

Interactive comment on “Projected decreases in future marine export production: the role of the carbon flux through the upper ocean ecosystem” by C. Laufkötter et al.

Anonymous Referee #1

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Review of Laufkoetter et al. “Projected decreases in future marine export production: the role of the carbon flux through the upper ocean ecosystem”

This manuscript describes in detail the differences between 4 global biogeochemical models in the way that they represent the processes of POC production and sinking. Future projections are used to assess how the different model formulations lead to the wide range of projected changes in export production. The manuscript provides useful information for model users wishing to understand in greater detail how uncertainty in projections of future export arise and how individual models construct estimates of export. Although the manuscript doesn't really have a big, novel conclusion as

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such, as it is more about model exploration, it is nevertheless worthy of publication in Biogeosciences. I have only a few minor comments:

Page 19943, Line 24: “lower/higher” – this isn’t clear and confused me. Please rephrase.

Page 19949, Line 10: Should refer to Figure 5

Page 19950, Line 10: Parameter values are listed in tables 5-8, not in appendix

Model descriptions section – refer to the relevant tables with parameter values when discussing the different models. Also is the model output annual average? Or monthly?

Page 19953, Line 20: Is this 35% a fixed value or an average?

Page 19954, Line 17: Lima et al. 2015 not in references list

Model evaluation: although all of the models have been validated in detail elsewhere, I think it would be useful to include a Taylor diagram (or some other quantitative information) on how model and satellite-derived export estimates compare, alongside Figure 2 which just gives a visual overview.

Page 19962, Line 21: I think this makes more sense if written as “e.g. 12 to 14% of NPP as +2[%NPP]”

Page 19962, Line 23: High latitudes, not just Southern Ocean as written here.

Page 19969, Line 21: “this process” – not entirely clear what the authors are referring to here. Do you mean “the fraction of grazed material that becomes sinking/exported as faecal pellets”?

Page 19970, Lines 7-10: reference to “realistic e-ratio changes”, “the processes how particles are formed” etc. If only we knew what the important processes, their magnitude and variability were in the real world! Then we could really say whether one model was better than another. But just the huge range in satellite-based global e-

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ratio estimates (like the Dunne and Henson algorithms used here) emphasises that we don't know how the real world behaves either! Some discussion of how this uncertainty makes it difficult to judge whether a model is “realistic” or not would round out the discussion.

Page 19971, Line 5-10: But how would/should we choose/identify the “most important processes”? I'm sure every observationalist you ask would give a different answer of what is most important! Can you make any suggestions about what the most important processes might be?

Appendix: add reference to the relevant parameter tables (tables 5-8) in the model descriptions.

Figure 7: The numbers on this figure were so tiny I really struggled to read them. Label the 2 columns low latitude and high latitude to make it easier for the reader. In TOPAZ, high latitude, the grazing and mortality arrows don't seem to go through the zooplankton box. Note in the caption that PISCES includes DOC aggregation; and that diatom and nanophytoplankton are denoted D and N respectively in the green boxes.

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