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Earth System Dynamics
Discussions

Interactive comment on "Characterization of ocean biogeochemical processes: a generalized total least-squares estimator of the Redfield ratios" *by* V. Guglielmi et al.

Anonymous Referee #2

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This manuscript builds a Generalized Total Least-Squares estimator of Redfield ratios using hydrological characteristics of the Atlantic Ocean, with the assumption that the estimator could be used in other areas of the global ocean. This method of determining the Redfield ratios (the fundamental concept that there is a similarity between the C:N:P ratios of plankton living in the surface ocean to that of dissolved nitrate and phosphate in the deep ocean) uses ocean circulation (water masses) and the composition of seawater.

The manuscript requires a full copy-edit, as many of sentences need revising, the tense needs to be changed (at times first person, change to third person), and the choice of

words (at times conversational) needs to be modified. Throughout the manuscript, I found it difficult to interpret the authors meaning. My review will focus on the outcomes of the manuscript, as the theory and calculation (Section 3 &4) was difficult to follow – and will require review by a statistician or a modeler.

My main concern is the use of only conservative tracers (physical and chemical parameters) to determine the Redfield ratios of different ocean masses. Within the past 4-5 years, it has been determined that there is substantial elemental variation among plankton taxa, and many of the small plankton in the ocean gyres are not homeostatic and changes in physiology, nutrient supply can govern the differences observed in elemental stoichiometry. There are even regional differences in the elemental stoichiometry – depending on whether you are sampling in an oligotrophic gyre, an upwelling region, or a polar region. The C:N:P ratios are not static, as Redfield hypothesized, and differences in the environmental conditions, plankton community composition ultimately lead to the variations observed in the elemental composition of particulate organic matter (POM). Many of the large observed variations of the C:N:P ratios within POM cannot be solely explained by physical and chemical parameters (see Martiny et al 2013a and Martiny et al 2013b). The manuscript needs to review some of the more recent literature on the subject of elemental stoichiometry of the ocean and of POM, as the manuscript does not reference many publications within the past 5-10 years. Publications to consider are listed below, however, there are many more. The authors also make many statements throughout the manuscript that require citations, to name a few:

Pg. 2384 – Introduction – paragraphs one and two. Pg. 2386 – "Since then, numerous studies have been conducted. . .. Pg. 2389 – Section 2.3 Conservative tracers section need citations. Pg. 2402- 2403 – Section 5.1.1 The Atlantic Ocean section is missing many citations regarding ocean circulation. Pg. 2405 – Section on Water Masses Pg. 2408 – Lines 16-20, "In the literature,. . .."

Based on the current literature, I disagree with the overarching statement, on page

2409, “Today, the only agreed-upon conclusions are both the confirmation of the Redfield’s concept (which has also been extended to other ecosystems than the ocean), and the variability of these ratios depending on the ocean area.” I do agree with the authors that at depth, there are similarities to the Redfield ratio (once much of the organic material has been remineralized), however, the plankton in the surface water can cause large variations in the elemental stoichiometry based on the taxa present, nutrient availability and plankton physiology.

References to be considered:

1) Martiny, A. C., J. A. Vrugt, F. W. Primeau, and M. W. Lomas. 2013a. Regional variation in the particulate organic carbon to nitrogen ratio in the surface ocean. Global Biogeochem. Cycles 27: 723-731.

2) Martiny, A. C., C. T.A. Pham, F. W. Primeau, J. A. Vrugt, J. K Moore, S. A. Levin, and M. W. Lomas. 2013b. Strong latitudinal patterns in the elemental ratios of marine plankton and organic matter. Nature Geoscience: Letters DOI: 10.1038/NGEO1757.

3) Galbraith, E.D. and A. C. Martiny. 2014. A simple nutrient-dependence mechanism for predicting the stoichiometry of marine ecosystems. PNAS DOI: 10.1073/pnas.1423917112

Interactive comment on Earth Syst. Dynam. Discuss., 6, 2383, 2015.