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Biogeosciences
Discussions

Interactive comment on "Including high frequency variability in coastal ocean acidification projections" *by* Y. Takeshita et al.

Anonymous Referee #1

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General comments This paper uses data from existing long term monitoring programs (sensors) and cruises and combines it with known empirical relationships for the region as well as atmospheric CO2 records to achieve modeled carbonate system projections for different habitats in the Southern Californian Bight. This is an excellent example of how existing datasets can be used for interesting habitat specific projections of CO2 chemistry. Using existing data and relationships has the disadvantage that there are some basic differences between e.g. sensor deployment heights (2, 3, 0 and 12m above the surface) and regional empirical relationships are not exactly matching discrete samples for TA. The study also uses a lot of estimates (phosphate concentrations p7136, line 19-20); ΔDICdiseq (p7137, lines 7-10) instead of values based on measurements. As the paper is based on existing data and published empirical relationships, it is not really novel, although the combination and comparison of different

habitats and the estimate of future pH variability in these zones are interesting and merit publication.

Specific comments page 7133-paragraph 2.3 – Honeywell Durafet III pH sensors are reported to have excellent stability for months or even years, with an estimation for this study (line 15) of better than 0.005 (units). This is very likely but not verifiable from the text as the authors do not mention if the calibration samples were taken at the beginning of the time series or/and at the end and do not report (absence of) drift.

How was accuracy estimated?

The section of TA estimation (line 20 and below) is difficult to read without the citation (Alin et al. 2012) detailing the regional empirical relationship. It would be useful to know the relationship is based on temperature and salinity for instance. The abbreviation RMSE (root mean square error) is not explained. It is unclear if the offset used to account for differences between measured values (discrete samples) and the empirical relationship for TA for the larger system applied to all three subsurface sensors. If so, what could have caused the discrepancy between the relationship in previous years (2005-2011) and 2012? Uncertainty for resulting DIC, pCO2 and ΩAr is pH-dependent (line 26), but how much uncertainty is introduced by using estimates based on an empirical relationship that needs to be corrected with an offset?

Page 7134 – paragraph 2.4.1 – future and pre-industrial TA is fixed at 2012 levels. How realistic is this? E.g. will there be no change in watershed dynamics in the coastal zone or is there little influence of river runoff?

Page 7135 – lines 5-6: "Although large deviations from equilibrium conditions are often observed in the coastal ocean due to upwelling and biological production (Hales et al., 2005), the mean pCO2 calculated from sensor data at the surf zone was 394 μatm, suggesting that the surface water at the study site was near atmospheric equilibrium."

Biological production can cause large fluctuations that still can have an average close to atmospheric equilibrium. How variable was the pCO2 at the surf zone? The authors later give this information in Table 3 but it would be nice to have it here.

Page 7139 & 7140 – It is surprising that the mean daily range of the canyon edge was higher than in the kelp forest. The authors discuss that this could be due to amplification of tidal energy but still it seems odd primary production and respiration in a kelp forest would not cause larger daily fluctuations. In fact, the mean daily range in pCO2 for the kelp forest is the lowest for the four sites (Table 3). Supposedly the sensor was placed within the canopy (3m above the seabed), it would be helpful if the authors could comment on the processes behind the fact that different water masses brought in by tides cause larger daily fluctuations compared to a productive kelp forest. Would this be a representative situation for the region? For sites with upwelling?

Page 7141-7142 – lines 27,28 &1-3: "all habitats studied here have left, or are about to leave, the pCO2 pH, and ΩAr conditions that were experienced during preindustrial times. This is significant as organisms at these sites are now surviving in conditions that are significantly different than the conditions under which their ancestors evolved."

Agreed that the average conditions are significantly different than the conditions under which their ancestors evolved. However, the daily range given in Table 2 is larger than 1 SD, so organisms living in these sites must have developed certain flexibility and adaptations to cope with these fluctuations. Figure 8 and 9 nicely show how greater extremes will be reached, and the amount of time spent in these situations will increase, which is more important for organisms than the higher average conditions. However only one site is shown (Del Mar Buoy) and the interesting comparison between different habitats is not visually plotted although figure 10 gives a reasonable summary. It would be nice to reproduce figure 10 more prominently, or add a similar figure as 9 for the kelp forest and discuss the differences between vegetated and non-vegetated habitats more explicitly.

Page 7146 – lines 19-21 – "temperatures observed in 2012 were used to parameterize

the model. Sea surface temperature has increased over the past century due to climate change (Smith et al., 2008), and is expected to continue."

Temperature increases do not only affect the chemical reactions of the carbonate system but can have a big influence on biological responses. For instance temperature increases might greatly affect the productivity of plankton or kelp forests. The biological signal due to respiration/productivity and thus carbon uptake might change in areas where vegetation can influence daily and seasonal patterns.

Interactive comment on Biogeosciences Discuss., 12, 7125, 2015.