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Biogeosciences Discussions

Interactive comment on "Functioning of the planktonic ecosystem of the Rhone River plume (NW Mediterranean) during spring and its impact on the carbon export: a field data and 3-D modelling combined approach" *by* P. A. Auger et al.

P. A. Auger et al.

pierre-amael.auger@aero.obs-mip.fr

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We are very thankful for the constructive comments from the two referees and are pleased to present our answers. Most of the suggestions and corrections of the referees are included in the revised manuscript.

According to the referees' comments and suggestions, the manuscript has been partly rewritten, deeply restructured and reorganized in 1 Introduction – 2 Material and Meth-

ods – 3 Validation of the ecosystem modelling – 4 Results – 5 Discussion – 6 Conclusion. BIOPRHOFI measurements within a LSW lens (Trajectory 2) provide us an opportunity for validating an ecosystem model, and have been fully used to validate model outputs in term of stocks and bacterial/primary production without salinity discrimination anymore. Since the Trajectory 1 was not sampled in such LSW lens, all data from this trajectory have been actually removed from the analysis of BIOPRHOFI measurements and the validation data set. This alteration enables to shorten and simplify the new version of the paper. On the whole, the focus on the key factors actually controlling the particulate organic carbon (POC) deposition on the Gulf of Lions shelf has been increased and the discussion part has been significantly enriched. The model provides us a diagnostic on the POC deposition during the study period (spring). Moreover, a sensitivity test to particulate organic matter (POM) inputs from the Rhone River allows us to investigate the role of terrestrial inputs and biological processes on the POC deposition within the Gulf of Lions shelf. Besides, we propose a modification of the manuscript title: "Functioning of the planktonic ecosystem on the Gulf of Lions shelf (NW Mediterranean) during spring and its impact on the carbon deposition: a field data and 3-D modelling combined approach"

Specific response to Referee #1 RC: "The manuscript is not well written and not well structured, it is very hard to read and many important results are lost in crowded text. The conclusion part does not reflect the results of the major findings from this research, also the abstract is poorly written. The conclusion part is superficial; it mostly repeats known ideas whereas it should provide answers on key factors controlling the organic carbon deposition." AC: According to referee's comments and suggestions, the manuscript has been partly rewritten, deeply restructured and reorganized in 1 Introduction – 2 Material and Methods – 3 Validation of the ecosystem modelling – 4 Results – 5 Discussion – 6 Conclusion. Both abstract and conclusion parts have been rewritten to present the major findings from our study focusing on the key factors controlling the organic carbon deposition on the Gulf of Lions shelf. The maximum contribution of terrestrial POM inputs from the Rhone River to the total POC deposition on

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the Gulf of Lions shelf is estimated to 17% during the study period, which suggests a major contribution of marine POC. Our modelling study shows that trophic interactions within the zooplankton community primarily supported by terrestrial inputs mostly drive the POC deposition on the shelf. Precisely, zooplankton biomass may be favoured by peak discharges of the Rhone River, and then increase the gradient of POC deposition between the prodelta and the offshore area on the Gulf of Lions shelf through grazing processes.

RC: "Sections 5.2 – 5.4 include important results of sensitivity tests but very hard to follow, this needs to be re-organized in a logical manner. [. . .] At present form it takes too long to read, especially the parts that focus on model-data comparison and sensitivity analyses are very hard to follow. [. . .] It may help to separate results-discussion-conclusion parts." AC: The model-data comparison has been shortened and also limited to BIOPRHOFI measurements from the Trajectory 2. The old sections 5.1 – 5.4 (results and discussion on the sensitivity analysis) have been reorganized to make it easier to read. The description of the POC deposition on the Gulf of Lions simulated during the study period is first presented (Section 4.1). Then, the results of the sensitivity test to POM inputs from the Rhone River are presented in term of POC deposition (Section 4.2) as well as POC contents in the water column especially near the bottom (Section 4.3). The results are now presented as the difference "Reference – noPOM", so in an opposite way than in the previous version of the manuscript. Thus, the influence of terrestrial inputs from the Rhone River is highlighted in a much more logical manner. The discussion part has been finally enriched focusing on the role of zooplankton (5.1) and the key factors actually controlling the organic carbon deposition on the shelf (5.2).

RC: "For example, results given in Figure 17 should be the core of this research, most pronounced feature is the alternating export patterns between 200m and 1500m. Authors mention about canyons but this is not obvious, why do these sharp fluctuations in POC flux occur?" AC: In the first version of the manuscript, the figure 17 represented

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the particulate organic carbon (POC) flux at 200m depth, and then a POC deposition when the depth of the seabed was lower than 200m (on the shelf). Actually, the core of our research deals with the POC deposition on the seabed, especially on the shelf (depth<200m). In the new version of the manuscript, the POC deposition on the seabed is then considered instead of the POC flux at 200m depth, and so whatever the depth of the seabed.

Response to Specific Comments: RC: "Pg 9041: I wouldn't call this an "innovative" model, maybe a complex model." AC: In the abstract, such adjective has been removed to characterize the model.

RC: "Section 2.2. It would be good to have a figure that shows biogeochemical model compartments and their interactions (wire diagram)" AC: A diagram of the schematic functioning of the biogeochemical model used in this study has been added in the section "2.1.2 Ecosystem model".

RC: "Section 2.5 should be shortened" AC: In fact, Section 2.5 and 3 have been shortened and gathered together in a new section "2.2.2 Biogeochemical analysis of BIOPRHOFI data"

RC: "Section 3.2: Authors talk about increase and decrease in nutrient concentrations, relative to what?" AC: In fact, LSW lenses are confined structures in which the residence time of freshwater masses is increased by a slow dilution with surrounding waters (Diaz et al., 2008). The LSW lens was sampled during the BIOPRHOFI cruise (Trajectory 2) through a lagrangian strategy. As a consequence, we consider an evolution of the biogeochemical characteristics within the LSW system as a function of time, the size of open circles increasing with time in the figures 4 and 5 of the revised manuscript.

RC: "Section 5.1: Where is the river mouth? It is hard to follow what is being described in this section. The canyon effect on export needs to be detailed" AC: The Rhone River mouth is now indicated in all 2-D figures. Moreover, this section has been modified and

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the different contributions of living organisms (PhytoC), SPOC and LPOC have been addressed both spatially and at shelf scale.

RC: “Section 5.3: Relative contribution of different phyto groups on export is an important result, why this is not given in abstract and conclusion?” AC: In the model, only microphytoplankton has a sedimentation rate different from zero and the sedimentation rates of the other size classes are considered to be zero. Then, only microphytoplankton group participates to the POC deposition on the seabed.

References Diaz, F., Naudin, J. J., Courties, C., Rimmelin, P., and Oriol, L.: Biogeochemical and ecological functioning of the low-salinity water lenses in the region of the Rhone River freshwater influence, NW Mediterranean Sea, Cont. Shelf. Res., 28(12), 1511-1526, 2008.

Interactive comment on Biogeosciences Discuss., 7, 9039, 2010.