Biogeosciences

Discussions

Open Access

EGU

BGD

Interactive
comment

Interactive comment on "Modelling biogeochemical processes in sediments from the north western Adriatic Sea: response to enhanced POC fluxes" *by* Daniele Brigolin et al.

Anonymous Referee #1

Received and published: 4 July 2017

The present version of the manuscript is relatively well written and the objectives are well stated. The subject is very interesting and the approach used may be appropriate. However, the methods are not clearly detailed enough to allow the reader to appropriately follow what is done and how. In addition, there are many points on the form that are confusing: the use of different parameters to define (potentially) the same thing that may have different meaning in the literature (e.g., POC, Corg, OC%, . . .). The caption of the figures/tables that are not in agreement with what is written in the text or what is seen on the figure/table, . . . I tried to address most of them in the specific comment section below.

[Printer-friendly version](#)

[Discussion paper](#)

Overall, my most important comments concern: 1) the way bioirrigation is accounted in the early diagenetic model, which is one of the two parameters used to calibrate the model 2) the representativity of one porewater profile (and of 1 or 2 porewaters samples) to entirely support the bioirrigation process 3) the representativity of the measured O2 profiles and derived diffusive flux carried out under ex situ conditions without any stated precautions to be representative of in situ conditions. All the discussion/conclusion relies on those simplifications and potentially non representative data, that strongly limits its credibility.

Specific comments: Title: - define POC in the title or if you assume that it is 100% evident, it should be at least defined in the abstract and in the manuscript the first time it is used? The only place where it is defined is at L27, p3, clearly too late for the reader.

Introduction - L2, p2: please, precise the difference between faeces and pseudo-faeces? Do you assume that both materials are included in OM3 pool (deposited pool) defined later? It may help the reader to better understand. - L6, p2: replace the last coma by "and" - L9, p2: correct "Estuarine" - L14, p2: what "degree of deposition" means? Is it a characteristic of the deposition which is influenced by the local hydrodynamic?

Materials and Methods - L29-39, p2: This part is a little bit confusing: it seems to announce the organization of the Materials and Methods section but the following parts do not follow such structuration. There is no information allowing to link the POC production and the POC deposition (i.e., the deposition model). I suggest to improve this part in order to fit the following parts of the section (potentially separating the modeling approaches and the experimental approaches used to calibrate the models), or to remove it from here and resume it at the end of the introduction section. - L3, p3: remove "see" before Figure (to be applied to all the manuscript) - L18-19, p4: What is the impact of neglecting Fe and Mn biogeochemical related processes on the total biogeochemical processes? Are these processes really negligible? This could be the

case as sulfate reduction process appear negligeable (from SO42- profiles and in spite what your modeling result tend to indicate). In addition you do not have any NO3- data that could also be an important process in the area studied. - L1, p5: what is POM? Precise the relation we POC you assume. - L1, p5: what is TSM? Is it the same as TSS? Please homogenize throughout the manuscript and if there is a difference between these parameters, clearly explain it. - L2, p5: Why do you cite Rampazzo et al., 2013 as you mention that POC/TSM was extracted from the same previously cited paper (i.e., Brigolin et al., 2009)? - L2, p5: what is AE? - L5-6, p5: what is the influence of the farm on the current within the farm? This is the current within the farm that will drive the transport and deposition of particulate from the farm. This is not explained within the deposition model section. I think this is important for the reader. Please explain. - L5-10, p5: How the annual variability of the current was obtained as only 6-7 months (March-September) of measurement is available? - L15, p5: I guess you refer to the POC downward flux here ("Initial values of POC for the calibration...")? Please precise. - L17-18, p5: what do you mean by transient conditions? Is it the second EDM model that is mentioned at L4, p2? Is it a completely different one? - L21, p5: Diffusive O2 fluxes were assessed from the profile in the surface sediment? Accounting for water temperature and salinity, and tortuosity in sediment? Please precise - L24-25, p5: it appears that the end of the rearing cycle is the last days of August while the beginning is early September. Does this mean that the harvesting of the mussels occurs within these few days each year? Does the activity of harvesting induce a strong increase of the concentration of suspended matter that may remain several days within the water column and may impact the material trapped within the sediment traps deployed at the beginning of the new rearing cycle? - L34-35, p5: only one sediment core was collected per station. How the spatial heterogeneity can be addressed with only one core? - L35-36, p5: Did the profiling experiment carried out at in situ temperature? If not, please precise at least the in situ vs ex situ temperature. - L35-36, p5: Does the bubbling was performed using ambient air? Is it coherent with the in situ oxygen concentration? - L41, p5: how the porewaters were extracted?

