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Biogeosciences Discussions

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

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Thank you for your comments, which helped me to -hopefully- present my arguments more clearly. I will try:

Maximum phytoplankton growth rates: The enhanced maximum growth rates in these idealized experiments are much higher than anything observed and are not meant to simulate any real phytoplankton. These sensitivity experiments were set up to resemble earlier model simulations investigating an upper limit of the potential for iron fertilization by restoring surface nutrients to zero and thereby essentially depleting surface nutrients. Although it turned out that surface nutrients could not be fully depleted

even with a very high maximum phytoplankton growth rate of 10/day (Figure 5 of the original manuscript), the high growth rates were maintained as an attempt to illustrate the sensitivity of the carbon fluxes to change in surface nutrient drawdown. In a revised version of the paper, I will point out more clearly that these idealized perturbation experiments do not intend to simulate any realistic plankton behaviour.

Carbon inventory: This comment also refers to the idealized experiments which abruptly switch from "normal" to "almost complete" utilization of surface nutrients. This is a large-amplitude step-function perturbation on nutrient and carbon fluxes. This has nothing to do with any realistic perturbation associated with natural or anthropogenic climate change. The idealized step-function forcing is used in order to make the analysis of the temporal evolution of the response to a perturbation easier. The relative size of the responding carbon fluxes among the different carbon reservoirs is relatively insensitive to the amplitude of the step-function change. I have also performed runs in which atmospheric nitrogen deposition (using present-day estimates) was suddenly switched on. This is a perturbation orders of magnitude smaller than the abrupt increase of the phytoplankton maximum growth rate. The temporal evolution of the response and the relative partitioning among the different carbon pools turned out to be very similar to that of the large-amplitude perturbation reported here. The attached Figure 1 shows the equivalent of the manuscript's Figure 9 for the case of instantaneously switching from zero atmospheric nitrogen deposition to atmospheric N deposition corresponding to the year 2000 estimate of Duce et al. (2008, Science, 320, 893-897) in year 0 of the simulation. I probably should include this in a revised paper.

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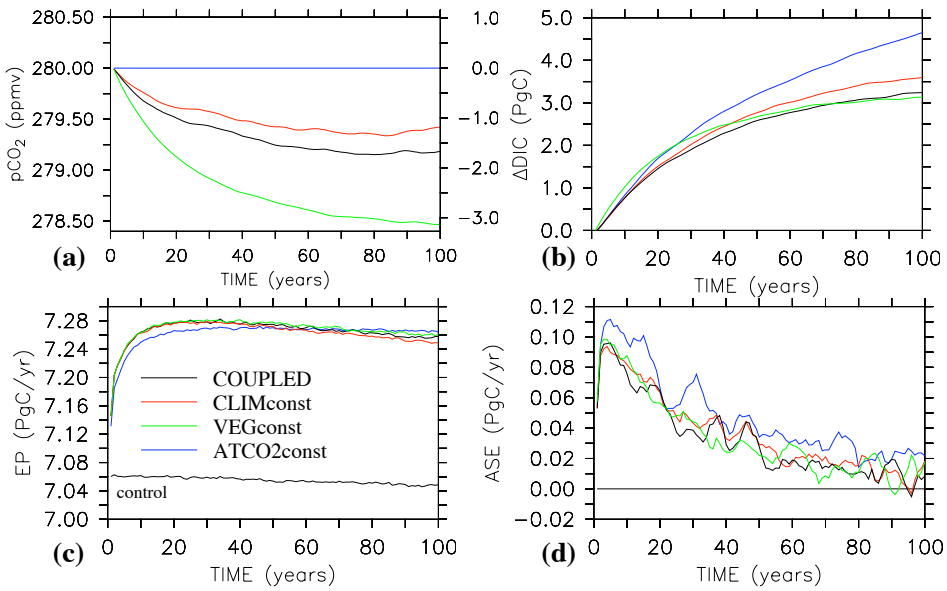
280.50
280.00
279.50
279.00
278.50
pCO2 (ppmv)
1.0
0.0
−1.0
−2.0
−3.0
(a)
0
20
40
60
80
100
TIME (years)
5.0
4.0
3.0
2.0
1.0
0.0
ΔDIC (PgC)
(b)
TIME (years)
7.28
7.24
7.20
7.16
7.12
7.08
7.04
7.00
EP (PgC/yr)
COUPLED
CLIMconst
VEGconst
ATCO2const
control
(c)
TIME (years)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
−0.02
ASE (PgC/yr)
(d)
TIME (years)

Fig. 1.