml

Week 11:
Kang et al. 2023: Global impact of recent Southern Ocean cooling. PNAS, https://www.pnas.org/doi/10.1073/pnas.2300881120

Week 13:
buffer/ENSO paper; e.g., Battisti et al. 2019: 100 Years of Progress in Understanding the Dynamics of Coupled Atmosphere-Ocean Variability. https://journals.ametsoc.org/view/journals/amsm/59/1/amsmonographs-d-18-0025.1.xml

Week 15: Wills et al, 2019: Ocean Circulation Signatures of North Pacific Decadal Variability. GRL, https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2018GL080716

Week 16:
Hedemann et al. 2017: On the subtle origins of surface-warming hiatuses. Nature Climate Change, https://www.nature.com/articles/nclimate3274

Further Background Reading

Papers:
Tba

Texts:
Gill, A. E., 1982: *Atmosphere-Ocean Dynamics*, Academic Press, 662pp.
Vallis, G. K., 2006. *Atmospheric and Oceanic Fluid Dynamics*. Cambridge University Press, 745 pp.