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Topographic internal waves in the laboratory: two experiments carried in the CNRM-GAME stratified water tank

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The geophysical fluid dynamics laboratory of the French meteorological service research center (CNRM-GAME, URA1357 Meteo-France and CNRS) 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 topographic internal waves are presented here.
The CNRM-GAME 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. They also influence the oceanic dynamics and are difficult to parameterize. An extensive dataset has been collected on waves generated at a pycnocline by direct interaction of a barotropic tide with a ridge. Various flow regimes have been observed, including soliton and train of solitons. The case where these waves are generated by an internal wave beam impinging on a pycnocline has also been explored.
Another recent set of experiments (see [3] and [4]) deals with two inter-related aspects of flow over orography in the atmosphere: the structure of the flow-field and the pressure drag exerted on the oncoming flow. The latter is of particular importance to oceanographers, climate modelers and researchers involved in the development of numerical weather prediction models, because of the need to parameterize the drag exerted by orography. 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. A complementary numerical study is ongoing in order to better analyze the data.

References

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