Geophysical Research Abstracts
Vol. 17, EGU2015-14401-3, 2015
EGU General Assembly 2015

Laboratory and numerical simulation of internal wave attractors and their instability.

Christophe Brouzet (1), Thierry Dauxois (1), Evgeny Ermanyuk (2), Sylvain Joubaud (1), Ilias Sibgatullin (3,4)
(1) Laboratoire de Physique de l'E ´cole Normale Supe ´rieure de Lyon, Universite ´ de Lyon, CNRS, 46 Alle ´e d'Italie, F-69364 Lyon cedex 07, France, (2) Lavrentyev Institute of Hydrodynamics, Novosibirsk State University, Novosibirsk, Russia, (3) Moscow State University, Moscow, Russia, (4) P.P.Shirshov Institute of Oceanology of the Russian Academy of Sciences

Internal wave attractors are formed as result of focusing of internal gravity waves in a confined domain of stably stratified fluid due to peculiarities of reflections properties [1]. The energy injected into domain due to external perturbation, is concentrated along the path formed by the attractor. The existence of attractors was predicted theoretically and proved both experimentally and numerically [1-4]. Dynamics of attractors is greatly influenced by geometrical focusing, viscous dissipation and nonlinearity. The experimental setup features Schmidt number equal to 700 which impose constraints on resolution in numerical schemes. Also for investigation of stability on large time intervals (about 1000 periods of external forcing) numerical viscosity may have significant impact. For these reasons, we have chosen spectral element method for investigation of this problem, what allows to carefully follow the nonlinear dynamics. We present cross-comparison of experimental observations and numerical simulations of long-term behavior of wave attractors. Fourier analysis and subsequent application of Hilbert transform are used for filtering of spatial components of internal-wave field [5]. The observed dynamics shows a complicated coupling between the effects of local instability and global confinement of the fluid domain. The unstable attractor is shown to act as highly efficient mixing box providing the efficient energy pathway from global-scale excitation to small-scale wave motions and mixing.

Acknowledgement,
IS has been partially supported by Russian Ministry of Education and Science (agreement id RFMEFI60714X0090) and Russian Foundation for Basic Research, grant N 15-01-06363. EVE gratefully acknowledges his appointment as a Marie Curie incoming fellow at Laboratoire de physique ENS de Lyon. This work has been partially supported by the ONLITUR grant (ANR-2011-BS04-006-01) and achieved thanks to the resources of PSMN from ENS de Lyon

1. Maas, L. R. M. & Lam, F.-P. A., Geometric focusing of internal waves. J. Fluid Mech, 1995,. 300, 1–41
L. R. M. Maas, D. Benielli, J. Sommeria, and F.-P. A. Lam,
Nature (London) 388, 557 (1997).
2. Dauxois, Thierry; Young, W., Journal of Fluid Mechanics, 1999, vol. 390, Issue 01, p.271-295
3. Grisouard, N., Staquet, C., Pairaud, I., 2008, Journal of Fluid Mechanics, 614, 1
4. Scolan, H., Ermanyuk, E., Dauxois, T., 2013, Physical Review Letters, 110, 234501
5. Mercier, Matthieu J.; Garnier, Nicolas B.; Dauxois, Thierry Reflection and diffraction of internal waves analyzed with the Hilbert transform Physics of Fluids, Volume 20, Issue 8, pp. 086601-086601-10 (2008).