2nd review of 'Perspectives on future sea ice and navigability in the Arctic' by Chen et al.

I think this is clearly an improved manuscript compared to the initial submission. However, I still think there is some work to do before it can be published. I think the authors can do better than this.

Major comments

(1) My first major comment is related to a question I asked in my first review. I am still puzzled by how you calculate the ice number (equation 1) from the CMIP6 outputs. The ATAM approach for calculating the ice number involves many partial concentrations (Ca, Cb, Cc...). Some of the models that are used are based on a multi-thickness category approach (e.g. CESM2). In other words they simulate a thickness distributions (with partial concentrations...). But then do you have access (in the outputs) to these partial concentrations or you only have the total concentration (along with one value of thickness).

I don't know all these other models but I would guess that some of these, on the contrary, are one-category models. In this case they simulate the total concentration and the mean thickness in a grid cell. This means you would only have one concentration C for ice (and the remaining fraction, 1-C, representing open water).

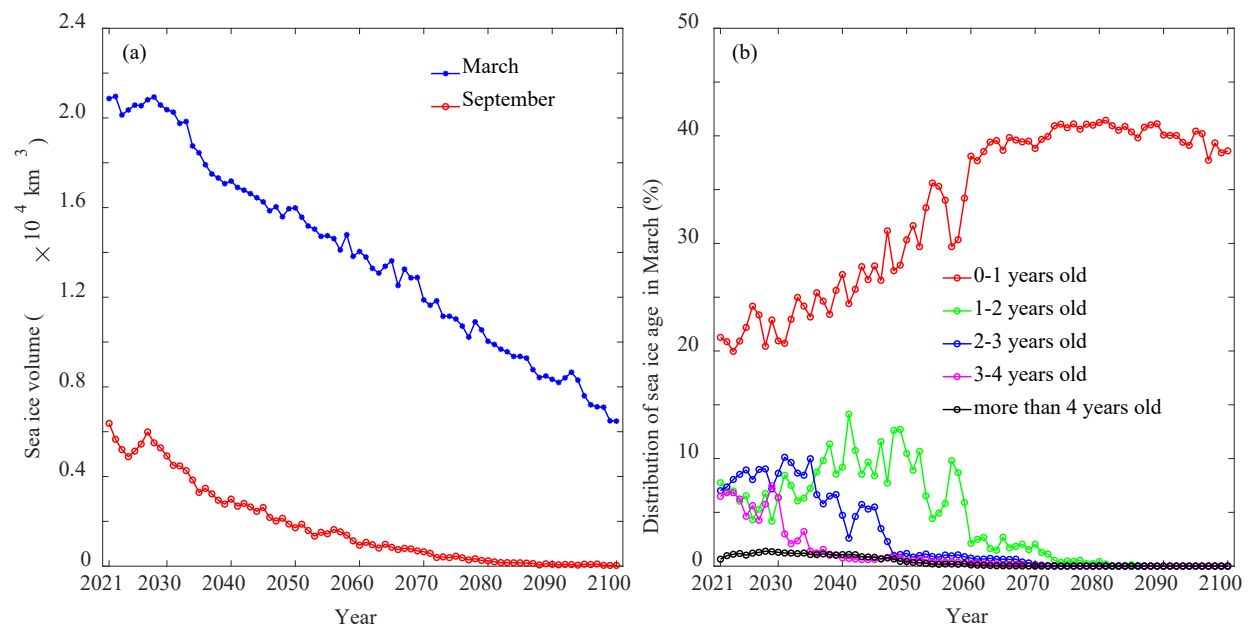
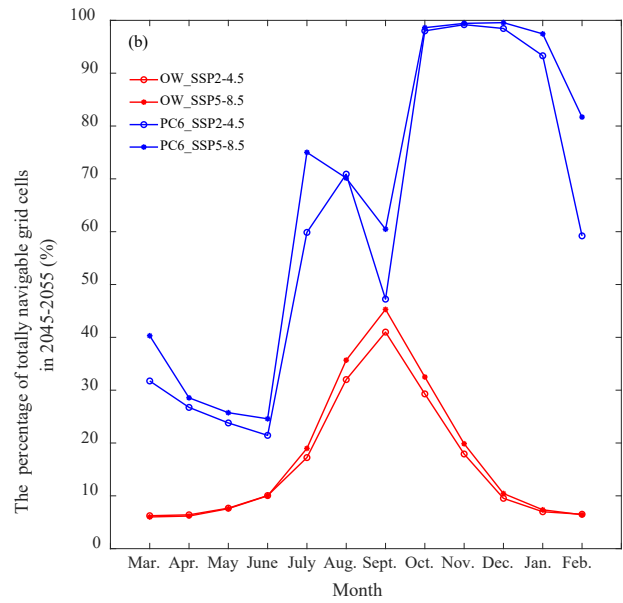
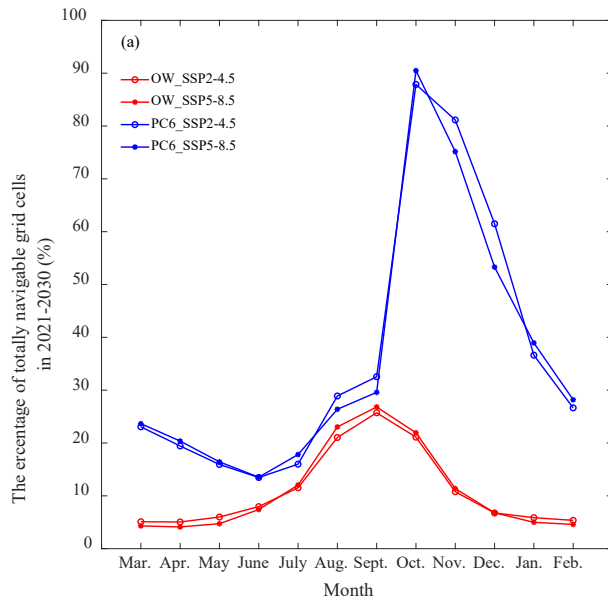
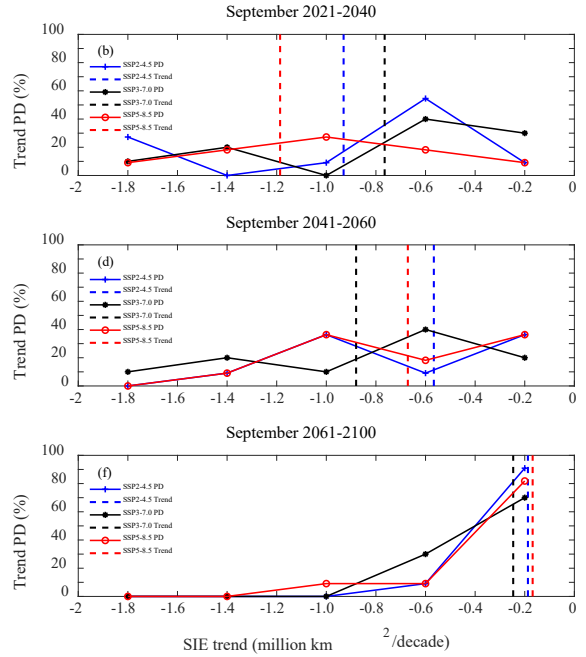
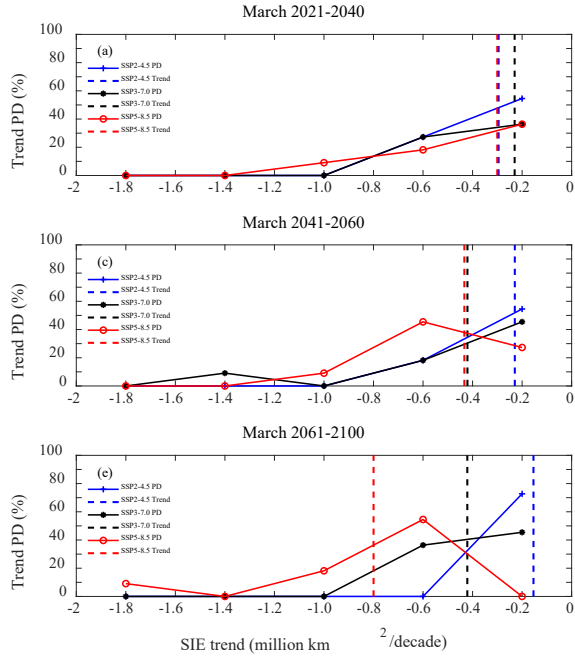
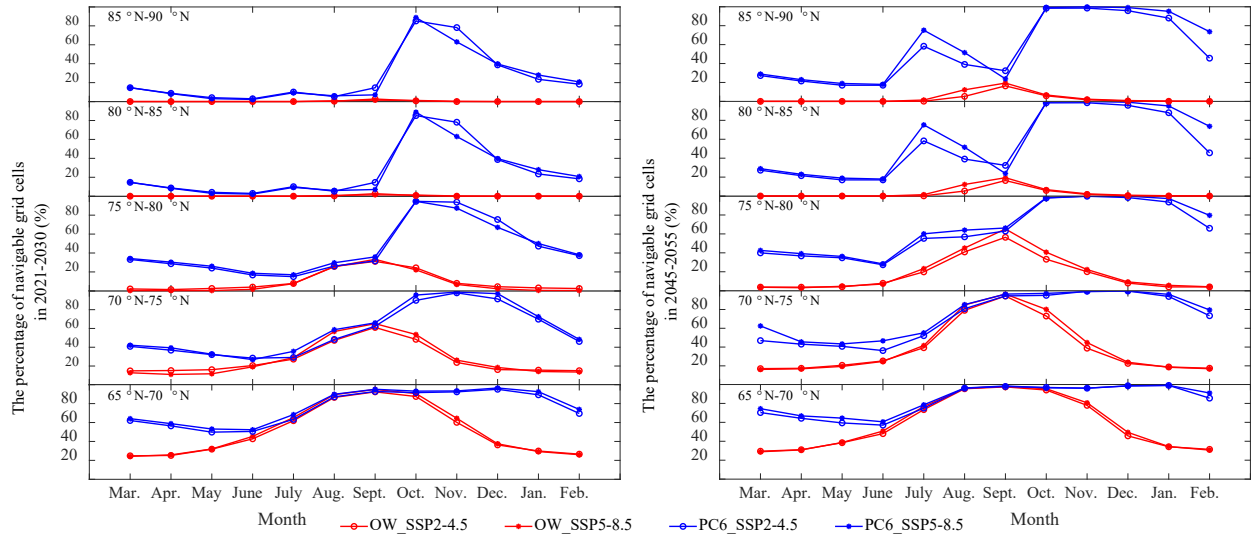
So I really think that this needs to be clarified. Do you ONLY have access to the total concentration and one thickness value at each grid cell? If so, I would keep equation (1) but create a new equation (2) describing how IN is calculated from the CMIP6 outputs: IN=C*IMa+(1-C)*IMb. I would also add in the conclusion that a possible improvement to the current approach would be to have access to the whole thickness distribution for calculating IN.

