GFD-1 Geophysical Fluid Dynamics - Models and their main properties

Vladimir Zeitlin
3 ECTS

This course is shared with other OACOS specialities

The course is a comprehensive introduction to models and methods of geophysical fluid dynamics (GFD), and principal dynamical phenomena at large and medium scale in the atmosphere and the ocean. After recalling the fundamentals of fluid mechanics, the dynamics of stratified fluids on the rotating sphere is described and the approximation of the tangent plane is introduced. Governing "primitive" equations for the large-scale motions in the atmosphere and the ocean are established and reformulated using geometric, isobaric, and isopycnal or isentropic systems of coordinates. Starting from the full primitive equations, simplified layered models are obtained by vertical averaging. The notion of potential vorticity is then introduced and vortex-(inertia-gravity)wave paradigm in GFD is illustrated in an hierarchy of models of increasing complexity. The fundamental process of geostrophic adjustment is explained and (geostrophically) balanced models for vortex motion are derived and analyzed. First notions of the baroclinic instability are given on this basis. The dynamics in the equatorial waveguide is introduced, with explanation of the properties of typical equatorial waves. The influence of horizontal boundaries and bottom topography upon the dynamical processes is explained and the dynamical role and properties of boundary (coastal) and topographic waves are highlighted.

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