Answer to Referee #3

We thank Referee #3 for the time spent on reviewing our manuscript and for his/her thoughtful comments on the representation of the organic carbon pool in our model. We include below our detailed answers to the Referee's major comment and to all the specific comments and describe the proposed changes to the manuscript.

Major comment

Representation of the C cycle in NPZD

I would also like to introduce a philosophical issue. The NPZD has difficulties to reproduce properly the C cycle in coastal upwelling zones for two reasons: ii) DOC is not properly included in the model; and ii) benthic nutrient mineralisation is not considered.

For the case of DOC, the authors have found a way to overcome the problem by introducing two POM pools (sinking and suspended) and considering DOC part of the suspended POC pool. It could work. In this regard, lateral Corg fluxes are reported without differentiating the pools considered (Phyto, Zoo, large POM, small POM + DOM). Are you reporting only small POM + DOM or also the other pools?

For the case of benthic mineralization, in EBUEs with wide continental shelves, as it the case of the NW Africa EBUE, 40-60% of the nutrients used for phytoplankton growth could come from the underlying sediments. Is this process included in the NPZD model in any way?

Answer

The organic carbon pool in the present NPZD model consists of four compartments, namely Phytoplankton, (PHY) Zooplankton (ZOO), Small Detritus (SDet) and Large Detritus (LDet).
The presented Corg fluxes refer to the total organic carbon pool, therefore to the sum of the four modeled pools. Of these organic carbon types, only ZOO does not sink (see Gruber et al, 2006 for a complete set of parameters). The NPZD model does not include any dissolved organic carbon pool. In spite of this limitation, the modeled SDet, with its small sinking speed and large abundance, shares strong similarities with a suspended POC pool and, to some extent, with semi-labile DOC. A full discussion of the consequences of this representation of the organic carbon pool in our model is provided in Lovecchio et al., 2017, and in the BGC Discussion page of the same paper, especially the answer to the Major Comment 1 of Referee #1.
With regard to benthic remineralization: sediments in the NPZD model are not a sink for POM but act as a temporal buffer, meaning that all the POM that sinks into the sediments is slowly remineralized there back into inorganic constituents, which are then released immediately back into the bottom water. No burial of POM is considered in our model. Thus sediments are indeed a source of nutrients for the water column in our model. A clear drawback is our lack of consideration of benthic denitrification and other special processes altering the biogeochemistry of the sediments and of the overlying water column.
In order to better clarify this point, we will add this statement to the Methods section:
"The modeled total C_{org} pool consists of a non-sinking zooplankton class, a sinking phytoplankton class and two detritus pools, one slow and one fast sinking. Sediments in the NPZD model are not a sink for C_{org} but act as a temporal buffer: all the material that sinks into the sediments is slowly remineralized then release back into inorganic constituents of the bottom layer. See Lovecchio et al., 2017 for a discussion of the strengths and limitations of the representation of the organic carbon fluxes in NPZD."

Answers to specific comments

SC1) *Page 1, line 4 – I would not say that a model will be able to "demonstrate quantitatively" that eddies and filaments are exporting organic matter from the coast to the open ocean at the NW Africa EBUE scale. A numerical model is a tool that tries to approach as much as possible to reality, but it is (rather) imperfect.*
Answer:
We will rephrase this sentence as follows.
"Yet a comprehensive analysis of this mesoscale flux and of its impact in the entire Canary Upwelling System (CanUS) has not been provided."

SC2) *Page 5, caption of Figure 1 – explain what is "01/12/0030" and change "9.5 ◦ N and 32 ◦ N" by "32 ◦ N and 9.5 ◦ N".*
Answer:
We thank Referee #3 for this comment, but we think that it's correct to list the latitudes in an increasing order. Day 01/12/0030 is the first day of the 12th month of the 30th year of simulation including spinup. We will rephrased this part of the caption as follows:
"from Dec. 1 of year 30 of the run (01/12/0030)."

SC3) *Page 7, line 13 – salinity is unit less*
Answer:
Thank you, we will correct this.

SC4) *Page 9, line 1 – It is a bit optimistic to state that the patterns of the model and the observations are "very similar". I would say just "similar" or even "roughly similar".*
Answer:
We will strike "very" from "very similar".

SC5) *Page 11, line 2 – Please, erase "found"*
Answer:
We will substitute the expression "abundant found" with "abundantly found"

SC6) *Page 11, line 18 – Please, indicate what organic matter pools are included in C_{org} (Phyto?, Zoo?, large POM?, small POM + DOM?).*
Answer:
We will add a short description of the NPZD model following the first sentence of the methods, as proposed in the answer to the major comment:
"The modeled total C_{org} pool consists in one non-sinking zooplankton class, one sinking phytoplankton class and two detritus pools, one slow and one fast sinking. Sediments in the NPZD model are not a sink for C_{org} but act as a temporal buffer, meaning that all the material that sinks into the sediments is slowly remineralized there back into inorganic constituents. Please, refer to Lovecchio et al., 2017 for a discussion of the strengths and limitations of the representation of the organic carbon fluxes in NPZD."

