Fragment breaking, motions and size distribution in a laboratory model of fragmentation of a 2D floating membrane by surface waves.

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When particles measuring a few tens of microns are dispersed on a water surface, they aggregate due to the action of capillary forces, forming a thin, buoyant membrane known as a particle raft. In a tank containing a raft composed of graphite powder, we generate gravity surface waves. The wavelength of these waves, approximately 17 centimeters, is significantly larger compared to the thickness of the raft, which is approximately 10 μm. For sufficiently strong wave amplitudes, the raft undergoes progressive fragmentation, resulting in the formation of smaller fragments on a time scale longer than the wave period [1]. The visual appearance of these fragments, surrounded by open water, bears a resemblance to the floes formed by the fracturing of sea ice by waves. Our experiment allows us to observe the fragmentation cascade at various stages of the process, as illustrated in Fig. 1. Building upon our previous work [1], we investigate the statistical properties of fragments as a function of time under stationary wave forcing.We focus on the decrease of mean area of fragments, the shape evolution, the drift motion, and specifically the area distribution. We then use an equation of population evolution to model the corresponding size distribution functions.

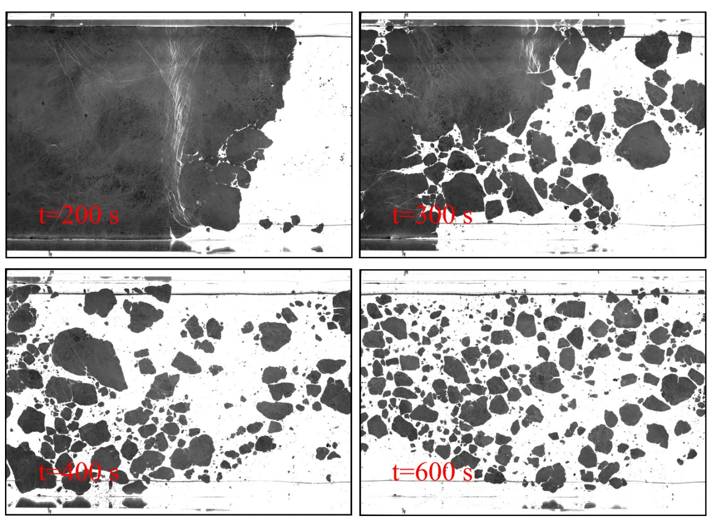

Figure 1. A thin particle raft floats at the water surface and is broken under the action of gravity waves generated by a wavemaker and coming from the right. The transparent tank is illuminated from below. The raft is gradually broken into smaller and smaller fragments. Wave frequency 3.0 Hz and amplitude 1.27 mm.

Références

1. L. Saddier, A. Palotai, M. Aksil, M. Tsamados, M. Berhanu, *Physical Review Fluids*, **9**, page (2024).