

## **Review of EGU 2251, An upper mesopelagic zone carbon budget for the subarctic North Pacific**

In this study the authors used multiple approaches to constrain the magnitude of the processes contributing to the mesopelagic zone carbon budget as well as its uncertainties. A snapshot of the budget in August, based on ship measurements showed an imbalance between the estimated organic carbon supply and demand. Instead, the amount of organic carbon necessary to cover the estimated carbon demand in late summer must have come from previous production in spring. This finding challenges the idea of a “steady state carbon budget” in the region of study for timescales of weeks. Independent measurements of the same process (e.g., particulate organic carbon flux) as well as measurements over different timescales (e.g., week-long ship-based measurements vs long-term moorings) provide robustness to the estimated budget and its uncertainties.

This is a relevant and robust study worth publishing, as addressing the range of methodological uncertainties to constrain the carbon budget in the mesopelagic region is important in view of rapidly developing technologies that aim to sequester carbon from the atmosphere via enhancement of the biological carbon pump.

### **Specific comments:**

L45: The line about NCP seems to be missing a verb: “Net community production (NCP) rates measured during the preceding spring and early summer of 2018 based on long-term mooring estimates of dissolved inorganic carbon concentrations.”

L98-100: Since the conditions were typical for late summer, I find this sentence a bit confusing, were temperatures warmer than expected in 2018? or warmer as compared to when?

L152: I would suggest to change “collected” to “selected from” or something similar, to leave no place for ambiguity as to what was newly sampled in EXPORTS and what was already publicly available. Same goes for L156.

L204: although the Po-based POC flux at 500 m was, within uncertainty, similar to the Th method ( $1.2 \pm 1.2$ ), as per the uncertainty ranges shown in Fig. 2b and 2c.

L241: Is it possible that 53.7 is 56.7 mmolCm<sup>3</sup> maybe? (as per Figure S1a) Otherwise I do not understand how the July-Sept difference is more than twice the instrumental uncertainty of 1.4mmolCm<sup>3</sup>.

L279: The authors mention that “the oxygen-based NCP measurements are of higher spatial and temporal coverage” The temporal coverage of the glider seems to be smaller than the mooring, I wonder if the authors mean, resolution, rather than coverage?

L450: typo in the first word “th1e”

Figure 1. Initially, I thought the numbers in the X-axis represented the day of the month

Figure 3. A vertical line for March could potentially help the reader, as this is a time that was considered to demonstrate NCP contributions (L281).

Throughout the text, I had some questions relative to the regional variability of the samples collected by the different platforms. I feel that these could be clarified with a simple map of the location of the different campaigns/platforms (e.g. to add in the supp). These are examples of the questions:

- Were the DOC profiles sampled at the same location? I understand that the three DOC profiles were collected during the OOI cruise, was the OOI cruise also within the eddy that the EXPORT cruise was sampling? Were all the stations less than 70 km apart? (as that is the maximum distance for water movement according to your L451) Is this relevant for your uncertainty assumption of minimal lateral advection?

- I understood that the 2 cruises were moving because they were following a float. How does this look in space? Do I interpret right that all the epochs represent the same water parcel (because the cruise was following the float)?