Results L17, p6: What is CV? L21, p6: why to chose days 10 and 360? Because they correspond to the min and max situation? Precise. L22, p6: why the footprint is related to the presence of lines here? The shape of the farm appear also clearly on the deposition map (with or without the lines visible). L22, p6: "is clearly visible at days 120 and 360" It is also the case the day 10. L25, p6: OC% not defined and no information about its analysis. In Table 1 "TSS" seems to be Total mass fluxes, OC% seems to be Corg(%) and POC flux seems to be Total Carbon flux? Please be consistent all throughout the manuscript. L30, p6: if you decide to call the station outside the farm a "reference station" please use this terminology all through the manuscript. L33, p6: no information about how porosity was measured. L36, p6: "Oxygen shows a quasi-monotonous decrease in concentration" you mean downward in the sediment? L37, p6: what do you mean by low variability? L4-5, p7: I clearly doubt that the trend in the only one DIC profile (and the two subsurface samples) reported can indicate anything about bioirrigation. L7, p7: O2 with 2 in index (same all through the manuscript) L13-14, p7: Is the bioirrigation expected to decrease the porewater concentrations at a precise depth? I think there is a need to better explain how bioirrigation is taking into account in the model. Usually, the bioirrigation rate is applied over a depth interval with the intensity decreasing (linearly or not depending the model) with depth from a maximum value at the surface to a 0 value at a specific depth. This induces a dilution effect of the porewater by the overlying water decreasing with depth. Is this not the case here? If not, please precise this aspect. In addition, information on the macrofauna species and bioturbation behavior may help to define the way to account for bioturbation (sediment reworking + bioirrigation) processes (in Colla, 2017?). L14, p7: I'm not agree with this affirmation. The range of concentration between measured and modeled profiles are similar but the vertical trends clearly differ. L17-20, p7: Figure 7 seems to show the diffusive O2 fluxes for IN and EST stations. I can't see any comparison between modeled and measured data. L17-20, p7: how the measured ex situ O2 profiles, and assessed O2 diffusive fluxes, may be used here to gain information on the oxygen uptake in situ since: 1) profiles seems to haven't been performed at in situ temperature

and in situ oxygen content, and 2) under sunlight influence that could be clearly higher than under in situ condition (observation microphytobenthos production that is know to strongly impact the diffusive fluxes at the sediment-water interface as well as the O2 penetration depth). This is a crucial step that may to be clearly addressed. - L22-23, p7: the three pools of OM: you actually mean the total organic matter that correspond to 2 pools in EST station and 3 pools in IN station? - L24-25: this is not what is reported in Figure 7.

Discussion L4, p8: What is ED? It should be EDM as previously L24-32, p8: You said that modeled POC flux from EDM agrees with POC flux measurements from a sediment trap. (that already was the subject of the previous section) but then try to explain why there is a factor 2 difference. L12-13, p9: This is an important point.

Table 1: - title do not correspond to what can be seen in the Table - please add a mention specifying the stations that are inside the influence of the farm and those outside the farm (reference?) and gather results for stations IN and EST to help the reader. - be careful to the significant digits. - homogenize the position of the text inside the cell

Table 2: - Second line corresponds to POC deposition I guess. This should be clearly mentioned. - please add a mention specifying the data for inside the influence of the farm and this outside the farm (reference?) to help the reader. - How can you assume that the CNP ratios are the same in both stations. - mineralization rates reported correspond to total (OM1 + OM2 + OM3) organic carbon?

Figure 2: The caption is clearly no detailed enough? What are the red bubbles? The black rectangles? The blue lines?

Figure 4: Please add the simulation day on the figure. It will help the reader to follow the writing.

Figure 5: - specifiy "por" in the caption or write "porosity" on the figure. Same for DIC.

- I doubt the unity of porosity is % as mentioned. - the term "micro-profile" is only applicable to O2 and eventually to porosity profiles.

Figure 6: precise this caption.

Figure 7: - caption of the figure 7 is unrelated to the figure 7 - write on the figure (noted Figure 7) that it correspond to O2 diffusive fluxes (if this is well the case).