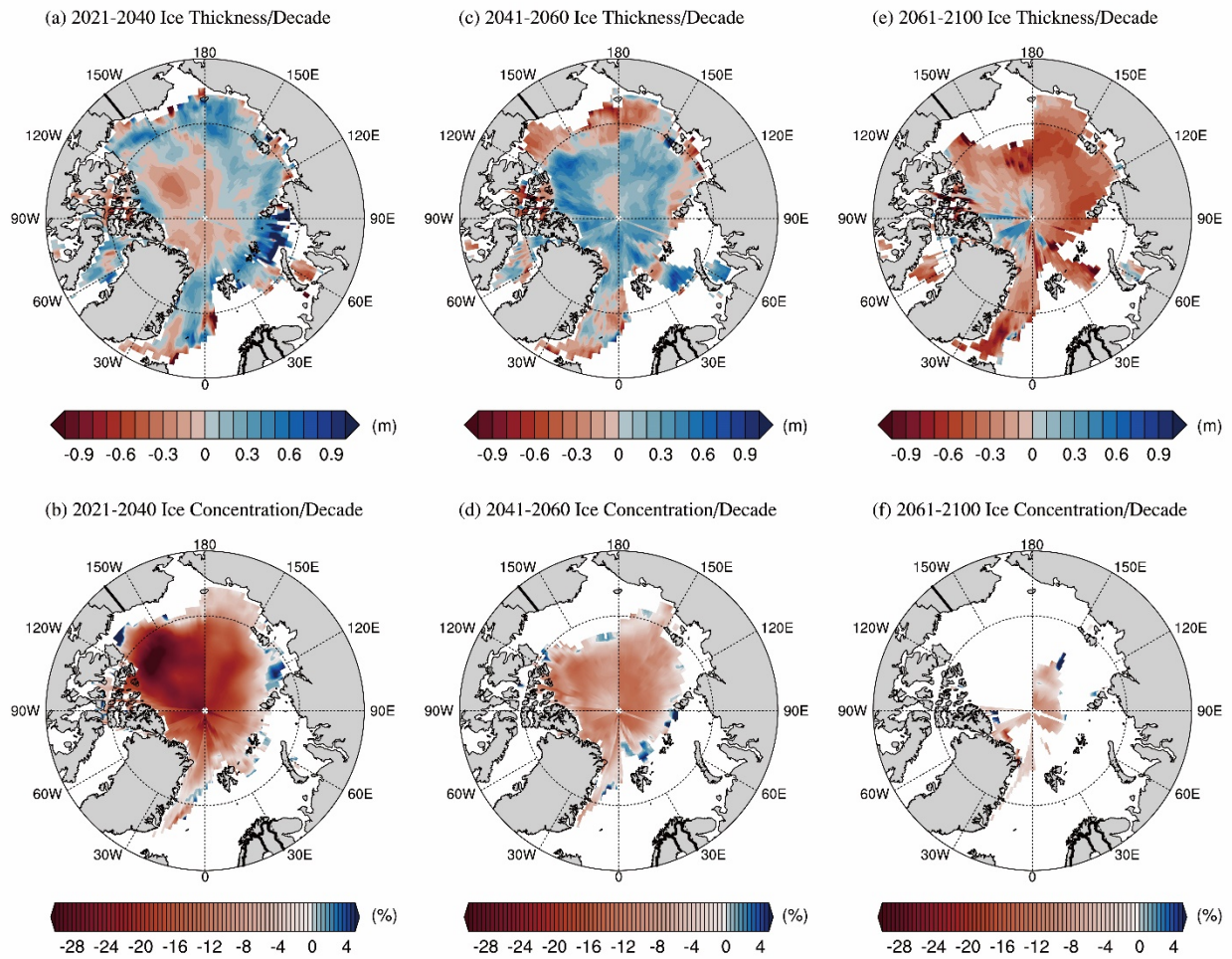
A1: Thanks for your question and discussion.

