

First and Second Harmonic Internal Waves from a Horizontally Oscillating Sphere

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A horizontally oscillating sphere in a density-stratified fluid is studied experimentally and theoretically, as a paradigm of the generation of three-dimensional internal tides by super-critical topography. The experiments implement a novel technique for the measurement of the spatial structure of internal wave fields, based on horizontal fluorescent dye planes and a mobile vertical laser sheet; they are compared with an original linear theory. Spectral analysis reveals the presence of two harmonics, namely a first harmonics at the fundamental frequency and a second harmonics at twice this frequency. The first harmonics has a dipolar structure, an amplitude varying linearly with the amplitude of oscillation, and is quantitatively described by the theory. The second harmonics is present at amplitudes of oscillation higher than one tenth of the sphere radius and has a quadrupolar structure. Its amplitude varies quadratically with the amplitude of oscillation, and may exceed the amplitude of the first harmonics. At frequencies smaller than half the buoyancy frequency, the second harmonics is evanescent and confined to the vicinity of the sphere; at frequencies larger than half the buoyancy frequency, it propagates away.

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