Artificial ice sheet at the laboratory scale : experimental model

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The North Pole is covered by an ice sheet of about 1m in thickness, generated by sea ice freezing during the winter. At the edges of the polar ice region, ocean waves can break this ice sheet, over 500km, creating a mixed area of ice fragments and open water, called the Marginal Ice Zone (MIZ) [1]. The ocean waves can propagate through the MIZ, which enhances mixing, melting and affects the dynamics of the whole arctic [2]. What determines the breaking of ice sheet by waves and how does it depend on wavelength and ice thickness ?

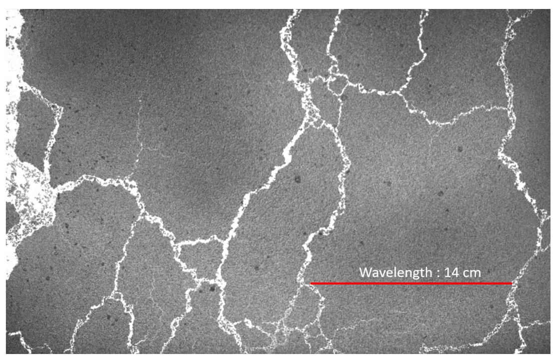

Figure 1. Picture of a thin elastic brittle membrane broken by surface waves generated in the laboratory. Tentative of scaling down ice breaking by ocean swell.

In the lab, we design a model experiment to study at a smaller scale the fracture of a thin, brittle, elastic sheet under surface wave mechanical loading. We use a varnish that forms a thin ($100\mu m$), cohesive, granular material which is brittle enough to be broken by waves of millimetric amplitude (cf. Fig. **??**). We first show that this material mimics the wave elastic response of an ice sheet and we measure the effective Young's modulus of our heterogeneous material. Using various wave geometries (propagative and stationary sloshing modes), we study the breaking threshold as a function of the amplitude and the wavelength of the incident wave.

Références

1. T. D. Williams, L. G. Bennetts, V. A. Squire, D. Dumont, & L. Bertino, Wave–ice interactions in the marginal ice zone. Part 1 : Theoretical foundations, *Ocean Model*, **71**, 81–91 (2013).
2. J. Thomson et al., Overview of the arctic sea state and boundary layer physics program, *Journal of Geophysical Research - Oceans*, **123**, 8674–8687 (2018).