

Interactive
Comment

Interactive comment on “Evidence for aggregation and export of cyanobacteria and nano-eukaryotes from the Sargasso Sea euphotic zone” by M. W. Lomas and S. B. Moran

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Reviewer #2.

1) Difference in pigment concentrations between pumps and bottles. Yes, there is a difference in the mPF pigments between pumps and bottles. This is not unexpected as we also know from other studies (e.g., Altabet et al. 1992 and Gardner et al. 2003) that parameters measured concurrently with pumps and bottles can be 5-200 times different, due to a variety of reasons associated with each method for collecting marine particles. The truly important point here is that the difference for pPF and nPF pigments between pumps and bottles is much greater than that for mPF. There is likely some

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background consumption of particles and inherent differences in what each system (pumps versus bottles) samples, but these differences that are likely to be consistent across size fractions, are swamped by the lack of a GFF-10 μ m fraction for analysis. We have added in some qualifying text for this but have kept the focus on what we measured and know we didn't measure rather than speculating about what we didn't.

2) Quantifying the composition of sinking material. I think the reviewer listed the wrong figures for comparison. Regardless, we did not measure pigment concentrations in bottles at depths down to 500m so we cannot comment on how much pigment is missing in the GFF-10 μ m fraction and therefore cannot comment on the reviewers assumption the proportion is maintained with depth to 500m. Furthermore, in this manuscript we only make statements about quantifying the composition of the sinking material that we actually captured (ie., >10 μ m). We do not try to infer the composition of any material that is missed (ie., GFF-10 μ m fraction), nor do we use that any of the calculations. It is entirely possible that we are underestimating the importance of pico- and nano-plankton because the lack of a GFF-10 μ m fraction but we do not attempt to quantify this component. We have not changed anything as we, and the other two reviewers, thought we were clear enough in wording that we were only doing calculations on what was captured, not what was missed.

3) Table 2. We apologize for the confusion and corrected it. 200m is the only exactly matching depth from which both bottles and pumps sampled. For the '75'm depth, we used the 75m sampling for the pumps and the 80m sampling for the bottles (see table 1). For the '150m' sampling we used the 150m sampling for the pumps and the 160m sampling for the bottles. There is no 300m sampling for bottles so there is no Bottle-Pump value given. Yes, FCM and pigment samples from bottles are coherent.

4) Use of CHEMTAX vs. the proportion factor analysis of NASA. We used the wrong wording when we stated '... to limit subjectivity'. The point we were trying to make was that cells in the euphotic zone are different from cells at depth (due to grazing impacts on pigments/ratios, senescence, etc.) and using CHEMTAX to derive a single pigment

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ratio for all samples to convert to relative taxonomic distributions does not seem appropriate. It was not our intention to imply one method was better/worse than another. To address this we have simply stated the method we used and removed all reference to CHEMTAX or comparisons between methods. We agree that POC:Pigment ratios are not always constant with depth (or time or space for that matter), but in this case we statistically tested the POC:pigment ratios and due to high variability were not found to be different with depth – perhaps because the vertical distance is not great enough for a significant change to manifest itself. We simply presented the data as observed. As a point of correction, we did not use indicator pigment:chl_a ratios in any of our calculations as the reviewer suggested. The only ratio used was POC:pigment ratio and so the assertion that multiple ratios with multiple ranges of error were included in the calculations is not correct.

5) Comparison of chlorophyll and degradation pigments. Agreed, the particle size ranges for pump samples and bottle samples are not the same and so the same ‘size fractions’ can’t be compared. Their inclusion or exclusion doesn’t make or break our contention so we have decided to leave them in, as neither of the other two reviewers had a concern with these figures.

6) The brine was 50g/L over ambient SW as stated.

7) Convective mixing to depth of cells. There are several key points here. First and foremost, we do not at any time discuss or calculate the GFF-10um ‘missing fraction’ at depth, the reviewer is reading into this paper things we have not written. Second, convective loss of individual particles to depth would not explain the similar proportions of pigments at the large size fractions actually measured in this study. The only way that convection could yield the similar pigment proportions over the much larger size ranges is if the same distribution of autotrophs (and therefore pigments) was present in each size class initially prior to mixing and we know that isn’t correct; i.e., there are no >53um autotrophs containing divinyl Chl-b, for example. Therefore small particles must have ‘aggregated’ such that their effective size increased allowing them to be

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captured on filters with larger pore sizes. Lastly, we never stated that convective mixing of small particles (<10 μ m) didn't happen. Rather we focused on the analysis of the large particles that we actually collected and their similarity across size ranges, not the missing fraction as the reviewer implies. Absolutely, convective mixing of particles to depth that are then left behind (turbulent drainage; Backhaus et al 1999, 2003, Gardner et al. 1995) would only increase the importance of pico- and nano-plankton to carbon export beyond what we've shown; we don't have any data on that and did not wish to speculate and these particles wouldn't show up in the larger size fractions. For the November, January and March cruises respectively, mixed layer depths were 78 ± 10 m (n=14), 129 ± 50 m (n=11), and 133 ± 53 m (n=16); while particles at 200m might be convectively mixed material, particles at 300m surely are not. We have added this information to the text.

While it is for sure possible to measure pigments in sediment traps, the only way to convert those values to POC is to use assumptions and ratios identical to that used herein, so it would be just as uncertain and therefore no less complicated. Furthermore, traps aren't going to catch GFF-10 μ m particles, they are only going to catch the larger particles that will sink; the particle sizes we measured and reported. So comparing trap samples to pump samples would likely give very similar results. The reason trap samples were not used in this study is that insufficient material is captured in surface traps over the 3-day deployment at BATS to provide a reasonable analysis. Longer deployments at shallow depths with warmer water temperatures would have resulted in material degradation compromising sample integrity and interpretability and adding, not subtracting, variability to the estimates.

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