

Interactive comment on “A linear model to derive melt pond depth from hyperspectral data” by Marcel König and Natascha Oppelt

Anonymous Referee #2

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König and Oppelt developed a model to retrieve the depth of melt ponds on sea ice using in situ spectrometer measurements. The manuscript is structured logically, generally well presented and the methods appear sound. The purpose of the work, however, is not clearly articulated, many of the concluding statements are not supported by the evidence, and the novelty and significance of this work is limited. For these reasons, I recommend that the authors either substantially broaden the scope of the manuscript or consider submitting to a more specialized journal. I outline some potential improvements in my major and specific comments below.

Major comments

The authors provide no justification for deriving melt pond depths in the introduction. Do deeper ponds have a substantial impact on sea ice energy balance? Are melt pond

C1

volumes required inputs for sea ice modeling? From the introduction, it appears we only need melt pond fraction for forecasting September sea ice area. Without these statements, it is difficult to understand why the authors have put effort into deriving a model for simulating melt pond depths.

The conclusions of this study are not supported by the evidence. In L204-205, the authors claim that their approach is “universal” and able to derive depths from dark and bright melt ponds. However, in the results, it looks like the R² for the dark ponds is much worse than for bright ponds. It is misleading to claim that their model is accurate for dark ponds.

Likewise, the authors state that their study provides “the most comprehensive set of Rrs and depth measurements from Arctic melt ponds...”. However, the study only presents 49 depths from three melt ponds with a depth range of 6 to 25 cm. A quick search of the literature reveals that this statement misleading. Malinka et al. (2018) <https://doi.org/10.5194/tc-12-1921-2018> used coincident depth and spectra measurements from three different areas of the Arctic (SHEBA experiment in 1998, Barrow in 2008 and the Polarstern in 2012). Tedesco and Steiner (2011) [doi:10.5194/tc-5-445-2011](https://doi.org/10.5194/tc-5-445-2011) and Legleiter et al. (2014) [doi:10.5194/tc-8-215-2014](https://doi.org/10.5194/tc-8-215-2014) collected hundreds if not thousands of coincident depth and spectra measurements in a melt pond on the Greenland Ice Sheet that had depths of up to 10 m. The authors should review this literature (including those studies from the Greenland Ice Sheet) before making such claims.

The problems outlined above raise questions about the novelty and significance of the study. The only real result in the abstract is that the “...results indicate that pond depth is retrievable from optical data under clear sky conditions”. As far as I understand (and based on the references in the previous paragraph) this is not a novel finding. The authors should think more deeply about how their study advances our understanding and build on previous research. However, in the present version, this study may only have limited interest to the cryospheric community.

C2

The writing style is vague in many places. For example: L5: “Key elements” L33: “easy-to-use” L96: “expert knowledge” L234: “hitting the same spot” L235: “tricky” L245: “widely independent” The authors should consider being more specific where possible to improve the readability.

Specific comments

L28-209: Considering the apparent similarity between this work and Malinka et al. (2018), the authors should consider adding a much more thorough description of how the two models differ in the introduction.

L29: R2 of 0.62. . . against what? In situ depth measurements?

L52: How long was the pole?

L57: Replace “has been” with “was”

L67: Why was the ice surface dark?

P126: Please justify why pond depth is extrapolated to 1 m when the maximum pond depths in this study were 25 cm.

L186: Excessive referencing of Pedregosa et al. (2011) and scikit-learn developers is unnecessary. Consider removing some of these references.

L191: Please separate dark and bright ponds when presenting correlation coefficients.

L194: “18.17” check precision

Figure 1: Scale bar required for images

Figure 2A: I thought the spectrometer was mounted on a pole. Why is it on the ice surface?

Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2019-261>, 2019.