

## ***Interactive comment on “Estimating Parameters in a Sea Ice Model using an Ensemble Kalman Filter” by Yong-Fei Zhang et al.***

**Anonymous Referee #1**

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This study utilizes a perfect model study with the sea ice model CICE5 and an Ensemble Kalman Filter in order to demonstrate the usefulness of varying a selected parameter. In this case the Snow grain size ( $R_{snw}$ ). The study investigates both a constant  $R_{snw}$  and a  $R_{snw}$  that varies in space. The spatially varying  $R_{snw}$  improves the results near the sea ice edge but degrades the results in the central Arctic.

Results are based on a series of 18 month experiments that includes a data assimilation period of 6 months during summer as  $R_{snw}$  only influences the results here.

A general note is that studies like these are valuable for calibration purposes, however with a model like CICE that is very complex it can be hard to extract one parameter and calibrate this without calibrating the entire model. This is nicely outlined from line 215 to 220 where the author describes a potential less obvious mechanism that

C1

causes a slightly unexpected result.

The study is conducted as a perfect model study which means that all state variables are available and the truth is known. Can this be transferred to a real observation? I would like to see some comments about this as for instance ice thickness based on altimetry is not available in summer, which is the period chosen for the calibration.

With some minor corrections I find the study worthwhile for publication

I would like the authors to check the figure references as they seem to point to wrong figures from time to time. Especially in the description of figure 3.

Abstract : I would like a comment on the variation of  $R_{snw}$  vs the constant.

Line 39. Despite DA being a normal acronym for data assimilation I would write it in full potentially adding the short version. One should be able to read the abstract without reading the rest in order to find acronyms.

Line 64: Calibration of the none model state parameters are still calibrated in order to improve model state (in this case ice concentration ice thickness). I would rephrase this a bit.,

Line 80: The aim is to improve sea ice forecast all year (I would assume) but the parameter that is chosen is active in summer therefore it makes sense to focus on summer. A slight reformulation is desirable

Line 108. I assume that this is only  $R_{snw}$  that is updated beside the state vector. This is mentioned later but I would like it to be here.

Line 127 – 164: I think that it would make it easier to read if you start describing the free run, then the data assimilation runs (constant  $R_{snw}$ ), and at last the experiments with varying  $R_{snw}$  (either spatially constant or spatially varying).

Line 185 RAB?

C2

Line 192. How does figure 1b show the positive increment of  $R_{snw}$ ? Is it 1c?

Line 238 Is it Figure 3a and 3d?

Line 253 Any explanation for the ice thickness? This is lacking a bit.

Line 347. Is this a report? Can it be found?

Table 1: Two different RMSE's are defined in section 2. Which one is referred to here.

Figure 1 The classical ice concentration/volume annual time series. The problematic part is that the variation from summer to winter is much larger than the variation between ensembles, truth and mean which is the interesting part. I think that it would make sense to normalize with the truth. I don't see the green line in the legend of c.

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Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2020-96>, 2020.