A1.1: The IN was calculated by various combinations of C (concentration) and IM (ice multipliers in equation (2)) if there are multiple values within this grid. To avoid confusion, the equation (1) was revise as $IN = C_a * IM_a$ in lines 148-151. Because in this paper, ice concentration and ice thickness were normalized to 1°×1° by bilinear interpolation, and IN was calculated with the total concentration and the mean thickness in a grid cell (only one concentration and one thickness).

A1.2: IN=C*IMa+(1-C)*IMb is inappropriate for CMIP6 outputs. C is ice concentration, but 1-C does not make any physical sense.

(2) In my first review I had mentioned that the figures needed a lot of work. I don't see huge improvements. You can certainly increase the font size of labels and legends in many of these. Look for example at figure 5a. Why don't you make the legend (March, September) bigger? Same idea for the x and y labels. I could make the same comment for other figures (e.g. Figure 3).

A: The figures were improved by increasing the font size of labels and legends after first review, but the resolution was reduced when inserted to the word. The original figures, which are very clear with 600dpi, will be submitted to editor when published. The size of labels and legends in Figure 3, Figure 5, Figure 7, and Figure 8 was increased again.

(3) I just realized that Figure 4 is really confusing. It is really hard to compare the panels on each row has the colorbars do not cover the same ranges (e.g. panel (a) shows trends between -7 to 5 while panel c goes between -3.6 and 2.7). This is very confusing and does not show the details (especially for thickness trends). I would set the colorbars between -1 and +1 for the thickness panels and between -30 and +5 for the concentration panels. Also, why do we see trends in regions where there is certainly NO sea ice in September (e.g. panels b, d and f for example West of Norway). You should put a threshold (5%???) on concentration and leave these regions white when there is no ice or very little. Actually you could even use the same threshold (concentration) for the thickness and concentration panels.

