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Interactive comment on "Dissolved Inorganic Nutrients in the Western Mediterranean Sea (2004–2017)" *by* Malek Belgacem et al.

Malek Belgacem et al.

jacopo.chiggiato@ismar.cnr.it

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On behalf of all authors, we would like to thank the reviewer for their thorough reading of the manuscript and their constructive remarks and suggestions. Your comments provided valuable insights to refine and clarify the manuscript. We have taken into consideration all suggestions. In the following, we try to address all issues raised as best as possible.

R: It seems to be a two-step procedure with data flagged as questionable (i.e. flag "3") removed from the adjusted product. For cruises where the whole cruise was considered as of "poor quality" (as assessed from excessive scatter etc.) are still included in the product but flagged as questionable. Why include questionable cruises in the

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product at all?

A: In the adjusted product, flags were based on the results of the 2nd QC, so "flag 3: Adjusted and recommended questionable", is a flag based on 2nd QC recommendation in section 4.4. i.e. It is a layer of flags in the final product for “flag 2: adjusted and acceptable” and “flag 3: adjusted and recommended questionable”. We did clarifyy better it in Table 3 and in the supplementary Materials (Supplementary material – Part 2 (A2)). As mentioned in section 4.4, we have done the evaluation of the cruise overall quality but leave it up to the users how to appropriately use these data.

R: I appreciate having access to the original data (i.e. prior to adjustment), but that does not preclude the need to link to the individual cruise files. These can be in a common format on a dedicated place, or it could be links to the original data file in a repository (NODC, SeaDataNet, or similar). That has value since for instance some of these cruises probably have associated “other” data, such as oxygen etc. that might be of use for the user. I recommend to establish links to the original data files.This last comment does also go for the meta-data of the cruises. I guess in most cases this would include reference to a cruise report. I could not find any such references, please add links to cruise reports.

A: We agree that it is important to have easy access to the original, individual data files and metadata. Some of the cruise metadata such as cruise reports are available on http://www.seaforecast.cnr.it/reports/, but not all. We will add cruise reports for the missing cruises and submit all the individual cruise files to the SeaDataNet repository.

R: For the secondary QC, the authors choose to adjust all data to 5 reference cruises that was considered to have particularly high quality. One of the reasons was the well-known issue with bias in nutrient measurements being introduced by freezing of samples and analyzing them on land post-cruise.

A: We have modified the text to state that this is one of the criteria, but not a requirement for being a reference cruise.

R: However, not all reference cruises had nutrient measured on-board. Why then include them as reference cruises?

A: As reference cruises, we use only cruises that are known to have followed best practice standards, where nutrient analysis followed the recommendation of the World Ocean circulation experiment (WOCE) and the GO-SHIP protocols, and have undergone rigorous quality control following GLODAP routines or in the framework of the MedSHIP programme. We believe that observations of these cruises are of high degree of reliability, independently if the analysis was made on-board or on-land.

R: Although it seems that the low-nutrient water of the Mediterranean might be less prone to bias due to freezing, the result from this study seem to suggest something different with all three variables being adjusted preferentially upward or downward. That might be an interesting result. Or maybe this is a function of bias in the measurements??

A: We agree it could be due to bias in the measurement, we did not generalize it to all cruises. We tried to understand and find out what was the source of bias in the observations and the storage time was one of them. Freezing is not the main cause of the bias if samples were well preserved and unfrozen. One of the main reasons for the upward and downward biases would be the lack of use of Reference Material for Nutrients in those cruises as also noted in CARINA (Tanhua, T., Brown, P. J., and Key, R. M.: CARINA: nutrient data in the Atlantic Ocean, Earth Syst. Sci. Data, 1, 7–24, https://doi.org/10.5194/essd-1-7-2009, 2009.) or the most recent global comparability exercise (Aoyama, M.: Global certified-reference-material- or reference-material-scaled nutrient gridded dataset GND13, Earth Syst. Sci. Data, 12, 487–499, https://doi.org/10.5194/essd-12-487-2020, 2020)

R: It would be useful to have a directory of crossover plots for all cruises. The method of GLODAP and CARINA could be taken as an example, but a repository on the web where the crossoverplots can be downloaded would go a long way. This would allow

users to judge the validity of the adjustments.

