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Interactive comment on "Intercomparison of four methods to estimate coral calcification under various environmental conditions" *by* Miguel Gómez Batista et al.

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We thank the reviewer for her/his comments and suggestions on our manuscript. We agree with most comments and modified/updated the manuscript accordingly. Below is a point-by-point reply.

This is an interesting study that compares 4 different methods for quantifying calcification rates under high and low pH conditions. The authors conclude that that alkalinity anomaly, Ca anomaly, and 45Ca methods are all in close agreement, but the 13C method is not. This is a helpful study for researchers that are trying to calculate calcification rates of individual corals. The methods are rigorous. However, I personally have

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only done the TA anomaly technique so hopefully the other reviewers have hands-on experience with the other 3 methods. My comments below are minor. I believe this will make a nice contribution to the coral biogeochemistry literature.

Abstract

Line 27: add a comma after calcification

Done

Line 41: This is a bit of a meta comment, but what if the 13C method is accurate and the other 3 are highly correlated, but wrong. How do we know which of these methods are “true” net calcification?

Interesting comment. The reason why we reject the 13C method (as applied in our study) is not only because 13C based rates are not correlated to the other methods but also because calcification rates based on this technique are much higher and much more variable than rates based on the other methods. As mentioned in the text, it is very unlikely that dissolution was a significant process during our incubations as nubbins were fully covered with tissue, therefore there is no distinction between net and gross calcification. Now, calcification (net or gross) consumes 1 mole of carbon and 1 mole of calcium to produce 1 mole of calcium carbonate. The fact that D[Ca] and D[AT] and highly corelated following a 1:2 ratio fully confirms this. We should therefore have a 1:1 ratio between C and Ca fluxes, the fact that higher rates were obtained with the 13C technique is problematic. Finally, several studies have shown that most of the calcium used by the calcification process comes from seawater, a significant proportion of the carbon used comes from the metabolism of the organism, suggesting that rates based on C incorporation (14C or 13C) must significantly underestimate true net calcification.

Introduction

Line 77: You can account for changes in nutrients (by measuring nitrate, phosphate,

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and ammonium and incorporating into the delta TA) as well as evaporation (normalize to salinity) in the alkalinity anomaly technique.

The reviewer is correct. We have added this small paragraph to deal with this comment: “This method assumes, however, that calcification is the only biological process influencing AT (Smith and Key, 1975). Nitrogen assimilation through photosynthetic activities, nitrification as well as aerobic and anaerobic remineralization of organic matter are known to impact AT through the consumption or release of nutrients (ammonium, nitrate and phosphate) and protons (Wolf-Gladrow et al. 2007). While for some group of species (e.g. bivalves, sea urchins), corrections appear necessary to take into account the effect of nutrient release on AT, changes in nutrient concentrations during incubations of isolated corals are too low (i.e. several orders of magnitude lower than changes in AT) to introduce a significant bias in the calculations (Gazeau et al. 2015).”

Furthermore, ammonium concentrations have been measured at the start and end of selected incubations (only at ambient pH) that confirmed this assumption (D[NH4] were at least 2 orders of magnitude lower than DAT).

We do not discuss here the need to correct for evaporation as this is discussed in details later in the text.

Line 96: Replace comma with semi-colon and add comma after “therefore”.

Done

Line 113 – 114: Incorporate this sentence into the last paragraph

Done

Methods

Line 147: replace “a” with “and”

Done

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Line 180: remove “a”

Done

Line 265 states that initial levels are not necessary to compute calcification and only final values with and without corals are used, but line 269 says that T1 are concentrations are the start of the incubations. This is a bit confusing. Please clarify.

Equations 3 and 4 present the calculation procedure showing that initial levels are not necessary to compute calcification rates as stated in the text above the equations. We believe it is important to detail these equations and do not believe this is confusing as presented. However, to make sure there is no misunderstanding we added: “where AT1 and Ca1 are AT and Ca2+ concentrations at the start of the incubations (in μmol kg-1; not used in the computations), . . .”

Line 275 – 276: Please explain the parameters in the equations.

Done.

Line 280: There is an empty box on the equation.

Corrected.

I think it is worth discussing why different incubation times were used. Why not do them all at the same time to reduce error with changing carbonate chemistry in the background (i.e. the longest time needed to get a result from all 4 methods)?

We did not have this information before starting this study. Incubation times have been chosen based on practical aspects (access to the lab etc. . .). The fact that they differ between different incubations is not in conflict with our objective which was to compare changes in various parameters during the same incubation, not to compare different incubations between each other. A sentence has been added in the Material and Method section: “Incubation times were not fixed based on scientific considerations and differed between the different incubations due to practical constrains (i.e. access

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to the lab etc. . .).”

Please add incubation temperatures to table 1 or 2

As temperature was maintained constant and at the same level for all incubations, the temperature level is now mentioned in the legend of both tables.

Results section throughout: Instead of saying X and Y are presented in Figures 1 and 2, make a statement about the result and cite the figure and table after. (For example, see like 368).

Modified accordingly.

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