

The Cryosphere Discuss., referee comment RC3
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Comment on tc-2021-353

Anonymous Referee #3

Referee comment on "Seasonal Sea Ice Prediction with the CICE Model and Positive Impact of CryoSat-2 Ice Thickness Initialization" by Shan Sun and Amy Solomon, The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-353-RC3>, 2022

In this paper the authors analyse the seasonal prediction skill of a stand-alone CICE model forced/initialised using CFSR. The study is bipolar, although there is a much stronger focus on the Arctic. The authors show that initialising the model with observed sea ice thickness inferred from CryoSat-2 radar altimetry considerably improves the forecast skill, as has been shown previously for other models in other studies (as they correctly point out).

The manuscript is relatively well written and presented and the results will be of interest to the community. Therefore I think it worthy of publication in The Cryosphere.

However, the figures could do with a bit more attention in relation to figure captions and colourmaps. Furthermore, the study could be better motivated, and the discussion of the figures/results is often rather on the shallow side. I therefore recommend that this manuscript requires considerable revision before it is accepted for publication here.

Particular points

A detailed list of comments can be found in the attached pdf document but I highlight here a few points that will particularly need addressing.

- the study needs to be a bit better motivated. The main motivation I can see for the

study is lines 36-42 which states that fully coupled (AOIL) models are "considered the ultimate tool" (which incidentally would be considered an insult here!) for sea ice seasonal prediction but here the stand-alone model is used in order to "separate various feedbacks among the components of a fully coupled model". However, this separation of feedbacks is not done in the ensuing manuscript! It is also not mentioned anywhere (albeit a trivial point) that the stand-alone approach is much cheaper.

- there is no consideration of internal variability, which is a huge factor for sea ice and in polar regions generally, or significance. Many of the figures contain means of multiple years of model runs, which could also include error bars or shading to help understand the impact of internal variability (or at least inter-annual variability over the study period). Likewise hatching could be added to difference plots to try and portray to the reader how significant the changes are in relation to natural/chaotic differences.
- the CryoSat-2 data, and the way that it is used to initialise the model, are poorly described and so I am left wondering whether things have been done sensibly. There is no mention of what happens with thinner ice (for which CS-2 errors are near-infinite!) and no mention of what is done with the snow on top of the sea ice. Furthermore, it looks like they have not been very careful with their QC because the CryoSat-2 "pole hole" appears as open water in the sea ice concentration for their "alt-init" runs!
- >95% of the article is focussed on the Arctic but with approx. 4 sentences and a 1-panel figure on the Antarctic, which feels a bit orphaned within the bigger picture of this manuscript. I think the authors should drop the Antarctic and limit the scope of this study to focus on the Arctic only - particularly given that the impact of SIT initialisation cannot be evaluated there, which is actually the second half of the manuscript title!
- the results are often only described in a very shallow way without any mechanisms or processes being given. For example, the increased basal & top melting for the runs with thinner sea ice is not obvious and so the mechanisms should be talked about
- there is general confusion between 1D and 2D sea ice variables/quantities in the figures and accompanying text. For example, sea ice "extent", "area" and "concentration" seem to be used interchangeably and so are "thickness" and "volume"
- many of the titles, legends and colourmaps used in the figures are not intuitive for the reader. there are also some 'rainbow' colourmaps, which are also problematic for people who suffer from colour-blindness.

Please also note the supplement to this comment:

<https://tc.copernicus.org/preprints/tc-2021-353/tc-2021-353-RC3-supplement.pdf>