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Geoscientific Model Development Discussions

Interactive comment on "NEMO-ICB (v1.0): interactive icebergs in the NEMO ocean model globally configured at coarse and eddy-permitting resolution" *by* R. Marsh et al.

Anonymous Referee #1

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This paper describes simulations of an iceberg model coupled with the NEMO ocean model in two different resolutions (0.25 degree and 2 degree), using atmospheric forcing data. The results seem reasonable, although they often differ from those produced using the same iceberg model coupled with a different ocean model (Martin and Adcroft 2010, "MA"). An interesting result of the paper is the significant difference in Antarctic Coastal Current transport at the different resolutions, associated with changes in the density gradient and sea ice divergence. The paper is well written and contains a great deal of useful information, but several points need to be clarified.

1. My primary suggestion to the authors regards the comparisons with MA. In particular, a paragraph describing essential differences between MA's model configuration

and the present model could be helpful for understanding these differences. It should include atmospheric forcing, calving rates, ocean mixing, and anything else likely to be important that is referred to in this paper.

P 5663 line 23. Why are MA's results so different? Is it because of the change in deep water formation mentioned in line 29?

P 5665 line 12. Are you using the normal year forcing or interannually varying?

P 5669 line 25. Please explain MA's calving rate.

2. Another concern regards the way in which sea ice/iceberg dynamical interaction is addressed in the paper. (It is not addressed explicitly in the model.)

P 5666 lines 17-21. This is very vague and considering your later results, it's not clearly true. Hunke and Comeau (2011) estimate that the dynamical effect is no more than a few percent of total sea ice volume, but your results using thermodynamic coupling show that icebergs change total sea ice mass by only 4% (page 5672 line 12). I agree that dynamical iceberg/sea ice interaction effects will likely be smaller, but I'm not convinced that they are negligible compared with the thermodynamically induced effects.

P 5666 line 26. Using the need to recode as an argument for implementing the iceberg model in the ocean model seems irrelevant – now it would have to be recoded for a different ocean model. An argument for closer coupling with the sea ice model would be to allow the dynamical effects between them, similar to the physical argument for coding icebergs in the ocean model.

P 5672 line 28. "Suggesting a dynamical effect" seems contradictory given earlier discussion about iceberg/sea ice dynamical interaction. It would be helpful to clarify here that you are referring only to dynamics internal to the sea ice model (or possibly forced by the ocean or atmosphere, but not by icebergs).

P 5673 line 1. How do icebergs increase sea ice convergence? Your sea ice model likely includes ice divergence as an output field, or it could be calculated. This would

be interesting to see.

3. Some quantities need further explanation.

P 5667 line 12 and 17. Why do you choose much lower calving rates than used in the other studies cited here, especially considering the Rignot et al (2011) results? What rates do MA use?

P 5667 line 14. I do not understand this at all. Are you using a different ice density?

P 5669 line 11. Is the mass of the giant icebergs included in the mass of smaller modelled bergs, or is this part of the 'missing' mass flux compared with other studies' calving rates?

P 5671 lines 21-27. Here you seem to be comparing apples and oranges, talking about P-E (without sea ice fluxes) or net freshwater fluxes (fig 4) in your model versus total freshwater flux in MA. Please clarify.

P 5672 line 24. Is this thickness the actual thickness over the sea ice covered area, or the mean thickness over the grid cell?

P 5676 line 23. Please mention here and in the abstract that the total mass changes by 4%.

Table 2. Is the virtual coverage by icebergs subtracted from grid areas occupied by sea ice? I.e. is A_bergs + A_seaice + A_openwater = A_gridcell for areas A?

Figure 5. Do the differences here take into account the area occupied by icebergs?

4. Other comments:

P 5664 line 19. What does ICB stand for?

P 5664 line 5. Use 'simulate' instead of 'stimulate'

P 5665 line 19. Treating icebergs as Lagrangian particles seems to contradict lines 3-5 on page 5663. I suggest adding "Collections of" to the beginning of this sentence.

P 5667 lines 23ff. The way this is written, the numbers seem to be for ice discharge only, not liquid water. I suggest changing "ice discharge" to "ice sheet mass discharge".

P 5671 line 8-9. Why do the larger bergs drift farther north?

P 5673 line 18. The differences appear to be negative everywhere near Antarctica in the lower resolution runs. Please be specific.

P 5675 lines 1-4. Which resolution and years are shown in figures 11 and 12?

Figure 2. Please remove the "trajectories" labeling in the figure.

Figure 3. What limits the flux along the eastern side of the Antarctic Peninsula?

Interactive comment on Geosci. Model Dev. Discuss., 7, 5661, 2014.