We would like to thank the reviewer for the comments. The point-to-point responses (in blue) to the reviewers' comments are listed below, and the revised texts are displayed in red.

Reviewer 1

Major comments:

1. The authors derived annual net community production using the mass balance of oxygen and dissolved inorganic carbon. The estimate based on dissolved inorganic carbon is higher than that based on oxygen concentration. The authors argue that this difference stems from residence time scale and horizontal advection. Since the model does not take into account horizontal advection, the latter makes sense to me. However, I cannot catch the explanation of residence time scale. I am not sure whether I am right. For example, if there is no gas exchange (very long equilibrium time scale), dissolved inorganic carbon balance still reflects net community production according to equation (2)?

In our case we are using both tracers to study the short-term (sub-annual) variations of ANCP, so gas exchange is a very important term for both tracers. As shown in Table 2b, for the DIC mass balance, gas exchange has a magnitude of about 50~80% of ANCP, which cannot be taken away from the mass balance calculation. For DIC since it has a relatively long residence time with respect to gas exchange (more than 1 year), it has already been "averaged" over a long period. On the other hand, due to the long residence time, horizontal advection also becomes more important for DIC, which causes the signal to be "averaged" over a larger spatial scale. Overall, the DIC tracer integrates temporally over many years and spatially over thousands of kilometers, and thus is a valuable tracer to get a big picture of biological carbon production over a long period or a large area without having to make many measurements. However, it may not be suitable for studying the sub-annual changes of NCP or inter-annual changes of ANCP.

2. According to the estimates based on oxygen mass balance, the annual net community production decreases during the "Blob". According to the authors' analysis, this decrease is likely attributable to the shift in phytoplankton community structure. I am thinking, whether can we dig a little deeper. Fundamentally, the net community production is controlled by light and nutrient availability on bottom-up control. So, I am wondering, whether we could find a connection to photosynthetically active radiation, mixed layer depth, and nutrients (e.g., nitrate). Probably, the authors have already analyzed those.

(1) We did analyze the influences from light and nutrient based on the available data, but they all seem to have little impacts. We added this part as Text S2 in the supplementary material.

Text S2 Analysis of other environmental parameters that may cause ANCP variation

(1) Shortwave radiation

Unfortunately there was no PAR sensor on the mooring (https://www.pmel.noaa.gov/ocs/sensors). On the other hand, it does have sensors measuring shortwave radiation, and the result (Figure 1, from https://www.pmel.noaa.gov/ocs/data/fluxdisdel/) doesn't show significant changes in shortwave radiation during those four years.

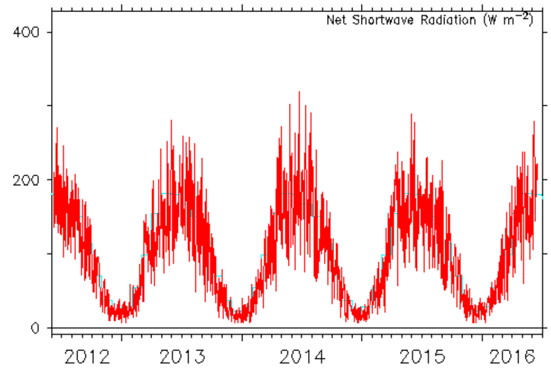


Figure S1 Net shortwave radiation data from Ocean Station Papa surface mooring (June 2012 to June 2016)

(2) Nutrient (nitrate) availability

Figure S2 shows the mixed layer nitrate concentration measured by an Argo near station Papa (Monterey Bay Aquarium Research institute (MBARI) Argo Float F7601, WMO # 5903714, http://www.mbari.org/science/upper-ocean-systems/chemical-sensor-group/floatviz/). There was no nutrient limit when the ANCP was the lowest in 2013-14. The nitrate concentration was near zero for a short period in the fall of 2015, but it went back in a short time and it didn't seem that nitrate is the limiting factor for biological production in this case.

