

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

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Since we are not native from an English speaking country, we can understand that the manuscript needs a full copy-edit, and we will do it. We will also add more (and recent) citations (including the 6 suggested), throughout the manuscript.

We do not understand the disagreement "The method presented would be correct IF the stoichiometric ratios were constant, but there is more and more evidence that they are not". Since the following sentence says : "That the N:P:-O₂ ratios appear nearly constant in the interior of the ocean after correcting for the preformed components, reflects the circulation averaging of the respired material". That's exactly what we are

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saying. Since it is well known that there are large variations in elemental stoichiometry of the surface water, we are excluding the upper layer (page 2384 "... below this mixed layer", page 2404 "... recall that we must consider only the data from below the mixed layer").

It follows : "It might very well be that the constant stoichiometry assumption is valid for some purposes, but it isn't clear from the manuscript if this is the case or not". As mentioned in our introduction, all the back-calculation methods used to estimate the anthropogenic carbon in the ocean (and consequently ocean acidification), are based upon the Redfield ratios. Thus, it is very important to know, as accurately as possible, how they vary, and how to calculate them.

Most of our work consisted in finding a new way to calculate the ratios (sections 3 and 4). The problem is not always an underdetermined problem. On the contrary, when there are less water masses than conservative tracers, the matrix D of Eq. 20 has more rows than columns and is not of full rank, then solving Eq. 20 is an overdetermined least squares problem.

It is effectively an ill-posed problem, which needs regularization as we explain page 2402 : "Furthermore, our problem is an "ill-posed" inverse problem: the matrix containing all the measurement data is ill-conditioned, due to both the additive noise and the significant differences in the orders of magnitude among the tracers. This bad conditioning prohibits any direct pseudoinverse solution. On the contrary, in order to "regularize" the problem, the estimation algorithm suggests truncation, if necessary, of the lowest eigenvalues of this matrix". So, we do not regularize it by limiting the number of water masses. Furthermore, if we have tried to reduce artificially the number of water masses involved, our estimation algorithm would have diverged. The number of water masses is based upon the current knowledge of ocean circulation (Fieux, 2010).

Page 2048, we indicate that the ratios are in "good agreement with the existence of the Redfield's concept" because the variations between the values obtained for the

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different zones are small. If the variations were large (as in the surface water), trying to define Redfield ratios (constant for each zone) would have no sense, except in a statistical mean point of view (which is not our objective). But the variations of the ratios with latitude and depth, even if they are small, are significant. For instance, in order to estimate the anthropogenic carbon in the ocean, it is very important to know, as accurately as possible, how the ratios slightly vary, and how to calculate them.

In section 3.1, there is no Singular Value Decomposition of a matrix. Section 3.1 only defines assumptions and notations used in section 3.2 to determine the existence of a linear solution between tracers. In section 4.3, the Generalized Total Least-Squares estimation algorithm uses SVD to inverse (and regularize) the calculation matrix A .

We will suppress the discussion about salts in seawater and potential temperature.

Concerning "oxidations", we do agree with the referee and we will rephrase this section to make it clear. We study only the ratios of the variations in nitrate concentrations, and not the different processes increasing or decreasing the values of nitrate concentrations.

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