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Comment on egusphere-2022-94

Anonymous Referee #1

Referee comment on "Influence of fast ice on future ice shelf melting in the Totten Glacier area, East Antarctica" by Guillian Van Achter et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-94-RC1, 2022

Review comments for "Influence of fast ice on future ice shelf melting in the Totten Glacier area, East Antarctica" by Van Achter et al. ï¼□egusphere-2022-94 for TC).

General comments
This study used a high-resolution (2km) regional ocean-sea ice-ice shelf model to investigate the responses of landfast ice, sea ice, ice-shelf basal melt, and ocean around the Totten Ice Shelf (TIS) to a future warming climate scenario (SSP4-4.5). The novelty of this study is applying the prognostic fast ice component that the authors developed as a part of a sea-ice model component in their previous study. Although I have several concerns and suggestions, I think that this paper will be suitable for publishing in The Cryosphere after substantial revision.

Specific comments
1. [Major] L9-11 "The representation of fast ice ..."and discussions with Table 2.
This study concludes that the response of ice-shelf basal melting at the Totten Glacier becomes prominent in the experiments with landfast ice, compared to those without landfast ice. I think that the conclusion is slightly misleading. The areal extent of fast ice becomes small under the future warming condition, and there are no significant differences in the Totten Glacier melting between the numerical experiments with and without fast ice. A large difference in the TIS basal melting is only found in the present-day (1995-2014) condition, creating the tendency in the experiments with and without fast ice.

2. [Major] The literature, Pelle et al. (2021), used a high emission scenario, but this study used the moderate one, SSP4-4.5, without any explanation/motivation. If possible, I strongly recommend performing additional experiments under high emission scenarios to compare the previous study and obtain more solid results under warming climates.

3. [Major] Which forcing drives the future changes in fast ice, sea ice, and ocean fields, atmospheric forcing or ocean forcing? Additional experiments to separate the effects and analyses on them are helpful for readers.

4. [Major] L110-112
I don't think that the two-year spin-up is enough to obtain the quasi-steady states in oceanic variables. In fact, large declining trends in ice-shelf basal melting are found in the first seven years (Figs. 7 and 8). Are these model drift or interannual variability? To avoid including (or decreasing) the model drift signals, results from the second cycle (after the first cycle of the 20-year run) are preferable.

5. [Major] Pelle et al. (2021) pointed out that weakening of Antarctic Slope Front/Current is important for ice-ocean interaction in this region, but the lateral boundary condition in this study is the opposite (e.g., stronger slope current in the future). It is OK there are differences among the studies. This manuscript is a numerical modeling study, and thus I suggest that the author perform additional numerical experiments to identify the role of the strength of the slope current. It is also helpful to understand the difference between the studies.

6. [Major] L155-156 "This acceleration mainly results from the retreat of fast ice, ...". No evidence in the manuscript supports this sentence.

7. [Major] L161-170.
To examine the ASC intensification, some analyses of the climate model (EC-Earth3) on a wider scale are required. Since the ASC is a large-scale phenomenon, not only local wind but also wind over the remote Antarctic coastal regions becomes a driving force.

8. [Major] L197-199 and L226-228
There are no results on sea ice production in the manuscript.

9. [Major] I think spatial distributions related to the ice shelf/glacier basal melt rate are missing in the manuscript.

Technical corrections
10. Figure2: Where are the locations of these observations? There are unrealistic connections in the profiles (probably connecting lines between different locations?).

11. Figures 5, 6, and 9: Please increase latitudes' tick marks (e.g., adding 65S and 67S if they are in the range).

12. Figure3: Please use a linear scale for the vertical scale. Line or shade showing bottom topography is required for panels a-c. A vertical line showing the model domain (63S) is also helpful.

13. Figure 4: Please consider adding 0.75 contours in panels a-b to allow readers to compare the observational result (Fig. 1).

14. Figure 6: Please consider adding contours of the bottom topography.

15. Figures 7 and 8: Please use the same vertical scales, at least for the same regions (TIS for panel a and MUIS for panel b).

16. L268-269: References are required.