Reply on RC2

Our response is highlighted in blue.

General Comments

This manuscript presents an intercomparison between different ICESat-II products (ATL07, UMD) with coincident high resolution LiDAR data captured on the MOSAiC expedition, including excellent work on relative lead detection rates. A very nice, quantitative, abstract is presented providing a concise overview. The methodology is robust and sound, and explained in an appropriate level of detail, in particular the colocation process is very well explained. A comprehensive set of results are presented and discussed extensively, leading to robust and clear conclusions, with any potential limitations clearly indicated and discussed. This is an excellent manuscript of substantive importance and requires only very minimal modifications to further enhance clarity.
We thank the reviewer for this helpful feedback. We have addressed the specific comments below. We will provide a track-change version together with the revised paper.

Specific Comments

Line 3: Suggest replacing 'nearly' with 'over' although I appreciate that 'nearly' was substantially correct at time of submission!
Agreed.

Line 13: Consider removing the word 'significantly' as this typically implies some kind of statistical technique has been applied, which would be quite abstract considering the ATL07 product only indicates one lead.
At line 13, the sentence "Significantly higher detection rates of 42% (30%) are achieved when using the UMD product" is related to the ridge detection (see the previous sentence). We will slightly modify the sentence for clarity: "Significantly higher detection rates" -> "Significantly higher ridge detection rates".

Line 31: Lead identification also has important anthropological implications such as on shipping/navigation, but I leave it to you to decide if including something on this would add or detract from your narrative.
Thank you for this suggestion. Shipping/navigation is a good use case of better lead monitoring. We will add a sentence in the introduction.

Line 49: This sentence introduces ambiguity because it implies that OIB has a 2m footprint, whereas I think this is only related to the ICESat-II April 2019 campaign that was flown at a higher altitude. Consider revising to refer to this specific validation campaign instead of the instrument in general.
Agreed, we revise this sentence: "... Kwok et al. (2019a) used lidar data from a campaign in spring 2019 operating at an altitude of ~1000 m, resulting in footprints of ~2 m, enough to verify the presence of …".

Line 93: I think it would be helpful to the reader to concisely specify which interpolation method is used.

We have used a linear interpolation in 2D here. We will add this information in the manuscript accordingly.

Line 95: I appreciate reporting the altitude in ft if that was the unit it was originally measured in, but I would suggest giving preference to SI units initially.

Agreed. We will report the altitude in SI units first. But we also keep the altitude in ft since this is still commonly used in aviation.

Line 105: Make it clear these flip.

Agreed. We add a sentence to make clear that they can flip: "It must be noted that the naming `gt2l' and `gt2r' depends on the orientation of the satellite and is mutable so that 'gt2l' can be the strong beam and vice versa for other trajectories." We will also add "weak" and "strong" as annotation in Figure 2 as suggested in the other referee comment.

Line 206: This seems entirely reasonable, but could you comment at all on the stability of 250m? Ie. in the region of this value is it invariant to small changes or not.

Considering the strong beam gt2r: When we reduce the maximum distance by 10% to 225 m, we receive very similar values and counts only change for ATL07 seg (85 instead of 87 detections) and ALS seg (101 instead of 102 detections).Increasing the maximum distance by 10% leads to small changes in counts for ALS-full (534 instead of 532), ATL07 seg (89 instead of 87), and ALS seg (103 instead of 102 detections). The mean values (to one decimal place as in Fig. 9) for the different parameters remain the same.

Line 211: Really great justification!

Line 250: Suggest add 'pearson'

Agreed.

Line 327: Suggest rephrasing the rhetorical question at the end of this sentence.

Agreed. We will rephrase this sentence.

Line 437: Some characterisation of the magnitude of 'small' would be helpful here.

Agreed. We will quantify "small" here.

Line 481: Fewer photons

Agreed. We replace "less" with "fewer".

Figures

Figure 1 Caption: May help to instead provide a citation for framsat – similar to as you have provided with OSI SAF. This would allow you to avoid using url hyperlinks within the caption and specify the access date.

Agreed. We will add a reference for FramSat.

Figure 4 Caption: The plot order is ALS/ATL07 Seg/ALS full – but they're introduced in the caption as ATL07 Seg/ALS Seg/ALS full. Please introduce ALS seg before ATL07 seg as per plotting order.

Agreed. We will change the order in the caption.

Figure 4 Caption: I think using the word pair to refer to a set of two strong beams creates ambiguity as pair is normally a strong and a weak beam.

Actually, "pair" here refers indeed to a strong and a weak beam, of which the strong beam of the pairs number "two" and "three" is meant here. We will modify the sentence to make this clearer.

Figure 5 Caption: I would also add a sentence discussing the rmsd as in line 243, this would aid interpretation of this figure as a standalone artefact.

Agreed. We will add a sentence in the caption.