Answer to reviewer 2

An impressive and complete methodology and dataset! Looking forward to where this goes next and the new avenues it opens for more data on wave-induced sea ice fracture!

We thank the referee for their reading and comments as well as their enthusiasm for our methodology and dataset. Please find below our answers to the questions raised by the referee.

Can you comment on whether this dispersion relation was expected? i.e. that the presence of sea ice did not change the dispersion relation relative to that which we expect from open water? If so, why? Was it due somehow to this specific sea ice type? I ask because I know that there is quite a lot of literature regarding developing dispersion relations which do consider the presence of sea ice (i.e. with the implication that the presence of sea ice can modify the dispersion relation).

During the Bicwin24 campaign, we observed and characterized both ice floes, and continuous ice of thickness ranging from 10 to 25cm (except for the 11/02 in Saguenay fjord). Figure 7a is representative of the sea ice conditions near the ice edge we observed during the Bicwin24 campaign. The ice edge was composed of small ice fragments ranging from a few centimetres to less than 5 meters large, and the thickness $h \sim 16$ cm. Most of the waves energy was carried by waves with a typical wavelength ranging between 20 and 30 meters. In this configuration, all fragments have sub-wavelength dimensions, and therefore, do not modify significantly the dispersion relation. However, these fragments generate dissipation of the wave energy.

Further from the ice edge, the ice is continous and may affect the dispersion relation. In the presence of a floating elastic plate of thickness h, density ρ and flexural modulus D above a water column of height h_w, and neglecting dissipative effects, the most general dispersion relation of hydro-elastic waves that can be found in the literature [1, 2] writes :

$$\omega^2 = \frac{\left(gk + \frac{D}{\rho_w}k^5\right)\tanh(kh_w)}{1 + kh\frac{\rho}{\rho_w}\tanh(kh_w)} \tag{1}$$

We can evaluate the different terms of the above dispersion relation in our field conditions. The typical wavelength (20 to 30m) is much greater than the ice thickness, leading to $kh \sim 4.5 \times 10^{-2}$. The term $hk\frac{\rho}{\rho_w}\tanh(kh_w)$ associated to sea ice buoyancy can therefore be neglected. We can also compare the gravity and elastic terms using the gravito-elastic length $l_D = \left(\frac{D}{\rho_w g}\right)^{1/4}$. Considering a Young modulus $Y = 1.5$ GPa and Poisson coefficient of $\nu = 0.38$ as measured on February 26 (table 2 of the manuscript), the gravito-elastic length equals $l_D \sim 4.7$ m. This typical length is much smaller than the wavelength, meaning that the observed waves are in a purely gravitational regime as represented in Figure 7c and 7d. The measured water depth $h_w = 5.9$ m influences the wave propagation, and the dispersion relation indeed shows both shallow water and deep water regimes.

SPECIFIC COMMENTS

- *"Therefore, achieving accurate and multi-scale estimates of ice parameters will set the new standards of sea ice monitoring." Consider rewording, this is a bit hard to follow.*

  We have modified the sentence as follows

  Therefore, obtaining accurate, multi-scale estimates of ice parameters will establish a new benchmark for sea ice monitoring.

- *Regarding figure five* (we assume the reviewer means Figure 6)*: "The polarization of the flexural wave is in the sagittal plane." This is the out-of-plane wave, correct? Is it necessary to have two different naming conventions? If so, the first time "flexural wave" is introduced, maybe put "out-of-plane wave" in brackets next to it.*

  We agree that sagittal plane can be a bit misleading, so we have modified the text to clarify that:

  The polarization of the flexural wave lies in the sagittal plane (defined by the normal to the ice surface and the wavenumber), with its energy mainly oriented in the vertical direction.

  However, it should be noted that the longitudinal wave is also polarized in the same plane. Therefore, it makes little difference whether we refer to in-plane or out-of-plane motion, since both waves contribute to these motions—albeit in different proportions. We hope this clarifies things a bit.

- *It would be helpful to guide the reader a bit more if you included panel labels which are referred to in the text (Fig. 5a–i).*

  We assume the reviewer means figure 6. Yes, thank you for the suggestion. We have added panel labels in Figure 6, and referred to each of them in the analysis of Figure 6.

- *"where on can see" should be "where one can see".*

  Thank you for spotting this typo. It has been corrected.

- *Figure 9 is missing "a), b)" labels on the panels despite being referred to in the caption.*

  Thanks again! This has been corrected.

[1] A. G. Greenhill, Wave Motion in Hydrodynamics, American Journal of Mathematics **9**, 62 (1886).
[2] H. H. Shen, enWave-in-ice: theoretical bases and field observations, Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences **380**, 20210254 (2022).