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Re: bg-2015-346

To the Editors,

Thank you for the opportunity to re-revise my manuscript and provide more detail about how the manuscript was revised. Beginning on the next page, the specific responses to the referee's comments are detailed. I have also uploaded an annotated manuscript with the changes highlighted, and new higher-quality graphics.

Sincerely,



Richard G. Keil  
Professor of Chemical Oceanography

### Comments for Referee #1

Referee 1 liked the manuscript and made suggestions for improving the flow and the content. The major suggestions were to add detail in the methods and to merge two potential mechanisms into sub-components of the same overall theme (ballast protection). We have incorporated both these suggestions into the revised manuscript. This resulted in a small restructuring of the abstract, introduction, methods and discussion, but did not result in lengthening the manuscript more than ~200 words.

While making these corrections, I came across a recent paper that was published during the time the present manuscript was being written. I somehow missed it prior to this week. In the 'discovered' manuscript (Marsay et al 2015), a strong correlation between temperature and sinking flux attenuation is found for the North Atlantic. Since this is an exciting correlation, I added it to the text in the form of three new sentences in the introduction and a new brief paragraph in the discussion.

### Specific Responses for Referee #1:

1. *Add more information to show which hypotheses are directly assessed by data and which are better addressed by literature.* We attempted to do this in subtle ways throughout the manuscript, including in the introduction (new sentences added, changed sections are highlight in yellow).
2. *Minimize the zooplankton and sinking speed parts of the intro since there is no direct evidence in the data.* We didn't do this because we feel that the manuscript specifically tries to call attention that more work is needed to tie all these things together. We did clarify more (see comment #1) what is assessed directly and what is evaluated via literature.
3. *Combine M4 and M6.* Done. Thank you for the suggestion.
4. *Sampling methods.* More detail has been added to the methods section to make our deployments and analyses clearer.
5. *Statistical evaluations.* Per editor instructions, and following upon the previous rebuttal of this request, we have expanded the information about the data presented in figure 2 by expanding the figure legend. We added the following text: At stations 2 and 3 multiple traps were deployed at nearly the same depth. Individual symbols represent the average of duplicate analyses of each trap sample. That is, replication is shown at the 'trap' level, and the variation within duplicate analyses of an individual trap sample is encapsulated within the size of the symbol.
6. *Add a closing sentence at the end of section 4.2.* Done.
  - Clarification of flux statement on 17053: done
  - Staccato openings for different sections: we attempted to clean this up with small word changes
  - 17054: reference added as requested
  - 17055: reference added as requested
  - 17056: depth range and formula: added reference to table 1, but as the data were not used to calculate fluxes, no reference to a formula is needed.
  - 17059: why do the experiment only once using data from 80m at station 3? The simple answer is that we didn't think to do the experiment until the end of the cruise and we couldn't obtain bags from the Ward lab until they were finished using them. We used 80m samples because they have not yet entered the OMZ so any impact thereof should not have already started. Text has been added to hint at this and clarify how oxygen content was determined.
  - 17060: how much faster were particles consumed at station 3 relative to stations 1 and 2? We added a sentence with an approximation in it. However, we note that the Martin attenuation coefficient has both remineralization and sinking speed components within it, making a clear link between attenuation and degradation tenuous.

- 17062: describe the DIC production data in the lab experiment more, and add a little more to the intro. We did the first (enhanced the description) but not the latter. Why? Because the lab experiment measured degradation rates while the attenuation coefficient mixes degradation and sinking speed (the Achilles heel of comparing the approaches). Additionally, our lab has become very suspect of lab experiments that intentionally or unintentionally change redox. We find them useful in helping elucidate general effects, but not useful in determining actual rates. This is why our lab currently conducts these types of experiments in situ.
- 17063: what did other studies suggest? Added to the text.
- 17065: depth (thickness) of typical OMZ with reference? Added
- 17066: histones are explained better now.
- 17069: we agree that anammox is unlikely to add chemoautotrophic carbon to the sinking flux and believe that our wording is in agreement with that. The text is here because we have found that others do not particularly agree. In general, the idea that anammox bacteria are free-living while heterotrophic bacteria are on particles (or 'jump on and off') is not well known.
- 17070: Great idea – we added text to describe this.
- 17073: also a great idea and incorporated as previously discussed.
- Figure 1: modifications made to make figure clearer
- The reference Le Moigne et al 2012 added in several new places.

### **Comments for Referee #2**

Referee 2 wrote a very brief and positive review. They ask for clarity about which mechanisms for controlling flux attenuation were directly evaluated versus evaluated using inference and literature data. We tried to address this in the abstract, the introduction and throughout the discussion by placing brief statements of clarification throughout.

- Clarification of poison and swimmers was added to the methods section. We don't use poisons because we want the material for subsequent experimentation (e.g. Babbin et al 2014, Chang et al 2015), we minimize the deployment time in an effort to minimize the effects of not using poisons, and we don't see swimmers often because the waters are oxygen deficient.
- We did not specifically add a component about TEP, but we added some text in the discussion of M4 (ballasting effects) about it. We hadn't previously read the Azetsu-Scott and Passow paper (it is referenced in the manuscript now). We welcome more research on the topic of particle production, destruction, and reconstruction; this is mentioned near the end of the manuscript.
- Clarification of pellet: new text was added
- Why conduct experiments using the 80 samples – discussed previously per referee #1
- Table 1 updates: done and note that trap duration was already in the table so there was no need to add it.
- Figure 2: No update needed – the data shown are inorganic flux, not total flux. Figure legend updated to explain this.
- Figure 7: the 40  $\mu$ molar oxygen data are from two separate experiments. The revised caption now explains this.