Biogeosciences Discuss., 9, C1302–C1307, 2012
www.biogeosciences-discuss.net/9/C1302/2012/

Biogeosciences
Discussions

Interactive comment on "Riverine influence on the tropical Atlantic Ocean biogeochemistry" *by* L. Cotrim da Cunha and E. T. Buitenhuis

Anonymous Referee #2

Received and published: 16 May 2012

Cotrim da Cunha et al. published a global modeling sensitivity study of the 'Potential impact of changes in river nutrient supply on global ocean biogeochemistry' in 2007 in GBC. This new 2012 manuscript uses the same global biogeochemical model with similar methods, but is focused on the impact of riverine nutrients on the biogeochemistry of the tropical Atlantic Ocean. It also specifically examines and discusses the role of South American and African rivers in these biogeochemical changes. The model used in this analysis admittedly does not fully resolve all processes that affect biogeochemical changes in the tropical oceans; however this does not necessarily mean that the results discussed here are not useful and interesting. The manuscript could be dramatically improved, however, if the comments listed below are addressed.

General Comments: (1) The model was spun up with real river nutrient inputs from

1948 until 1993, and then the rivers were turned off from 1993 to 2005 in one run (NO_RIVERS) and left on in another (TODAY). The averaged per year difference between these two runs from 1998-2005 was calculated as 0.2 PgC. It seems possible that deep nutrients in the open ocean would be very different in a simulation where the rivers were turned off in 1948, as compared to a simulation in which the rivers were turned off in 1993. Basically, are the authors sure only 5 years are needed to spin up the nutrients in this scenario? Can this be demonstrated?

(2) In Table 2, all of the Mean Absolute Errors (MAE) between PISCES-T simulations NO_RIVER and available data for the tropical Atlantic Ocean are smaller than those between model simulation TODAY and available data. Does this mean that the model simulation NO_RIVER fits the real observations better than the model simulation TODAY in the tropical Atlantic Ocean? Lines 11-25 on page 1949 and lines 1-13 on page 1950 describe how good the agreement is between data and the TODAY simulation, with no mention of Table 2 and MAE at all. It appears that in the global scale model simulation, TODAY fits better with real observations (Cotrim da Cunha et al., 2007), but this does not appear to be the case for the tropical Atlantic Ocean. More explanation is definitely needed here.

(3) Table 3 needs to be double checked in terms of the % calculations. For example, the % increase for CFLX and COASTAL CFLX for TODAY and S_AMERICA are not correct. The % increase numbers in the text need to be checked too. For example, line 22 on page 1950: isn't the increase of 0.7 Pg C a-1 for open ocean PP equal to +9.2%? But the authors state +14%. Also, aren't the first columns for PP, EP and CFLX numbers in Table 3 specifically for open tropical Atlantic Ocean, instead of for the whole tropical Atlantic Ocean?

(4) What are the consequences for ecosystem structure in the tropical Atlantic Ocean? Are there any changes in different scenarios as were discussed in Cotrim da Cunha et al. (2007)? It would be very interesting to have this simulated model result discussed in the manuscript.

(5) It is confusing to read in the Conclusions that the western rivers were responsible for up to 81% of the PP increase and that the eastern rivers were responsible for 48% of this increase, since 81+48 > 100%! After reading the paper in its entirety it is clear how these numbers were derived, but a solid conclusions section should be understandable even to a reader who only reads the Abstract and Conclusions. Can the authors instead simply say that the South American rivers were responsible for the majority of the increase in open ocean PP difference between the case with no nutrient inputs from the rivers, and the case based on real river inputs? Similarly, rather than saying that the African river nutrients are responsible for 71% of the open ocean EP difference and the South American river nutrients were responsible for 69%, the authors could simply state that the African and South American river nutrients contributed equally to the EP changes. In fact the authors seem to claim that 71% is significantly greater than 69%, but this is not substantiated. The conclusion here should be that both eastern and western rivers contribute nearly equally.

Specific Comments:

Abstract, line 2: Actually the authors compare three sensitivity cases (no rivers, east only and west only) to a reference run (both rivers). In the abstract they say they just perform two sensitivity tests, which is a little misleading.

Abstract, line 6: “70W-20” should be “70W-20E” (although it looks more like 12E?)

