EGUsphere, referee comment RC1
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Comment on egusphere-2022-1122

Anonymous Referee #1

Referee comment on "Linking scales of sea ice surface topography: evaluation of ICESat-2 measurements with coincident helicopter laser scanning during MOSAiC" by Robert Ricker et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-1122-RC1, 2022

General thoughts

This manuscript presents a comprehensive evaluation study of ICESat-2 ATL07 as well as the high-fidelity surface elevation product developed by the University of Maryland using near-coincident helicopter-based airborne laser scanner data from MOSAiC. The detection rates, something that has only been discussed in limited capacity up till now, is very much needed to better interpret ICESat-2 topographic data. The statistics and data comparisons that the authors present are quite thorough and well communicated. Given that the paper is well-structured and the science is sound, the corrections that I point out are minimal. Overall, I think the values given here are critical in the interpretation of how to best use ICESat-2 ATL07 data on larger scales.

More detailed comments

- Line 11: I would remove the “the” before ICESat-2 as it is a proper name.
- Lines 16-17: I do not see the need to include outlook in the abstract.
- Line 32: I would reword “of high interest” and substitute it with something like “important” for simplicity.
- Line 38: A citation of a manuscript discussing how altimeter satellites “cannot resolve the surface topography” is needed here.
- Line 57-58: Maybe mention why the other helicopter flights were unusable?
- Line 117: Remove “, and” from this sentence.
- Line 130-133: This is a bit confusing; you state that the 15th and 85th percentiles of the distribution are retained but later go on to say that the 99th percentile of the trimmed height distribution defines the sea ice surface? Is the 99th percentile of the

15-85 percentile-trimmed distribution? And if so, wouldn't that mean that it is simply the ~85th percentile of the original data suggesting it is NOT the "first interface encountered by the laser"?

- Line 145: Perhaps, if it is not too complicated, it might be worth also checking the 11 m footprint? Authors can then briefly comment on how much of a change that makes to the values but do not have to include any associated plots.
- Line 208-209: Is the local level ice subtracted from all measurements prior to the peak detection algorithm? If so, where is it discussed?
- Line 319: Why do we get this discussion here? Shouldn't these differences be reported on in the Methods and data section?
- Line 356: I am not sure what "a detectable rougher surface in the open leads" could be? Despite picking out the 99th percentile of the distribution, I would expect a distribution collected over an open lead to still register as smooth.
- Section 4.3: Why do you not discuss the 11 m ATL03 footprint, which is likely larger than most features you detect with the 0.5 m resolution ALS, as a source of uncertainty?
- Line 411: Change "previous studies" to "a previous study" or add more citations!
- Line 500-501: You've shown that the weak beams are still useful but perhaps you can elaborate on why one would use them instead or in tandem with the strong beams?

Figures

- Figure 1: "White arrows show the low resolution sea ice drift from OSI SAF" - then maybe change the appearance of the arrow indicating where the helicopter turned and the arrow indicating North?
- Figure 2: Change gt2l, gtr to weak beam, strong beam in the legends - which is which depends on the orientation of ICESat-2 and while it is correct for the time-frame of your study, given their mutability, I would suggest using immutable names where possible.
- Figure 6: What's the significance of "trimmed" and "untrimmed" here? Is the latter the version with the anomalous values? Maybe worth reiterating here.
- Figure 7: Define the hist_w parameter again, the figures and their captions should be as independent as possible.
- Figure 9: May I suggest further reducing the size of histograms and shifting them to the left from bottom up? This should mitigate the initial peaks completely obscuring the bars from histograms that are further up. This is especially confusing when the overlap extends to the histogram that is above the directly neighboring one.