Waves and wave attractors in geophysical flows

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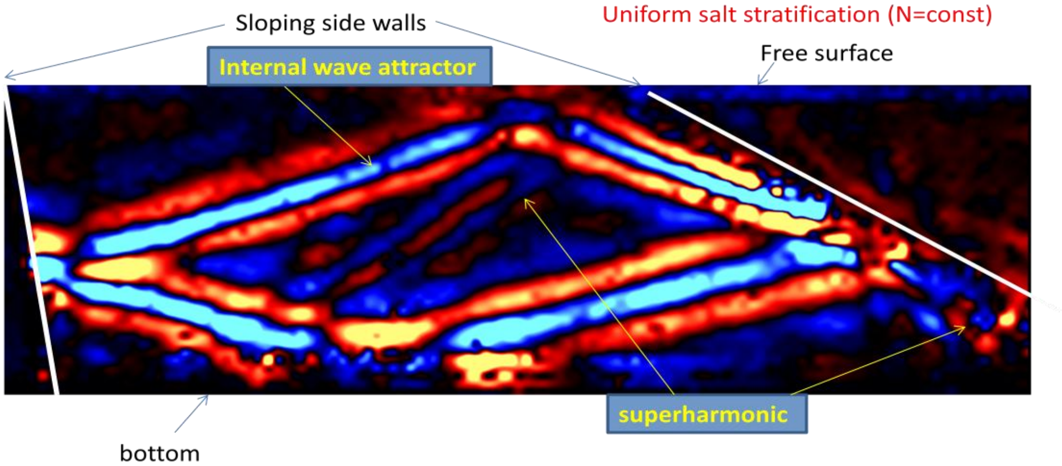
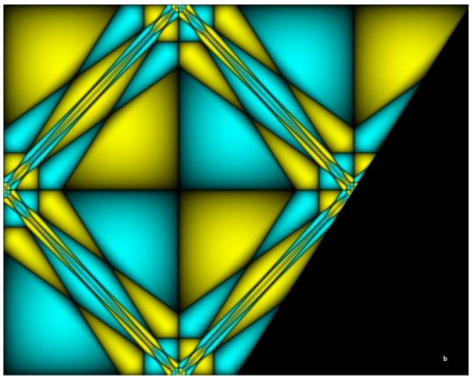


Student experiment: internal gravity waves excited by weak horizontal sloshing showing appearance wave attractor and higher harmonic in density perturbation field (color)

Abstract

Density-stratified, rotating or magnetized fluids constitute anisotropic equilibria. Such fluids arise in Earth's oceans, atmosphere and liquid outer core, as they do in planets and stars. Small-amplitude perturbations of these equilibria lead to internal waves (IWs) that attain maximum displacements within the fluid domain. Small-scale IWs present an important, but often missing link between the global forcing scale, traditionally of interest to Geophysical and Astrophysical Fluid Dynamics, and the small viscous scales, at which mixing occurs.

Owing to the anisotropy, IWs in general propagate obliquely through the fluid domain, along an inclination that is preserved when IWs reflect from sloping boundaries. The consequence is that, depending on the shape of the fluid domain, IWs are 'attracted' to certain fixed points or periodic orbits (wave attractors) that act as IW 'sinks', or mixing regions. Here, we illustrate these issues for uniformly-stratified fluids. We show that while perturbations are described by a linear IW field, its spatial structure is essentially solved using a *nonlinear* map of the boundary onto itself. It endows the solution with a spatial, spectral and parameter self similarity. Both free and forced IW problems ('tide topography interaction') will be addressed in nontrivially-shaped fluid domains.



IW stream function in uniformly stratified fluid in vertical plane