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Interactive comment on "The relative importance of phytoplankton aggregates and zooplankton fecal pellets to carbon export: insights from free-drifting sediment trap deployments in naturally iron-fertilised waters near the Kerguelen plateau" *by* E. C. Laurenceau et al.

Anonymous Referee #1

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General comments: The discussion paper is from my point of view a very interesting following up to the previous KEOPS 1 study. In contrast to the previous study, which focused on the contribution of phytoplankton aggregates and zooplankton fecal pellets to the vertical flux during the Austral summer months, the present work investigates this topic during an early spring bloom. It is revealed that phytodetrital aggregates stand for an important contribution to number and volume flux, but that cylindrical fecal pellets represent the major fraction in terms of carbon flux. This is in my opinion a

very interesting result, as it indicates the importance of qualitative characterization of sinking material. Furthermore, the paper confirms previous studies and shows a negative correlation between the net primary production and the export efficiency. In general, I think it is an interesting study, well-written and absolutely worth publishing. You might however consider the following aspects, before publishing it in BG.

1) A short comment on your study design: You deployed PPS3/3 sediment traps first to determine the POC flux and then compare the POC flux directly with the POC flux estimated from the particle composition of the gel traps (deployed after recovery of the PPS3/3 traps). I am very well aware of the logistical challenges when deploying free-drifting sediment traps, but my own experience from the Barents Sea however indicates a high patchiness in phytoplankton and zooplankton distribution and a frequently higher POC flux in free-drifting sediment traps (KC Denmark) deployed for 4-5 h compared to subsequently deployed traps for 24 h (data from the Barents Sea – Wiedmann et al. 2014, JGR: Oceans, In Press – and a fjord at the Western Coast of Svalbard, unpublished data). Similar challenges may exist in your data set (13638, section 3.3, line 12-13; 13639, section 4.1, line 7-9)? For further studies, you may therefore consider to deploy gel traps and sediment traps together (if technically possible) to be really able to compare the two different ways to estimate the POC flux.

2) In your analysis, you exclude large, rare particles due to statistical reasons. I understand absolutely your decision, but you may also take into account that these large, rare particles may stand for a substantial carbon transport. We just conducted a similar study in the Barents Sea (Wiedmann et al., 2014, JGR: Oceans, In press) and including the rare, large particles improved our results substantially (POC: volume ratio of the sinking material under different physical and biological situations then met the literature values of fecal pellets or diatom aggregates). Large, rare particles may be worth considering.

3) I would appreciate, if the authors describe more clearly, at which stage of the spring bloom they expected to meet at the different sampling station of KEOPS II. Section

2.2 gives a coarse characterization of the different stations (may be it would be more natural to place it in the results section?), but for me, not knowing the study area, it is however very difficult to decide the bloom stage based on the presented details. Providing numbers instead of only a list of dominant species (Table 6) may here also help, as well as including Ez 1%. In addition, sampling at station E-1 to E-5 took place during a period of three weeks and I wonder if you observed any succession during this time? I assume so (13636, line 3-4, 13643, line 1-3: "temporal evolution of the flux between E-1, E-3, E-5. . ."), but clarification would make it easier to follow and help to explain your data (the shift from a high to a low e-ratio at these stations). It would also be very interesting to include these stations in the discussion, instead of only focusing on R-2 and A3-2.

Detailed comments:

Introduction: 1) A definition of "fecal aggregates" the first time you mention it would help your reader to understand what you are talking about

