SIOC 212A (Winter 2019)

Geophysical Fluid Dynamics I

Instructor: Ian Eisenman, (office) Nierenberg Hall 223, (email) eisenman@ucsd.edu, (phone) 858-534-3907.

Lectures and assignments *(evolving)*

Lecture schedule:

- Tue 1/08: Basic equations [relevant textbook sections: Vallis (V) chapter 1, Cushman-Roisin & Beckers (C) chapters 1 & 3]
- Thu 1/10: Geoid, coriolis force (V 2.1-2.3, C 2.1-2.5)
- Tue 1/15: Inertial oscillations (V 2.3, C 2.3)
- Thu 1/17: Momentum equation scaling, hydrostatic approximation (V 2.7, C 4.3)
- Tue 1/22: *No class (instructor on travel)*
- Thu 1/24: Shallow water equations (V 3.1, C 7.1-7.3)
- **Mon** 1/28 *(make-up class at 3:00-4:20 in NH 101)*: Geostrophic adjustment (V 3.8, C 15.2)
- Tue 1/29: Potential vorticity (V 3.6.1, C 7.4)
- Thu 1/31: Scaling and balances in shallow water equations, non-rotating adjustment
- Tue 2/05: Boussinesq approximation, stratification, thermal wind (V 2.4 & 2.8.4, C 3.7 & 15.1)
- Thu 2/07: Eddy viscosity (C 4.1-4.2)
- Tue 2/12: Ekman spirals (V 5.7, C 8.3)
- Thu 2/14: Ekman transport (C 8.6)
- Tue 2/19: *No class (instructor on travel)*
- Thu 2/21: Ekman pumping, Sverdrup transport (V 19.1, C 8.4 & 20.1-20.2)
- **Mon** 2/25 *(make-up class at 3:00-4:20 in NH 101)*: Western boundary currents in subtropical gyres (C 20.3)
- Tue 2/26: Vorticity equation with barotropic streamfunction (V 19.1)
- Thu 2/28: Stommel and Munk solutions for western boundary current (V 19.1-19.2)
- Tue 3/05: Quasigeostrophic approximation (V 5.3, C 16)
- Thu 3/07: Quasigeostrophic potential vorticity equation
- Tue 3/12: Rossby waves (V 6.4, C 9.4)
- Thu 3/14: Overview of baroclinic instability (V 19.5 & 19.7-19.8, C 17.3-17.4); Review session
- Sat 3/16 - Sat 3/23: Take-home final exam.

Lecture notes: (1) Governing equations, (2) Shallow water, (3) Stratified flow, (4) Wind-driven circulation, (5) Quasigeostrophy, (6) Review.

Homework assignments:

- HW-1 *(due 1/17)*
- HW-2 *(due 1/31)*

Course description

Date, time, location: Tuesdays and Thursdays, 2:00-3:20, Spiess Hall 330.

Synopsis: The course will provide an introduction to the dynamics of rotating stratified flows. Many of the equations apply to both the ocean and the atmosphere, although we will focus primarily on large-scale flows in the ocean. Prerequisits include graduate-level coursework in fluid dynamics or permission of the instructor.

Office Hours: Students are welcome to stop by my office anytime (knock if door is shut), but I recommend checking beforehand to make sure I am in. One ideal time is right after class. You can also make an appointment.

Grading: 50% homework, 50% take-home final exam.

Homework: There will be periodic homework assignments. Homework assignments may be turned in one class later than they are due (grace period). Homework will be graded on a ✓+, ✓, ✓- basis. Students are encouraged to work together on homework exercises as long as each student turns in only his or her own work. Please do not consult homeworks or solutions from previous years.

Exam: There will be a take-home final exam.

Textbooks: Recommended readings will be drawn from
Atmospheric and Oceanic Fluid Dynamics by Geoffrey Vallis (2017) [individual chapter PDFs or all chapters in single PDF],
Introduction to Geophysical Fluid Dynamics by Benoit Cushman-Roisin and Jean-Marie Beckers (2011) [individual chapter PDFs or all chapters in single PDF].

Other textbooks covering aspects of the material we cover that you may also find useful:
Intro to Physical Oceanography by Robert Stewart (2008) [here],
Atmosphere-Ocean Dynamics by Adrian Gill (1982) [here],
Ocean Circulation Theory by Joseph Pedlosky (1998),
Geophysical Fluid Dynamics by Joseph Pedlosky (1987),
Atmosphere, Ocean and Climate Dynamics by John Marshall & Alan Plumb (2008) [here or here].