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Topographic internal waves in the laboratory: two recent 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 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 a density-stratified mixture of water and brine.
Experiments have been recently carried out in order to investigate mountain-induced rotors ([2]). Some recent aircraft accidents were attributed to these turbulent regions of stagnant or counter-rotating air on the leeward side of mountain ridges, which has renewed the interest in this atmospheric phenomenon. If various laboratory experiments have been done on mountain lee-waves, none have been performed on rotors before these experiments. Experimental set-up was guided by previous numerical simulations and a flow regime diagram has been constructed.
Another recent set of experiments (see [3] and [4]) deals with two inter-related aspects of flow over orography: the structure of the flow-field and the pressure drag exerted on the oncoming flow. The later 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 with spatial scales below the model grid scale. Results are expected to validate experimentally 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.

References

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