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Biogeosciences Discussions

Interactive comment on "Towards an unbiased estimate of fluctuations in reef abundance and volume during the Phanerozoic" *by* W. Kiessling

Anonymous Referee #1

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General Comments

This manuscript is certainly relevant in that it addresses the problems with strictly interpreting the geologic record of reef numbers and volumes (the PaleoReefs database) in terms of environmental control. While the PaleoReefs database is excellent, it naturally suffers from several biases that relate to differences in both preservation (geological) and exploration/reporting (socioeconomic). The task to remove such bias from this dataset is daunting: Kiessling attempts to adjust the number and volume of reefs reported over time to come up with a more realistic timeline of reef distribution and volume. The results are interesting, among other things suggesting that reef development in the Silurian and Devonian was much more prominent than the raw record suggests, and was much less prominent in the Neogene.

The paper is well written and organized, and to the point, and I greatly appreciate that.

However, the description of the techniques and the justification for using them, as well as the errors that are introduced by these techniques, may be too curse in some areas. It is clear that the author put a lot of thought into how best to do this, but the reader would benefit from a few discrete examples to help describe the justification behind the assumptions (examples using specific countries, etc.)

Finally, given this “new” timeline of reef waxing/waning, I would appreciate an effort to bolster the interpretation of the new results; e.g., is there other evidence to support the new database, and does it suggest that it is better in line with what we know about environmental changes? Perhaps that is stuff for another paper, but before I would use the new database, I would like author to convince the reader that it is indeed more trustworthy than the original!

Specific Comments

Removing certain reefs: I understand why open ocean reefs and subsurface reefs were removed, and I agree that they should have been removed, but this introduces another kind of bias into the database that should be acknowledged. The assumptions here are that 1) the proportion of reefs that were open ocean has remained constant through time, and 2) the chances of coral reefs becoming part of the subsurface substrate has remained constant through time. There is no way to test whether (1) is true, since open ocean reefs have such poor preservation potential. I’m not sure if (2) can be tested either, but it would be good to see a bit more discussion on this aspect.

GDP adjustment: (numerous questions):

1) A country’s GDP is used as a proxy for research effort that leads to identification and quantification of reefs in that country. The author cites his recent paper in Facies (Kiessling 2005) as background that justifies using this approach. He also re-calculates the correlation between GDP and reef number and volume with the open ocean reefs and subsurface reefs removed, and limits the correlation to countries with at least 5 reef sites. The relationship between GDP and reef number/volume remains, even when the

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subsurface (oil-potential) reefs are excluded. It is hard for a reader who has not read the Facies paper to move past this paragraph, and it would be nice to have a little more background information here; for example, a table comparing the two analyses (with and without subsurface reefs). I am also unclear why the relationship was limited to countries with 5 or more reef sites - is this a statistical requirement, or was that done for some other reason? In the Facies paper, the sampling bias (due to socioeconomic factors, proxied by GDP) made a very big difference, and indeed, accounting for GDP differences in the present paper resulted in very large adjustments to the database. So in short, this step needs to be better justified in the paper.

2) Why are reef sizes overestimated when they occur in less-developed countries (p. 1494 line 5)?

3) The paragraph on the correlation between reef density and GDP was confusing (p. 1494, lines 8-19). The discussion seems to center around the fact that more ancient reefs are reported from countries with low GDP. Is this an important point? If so, then the lead sentence in the paragraph that follows: “It is reasonable to assume that the global number of reefs is overestimated with respect to other time intervals when the majority of reefs from a particular time interval are known from countries with a high GDP density, whereas the number of reefs is underestimated when most of the reefs are known from countries with a low GDP density” seems a little shaky. Otherwise this reader is simply confused.

4) In that same paragraph, the statement “I just adjust for those countries where reefs in a particular time interval have actually been recorded” is confusing.

5) Can this “adjustment to GDP” technique be tested beyond the correlation between the two? Since reefs and reef tracts cross national borders, it would be nice to see examples of reef numbers and volumes from two adjacent countries that have very different GDPs (e.g. US and Mexico?; east and west Europe?).

Results

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1) I suggest a sentence or two on the relative effect of removing oceanic versus subsurface reefs (e.g., breaking down the two in Table 2?); for example, is the reduction in the Devonian peak due to the removal of subsurface reefs from the data set?

2) The point that the rapid reef recovery following the P/T extinction may be an artifact of the data is an important conclusion, but I found this difficult to see in the figures.

Tables and Figures

1) I found these to be fine, but some of the captions are too brief; they certainly don't stand alone (although I don't know if this journal promotes brevity or completeness in the captions. For example, in Figure 3, it would be useful to note that the brown line for N(o) is the same as the red curve in Figure 2; and so on for figures 4-6.

2) In Figure 7, I also think it would be truer to the results to keep the vertical scales the same where appropriate, e.g. a & b, c & d, etc...

Technical Corrections

p 1492, line 21: change "PaleoReefs" to "The PaleoReefs database"

p 1493, line 18: remove "which are now situated"

p 1494, line 5: change "where N is the number of reef sites, and area is the land area ... and GDP is the gross domestic product ..." to "where N is the number of reef sites within the country, and area is the land area of the country, " ... and GDP is the gross domestic product of the country..."

p 1495, line 5: change "The amount of preserved sediment is well known to fit an exponential ..." to "The amount of sediment preserved with time is well known to fit an exponential ..."

p 1496, line 23: change "The first is the biological control of flooding on habitat area." to "The first is the control of flooding on habitat area."

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Interactive Comment

p 1497, line7: change “stronger” to “more strongly”

p 1498, line 8: change “the raw data a little affected” to “the raw data are little affected”

p 1498, line 21: the sentence “Due to the higher...” is confusing.

p 1499, line 7: add the dates of the Emsian-Eifelian time interval.

p 1499, line 14: change “... large estimated volume in countries...” to “... large estimated volume being in countries...”

p 1499, line15: remove the comma in “prominent, peak”

p 1499, line 27: in “The overall similarity of the curves ..” - which curves? please be more explicit.

p 1500, line 4: change “The pattern of changes ...” to “The patterns of changes ...”

p 1500, line 19: Change “involved in” to “introduced by”

p 1500, line 24: change “carbonates somewhat” to “carbonates are somewhat”

Interactive comment on Biogeosciences Discussions, 2, 1487, 2005.