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A laboratory model of fragmentation of a 2D membrane by waves. Analogies and differences with sea ice.

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The marginal ice zone is the transition region between the dense floating ice pack and the open ocean. In this zone, the interaction of surface waves with sea ice is highly complex. The sea ice is broken up into fragments, the floes, which can split into smaller parts and drift under the action of waves and underwater current. Although the downscaling is challenging, laboratory model experiments can contribute to a better understanding of this process coupling fluid and solid mechanics on a large range of time and space scales. We propose to study the fragmentation of a floating membrane, made up of 10 µm graphite particles arranged in a monolayer, by gravity surface waves with a wavelength of around 15 cm **[1]**. For a sufficiently strong wave amplitude, the raft progressively breaks up, developing cracks and producing fragments whose sizes decrease over a time scale that is long relative to the wave period. We then study the distribution of the fragments produced during the fragmentation process. The visual appearance of the size-distributed fragments surrounded by open water bears a striking resemblance to the floes produced by the fracturing of sea ice by waves. The fragmentation concepts and morphological tools developed for sea ice floes can be applied to our macroscopic analog. Although the mechanics of the two systems differ in their physical properties and in the fracture process, our experiment provides a model laboratory system for studying the fragmentation of floating 2D materials

[1] Saddier, L., Palotai, A., Aksil, M., Tsamados, M., & Berhanu, M. (2023). Breaking of a floating particle raft by water waves. In arXiv preprint arXiv:2310.16188**.**