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Biogeosciences Discussions

Interactive comment on "Regional and temporal variability of sinking organic matter in the subtropical northeast Atlantic Ocean: a biomarker diagnosis" *by* I. J. Alonso-González et al.

Anonymous Referee #3

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General

The authors examined the spatial and temporal variability of export fluxes collected by a free drifting-trap array in an area characterized by cyclonic and anticyclonic mesoscale structures, located south of canary islands in the Northeast Atlantic ocean, and at two seasons. Analysis of POC, PON, chloropigments and total hydrolyzed amino acid biomarkers in trap material aim at deciphering the major processes involved in particle production and transfer to depth. Understanding the impact of mesoscale structure on the fate of biogenic matter exported to the mesopelagic layers is a major challenge in oceanographic studies. Undoutbtedly, this topic is of interest for Biogeosciences

audience.

The deployment and recovery of drifting sediment traps is difficult and scarce, and makes the authors field work important to the biogeochemist community. Most export fluxes have been calculated at ocean scale, on the basis of permanent deployment at open ocean observation sites. The topic investigated by Alonso-Gonzales and coauthors is a new step towards understanding export flux regional variability due to geographical and hydrological singularities. In this field of research, the authors provide some evidences highlighting that the eddy field enhances the flux by 2 compared to stations outside, and stress the strong variability of processes potentially controlling export fluxes in the Atlantic Ocean.

However, the role of food web structure in the eddy-field, namely diatoms versus carbonate-rich plankton, put forwards by the authors (based on the biomarker patterns) as a major factor influencing organic matter flux variability is less convincing. The pattern of fucoxanthin does not support the discussion. The diagnostic biomarkers interpretation is either a bit speculative and/or need to be re-written and tightened. A diagnostic table of pigments and amino acids in the result section would help clarifying the conclusions. More informations about phytoplankton community structure in eddies should be added to support the conclusions.

In addition, the authors must acknowledge the presence of additional sources of variability that they did not mention like the wind regime at the time of sampling. A brief description of the wind regime and the age of the eddies should be reported in the Oceanographic settings section.

An other point is that there is too little reference to previous studies on sediment trap deployed in highly dynamics fields. A number of studies specifically adressed the role of mesoscale structure versus seasonal patterns by using sediment trap biomarker records (Jgofs Frontal and Alboran sea projects, the POMME experiment in the North Atlantic) (Sanchez-Vidal et al. 2004 JMS 52, 89; Tolosa, I et al. 2003. Mar. Chem.82,

161–183; Tolosa et al. 2004. Mar. Chem. 88, 103– 125; Goutx et al. 2005 JGR 110, C07S20, doi:10.1029/2004JC002749; Tolosa et al. 2005 Journal of Sea Research 54 2005 125– 142).

Finally, I would like to draw the attention of the authors about the presentation of the results in the text, table and figures that needs more rigorous representation : standard deviation should be reported whenever average numbers are given, significance of the variability observed should be discussed, the amino acids composition at S8 is not in table, the fact that pigment and amino acid have not been analyzed in CE2 trap material should be reported in material and methods.

In conclusion, the work is important to the topic adressed and deserve to be published although it needs major revision and polishing of the text.

Detailed specific comments:

Abstract :

Line 11 to 14: This a very important issue. Please homogeneize the presentation of results, consider replacing 70% in THAA by x 1.7 times.

Line 18 : “PCA also suggests that phytoplankton community structure, particularly the dominance of diatoms versus carbonate-rich plankton, is the major factor influencing the POC export within the eddy field”

This seems contradictory to the fact that fucoxanthin, a pigment diatom marker was not determined in most August samples (Table 2) when the eddy field was investigated. How did you identify diatom sources versus carbonate-rich plankton in August? reference to studies of pure phytoplankton culture must be included in the results presentation. See also comments on p 11099 below.

Introduction :

Paragraph 2 : “Most sediment traps .....”

This paragraph should be better documented or reorganized. As the sentence starts with “Most sediment traps ..” .a litterature survey on particle export is expected. Though, most cited previous studies are referring to suspended material in eddies, not sinking material (see my general comments above). In general there are very few reference to previous studies on sinking particle in mesoscale feature involving biomarker diagnosis.

Material and Methods

.

2.4. Give pigment method sensitivity/detection limit, it has consequence on fucoxanthin detection.

2.5. Give amino acids method sensitivity/detection limit.

3.1. Oceanographic settings

p 11097 line 23, add chla equivalence with volts,

provide calibration data of the seapoint sensor in p. 11093 material and methods

add units in figure 3 c and d

add information on wind forcings

3.3 Pigment fluxes and composition

p 11099

Line 7 The authors should consider providing a diagnostic table for pigments and amino acids biomarkers indicating how they identified the major sources in POM, process and/or degradation status (diatoms, carbonate-rich plankton, grazing, bacterial degradation). Biomarkers are ubiquitous and not always highly specific. However, it is important for the readers to know the basis for the biomarker interpretation by authors. In addition, they could refer to this table throughout the text, which may lighten the

discussion.

