

Interactive comment on “Organic nutrients and excess nitrogen in the North Atlantic subtropical gyre” by A. Landolfi et al.

A. Landolfi et al.

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Reply to comments by Referee #3:

We would like to thank referee #3 for reviewing the manuscript and for the valuable and detailed suggestions that have greatly helped to improve the quality of the manuscript.

1. (Point raised also by referee#1). We have reorganized the text to better describe the concept of TNxs, our justification of focusing on variations about $\Delta TN : \Delta TP = 16$, and that our only a-priori assumption is that mass of N and P is conserved in the ocean. Briefly, our aim is to identify and quantify large scale changes in the total N and P inventories that deviate from Redfield stoichiometry. Our starting point is the assumption that the formation of organic matter on average follows the Redfield ratio of N:P=16:1. We recognize that an allochthonous constant refractory pool (e.g. a terres-

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trial TON pool) introduced within the system would impact on the total N inventory and thus on the total N:P. However by focusing on the deviations of actually measured from preformed organic and inorganic nutrient concentrations (which would both include a constant refractory pool) we can detect net accumulations/decrease of the respective N and P inventories. Net deviations from the preformed TNxs value are expected to occur only when a net non-Redfieldian change in the N and P inventories occurs. As reviewer 1 also pointed out, deviations from the preformed stoichiometry are commonly observed in the organic fractions as the effect of remineralization processes occurring within the water column. For example, preferentially remineralisation of TOP relative to TON will result in a positive TONxs anomaly. This will, however, not result in a net variation of the total N and total P inventories (as DINxs will decrease by the same amount because an equivalent pool of phosphate would build up as both total N and total P mass is conserved). Hence, we suggest to look not at excess N in the inorganic (DINxs) or organic (TONxs) fractions separately, but instead consider the sum of both (TNxs), which is only affected by changes in total N and P inventory changes.

2. Unfortunately separate ammonium measurements have not been taken. We believe that given the oligotrophic conditions, ammonium concentrations would be very low due to rapid cycling and turnover. However if this pool had built up in significant concentrations it would have been measured within the TN pool.

3. The use of the Redfield concept to assess total N and P imbalances has been described above (see point #1). As to what concerns the conditions that might lead to differential remineralization, that do not alter the net inventories of N and P, some comments have been included in the text. However, we preferred not to enter in the details of the biological process because we felt this might diverge from the present scope of this study. We have a separate study in preparation, in which we aim to quantify specific processes.

4. The necessity to use the total organic N and P pools, not only their labile fractions is essential if we want to measure deviations of the total N and P inventories. The

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insensitivity of the TNxs tracer to a pool of allochthonous refractory material is assured by measuring changes of TNxs relative to a preformed/refractory TNxs value.

Specific comments:

Pg 690-691: We have clarified that the analytical reproducibility of both the colorimetric method, which estimates the oxidized (both N and P) inorganic nutrients and the high temperature catalytic oxidation, was estimated based of the coefficient of variation of replicate samples of the same sample. The precision, where possible, was estimated from the replication of duplicate samples.

Pg 701: We have clarified that the TONxs signal is affected by the accumulation of refractory material, but the TNxs tracer is not. Units and definitions have been checked carefully and checked for consistency.

Pg 702 The reference to Abell et al. (2000) has been included in the text to differentiate between total and dissolved organic material in oligotrophic environments.

Fig. 1 has been modified

Fig. 2 has been modified

Fig. 7 has been removed

Fig. 9 caption has been corrected

Fig.10 caption has been corrected

References: Abell, J., Emerson, S., Renaud, P. Distributions of TOP, TON and TOC in the North Pacific subtropical gyre: Implications for nutrient supply in the surface ocean and remineralization in the upper thermocline. *Journal of Marine Research*. 58(2). P-203-222.

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