

Interactive comment on “Ocean Carbon Uptake Under Aggressive Emission Mitigation” by Sean Ridge and Galen McKinley

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The study of Ridge and McKinley is to be commended for their investigation of mechanisms that contribute to controlling the net ocean uptake of carbon under future climate change. However, there are a few points that I think should be clarified in order that the study be more firmly anchored in previously published research.

Readers of this work should be informed however that Gnanadesikan et al. (2015) is not the definitive work on attribution of the mechanisms controlling the flux of CO₂ between the surface ocean and the interior. The study of Ludicone et al. (2016, SR) in fact considered this question of the relative importance of diapycnal transports and diffusive processes, and demonstrated for the primacy of diapycnal transports as part

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of the overturning circulation in controlling the formation of the ocean interior carbon reservoir

With that in mind, I would recommend that the mechanism highlighted in the manuscript in Equation 14 (ocean dynamics term as being diffusive) be described as an assumption based on the authors' interpretation of the previous study of Gnanadesikan (2015), rather than as a result or a conclusion. But it should also be stated that this interpretation was not in fact tested or fully asserted by Gnanadesikan (2015), I believe that they saw it more as a curiosity that a diffusive model can be tuned to give a result that matches what one finds with a forward model under very specific scenarios.

Putting all of this into more broadly resonant language, I think that it is commonly understood that mode water formation should not be understood to be a fundamentally diffusive process, and given the importance of mode waters for the uptake of anthropogenic carbon (of order half the global uptake) a dominantly diffusive uptake model would run counter to oceanographic observations and oceanographic theory.

I think that this needs to be very clearly communicated to the reader in order to firmly anchor this study in the context of broader oceanographic process understanding. I think that this will then strengthen the scientific presentation of the study.

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