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Interactive comment on "Variability of phyto- and zooplankton communities in the Mauritanian coastal upwelling between 2003 and 2008" *by* Oscar E. Romero et al.

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Variability of phyto- and zooplankton communities in the Mauritanian coastal upwelling between 2003 and 2008 (bg-2019-314)

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As required by BG, the response to the Referees is structured in the following sequence: (1) comments from Referees (RC), (2) author's response (AR), (3) author's changes in manuscript (ACM).

Comments from Referee #2

RC: Title. The current title is somewhat misleading. As it reads now it seems that authors documented phyto- and zooplankton communities from the upper water column. Since phytoplankton and zooplankton assemblages can be severely altered before reaching the sediment traps I would suggest to find alternatives for the current title. Mentioning the terms sediment trap or fluxes would help to give the reader a better idea of the content of the article.

AR & ACM: We rephrase the MS title as: 'FLUX variability of phyto- and zooplankton communities in the Mauritanian coastal upwelling between 2003 and 2008'.

RC: Lines 20-21. Do authors mean calcareous and organic dinoflagellate cysts? Please revise.

AR & ACM: This is what we meant. It will be rephrased accordingly.

RC: Lines 55-60. Authors provide a short summary of previous long-term monitoring ex- periments in the global ocean. As stated in the text, this type of studies is scarce, however, there are several sites in the global ocean where multiannual records of microplankton and biogeochemical fluxes have been analysed. The IOC-UNESCO report only covers very few of these sediment trap experiments. Since the current work is based on sediment trap samples, it is important to include in the introduction some of these studies in order to provide the reader with better picture of previous similar work.

AR & ACM: Please see our comment above on Dr. Bringué's comments on additional references for long-term trap-based studies.

RC: Section "3.1 Moorings, sediment traps and fluxes". Can authors provide the depth of the water column at the study region? It is important to know the distance from the sea floor in order to assess the possible influence of resuspended sediments in the trap record.

AR & ACM: We will address this issue by adding an additional column in Table 1 with the ocean bottom depth corresponding to each mooring.

RC: Line 184: "Uncertainties with the trapping efficiency due to strong currents (e.g. undersampling, Buesseler et al., 2007) and/or due to the migration and activity of zooplankton migrators ('swimmer problem') are assumed to be minimal in this depth range." Is this assumption based on Buesseler et al. (2007) paper? Or is this an assumption made by the authors? I would suggest to include the reference at the end of the sentence to support the whole statement and/or explain better.

AR & ACM: We will move Buesseler et al. (2007) reference to the end of the sentence.

RC: Line 246-248: Authors refer to a taxonomy key that they used for dinocyst identification. However, no names of dinocyst taxa are provided in the manuscript. Why do authors provide species names for all microplankton groups but not in the case of the dinocysts? Please clarify.

AR: We are afraid that Referee #2 overlooked Table 3. The originally submitted version of this Table includes all species of all groups found between June 2003 and February 2008 in samples collected with the CBeu trap.

RC: Line 333: "On average, the carbonate fraction (CaCO3) dominates the mass flux (41% to the total mass flux)" Is this average a mean of all samples without considering the magnitude of the flux? Or is it an annual integrated average? I would recommend that authors provide annual values of main biogeochemical components of the flux, mi- croplankton groups and major taxa in an additional figure. This information would greatly facilitate the comparison of the results of the current study with other investigations conducted in other regions of the world's ocean.

AR: averages depicted in Fig. 2 (horizontal dashed line for each parameter represented) and the values discussed in the MS refer to the entire sampled period (June 2003 – February 2008). We will clarify this correspondingly in the text.

ACM: In addition, we will add and discuss two new tables with annual averages of (1)

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bulk components (Table 4), (2) flux of organisms, and (3) relative abundances of taxa (Table 5) represented in Figures 2-4 for those years with full calendar year sampled (2004-2007). In doing so, data will be available for future comparisons.

RC: Lines 336-337. I do agree that the main contributors to CaCO3 and BSI must be the ones listed in the text. But how do authors know that the bulk of the organic carbon is delivered by diatoms coccolithophores and organic dinoflagellate cysts? Although this possibility is likely, the data provided in the current manuscript h is insufficient to reach such conclusion. In particular, in the case of diatoms, they were treated with chemicals that removed their organic content, a process that impedes the estimation of the number of cells that reached the trap with their cellular content intact. An important fraction of the organic matter could correspond to other phytoplankton or zooplankton groups, faecal matter or other components of the marine snow. Is this statement based on previous research in the study region or is it just an interpretation by the authors? I would suggest to either provide more evidence or be more cautious with this statement. Moreover, could authors provide some insights into the contribution of the different components of the CaCO3 flux to the total CaCO3? It would be really interesting to see which microplankton groups are the most important in CaCO3 export to the deep sea.

AR: We agree with Referee #2 in that the sentence as originally written was misleading and did not express our observations properly. This will be accordingly re-phrased. Since we did not perform any quantitative analysis on how much organic matter each studied plankton group is contributing with, we are not able to provide any absolute or relative values of contribution of particular group/s to either organic carbon and/or calcium carbonate. Part of our current work on the seasonal and interannual variability of microorganism and bulk fluxes off Mauritania focuses on the issue of how much each of the calcareous groups contribute to the flux of CaCO3 as measured in trap samples. Although we are not able to provide any actual values at this stage, we are still convinced that diatoms and coccolithophores are important contributors to the flux of organic carbon at the CBeu site.

