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Comment on bg-2021-14

Christopher Sabine (Referee)

Referee comment on "Oceanic primary production decline halved in eddy-resolving simulations of global warming" by Damien Couespel et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-14-RC2, 2021

I found this to be a well thought out scientific investigation into the effects of model resolution on NPP changes under a climate change scenario. The manuscript is well organized and the conclusions are clear. This work clearly illustrates the importance of mesoscale processes on nutrient supply and the limitations of the sub-grid scale parameterizations in coarse resolution models. As an observational oceanographer, the methods description and results generally seemed clear and complete but I defer to other reviewers that are more familiar with model details to judge that.

The one aspect that I thought could use a little clarification is how the MOC works in the simplified, two-gyre model. The authors state that the two-gyre model could represent the Atlantic or the Pacific, but of course in the real world the MOC is quite different in these two oceans. I was unclear what exactly drives the MOC in this configuration and how real-world climate change effects that earth system models have suggested will lead to a slowdown of the MOC would be replicated in this two-gyre model.

I would also like to see at least some recognition in the manuscript that this work is examining the climate change effects only on the idealized large-scale open ocean NPP. The simplified two-gyre model with vertical walls and only one ocean, clearly does not reflect the complexities of the real world with dynamic coastal regions and marginal seas that may respond very differently to climate change and anthropogenic forcing. It also does not address how changing ecosystems, for example nitrogen fixers, might take advantage of the increased stratification and reduced nitrogen supply to compensate for a decline in the traditional primary producers. I don’t think the lack of coastal waters or multiple ocean basins is a problem, but it should be recognized that this is just one piece of a much broader and more complicated response of the ocean to climate change.

I appreciate all the figures in the manuscript and as part of the appendix. The one figure that I did not find particularly interesting or necessary is figure 7. I appreciate that the authors were trying to produce a summary infographic, but this did not clearly convey the

idea that model resolution was the driver for the changes outlined in the figure. Perhaps something more than just the words at the top to illustrate this central aspect of the study.

I recommend publication of this manuscript after minor revisions.