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Interactive comment on "Impact of atmospheric and terrestrial CO_2 feedbacks on fertilization-induced marine carbon uptake" *by* A. Oschlies

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This is a useful contribution that hopefully will bring clarity to a nagging issue regarding the assumptions underlying computations of oceanic CO2 removal efficiencies. The CO2 back-flux from the ocean that is induced by reduced atmospheric CO2 has been discussed in the literature before, though it continues to cause confusion. Indeed, I would suggest that this paper would be improved by a recapitulation of this point (that is, an explicit statement that the reduced efficiency of oceanic uptake is due to the back flux of CO2 that occurs when atmospheric CO2 is reduced) in the conclusion section. It is presently covered in just 3 lines (9 to 11) on p. 4501 in the middle of

the paper. A sentence in the abstract would also be good. Furthermore, I also think it might be a good idea if the authors made some attempt to discuss what the appropriate way to do this calculation might be. B. Schneider raises a highly relevant point in his review, which is that the calculation of efficiency will be sensitive to the assumptions made about the time trajectory the background atmospheric CO2 is undergoing. In other words, if atmospheric CO2 is growing due to fossil fuel emissions, the non-linear impacts of this on the oceanic buffer capacity and the terrestrial CO2 fertilization effects will influence how much back flux there is from the land and from the ocean.

What IS new in this study is the inclusion of a terrestrial biosphere response, though I am not very confident that there actually will be increased terrestrial vegetation growth in response to increasing atmospheric CO2 such as assumed in most land vegetation models. Evidence of such CO2 fertilization has not been found in temperate latitude forest inventories (e.g. [Caspersen et al., 2000]), though the overall situation is still unclear (cf. [Pacala et al., 2007]); and evidence of rapid increases in CO2 uptake in tropical rain forests (e.g. [Lewis et al., 2004]) indicates that it is almost two orders of magnitude greater than can be accounted for by the fertilization effect (although it is mostly canceled by rapid increases in respiration). I suspect climate may be the main cause, but in any case, some caveats are in order.

Finally a comment on the Schneider comments: while I agree that the inclusion of the anthropogenic input to the atmosphere would reverse the sign of the net flux from the land, the perturbation to this flux induced by the reduced growth rate of atmospheric CO2 resulting from increased oceanic uptake would still have the same sign – that is, it would be out of the land into the atmosphere. The magnitude would almost certainly be different, however, unless the CO2 fertilization effect is linear.

References:

Caspersen, J. P., et al. (2000), Contributions of land-use history to carbon accumulation in U.S. forests, Science, 290, 1148-1151. Lewis, S. L., et al. (2004), Concerted

changes in tropical forest structure and dynamics: evidence from 50 South American long-term plots, Phil. Trans. R. Soc. Lond. B, 359, 421-436. Pacala, S., et al. (2007), The North American carbon budget past and present, in The First State of the Carbon Cycle Report (SOCCR): North American Carbon Budget and Implications for the Global Carbon Cycle. A report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research edited by A. W. L. D. G. P. Z. King, D.M. Fairman, R.A. Houghton, G.H. Marland, A.Z. Rose, and T.J. Wilbanks, National Ocean and Atmospheric Administration, Climate Program Office, Silver Spring, MD, USA.

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