Axisymmetric internal wave super-harmonics

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Due to their relevance in mixing processes, numerous studies have been devoted to non-linear phenomena involving inertia-gravity waves. Of particular interest is the generation of waves at different frequencies from the primary wave field, as it is often associated with other wave numbers and therefore other scales to which energy can be transferred. Sub-harmonics generation, for example, has been the focus of various experimental and theoretical works through Triadic Resonant Interaction (TRI) [4]. The generation of super-harmonics, however, has been less extensively studied.

For plane waves considered in a cartesian geometry, non-linear self-interaction terms are null, preventing super-harmonics from existing in linearly stratified fluids. Super-harmonics are thus only expected to appear in non-linear stratifications and recent studies have delveed further into this non-linear process [1]. In axisymmetric geometry, however, the description of the wave field in terms of Bessel functions yields non-zero self-interaction terms, even in a linear stratification, and theory therefore predicts spontaneous generation of super-harmonics.

Using an apparatus that has been proven capable of generating axisymmetric internal wave fields [2], we present an experimental observation of super-harmonics generation in linear stratified fluids. Excited at sufficiently low frequency, the wave field and its first harmonic are both propagating waves and we show that they remain axisymmetric and can be described by modes, or combination of modes. The selection of these modes is controlled by the doubly confined (lateral and vertical) geometry [3].

Références

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