Review of the manuscript “Sea ice melt pond bathymetry reconstructed from aerial photographs using photogrammetry…” by Fuchs et al.

In this study the authors apply a photogrammetric technique for reconstructing sea ice surface topography with the focus on melt pond bathymetry. For method elaboration and testing results of two field summer campaigns in the Arctic, including Mosaic are used. The major novelty of the proposed approach is a correction factor to account for refraction at air-pond surface interface incorporated in the data processing and analysis workflow. Authors further analyse the derived DEM of melt ponds providing basic statistics on their geometry, and using bootstrapping assess a representativeness of pond depths from in situ measurements for pond water/volume estimates. Proposed correction factor can then be used for more accurate calculations of melt pond volumes from in situ measurements.

I am generally very positive about the presented work. Since I did myself a similar study some years ago, I am very much familiar with the scales of technical work/various challenges/computations required for this kind of study. There are only a few minor remarks/suggestions I would like the authors to address, both technical and regarding the analysis of the data.

Line 141: Should it be just 2x2 km^2 ?

Line 146: “Photogrammetrically reconstructed DEMs from 30 June 2020 and 22 July 2020 were leveled to zero water level using a flat plane fitted trough all lateral snow/ice‑open water boundaries positions in the DEM within the cropped…”

I wonder if these Z-control points were selected manually or identified automatically from “melt ponds” objects that fell into the edge?

I have a number of technical comments to Section 3, more to satisfy my curiosity need to say.

What lense correction model the authors have used? The “standard” one available in Agisoft or you ran a target based calibration specifically on the camera and the lens used in the setup? Also, how did you disable the autofocus (just curious, since any movement of lenses changes the optical parameters of the camera system, this must be made rigid in one or another way).

I wonder also if the authors worked with the raw image format or compressed jpgs? One of my challenges (some 10 years ago) was linked with a computational intensity of the entire process due to dealing with tiffs in the original resolution. How computer intensive, in general, the process was in your case. Did Agisoft manage to “digest” the entire “Fortress” in one go or you had to break the scene in pieces? How many images in total where involved into a bundle when building the “Fortress” DEM?

I also noticed that the authors did not apply any ice drift correction to camera positions prior to triangulation. From my experience the drift of sea ice causes the emergence of scene-scale gradients in the reconstructed DEM, but I assume, “forcing” the edges of the derived Fortress DEM through the plane could have helped to resolve the problem.

Line 263: Can you please discuss, how would it work with well elaborated melt ponds later in the season, when nearly vertical walls of the ponds with some 10-15 cm freeboard could emerge by melting?

Line 294: Did you actually run the classifier first with all 9 subclasses and then combined, or you used 3 classes only directly?

Line 336: Are there any more details already published on this vast melt pond? Appears to be a rather unusual object, for the pond to be that deep.

Line 379: I do suggest referring to the Discussion section here where this phenomenon is discussed and the likely explanation proposed, as such a drastic change in elevation (over 1.5m!) immediately grabs attention.

Fig.14 caption: Please add grade shade scale bar for surface elevation (above 0). BTW, did you try to compare DEM from ALS and photogrammetric DEM from this study?

Line 388: What is the contribution of these two largest ponds into the total meltwater/pondwater budget? In general, one can consider making a pdf of pond sizes/pond water volume in order to see which ponds contribute most to the overall pond water budget.

Line 446: “young ice” or “FYI?”

Line 490: Good also to have the elevation (freeboard) measured at these GCPs too , close to the timing of overflight. My experience show that even without accurate XY GCPs, Z-control points already improve the accuracy greatly at they "force" the DEM into their proper position eliminating the elevation gradient.

Line 557: The effect of reducing pond coverage was also observed in Divine et al., 2015 (https://doi.org/10.5194/tc-9-255-2015) when melt pond fraction declined towards the edge of the MIZ due to decreasing floe sizes and hence stronger lateral drainage.