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Interactive comment on "Revisiting ocean carbon sequestration by direct injection: A global carbon budget perspective" *by* F. Reith et al.

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Please see attachment for response to reviewer#1.

Interactive comment on Earth Syst. Dynam. Discuss., doi:10.5194/esd-2016-20, 2016.

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Discussion paper

Responses in Italic

First of all, the authors thank the reviewer very much for his thoughtful and constructive comments and advice.

The authors investigate the impacts of ocean carbon injection (and of direct carbon capture and storage with no leakage) on the carbon inventories of the atmosphere, the ocean, and the land biosphere using the UVIC model. This is a solid study that should be published after taking into account the following comments:

1) The authors evaluate the impact of climate change on the fraction retained by comparing their complete mitigation (CM) simulations without emission forcing after 2020 and the RCP8.5 simulations with continued emissions (WE) (Line 181). They conclude (line 182) that larger climate change in RCP8.5 leads to a higher fraction of injected carbon retained in the ocean (FR).

I doubt that the difference between the CM and RCP85-WE simulations is indicative of climate change. I suspect that the higher fraction retained in the CM compared to the WE simulation is largely the result of differences in the Revelle factor/carbonate chemistry. The higher carbon emissions under RCP8.5 lead to a higher atmospheric and oceanic CO_2 and a higher Revelle factor. In turn a smaller fraction of anthropogenic carbon ends up in the ocean in the RCP8.5 case compared to the zero emission CM case. As in the long run, both simulations with and without ocean injection tend to achieve the same carbon partitioning between the ocean and the atmosphere (when neglecting ocean-sediment and weathering fluxes as done here) this mechanisms also affects the fraction retained. More injected carbon remains in the ocean for the low than for the high emission case.

A proper evaluation of the climatic impacts would require RCP8.5 simulations with carbon emissions, but with radiative forcing from anthropogenic agents set to zero. Then, climate would remain at equilibrium while atm. CO2 and carbonate chemistry would still change.

(Alternatively, I may misunderstand the experimental protocol. This would then require a clarification in the method section.).

Fig. 1. Response to reviewer#1