

**GFD I, SIO 212a Syllabus**  
**Professor Jennifer MacKinnon**  
**Winter Quarter 2016**

**Course Overview**

The course will cover basic dynamics of rotating stratified flow, generally applicable to both the ocean and atmosphere. Topics will range from large-scale quasi-balanced flows to small-scale turbulence. Prerequisites include graduate-level coursework in fluid dynamics or permission of the instructor.

**Textbooks**

Homework and exams will be based only on material covered in class. Useful additional information can be found in

\* "*Atmospheric and Oceanic Fluid Dynamics: Fundamentals and Large-scale Circulation*" by Geoffrey Vallis (2006) [online e-reader [here](#)]

\* "*Introduction to Geophysical Fluid Dynamics*" by Benoit Cushman-Roisin and Jean-Marie Beckers (2011), [online chapter PDFs [here](#)].

**Schedule**

*Part I*

1/5: Introduction, basic equations (V 1, C 1 & 3)\*

1/7: Rotating coordinate systems, earth's geoid (V 2.1-2.3, C 2)

1/12: Scaling, hydrostatic approximation, Boussinesq approximation (V 2.4-2.7, C 3.7 & 4.3)

1/14: Eddy viscosity, Ekman spirals (V 2.12, C 4.2 & 8)

1/19: Ekman spirals (cont'd), Ekman transport (V 2.12, C 8)

1/21: Ekman pumping, inertial oscillations, dimensionless numbers, shallow-water equations (V 3.1 & 2.8.1 & 2.12.1, C 2.3 & 4.5 & 7.1-7.3)

1/26: Geostrophic adjustment (V 3.8, C 15.2)

1/28: Potential vorticity (V 3.6.1, C 7.4)

2/2: Thermal wind (V 2.8.4, C 15.1)

2/4: Midterm exam [[solution](#)]

*Part II*

2/9: Two-layer shallow water

2/11: Intro to QG (V 5.3, C16 + Rick Salmon's GFD book)  
2/16: QG continued and Rossby Waves  
2/18: Rossby waves continued  
2/22: Baroclinic Instability I (V 6.5, V6.7, V6.8, C17.3-17.4)  
2/25: Baroclinic Instability II  
3/1: Continuously stratified equations: Internal waves and related instabilities  
3/3: Continuous stratification II: rossby waves and baroclinic instability  
3/8: student presentations  
3/10: student presentations

\*Relevant sections in Vallis and Cushman-Roisin textbooks.

### **Office hours**

Students are welcome to stop by anytime (OAR/Keck 260), but can be useful to call ahead to make sure I'm there. Or make an appointment.

### **Grading:**

There will be a daily quiz at the beginning of some classes, which will be graded on a pass/fail basis. You can miss up to 2 quizzes with no consequence.

There will be homework due every week or two. You are encouraged to work in groups, but please write up your own assignment. Assignments will be posted here when available.

There will be both a mid-term and final exam. In each case you'll be allowed to bring in one 8.5x11 piece of paper covered with whatever you deem appropriate.

Each student will be asked to choose a relevant journal article (with assistance from the instructor) and present it to the class near the end of the quarter.

The final grade will determined as follows: daily quizzes (10%), homework (25%), paper presentation (10%), mid-term (25%), final exam (30%).