The Cryosphere Discussions

The Cryosphere Discuss., referee comment RC1
https://doi.org/10.5194/tc-2021-4-RC1, 2021
© Author(s) 2021. This work is distributed under
the Creative Commons Attribution 4.0 License.

Reviewer response to tc-2021-4

Jennifer Arthur (Referee)

Referee comment on "Supraglacial lake bathymetry automatically derived from ICESat-2 constraining lake depth estimates from multi-source satellite imagery" by Rajashree Tri Datta and Bert Wouters, The Cryosphere Discuss., https://doi.org/10.5194/tc-2021-4-RC1, 2021

General comments:

This manuscript presents a new algorithm, 'Watta', for automatically extracting supraglacial lake depth estimates using ICESat-2 geolocated photon heights (ATL03) which are then used to validate empirically-derived lake depths from Landsat 8, Sentinel-2, Planet Labs Skysat and PlanetScope imagery. The authors test the algorithm performance on 46 supraglacial lakes near Jakobshavn Glacier in West Greenland during an intense melt season (2019). Finally, they use this stacked dataset in combination with Operation IceBridge imagery to track volume, drainage mechanisms and ice cover evolution of two individual lakes in this region.

Supraglacial lakes form in the ablation zones of Greenland and Antarctica during the summer melt season and can impact ice sheet dynamics, making lake detection and depth retrieval important. However, lake volumes have been difficult to quantify due to a lack of *in-situ* measurements and uncertainties associated with image-based methods. This manuscript builds upon other recent studies by applying a novel method for lake depth extraction, which is the first application of high-resolution Planet Labs satellite imagery to calculate supraglacial lake depths in combination with other imagery sources and ICESat-2 heights. It also provides useful insight into lake dynamics and ice cover evolution, which to date have been limited by the comparatively coarse resolution of publicly-available satellite datasets (Sentinel, Landsat).

Therefore, it is my view that the findings are of broad interest to the cryospheric community and represent a promising step forward for studying supraglacial hydrology and dynamics. I look forward to seeing further development of this method and its applications elsewhere on the Greenland and Antarctic ice sheets, particularly on floating ice shelves.

In general, this is a well-written manuscript and most of my comments are relatively minor. I would like to see in places some additional detail around the discussion of lake depth retrieval methods (see specific comments attached).

Lastly, The Cryosphere's data policy states that "Authors are required to provide a statement on how their underlying research data can be accessed. This must be placed as the section "Data availability" at the end of the manuscript." Although the authors state at the end of the manuscript that the Matlab code will be converted and shared publicly, I would like to see this section added including statements of how Landsat, Sentinel and Planet imagery can be accessed.

Once the authors address these points and my comments below, I can therefore recommend that this manuscript is suitable for publication in *The Cryosphere*.

Please also note the supplement to this comment:
https://tc.copernicus.org/preprints/tc-2021-4/tc-2021-4-RC1-supplement.pdf