Geosci. Model Dev. Discuss.,
https://doi.org/10.5194/gmd-2019-16-RC2, 2019

Geoscientific Model Development Discussions
Open Access
EGU

Interactive comment on "On the discretization of the ice thickness distribution in the NEMO3.6-LIM3 global ocean–sea ice model" *by* François Massonnet et al.

Anonymous Referee #2

Received and published: 2 April 2019

The paper examines the impact of the discretization of the subgrid-scale Ice Thickness Distribution (ITD) on the evolution of sea ice in an ocean – sea ice model. Sensitivity experiments are discussed changing the number and the range of ice thickness categories. The authors find that the number of categories and the lower bound of the thickest category have an impact on winter ice volume of up to 30% in the Arctic and 10% in the Southern Ocean. They contribute this change to the larger basal ice growth rate in a better resolved ITD. Altogether, the authors conclude that the default ITD discretization with 5 thickness categories is recommended for large-scale climate application.

Printer-friendly version

Discussion paper

The ITD is a key part of most sea ice models used for climate application and the best way to apply the ITD is a relevant scientific question. The applied model and the performed sensitivity studies are suitable to address this. With a few exceptions the paper is well structured and clearly written. The information provided allows the community to reproduce the presented experiments. While the impact of the number of ice thickness categories on ice properties has been studied in the past, the amount of sensitivity studies is novel. The key result that the default ITD discretization is sufficient confirms existing studies. The described impact of basal ice melt on ITD is known to sea ice modellers, but this has not been published in such a clear way beforehand. However, there are issues which need to be addressed.

Major issues:

1. From a principle point of view, the discretization of a distribution will become more realistic by increasing the number of categories. Here, Arctic sea ice extent and volume are most realistic for 1 category only and they become worse by increasing the number of categories. It is stated as a side comment that the total ice volume does not converge (higher for 100 categories when for 50 categories). This is worrying and mentioning that the sensitivity experiments have not been tuned and that there are uncertainties in the observations does not address this issue properly. A comprehensive analysis why the ice becomes thicker is required. It has been shown that the basal ice growth depends on discretization of the thinner categories, but the explanation for the increase from S2.07 to S2.09 (leaving more room for thinner ice) is not convincing and needs further evidence.

2. While the Conclusions summarize the paper quite well, the abstract does not. In the abstract the key statement (default ITD discretization with 5 thickness categories is fine for large-scale climate application) is missing and the impact of ITD discretization is overstated.

Minor points:

3. Page 1, Line 3: “how to implement” the ITD is too general given you only address the discretization.

4. Page 2, Lines 5-6: Melt ponds should be added.

5. Figure 1: S3 panel: Typo for experiment name: S3.09 (not S2.09).

6. Figure 7: I do not understand this figure: Why are only grey bars shown for n-1 categories? Why is the fraction per category divided by thickness, so the integral is not 1?

7. Conclusions: better inclusion of literature mentioned in Introduction.

8. Figure A2: S3.09 (not S2.09).

Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2019-16, 2019.