ACM: We will add following sentence, Diatoms, coccolithophores and organic dinoflagellates are important contributors to the flux of organic carbon at the CBeu site.

RC: Line 404. Why not dinocyst species are presented? Authors should provide a list of species, not only groups.

AR: as commented above, the originally submitted version of this Table includes all species of all groups found between June 2003 and February 2008 in samples collected with the CBeu trap.

RC: Line 416. Defining Globigerina bulloides as an upwelling species is an oversimplification of the environmental preferences of this species. The contribution of this species is often higher at times and in regions of high primary productivity, but such conditions are not necessarily linked to upwelling. Please explain better and provide references to support the affinity of this species for certain environmental conditions. Please also note that planktonic foraminifera species distribution is also influenced by changes in primary productivity not only SST as suggested in the discussion (line 582).

AR: we revised the ecological interpretation of G. bulloides' temporal occurrence at site CBeu. The planktonic foraminifera group including G. bulloides will be re-named 'high nutrient waters' (instead of 'upwelling').

ACM: We will rephrase the corresponding sentences as follows: Globigerina bulloides is usually associated with temperate to sub-polar water masses and seasonally enhanced primary production due to increased nutrient availability. Additionally, G. bulloides is a common fauna component in low-latitude areas influenced by upwelling (compilation in Schiebel and Hemleben, 2017, Planktic Foraminifers in the Modern Ocean). At site CBeu, it is generally more abundant between summer and fall (Fig. 4).

RC: Line 425. "Heliconoides inflatus (formerly known as Limacina inflata)" Why two names for the same species are provided? Please clarify and provide references supporting this statement.

AR & ACM: this will be properly rephrased and only the name ‘Heliconoides inflatus” will be used throughout the MS and Figures. However, we will present the former name in brackets) in Table 3.

RC: Lines 437-448. Authors do not mention the relationship between the different phytoplankton groups and Chlorophyll-a in Figure 5. Why? This is an important parameter that should be discussed.

AR: we do agree with both Referees in that this should have been discussed in the first submitted version. A short discussion will be added in the revised version.

ACM: Interestingly, the satellite-gained data we used for our statistical analysis do not show a significant correlation with fluxes of major microorganism groups studied at site CBeu. This possibly indicates that (1) a large portion of satellite-measured chlorophyll concentration is delivered by microorganisms, which do not reach the CBeu trap, and/or (2) due to strong ballasting effect, part of the microorganisms’ remains reach the trap cups independent of intervals of highest chlorophyll values as measured by satellites. An alternative explanation is the fact that (3) satellites measure chlorophyll concentration in the uppermost centimeters of the water column while those microorganisms collected with the CBeu traps thrive mostly in waters deeper than those reached by satellite sensors. All three explanations for this observation will be discussed in the revised version.

RC: Line 479. Many other studies (including sediment trap studies) have documented a simultaneous increase in the abundance of different microplankton groups during favorable conditions for phytoplankton growth. Perhaps authors could discuss their results in light of Barber and Hiscock (2006, GBC). Please consider this suggestion and incorporate if appropriate. I found interesting that dinocysts increase their fluxes together with those of diatoms and coccolithophores. I would expect that the cysts are developed at the end of the productive period. Could authors briefly summarize/mention previous studies that describe the environmental parameters that trigger dinocyst formation?

AR: Barber and Hiscock (2006, Global Biogeochem. Cy 20, GB4S03) will be discussed in the revised version.

ACM: Barber and Hiscock (2006) observed that marine picoplankton is not replaced by diatoms when chemical transient (e.g., added iron) abruptly provided favorable growth conditions. Contrary to conventional wisdom, both groups of phytoplankton increase in growth rates and absolute abundance, but the biomass increase of the ambient non-diatom assemblage is modest, especially compared to the order of magnitude or more increase of diatom biomass. This enormous proportional increase in diatom biomass has fostered the misconception that diatoms replace the non-diatom taxa by succession as the bloom matures.

RC: I found interesting that dinocysts increase their fluxes together with those of diatoms and coccolithophores. I would expect that the cysts are developed at the end of the productive period. Could authors briefly summarize/mention previous studies that describe the environmental parameters that trigger dinocyst formation?

AR: This suggestion is accepted and will be accordingly addressed in the revised version.

ACM: Sexuality and the formation of gametes of dinoflagellates can be triggered by a number of environmental factors such as nutrient limitation, darkness, suboptimal temperature, endogenic rhythms, cell density and day length (e.g., Anderson et al., 1985; Ellegaard et al., 1998; Sgrosso et al., 2001; Uchida, 2001; Figueroa and Bravo, 2005; Kremp et al., 2009). In field studies, sexual reproduction generally starts at periods with high vegetative cell concentrations in the water column and maximal cyst production occurs notably at the termination of dinoflagellate blooms (e.g., Matsuoka and Takeuchi, 1995; Bravo, et al., 2010; Figueroa et al., 2018). With exception of the calcareous dinoflagellate cysts Leonella granifera and Thoracosphaera heimii that are known to be produced during the vegetative life cycle, the calcareous and organicwalled cysts of all other dinoflagellate species can be considered to be produced as part of their sexual life cycle (e.g., Meier et al., 2007; Bravo and Figueroa, 2014, and references therein). As a consequence, high numbers of trap-collected cysts can be considered to be the result of high abundance of motile cells of these species in the upper water column.

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