Department of Applied Physics and Applied Mathematics
Columbia University
APPH E4210. Geophysical Fluid Dynamics
Spring 2005

Instructor: Samar Khatiwala (spk@ldeo.columbia.edu)
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Course home page: http://www.ldeo.columbia.edu/~spk/Classes/APPH4210_GFD/gfd.html and CourseWorks

Course description: This is an introductory course on the large scale dynamics of rotating geophysical and planetary fluids such as the ocean and atmosphere. The focus of this class will be on using simplified physical and mathematical models to understand how the ocean and atmosphere "adjust" when perturbed by "external" forces. This adjustment is strongly modified by the combined effects of gravity and rotation, and largely manifested through "waves". A variety of processes fundamental to how the ocean and atmosphere operate can be understood by studying these wave motions, and that is the approach we will take. This class is a prerequisite for more advanced courses in climate studies, atmospheric science, and physical oceanography.

Topics to be covered include: Review of the governing equations of mass and momentum conservation; wave kinematics, dispersion, group velocity; surface and internal gravity waves; shallow water theory; stratified fluids and normal mode analysis; waves in rotating fluids: Kelvin, Poincare, and Rossby waves; the Rossby adjustment problem and conservation of potential vorticity; the quasi-geostrophic approximation; planetary waves and Charney-Drazin theory; barotropic and baroclinic instability theory.

Prerequisites

Basic linear algebra and PDEs (at the level of E3102 - *Applied Math II*); a course in fluid dynamics such as *Physics of Fluids* (E4200); some knowledge of programming would be useful.

Texts:

Required text: Pedlosky, J. Waves in the Ocean and Atmosphere, Springer-Verlag, 2003.
Strongly recommended: Gill, A.E. Atmosphere-Ocean Dynamics (2nd edition), Academic Press, 1982.
Suggested reading:
Pedlosky, J. Geophysical Fluid Dynamics (2d edition), Springer-Verlag, 1987.
Kundu and Cohen, Fluid Mechanics, Academic Press. (This book is pretty good if you need to review basic notions of fluid dynamics.)
The first three books will be on reserve in the engineering library.

Grading: Homework 40%; Midterm 20%; Final 40%.