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Interactive comment on "The ocean carbon sink – impacts, vulnerabilities, and challenges" *by* C. Heinze et al.

Anonymous Referee #1

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General remarks. The paper submitted reviews the state of the knowledge of the marine carbon cycle research, in particular in respect to the uptake of anthropogenic carbon into the ocean. The paper addresses an important topic, which is suitable to be published in the Journal "Earth System Dynamics". The paper is generally well written, and I recommend it for publication after minor to moderate revision by consideration of the points listed below.

I recommend to reorganize Chapter 3 and to address the variability of the oceanic carbon sink by distinguishing between the natural and anthropogenic carbon variability (perhaps in two independent sections) and then address the processes that lead to the changes. Include a discussion on how the natural and anthropogenic sources and sinks depend on seasonal variability, interannual (e.g. ENSO), and decadal variability

(e.g. NAO/NAM, PDO, AMO).

Section 6.4 should be extended, for example on the North Atlantic and North Pacific Ocean. The North Atlantic Ocean is of interest because carbon uptake is sensitive to changes in the Atlantic meridional overturning circulation. Results from eddy-resolving ESMs with freshwater pulses due to melting glaciers by climate change (e.g. Weijer et al., GRL, 2012) indicate a significantly different tracer distribution than non-eddy resolving ESMs.

Please change “ppm” to “ppmv” throughout the text.

Specific line by line comments:

Abstract

L. 1 Change “important” to “abundant” L. 2 Change “mitigation” to “adaptation and mitigation” L. 12 Change “load” to “inventory” L. 13 Replace “services” with “impact”

Page 4 L. 2 Reference Figure 1 L. 4. During the geologic past atmospheric pCO2 was variable. Specify geologic time for which the 280 ppmv value is applicable (e.g. Holocene).

Page 6 Section 2 L. 2 Change “gas exchange” to “air-sea gas exchange”

Include references for air-sea gas exchange (e.g. Liss and Merlivat, 1986; Wanninkhof, 1992), solubility (Weiss, 1974), and carbon dioxide dissociation (Broecker and Peng, 1982)

Page 7 L. 17 Quantify the solubility with an example, e.g. for an increase of 3 C (For 2XCO2) from ∼14 C (which is about the global mean SST); references Weiss (1974)

Page 8 L. 13 Reference Volk and Hoffert (1985).

Page 15 L. 20 Change “oxygen” to “dissolved oxygen”

Page 16 L. 3. Perhaps the section title could be renamed to “Observed variability of

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the ocean carbon sink"

Page 17 L. 21 Reference Wetzel et al., 2005, Global Biogeochemical Cycles

Page 19 L. 27 Reword sentence, include reference: Copenhagen Accord U.N. Framework Convention on Climate Change. United Nations. 18 December 2009.

Page 30 L. 13 Change "reviewed in Heinze and Gehlen, 2013" to "see e.g. Heinze and Gehlen, 2013, for review"

L. 23. Reword "not easily done". For the reader it is rather of interest what the novel approaches or challenges are.

L. 27 Reference see CMIP5 simulations

Figure 2. Carbonic acid can be deleted from the equation because the concentration is less than 0.1% (see Schulz, Marine Chemistry, 2006). In the figure you can replace H2CO3 with dissolved CO2.

End of review

Interactive comment on Earth Syst. Dynam. Discuss., 5, 1607, 2014.