

The Cryosphere Discuss., referee comment RC1  
<https://doi.org/10.5194/tc-2021-271-RC1>, 2021  
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## Comment on tc-2021-271

Anonymous Referee #1

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Referee comment on "Estimating snow depth on Arctic sea ice based on reanalysis reconstruction and particle filter assimilation" by Haili Li et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-271-RC1>, 2021

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Review on "Estimating snow depth on Arctic sea ice based on reanalysis reconstruction and particle filter assimilation" by Li et al..

The author provides a new method for estimating snow depth, and gives a detailed evaluation of data accuracy. Snow thickness is an important parameter in the cryosphere, which is of great significance to the mass balance of Arctic sea ice, the radiation balance of ocean and the retrieval of sea ice thickness using satellite altimeter data. Therefore, it is a paper suitable for publication in TC. However, at present, there are still many issues that need to be improved or corrected in the method and expression of this paper. Therefore, I recommend that the publication of the paper be considered after major revision.

### General comments

The data used for validation is the focus of evaluating the product quality of the estimated snow thickness data. Therefore, it is necessary to evaluate the quality of the validation data itself and the characteristics of the data source in detail. For example, the data of buoys get the snow thickness on flat ice, which is generally low. A negative value does not indicate error, but indicates that the sea ice surface has melted, etc.

This is a paper that introduces new methods and new data. The access path of new data should be given in the data availability section.

## Specific comments

Line 30: " limits solar radiation absorption" changes to " limits solar radiation absorption by the ocean".

Line 33: "Meltwater originating from thin snow" not just from thin snow, so, changes to "snow and ice surface"

2 Data: Instead of just listing data, we should give application purposes of different data at the beginning, which will make readers more understand the research ideas.

3 Line 100 "Data pertaining to the ten subregions covering the period from 2012–2020 are selected" --This sentence has been repeated several times.

4 Ice mass balance buoy (IMB) data are retrieved from the Cold Regions Research and Engineering Laboratory (CRREL)-Mass Balance Buoy Program-- This data base is initiated by the CRREL, but is jointly maintained by the CRREL and University of Dartmouth.

5 Line 125 "This dataset is developed to monitor the sea ice volume": The IMB cannot monitor the the ice volume because it is not the point measurement.

6 Line 170: Blowing snow lost to leads: wind forcing causes any snow lost from the new snow layer to lead/open water: When the sea ice is relatively compact, the destination of wind blown snow may not be in the waterway or open water, but also in the downwind direction of the ice ridge. Therefore, the snow depth of level ice is generally smaller than that over the ridge.

Refer to:

Wagner, DN, Shupe, MD, Persson, OG, Uttal, T, Frey, MM, Kirchgaessner, A, Schneebeil, M, Jaggi, M, Macfarlane, AR, Itkin, P, Arndt, S, Hendricks, S, Krampe, D, Ricker, R, Regnery, J, Kolabutin, N, Shimanshuck, E, Oggier, M, Raphael, I, Lehning, M. 2021. Snowfall and snow accumulation processes during the MOSAiC winter and spring season. *The Cryosphere Discussions*: 1-48. DOI: <https://doi.org/10.5194/tc-2021-126>.

Lei R\*, Tian-Kunze X, Li B, Heil P, Wang J, Zeng J, Tian Z. 2017. Characterization of summer Arctic sea ice morphology in the 135°-175°W sector using multi-scale methods, *Cold Regions Science and Technology*, 133, 108–120.

7 Line 195 “the 2-m temperature ( $T_{air}$ ) 195 is higher than 0 °C”: Snow may also melt below 0 degrees Celsius, mainly due to solar radiation.

Refer to:

Bliss, A. C., & Anderson, M. R. (2018). Arctic Sea Ice Melt Onset Timing From Passive Microwave-Based and Surface Air Temperature-Based Methods. *Journal of Geophysical Research: Atmospheres*, 123(17), 9063-9080.

8 Line 200 “wind transports snow into the atmosphere” Most of the snow due to the Blowing snow will fall back to the ice, but there is a spatial redistribution. Main mechanism to transport snow into the atmosphere is evaporation.

9 Line 243 "OIB-measured snow depth is 10.79 cm": Whether the two digits after the decimal point are meaningful? also in other similar places. According to my understanding, the observation accuracy of snow depth can hardly be better than 1cm.

10 Line 283 "the IMB-measured snow depth are much smaller than 0, indicating great snow depth underestimation": it is not underestimation, but means the melt of ice surface.

11 Figure 8: what the meaning fro the the increased jump at the end of September?