A: Thanks for your suggestion. Figure 4 set the colorbars between -1 and +1 for the thickness panels and between -30 and +5 for the concentration panels, and gave a threshold (5%) on concentration in the revised manuscript.

Minor comments

1) line 19: decreasing sea ice...are we talking about the extent here?

A: Yes, it was revised as "...decreasing sea ice extent…"

2) line 44: what timing?

A: This sentence was revised as "Continued declines in sea ice have been projected by the Coupled Model Inter-comparison Project Phase 5 in the Arctic through the end of the century (Meredith et al., 2019)"

3) line 56: The end of shipping season for open water (OW) vessels has reached October 24th since 2010...is it so precise? Do you have a reference for that?

A: Yes, the reference is Chen et al., 2019. It has been cited after this sentence.

4) line 122 change "Index in the" by "Index of the".

A: Changed.

5) line 123 change to "...The selected models are those that have a correlation..."

A: Changed.

6) line 125 change to "Five-point moving averages of the simulated and observed sea ice extents are displayed in Figure 1."

A: Changed.

7) line 132: replace "have not been released on" by "have not been released for"

A: Replaced.

8) line 169: replace "remaining sea ice" by "sea ice extent".

A: Replaced.

9) lines 170-172 and Figure 2: I am a bit confused...do you produce the observation trend using model outputs (line 171, historical ensemble averages) instead of using the observed 1979-2019 NSIDC trend and extending the time series in the future? Please rephrase and clarify.

A: Sorry for the confusion. It is the observed 1979-2019 NSIDC trend and extending the time series in the future. This sentence was revised as "As shown in Figure 2, the observation trend was made with least square regression of sea ice extent from 1979 to 2019".

10) lines 177-186: I would be a bit more careful with this discussion here. The "observed" time series of the extent are in fact extrapolations from a previous time period (1979-2019). We don't know exactly what will happen. I would not write "This will occur in September 2060 with high probability". I would rather use expressions such as "The extrapolated observed time series suggests...".

A: Thanks for your suggestion. This sentence was revised as "The extrapolated observed time series suggests "ice free" will occur in September 2060".

11) line 193: "...with an interval of 0.4..." Give the units after 0.4.

A: Thank you. It should be 0.4 million km^2/decade.

12) line 206: replace "while the results are reliable" by "while the trends are consistent".

A: Replaced.

13) line 234 replace "The oldest ice..." by "As displayed in Figure 5, the oldest ice...".

A: Replaced.

14) line 247 Start the sentence with "Panel a indicates that the probability..."

A: Revised.

15) lines 259-264 When you use the expression grid(s) do you actually refer to grid cells? Example line 264 do you mean it is the percentage of grid cells where INs are greater than 0? (By the way don't forget to add "than" before "greater"). If it is the case it should be weighted by the area as the area of grid cells is not constant (1 degree by 1 degree is not constant). Please clarify.

A: Yes, the grid(s) refer to grid cells. It is the percentage of navigable grid cells other than the area. The area percentage is hard to obtain for the different and unknown area values under 1 degree by 1 degree. To avoid the confusion, "Totally navigable area" in figure 7, Figure 8, and manuscript was revised as "The percentage of totally navigable grid cells".

16) lines 272-273 I see the same decrease for 80-85 not just 85-90.

A: It was revised as "80-90".

17) lines 296-297 "The decadal sea ice extent will increase under SSP5-8.5 in March but decrease in September". Please rephrase as it does not make sense.

A: It was revised as "The decadal rate of sea ice extent will increase under SSP5-8.5 in March, while it will decrease in September."

18) lines 328 I don't think you have defined SIT and SIC before.

*A: Thanks for your reminding. Lines 336-337 were revised as "...for the same sea ice thickness (SIT) * sea ice concentration (SIC) (e.g. SIT * SIC = 0.3), pack ice (say SIT == 0.3 m and SIC = 100%..."*

19) lines 330-331 Please rephrase the sentence "ATAM is hard to...".

A: This sentence was revised as "ATAM is unable to ..."