Review of
Observing the Evolution of Summer Melt on Multiyear Sea Ice with ICESat-2 and Sentinel-2
by Buckley et al.
https://doi.org/10.5194/egusphere-2023-189

Thank you for the review of the manuscript. Your suggestions and comments have improved the manuscript. The following responses (in blue font) address your comments point by point.

General comments:
The paper presents high-resolution data of melt pond properties in three dimensions (melt pond fraction, size distribution, depth), which are obtained from satellites (Sentinel-2, Maxar WorldView, ICESat-2) of the newest generation. Analysis is focused on the region of most persistent ice cover in the Arctic, where second- and multiyear-ice is the dominant type of sea ice. The data set covers the whole 2020 melt season, which allows to investigate the full life-cycle of melt ponds from formation to refreeze.
Melt pond depth is retrieved from ICESat-2 by using two different algorithms. UMD-MPA requires manual input, DDA is an automated algorithm. The comparison of the results of both algorithms is very valuable as well as the description of the limits like minimum retrievable pond width and depth. The systematic analysis of pond depth in a wider region of the Arctic Ocean is a big step forward to better understand the three-dimensional evolution of melt ponds during the melt season. Such data is also extremely valuable for validation and improvement of melt pond parameterisations in sea ice models. One example, the relation between pond depth and melt pond fraction, is given in the present paper.

We are glad to hear the reviewer found both the results and discussion of the limitations of the tested methods to be valuable, and that they agree that the resulting data set will be valuable for validation and improvement of sea ice melt pond parameterizations.

As cloud-free conditions are a prerequisite for retrieving melt pond properties from the three satellites used, it is still not possible to analyse melt pond evolution in a very high resolution in time in a wider area. However, airborne campaigns could bridge certain gaps. As outlined in the conclusions, such airborne observations as well as in situ observations (coincident with ICESat-2 passes) will also be very helpful to quantify the uncertainty from ICESat-2 measurements.
To summarize, the paper addresses very relevant scientific questions within the scope of TC, and it presents novel data. Substantial conclusions are reached. The scientific methods are clearly outlined and the results are sufficient to support the conclusions.
The title reflects the content of the paper, the abstract provides a complete summary and the paper is generally well structured. The review of existing published work is very good, the number of references is appropriate. Overall, figures and tables are clear and their captions self-explanatory. Mathematical formulae, symbols and abbreviations are correctly defined and used. The use of the English language is very good.

Specific comments:
It might be worth to add another aspect to the discussion. Based on the described errors and limitations in the melt pond properties retrieved from Sentinel-2 and ICESat-2, what is the impact of those errors and limitations on estimates of surface albedo?

We added a sentence to the Section 7 to acknowledge the impact of melt pond fraction results that are biased low on albedo estimates. Following the sentence: “Comparisons with higher-resolution WorldView images suggested that MPF estimates derived from Sentinel-2 are biased low by 7.2% on average, and up to 20% at the peak of the melt season (Sections 5.3 and 5.1),” we add: “Using these data for the derivation of albedo may lead to an overestimation of sea ice surface albedo, as an unponded surface has a higher albedo than a ponded surface.”

Technical corrections:

Line 93/94: Please, check the years in “September 2020 average sea ice extent … (Fetterer et al., 2017)”

This is a dataset with the reference dated to 2017, but updated regularly. added “updated 2023”

Line 395: Please., check “decreased in”.

change “in” to “from”

Line 407: “The the distributions …”, delete “the”.

deleted