

Interactive
Comment

Interactive comment on “Glacial-interglacial variability in ocean oxygen and phosphorus in a global biogeochemical model” by V. Palastanga et al.

Anonymous Referee #1

Received and published: 29 June 2012

general:

The paper describes changes in marine oxygen and phosphorus fields obtained for glacial and interglacial environmental conditions with a global ocean circulation model. A main result is that reasonable patterns of glacial oxygen and reactive P burial can only be obtained with the input of terrigenous particulate organic C and P. This hypothesis is of great scientific interest, and the manuscript is meant to make a substantial contribution towards strengthening this hypothesis. However, the current version of the manuscript suffers from sloppy presentation and a not fully adequate discussion of hypotheses, implicit assumptions, improvements and remaining model deficiencies.

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Interactive Discussion

Discussion Paper

Already the introduction is confusing and should be more to the point: Why do you want to study particulate C, P and Fe inputs in addition to the dust input fields used in previous work? Which model results do you want to improve by considering these additional sources? The conclusion should then discuss more clearly to what extent your initial hypothesis is supported by your results and where considerations of other processes may be required in future work. I recommend major revision of the manuscript before it should be considered for publication in biogeosciences.

major points:

1. importance of sediment processes: The study repeatedly stresses the importance of sediment processes. Already the introduction starts with focussing on P burial in the sediments. Most of the discussion, though, later centers on the simulation of water-column oxygen fields. It would be helpful to clarify from the very beginning of the introduction what the main goal of the paper is. If it is P burial, then the results and discussion sections should present this area in more detail (it does not help that figure 6 is missing in the pdfs I managed to download).

From the results presented I could not really infer the importance of sedimentary processes. How different would the results look if P burial was neglected? The response of the different LGM experiments to additions of PP and/or POC seems pretty linear. I think that a more detailed analysis is required to show how linearly/non-linearly the different PP, POC, dust supply routes interact. Are there significant non-linear feedbacks that could give rise to a non-linear additive behavior of the various P (and Fe, C?) inputs?

2. importance of particulate Fe. The model description emphasizes the separate consideration of "highly reactive Fe" and "particular Fe". From the tables/text it is not completely clear whether all experiments use inputs of both types of Fe (I assume that this is the case). I think that in order to support the above claim it would be appropriate to show the sensitivity of the model's results with respect to the supply of one (or both)

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iron types. Also, from the material presented it is not obvious why the input of particulate Fe into the sediment is relevant for the distribution of water-column O and P. Is it possible to estimate how relevant the input of particulate Fe is with respect to Fe input from hydrothermal vent systems or from continental margins? This might change with glacial/interglacial changes due to sea level change. How good is the assumption to neglect possible changes in these supply routes?

3. importance of Fe-P sink. This process seems to be underestimated in the model (p. 4830, l.22). Does it matter, if not why not? With Fig.6 absent in my pdf, I cannot really comment on the analysis, but it would be helpful to have a more detailed interpretation of the Fe-P concentration changes in terms of the simulated changes in O₂.

minor points:

p.4826, l.25. What annual mean dust deposition fluxes are prescribed? glacial/interglacial ones?

p.4827,l.2: what exactly is meant by LGM forcings? LGM circulation, LGM dust, LGM Fe oxides?

p.4827, l.6 "almost" no grid points with depths < 200m. This is not really a good argument. You could equally well say that there is almost no ocean area with depths < 200m. Why should the model grid underestimate the shelf area? It might equally well overestimate it?

p.4828, l.24. What do you mean by reasonable agreement?

p.4836,l.12 there are no observations of O₂ in the glacial ocean, all we have are observational estimates.

Interactive comment on Biogeosciences Discuss., 9, 4819, 2012.

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