Flexural and compressive strength of the landfast sea ice in the Prydz Bay, East Antarctica
by Wang and others

General comments

I suggest you try to keep the result to *your own results only*. The comparison to others and discussion on why fit better in the Discussion section. For example sub-section 3.2.1 is almost only comparison with others and discussions on why. Put this content in the Discussion section.

1. Introduction

OK, perhaps also refer to Strub-Klein and Høyland (2012).

2. In-situ sampling and laboratory experiments

2.1. In situ sampling

1. Ice temperature profile during field work? I suggest you move this information from section 4.2 into the *In-situ sampling* section.
2. What was the air temperature during field work? Do you have a air temperature history a few weeks back?
3. How long time did the field work take? Or how long was the ice exposed to the air temperatures and possibly solar radiation?

2.2. Laboratory experiments

2.3. Crystal structure

2.4. Bending tests

Elastic modulus. Could you explain how you derived these? Equation 2 only give a force and a displacement. But, there must be some kind of $\Delta F/\Delta\delta$? There are several ways to do this, one may search for the steepest part of the curve, use some kind of average etc.

2.5. Compression tests

1. Measure of displacement. I assume this is the position of the loaded plate and not the compression of the ice sample? I don't know your machine, but usually there is some elasticity in the machine that gives a somewhat lower compression of the sample than what is given by the displacement of the loaded plate.
2. Equation 3. Perhaps use F_{max}?

2.6. Uncertainty analysis

The numbers here could be used to give a reasonable amount of numbers in the dervied properties.

3. Results

3.1. Crystal structure

Where is the water line in Figure 4?

3.2. Flexural strength

1. The values of flexural strength are given with a lot of number. But, if you consider an uncertainty of 0.002 and a value of about 700 it should be sufficient to give numbers like 511 kPA, 846 kPa etc.
2. Why not give flexural strength of snow ice also here?
3. As explained above I suggest to move the content of sub-section 3.2.1 (Congelation ice) to Discussion.
4. Line 192. *the region specific*. I don't like this explanation at all. The ice does not know where it is, it only knows which physical conditions it has been exposed to. It is OK if you cannot explain why things are different, but do not blindly blame Geography!
5. Differences to Timco and O'Brien (1994). T&B give some kind of upper limit and this means that almost any set of experiments will give lower average values. In other words it is natural that you find lower values.
6. Differences to Karulina et al. (2019). Here your results are higher and there are some obvious differences that should be discussed. Firstly, Karulina et al. (2019) tested in field, secondly they tested larger beams larger beams. It could be that their beams had more weaknesses than yours. You prepared the beams carefully in the lab and these two facts may help to explain. Also the different testing methods may have contributed.
7. It is interesting and new that you investigate the flexural strength in relation to grain size and platelet spacing. Very nice.
8. Figure 5. It is interesting to note that the slope was more or less equal for the columnar and mixed ice, in spite of different strengths. And that the peak deformation was equal for the snow ice and the mixed ice in spite of very different strengths. Was this coincidental?

3.3. Effective modulus

1. As explained above you need to explain how you found the effective elastic modulus (E).
2. E is a function of force, displacement and time. The more time a tests takes the more important becomes the viscous (or delayed viscous) deformation. The time-dependent deformation is know to be a function of salinity(brine volume). Did Karulina et al. (2019) load with the same load/displacement rate as you did? If they loaded more slowly it may explain why they found $E = f(brinevolume)$?

3.4. Uniaxial compressive strength

3.4.1. Congelation ice

There is much more available published data on uni-axial strength and it is good to see that your results are more or less in line with what we think we know from before.

3.4.2. Mixed and snow ice

Any comment on physical properties of the snow ice? You do not report densities or porosities. Why? If the ice was too porous to shape samples properly, please say so. Did you have any impression from visual observation? Was the ice more porous or why was it weaker?

4. Discussion

4.1. Ratios between strengths

You could also compare with Moslet (2007) and Strub-Klein and Høyland (2012), they also report vertical / horizontal uni-axial compression strengths. I don't think you can claim that you have found the unique ratios between uni-axial compression in vertical direction, the same in horizontal direction and flexural strengths. Moslet (2007) argues that this is a function of ice temperature among other things.

4.2. Comparison between field and lab

This discussion should be linked to the comparison with Karulina et al. (2019). One important aspect I suggest you think about is cooling and then heating of the sea ice. We have tested relatively warm ice in-situ, then sampled cooled down (-15C) and stored (some weeks or some months), and finally heated again and tested. The samples that were cooled down and heated again were clearly stronger than the in-situ ice even if the temperature was the same! I think this is an important, and not understand mechanism in ice mechanics that should be studied, it may explain why SYI and Old Ice are both stronger than FYI even for comparable temperatures, and porosities.

4.3. Bearing capacity of landfast sea ice in the Prydz Bay

5. Conclusions

References

Karulina, M., Marchenko, A., Karulin, E., Sodhi, D., Sakharov, A., Chistyakov, P., 2019. Full-scale flexural strength of sea ice and freshwater ice in Spitsbergen Fjords and North-West Barents Sea. Applied Ocean Research (90, 101853), https://doi.org/10.1016/j.apor.2019.101853.

Moslet, P. O., 2007. Field testing of uniaxial compression strength of columnar sea ice. Cold Regions Science and Technology (48 (1)), 1-14.

Strub-Klein, L., Høyland, K. V., 2012. Spatial and temporal distributions of level ice properties: Experimental and thermo-mechanical analysis. Cold Regions Science and Technology 71, 11-22.

Timco, G. W., O'Brien, S., 1994. Flexural strength equations for sea ice. Cold Regions Science and Technology (22), 285-298.