Biogeosciences Discuss., 6, C1606–C1612, 2009
www.biogeosciences-discuss.net/6/C1606/2009/
© Author(s) 2009. This work is distributed under
the Creative Commons Attribute 3.0 License.

Biogeosciences Discussions

Interactive comment on "Response of the temperate coral *Cladocora caespitosa* to mid- and long-term exposure to pCO_2 and temperature levels projected in 2100" *by* R. Rodolfo-Metalpa et al.

J. Ries (Referee)

jries@unc.edu

Received and published: 21 August 2009

Overview

In their manuscript, "Response of the temperate coral Cladocora caespitosa to mid- and long-term exposure to pCO2 and temperature levels projected in 2100," Rodolfo-Metalpa and co-authors present a set of short- and long-term experiments in which they investigate the impact of pCO2 (400 and 700 ppm) and temperature (normal, normal + 3°C) on net and gross photosynthesis, gross respiration, zooxanthellae density, chloro-

phyll density, protein density, and rates of light and dark calcification in the temperate coral Cladocora caespitosa. The authors demonstrate that the impact of elevated temperature is more severe than the impact of elevated pCO2, at least over the range of pCO2 and temperatures investigated. Elevated temperature was significantly ($p<0.05$) associated with a reduction in each of the measured parameters except for protein density and dark calcification, while elevated pCO2 was only significantly ($p<0.05$) associated with a reduction in zooxanthellae and chlorophyll density.

Strengths

Rodolfo-Metalpa et al.'s experiments are reasonably well-designed and should make a substantial contribution to the field of ocean acidification research. They are among the first experimental studies to investigate the impact of both pCO2 and temperature on the growth, calcification, and physiology of a temperate coral. They are also some of the first ocean acidification experiments – conducted on any species – to investigate such a wide range of variables (net and gross photosynthesis, gross respiration, zooxanthellae density, chlorophyll density, protein density, and rates of light and dark calcification). The experiments are also the first to investigate the impact of pCO2 (as well as temperature) over both short and long timescales for a given species. And the long-timescale experiment is amongst the longest of the single species ocean acidification studies conducted to date. The methods employed to manipulate (CO2 sparging) and measure the carbonate chemistry (pH and alkalinity) of the experimental seawaters are reasonably justified. And the authors employ both the alkalinity anomaly and buoyant weighing to estimate net rates of calcification (indeed, the comparison of these two methods is valuable in and of itself). The authors' treatment of the data appears to be statistically rigorous, and their conclusions generally follow directly from their observations.

Suggested revisions

The authors should consider making the following changes to the manuscript in order

BGD

6, C1606–C1612, 2009

to improve its quality and readability and to augment its overall impact:

Title: “projected for the year 2100 AD”

P7104, L9-12: the measured parameters should be spelled out in abstract, rather than lumped together as “physiology and growth”

P7105, L13: change “Climate change” to “Rising pCO2”

P7105, L22: delete “ability”

P7107, L17: “days” should be singular

P7107, L20: explicitly define “normal temperature”; is this ambient seawater temperature?

P7107, L27: change “Except” to “With the exception of”

P7108, L14-15: change to “electronic temperature controller”; change to “The precision of the temperature controller. . .”

P7108, L20: this sentence is confusing at it is currently written; does “CO2-free air” refer to the 400 ppm pCO2 air?

P7108, L23: change to “furnished seawater to two. . .”

P7109, L9: the precision (repeatability) and accuracy of pH and alkalinity measurements should be stated

P7109, L18: change “integrate” to “integrated”

P7109, L19: change to “do not discriminate between”

P7110, L8: change to “cleaned of epiphytes”

P7111, L7: “was measured”

P7111, L8: spell out PAM acronym

BGD

6, C1606–C1612, 2009

P7111, L21: “inverted microscope”

P7112, L26: change to “designed”

P7113, L5: state what method was used to calculate the regression (e.g., least squares); for consistency, error should be reported as either standard deviation or standard error of the mean – presently, error in the chemistry data is presented as s.e.m., while error in the measured coral parameters are presented as s.d.

