

The Cryosphere Discuss., referee comment RC1
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Comment on tc-2021-389

Anonymous Referee #1

Referee comment on "Flexural and compressive strength of the landfast sea ice in the Prydz Bay, East Antarctic" by Qingkai Wang et al., The Cryosphere Discuss.,
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This paper presents mechanical property test results of Antarctic sea ice and links those to the prevailing physical properties including porosity, brine volume, grain size, platelet spacing and strain rate. The paper contributes to the state of the art by providing valuable insights of the applicability of several existing methods to the estimation of Antarctic sea ice properties, specifically in the Prydz Bay, and by offering location-specific ice mechanical property and bearing capacity estimation for engineering purposes. The extensive effort to accomplish the research purpose is appreciated and the results are presented and analysed in a logical and clear manner.

The specific comments are:

1. The brine volume and porosity were calculated using ice temperature, salinity and density using Cox and Weeks formulae. The calculation will most likely involve uncertainties which may have an impact on the later investigations. The authors are suggested to comment on the significance of this uncertainty source and its influence on the results of this work.
2. Line 105: the authors are suggested to specify the speed of loading. It is not very clear what 'time-of-loading' means. I assume the ice beam fails very soon after loaded.
3. Line 199-200: some example references can be added to explain 'other commonly used functions'
4. The confidence intervals adopted for various analyse vary from 90% (e.g. Figure 7) to 99% (Figure 6). Is there a ration behind the selection of confidence intervals?
5. It would be helpful to indicate the range of salinity measured among the samples. It is found that the flexural strength is not sensitive to brine volume. Would it be possible that this is because of the small range of salinity coverd by the samples (since they are from the same ice block)?
6. How does Eq. (7) compare to the existing equations in the literature? Are they similar or do they differ a lot?
7. Line 258-259: the sample size may be too small to draw the conclusion on temperature effect.
8. The first paragraph of 3.4.1: nice and thorough explanations are provided here to explain the measured trend of compressive strengths. More references are suggested here to support the reasoning, so that it does not look like own speculation. Same for later parts with such explanations.

9. The small size ice samples are cut from different positions along the thickness direction. Does the measured mechanical properties exhibit dependence on the thickness position? Typically congelation columnar ice is stronger at the top than at the bottom. This relates to Figure 14, where all the measurement has been plotted together in the same figure. The lower envelope probably corresponds mainly to flexural strength at the bottom, while in the case of bearing capacity ice fails at the top layer. This leads to conservative estimation of the bearing capacity.
10. It may be worth also mentioning the influence of platelet spacing in the conclusion part.

Some technical corrections:

1. Line 51: the statement after 'because' tells why there are more understanding of mechanical properties of Arctic sea ice, but not really the reason why there are very few for the Antarctic. Consider rephrasing to make it more natural.
2. Line 53: 'south pole' means exactly the pole (latitude 90). Here it should be something like 'Antarctic continent'.
3. Line 128: rule -> ruler?
4. Figure 4b: the pictures are small, making it difficult to see clearly the crystal structures. Consider enlarging.
5. Eq. (8): typically equation follows immediately where it is firstly mentioned -> move 'overestimation ...' to after Eq. (8)
6. Line 379: empirical -> empirically
7. Line 420: photted -> photoed
8. Line 438: radiuses -> radii