Biogeosciences Discuss., 6, C1422–C1426, 2009
www.biogeosciences-discuss.net/6/C1422/2009/

Biogeosciences Discussions

Interactive comment on "Impact of changes in river nutrient fluxes on the global marine silicon cycle: a model comparison" *by* C. Y. Bernard et al.

Anonymous Referee #2

Received and published: 3 August 2009

Review Impact of changes in river nutrient fluxes on the global marine silicon cycle: a model comparison C. Y. Bernard et al.

GENARAL COMMENTS:

The manuscript addresses an important component of the ocean biogeochemistry: Rivers can have a significant impact on the hydrography and biogeochemistry of ocean areas. This manuscript is well written and easy to read. However there are some issues that need to be addressed before the paper is suitable for publication.

In the text, the authors say the results are "surprisingly similar" when comparing the models in long-term simulations. So the reader might conclude the models are so different (indeed they are) that a comparison study wouldn't even be feasible. The

authors also don't discuss/compare their results to other modeling efforts (with both box and biogeochemistry models coupled to general circulation models) made to address how riverine nutrients may influence the ocean biogeochemistry. Most of them are not focused on the silicon cycle alone, but it is worth to have them in mind. I think this would add more value to this manuscript. Here are some citations, as suggestion to the authors:

1)Mackenzie, F. T., et al. (1998), Role of the continental margin in the global carbon balance during the past three centuries, Geology, 26,5, 423-426. 2)Ver, L. M. B., et al. (1999), Carbon cycle in the coastal zone: effects of global perturbations and change in the past three centuries, Chemical Geology, 159,1-4, 283-304. 3)Rabouille, C., et al. (2001), Influence of the human perturbation on carbon, nitrogen, and oxygen biogeochemical cycles in the global coastal ocean., Geochimica and Cosmochimica Acta, 65,21, 3615-3641. 4)Cotrim da Cunha, L., et al. (2007), Potential impact of changes in river nutrient supply on global ocean biogeochemistry, Global Biogeochemical Cycles, 21,GB4007, doi:10.1029/2006GB002718. 5)Giraud, X., et al. (2008), Importance of coastal nutrient supply for global ocean biogeochemistry, Global Biogeochemical Cycles 22,GB2025, doi:10.1029/2006GB002717. Slomp, C. P., and P. Van Cappellen (2004), Nutrient inputs tp the coastal ocean through submarine groundwater discharge: controls and potential impact., Journal of Hydrology, 295, 64-86.

Using shorter time-scale simulations, (L. Cotrim da Cunha, E. T. Buitenhuis, C. Le Quéré, X. Giraud, W. Ludwig, Global Biogeochemical Cycles 21, doi:10.1029/2006GB002718 (2007).), but a similar biogeochemistry model (PISCES-T) to HAMMOC5, found that riverine Si (as well as N, P) inputs didn't have a large impact in coastal or oceanic export and primary production. These authors results suggest that most of the export production in the coastal ocean may be sustained by nutrient transport from the open ocean, by local nutrient recycling, and by sediment resuspension, with the exception of riverine Fe. Do you think that the difference in the impact in Si production found in this manuscript is due to the longer simulation time?

The manuscript conclusions are mainly focused in the results of the comparison of the 3 models, citing the advantages and disadvantages of each one. Maybe the conclusion could be divided into 2 sections, one about the limitations of each model, another one assessing the impacts of changes in riverine nutrient inputs to the ocean.

SPECIFIC COMMENTS:

Page 4473 - "...The box model, also includes other sources of Si: bSiO2 (Conley, 1997), ground water inputs (Slomp and Van Cappellen, 2004) and aeolian dust deposition on the open ocean (Tr ′eguer et al., 1995)."

It would be interesting for the reader to have these numbers listed in a table - one could better compare the box- and gcm models, and how to compare the magnitude of riverine, ground waer and atmospheric input of silica.

Page 4475 - "Export production of opal and burial of Si in the sediment were used as indicators of pelagic and benthic Si processing in the box model and HAMOCC2 as done by Heinze (2006)."

Which depth do you consider for "export production" in each one of the models? It appears only in the figures, you could cite it in the text too.

Page 4475 - "Results show that a 25% reduction in Si inputs induces comparable decreases in both models for export production and sediment burial (Fig. 2a, b)."

To avoid confusion, it would be better to refer to the simulation as either "Simulation 1" or use "a reduction of 75% in Si inputs"and so on, or create subsection for each one of the simulations. One other suggestion is to say that model results "suggest" instead of "show" - after all model results are different from sample results.

Page 4476 - "Overall, while HAMOCC2 appears to reach a new steady state after only 20–30 kyrs, despite a residence time for 5 Si of 23 kyrs. While it takes about 100 kyrs for the box model, with the shorter residence time of 17 kyrs, to reach a new equilibrium."

I think these sentences need rewriting - they are fragments of 2 sentences. Are you comparing the time needed for the 2 models to reach the steady state after the perturbation in the Si inputs?

Page 4477 - "The step function, imposing a very strong increase of riverine Si input (10-fold) followedby a shutdown results, in a strong increase in export production and opal burial followed by a significant drop 50 kyrs after the beginning of the simulation in both models."

Here again I think the sentence needs re-writing; seems to be missing a verb after 'shutdown results'.

Page 4478 - Comparison between HAMMOC5 and the box model: To maintain the manuscript text style, could you describe the simulations as in section 3.1? Use something as scenario/simulation 1/2/3 etc, as previously used. You could also include all simulations, with a brief explanation for each one in a table.

Page 4479 - "The opal production is limited by other nutrients such as N, P or Fe. As a consequence, switching off the riverine input of N and P (Fig. 3d) causes a stronger decrease of the opal export production (-22%) than switching off the riverine silica input alone (-16.6%)."

Here I repeat the comment of page 4478: a table and a brief explanation in the text of all scenarios would make the text easier to read and understand. It is not clear from a first reading that riverine N and P input were also changed in the comparison between HAMMOC5 and the box model.

Pages 4480-4481 - About the fate of the Amazon Plume: The Amazon River plume delivers not only Si but also other nutrients towards the Caribbean Sea. How was the behaviour of the plme in the simulation without river nutrients? In this area, a large fraction of the delivered nutrients could be already taken up by phytoplankton as soon as the light limitation is alleviated. Would the Amazon River Si inputs alone be able to

support the N Atlantic Si uptake?

Page 4489 - Figure 1 - Are the units in Tmol Si yr-1? Are there opal primary production numbers for HAMMOC2 and HAMMOC5?

Page 4491 - Figure 3 - Please explain each one of the panels, as in figure 2 and figure 4

Interactive comment on Biogeosciences Discuss., 6, 4463, 2009.