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Interactive comment on "Dynamics of particulate organic carbon flux in a global ocean model" *by* I. D. Lima et al.

Anonymous Referee #1

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Review of Lima et al., "Dynamics of particulate organic carbon flux in a global ocean model"

This manuscript describes the influence of ballasting and community structure on POC flux and transfer efficiency in a biogeochemical model. I found the manuscript well-written, informative and useful. The manuscript's conclusion that separating out the effects of community structure and ballasting on export efficiency and transfer efficiency is very difficult is an important point and one well made in the manuscript. I have therefore relatively few comments and recommend the manuscript be published after minor corrections.

General comments: with the exception of a couple of papers, almost all reports of export efficiency, export flux, transfer efficiency etc. use 100 m as the 'export depth'.

Why have the authors chosen their definition of export depth and how does this affect comparison of their results with observational data?

Occasionally, the authors present an interesting result without discussing why this might arise or what the implications might be. I've highlighted a couple of particular examples in my comment below, but this is something the authors should be aware of in making the changes to the manuscript – it will make the paper more accessible to a broader audience if they can spell out what may be obvious to them as the originators of the model.

Introduction: page 14717, line 12 – the ballast hypothesis is mentioned only in passing here and in such a way that would be difficult to grasp from this section if the reader didn't already understand it. It's important to the authors' later discussion, so I suggest they explain more directly what the ballast hypothesis is.

Page 14718, line 6 – deep moored sediment traps do resolve temporal variability, as they can be set to rotate their sampling cups at fixed intervals (often monthly, e.g. http://usjgofs.whoi.edu/mzweb/data/Honjo/sed_traps.html)

Methods: Page 14721, lines 21-22 – are you excluding seasonally ice covered areas, or perennially ice covered?

The authors use the Lutz model to provide 'observed' flux estimates. Why not also compare with other empirical algorithms, e.g. Seuss, 1980 (Nature), Pace et al., 1987 (Nature)?

Is there any influence of domain choice on the results? i.e. satellite and in situ trap data have model domains imposed on them, which assumes that the model circulation gets major features in about the right place. I don't imagine it makes much difference, but sensitivity to domain choice could be tested by recalculating the results with a different set of domains, e.g. Longhurst provinces or Sarmiento et al., 2004 (GBC) biomes.

Results: Page 14724, lines 19-20 – The authors state that particle export tends to be

higher where the export depth is shallow. Is there a mechanistic explanation for this, or is it just mathematical? i.e. where export depth is shallower there is less time for any remineralisation to have occurred, resulting in higher export.

Page 14727, lines 3-5: this is an interesting observation. What might drive this?

Section 3.2 – What happens to the regression if CaCO3 is removed from the equation? Also, please describe in the text the order of importance for explaining the variability in export ratio (from Table 2).

Section 3.4 – I think this section should be moved to the start of the results section. Having it last in the results implies that this is the culmination of your work, which it isn't. Also, it's more usual to find the model validation stuff first in a paper before exploring the interesting relationships.

Discussion: I'd like to draw the authors' attention to a couple of additional papers that are relevant to their discussion and they might like to include: Laws et al., 2011 (L&O); Wilson et al., 2012 (GBC).

Figures: Figures 2 and 3 – Much of the detail in these plots (particularly for lambda and f) is lost due to the poor choice of colour scale – all I see is lots of blue, making it hard to discern details. In Figure 3, please spell out what alpha, lambda and f are. The coloured circles are also hard to make out.

Figure 5e – the green line seems to be missing.

Interactive comment on Biogeosciences Discuss., 10, 14715, 2013.