SIO 212B: Geophysical Fluid Dynamics B – Spring 2024

Instructor

My name is Paola Cessi, and my office is in Room 366 in the OAR building (a.k.a. the Keck Building). My e-mail addresses is pcessi@ucsd.edu. I will not enter into extended electronic correspondence but for quick questions this is the best way to communicate. Please make an appointment by email for discussions during office hours (in person or Zoom).

Class schedule

The schedule is Tu-Th from 11am to 12:20pm in NH101 with a recitation at a time and place convenient to all.

Assignments and assessment

The course is offered for **letter grade or S/U**: your choice.

I will assign problems regularly on the day before the recitation, due one week later, and then discuss them in the recitation session on the next day they are due. As I have one day to assess them, I will not accept late homework. It would be best to hand them in Latex, so they are easy to read. To facilitate Latex assignments, I will upload the Latex file, as well as the pdf of the assignments, so you do not have to retype the equations that are already there. If this is too onerous *and* you have a legible handwriting, hand-written assignement are acceptable.

In the recitation session it would be best if a student could volunteer to lead the discussion on the assignment.

The grade in this course is based on the assignments (20%), a mid-term (40%) and in-class exam on the last week of classes (40%). There is no final exam during final-exam week.

Recommended texts

I will follow different books for different topics. Here is the list I use:

Vallis, G.K. Atmospheric and oceanic fluid dynamics, Cambridge University Press, 2017.

Gill, Adrian E. Atmosphere-ocean dynamics. New York : Academic Press, 1982.

Pedlosky, Joseph. Geophysical fluid dynamics. 2nd ed. New York : Springer-Verlag, c1987.

Pedlosky, Joseph. Ocean circulation theory. Berlin ; New York : Springer, c1998.

Salmon, Rick. Lectures on geophysical fluid dynamics. Oxford University Press, 1998.

Syllabus for SIO 212B

Homogeneous circulation theories for wind-driven gyres and channel flows: Sverdrup balance; The linear theories of Stommel and the nonlinear inertial boundary layer; Vertical

structure of Ekman cells; The effects of topography in gyres and channel flows. (Vallis 2017 Ch. 19)

The vertical structure of the wind-driven circulation: Two-layer QG Continuously stratified equations; Baroclinic instability (Vallis 2017 ch. 9.5 and 9.7); PV homogenization.

QG models of planetary scale flows; The ventilated thermocline. (Vallis 2017 Ch. 20, Pedlosky GFD, chapters 6.21-6.23, Pedlosky OCT Chapters 3 and 4).

Two-dimensional and geostrophic turbulence (Rick Salmon guest Lecture). (Vallis 2017 ch. 12 and Salmon ch. 4 and 6)

The meridional overturning circulation: abyssal and mid-depth cells; simple models with multiple equilibria. (Vallis 2017 ch. 21).

The concept of residual circulation and transformed Eulerian mean (Vallis 2017 Ch. 10 + notes and papers).

As time permits:

The general circulation of the tropical atmosphere: symmetric models of the Hadley circulation. (Vallis 2017 Ch. 14 + in-class notes)

The Walker circulation: Gill's and Matsuno's models (Gill Chapter 11.14 and Vallis 2017 ch. 8.5 and 22.6)

The general circulation of the mid-latitude atmosphere: the maintenance of the midlatitude jet (Vallis 2017 ch. 15.1)

Simple models of El Nino - Southern Oscillation (Vallis 2017 ch. 22.7-22.9)