

The Cryosphere Discuss., referee comment RC2
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Comment on tc-2022-128

Jim Thomson (Referee)

Referee comment on "First observations of sea ice flexural-gravity waves with ground-based radar interferometry in Utqiagvik, Alaska" by Dyre Oliver Dammann et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2022-128-RC2>, 2022

This is a well-organized manuscript presenting exciting new observations of wave propagation in sea ice using Gamma Portable Radar Interferometer (GPRI). The results are mainly limited to two idealized examples from the larger GPRI dataset; these examples are both novel and convincing. Additional measurements from Ice Wave Recorders (IWRs) provide wave direction estimates that are essential to GPRI data interpretation, as well as ground-truth measurements for the waves inferred from the GPRI data.

The IWR measurements could use a slightly more careful treatment prior to final publication. Infragravity waves are notoriously difficult to measure with buoys (seafloor pressure gages are preferred). Certainly, the contrast between the broad-band signals of Fig 3 and the narrow-band (low frequency) signals of Figure 6 is striking... but what are the confidence levels for such small amplitude signals? I think it would be helpful to show an ensemble spectrum of the IWR observations from 24 Apr 2021 with confidence intervals based on the classic χ^2 distribution for a spectrum of that many degrees of freedom. Something like Figure 7 from the recent Squire et al, Wave Motion, 2021. Does the infragravity peak at 43 sec stand-out above this confidence level? My guess is that it does, but it is not resolved particularly well.

Another way to improve the IWR measurements would be to present more details about the noise floor of the instrument. What does an ensemble spectrum from this instrument look like when placed on land, away from industrial vibrations and other signals? Based on this empirical noise estimate, or on the sensor specifications, is it reasonable to expect to observe mm scale motions? These questions do not intend to undermine the results presented, but rather to provide better uncertainty estimates in comparing the GPRI and IWR results.

Some minor additional comments, by line:

line 21: This opening paragraph needs a sentence specific to infragravity waves in sea ice, which have many unique aspects (e.g., bound versus leaky modes, edge wave propagation) compared to sea and swell waves. Two recent papers by Kovalev (ECCS 2020 and CRST 2020) are worth citing.

line 28: a better reference for stereo measurements of waves in ice would be Smith and Thomson, *Anal. of Glac.* 2019.

line 197: identical is a big word. Suggest changing to "the same, within measurement uncertainty"