

The Cryosphere Discuss., referee comment RC7  
<https://doi.org/10.5194/tc-2021-35-RC7>, 2021  
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## Reply on AC1

Luofeng Huang (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-RC7>, 2021

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The replies look good. I recommend the manuscript may be acceptable with consideration of two minor comments based on the authors' answers.

A12: Thanks for your suggestion. Ice conditions considered in this study were ice thickness and ice concentration, in which the function of ice thickness was regarded as a value according to the corresponding interval in formula (2-3). It is hard to distinguish different types of ice, such as level ice, pack ice, and pancake ice in our calculation and Figure (6), but their different navigability for two types of ships has already been quantified based on the ice thickness and ice concentration. So ice conditions still have different functions in ATAM.

Comment: I can understand that it is hard to clearly distinguish ice conditions in your climate model, so you consider them as ice thickness and ice concentration. However, different ice conditions do make a big difference to ship navigability. For example, for the same ice thickness \* ice concentration (e.g.  $t * C = 0.3$ ), pack ice (say  $t = 0.6$  m thick and  $C = 50\%$ ) have a high degree of freedom that level ice (say  $t = 0.3$  m and  $C = 100\%$ ) doesn't have. Thus, ships are easier to navigate in broken ice floes. I think you should at least mention this limitation and say it can be a future direction. I suggest you look into this paper to get insights into the ship interaction with unconsolidated ice floes:

Huang, L., Tuhkuri, J., Igrac, B., Li, M., Stagonas, D., Toffoli, A., Cardiff, P. and Thomas, G., 2020. Ship resistance when operating in floating ice floes: a combined CFD&DEM approach. *Marine Structures*, 74, 102817.

A13: Thanks for your question. The navigability of PC6 ships and OW ships was focused in this study. They also attached a lot of attention in previous researches, such as Smith and Stephenson, 2013 and Melia et al., 2017. Besides, PC3 was concerned in some work. In our opinion, the study for OW ships is more important to shipping industry. This study showed that the Arctic would be accessible to PC6 ships in September in the next 10 years. Certainly, PC3 ships would be navigable.

Comment: as you said, lower ice-class vessels are increasingly important for the current

research. Although your work addresses PC6 ships, I still suggest you give a brief/rough prediction (or comment) based on your research, regarding how many days are navigable for PC3 and open-water vessels, which will very valuable information. Maybe you could also say that you intend to do a detailed future study for PC3 and open-water vessels, or recommend other scholars to look into it.