

Gravity and vorticity waves on shear currents: linear and nonlinear dynamics

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Abstract

Waves and currents are the two main types of motions in geophysical fluid dynamics. We discuss their interplay by examining waves on free surface flows with vertical and horizontal shear and focusing upon two major classes of wave motions in shear flows: gravity and vorticity waves. The following topics will be discussed.

- (1) **Linear dynamics of surface gravity waves on horizontally inhomogeneous currents with vertical shear. Conservation of wave action.**
- (2) **Vorticity waves**
 - a) Concept of quasi-modes. Nonlinear dynamics in boundary-layer-type flows with vertical shear. Phenomenon of explosive instability or blow-up.
 - b) Shallow water scaling - the Kano - Nishida theorem
 - c) Examples of nonlinear dynamics of vorticity waves for horizontally sheared flows: solitons and explosive instabilities.
- (3) **Oceanic gravity waves on jet currents**
 - a) Two paradigms of wave description on jet currents
 - b) Linear boundary value problem for gravity waves trapped by a jet current. Properties of trapped modes.
 - c) Triad resonant interactions of deep water gravity waves
 - d) Robust solitary waves
 - e) Laboratory modelling of wave dynamics for waves trapped by a jet current.
 - f) Implications for freak wave context.