Reply on RC1
Chiho Sukigara et al.

Author comment on "Observing intermittent biological productivity and vertical carbon transports during the spring transition with BGC Argo floats in the western North Pacific" by Chiho Sukigara et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2022-9-AC1, 2022

To Reviewer #1

Thank you for your comments concerning our manuscript. We have studied all of your comment carefully and answered your comments. (Reviewer’s comments are in italic.)

The study is very descriptive. I’m not sure I learned much about how the ocean works that isn’t already well-established. The authors spend a lot of time talking about what exactly happened to the floats, but due to the complexity of the ocean relative to the measurements they have, they tend to just give generic explanations of why things they observed may have happen, which are impossible to verify. And there is very little focus on what was learned. It really reads as ‘we made some measurements, this is probably why the measurements look the way they do.’ It’s really up to the journal whether this meets its standards for publication, but I would strongly encourage the authors to focus much more on what these measurements teach us about how the ocean works that we didn’t already know, or what else would be necessary to learn something new about the ocean from these measurements.

We found that the physical and biogeochemical processes in our observed area by two BGC–Argo floats varied widely in space and time. Even though the two floats moved in close trajectories, they showed different temporal changes in water mass structure and biogeochemical parameters. For example, the increases in POC concentration in the surface layer differed by a factor of 6 in Case 2. In Case 4, the increases in surface POC concentration differed by a factor of 3. The fact that biogeochemical parameters vary widely in the small areas is important information when considering the material budget of the broad subtropical region. To reveal this, it was necessary to measure biogeochemical parameters with the same vertical resolution as temperature and salinity (e.g. every one meter) using BGC–Argo floats and to analyze them carefully. In the revised manuscript, we will specifically describe the large spatial variation revealed by our study in Abstract and Conclusion. In addition, although the evaluation of the impact of the change in water mass structure on biological process shown in this study required complex discussions, the accumulation of BGC–Argo float data and the use of AI-based deep learning will simplify the quantitative evaluation of physical and biological processes in the large area in the near future. This outlook will be also described in Conclusion.
The Chlorophyll-fluorescence comparison is pretty concerning and either should be redone, with a better description of the observed relationship and some proper uncertainty calculations given the weakness of whatever relationship the authors will find, or dropped entirely.

We recalculated the chlorophyll fluorescence value and the measured value by pigment extraction (see a supplemental figure). Previously, we used only data from the float close to the CTD station in KS-18-04, but this time we looked for data from two floats that have closer to the temperature and salinity of the water sampling layer and compared fluorescence values of floats to the measured values. This allowed us to perform a better fitting. In the revised manuscript, we estimate the chlorophyll concentration using the new equation.

1 – Should transports be transport?

We rewrite to ‘transport’.

2 – Pick one of BGC-Argo vs. BGC Argo and stick with it – and at some point the authors should spell out what the BGC acronym refers to

We use BGC-Argo in the revised manuscript. We add the explanation of the BGC acronym where BGC first appears in the text (title).

18 – Ocean (physical) structure?

We rewrite to “ocean physical structure”.

21 – Why no symbol for nitrate?

We add the explanation of “to estimate nitrate and nitrite concentrations”.

25 – How deep?

We add specific depth (300 m).

32 – Are deep POC increases statistically significant?

Since the error of the estimated POC concentration is ± 0.75 mmol kg\(^{-1}\), the deep POC increases are within the error. However, the large difference between the measured and estimated values appeared mainly at the surface. Therefore, the error at the depths deeper than 300 m was ± 0.37 mmol kg\(^{-1}\), and was smaller than that using all of the data. With this result, we analyzed the deep POC increase as significant. We will add this explanation in the revised manuscript.

34 – Grammar: ‘to observed’

35 – This is not unique to your study and I’m not sure it belongs in the abstract

We delete this sentence and write the characteristics and claims of this study.

40 – Can CO2 be used without explanation, i.e. ‘carbon dioxide (CO\(_2\))’? Also Giering et al. 2020 is not the right reference for this

We add the explanation of CO\(_2\). We delete Giering et al. 2020.

41 – ‘Events’ isn’t really the right word – processes is better
We rewrite to ‘processes’.

134 – Was there only one measurement made of euphotic depth?

Yes. We measured the light in the water column only once. And we apply that depth of the euphotic layer to all float observation. We explain that in the text.

141 – It should be stated somewhere that the nitrate concentrations actually reflect nitrate+nitrite, then, right?

We rewrite to ‘nitrate + nitrite’.

212 – It’s nice to see that the authors calculated their own bbp-POC relationship

We use all the data of POC and make a new correction formula.

239 – It’s also possible it’s due to errors in the reanalysis product the authors used

We add a description of the error on line 238-239.

262 – This bit about how MLD is defined seems better-suited to the methods? This is also true for other calculations (e.g. quasigeostrophy) in sections 3 and 4

We move the description of definitions to the methods.

266 – Can you use a shorthand rather than the full 7-digit string, like ‘float A’ & ‘float B’? It will confuse readers because both float numbers are composed of 2s, 9s, 0s, and 3s.

Yes. We will change the float description to ‘float A’ and ‘float B’.

311 – Better not to use acronyms in headings when possible

We will delete this sentence according to reviewer 2’s comment.

410 – This is interesting

We appreciate your comment.

Figure 2 – This is pretty concerning and draws into question the authors’ chlorophyll measurements. I would like to see an attempt to fit these data with e.g. a saturating function, and an error quantification, given that the fit is so poor. You can’t call your four largest fluorescence values outliers.

We will change to a better correction method as answered in the second major comment.

Figure 3 – Again, why are you calling these outliers? They even fit the trend! This is much more encouraging. I would strongly recommend recalculating this, using all of your data, and propagating uncertainty from the regression coefficients.

We will also use a better correction equation using all the data.

Figure 4 – Some of these MLD changes are encouragingly really quite large. I would emphasise this as it’s currently vague in e.g. the abstract whether these are MLD changes of 20m or 200m. I would also try a couple more methods for calculating MLD to show that these results are robust to MLD method, as there are different ways of defining this and this is important to your story.
We calculate MLD with other definitions and compare them.

*Figure 7 – Can you plot MLD please too?*

Yes. We add the figure of MLD in Figure 7.

*Figure 7d – fix y-axis scale so all points are plotted*

Yes. We expand the y-axis to fit the maximum value.