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Biogeosciences Discussions

Interactive comment on "Evidence for aggregation and export of cyanobacteria and nano-eukaryotes from the Sargasso Sea euphotic zone" *by* M. W. Lomas and S. B. Moran

Anonymous Referee #2

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In this study, Lomas and Moran show the presence of marker pigments of cyanobacteria and nano-eukaryotes in aphotic layers (down to 500 m) of the Sargasso Sea during three cruises in November, January and March 2006-2007. The conclusion is that small phytoplankton make a significant contribution to the sinking material leaving the euphotic zone. The data are timely in the ongoing discussion about the importance of the plankton small fraction in exported biogenic material. The paper presents some methodological inconsistencies that, in my opinion, should be addressed to improve the paper's conclusions. The approach of combining, in a rather complicated way, samples from pumps and floating sediment traps to determine the composition and sinking rates of the exported material appears weaker (several weak assumptions are needed) than

the more conventional and straightforward analysis of the material collected by the sediment traps. Finally, I suggest an alternative explanation for the presence of small phytoplankton in aphotic layers that does not invoke sinking but entrainment of surface water into deeper layers because of winter physical convection. 1. The authors draw most of their conclusions from material collected by in-situ submergible pumps on filters larger than 10 um. The amount of material collected on these filters is orders of magnitude lower than that collected on GFF filters with water from Niskin bottles at comparable depths. According to the authors, the material in the GFF-10 um fraction, missing in pumps samples, should account for this difference. However, the concentration of pigments from mPF, the microphytoplankton larger than 20 um, collected by the bottles is about one order of magnitude larger than the total material collected by the pumps (Table 1). An alternative explanation is necessary. 2. If one accepts that the discrepancy between bottles and pumps is due to the GFF-10 um fraction, this means that about 90% of the pigment concentrations are in the GFF-10 um fraction at 200 m, where pumps and bottles are measured simultaneously. Combining the results presented in Fig 3 and 4, it appears that this proportion is maintained down to 500 m. With this result in mind (90% of the pigment fraction missing in the analyses) it is difficult to follow how the authors can quantify the composition of the sinking material, less the contribution of cyanobacteria and picoplankton to the POC vertical flux. 3. I am confused with Table 2. "Bottle-pump" parameter is the difference between bottles and pumps but, according to Table 1, only samples at 200 m depth were taken with both systems. From which bottles were bottle samples taken at 75, 150 and 300 m? If they exist, why are those samples not presented in Table 1? Are FCM cell numbers and pigment concentrations from bottles coherent? 4. The authors do not use CHEMTAX to distinguish the pigment contribution of the different phytoplankton groups. Their reason is that marker pigment to chlorophyll-a ratios should be assumed. This is not totally correct because CHEMTAX finds out the optimal ratios according to the distribution of pigments in the database (and then estimates the contribution of the groups). This property allows the use of random initial ratios to reach correct final ratios with

CHEMTAX (Latasa 2007 Mar Ecol Prog Ser, 329, 13). On the other hand, the authors, reluctant to use pigment to chlorophyll-a ratios to avoid subjectivity, use depth-fixed POC (derived from cell concentration) to pigment ratios to estimate the contribution of each group to POC. This is not a very consistent behavior. Pigment to chlorophyll-a ratios appear to vary mostly in a relatively narrow range (2-3 times, Goericke and Montoya 1998 Mar Ecol Prog Ser, 169, 97), while changes in POC to chlorophyll-a ratio can reach orders of magnitude (Geider et al 1998 Limnol Oceanogr, 43, 679). In the study, both pigment to chlorophyll-a and POC to chlorophyll-a ratios are combined which greatly increases the uncertainty. The quantification of the different groups to the sinking POC is based on too large uncertainties and assumptions that we know are not correct (e.g. constant POC to pigment ratio with depth). 5. It is confusing how the deep pump and euphotic bottle samples are treated, e.g. the chlorophyllide to chlorophyll-a ratios for the euphotic zone and depth are compared, but for surface they correspond to the whole phytoplankton fraction while for depth they correspond to the minor >10 fraction. The same treatment is applied to the pheopigment to chlorophyll-a ratio. Please, compare material of the same size fraction. 6. Was the brine solution 50 or 5 g NaCl/L above seawater? An alternative explanation for the results presented here not invoking vertical sinking is that, in winter, discontinuous water column mixing events inject euphotic material into the deep layer in the Sargasso Sea. This convection-sunken material would be composed by winter small phytoplankton, which would explain the overwhelming importance of the GFF-10 um fraction also at depth. The sunken material would have a more or less constant composition down to the deep mixed layers, as the results show here. The winter convection in the Sargasso Sea has been shown to be responsible for the export of the summer dissolved organic carbon pool, a pool without gravity sinking capabilities (Carlson et al 1994 Nature, 371, 405). I do think that small plankton is exported to deep layers. However, the results presented here do not provide, in my opinion, clear evidence for aggregation and sinking of pico and nanophytoplankton, less they allow quantifying the contribution of those fractions to the POC vertical flux. In any case, pigment measurements of the material collected by floating

sediment traps would have provided a much more straightforward measurement of the composition and sinking rates of the exported material (Scharek et al 1999 Deep-Sea Res I, 46, 1051).

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