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The Cryosphere Discussions
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Interactive comment on "Observations of Sea Ice Melt from Operation IceBridge Imagery" *by* Nicholas C. Wright et al.

Anonymous Referee #2

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Summary

The authors provide an update to the Open Source Sea-ice Processing (OSSP) algorithm and apply it to the optical Digital Mapping System (DMS) images acquired during Operation Ice Bridge flight tracks flown in melting conditions. The OSSP derived relative surface fractions include ice, open water, and melt pond. Statistics on melt pond fraction are important for understanding sea ice evolution, light exchange, and for parameterizing models. The documented improvements to the OSSP are important since the code is being made freely available and potentially facilitates some standardization in the processing of high resolution optical datasets of sea ice during melting conditions.

In general the paper is well written and organized, and the output figures and tables

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concise and informative. The improvements to the OSSP are well documented, however there are some problems with the analysis of the output data from the OSSP applied to the optical DMS data from the Ice Bridge flights. The assertion that, based on the analyzed data, first-year ice (FYI) often has lower melt pond fraction than multiyear ice (MYI) is misleading. There is insufficient data analyzed, and the temporal component of melt pond fraction evolution (including a comprehensive review by one of the co-authors) is mentioned but largely ignored for the purpose of supporting the assertion. Lines 288-293 describe the timing of the acquisition of the DMS images for this study as being in late in the melt season, when ponds have drained to sea level. In this case it can be expected that, for any sea ice that is still above sea level, the mechanically weak FYI will have likely drained and melt pond fraction will be lower than it is for MYI undergoing similar melting conditions. That is consistent with the stage of melting, not the overall behavior of FYI and MYI during melting conditions. The hypotheses in the introduction are therefore poorly stated, the analysis misguiding, and the resulting conclusions are flawed. That FYI experiences greater melt pond fraction than MYI has been more than posited, as stated on line 55, it has been well studied in the context of sea ice geophysical evolution. The authors must analyze their data in the context of the fairly well understood temporal behavior of melt pond fraction evolution on FYI and MYI, and situate their observations in the correct context (late season), using ancillary data if needed. It would make more sense to present the data as is, and evaluate the OSSP algorithm performance, without the general assertions about FYI and MYI behaviors – this not detract from some very interesting results.

Other comments 1. In cases where the sea ice has melted to sea level, and the ice floats below sea level, that is ocean water and sea ice – not melt pond covered sea ice. Has this been correctly specified in the algorithm and resulting statistics?

2. Consistent terminology regarding the season and stage of melt would make the paper clearer and easier to follow. For example, are spring conditions (line 86) actually spring when it is freezing conditions? The June 1st cut-off for categorizing freezing-

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melting conditions is arbitrary.

3. More information on the nature of the training data is required. It would be interesting if the algorithm could be trained to detect drained FYI (i.e. ice previously covered by pond which has then drained once connectivity with the ocean is achieved), since this ice has much different fluid and gas exchange properties compared to exposed ice.

4. Once FYI and MYI are defined the full terms are not required.

5. The assertion on line 225 is biased. Consideration of typical melt pond fraction conditions would include temporal domain, not just the spatial. This has been well documented. There could very well be low pond fraction if the FYI has drained and I would suggest that the sea ice community is aware of this.

Detailed Comments

L=Line L32: 'fine' detail instead of exquisite

L73-74: specify the extent i.e. ground coverage of the images

L108-109: more detail on expanded training datasets is needed

L145: Start this section by defining a pond-free ice area. Otherwise it is a bit confusing, as all areas of exposed ice (1-PF) are pond-free ice areas.

L185: ". . .the large the variability . . ." delete extra 'the'

L217-219: There has been much work done understanding the melt pond fraction evolution for FYI and MYI, and pond evolution is likely explained by drainage mechanisms in this late period.

L269-277: Missing from this paragraph is the occurrence of late season FYI when ponds have drained but the ice is still above sea level. In this case, FYI pond fraction would be less than MYI (likely the case in Figure 10f, for example).

L282-285: There should be mention of diurnal variations in pond fraction due to vari-

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able meltwater input and drainage process which, for level sea ice, can lead to dramatic changes in melt pond fraction over very short periods of time. Subtle changes in air temperature or surface energy balance can predicate these changes in melt pond fraction.

L331-332: This hypothesis is not investigated in the paper since it does not utilize data from early stages of melt pond coverage, when ice is relatively impermeable and differences in melt pond fraction are related to topography hence ice type.

L443: The blue color scheme for pond fraction is difficult to interpret in the figure.

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