

The Cryosphere Discuss., referee comment RC4  
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## Comment on tc-2021-35

J.-F. Lemieux (Referee)

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Referee comment on "Perspectives on future sea ice and navigability in the Arctic" by Jinlei Chen et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-35-RC4>, 2021

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Review of 'Perspectives on future sea ice and navigability in the Arctic' by Chen et al.

In this paper, the authors use CMIP6 simulations to assess the navigability in the Arctic until the end of the 21st century. I think the topic of this manuscript is very interesting and timely. Although the manuscript has the potential to be a nice scientific contribution, I find that it requires a lot of work and substantial revisions. The authors need to clarify many aspects of their methodology. Moreover, I find that the figures require a lot of work; there are typos, captions are incomplete and readability is difficult due to the font size. Finally, I really think the English should be improved. This manuscript could be considered for publication in The Cryosphere once the authors have addressed the following comments.

### MAJOR COMMENTS

1) Section 2.1: the authors need to better explain how they selected a subset of CMIP6 models for their study.

-For a given model, did you use all the members or just the ensemble mean? What do we see in Figure 1?

-I don't understand why the authors base their selection on the correlation coefficients and not on the trends of the sea ice extent. Is the correlation calculated in detrended time series or on the original ones? I guess on the original ones, the correlation in fact measures the quality of the trend. Please clarify. Note that another way to select a subset of models would be to follow the approach of Notz and SIMIP community GRL 2020.

-In Figure 1, there is more variability in the observations than in the CMIP6 time series. Is it because the averaging window (5 points) is not applied to the observations? Please clarify.

-For many analyses and figures (e.g. figure 6) it is not clear if the authors use the multi-model ensemble mean? Please clarify.

2) Section 2.2: the authors need to clarify equations (1), (2) and (3).

-what are the ice types in equation (1)? Do you get these from the CMIP6 simulations? I would be surprised. I guess you get concentration and thickness. Related to this, please make sure you use the thickness ( $h$ ) and not the mean thickness in a grid cell or in other words the volume ( $h \times \text{concentration}$ ).

-once you find an IM (e.g. equation (2)), how do you calculate IN in equation (1)? Is it the same IM for all the ice types? This needs to be clarified.

-what do you show in Figure 6? Is it IN? Why is it called Arctic navigability then? Also explain how you define navigable area. Is it where IN is greater than 0?. Please clarify.

3) The figures need to be improved. Here are some comments related to that.

-all the figure captions need to be reworked. At the moment, they don't provide enough details.

-use units and labels that are commonly used. Example, in figures 1 and 2, the units on the y axis should be M km<sup>2</sup> and the label should be September sea ice extent (not remaining ice in September...with the typo in remaining).

-increase the font size for the text. It is often very difficult to look at these figures.

-figure 3: wouldn't it be better to use a histogram instead?

-there are lines or features emanating from the North Pole in many figures (e.g. figures 4 and 6). Is it the interpolation that is used? I am sure the authors can do better than this.

4) lines 250-255 and lines 306-310: the authors show an abnormal decrease in the navigable area at high latitudes in September. They mention it but argue that this is difficult to explain. As the navigability depends on the concentration and thickness, I think they can explain it if they investigate it a bit further.

#### MINOR COMMENTS

1) lines 42-44: the authors describe a mix of two physical mechanisms in the same sentence. Sea ice reflects a significant fraction of the solar radiation because it has a high albedo. It also reduces the heat transfer between the ocean and the atmosphere as it acts as an insulator.

2) line 103 (and at other places): replace 'excellent models' by 'selected models'.

3) usually the discussion comes before the conclusions. Given the fact that the discussion is really short, I would combine it with the conclusions and name the section: Discussion and concluding remarks.

Jean-Francois Lemieux

ECCC