Biogeosciences

Discussions

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Interactive comment on "Coral reef carbonate budgets and ecological drivers in the naturally high temperature and high total alkalinity environment of the Red Sea" *by* Anna Roik et al.

Anonymous Referee #1

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This paper presents an interesting study that aimed to characterize the effects of biotic and abiotic factors on the carbonate budget of different sites of a reef in the Red Sea. This study is based on a pretty extensive dataset that combines benthic community monitoring, determinations of organisms' calcification, monitoring of chemical and physical parameters, etc. The paper could be pleasant to read but the discussion drags into discussing obvious facts and do not really discussed the results and the significance of this study. Aside of the specific comments listed below I have 2 major comments:

- First, the determination of pH and then the carbonate chemistry was incorrect. pH

on the NBS scale is not the appropriate scale to determine seawater pH. Furthermore, the authors used the R package seacarb and the pH free-scale (while measurements were done on the NBS scale) for all the calculations of the carbonate chemistry, which is incorrect. A quick test on CO2sys shows that for a pH of 8.1 (NBS scale), a TA of 2300 and a temperature of 28, the corresponding pCO2 is 507 and the saturation state 3.19. Using the same pH value on the free –scale yields to a pCO2 of 472 and a saturation state of 3.34.

- Second, one of the main conclusion of the authors is that TA is the main driver of reef calcification. While I do not question the mathematical approach of the authors, I do not believe that the relative minor differences in TA between sites can explain the large differences in Gnet and Gbudget between sites. From a biological and biogeochemical point of view, TA differences of $\sim$ 15-50 umol are not highly significant and are not sufficient to explain the large differences in precipitation and erosion between sites. A positive effect of TA on coral calcification has indeed been shown in previous studies but the TA enhancement was of several hundreds of μmol.

Specific comments

L-25-26: "Beneficial and detrimental factors" is not clear, what does that refer to? L-49-50: Sediment export is also very important in a reef budget. L-52-53: What about flow and light? Those two parameters are critical but not discussed at all in the manuscript. L-57: It would be good for the reader to start by clearly defining what Gbudget and Gnet are referring to in this manuscript. L-59: Not clear, calcification rate of the reef or corals? L61-63: This is not entirely true. Calcification rates of some organisms are actually enhanced by warming. Also, the temperature threshold between decrease in calcification and death is very thin for corals. L-64-65: This is still an hypothesis that is highly debated. L-67-69: What about a crown-of –thorn starfish outbreaks? L-86-87: Tambutté et al. 2011 is not the best reference here.

L120-121: The pH probes from CTD are unreliable and not recommended to charac-

terize pH in seawater. L127-144: See my major comment#1 L-146-156: It is not clear how many blocks were deployed and retrieved at each sites/time points. L-182-188: I would recommend adding the supplementary material text here.

Results: It is a bit strange to separate the pH from the other carbonate chemistry parameters.

L270: Aside of the problem with the scales, there are some discrepancy between pH continuous and pH discrete. As a result, if the parameter of the carbo chem were calculated from the pH continuous the results for the saturation state etc would be completely different (especially for the inshore sites where continuous pH was much higher than the discrete one). Were any cross-calibrations made between the pHcontinuous and the pH discrete?

L-304: n= ?

L323: Why is pH continuous used in the model while the carbonate chemistry parameters are calculated from pHdiscrete?

L-326-327: As explained before it is hard to explain biologically how such small changes in At can explain 65% of Gnet.

L-347-348: O2 could indeed be an important driver, why was O2 not determined?

L-351-354: ...and the wrong scale was used.

L-358-359: The high temperature of the Red Sea also explains the high omega.

L-365-366: This is already well known...

L-376: pH goes down to $\sim$ 7.3 in Camp et al. 2017 (Sci Rep)

L-381: pH variations are not an indication of fluctuation in AT.

L-405: PO43- is not "a source of energy".

L-446-452: Isn't that the case in a lot of reefs?

C3

L489-490: Was this decrease in calcification linked to bleaching events, etc?