

## **Reviewer's Comments on the manuscript tc-2023-26: "Ice plate deformation and cracking revealed by an in-situ distributed acoustic sensing array"**

This manuscript discusses the use of a Distributed Acoustic Sensing (DAS) array for studying seismic events and wave propagation within ice plates, with a focus on understanding processes like ice structure dynamics and fracture mechanics. The study employed DAS technology on a frozen lake, detecting seismic signals including icequakes and low-frequency events. Icequakes were associated with ice cracking and localized temperature changes, while low-frequency events exhibited characteristics of flexural-gravity waves, providing insights into ice plate properties. The research demonstrates the effectiveness of DAS arrays for in-situ dense seismic monitoring of ice plates, such as ice shelves, contributing to a better understanding of their dynamic behavior and potential disintegration.

The structure of this manuscript seems to be fine, as well as the conducted research. However, I have concerns regarding the language. I think the authors should improve it before this manuscript can be recommended for publication. I provided number of language issues in the comments below.

A number of general and specific comments and possible suggestions for the improvements are given below.

1. Line 17-18: "Our study demonstrates the effectiveness of a Distributed Acoustic Sensing array as an in-situ dense seismic network in for investigating the internal failure process and dynamic deformation of ice plate such as ice shelf". In this sentence, "in" should be removed. In addition, I think it makes more sense to use "ice plates" instead of "ice plate".
2. Line 77: I feel that the words "experiment commenced" and "experiment concluded" sound a bit weird. I would suggest that the authors use simpler words applicable to experiments such as "started" and "finished" or similar.
3. Lines 70-80: I suggest that the authors provide some details on what exactly they measured with the installed fiber-optic cable. I think a sentence will be enough.
4. Line 87: The authors should replace "exhibits" with "exhibit".
5. Line 89: Remove "to" before "related".
6. Figure 2c: On this figure the authors provide temperature curve. Is this the air temperature? I suggest that the authors indicate this either on figure itself or in the caption. Besides, I do not see an axis for the temperature and, therefore, have no idea of what is the temperature. I suggest that the authors add an axis for temperature measurements they provide.  
In addition, the authors state that the temperature was measured locally. How far was it measured from the experimental site?
7. Line 194: "where" is missing at the beginning of the line.

8. Line 194: After the word “study”, there should be a comma, not full stop.
9. Line 197: Q is due to..., M is due to... I suggest that the authors rephrase it as it is weird to start a sentence in this way.
10. Discussion section: I suggest that the authors do not start the discussion section with the word “Indeed”.
11. Line 214: “In the study of Nziengui-Bâ et al. (2022), the Young’s Modulus are below 5 GPa”. Replace “are” with “is”.
12. Line 217: In this sentence, the authors state that when the lake surface is covered with clear ice free from snow, that implies a stronger stiffness. I would disagree with this statement. I do not think that if the ice is clear, it means it has greater stiffness. I suggest that the authors either rephrase this sentence, or provide a reference to the work that confirms that the clearer the ice is, the stiffer it is.
13. “This range represents the stiffness or rigidity of the ice material, with higher values indicating greater stiffness.”. Is this sentence necessary? Does it bring new value to the reader? I leave it for the authors to decide.
14. Since the authors put a lot of efforts into the discussion of the measurements of Youngs modulus that were done in the past, I think the authors should mention this work (reference below) where the authors investigated how Youngs modulus of ice is affected by compression/straining and cracking in along different directions (most results depicted in Figure 3). The authors found that the Youngs modulus initially is around 9.5GPa but starts to decrease once the ice is compressed uniaxially and saturates at about 8.5GPa along the loading direction and 7GPa along two other directions perpendicular to the loading direction. I think this observation is pretty interesting.  
Renshaw, C. E., Schulson, E. M., Iliescu, D., & Murzda, A. (2020). Increased fractured rock permeability after percolation despite limited crack growth. *Journal of Geophysical Research: Solid Earth*, 125, e2019JB019240. <https://doi.org/10.1029/2019JB019240>.
15. I suggest that the authors mention the relationship between stiffness and Youngs modulus since they use these two terms very often, or why they sometimes use the word stiffness and sometimes Youngs modulus.
16. Line 232: I am actually a bit surprised that it is possible and interested in how is it possible to estimate the thickness of the grain boundaries using a value of Youngs modulus. The authors claim that it is possible and provide a reference to Wang 2008, however, I did not find this reference in their Reference list. The authors have to fix this.