Biogeosciences Discussions

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Comment on bg-2021-82

Anonymous Referee #1

Referee comment on "Particulate organic carbon dynamics in the Gulf of Lion shelf (NW Mediterranean) using a coupled hydrodynamic–biogeochemical model" by Gaël Many et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-82-RC1, 2021

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The study by Many et al., used the 3-D numerical model to simulate the physical and biogeochemical processes in the Gulf of Lion shelf, one of the well-characterized coastal regions in the world ocean. The encouraging agreement between model projections and field measurements gives confidence in the accuracy and rationality of model simulations. With the particular focus on the POC budget, temporal and spatial variability of multiple POC fluxes and associated underlying mechanisms were discussed. Overall, the manuscript is well organized and this work represents an important step toward better understanding the interactions between physical and biogeochemical processes as well as the regional carbon cycling. However, some major concerns need to be addressed before getting published.

Major concerns:

1) Confusion on the research goal: toward closing regional POC budget or just analyzing the spatiotemporal variability of some of key POC fluxes? "POC budget" was mentioned in the title and many places throughout the main text. In principle, the "budget" means the effort to balance the time rate change of POC inventory by the multiple processes including biological activity and physical transport. If so, the paper should start with the introduction about the mass balance equation (i.e. POC/dT= POC_{bio}+$POC_{horizotnal}$ advection + $POC_{depostion}$+POC_{export}+….) and go over the main processes.

From the mass balance perspective, the NEP is the best term to represent the net biological process in governing the time rate change of POC and partition into GPP, NPP CR and seems redundant. Also, given that horizontal advection is important as the author mentioned in the introduction, it should be discussed in the main text. I envision the paper should end with a schematic diagram something like a box showing how different processes balance the change of POC in the seawater. However, in the current version, the authors seem to focus on some POC fluxes that author are interested in rather than a comprehensive overview of POC fluxes with the aim to balance the time rate change of POC. I am not saying the present way is wrong. I am open to both strategies and it depends on the study goal. Therefore, I think the author should be cautious in using "POC budget and be more clear about the research goal.

2) Issue about DOC portion in GPP, NPP and respiration: the author refers GPP, NPP and respiration to one of POC fluxes. Primary production and respiration both the include POC and DOC production, even though some field measurements of primary production (i.e. ^{14}C-based approach) is biased toward POC production because of methodological problem. I am not mistaken, primary production and respiration in the model encompass both DOC and POC portions. In the coastal region, the DOC production/consumption are significant. Since this study focus on POC dynamics, did the author pay any effort to isolate the DOC portion in these biological terms?

3) Missing the information about the methodology in simulating POC fluxes: as the core components, I have not seen the descriptions about how multiple POC fluxes were calculated in the model and definitions about different processes. As mentioned above, how did you calculate the primary production, respiration and partition the POC portion from the total organic carbon term? How did you define/differentiate the POC deposition, cross-shelf transport and horizontal advection? It should introduce in the method section briefly rather than citing the previous paper.

Minor comments:

Line 170: provide the link for accessing the satellite data.

Figure 3: add the “surface” and “bottom” on the top of the panel for clarification (like Figure 2).

Figure 6c: Introduce the way to calculate stratification index in Method section.

Table 2: does the “stock POC” mean the POC inventory (t Cyr-1) or the time rate change of POC

inventory (t Cyr-1)? The other terms listed in this table are all flux (t Cyr-1).

Section 4.2: Regarding the primary production, do you have a specific reason to focus on NPP rather than GPP or both?

Line 500: does primary production refer to the NPP or GPP? Please clarify herein

Revise the expressions throughout the text: change Chl-a, umolC L^{-1}, NO3 and PO4 to Chl-*a*, umol C L^{-1}, and , respectively.