Line 16-17 “Fucoxanthin was not detectable in these samples probably it could have been a detection problem due to sample size”.

Any other reason? Please further comment in the text, add detection limit in the material and method section.

Line 19

Average total pigment fluxes (add the number +/- SD).

P11100

Line 8 “Amino acid export was in general higher (70%) at eddy-field stations (except AE1)”

Please consider writting 1.7 times higher instead of 70% for homogeneisation.

Line 18 “Mole % of glycine, glutamic acid and ornithine were enriched at eddy-field stations relative to FF stations”. Does not fit well with data in Table 4. Please check. It is true for Gly and Orn at CE1, only.

Line 24 to 28 and through the end of paragraph next page : Provide standard deviation when reporting average concentration or give the range.

Or for example says line 27 : ...latitudinal differences, with the highest fluxes (1447 and 1657 μmom m^{-2} d^{-1} at S3 and S4, respectively) in the Cape Blanc upwelling region.

Page 11101

Line 3 to 12 : provide standard deviation for mean %.

4 Discussion

4.1. Eddy-field influence on organic matter fluxes

The phytoplankton and zooplankton sources of organic matter in the eddies are not

well supported by biomarkers as it is described in the text. For the identification of the diatom source, there is no convergence between amino acid and pigment diagnosis. It is regrettable that CE2 pigments data are not available; pigment concentrations should not be limiting fucoxanthin analysis in CE2 (if diatoms were present) and pigment description in CE2 where chla biomass is high may have supported the authors interpretation. Thus the absence of biomarker analysis in CE2 sample should be reported at the beginning of the study (Material and methods). Less emphasis should be put on the diatom versus carbonate-rich phytoplankton explaining PC1 unless other arguments are included. The authors may consider that different degradation processes may reflect the main pattern along both axis in summer.

P 11103

Line 17-21

“FF2 was enriched in glycine and serine, suggesting the presence of diatoms”.

Is there any reasons for the absence of fucoxanthin, other than sensitivity problem?

Line 26-28 “Our amino acid and chloropigment compositional data indicate less impact of grazing by micro and mesozooplankton within eddy-field relative to the FF stations (Tables 2

and 4)”.

Check the coherence with what is said on P 11099 section 3.3 :

line 14-15 “FF2 was enriched in glycine and serine, suggesting the presence of diatoms. FF1 was more enriched in aspartic and glutamic acids and -aminobutyric acid (Gaba), suggesting a mixture of fresh calcium-carbonate associated organic matter and microbially degraded organic matter”.

Which indices suggest the role of zooplankton?.

P11104

“CE1 was relatively enriched in diatoms, which could explain why POC flux was slightly lower in CE1 than in AE1”.

Remove the sentence from 4.1 and consider including it in 4.2.

In general, reduce this 4.1. discussion section.

P11106

Line 17 “Indeed, higher total diatom abundance was found at cyclonic eddy CE1 relative to FF and anticyclonic stations (S. Lasternas, personal communication, 2008).”

If the community structure has been studied in the eddies, the authors should consider adding more information on phytoplankton in the Oceanographic setting section.

Line 26 “Regarding organic matter lability, both types of eddies showed similar negative site scores on PC2, suggesting that organic matter exported from CE1 and AE1 had similar degradation states.”

It is difficult to agree as both axis are associated with degradation indices (P 11103 line 13-21), please clarify or remove.

P 11109 Conclusion

Line 5. The sentence “Our findings are consistent with the hypothesis proposed by the E-Flux and EDDIES programs of higher trophic levels reducing POC export within eddies.

seems contradictory to assertion page 11104 line 22-23 where the authors said that : “ On the contrary, our results suggest that zooplankton grazing pressure had a minimum impact in the Canary Island eddy field.

It is difficult to catch the message. Do you mean that : during the period investigated, eddies enhanced fluxes were due to low grazing pressure, according to the E-flux and EDDIES programs of higher trophic level reducing POC export within eddies? Please

clarify.

Line 8 : heterotrophic activity include microbial degradation/mineralization and zooplankton grazing, please clarify.

Line 12 to the end : There is a lack of synthesis. Please remove “results-like” sentence and concentrate on the main conclusions.

Figure 1 : Check the circles around CE2 and remove one circle.

Figure 3 c and d : add the unit for fluorescence

Figure 5 : add reference to abbreviation as in table 2 and table 4 in the legend and homogeneize the abbrevitions.

Interactive comment on Biogeosciences Discuss., 6, 11089, 2009.