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Discussions

Interactive comment on "Response to Filchner-Ronne Ice Shelf cavity warming in a coupled ocean–ice sheet model. Part I: The ocean perspective" *by* Ralph Timmermann and Sebastian Goeller

Anonymous Referee #2

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This manuscript by R.Timmermann and S. Goeller describes a configuration of a coupled ice sheet-ice shelf-ocean model to investigate the impact of A1B warming scenario on the Filchner-Ronne Ice Shelf. Given the enormous impact on human society that Antarctic mass loss might have in the future this topic is highly relevant. The model is at the state of the art, the experiments described are well designed and the analysis of the results is clear. Therefore I have only minor comments to help improve the manuscript before publication.

Specific comments:

There is no comparison between the model and temperature observations, is it because there are no observations in this region or because such a comparison has already been done with previous versions of the FESOM? I imagine it is a big challenge to have a realistic ice shelf thickness and position of the grounding line because it might be highly sensitive to mean biases of ocean temperature and most ocean models have up to a few degrees of ocean temperature bias. What is the reason here for the good position of the grounding line? Is is because RAnGO has very little temperature bias or because there is room to tune the melt rate relations or because temperature is not so important in the melt rate or grounding line position change have a long time scale? It would be interesting to discuss this point in the manuscript.

How realistic is the little increase of ice shelf area during the A1B scenario? One could expect that calving would also increase and the area of ice shelf could reduce. How is calving modelled and how dependent on ice shelf thickness is it?

Also there is no comments about the feedbacks with the ice sheet. I understand this will be discussed in detail in a following paper but it would be nice to say a word also here. The thickness change in the ice shelf depend both on ocean melt rate and on ice inflow from the ice sheet, there are probably feedbacks between these because it is said in the manuscript that an increased vertical slope of the boundary between ocean and ice shelf increases ocean currents along the ice shelf which increases the melt rate.

How does the discussion of section 3.3 relate to the concept of Marine Ice Sheet Instability? Is there locations of reverse slope bed in this region? I expect that the conclusion of this study that to first order using a model with constant ice shelf topography is fine, would have been very different if the ice sheet had been on a reverse slope bed. A discussion of this point in the discussion and a comparison with other ice shelves would help put the results of this manuscript in context.

The ocean part of the RAnGO model is only in contact with an ice sheet model in the

Filchner-Ronne region, how is the interface between the ocean and the ice shelves modelled in ocean regions? In an A1B scenario one would expect that freshwater would be entering the ocean in other regions, could this have an effect on the local ocean circulation?

Small comments:

p.3, l.4: “Is” should be “it”

p.4, section 2.4, the basal melt rates are averaged yearly, is there no seasonal cycle and would it influence the ice model?.

p.8, section 2.6, why does it take so much time to build the 3D grid? The surface grid is already computed, which steps are left? In a typical free surface ocean model with sigma coordinate like ROMS, the sigma coordinates adjust vertically at each time step, this is a very fast process.

p.9, l.5-6 why is figure 7 referenced here? It does not show the in situ freezing temperature.

p.11, l.10 “my” should be “by”

p.18, l.20-21, if some work does this parameterisation it would be helpful to reference it here.

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