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

I. General comments

In this manuscript, the authors reported the in situ pH dynamics in coastal shallow waters with different benthic communities. They identified the temporal (diurnal, seasonal) and spatial variations of seawater pH and related these pH changes mainly to the biological influences (photosynthesis/respiration, biomass, community structure et al.). Although the research topic meets the general interest of Biogeosciences and these pH data are valuable, I find that the manuscript is more like a data report rather than a research paper: it only reported one single parameter (pH) while no other data is provided to support in-depth discussion on the controlling mechanism of the observed pH dynamics. The authors are encouraged to add more environmental information (tide, temperature et al.) and to carry out more analysis for a better examination of the pH variability. The Results and Discussion sections could also be better organized to present the findings of this study. Please see below for my detailed comments.

II. Specific Comments:

1. P 19482, line 1: Rewrite the first sentence of the abstract.
2. P 19482, line 5: "Most experiments designed to make predictions about futue climate change scenarios are carried out in coastal environments…". This statement is not correct. Most ocean acidification experiments are currently carried out in laboratory.
3. The abstract did not summarize the major findings of this study. P 19482, line 15 "The pH variation observed ranged by between 0.09 and 0.24 pH_{NBS} units.)." This sentence did not clearly point out the timescale of the pH variation. Diurnal and seasonal variability of pH should be both presented in the abstract followed by their controlling mechanisms.
4. P 19483, line 3 "However, when CO_2 dissolves in seawater the gas reacts and

forms carbonic acid (H_2CO_3) which then can dissociate and lose hydrogen ions resulting in the formation of bicarbonate and carbonate ions.". This sentence might result in a wrong impression that the oceanic uptake of CO_2 increases the concentration of carbonate ion. When CO_2 dissolved in seawater, it could be described as "$CO_2 + CO_3^{2-} <==> 2HCO_3^-$, which results in an increase in bicarbonate iron and **a decrease in carbonate ion**. Please rewrite this sentence.

5. P 19483, line 20 "Separate studies specifically measuring pH and carbonate levels in the same habitats often result in values that are inconsistent with pCO_2 averages used in studies.". Please clarify what is the "inconsistent" in this sentence (the inconsistent between the target pCO_2 levels vs. the pCO_2 values calculated from the measured carbonate variables?).
6. Second paragraph on P 19483: this paragraph should first present the current observation results and understanding of the ocean pH dynamics (from open ocean to coastal waters), followed by the knowledge gap "Little is known about the influence of different phytocenoses on pH."
7. For in situ sensor deployment, the instrument drift and biofouling tend to be significant problems affecting the quality of the data. The authors should provide some information on these two issues.
8. It is suggested that, in the future deployment, the pH electrode should be directly exposed in the water rather than be placed in the protecting case. It seems from Fig. 1 that the protecting box might limite the water exchange although the authors suggested that there are several openings on the box.
9. The Results section is not so well organized. I would suggest to divide it into two subsections ("3.1 Diurnal variability" and "3.2 Seasonal variability"), and describe the similarity and difference of the results observed at these sites in each subsection. The same applied to the discussion of the controlling mechanisms of these pH variations.
10. Tidal mixing is a key physical process affecting the water chemistry in coastal shallow waters. Previous study has suggested that tidal advection could be the

dominant controlling factor on water chemistry in certain coastal systems [*Dai et al.*, 2009, although pCO_2 is observed in this study, the same appllied to pH] or could modulate the diurnal pH variation range on spring-neap tidal cycle [*Jiang et al.* 2011]. Although the pH dynamics in this study should be dominated by biological activity, the tidal height data should be presented together with pH as it might play certain roles in modulating pH changes (e.g. if it modulates the time when daily pH maxima/minima was observed?).

11. Temperature is another factor affecting the seawater pH. Is there any available temperature data to discuss the temperature effect (although it might only play a minor role in this study)?
12. If carbonate data (dissolved inorganic carbon, total alkalinity) are available, the influence of calcification should also be discussed.
13. For the "Time period" column in Table 3, it is better to present the specific dates of the observations following the "season".
14. In the discussion section, the authors should compare their results to similar coastal systems where pH dynamics are dominated by biological activities, while the open ocean water case (P 19487, line 23) should not be included here (move it to the introduction section). Other coastal systems where pH is significantly affected by other physical and biogeochemical processes should also be discussed: for instance, tidal mixing [*Dai et al.* 2009; *Jiang et al.* 2011], eutrofication [*Cai et al.*, 2011], underground water input [*Wang et al.* 2014], fresh water input in estuaries et al.

References:

Cai, W. J., et al. (2011), Acidification of subsurface coastal waters enhanced by eutrophication, *Nat Geosci*, *4*(11), 766-770.

Dai, M. H., Z. M. Lu, W. D. Zhai, B. S. Chen, Z. M. Cao, K. B. Zhou, W. J. Cai, and C. T. A. Chen (2009), Diurnal variations of surface seawater pCO_2 in contrasting coastal environments, *Limnol. Oceanogr.*, *54*(3), 735-745.

Jiang, Z.-P., J. C. Huang, M. H. Dai, S. J. Kao, D. J. Hydes, W. C. Chou, and S. Jan (2011), Short-term dynamics of oxygen and carbon in productive nearshore shallow seawater systems off Taiwan: Observations and modeling, *Limnol. Oceanogr.*, *56*(5), 1832-1849.

Wang, G., W. Jing, S. Wang, Y. Xu, Z. Wang, Z. Zhang, Q. Li, and M. Dai (2014), Coastal Acidification Induced by Tidal-Driven Submarine Groundwater Discharge in a Coastal Coral Reef System, *Environ. Sci. Technol.*, *48*(22), 13069-13075.