

## ***Interactive comment on “Anthropogenic carbon dynamics in the changing ocean” by J. F. Tjiputra et al.***

### **Anonymous Referee #1**

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In this submission, Tjiputra et al. describe the evolution of CO<sub>2</sub> fluxes and transport rates in the framework of a coupled climate carbon cycle model (Bergen earth system model BCM-C). For the first time, the evolution of meridional transport rates of anthropogenic carbon is investigated under future climate change. This study provides new insight in the evolution of the carbon cycle - climate interaction and is an important contribution to this field. Therefore, the submission is relevant for a broad readership and is appropriate for publication in OS.

In general, the manuscript is well written, however there are some issues that should be addressed before publication.

The main major comment I have addresses a key finding of the study, i.e. the future evolution of the Southern Ocean air-sea fluxes. These fluxes strongly depend on the

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retreat of sea-ice. A proper modeling of these processes is therefore very important to make any assessment on the future behavior of air-sea gas exchange. I think it is necessary to show how the model performs on present day Southern Ocean sea-ice cover and compare it to other modeling studies. How are the reported changes in Southern Ocean temperature, resp. solubility in the BCM-C compared to other models?

Other comments:

1) It is not clear how EXP1 is conducted. Is the atmospheric CO<sub>2</sub> concentration fixed throughout the simulation, or just the radiative forcing? In EXP3, what is prescribed? Is the terrestrial biosphere also forced with the climate from EXP2? Did you include land-use changes?

2) How is anthropogenic carbon calculated? Are the two simulations averaged over a certain time period to smooth out variability?

minor comments:

3) p.394 line 5-10: It would be convenient to have the references for the different model components.

4) p395 line 17 and line 25: What represents the error in the anthropogenic and contemporary carbon uptake rates?

5) p396 line 5: What represents the error in the time integrated uptake rate?

6) p396 line 19: The simulated variability "is realistic in a statistical sense". Could you clarify?

7) p398 line 13: Typo in the word "understand".

8) p398 line 23: "The early anthropocene period", add years.

9) p401 line 8: Typo in the word "inventory".

10) p411 Figure1 d): Is this the change in annual mean sea-ice cover? Shouldn't the

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units read: km<sup>2</sup>/deg?

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