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Topographically induced waves in a pycnocline: internal solitary waves and trapped orographic waves in the Toulouse stratified water flume

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The Meteo-France and CNRS geophysical fluid dynamics laboratory located in Toulouse (French meteorological service research center CNRM-GAME, UMR3589) provides facilities for fundamental and applied study of homogeneous, stratified and/or rotating flows. The research activities of the team focus on atmospheric boundary layers and internal gravity waves. Two recent experiments related to topographically induced internal gravity waves are presented here.
The Toulouse stratified water flume is a unique facility to study neutral or stratified flows (e.g. [1]). It has been specially designed to generate accurate and exhaustive datasets on flows similar to the atmospheric or oceanic ones under perfectly controlled conditions. It is thus a good extension of field experiments which are limited by the fact that data are scattered and conditions are not well controlled. This 30 m long, 3 m wide and 1.6 m deep density-stratified water flume can also be operated as a towing tank filled with water or with density-stratified brines.
Experiments have been recently carried out in order to investigate internal solitary waves generated over an oceanic ridge in a configuration close to the one used by Dossmann et al. 2011 ([2]), but in a much larger tank. These waves are quite frequent in some areas, and can have a strong impact on sea structures (e.g. offshore platform). They also influence the oceanic dynamics and are difficult to parameterize. An extensive dataset has been collected on waves generated in a pycnocline by direct interaction of a barotropic tide with a ridge (primary generation) and by an internal wave beam generated over a ridge impinging on a pycnocline (secondary generation). Various flow regimes have been observed, including soliton and train of solitons.
Another set of experiments (see [3] and [4]) deals with trapped orographic waves generated over an isolated mountain. These experiments have been inspired by a theoretical model which predicts the structure of internal waves and the drag exerted by a mountain on the atmosphere from a small set of parameters. The latter is of particular importance to climate modelers and researchers involved in the development of numerical weather prediction models, because of the need to parameterize the drag exerted by orography. Boundary layer and internal waves interactions are explored from complementary numerical simulations in order to investigate the cause of some discrepancies between predictions of the theory and results of the experiments.

References

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