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Interactive comment on “Changes in ocean circulation and carbon storage are decoupled from air-sea CO₂ fluxes” by I. Marinov and A. Gnanadesikan

Anonymous Referee #2

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General comments: The paper by I. Marinov and A. Gnanadesikan “Changes in ocean circulation and carbon storage are decoupled from air-sea CO₂ fluxes” is a nice piece of work. It shows that changes in the spatial pattern of air-sea fluxes of carbon dioxide have almost no impact on the carbon storage capacity of the deep ocean. By employing a suit of different versions of MOM-3 coupled to an OCMIP-2 style carbon cycle model the authors found a compensation effect between ocean circulation and biogeochemistry. When diapycnal diffusivities (KV) in the thermocline increase from 0.15 to 0.6 cm²s⁻¹, the authors found a regime shift in the ocean circulation and, hence, changes in the strength of the biological and solubility pump. Although higher KV's lead to a weakening of both, the biological and the solubility pump, the total pattern of

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air-sea gas exchange changes only little. This is an interesting result, which deserves publication in Biogeosciences, subject to minor revisions.

Specific comments: To investigate the response of the biological carbon pump, the authors use simple restoring to surface nutrient concentrations, which could lead to biased results. Although in the conclusion section on page 7994 (lines 26-29) the caveats have been shortly mentioned, it would be more appropriate to discuss this issue at a more prominent place (i.e. Methods section) of the manuscript. In this regard it should also be clarified, by which extend numerical diffusion could affect the simulations, notably in the limit of small KV's.

Technical corrections:

Page 7986 line 14 replace “the the” by “the”

Page 7990 line 3 replace “supports out contention” by “supports our contention”

Page 7992 line 18 replace “patern” by “pattern”

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