Abstract, lines 8 and 9: How are ‘open ocean’ and ‘coastal’ quantitatively defined here? Are they separated by a specific isobath? Does the ‘open ocean’ value represent everything seaward of the 500m isobath, within the 20S-20N and 70W-20E region? If these were reported per square meter, presumably the effect on the coastal region would be much larger?

p. 1946, line 21: In addition to the three largest rivers, how many other rivers have direct discharge to the tropical Atlantic Ocean in this model? It would be helpful to have a map showing the location of the major and minor rivers.

p. 1947, line 20: Sometimes the authors refer to DOM and POM and sometimes DOC and POC. Please be consistent.

p. 1947, line 22: For this region, what percent of the freshwater input comes from the eastern vs. western rivers? How about for nutrients – what percent comes from the east and what percent comes from the west?

p.1948, line 8: Because river transport is a main focus of this paper, it would be best to include at least a few sentences describing how Cotrim da Cunha et al. (2007) computed annual riverine inputs of nutrients.

p.1948, line 10: This is a little confusing, because the Carr comparisons were for 1998. Is this model run (1948-2005) the same as that used in Friedrichs et al. (2009, JMS 76, 113-133.) It also might be worth noting that this model did extremely well, and in fact nearly the best of all the biogeochemical ocean circulation models tested, in Saba et al. (2010, GBC, 24, GB3020; doi:10.1029/2009GB003655.)

p.1948, line 11: If the model reaches steady state after 3-4 years, why was a 44-year spin up needed?

p.1948, line 21: This is a little misleading, because damming would stop water flow, which is not stopped in this experiment. “due to river damming” should be removed. Also on line 28 “the South American river inputs were stopped” should be changed to something like: “Nutrient input through the South American rivers was stopped.”

p. 1948, line 24: Can a reference be provided for the 99% Fe loss?

p. 1949, line 19: The text says what was used in TODAY for OC, but not for DIC. Are the modeled or measured values used in “TODAY”? Why are the modeled values so far off? What impact will this have on the results of the sensitivity studies discussed here?

p. 1949, line 23: If the model produces values $\sim$75% lower than observed, is this really our “best estimate”? Why not force the model with the observed river nutrient fluxes?

Wouldn't that be a better estimate?

p. 1950: Reference to Figure 1 is needed here.

Figure 1: Why not show (also or instead) satellite surface chlorophyll for the particular years being analyzed here? In Figure 1 it looks like climatological (in situ?) chlorophyll is being compared to a model run for 1998-2005. Why not compare satellite chlorophyll from 1998-2005 with model output for the same years? Also, can the 3 large rivers be added on here, and labeled? Is there any reason a log scale wasn't used here?

p. 1950, line 9: How do you quantitatively define open vs. coastal ocean?

p. 1950, line 20: "rivers outflow" should be "river outflows"

p. 1950, line 25: "open ocean eastwards the Congo" Grammatically this doesn't make sense, and is 'eastwards' supposed to be 'west of'?

p. 1950, line 26: But the percent increases seem to be nearly exactly the same size (in terms of EP) and much greater in terms of air-sea CO2 flux. This needs to be discussed.

p. 1950, lines 9-12: This model-data comparison doesn't seem appropriate for this section which is discussing an idealized sensitivity experiment. (Similarly, the model data comparison on p. 1952, lines 21-24 would also be more appropriate when discussing the TODAY simulation.)

p. 1951, line 16 & page 1953, line 21: The description of increase on EP and sea-to-air CO2 flux needs to be more accurate. As shown in Table 2, both increases on EP and sea-to-air CO2 are much smaller than those on PP on absolute flux. The % increase on sea-to-air CO2 flux, however, is very significant.

p. 1951, line 17: How could the doubling of CFLX (from .03 to .06 in Table 3) be due to riverine outgassing, when the rivers don't appear to be inside the model domain?

p. 1952, line 16: Actually it looks like there is some change between 10-20N in the

West. Why is that?

p. 1956, line 26: "of the increase in EP if the same export production increase". Not sure what is meant by this? Perhaps some words are missing here?

p. 1956, line 27: "depend" should be "depends".

p. 1957, line 2: "eastern margin" should be "eastern ocean margin" to make it clear that you mean the eastern ocean (which is along the western continental margins.)

p. 1957, line 11: "On" should be "In"

Figures 2-4: These figures would be much clearer if they were labeled as to what each panel represents. This information is included in the caption, but it would be best to also include this information on each panel.

Interactive comment on Biogeosciences Discuss., 9, 1945, 2012.