

Geosci. Model Dev. Discuss., referee comment RC2
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Comment on gmd-2022-170

Anonymous Referee #2

Referee comment on "Sensitivity of NEMO4.0-SI³ model parameters on sea ice budgets in the Southern Ocean" by Yafei Nie et al., Geosci. Model Dev. Discuss.,
<https://doi.org/10.5194/gmd-2022-170-RC2>, 2022

The authors address the topic of parameter sensitivity for simulating Antarctic sea ice, an important topic, and demonstrate some parameters which are particularly important. This is a valuable piece of work that is worthy of publication.

However, I must disagree with reviewer #1 that the paper was well-written. I may not have the requisite expertise to fairly review the paper, but I found the manuscript to be incredibly hard to follow, the Methodology was poorly explained and in particular I was not sure how to interpret many of the figures. I've attached an annotated PDF but here are some general comments that I think the authors should address:

1. Methods - I'm not very cognizant of Emulator techniques, and I struggled to understand many of the results because I wasn't sure how to interpret most of the metrics. I think some concise and clear description of what the metrics indicate, why different emulators are employed etc would be helpful

2. Figures. There are a **lot** of figures, many of which are buried in the Supplemental Material. I think where an entire paragraph or more is devoted to a figure, it cannot be fairly described as Supplemental. There seemed to be no logical reason why some figures are in the ms and some in the Supplement. I don't think the Authors have given sufficient thought on what their key messages are, and what figures are required to convey that message (and more importantly which are not). I suspect that the ms will get much more impact with fewer but well-explained figures, appropriately placed in the main text.

3. Parameter names; the authors consistently refer to the model variable name (or symbol as per Table 1 header) for each parameter (e.g. Cd_ice) rather than a more physically-meaningful long name. For anyone not intimately familiar with SI3 this makes it really hard to follow, without frequently referring back to Table 1. Since the authors focus on only 4-5 parameters, perhaps be a little kinder to the reader and use long names ('Description' in the Table 1 header) in the text.

4. Sub-sections. It took me a while to work out the aim of some of the subsections. Some slightly more meaningful sub-headings would be helpful, and maybe an opening sentence (e.g. in the last section we showed which parameters the model is most sensitive to, we now explore the optimal values of those parameters to match the observed budget..)

Please also note the supplement to this comment:

<https://gmd.copernicus.org/preprints/gmd-2022-170/gmd-2022-170-RC2-supplement.pdf>