Review #1

This is a well-written manuscript with a thorough analysis on a set of difficult to obtain field data. The topic is of significant climate interest. This reviewer strongly supports its publication.

All comments below are on minor issues, but should be addressed before publication.

1. Proofread the whole manuscript to eliminate some typos. For example: line 54, remove “be”; line 335, change “smaller the” to “smaller then”.

We thank the reviewer for pointing this out. We confirm that the manuscript has been proofread again and typos have been corrected.

2. Questions on some reference.

2a. The reviewer could not find the spectral attenuation data from Thomson et al. 2018 as mentioned in Fig. 4. The figure caption says that these data were in Liu et al 2020. However, in the Liu et al paper (Fig. 10) one clearly sees 10(c) corresponds to the pancake group in the present manuscript, and 10(f) corresponds to the broken pack ice group in the present manuscript, but no where can the grease ice data be found in Liu et al 2020. Please clarify or revise since this is an important dataset for many readers.

The reviewer is correct that the data used in Fig. 4 cannot be directly obtained from Thomson et al. (2018) who published only the non-averaged values of their experiment. Instead, in the comparison we printed the experiment averaged values which were retrieved from Liu et al. (2020) which are based on the data published in Thomson et al. (2018). Experimental averages of the observations in grease ice are provided explicitly in Kodaira et al. (2020). We note that this is indicated in the caption of Fig. 4, but acknowledge that this was not clarified in the main text. We will therefore mention this in the main text as well.

2b. Line 45, the reference Liu et al 2020 is on comparison of different Sice models, not on model calibration. There are two other papers both exactly on calibration: one using in-situ data and the other using satellite observations. Replacing Liu et al 2020 by these two (and maybe other too) is appropriate: Cheng, S., Erick Rogers, W., Thomson, J., Smith, M., Doble, M. J., Wadhams, P., . . . Shen, H. H. (2017). Calibrating a viscoelastic sea ice model for wave propagation in the Arctic fall marginal ice zone. Journal of Geophysical Research: Oceans, 122, 8770–8793. https://doi.org/10.1002/2017JC013275 and Cheng, S., Stopa, J., Ardhuin, F., and Shen, H. H.: Spectral attenuation of ocean waves in pack ice and its application in calibrating viscoelastic wave-in-ice models, The Cryosphere, 14, 2053–2069, https://doi.org/10.5194/tc-14-2053-2020, 2020.

On the suggestion of the reviewer, we will replace the reference of Liu et al. (2020) by Cheng et al. (2017) and Cheng et al. (2020).

2c. Line 57. The following paper is on ice tongue measurements. It should also be included as in situ data for landfast ice: Squire, V., Robinson, W., Meylan, M., & Haskell, T. (1994). Observations of flexural waves on the Erebus Ice Tongue, McMurdo Sound, Antarctica, and nearby sea ice. Journal of Glaciology, 40(135), 377-385. doi:10.3189/S0022143000007462.

We thank the reviewer for the reference, and will include it in the manuscript.

3. In section 2, for completeness, a brief description of the meteorological conditions would be helpful.

Unfortunately, no wind atmospheric conditions were measured by the instrumentation deployed. However, an indication of the atmospheric conditions can be retrieved from a nearby weather station at Isfjorden. During the experiments, the wind speed ranged from 0-22 m/s, with a mean of about 8 m/s. We note that this wind speed is somewhat higher than what we would expect in Gronfjorden. We will add this information in the manuscript.

4. Appendix C. All models here have alpha explicitly given except C1. For completeness the authors should also obtain alpha from Eqs. (C1&C2) and provide it here.

For this model, retrieving alpha from Eq. C2 is not trivial. For completeness, we already defined $\alpha = 2k_i$ included in-line below C2 but will, on the suggestion of the reviewer, number this formula explicitly as well.

5. Lines 112-113. "For the Antarctic experiment, this assumption was tested using ERA5 re-analysis data in the open water just north of the marginal ice zone indicating a relative bearing of approximately 15 degree." What does this mean? A 15 degree off the line between the buoy pair? How was this accounted for? Did the authors modify the distance in Eq. (3) accordingly? In fact, since each frequency might have its own direction, in fact a directional spectrum is needed. Can the authors discuss this in the manuscript?

Indeed, the incoming waves are not perfectly aligned with the transect of the buoy pair in the Antarctic experiment. Unfortunately, no reliable information is available to determine the direction of waves, for which we therefore have to rely on ERA5 re-analysis. We did not correct for this difference, as we cannot guarantee the accuracy of ERA5. Nevertheless, a 15 degree bearing would imply an error (underestimation) of about 5% of the estimated attenuation rates, which is smaller than the uncertainty of the Antarctic observations.

To attend the reader on this limitation, we will add the following to the manuscript: *"As we do not have in-situ observations of the wave directions (ideally obtained through the directional wave spectrum), we did not correct for this misalignment. We note that for a relative bearing of 15° the estimated attenuation rate would be increased by no more than 5%."*

6. Lines 122-126. The authors remind us that ice viscosity is a parameter, which value depends on the spring-dashpot model used. Hence, it is also necessary to remind us which model was used in Tabata 1958 and Lindgren 1986 when they reported their measured ice viscosity values. The model Marchenko et al 2020, 2021 used is already given in the present manuscript.

Tabata (1958) and Lindgren (1986) describe the ice as a Burgers material (Maxwell-Voigt spring-dashpot model). We will add this information in the manuscript.

7. Lines 219-222. This discussion on the source of turbulence triggers a question: what is the tidal condition in the fjord?

At Gronfjorden, where the Arctic experiment was performed, the maximum tidal range was approximately 1.5 m. However, while this may be a source of turbulence under the ice, it is unlikely to have contributed to attenuation of waves, at least, to a first order approximation.