

The revised version of this manuscript resolves all the major and minor concerns I had about the initial version. It is a novel and valuable contribution to the growing scientific literature on remotely sensed depth estimates for supraglacial lakes. I recommend the manuscript for publication subject to the following technical corrections:

102: typo - delete "Center track, s"

Corrected

107: put a comma or "and" between "instrument" and "distributed"?

Comma added

110: you already specified earlier what ATLAS means

Full name removed

113: I see now what you mean by signal photos per shot. You might consider something along the lines of replacing "using" with "returning" because the instrument uses many more photos per laser pulse, just that only this few are returned to the sensor as signal photons. You may also replace "shot" with "laser pulse" to conform to the ATLO3 ATBD Appendix D (Lexicon), but I'm aware that the ATBD and Technical Specs webpage contradict themselves with that nomenclature so "shot" should be fine as well.

We adopted both suggestions. The sentence now reads ‘with the strong beam returning 0.6-3.9 signal photons per laser pulse vs 0.6-1.0 signal photons per laser pulse for the weak beam’

150: replace the comma with a full stop before "We discuss"

Fixed.

170: "probability of likelihood" is a tautology

Indeed! We removed ‘probability of’.

179: add spaces between numerical value and unit in "0.1m" and "0.3m" (SI unit style convention; also in other locations later in this manuscript)

Fixed throughout the manuscript

221: typo - replace (g) with (b)

Fixed

*223-224: The ATLAS dead time is ~3 ns, so the second return should be roughly $3 \text{ ns} * (\text{speed of light}) / 2 \approx 0.45 \text{ m}$ below the primary surface. Looking at a few tracks with clear dead time*

artefacts show that this is indeed the case (e.g. track 848 GT3L on 2019-08-22 between at 79.087<lat<79.127). You can cite Lu et al. (2021, <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2021EA001729>) on this. However, I am aware that the ATL03 known issues document incorrectly states that the echo would occur around one meter below the surface. So the confusion here is not the fault of the authors, but this number should still be corrected to prevent readers from mistaking sensor artefacts for signals in the data. This will be updated in the ATL03 known issues document for release 005.

We thank the reviewer for pointing this out. We were confused ourselves about the 1 m, given the 3 ns deadtime, and read the paper by Lu et al. with much interest. A reference to this is now included in our revised manuscript.

227: "we assume subsurface ice because the layer is less than 1m from the surface": unfortunately, you can't make that argument here, because you would expect the dead-time return to be around half a meter from the surface. Your reasoning for a likely ice layer seems convincing enough even without this remark, so I would just scratch that part.

Following the reviewer's suggestion, we removed the part about the layer being at less than 1 m below the surface. The last part of the paragraph now read: "In this case, we assume subsurface ice because the layer shows trailing photons towards a weakly-resolved lake bottom rather than a distinctive sharp horizontal layer with no curved bottom return."

229: "If this were a specular return, we would expect a high energy surface return to obfuscate the lake bottom entirely." This is not true - as counterexamples see the section of track 848 mentioned above, or the lake over ice example in Lu et al. (2021). Remove this sentence.

Sentence removed

252: footprint size seems more relevant here than geolocation accuracy, but the footprint is 13 m in diameter, so a radius of ~6m seems reasonable either way

OK

279: supplemental fig S3, not S4

Corrected

460: ~0.45 m and possibly ~0.9 m for the specular return

Corrected

483: typo: add a space between "lakes" and "are"

This seems to be Word issue, there actually was a space but barely visible...Fixed!

512: typo: double comma

Fixed

In addition to the suggestions of the referee, we also removed a number of typo's, double or missing spaces, and the made the following changes (line numbers refer to the numbering in the document with track changes):

Line 31: (IPCC 2019, **Special Report on the Ocean and Cryosphere in a Changing Climate**) -> (IPCC, 2019)

Line 106: 'capturing lake depths at various stages of lake development during the summer of 2019, **an unusually intense melt season.**'-> 'capturing lake depths at various stages of lake development during **the unusually intense melt season** of summer of 2019.'

Lines 135-139: information added about ICESat-2 beams naming convention: "**Within a single track, the beam pair is designated by a number, i.e. \3" in "gt3r"**". Each beam pair consists of a strong and weak beam, with the strong beam returning 0.6-3.9 signal photons per laser pulse vs 0.6-1.0 signal photons per laser pulse for the weak beam (Neumann et al., 2019). **The beam is designated with "r" or "l", depending on the orientation of the satellite, as in "r" in "gt3r".**"

Line 159: Reflectance -> reflectance

Line 189: Supplemental Table [1] -> Supplemental Table 1

Line 198: *in situ* depth estimates (**D**)

Line 213-214: Clarified that 75 photons before and after the individual photons are used. This was ambiguous in the original text: "The Surface Detection module determines, for a collection of photons surrounding any individual photon (**75 collected before and 75 collected after; selected in step a.**)"

Line 224: 'with' removed: "the number of photons used to calculate a mean (window) increase **with** over several steps."

Line 244: "(e.g. as in Fig. 2 step a)" -> "(e.g. as **for the lake shown** in Fig. 2 step a)"

Line 340-341: "are shown in Supplemental Fig. S4, Table S1." -> "are shown in Supplemental Fig. S4 **and with their coordinates and relevant statistics listed in** Table S1."

Line 454: "(Supplemental Fig. S4)" -> "(**see also** Supplemental Fig. S4),"

Line 478-480: "with imagery below a 1 meter resolution" -> "with imagery **at a 1 meter resolution or below**"

Line 523-524: repetition of "slight" removed: "slight ice motion, e.g. a **slight** southward shift" -> "slight ice motion, e.g. a **small** southward shift"

Line 535: "These are shown in cyan in **Fig. 9d**" -> "These are shown in cyan in **Fig. 10d**"

Lines 559-561: "Pt." replaced by "point"

Line 617: "**matlab**" -> "**MATLAB**"

Line 620: author contribution added