

### Response to Anonymous Referee #3

*We would like to thank anonymous referee #3 for her/his thoughtful review. Our responses to all of the referee's comments and relevant short comments are italicized below.*

Sutton and co-authors introduce a valuable, impressive dataset and provide a useful analysis of the range of seasonal variability across moored timeseries for pH and Omega aragonite. They compare across 12 open ocean, coastal and coral reef locations. In section 2, they carefully assess sources of uncertainty and clearly describe the reasonable choices made in the omega calculations. The figures are clear. It's a very nice contribution, and I don't see a need for much revision prior to publication.

I would suggest the authors add some additional discussion of the degree to which we understand how organisms respond to variability outside the preindustrial range, as this is a major focus in the analysis. They discuss a few oyster species with Figure 9 in section 3.2. I would suggest referring to this in the introduction, so as to better motivate the analysis. And also if there are other examples that could be used as motivation, that would be helpful. The motivation is presently termed primarily in terms of the general processes occurring in the coastal zone and the performance of numerical models.

*This is a very useful perspective, and we agree additional background in the introduction on relevance to biological response would improve the paper. While our understanding of how organisms respond to variability outside pre-industrial conditions is limited, there are experimental studies that test organism response at pre-industrial, present day, and future ocean acidification conditions, which we can summarize to bolster the motivation.*

A few additional, minor points:

*We agree with making all edits and minor changes brought up by the referee. We respond to the comments that require more detailed responses below.*

Introduction, page 1, Line 32: Comment: 30% is not incorrect if one takes cumulative FF emission and cumulative land use emissions = cumulative anthropogenic emissions. However, with respect to land processes, this does ignore the fact that much of the cumulative terrestrial sink is, in fact, regrowth after previous land use clearing. And uncertainty is very large on the mean land use source. That the ocean has absorbed 41,48% of fossil fuel emissions (Ciais et al. 2013, Sabine et al. 2004) has less uncertainty. I suggest (but do not insist) the authors consider using either the 41 or 48% "of fossil fuel emissions" as this is better quantified.

*Our estimate takes into consideration a compilation of inventories of anthropogenic carbon (observational and model-based estimates), which gives an estimate of the global ocean inventory in 2010 of  $155 \pm 31$  PgC (Khatiwala et al., 2013, [www.biogeosciences.net/10/2169/2013/](http://www.biogeosciences.net/10/2169/2013/)). When combined with the latest, annually-updated Global Carbon Project budget estimates for total cumulative emissions from 1870 to 2014 of  $400 \pm 20$  GtC from fossil fuels and cement and  $145 \pm 50$  GtC from land use change (Le Quéré et al., 2015), the total global ocean sink is ~30%. We believe this is the most comprehensive analysis to date that takes into consideration the entire global carbon budget. Now looking at this with*

*a more critical eye, we should modify the citations for that statement to Le Quéré et al., 2015 and Khatiwala et al., 2013.*