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Biogeosciences Discussions

Interactive comment on "High-resolution ocean pH dynamics in four subtropical Atlantic benthic habitats" *by* C. A. Hernández et al.

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GENERAL COMMENTS

This paper provides a useful dataset on pH diurnal and seasonal variability in shallow coastal waters, relating such changes to site-specific biological activity (photosynthesis by different macroalgal communities). Such variability in carbonate chemistry parameters is of great importance to ocean acidification (OA) studies, yet has been relatively neglected.

The main conclusions drawn are almost certainly valid. Unfortunately the measurements made are not as comprehensive as would be desirable, and other useful contextual information is not currently provided.

The references cited are mostly >5 years old, and would benefit from being updated – particularly in the Introduction.

SPECIFIC COMMENTS

Title 'Coastal' (or shallow, or nearshore) should be included in the title. Also 'North Atlantic' rather than just 'Atlantic'.

Abstract Lines 1-5: The first sentence is over-long, over-complicated and ambiguous in two aspects. It needs re-writing, to better separate (into 2 sentences?) the main ideas. "Oscillations of ocean pH are largely unknown" suggests that oscillations don't occur, rather than they might do so but have not been well-studied; "most of what is known... in near shore environments" suggests that most experiments have been carried out in the field, is that intended?

Line 5-7: The second sentence repeats that claim: "Most experiments... are carried out in coastal environments": yet surely most experiments are carried out in the laboratory, and relatively few in situ?. "No research that takes into account natural pH variability" is incorrect; there have been some field-based studies, e.g. using mesocosms and CO2 vent sites, also a few 'community experiments' in the laboratory.

Line 9, 10: Suggest "site" and "sites" to replace phytocenoses and phytocenosis within the Abstract; the terms are not widely understood. But they could be used later, if explained.

Introduction Paragraph 1 Many/most of the references cited here should be replaced by those that are more up-to-date; eg. Le Quere et al (2015) [Global Carbon Budget 2014; ESSD 7, 47-85) and the IPCC 5th Assessment Report.

Page 19482, lines 25-26: Re-write this sentence, with a more up to date reference, e.g. IPCC AR5. Note that the doubling of atmospheric CO2 is scenario-dependent: it will only occur if emissions continue unabated (that, hopefully, now seems unlikely)

Page 19483, line 2: replace "CO2 levels present" by "the CO2 increase"

Line 4: replace “lose” by “release”

Line 6: delete “bicarbonate and”

Line 7: replace “ocean pH is thought to have” by “surface ocean pH has”

Lines 9-10: This is a scenario-dependent projection, not a prediction – comment above applies.

Paragraph 2 Page 19483, line 18-19: amend to “use as ‘control’ conditions already available global average values of surface water carbon chemistry parameters (pH, total alkalinity. . .”

Line 26: amend to “. . .anticipated in the near future based on atmospheric CO2 values”

Line 26: the Dupont & Thorndyke review only relates to sea urchins. More comprehensive reviews are provided by Kroeker et al (2013), as already cited and by CBD (2014) Tech Series 75, An Updated Synthesis of the Impacts of Ocean Acidification on Marine Biodiversity.

References should be given to justify the statements made beginning line 27, p 19483 (“Experimental studies. . .”) and line 1, p 19484 (“The combined impacts. . .). For the latter, a suitable reference could be Breitburg, Salisbury, Bernhard et al (2015) Oceanography 28, 48–61

Page 19484, line 11: replace “is also” by “may be”. Values can be lower or higher, depending on water depth, season etc

Material and methods

More detailed site descriptions – with additional measurements – would be highly desirable. Are there in situ temperature data? Were any discrete water samples taken at different times of day (e.g. early morning, late afternoon) for measurement of other carbonate chemistry parameters?

Page 19485, line 9 “about 5-10 m depth” seems very vague. Can you be more accurate? Are there significant changes in water depth due to tides/wind?

Other extra information could include: - Spatial extent of the benthic habitats (since water chemistry will be determined by conditions at scale of 10-100m, maybe larger, unless seawater state is exceptionally calm) - Was the water stratified or mixed (e.g. to depth XXm) during the study periods? - Is there any water current data? (relating to above) - Is there any met data from land-based measurements? (e.g. providing information on winds/storms during the study periods) - How far offshore were the sites? - Are there any CO2 vents nearby?

A detailed site location map, with water depths, would be useful. That might indicate whether some sites might be more influenced by deep-water conditions (upwelling) than others.

Results

Page 19485, line 25: Replace “Overall pH. . .” by “Mean site-specific pH. . .”

Page 19486, lines 8-9. This sentence seems odd: a clear daily cycle in pH has already been stated. Whilst smaller than the seasonal pattern, its scale can be similar (rather than “relatively small in comparison”).

Page 19486, lines 19-20. With regard to the difference in timing of pH maxima, could a difference in water depth be involved? Or is there any shading from land topography??

Discussion

The conclusion drawn regarding the influence of the different habitats (and their macroalgae) are almost certainly correct. But it is a pity that there wasn’t more physical/hydrographic information to support such ideas.

Page 19487, line 28: temperature is mentioned as an influence on the pH cycle. How much effect could it have had?

Page 19488, lines 8-9: the breakdown of the thermocline (delivering nutrients) is given as the reason for spring growth – but doesn't that breakdown occur much earlier, in the winter?

Page 19488, line 15: the ESTOC time series is mentioned. Is there diurnal/seasonal data available from that site for the same periods, that could be included for comparison?

References

Additional relevant references that could be cited (in addition to those already mentioned above) include:

Johnson ZI, Wheeler BJ, Blinebry SK, Carlson CM, Ward CS, et al. (2013) Dramatic variability of the carbonate system at a temperate coastal ocean site (Beaufort, North Carolina, USA) is regulated by physical and biogeochemical processes on multiple timescales. PLoS ONE 8(12): e85117.

Shaw EC, McNeil BI, Tilbrook B, Matear R, Bates ML (2013) Anthropogenic changes to seawater buffer capacity combined with natural reef metabolism induce extreme future coral reef CO2 conditions. Global Change Biology 19: 1632-1641.

Tables

Table 2 (or Table 3?) could usefully include information on when the different sites were studied (more exactly than 'autumn', 'spring' etc)

Figures

Whilst Fig 3 does include date information, it is hard to read – and ambiguous. Is 5/4/2012 the 4 May or the 5 April?

TECHNICAL CORRECTIONS

Page 19484, line 8/page 19492: "single day" not "singleday"; the Wooton et al (2008)

reference is not included in the reference list

Page 19488, line 3: "Gattuso" not "Gatuso"

Page 19491, the Middelboe & Hansen (2007) and Montanes et al (2006) references need to be exchanged [to keep to alphabetical order]

Interactive comment on Biogeosciences Discuss., 12, 19481, 2015.