Dear Reviewer 2,

Thank you for taking the time and effort to read our manuscript and provide feedback. We found your comments very helpful and believe it will improve our manuscript. We have presented our response to the comments below in **blue and bold**. As per TC guidelines, no revised manuscript is prepared yet, however, we have indicated the proposed changes to the manuscript in *italic*.

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p3: section about I_{br} could be improved - I have never heard the term "similitude" or of the "Pi-theorem" before - can you think of a better name? Using ka (steepness) and kh instead of converting k to λ would get rid of many factors of 2π, and I_{br} could become a stress relative to the flexural strength or a strain relative to the breaking strain for a beam. (The critical value would be about $4\pi^2 \times 0.014 = 0.55$ I guess). Since the relationship looks like it could have some universality it is worth presenting it somewhat more intuitively.

We appreciate the suggestion of the reviewer to use the wave number instead of the wave length. Despite the more attractive threshold value 0.55 (i.e. O(1)), we believe that the wave length is more intuitive than the wave number as it is a more 'direct observable' length scale in contrast to its inverse value (i.e. the wave number).

The Pi-theorem is a theorem in dimensional analysis and, at least in our experience, is commonly applied in the fields of physics and engineering. As this is the conventional term to describe the theorem, we decided to keep this term and will provide a reference to the original theorem: *"Buckingham (1914)"*. **To improve reading, we will replace the term "similitude" with** "*similarity*".

"sheet as an elastice plate" – "sheet as a thin elastic plate" (or maybe simply an elastic beam, since you are using the $\sigma = Y\epsilon$ relation below).

We thank the reviewer for noting this as it is an important point. We will edit the manuscript to have it read *"sheet as a thin elastic plate"*.

p16: "infinitely thin ice sheet becomes numerically unbreakable" -- the opposite problem is that the strain as $kh \to \infty$ (shorter waves/thicker ice) also becomes infinite. In that case including reflection by ice edges is one way to reduce the strain inside the ice [1, 2]. Using the ice wavelength instead of the open water one could also make a difference here too. For both points the ice sheet example of Cathles et al jumps to mind.

This is an excellent point mentioned by the reviewer and also related to the previous comment. Indeed, our current definition of I_{br} suggests that capillary waves, for example, would be able to break meters thick sea ice which is, of course, physically near impossible (aside from the fact that short waves won't penetrate far into the ice cover as they fully dissipate/scatter near the ice edge).
We forgot to specify that Eq. 2 assumes that the ice sheet is thin compared to the wave length (i.e. $h/\lambda \ll 1$) and thus the break-up parameter I_{br} cannot be applied to relatively short waves (i.e. $h/\lambda \gg 1$) as the ice is simply too 'heavy' to be impacted by short waves (and thus the ice will not move compliantly with the ice).

To discuss this point further, we will add the following to the manuscript in the Discussion section:

While the current definition of I_{br} *suggests that very short waves always break the ice, it is worth reiterating that the assumption underlying Eq. 2 is that the ice is considered to be thin with respect to the wave length (i.e.,* $h/\lambda \ll 1$*) and elastic (i.e. Eq. 2), implying that the ice moves compliantly with the sea surface. Thus, the threshold of* I_{br} *defined in this study does not necessarily hold for short waves or, strictly speaking, for* $h/\lambda \gg 1$*. While the exact range of* h/λ *for which the observed threshold of* I_{br} *is valid is uncertain, based on the observations presented here (Figure 8), it seems that it upholds for* $h/\lambda < 0.02$*. More observations are required to clarify its validity for* $h/\lambda = O(0.1 - 1)$*. We note that this is not necessarily a limitation of the parameterization of* I_{br} *as short waves are, in general, attenuated rapidly when entering the ice cover due to wave energy dissipation and scattering.*