ATS 610 Physical Oceanography

Department of Atmospheric Science
10:00-11:15 AM Tuesday and Thursday, 2024 Fall Term

Instructor Contact Information

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Office hours: By appointment

Course Description

This course tries to answer two basic questions: why does the ocean flow as it does, and how does it interact with the other Earth system components. We start with a quick tour of what we see in direct observations of the ocean. Then the characteristics of seawater are discussed, followed by a review of the equations of motion. Emphasis will be on potential vorticity and the important Taylor-Proudman theorem. This is followed by discussions of the wind-driven circulation and Ekman dynamics, stratification and the ventilated thermocline, waves, dynamic stability, mixed-layer dynamics and the dynamics of ocean eddies.

After this general description we dive into the different parts of the ocean, focusing on equatorial dynamics, the polar oceans and sea-ice, interocean exchanges and the global ocean circulation. On top of this we will discuss one or two subjects that the students bring up, e.g. role of the ocean in the carbon budget, marine biology and biogeochemistry, oceans on other planets.

Since this is a graduate level course the emphasis is strongly on understanding and less so on derivations. Discussions are the central element of the course, facilitated by questions from teacher and students, student presentations, past and recent papers that either were the first to present important new ideas or contain in-depth discussions.

Course goals

Students who complete this course successfully will be able to:
- describe and explain the origin of the present-day ocean circulation,
- have a critical understanding of the role of the ocean in the weather and climate system,
- critically evaluate the literature on this subject

Course materials

Detailed lecture notes will be available on Canvas in due course. The instructor does not use a specific textbook. The following textbooks provide basic and advanced material that relate to the course:
Henk A. Dijkstra (2008) Dynamical Oceanography, Springer
Joseph Pedlosky (1996) Ocean Circulation Theory, Springer.

Grading

The grading will be based on a small number of extended assignments, including running a simplified ocean model to study basic ocean circulation, student presentations and participation in discussions.

Overall structure

The following subjects will be covered:

1) What does the ocean look like: characteristics of seawater and present-day ocean circulation
2) In-situ ocean observations
3) Governing equations: potential vorticity, Kelvin's Theorem, Tayor-Proudman theorem
4) Wind-driven circulation, Ekman dynamics, Sverdrup Balance and western intensification
5) Ocean stratification and the ventilated thermocline
6) Barotropic and baroclinic waves and ocean eddies
7) Stability of ocean flows
8) Mixed-layer dynamics
9) Ocean satellite remote sensing
10) Equatorial Circulation and ENSO
11) Polar Oceans and sea-ice dynamics
12) Interocean circulations
13) Global Circulation
14) Paleooceanography

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Statement on Academic Integrity

This course will adhere to the CSU Academic Integrity Policy as found in the General Catalog (http://www.catalog.colostate.e and the Student Conduct Code (http://www.conflictresolution.colostate.edu/conduct-code). At a minimum, violations will result in a grading penalty in this course and a report to the Office of Conflict Resolution and Student Conduct Services.

COVID information for students

Masks are required inside university buildings. You must also meet university vaccine or exemption requirements. All students are expected and required to report to the COVID Reporter (https://covid.colostate.edu/reporter/) when:

- You suspect you have symptoms of COVID, regardless of whether or not you are vaccinated and even if your symptoms are mild
- You have tested positive for COVID through a non-CSU testing site, such as home test or test at a pharmacy
- You believe you may have been exposed to COVID go to the COVID Reporter and follow the guidance under "I believe I have been in close contact with someone who has COVID-19." This guidance will depend upon your individual circumstances

You will not be penalized in any way for reporting symptoms or concerns.

Do not ask me as your instructor to report for you. It is your responsibility to report through the COVID Reporter promptly. As your instructor I may not ask you about vaccination status or if you have COVID but you may freely volunteer to send me information from a public health official if you have been asked to isolate or quarantine.

When you complete the COVID Reporter, the CSU Public Health office is notified. Once notified, that office will contact you and, depending upon each situation, will conduct contact tracing, initiate any necessary public health requirements and notify you if you need to take any steps. If you do not have internet access to fill out the online COVID-19 Reporter, please call (970) 491-4600.

For the latest information about the University's COVID resources and information, including FAQs about the spring semester, please visit the CSU COVID-19 site https://covid.colostate.edu/.

Disclaimer

The instructor reserves the right to make modifications to this information throughout the semester.