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# *Interactive comment on* "A year in the life of a central California kelp forest: physical and biological insights into biogeochemical variability" *by* David A. Koweek et al.

**Anonymous Referee #1**

Received and published: 4 October 2016

General Comments:

This study presents 1+ year time-series data of weekly samples of carbonate chemistry across a small spatial scale of a kelp forest covering two summer seasons. The data include surface and bottom samples in exposed and protected sites and from inside to outside the kelp forest. The data are of extremely high quality. The paper is well written, articulate, and has logical organization with nice transitions. While carbonate chemistry time series papers are increasing in number, this paper contributes novel and valuable data on small scale spatial variability (depth and spatial). In support of publishing this paper, I consider my comments as minor revisions which would improve the scientific quality from 'good' to 'excellent'.



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Specific Comments:

I have three specific comments, two with regard to the spatial variability. First, bottom water sampled by site is confounded by depth, which is not explicitly addressed. The spatial variation of bottom water could just be an artifact of the stratification of the water column within which the kelp forest sits (deeper waters have more DIC, so therefore bottom waters of deeper sites will have lower DIC values than bottom waters of shallower sites). The potential depth dependency of the observed dynamics (and conclusions) should be addressed and contextualized with the aims of the study (and the sampling design of surface and bottom waters, which was not explained). The data are valuable in terms of understanding the variation of what, for instance, a benthic kelp forest inhabitant might experience, but then that perspective should be included (Introduction and Discussion).

Second, the most valuable portions of this study are the depth gradient (well developed and presented) and the spatial gradient of the time-series (from inside to outside a kelp forest, exposed to protected). The presentation of the latter (Section 3.5) is extremely short and the figures comprise mostly of statistical numbers and not meaningful observations. The authors do themselves a disservice by not highlighting this aspect of the study more in depth. Figures 9 and 10 do not contribute anything that could not be shown in a table (Fig. 9b, 8, and S8 display duplicate data in every plot). Fig. 9a could be interesting if shown as a line graph (bar graph is too cluttering) but I don't think it's necessary in the first place. Instead, I was expecting a figure showing the gradient in carbonate chemistry from inside to outside the kelp forest at the two contrasting sites (protected, exposed). How does these gradient change by season? It looks like the largest spatial differences occur between the exposed vs. protected site and not within the inside vs. outside (I suspect that differences between inside and outside kelp forest will only be apparent with higher frequency sampling). The statistics show this, but the figure space would be better used by using the real data (e.g. select parts of the time-series, moving averages, etc.).





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Lastly, the Discussion is largely devoted to the value of time-series, this could probably be condensed. As an edition, the results should be discussed in terms in the context of other studies of kelp forest or coastal variability in general (some were mentioned in the Introduction). Do these data fall within the range of biochemical observations made previously in other kelp forests?

Other and Technical Comments:

Shorten the LPJPSMR acronym

2.1 L23: of kelp of the kelp

2.4 L6: provide reason or reference for phosphate assumption

2.4 L8: pHT is defined but not used in subsequent reporting of pH values in the Results.

2.4 L11: double ))

For all time series figures: simplify x-axis date labels. Adding 01 as the day is not necessary and adds clutter. I recommend to simply label months as 1-12.

3.2 L23: “causing water column temperature differences of up to 4°C” add across what range of depths

3.3 L 16-17: “Surface DIC concentrations were generally much more spatially homogeneous than bottom water DIC concentrations.” Could just be function of depth.

3.3 L25: has should be had

3.3 L27: regarding pCO2 undersaturation, add “with respect to the atmosphere” if that is what you are measuring saturation against.

Table 2: Since bottom depth differs across sites (7.5-16 m) and there are obvious depth effects, add the depth in m in () following the listed value in Table 2.

3.4 L21: “drove large variations in the ability to buffer against ongoing ocean acidification”. Ocean acidification is not detectable across such a short time-series. Reword to





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simply say, “drove large variations in the Revelle Factor”.

3.5: Why was aragonite used here (and not TA or DIC)?

4.1 L28: Regarding this paragraph, it would be nice if you could find a reference showing the seasonality of phytoplankton blooms of this site. I imagine it is offset from the kelp forest growing season.

4.2 L22 - State the actual findings. The largest source of variation seems to be the protected vs. unprotected sites, which is actually a function of the oceanographic features, not a function of the biology of the kelp forest. The biological control is in this study is the depth gradient (where primary production takes up DIC at the surface).

Pg. 11 L9: inconsistent use of OA vs. ocean acidification. I recommend to not use the acronym at all.

Pg 11, L10: other studies have shown this previously also: pH sensor-based studies in coastal environments but also cruise data for offshore regions. Cite references in support of this conclusion.

Pg. 11 L13: The ocean is not acidic, acidifying and acidic are different.

Pg. 11 L16: Same as previous comment. It makes more sense to use ‘low pH’ instead of ‘high acidity’

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