Material and Methods: 1) 13629, line 11: ". . .varying biomass levels. . ." Do you think here about "Chl a surface levels" or about biomass in general? 2) 13630: How did you define the mixed layer? As the temperature curve in Fig. 1 is not further discussed in the paper, you may present a density curve here instead and document the mixed layer depth in this way in a more detailed way 3) 13632, line 19: "10 per gel" instead of "10 by gel"? 4) 13632, line 26: Can you describe a bit more in detail how you conducted this preliminary image analysis? 5) 13633, line 26: I am a bit unsure if I understand this sentence right: You assumed a) a spherical shape for the aggregates and computed the volume from the ESD, (does this mean V= 4/3 * (ESD/2)ˆ3 * pi?) b) and a cylindrical shape for the cylindrical fecal pellets (Why did you calculate the cylinder section in exactly this way?) Did you also use also an ellipsoidal volume calculation? (It is included in Table 2) 6) 13634, line 12: Writing "Figure 4, Line 2" aso. would make it easier to understand for the reader, where to look for line 2

Results: 1) 13636, line 16-19: "At all sites, most of the volume flux of phytodetrital material was carried by middle sized particles". I was just curious on which data you base this sentence – I assume you use the maxima in Figure 7? According to Jackson (Deep-Sea Research I (1997) Vol 44, No 11, pp. 1739-1767, Figure 13), I think that you would have to divide the volume flux by the image diameter to make the area under the curve proportional to the volume flux. I suggest having a look at that, as it might change your results.

Discussion: 1) 13643, line 15: A "." is lacking after the bracket 2) 13463, line 25-29: Are these statements deduced from the results of the present work or they general statements? Please give some references 3) 13644, line 5: Please state what Ez stands for 4) 13644, line 13-15: "carbon export efficiencies up to 10 fold lower during the early (spring) than late bloom stage (summer)": I have difficulties to reconstruct on which data you base this argument on. Could you please clarify it? 5) 13646, line 12 and following: You state that physical aggregation seemed to dominate over the biological aggregation, due to the rarity of fecal pellets. This appears a very general statement to me. Please include more details, which kind of physical processes you would suggest to dominate in aggregate formation and why? In the following you start a paragraph on the inverse relationship between net primary productivity and export efficiency, which is in my opinion a very interesting topic. However, your discussion of this observation is rather difficult to read (long sentences) and ends unfortunately a bit pointless. I would suggest rewriting this paragraph, and possibly including ballasting effects/ different abilities of the microalgae to produce EPS as "natural glue" for the aggregates/. . .? 6) 13647, line 1-9: ". . .unexpected high export efficiency considering its high zooplankton biomass". Zooplankton is doubtless an important factor in carbon attenuation, but they also can produce fast-sinking pellets, and contribute to an enhanced POC flux. You might include this.

Conclusion: 1) Conclusion 1 is absolutely right, however I think it is important to also point out that the conversion to carbon makes fecal pellets to an important carbon flux

vehicle (as named in the abstract). 2) Conclusion 2: “The decrease of productivity...” You may add “from KEOPS 1 and the present study” to clarify that these are your results and not a general statement . . .“shift from autotroph to heterotroph-dominated regimes”: Is this shown in your study, a KEOPS 1 vs. KEOPS 2 result or a general statement? Please state it more clearly. 3) Conclusion 3: You may use “appear to” instead of “could”? Conclusion 3 is very general, and I miss a bit the relation to you study. May be you would like to change it to something that is more specific for your study – perhaps that you observed more phytoplankton aggregates and fecal aggregates at depth?

Table 2: 1) Was your 10th bin actually including all larger particles since it has no upper limit?

Table 5: 1) Minimum export efficiencies in italic are rather difficult to find. May be underlined numbers would be better? 2) The maximum e-ratio of 0.32 is in bold, but not the e-ratio of 0.34. Was this on purpose? 3) Footnotes: Some of the abbreviations presented here are not used in the table

Table 6: 1) Include full name of T. nitzschoides once 2) Would be very interesting to include the depth of the euphotic zone here as well as numbers of phytoplankton and zooplankton 3) A3-2: “Appendicularians” should be in one line 4) “sp.” not in italics

Figure 2: 1) Unsure about the unit “μm Lˆ-1” for fluorescence. Perhaps you should use “Chl a” instead?

Interactive comment on Biogeosciences Discuss., 11, 13623, 2014.