

Interactive comment on “C : N : P stoichiometry at the Bermuda Atlantic Time-series Study station in the North Atlantic Ocean” by A. Singh et al.

Anonymous Referee #1

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The authors have examined the elemental stoichiometry of total organic material (TOM) and particulate organic material (POM) in the upper 100 m of the water column, as well as the inorganic nutrient pools, over an eight year period at the BATS station. The aim of this study was to quantify C:N:P ratios in all these pools and their relationship to biogeochemical cycling, community structure and the canonical Redfield ratio. The authors also analyzed the annual and seasonal variability in these parameters. All data were obtained from the publically available BATS web archive.

They found that the TOM C:N:P ratios exceeded those of the POM and they present linkages between the observed TOM and POM seasonal variability to that of phytoplankton cell abundance and taxonomic group, as well as potential climate drivers for C3750

the observed long-term variability in C:N:P stoichiometry.

Overall this is a rather straightforward analysis of time-series data from BATS. The C:N:P work appears solid, but I have questions about how the data were used and how that may influence the interpretation of the results. In addition, I believe some restructuring of the manuscript would help to improve its readability. For example there are quite a bit of data that is presented in the discussion section that would fit better into the results section.

Detailed comments:

P9276, In 16. “C:N:P ratios in the TOM pool were more than twice that in the POM pool”. I think this needs to be rephrased. The data in table 1 shows C:N and N:P being ~ 2x higher in TOM compared to POM, whereas C:P is ~4-5x higher in TOM than POM. I suggest breaking this out in its components to make this clearer.

P9280, In 20. At what depth were the sediment traps deployed? (this appears later in the discussion, but should be mentioned in the Materials and Methods).

P9281, In 5. How were the ‘depth mean ratios’ calculated? Was an elemental ratio calculated for each depth and then average over the 7 depths from 5-100 m, or was an average concentration of each element calculated and then the ratio made? How do you weight average the data when the sample spacing is not even (i.e. spacing 5m, 5m, 10m, 20m, 20m, 20m and 20m)? Have you thought about integrating the TOM and POM inventories over your sampling depths instead? This may alter the results but may be more relevant for the comparison of the two depth ranges chosen (0-25 m and 25-100 m).

Ln 20. Was this trend in TOP based on the depth averaged concentrations over 0-100 m? It is hard to see any ‘trends’ in the contour plot. My impression of the plot is that 2007 had unusually low TOP whereas during 2008 TOP appeared to be unusually high. Would you get a negative trend instead if using data from early 2008 to early 2009 that

would also be significant?

P9282, Ln 14. What determined the choice of depth division of the water column at 0-25 m and 25-100 m? Ln 16. How was the 0-25 m concentrations calculated when sampling depths were 20 and 40 m? Were the data interpolated between 20 and 40 m?

Ln 23-25. Does Trichodesmium not contribute to POM? I do not really see a peak in TOC, but TON and PON peak in month 6. Is that what was meant? This 'peak' also is seen in the 25-100 m portion but that is not mentioned in the text. I would suggest switching the wording around..from " the occurrence of higher Trichodesmium colonies" to " the higher occurrence of Trichodesmium colonies..." or "the higher number of Trichodesmium colonies".

P9283, Ln4-9. Much of this text is an iteration of the first paragraphs of the Results section. I would suggest moving the earlier text and incorporate that under section 3.2.2. instead. Also, see line 7-8 in discussion, which is very similar to what this paragraph is saying, but stated more clearly.

Ln 10. "Minimal variability in concentrations and ratios in the 25-100 m depth horizon.." How was that determined? I find Figs 4 and 6 remarkably similar in terms of the range in mean concentrations, seasonal patterns and variability (error bars) in the N and P pools. The N:P ratios also look quite similar in Fig 5 and 7. Only TOC and POC seem to differ somewhat in concentration range, variability and pattern between the two.

I would suggest changing "25-100 m depth horizon" to "25-100 m depth range"

P 9284 – Discussion. The discussion currently contains quite a bit of new data that I believe should be better presented under the result section. E.g. the trap flux data, flow cytometry and chlorophyll.

P9285, Ln 2-4. "On the contrary, our data suggests that TON values increase with depth while TOP values do not change (Figs 4 and 6)." From Figs 4 and 6 it does look like

C3752

TOP remains fairly constant in the two depth ranges compared, whereas TON goes up a little with depth. However, the TON:TOP ratios in Fig 5 and 6 doesn't seem to reflect this very clearly, and it even looks like TON:TOP may be slightly lower on average between 25-100 m than above. Am I misinterpreting these data or are there something else I am missing?

P9286, Ln 5-9. "...the gradual increase in Chlorophyll a during the four months prior to deep mixing is due to a similar increase in MLD before deep mixing". Is this to mean that the increase in chlorophyll is due to increased nutrient influx into the 0-25 m depth range? Could the annual pattern in chlorophyll a concentration be explained by the changes in light flux over the yearly cycle? I.e. phytoplankton containing more chlorophyll during the winter months with lower light flux, but not necessarily more biomass?

Ln 10-14. How were these correlations made? Depth averaged over 0-25 m, or 0-100 m? It is unclear as written. Figure 9 shows only 0-25 m data, but using only such a shallow range may result is a skewed picture. How would data from the full euphotic zone impact the interpretation of the influence of the taxonomic groups on the C:N:P stoichiometry of POM?

P9289, Ln 6. "Such ratios appear to be largely driven by..." This sentence seems to be referring to the average C:N:P ratios of both TOM and POM. Was that the intent? Or was it supposed to refer to the annual or seasonal variability observed, or the out of Redfield ratio that can be inferred from the Synechococcus and Prochlorococcus? I suggest adding some words to make the sentence clearer.

Table 1. What is the rationale behind the presentation of data collected prior to this study's window for some parameters?

What criteria was used to create the ratios? (The number of observations are much reduced for the ratios relative to each parameter measured by itself).

C3753

Figs 4-7. (see above question for ratios in Table 1). Are the ratios derived from a different subset of samples than what is presented for each parameter measured by itself? There are no "n" number mentioned in the figure legends.

Minor:

"Redfield Ratio" or "Redfield ratio". Both are used throughout. I suggest using only one version.

P 9286, ln 7. Spelling Chlorophyll

Suggestion on Figs 4-9. Box plots would be a very nice way to present these type of data as the data sets are large and the box plot format gives so much more information than the mean and std-deviation.

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