Review of:

Folding due to anisotropy in ice, from drill core-scale cloudy bands to km-scale internal reflection horizons

Submitted to: *The Cryosphere*

Summary.

Bons et al. use measurements of layer folding in ice, across a wide range of spatial scales, to test hypotheses for the mechanism of layer folding. Based on the frequency spectra of their observed folds, they find that folds which develop in the cross-flow direction of an ice stream (here, in Northeast Greenland) are the result of intrinsic anisotropy in ice. This is distinct from the conventional "Biot-type" fold which results from rheological contrasts (e.g., in a metamorphic rock with an intrusion). I find this study an important contribution to a developing body of work on this topic. The article is extraordinarily well written, fun to read, and a great fit for *The Cryosphere* after these minor revisions.

General Comments.

My most significant comment is that you could do more to draw a distinction between the two mechanisms of folding:

- Is there not a good way to include the frequency spectra analysis for biot-type folds? You have the model in Figure 7a, which is great, but for the sake of parallelism with the anisotropic fold (where you use the schist) can you also include some analysis of the image in Figure 2a? or use a different image of the Biot-type folding?
- Figures 2 (c and d), 3 (a and b), 6 (b and c), and 7 (a-c) are all drawing a contrast between the two fold mechanisms. Some parallelism between the figures (which is on top/bottom or left/right) as well as some annotations/labels for biot-type and anisotropic to make it abundantly clear the distinction you are trying to draw. That would all help me as a reader.

Is the horizontal resolution of the radar really 15 meters? Franke et al. (2022) say that the PRF is 10 kHz and aircraft velocity is 260 km per hour (72 m/s), so >100 pulses per meter. There is probably some onboard stacking, so less recorded traces, but even so, at a lower-

level data product there must be better along-track resolution than 15 meters. The reason I think this is important is that you may be able to fill in the gap in figure 10 (extending the radar layer to shorter wavelengths) which would make the entire manuscript stronger in my opinion.
Otherwise, you could consider other radar systems for this or future work? I know there have been recent ground-based surveys at EGRIP with the CReSIS accumulation radar (more like cm range resolution and probably ~cm along-track resolution as well).

The fold amplitude of the radar layer changes significantly with layer depth. Since these layers have harmonic folds, I think that this amplitude change would only shift your power spectra up/down uniformly, not change the exponent you derive. However, it would change the relative placement in Figure 10. Do you think that the nature of the cloudy band folds would change significantly with depth as well? Perhaps expand on this point with a could sentences in the discussion?

In the caption of Figure 8 you mention down-glacier (y-axis) extension in the context of the fabric development. I believe that strain component would not be included in your 2-d model. I don't think that it needs to be, but adding a couple sentences somewhere on how you think this may or may not affect your results would be useful.

Specific Comments.

L33 – space after comma

Eq1 – are you intentionally switching between l and lambda for wavelength?

Eq2 – same as in eq1, suggest using lambda in the text

L138 – I would reframe the start of this paragraph to focus on ice instead of schists. "Ice 1h is comparable to micas" rather than the reverse, since ice is the material of focus in this article.

L147 – citation to 4? Or referencing figure 4?

L148 – I am confused about the reference to figure 2 here.

L148-149 – I would argue that the line scan numbers are not very useful unless there is a history of using them as a convention that I am not familiar with.

L160 – As with the line scan numbering, I argue that citing (Franke 2022) is enough, the survey name doesn't mean much.

L183-184 – Is there a citation for the 16x increase in B?

L189 – is there a reference for the Potts model?

3.2.2 "measured" fold analysis? To draw a distinction from the previous section, it caught me off guard for some reason.

L201-202 – Is there a real reason to use the bag numbers instead of depth?

L219 – Fig 5 comes after 6 in the text

L219 – I assume that you are not implying the radar layer is representative of one of the layers in the ice core, could be worth stating that explicitly.

L238-239 – is this meant to be its own paragraph?

L262 – 7.5x or it says 8x in the figure caption, choose one for consistency.

L308 – Are you interpreting the contrast at 2 mm to be significant? Or within the uncertainty of the measurement. If you think it is representing some physical process, I would expand on it and make it more clear in the figure. Otherwise, I think you can ignore it.

L320-322 – I believe what you are saying here is that you are limited by the range resolution of the instrument? If so, you could consider adding more data for this or future studies (I expanded on this in general comments above)

L364-365 – The data are not really poor quality (the opposite in fact). I would say the range resolution is not sufficient for your objective.

Figures.

Figure 6 – I would keep the data and model results separate, 6a belongs in figure 4 in my opinion.

7&9 – the linear plots don't add much in my opinion. Power spectra are almost always plotted in log space anyway

Figure 7 – As I noted in general comments above, I think you could do more to emphasize the differences you want a reader to see here. Add annotations that point out the peak power at l=8 in (a). Perhaps consider grouping (b and c) separate from (a) to make it abundantly obvious that the reader is meant to be contrasting those.

Figure 8 –Are there any important differences between this figure and 6b aside from the inclusion of the stereographs in (b)? If the stereographs are important, this figure could emphasize those, otherwise, I think anything being demonstrated in (a) can be summarized in 6b.

Figure 9a – Are the two points below your regression line because they are approaching the length of the image? In line 208 you say you 65 mm is the length of the image, so I am not surprised that the power drops off as you approach that wavelength.