Surface Wave Damping by Particles of Different Shapes

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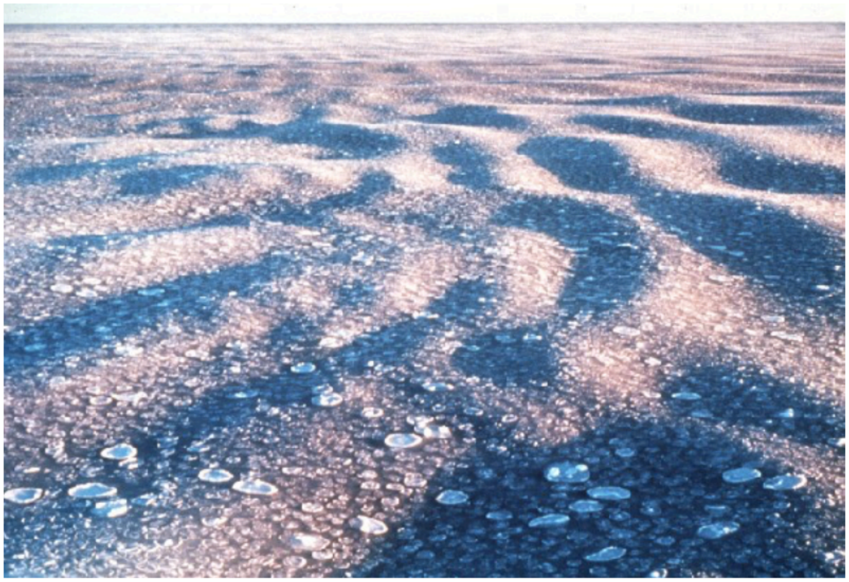

Waves beneath pancake ice [Brostrom & Christensen (2008)]

As surface waves approach floating ice sheets they must first pass through the ice margin, which consists of grease/frazil ice (slush), pancake ice and scattered ice floes. There have been several theoretical and observational studies of the impact of ice sheets (treated as an elastic membrane), and of damping of waves as they pass through slush, most assuming exponential attentuation with distance of a propagating wave and treating the slush as a Newtonian fluid (Newyear & Martin, 1997). The experiments were complicated by the piling up of slush at the far end of the tank due to wave propagation.

During the WHOI GFD summer programme in 2017, Neil Balmforth and I ran a series of experiments of surface wave damping by floating spherical particles showing that the waves arrest in a finite time and arguing that this was due to flow being alternately pushed out and sucked between the particles (Sutherland & Balmforth, 2019) - not due to side-wall effects as previous experiments on damping of waves by foam had posited (eg Sauret et al, 2015, Viola et al, 2018). However, particles in the marginal ice zone are not spherical, and it is expected that their shape has a significant influence on the damping time.

The proposed project will involve laboratory experiments to examine the temporal dampening of surface waves by cylindrical (like pancake ice) and cubical (like ice in a margarita) particles.

Further reading

- Brostrom & Christensen, “Waves in sea ice”, Norwegian Meteorological Inst, Report 5/2008 (2008)
- Newyear & Martin, “A comparison of theory and laboratory measurements of wave propagation and attenuation in grease ice”, J. Geophys. Res., **102**, 25091-25100 (1997)
- Sauret et al, “Damping of liquid sloshing by foams”, Phys. Fluids **27** (2015)
- Sutherland & Balmforth, “Damping of surface waves by floating particles”, Phys. Rev. Fluids **4** (2019)
- Viola et al, “Foam on Troubled Water: Capillary Induced Finite-Time Arrest of Sloshing Waves”, Phys. Fluids, **28**, 091701 (2016)