Syllabus for OC3321 Air-Ocean Fluid Dynamics (4-0)

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Course Description

A foundation course for studies of atmospheric and oceanographic motions. The governing dynamical equations for rotating stratified fluids are derived from fundamental physical laws. Topics include: the continuum hypothesis, real and apparent forces, derivations and applications of the governing equations, coordinate systems, scale analysis, simple balanced flows, boundary conditions, thermal wind, barotropic and baroclinic conditions, circulation, vorticity, and divergence.

Learning Outcomes

Recognize the links between mathematical equations (including vector and differential equations describing atmospheric motions) and the physical laws governing the Earth's atmosphere and oceans.

Understand the fluid dynamical equations governing the motion of the Earth's atmosphere and oceans, including momentum, continuity, thermodynamic, state and salinity.

Ability to perform a scale analysis on the equations of motion; derive and apply basic balances such as hydrostatic, geostrophic, gradient wind balances, and thermal wind relation.

Ability to distinguish between barotropic and baroclinic thermal flows.

Understand concepts of vorticity and potential vorticity.

Understand potential vorticity conservation and its application to oceanic flows.

Course Structure

Chapter 1 Fundamental Features of Atmosphere and Oceans

1.1. Conservation of mass
1.2. Some important characteristics of Earth system
1.3. Atmosphere and oceans are fluids
1.4. Characteristics of atmospheric dynamics