

Biogeosciences Discuss., author comment AC3
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Reply on RC3

Coulson A. Lantz et al.

Author comment on "Will daytime community calcification reflect reef accretion on future, degraded coral reefs?" by Coulson A. Lantz et al., Biogeosciences Discuss.,
<https://doi.org/10.5194/bg-2021-61-AC3>, 2021

Reviewer Comment #3

General comments:

This is a timely study that discusses the possible divergence between estimates of NEC and reef growth in degraded coral reefs. The authors provide an interesting perspective that thermal enhancement of calcification in other benthic members may highly influence NEC, especially in reefs where coral cover is low.

The limited amount of nighttime NEC measurement is a weakness of the study. Nighttime dissolution could significantly influence the 24 hours NEC signal, especially if other benthic groups are contributing substantially to the calcification signal. The authors do a good job discussing this issue in the "future considerations" section. However, the lack of these data could have influenced the conclusions of this study.

There are important information missing in the main text while the SI is too long. Authors could change the structure of the paper by including some sections of the SI (e.g. S2.2.) in the main manuscript.

Overall the paper is well written but there are some references and details missing which are highlighted in the specific comments.

We thank reviewer #3 for their review of this manuscript. Their concerns fall in line with Reviewer #1 and #2, requiring more text from the SI to be moved to the main text which can be easily rectified. Clarifications among the citations will also be fixed.

We also agree that nighttime dissolution could be a major driver of the NEC decline that we did not measure and, as they note, we admit this in the discussion. We will add more to this text and stress that this paper simply adds to the evidence that daytime measurements of reef metabolism may not be enough to discern changes in reef health, especially on reefs with high algal cover.

We endeavoured to provide some nighttime measurements and admit that the replication is not enough. We will be clear in the discussion that nighttime

measurements are important so flow metabolism teams should be constructed so that half the team sleeps during the day. Admittedly, we wanted to take more nighttime measurements but were flat out doing work on the reef all day for multiple different studies.

Specific comments

Abstract

L 23- erase coma after other.

Noted, will fix.

Introduction

L83-86- The authors should be more specific here by including the changes in coral cover after the bleaching event (from 7.1% to 5.8% coral cover).

Thank you for these details, they will be added to the text.

L88-94- Authors should mention that in the same paper, Kayanne also observed decreases in NEC following a bleaching event and decreases in coral cover in Palau.

We agree with this comment and will be adding the Palau results with the discussion of other publications showing a bleaching-driven decline in NEC (L56-65)

Materials and Methods

L 159-170- Authors need to provide more details about NEP and NEC calculations. This section is oversimplified specially compared to section 2.1. This information needs to be in the main manuscript, not in the SI.

Noted, much of the SI will be moved to the main text methods.

Why are nighttime measurements not included in this section?

Nighttime measurements will be added to this section.

Discussion

L253-255- The authors previously mentioned that the NEP values were not included for the slack-water approach given the large source of error in air-sea oxygen exchange. Therefore, they should not consider this data in the discussion.

The NEP values listed here are from the Eulerian approach which are collected close in time and do not exhibit the same error.

L 259 -Again, authors should mention the contrasting results reported by Kayanne et al 2005 between the Palau and Japan studies.

Noted, this will be added.

L 322-329 -This information is not accurate. Courtney et al did not **find** that the dissolution signal was a major driver of the 24-h zero NEC signal during bleaching. They **Hypothesize** that reductions in NEC could influence carbonate dissolution and they link

this hypothesis to the zero NEP observed during bleaching. Please, make the appropriate changes.

We will change find to hypothesize. Thank you.

Overall, I agree with the main point of the paper that NEC measurements may no longer be a good proxy for reef growth in degraded coral reefs. However, this is especially true for daytime measurements. During daytime, other benthic groups such as algal turfs, which are becoming more frequent as reefs degrade, can highly influence the metabolic signal of the reef. For example, Romanó de Orte et al. (2021) recently showed that, during daytime, algal turf communities have similar calcification rates than live corals. However, during nighttime, while corals are still net calcifying, algal turfs are net dissolving. This would likely influence NEC during a 24 hours cycle. It is crucial to have robust nighttime NEC measurements in order to access changes in NEC during bleaching events. Further, the algal turf calcification during daytime could also help explain the discrepancies described in L343-364.

We are aware of De Orte et al. (2021) and as noted with the other reviewers, we will be adding a similar back of the envelope calculation used in Figure 4 (modeled thermally-accelerated calcification) to project how the dominant fleshy algae cover on dead coral could have masked daytime declines in coral NEC. We agree it would be ideal to have more robust measurements of full 24-h NEC.

L 360 Erase "be"before influence

Noted, will fix

Note to Editor:

The driving need for these types of studies, in short, is to help the world find a way to measure coral reef health in the face of climate change.

We would like to add text to clarify that the specific emphasis behind this study is the development of marine ecosystem condition indicators for ocean accounting (<https://www.oceanaccounts.org/>). This is an international initiative by UN-member nations to advance environmental accounting procedures into the marine environment in response to the recently adopted SEEA (System of Environmental Economic Accounting). There is a specific focus in this initiative to find approaches that define marine ecosystem health and can be repeated by scientists and citizens trained by scientists around the world to be incorporated into environmental accounts maintained by governments, especially in underdeveloped nations where many coral reefs are located.

We will make every effort to admit more robust approaches (nighttime, dawn, dusk) will be needed to fully constrain 24-h NEC and we appreciate the reviewer's insight into these needs. We completely agree, from a scientific standpoint, that pairing nighttime measurements is extremely important. But we would also like to discuss that such requirements could prevent the application of this method on reefs which are hard to access at night due to navigation, technology, or safety constraints.

Altogether, we feel it is important to keep the bigger picture in mind of "how do we measure reef health throughout the world?" and would like to discuss that if daytime NEC cannot adequately do this on degraded reefs and nighttime measurements are required, this may limit the coral reef accretion estimates by flow metabolism in less developed nations who do not have access to

autonomous water samplers or on coral reefs which are inaccessible at night.

Please also note the supplement to this comment:

<https://bg.copernicus.org/preprints/bg-2021-61/bg-2021-61-AC3-supplement.pdf>