TRANSPORT OF PARTICLES BY INTERNAL WAVES

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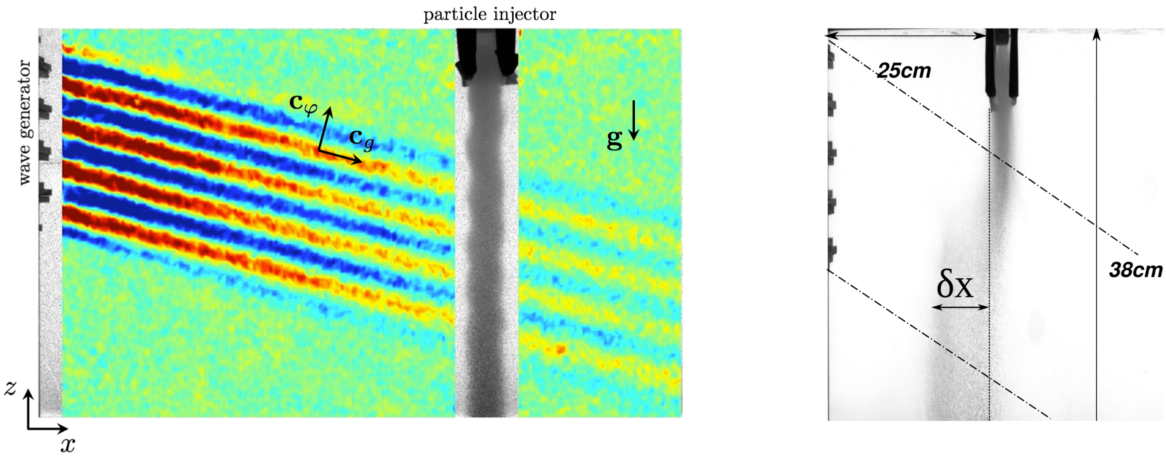
The settling of organic particles from the upper layers of the ocean to the deep sea (known as oceanic snow) has an intense effect on global ocean properties. It is substantial for the development of diversified life in the benthic layer and it also sequesters large quantities of CO_2 from the atmosphere. The dispersion and concentration of these particles will be strongly attached to the dynamics of the ocean via its carrying fluid. Internal waves, omnipresent in the ocean, can act as a mechanism producing resuspension of particles lying in the boundary layers and generate net transport of the oceanic snow that could play a role in the behavior of marine habitat [1]

Experimental and numerical efforts have been performed to understand the dynamics of a single body settling in a stratified environment [2], as well as the collective dynamics of particles settling in a stratified fluid [3]. In our work, we include an additional degree of complexity, by trying to study experimentally the main effects of an internal plane wave propagating through a column of slowly settling particles, in a stratified fluid.



(a) (b)

Figure 1. (a) Snapshot of an internal wave beam passing through a column of settling particles. The column oscillates following the group velocity of the wave. The colormap indicates the intensity of the horizontal gradient of density measured using Synthetic Schlieren technique [4]. (b) Column displacement obtained for a particular set of control parameters. The value of the displacement after a given time is denoted δx. In both figures, the wave field is generated in the upper-left corner and propagates to the lower-right corner.

The granular column formed by the particles oscillates around an equilibrium position due to the presence of the internal gravity waves (figure 1a). Depending on the frequency and the amplitude of the internal waves, the column can even be displaced as a whole (figure 1b). Surprisingly, this displacement is directed towards the source of the waves. A resonant behavior of this displacement with the frequency of the internal waves is observed. A theoretical approach based on the drift induced by internal waves is developed.

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