Response to reviewer comments for the manuscript: "Array processing in cryoseismology: A comparison to network-based approaches at an Antarctic ice stream"

We thank the reviewer very much for their additional valuable comments that have further improved the manuscript. Below are as detailed responses to the reviewers, stating exactly how we have addressed their points. All our responses are in red.

Reviewer comments:

The authors addressed most of my comments adequately and strengthened the results by repossessing their data using additional filters. Overall, this manuscript has improved sufficiently and can be published after addressing a few issues:

It is not 100% clear to me how the PDFs are used to locate the icequakes. How does the measured takeoff angle and S-P difference are related to the pre-computed values for each location? As far as I understand the PDF represents the probability of a source location given angle and S-P. Is the probability simply the misfit of observed and theoretical values for a given source location?

The overall PDF represents a stack of: the probability of an event arrival with a given take-off angle (both for P and S); and an event arrival having the event S-P time. Individual PDFs do indeed comprise of the misfit between observed and theoretical values. We now communicate this more clearly in the text (L151-153). Hopefully it is now clear. Apologies for the miscommunication/lack of clarity previously.

Figure 5: Now it is clear that the array-based and 3D-located icequakes are not on a vertical line. So, the icequake locations from both location methods are completely different. Or maybe I miss something? You write:" Uncertainty in the velocity structure of the firn layer, especially at P-wave wavelengths (< 10 m) limits the measurement of takeoff angle from apparent slowness used in the array-based method's 3D icequake location procedure. This is what causes the icequakes located using the array-based method to be miss-located directly beneath the array (red scatter points, Figure 5a,b)." Does this mean that the 3D location method fails completely? Wouldn't it be best then to remove this from the paper? You probably have good reason why you want to keep it.

Indeed. That is why we don't use the 3D method further. We include it to show how it fails, caused by the velocity structure of the firn layer take-off angles, in order to emphasise why it is important to account for near-surface velocity structure when performing array processing. We debated whether or not to include it, and decided to include it because it could be useful for deployments with no firn-layer (i.e. directly on ice). We have now endeavoured to make this even clearer in the text (L305-320) and extended the axis of Figure 5f to really exemplify the issue (labelling it on the figure too).

(By the way, it seems that your response to that point in the response letter is incomplete: "• Plot up column results in real detail – to show effect of firn layer")

Apologies for this. We made the change, so not sure why we didn't remove the comment.

Figure 7: ?? in caption. For an analyst it would be very difficult to visually associate these arrivals. I suppose the slowness filter ratio and the requirement of similar back-azimuth makes the association unambiguous for these examples (?). Plotting these examples on the more distant network stations would probably make it easier to verify that these phases belong together based on the move-out.

(also here the response is incomplete: "• Address after new locations and phase associations…")
Apologies for this. We made the change, so not sure why we didn't remove the comment.

Line 160: delete «We also create»
Thanks. Done.

Line 321: space missing "icequakeare"
Thanks. Change made.