A: Yes, we want to make available the crossover plots following the crossover and adjustment Data Repository for CARINA or GLODAP, however it cannot be done easily, before the paper is published, we will work on making it available with the cruise reports.

R: Why only discuss a selection of cruises in section 5.4? All cruises had adjustments. I recommend expanding this section to cover all cruises.

A: We have expanded this section to cover all cruises.

R: Minor comments: Line 67: I suggest changing “profiles” for “observations

A: Done, in the revised version.

R: Line 116 The CARIMED data product is not yet published and available

A: We added a sentence about CARIMED data product (not yet available). The CARIMED initiative lead by M. Álvarez is a compilation of carbon and carbon relevant data for the MedSea that is taking longer than expected to be published, hopefully in 2020.

R: Line 115: Please refer to the GO-SHIP nutrient manual

A: Done.

R: Line 188: I am not sure if this is a useful metric. The authors discuss the influence having observations in different sub-basins have on this statistic later. Why not create statistic that is for sub-basin by sub-basin?

A: This point was raised by referee#2 as well. The standard deviation of data deeper than 1000db was defined as a first assessment to get indications about the precision of the measurements in each cruise following (Olsen et al., 2016). Statistics in different sub-basins has been added to check all cruises that have measurements in different

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subregions (Table 4).

R: Line 221: The 2_ influence radius is probably fine for the Atlantic Ocean, but mostly not for the Mediterranean Sea. How did the author handle crossovers that were influenced by observations from nearby other sub-basins where a different nutrient concentration could be expected?

A: The reviewer is correct that we did not separate the analysis by sub-basin. The choice of the 2° was also partly for practical reasons since the number of reference cruises is too low to allow to restrict this radius. If we had more reference cruises, we could have reduced the 2° influence radius, but given that we only have 5, a relatively large influence radius is the only way to ensure statistically relevant results.

R: Line 226: If you know that the deep water is (potentially) changing fast, why include it in the crossover analysis? Would it work to have a crossover analysis covering, for instance, 1000 – 2000 meter only? If so, why was that not used, and how did the authors remove temporal natural variability of deep water?

A: The minimum chosen depth was 1000m, so that all cruises and all areas could be included in the 2nd QC and considering the relative low variability of the deep layer, compared to the intermediate and surface layers (nitrate CV=1.16, phosphate CV=1.005, silicate CV=0.75) the deep (>1000 db) layer (nitrate CV=0.15, phosphate CV=0.22, silicate CV=0.14)). The toolbox we use is not designed and tested to do crossover analyses for a part of the water column (e.g. 1000-2000m as suggested). It can only do it from Xm to the bottom. It would be possible to rewrite the code to do this, but that is beyond the scope of this paper, since we still aim to obtain results that could compare with other regions of the world ocean where the same method has been applied. The crossover analysis is done in density space. Thus, natural variability in the physics and water mass structure is accounted for in the method. Besides, we have a minimum adjustment limit for a reason and part of that reason is that we should not overcorrect when there is natural variability (which is always there).

R: Line 260: Here you decide not to include cruises that could not be adjusted in the product. On the other hand, you do include data that had only questionable data in the product (although flagged as such). Why? An alternative approach could be to include the data with a flag that indicate that the data did not undergo 2nd QC.

A: Yes, in the final product we included only cruises that underwent a 2nd QC, that is why we removed those that were not subjected to 2ndQC, those cruises are still in the original data collection. We did prefer to leave it up to the users how to appropriately use these data.

R: Section 6, and possibly elsewhere: GLODAP and CARINA are data products, rather than datasets. The difference being that the products have an additional layer of QC (2nd QC bias adjustment) applied, whereas a data set is a collection of data that are in its original form, possibly with consistent primary QC, unit conversion etc. Not so important perhaps, but a little of semantic difference.

A: We have changed this in the text, thank you for this important remark.

R: Line 427: Not a complete list of authors for this paper. A: The reference has been corrected.

R: Table 2: Why have a different format for this table compared to table 1? A: We have modified Table 2 to be comparable to Table 1.

R: Table 4: It would be useful to include the reference cruises in this table A: Table of the reference cruises is in the supplementary materials Table 1S, and we have added the number of samples.

R: Table 5: not a big deal, but the "*" sign in this table is applied in column 2, whereas in other tables (4) it is applied to column 1. A: The notation has been revised.

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