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Interactive comment on "Dynamics of seawater carbonate chemistry, production, and calcification of a coral reef flat, Central Great Barrier Reef" *by* R. Albright et al.

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1) The sinusoidal trend is clear for all carbonate system parameters except for total alkalinity. This is curious given the fact that there is a diurnal trend in NEC, and that is typically accompanied by increasing TA at night and decreasing TA during the day. Some discussion should be included as to why this is not the case for these data. As indicated by reviewer 1, there is not a clear sinusoidal curve fit for the NEC and NEP data. This is likely due to the lower sampling resolution (temporal) for the Lagrangian transects as compared to the autosampler measurements. Autosampler measurements were collected every 2 hours while Lagrangian transect measurements were collected

approximately 3x per day resulting in 3 clusters of NEC, NEP data (low in the morning, high at mid day, low at night). It is possible that the trend is sinusoidal, but the data do not exist to fill in the gaps to prove it. Discussion should be expanded to address this point.

Given the benthic composition with significant amounts of corals and crustose coralline algae, we expected TA to be drawn down both day and night. Night calcification of corals is approximately 1/3 of day-time calcification (e.g. Schneider and Erez 2006). Conversely, high rates of net photosynthesis during the day are contrasted by high rates of net respiration during the night. Therefore, changes in total alkalinity due to calcification are small relative to changes in DIC, making diurnal trends more difficult to discern.

2) Given the consistent trends in autosampler carbonate system data, the broad scatter in the NEC and NCP data suggests there is considerable error in one of the Lagrangian drift parameters. I am assuming that NEC and NCP rates were normalized to transect length because results are reported per meter squared. The equations on page 7649 do not indicate that (and they should). If not, then perhaps some of the error is due to variable transect lengths. Also as suggested by reviewer 1, there can be considerable inconsistency in drogue versus dye tracking of water masses. If concurrently collected drogue and dye data are available, then some discussion of consistency and potential error using these methods should be included. Discussion should be expanded to recognize the inconsistencies in transect data and these potential sources of error.

Please refer to our responses to Reviewer 1, Comments #1 and #2, concerning comparisons between the dye and drogue, and variability in the rate data.

3) There is no indication as to how pCO2 in air was measured or at what frequency for calculation of gas exchange. Methods should be included. If a constant value for pCO2 in air was assumed, then include it.

Atmospheric pCO2 was not directly measured; it was assumed to be 394 ppm. This

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has now been noted in the methods.

4) If there is a technical reference for the autosampler that was used to collect water samples on the reef flat, that should be included. If not, then a technical diagram would be helpful if this is new instrumentation.

The autosamplers are new instrumentation that was designed and built in-house. We have added a technical diagram to Figure 2 of the revised manuscript, detailing the sampler design.

5) Were all of the Lagrangian transects located within the 200m x 200m boundary defined by the benthic community structure surveys?

Yes, all lagrangian transects were located within the boundaries of the site (the sample site was 300 m2, not 200 m2).

6) What was the distance of the IMOS weather station from the study site?

The Davies Reef weather tower is located approximately 1.5 km from the center of the reef flat site. The tower is situated in the center of the lagoon.

7) Average net daily calcification was based on a 12:12 light dark cycle. What was the actual duration of the light dark cycles? And why not use that for your calculations?

Please refer to our response to Reviewer 1, Comment 8.

8) The outlier NCP measurements on 1/24/12 and 1/25/12 are curious given that respiration is typically relatively constant throughout the night. A review of the supplementary data shows no anomalous physical parameters associated with those measurements. Please comment on any other factors that may have resulted in these anomalous data points.

One of these transects was conducted during an incoming tide and ran from the lagoon to the reef crest (opposite direction to the majority of transects which were conducted during outgoing tides and ran from the reef crest to the lagoon). Although there were

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other transects that were conducted during incoming tides, and whose rate data were not anomalous, it is possible that a turning current would mix boundary layers over the reef, thereby leading to spikes or drops in carbon species until boundary layers are reformed. The other outlier transect ran at a slight diagonal through the sample site, and was therefore was longer than most of the other transects. It is possible that the slightly different trajectory through the sample site (possibly traversing a slightly different community) contributed to the different rates of respiration.

9) It would be a worthwhile exercise to plot daytime and nighttime NEC and NCP data separately to see if it improves the relation between these parameters. The differences in dominant process (calcification vs. dissolution) from day to night may “muddy” the trend in the combined data set. The recommendations above represent minor modifications to the paper. I have therefore recommended publication of the manuscript after minor revisions.

The plot of NEC and NCP has been removed from the manuscript. Please refer to our reply to Reviewer 1, Comment #5

Interactive comment on Biogeosciences Discuss., 10, 7641, 2013.