Referee comment 1:

Johnson et al describe an apparatus with which it is possible to obtain measurements within 0.5 m of the ice-water interface on growlers. They demonstrate the utility of this apparatus by obtaining short (less than 3 minute) time-series of water temperature and sound, as well as detailed images of the ice face, from some growlers in Hornsund Fjord, Svalbard. This apparatus permits measurements in the proximal boundary, which have previously mostly been limited to the quasi-horizontal ice-ocean interfaces or to snapshot observations further from quasi-vertical ice-ocean boundaries. The exception to this are recent observations obtained using IceFin, but such deployments are costly. As such, measurements obtained using this apparatus have the potential to improve our understanding of ice-ocean interaction in the vertical regime distal to subglacial discharge plumes, where existing parameterisations seem to perform poorly.

Whilst the apparatus has the potential to deliver important measurements, I question whether it is necessary to publish a paper dedicated to describing the apparatus and a test deployment. A lot of the manuscript is dedicated to a lengthy description of the deployment of the apparatus, which I'm sure will be useful information to anyone who uses the apparatus in future, but I'm not sure a paper is the best medium to disseminate that information. Instead, this information (and the rest of the description of the ice frame) might be better given in a users manual, which could be provided alongside a manuscript describing the important measurements and findings that the apparatus has been used to obtain (or could be used to obtain).

We appreciate the referee's comment that recent observations made under ice shelves in Antarctica using IceFin have been a great step forward in terms of making observations at ice-ocean interfaces. We will add a mention of the IceFin deployments in the description of previous observational efforts.

We understand the referee's questioning of whether it is necessary to publish a paper describing only the apparatus and methods of the ice frame. We intend to follow referee #2's suggestions to include some additional quantitative analysis of some of the data which was collected, and we would hope that this will improve the manuscript. We would also like to note that, to our understanding, reporting novel aspects of experimental methods and techniques falls within the purview of the brief communication manuscript type.

Whether or not this information remains in a paper or a user guide, I have some minor suggestions:

Line 1 and elsewhere: I think "apparatus" or similar would be more appropriate than "method". Further in the abstract the framing of the sentence around a "method" means that the ice frame doesn't really get described in the abstract and (as written) it just reads like you screwed the instruments directly to the glacier ice.

We agree that the frame itself should be referred to as something like an apparatus rather than a method. The intention with the use of the term "method" is to include also the procedures developed to deploy the frame, because we feel that describing these is important to enable others to make similar measurements successfully and safely, and without the multiple years of trial and error that we required. The point is well taken, though, and we will make an effort to distinguish more clearly in the text between the physical apparatus itself and the procedures of deploying it.

Line 27: “such processes” is a little ambiguous. Can you expand, or specify that you mean processes related to pressurized bubbles in glacier ice

Yes, we will specify that we mean processes related to the release of pressurized bubbles from glacier ice.

Line 28: “general agreement” – can you be more specific regarding the variable or behaviour here?

Yes, we will clarify that melting rates and observed boundary layer thermal and velocity structure are fairly consistent between bubble-free numerical modelling studies and bubble-free laboratory studies.

Line 29: “models also typically neglect the effects of bubbles” – consider rewording to “but neither the laboratory studies or numerical simulations include the effect of pressurized bubbles” (or similar).

Agreed.

Line 31: “submarine melting” should I think be “submarine melt rates”.

Agreed.

Line 43: perhaps specify that you mean the vertical part of icebergs here, because several studies have very prolonged measurements of horizontal ice faces. Also try to be more specific than “prolonged”, given that the time-series presented here are limited to a few minutes in duration.

Yes, we will specify that we mean vertical faces of icebergs, and clarify that we were able to collect up to ~1 hour of continuous data.

Section 2.1 or elsewhere: can you provide the weight of the frame somewhere?

Yes, we will specify the weight of the frame and its various components.

Section 2.1: can you provide the cost of the frame materials? (even just the total cost)

Yes, we will specify the total cost and cost of the significant components.

Section 2.1: I think the ice screw depth should be given here as well as an estimate of the melt out time during the field deployment (along with the weather conditions at the time) – could you have deployed the instruments for much longer under cooler conditions with larger ice screws?

The length of the ice screws (19 cm) is currently specified in Appendix A, but we can specify the depth that they were screwed into the ice, and also place this information in the main text. The typical time taken for the screws to melt out of 1-2 hours is currently given in section 3.1, which describes the performance of the frame. It is probably true that longer screws and cooler conditions would lengthen this time, and we can make this clear in the text.

Section 2.1: I think you should include how many attachment points for instruments are there on the current configuration of the frame? Could that be adjusted within reasonable weight constraints?

Currently there is one primary vertical beam to which instruments can be attached; the number of instruments is limited by the size and weight of the instruments. We had an additional auxiliary vertical beam, as can be seen in figure 2, which can also hold instruments. The beams are continuous, and instruments can be sampled to them at any point along their length, and there is no reason that a third beam could not be added. The tradeoff is that adding more instruments increases the complexity of the deployment, so it's difficult to specify a specific maximum number of instruments. We can add a more detailed discussion of this to the text, though.

Line 114: related to the above, “Once enough data had been gathered”, is quite ambiguous. Please be more specific to your setup during this deployment.

We agree that this is quite vague, and we will clarify that the factors influencing the length of the deployment were the melting out of the ice screws, and the estimated utility of additional data.

Section 3.4: “in principle other properties of the water…” – could you also measure the distance from some point on the frame to the ice face? Could that give you a direct measure of melt rates? (similar approaches are used to measure accumulation and ablation on glacier surfaces)

This is a good point, and indeed one could measure the distance from a point on the frame to the ice face to measure ablation directly. We will add this to the possible future applications listed.

Line 207: “rods would rest against the submerged face” – I can see how this works if the iceberg tilts towards the ice frame. Does it also work if the iceberg tilts away? Can you make that clear either way in the text?

Since the fixed attachment point is at the top, gravity will pull the frame down and in towards the ice face even if it is somewhat undercut, but of course it is true that at some angle of undercut this will not work. In practice, we tended to choose growlers with relatively flat faces to mount the frame on, partly because of this very issue. We will make this clear in the text.

Figure 2 or a separate diagram: provide the measurements of the ice frame struts. Perhaps also provide the packed dimensions.

The primary frame struts are about 75 cm long, and we will specify this in the text. All of the materials for the frame fit into a Zarges box of dimensions 0.8 x 0.4 x 0.4 m, and we agree it would be wise to specify this somewhere in the manuscript as well.

Figure 3: there are some interesting fluctuations in the temperature data with a wavelength of approximately 50 seconds. Are you able to determine how they come about? Or at least demonstrate that they are not caused by movements of the growler relative to the sensors?

This is a good point. While we expect that the combination of the ice screws and gravity should be holding the sensors in a fixed position relative to the growler, we cannot be entirely certain that the observed fluctuations are not a result of the frame and sensors shifting. Alternatively, they could be a result of different water masses moving past the sensors, but since we have no observation of the flow or 3D structure of the temperature, we can only speculate. We will outline these limitations of the present data more clearly in the text.