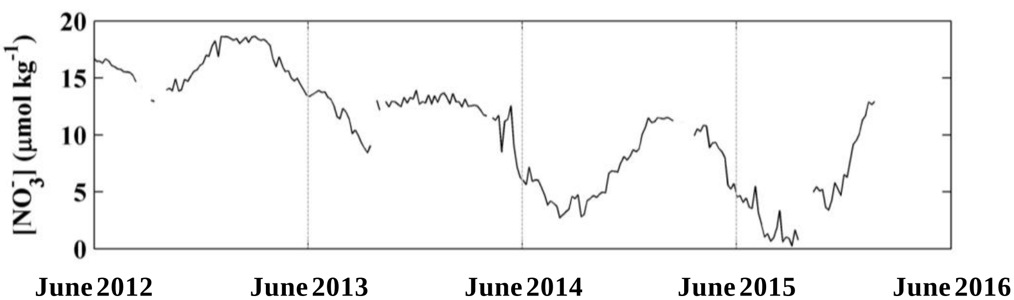


Figure S2 Nitrate data from MBARI Argo Float near Ocean Station Papa

(2) We define ANCP as the flux of organic carbon that escapes the "upper ocean" after a complete seasonal cycle. To be consistent with this definition NCP is integrated vertically from the surface ocean to the winter mixed layer depth (h). As shown in Table 1a, this value did vary from 91 to 111 m. To determine if this variation influences the ANCP trend, we did the calculation with a 4-year mean h value of 100 m (Line 322), and the result shows the same trend of ANCP.

(3) It is possible that the availability of iron (as mentioned by reviewer 2) played an important role in this case. See the response to reviewer 2.

Minor comments:

Lines 23-27: please see major comment 1.

See the response to major comment 1.

Line 28: shows?

Revised as suggested

Line 121: I am curious whether it depends on oxygen concentration gradient. I am thinking about this, because net community production is derived from oxygen concentration mass balance.

Revised as suggested to avoid confusion

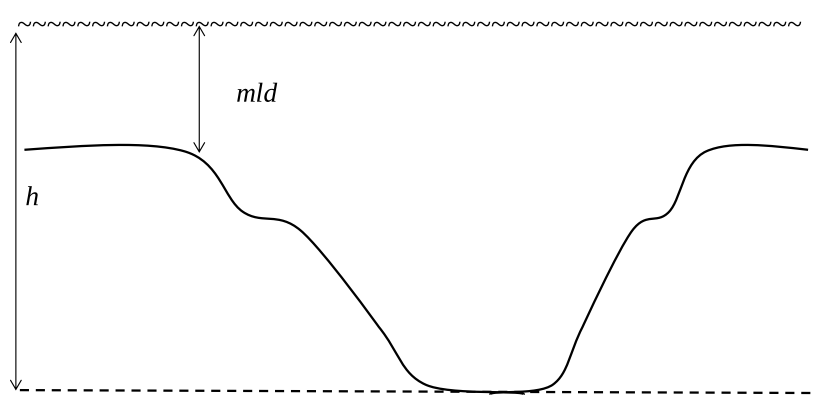
Line 157: Do we need more runs of Monte Carlo simulation?

Our test showed that 100, 200, and 2000 runs gave similar result.

Line 171: The assumption of no net dissolved inorganic carbon change is also related to no change in interannual variability in winter mixing? Or, there is no change in winter mixed layer depth?

The change of DIC in the upper ocean includes the DIC change in the mixed layer and the DIC change between the mixed layer and the base of the defined "upper ocean" (winter mixed layer in our case), as shown in Figure R1 and Equation 1. Because we only have DIC measurements from surface mooring (mixed layer), we assume that the second term equals to zero and the annual DIC changes in the upper ocean are all from the DIC changes in the mixed layer.

$$\frac{\mathrm{dh[DIC]}}{\mathrm{dt}} = \frac{\mathrm{dmld[DIC]_{mld}}}{\mathrm{dt}} + \frac{\mathrm{d(h-mld)[DIC]_{h-mld}}}{\mathrm{dt}} \quad (1)$$



An annual cycle

Figure R1 A schematic of the modeled “upper ocean”

As shown in Table 1a and 1b, there were inter-annual changes in winter mixed layer depth (h), which chances from 91 to 111 m during this 4-year period. For vertical flux (Fkz and Fv) calculation, we need the DIC gradient at depth of h, which was computed from the oxygen gradients calculated from measured oxygen gradients assuming dO2/dz to dDIC/dz ratio of 1.45 (line 168).