

## Comment on tc-2021-114

Anonymous Referee #2

Referee comment on "Freshwater Sources and Sinks for Arctic Sea Ice in Summer " by Don Perovich et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-114-RC2>, 2021

### Review of tc-2021-114

---

#### Summary

The authors calculate the freshwater budget for an area of sea ice during summer, evaluating the relative contributions of the sources and sinks, and volume storage in melt ponds, in a time series. Aerial photography provides the basis for scaling of the data according to ice concentration, and floe perimeter to area, the latter important for understanding the lateral melt contribution especially late in the season (around break-up). The rich SHEBA dataset affords them the ability to do this. The need for understanding the fate of melt water is well justified, as is the lack of knowledge on the seasonal cycle. The paper is well written and certainly fits the remit of *The Cryosphere* pending some minor revisions.

*Thank you very much for the helpful review. We will make all the suggested changes.*

Major comments:

More information about the snow and sea ice at the SHEBA measurement area should be given at the outset of the paper. SHEBA is relatively well known, and of course there are references to look up, but the authors should still provide the reader some specific information about the ice condition in the measurement area (snow and ice thickness, age/type, topography). It is not until Page 14 that we learn that it is a multiyear ice floe.

*We will add a paragraph presenting an overview of SHEBA ice conditions at the beginning of the Approach section.*

Measurements from a single lead are used to estimate the relative contributions of vertical and horizontal drainage over a 10-day span. When scaling by IC, it is assumed that measurements at the lead site are representative of the broader area. How safe is this assumption, i.e. are the ponds completely cut-off from the floe edge or could there be some linkages even near the sampled lead?

*The ponds are not cut off from the lead edge. The melt water in the lead is a combination of lateral melt and horizontal drainage from melt ponds. We realize that assuming that one lead represents all leads is a major assumption and will note that in the text.*

It would be helpful if the authors could place their results in the context of emerging sea ice conditions, as a point of discussion. Recognizing the lack of supporting data, some comments about expected sources and sinks could be made about a smoother, and thinner, first-year sea ice dominated Arctic with changing snowfall, floe size distributions, and increased bottom melting. In other words how the freshwater seasonal cycle would be expected to be different or similar to SHEBA. This would fit well with the points about the need for more studies and insights on data collection strategies at the end of the paper.  
*Excellent suggestion. We will add a paragraph to the discussion about this. Results from MOSAiC will eventually address this point.*

Specific comments:

(Page = P, Line = L)

P2L38: Please provide the reference(s) for the freshwater layer impact on gas exchange and aerosol particle production.

*We will delete this sentence.*

P2L41: Suggest "What are the relative contributions ... and how do they change with time?"

*Good suggestion. We will make the change.*

P4L69: The term meltwater is used here. Elsewhere the term freshwater is used. Meltwater is more appropriate in cases where the water isn't fresh such as the ice melt. If the authors choose to stick with freshwater then provide a definition early on such as all relatively freshwater is termed freshwater (or make the distinction).

*You are correct. We will change freshwater to meltwater everywhere in the paper, including the title.*

P6L108-110: Can get rid of '1998' since the year isn't specified elsewhere in the time series related analyses.

*We will delete 1998.*

P7L30: It may not carry much significance in relation to the calculated budget, and observed steady influx of freshwater to the ocean, but the authors should make a short note about whether or not there were any freezing events over the study period.

P13L193: Include mention of the role of wind forcing.

*We will add wind forcing.*

P14L228: It's probably implied that aerial observations would be included in any further studies. But it still would be worth highlighting here their importance for scaling as was demonstrated with the SHEBA data.

*Yes, the aerial observations are critical. We will add text highlighting their importance.*