P7113, L8: state p-value after “significant” (or at least cut-off for significance, e.g., $p < 0.05$)

P7113, L21: use “either, or” or “neither, nor”

P7113, L23: change to “significantly increased”

P7114, L23-24: change “as” to “to be”; change “concentration” to “partial pressure”

P7114, L25: change “to” to “by”; change to “significantly affect”

P7115, L7: change “to” to “with”

P7115, L7: change “confirming” to “supporting”

P7116, L18: delete “only”; define p-value after significantly here and throughout text

P7116, L21: change “exposition” to “exposure”

P7117, L5-10: note that the alkalinity anomaly technique may underestimate calcification because calcification may decline over the 5 hr incubation period as Ca2+ and CO3= ions are depleted in the incubation chamber, thereby lowering the aragonite saturation state and causing the rest of the carbonate system (HCO3-, CO2, pH) to deviate in unintended ways

P7117, L11: “To the best of our knowledge. . .”

P7117, L19-20: rewrite this sentence for clarity

BGD

6, C1606–C1612, 2009

Interactive Comment

P7117, L22: change “it” to “they”

P7117, L24: change “on” to “of” or “in”

P7117, L25-26: rewrite this sentence for clarity

P7118, L5-10: may also want to cite the following reference:

Ries, JB, Cohen, AL, McCorkle, 2009, Marine calcifiers exhibit mixed responses to CO2-induced ocean acidification, Geology, in press.

Authors may also want to discuss this work on Oculina arbuscula in the introduction, within the section that discusses the results of previous ocean acidification experiments on temperate corals (Fine and Tchernov, 2008; etc.).

P7118, L10: change “noticeable, on” to “pronounced for”

P7118, L15: again, replace Ries et al, 2008 with the Geology reference provided above. Instead of “suggested for other calcifying organisms” to “shown for coralline red algae, calcareous green algae, temperate urchins, limpets, crabs, lobsters, and shrimp (Ries et al., 2009).

P7118, L23: “this evidence”

P7118, L25: wouldn’t the Ca-45 uptake method also be subject to the effects of dissolution, and therefore no better a measure of gross calcification than either buoyant weighing or the alkalinity anomaly (since incorporated Ca-45 would also be re-dissolved along with the skeleton)

P7118, L29: change “consider the whole organism’s responses” to “consider whole organism responses”

P7119, L1: add “photosynthesis” to this list

P7119, L8 -10: change to “performance, particularly for marine invertebrates, which may reduce their fitness in the face of ocean acidification.”

BGD

6, C1606–C1612, 2009

P7119, L11: change to “entire temperature range”

P7119, L12: change “by” to “due to”

P7119, L17: there is really no evidence – based upon these experiments on temperate corals – to suggest that tropical corals would be similarly affected, especially when most of the empirical evidence suggests otherwise. This sentence can be removed from the concluding paragraph.

P7119, L22: change to “for surface seawater in most regions”

P7119: Concluding paragraph should be reorganized and rewritten for clarity

There are many awkward passages and sentences throughout the manuscript that will inevitably detract from its impact and readability. The manuscript should be carefully edited to ensure proper grammar and diction prior to publication.

Table caption 1: change to “salinity ranged from”

Table 1: the std deviations reported for wintertime temperatures are very high (5-10 deg C) – is this correct?

Table 2: table should show whether there was a positive or negative association between the variables

Figs 2-5: again, be consistent in reporting error, stick with either s.d. or s.e.m. throughout the text

Fig 5b. does this figure include data from the 2 different temperatures – if so, can the different temperature be shown in the graph (e.g., open square = 400 ppm; open circle = 400 ppm + 3 deg C; closed square = 700 ppm; closed circle = 700 ppm + 3 deg C)

Conclusion

I recommend publication of this manuscript in Biogeosciences Discussions with minor revision, pursuant to the modifications suggested above. This work represents an

BGD

6, C1606–C1612, 2009

original and important contribution to the fields of ocean acidification research, coral physiology, and coral biomineralization.

Interactive comment on Biogeosciences Discuss., 6, 7103, 2009.