Artificial ice packs: a model laboratory approach

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The Arctic ocean is covered with an ice pack of about 1m in thickness, generated during winter by sea freezing. Polar ice packs play an important role in global climate dynamics through their high albedo limiting radiative heating and their cooling properties of atmospheric and oceanic circulations. Their melting mainly occurs in the marginal ice zones (MIZ) [1], where oceanic swells break the ice pack in smaller fragments (see fig. 1a), leading to their increased melting and enhanced reduction thus affecting the dynamics of the whole Arctic region [2]. In this presentation, I'll show how we designed a set of model experiments that are able to scale down some of the physical phenomena at play in the MIZ.

In a first part, I will discuss the Hydro-elastic waves that appear when the water surface is covered by a thin elastic sheet, their physics being dominated by the bending elasticity of the sheet. I will then show that HEW open promising possibilities for wave control [3]. In particular, I will present experimental configurations that allow for building an HEW based "optics", revisiting Snell's law and geometrical optics in an hydrodynamical experiment.

In a second part, I will present a model experiment where we study the fracture of a thin and brittle elastic sheet under surface wave mechanical loading (see fig. 1b). I will show that this system is able to mimick both the elastic response of ice packs as well as their fragmentation, shedding a new light on the criteria for ice pack rupture and fragment size distributions.

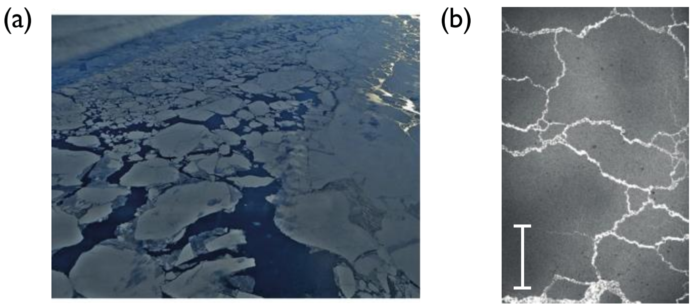

Figure 1: (a) Aerial view of the MIZ close to the occidental shore of Greenland. Credits: W. Malik. (b) Fragmented artificial elastic sheet under wave mechanical loading. The scale bar is 10 cm.

References

[1] T.D. Williams *et al.*, Wave–ice inter- actions 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).

[3] L. Domino *et al.*,Dispersion-free control of hydroelastic waves down to sub-wavelength scale. Europhysics Letters **121** (1), 14001 (2018).