**The Cryosphere
Discussions**

Interactive comment on "On the influence of model physics on simulations of Arctic and Antarctic sea ice" *by* F. Massonnet et al.

Anonymous Referee #1

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General comments

As the title states, the manuscript "On the influence of model physics on simulations of Arctic and Antarctic sea ice" analyzes the influence of changes in model physics in a sea ice model on the simulated sea ice in both polar regions. The authors thereby compare simulations from the LIM2 and LIM3 sea ice models, coupled to the NEMO ocean model. They define metrics to evaluate the difference in the simulations compared to observations, and use these metrics for both polar regions. This consistent and well-presented analysis is novel and shows very interesting results, which reinforce the fact that more advanced sea-ice model physics generally improve the simulation of the Arctic sea ice. By comparing the same variables in the Arctic and Antarctic, the author's show that this is not necessarily the case in the Southern Hemisphere, where both models show similar errors compared to observations. The results from this study

should hopefully encourage more and more modeling groups to use sophisticated sea-ice models with sub-gridscale thickness distributions and variable salinity profiles in their global climate models. It also points out the need for more studies of Arctic sea-ice and better reanalysis in the Southern Hemisphere. Overall, the article shows a novel study of the effect of improved sea-ice physics in a global model, and it was a pleasure to read. Only three comments for improvements are listed below.

Specific comments:

1. Section 2.1: Which ice parameters were tuned? Just ice albedo, or other parameters as well? As the purpose of the study is to investigate the differences model physics make, it would be good to know which parameters were tuned and how different they are in the LIM2 and LIM3 model. A table with the tuning parameters (if there are several) would be nice to add.

2. Section 2.4: As the main point is to compare the model simulations and the effect of model physics on the simulation, it would have been nice if the models were started from the same initial conditions. I am not asking to redo the simulations, but it would be good to explain here why different initial ice thicknesses are used for the LIM2 and LIM3, and whether these initial conditions still affect the results (one wonders whether they do, as why would one choose different initial conditions otherwise?). This is the most serious comment, and should be addressed before final publication.

3. Figure 2: If possible, I would put the NH and SH figures side by side, so that the figure can hopefully be printed bigger, so we can see the details of the wiggles better.