Iinternal waves interacting with particles in suspension

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Abstract

Internal waves are produced as a consequence of the dynamic balance between buoyancy and gravity forces when a particle of fluid is vertically displaced in a stably stratified environment. Geophysical systems such as ocean and atmosphere are naturally stratified and therefore suitable for internal waves to propagate. Furthermore, these two environments stock a vast amount of particles in suspension, which present a large spectrum of physical properties (size, density, shape), and can be organic, mineral or pollutant agents. Therefore, it is reasonable to expect that internal waves will have an active effect over the dynamics of these particles.

In order to study the interaction of internal waves and suspended particles, an idealized experimental setup has been implemented. A linear stratification is produced in a 80×40×17 cmˆ3 tank, in which two-dimensional plane waves are created thanks to the innovative wave generator GOAL. In addition, a particle injector has been developed to produce a vertical column of particles within the fluid, displaying the same two-dimensional symmetry as the waves. The particle injector allows to control the volumic fraction of particles and the size of the column.

The presence of internal waves passing through the column of particles allowed to observe two main effects: the column oscillates around an equilibrium position (which is observed in both the contours and the interior of the column), and the column is displaced as a whole. The oscillations produced on the column are found also beyond the limits of the incoming wave beam. The column is displaced depending on the characteristics of the column, the density gradient, and the intensity and frequency of the wave.

When displaced, the particles within the column are sucked towards the source of waves. The direction of the displacement of the column is explained by computing the effect of the Lagrangian drift generated by the wave over the time the particles stay in the wave beam before settling.

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