Fragmentation of a granular raft by surface waves.

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When particles of a few tens of microns are spread on the surface of water, they aggregate under the action of capillary forces and form a thin floating membrane, a granular raft [1]. In an experimental tank with a raft made of graphite powder, we generate gravity surface waves, whose wavelength is very large compared to the thickness of the raft. For a sufficiently strong wave amplitude, the raft breaks up progressively by producing fragments whose sizes decrease on a time scale long compared to the period of the wave. For this two-dimensional fragmentation process, we study the size, shape and drift of the fragments as a function of time. Since the fragments are randomly distributed, we perform a statistical analysis. The visual appearance of the fragments surrounded by open water bears a striking resemblance to the floes produced by the fracturing of sea-ice by waves in the polar oceans. Fragmentation concepts and morphological tools built for sea-ice floes [2] can be applied to our macroscopic analog, on which the entire dynamic evolution is accessible.

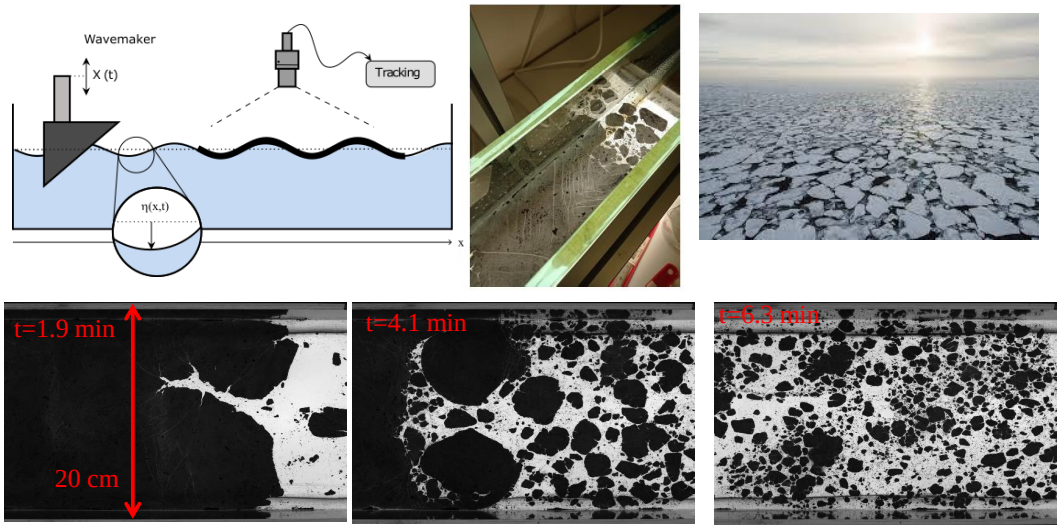

Figure 1. Top left, schematics of the experimental setup. A thin granular raft floats at the water surface and is broken under the action of gravity waves generated by a wavemaker. The transparent tank is lighted from below. The fragments are then tracked during the fragmentation process. Top middle, fragments on one side and oblique cracks. Top right, floes in the arctic ocean, *Credits Daniel Beltrá / Greenpeace*. Bottom, progressive fragmentation at three different time steps for incoming waves of frequency 3.0 Hz and amplitude 1.48 mm.

References

1. D. Vella, P. Aussillous and L. Mahadevan, *Europhysics Letters*, **68**(2), 212, (2004).
2. A. Herman, K.U. Evers and N. Reimer, *The Cryosphere*, **12**, 685-699, (2018).