Attractors of internal and inertial waves in an axisymmetric domain

E.V. Ermanyuk (Novosibirsk)

C. Pacary, T. Dauxois, P. Metz, M. Moulin, S. Joubaud (Lyon)

Internal and inertial waves are ubiquitous in the ocean and play an important role in energy transfer and mixing. The law of reflection of these waves in a confined domain allows for the existence of a limit cycle of a wave-ray billiard (so-called wave attractor) in 2D and 3D problems [1, 2]. This report presents a study of attractors of internal and inertial waves in an axisymmetric domain (a truncated cone) subject to external forcing by low-amplitude precession of a rigid lid (upper boundary of the fluid domain). Following previous studies [3], a ray-tracing algorithm is used to track the convergence of wave beams onto wave attractor in a 3D axisymmetric domain. The wave-ray skeletons for inertial (internal) cases are formally equivalent. Experiments conducted for internal and inertial waves demonstrate essentially different dynamic behavior. The existence of easily excited standing waves (resonant modes of the region) at frequencies below the forcing frequency makes possible a well-pronounced (global) triadic resonance in the case of internal waves similar to 2D case [4]. In the case of inertial waves, a similar effect is not observed in the studied configuration. The effect of dissipation on the symmetry axis was studied by conducting additional experiments in which a vertical cylinder was placed in the center of the region. This work is described in more detail in [5].

References

[1] L.R.M. Maas, F.P.A. Lam, *Geometric Focusing of Internal Waves*, J. Fluid Mech., **300** (1995), 1–41.

[2] M. Rieutord, B. Georgeot, L. Valdettaro, *Wave Attractors in Rotating Fluids: A Paradigm for Ill-Posed Cauchy Problems*, Phys. Rev. Lett., **85** (2000), 4277–4280.

[3] A. Rabitti, L.R.M. Maas, *Meridional trapping and zonal propagation of inertial waves in a rotating fluid shell*, J. Fluid Mech., **729** (2013), 445–470.

[4] C. Brouzet, E. Ermanyuk, S. Joubaud, G. Pillet, T. Dauxois, *Internal wave attractors: different scenarios of instability*, J. Fluid Mech., **811** (2017), 544–568.

[5] C. Pacary, T. Dauxois, E. Ermanyuk, P. Metz, M. Moulin, S. Joubaud, *Observation of inertia-gravity wave attractors in an axisymmetric enclosed basin*, Phys. Rev. Fluids, **8** (2023), 104802.