Review of the article "Impact of rapid sea-ice reduction in the Arctic Ocean on the rate of ocean acidification" by A. Yamamoto et al.

The authors compare two versions of the MIROC Earth System Model that project different Arctic sea ice reduction rates. Their goal is to investigate and quantify the impact of rapid sea ice reduction on the rate of ocean acidification (pH and aragonite saturation state). The authors show that the ESM with higher sea ice reduction rate projects an earlier undersaturation with respect to aragonite of Arctic surface water than the other model. Similar to previous studies they show that decreases in pH and aragonite saturation state in the Arctic Ocean are mainly driven by increases in both CO2 uptake and freshwater input, somewhat damped by changes in biological processes.

In general, the MS extends findings from other published studies (e.g. Steinacher et al. 2009, Frölicher and Joos, 2010) showing that the magnitude and timing of Arctic ocean acidification (decrease in pH and saturation state with respect to aragonite/calcite) depends on the rate of sea ice reduction. Previous studies such as the Steinacher et al. 2009 study focused on a single model with a relatively low sea ice reduction rate. Current observations show that recent Arctic sea ice loss may be more rapid than projected with CMIP3 AOGCMs. Therefore, a study that investigates Arctic OA in a model with more or less realistic sea ice reduction in a warming climate is timely and desirable.

The manuscript is clearly structured and the results are nicely backed-up with figures. However, in its present form, the MS is not yet ready for publication. Following major points should be clarified/addressed:

1) It would be good to add a table that compare the model components of the two different models. Interestingly, both models use identical physical ocean and sea ice models as well as the same ocean biogeochemical module, but different atmospheric components. I am curious to know why the inclusion of a more sophisticated atmospheric model (with increased vertical resolution) leads to a more rapid sea ice decrease? Any comments on that would be helpful.

2) The authors state that the spin-up simulation for the carbon cycle component in the old model was conducted by running the model for 250 years and by starting the model from initial conditions based on climatological data sets. Please specify if preindustrial or present-day initial conditions were used and please indicate literature reference for the used initial conditions. Furthermore, I am a bit puzzled about the short spin-up time. Please show that the deep ocean reaches quasi equilibrium. What do you mean with 'until globally integrated net CO2 fluxes at land and sea surfaces vanished'? Are the transient simulations drift-corrected? Additionally, please describe the spin-up procedure of the new model.

3) On page 10620 the authors discuss different regions where water becomes undersaturated with respect to aragonite during this century. They miss the discussion of the Eastern Boundary Upwelling Systems, such as the California Current System. Theses systems are naturally more acidic than the mean surface ocean (Feely et al. 2008) and are especially prone to progress toward widespread undersaturated conditions with regard to carbonate in a future high CO2 climate. Please discuss that in the introduction.

4) It would be good to put the results of this study into context to other simulations conducted for CMIP3. As most CMIP3 models underestimate the rate of sea ice decrease, one would expect that current ESMs underestimate the rate of OA changes in the Arctic Ocean. Please discuss that in an additional paragraph.

5) The naming convention of the models ("new" version vs. "old" version) is confusing. I assume

that the model will be developed further in the next couple of years. Therefore, I would prefer to write the name of the model version throughout the entire MS.

Specific comments:
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p. 10619, l.3: Please update current atmospheric CO2 concentration.
p. 10620, l.3: add reference Frölicher and Joos (2010)
p. 10620, l.6-9: I guess you refer to the surface ocean and you neglect coastal regions.
p. 10622, l.20: change to 'Ocean Carbon-cycle Model Intercomparison Project'
p. 10625, l.11: add 'was used by Steinacher et al. (2009) and Frölicher and Joos (2010)'
p. 10638/1039 : caption of Fig 2 should be caption of Fig 3 and vice versa.

Technical corrections:
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l. 10618, 1.3: 'sea ice'
p. 10628, l.6: 'undersaturated'
p. 10629, l.5: change DIC from italic to regular.
p. 10630, l.27: 'greater'
p. 10635, l.13: 'physical-biological'
p. 10625, l.28: 'Frölicher'
p. 10637, '(c); and March mean (d) sea ice extent'

References:
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1. Frölicher, T. L., F. Joos, 2010, Reversible and irreversible impacts of greenhouse gas emissions in multi-century projections with the NCAR global coupled carbon cycle-climate model. Climate Dyn. 35, 7-8, 1439-1459, doi: 10.1007/s00382-009-0727-0.
2. R. A. Feely, C. L. Sabine, M. Hernandez-Ayon, D. Ianson, B. Hales, Evidence for Upwelling of Corrosive "Acidified" Water onto the Continental Shelf. Science 320, 1490-1492 (2008)