

The Cryosphere Discuss., referee comment RC1  
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## Comment on tc-2022-266

Anonymous Referee #1

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Referee comment on "Using Icepack to reproduce ice mass balance buoy observations in landfast ice: improvements from the mushy-layer thermodynamics" by Mathieu Plante et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2022-266-RC1>, 2023

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Review on "Using Icepack to reproduce Ice Mass Balance buoy observations in land-fast ice: improvements from the mushy layer thermodynamics" by Plante et al.,

This manuscript needs a major revision or possible resubmission to the TC.

Undoubtedly, this research subject is important and is of potential interest to TC readers. This manuscript contains the following key elements: a) Icepack (v1.1.0); b) ice mass balance buoy (SAMS IMB), c) land-fast sea ice in Canadian Arctic Archipelago (CAA) and d) mushy layer ~ slush layer (mixture of snow and ice).

By the way, please use "SIMBA (snow and ice mass balance apparatus)" in the revised manuscript to present SAMS IMB since this acronym has been used in many papers to name SAMS IMB.

The authors presented the Icepack model; processed the SIMBA data (observations) using a newly developed automatic SIMBA algorithm based on existing methods; simulated ice thickness (calculations) using the Icepack model; Summarized results (observations and calculations); Concluded that the modelled ice thickness is better when applying a mushy layer parameterization; pointed out the simulation errors and give suggestions on further actions. The storyline of this manuscript seems ok, but the presentation suffers various ambiguities and makes it difficult to follow and understand.

Several major comments:

1 What is the relationship between Icepack1.1.0 and Bitz and Lipscomb's (1999) thermodynamics model? To my understanding, CICE is a 2D dynamic-thermodynamic sea ice model developed by the Los Alamos National Laboratory. Icepack 1.1.0 is the one-dimensional module of the CICE model. Bitz and Lipscomb (1999) is an independent one-dimensional thermodynamic sea ice model. Please clarify those models and present clearly how they support each other.

2) Are you trying to develop Icepack or simply to validate Icepack using SIMBA observations? Why is Bitz and Lipscomb's (1999) scheme mentioned separately?

3a) The paper structure is not clear. The current chapters 2 and 3 mixture of many things and need to be reconstructed. One possibility could be

## 2 Data

*Describe the data used in this study*

### 2.1 Weather data

*Describe weather conditions*

### 2.2 SIMBA data

*Describe SIMBA deployment and data*

## 3 Method

*Describe the model/algorithm used in the study*

### 3.1 Icepack model

*Surface energy budget*

*Heat conduction in snow and ice*

*Bottom heat and mass balance*

*Snow-ice interaction*

### 3.2 SIMBA algorithm

I would like to see a sub-section dealing with the weather data.

3b) The result chapter needs significant updates too.

I would like to see a sub-section presenting analyses of weather data. This is very important for readers to understand your model performance and the snow-ice interactions. The weather part is missing entirely both in the data and result sections.

Do you have ice core samples to show how the snow ice was distributed vertically? It would be interesting to add some on-site photos.

4) Several figures can be improved.

- a) Figure 1 is not very representative. Please show a much larger domain so readers can better understand the region's geography. What is the distance between those two SIMBAs? What are the air temperatures and precipitation patterns of those two sites?
- b) Figure 7-12 need revisions. Can authors make those figures to be consistent with the SIMBA figures? The figure captions need improvement for better clarity. Some of the results lines need to be smoothed, e.g., 5-day running mean.

5) Surface retrieval algorithm validation: Could authors perform some statistical analyses to give a concrete assessment of your algorithm performance?

6) section 4.2 (In situ ice mass balance conditions) should be moved to the data section.

7) Icepack simulations section looks weak. I see a description of the results, but please carry out some in-depth analyses.

8) The discussion section looks weak too. I would like to see some tables and comparisons with other studies. I am sure there are a lot of land-fast sea ice modelling papers and snow-ice simulations. Please make some concrete discussions.

9) "Code and data availability. All codes (model and analysis) are available on github upon request. The buoy data are available upon request." I think this statement is not acceptable to the TC. Please make your code and data available with doi link or weblink.