SC7) *Page 12, Figure 5 – Why Corg was integrated through the entire water column instead of just in the upper 100 m. No scale for current vectors has been added in panel (a).*
Answer:
We will substitute the plots in Figure 5 with 100m-integrated organic carbon plots shown below in Figure 1.

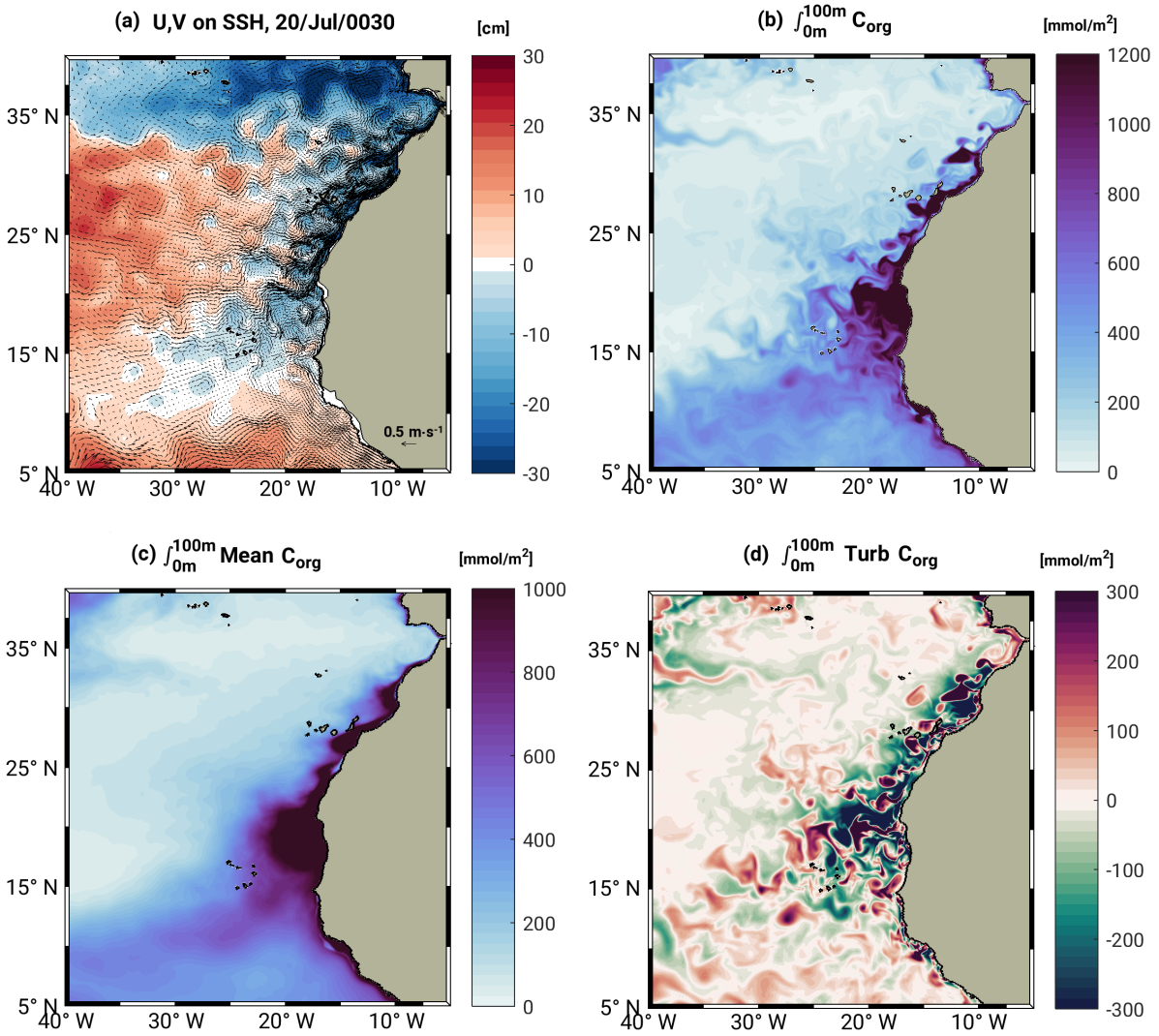

Figure 1: *Modeled 2-day mean variables for July 20 of year 33 of the simulation. The Corg components are integrated throughout the first 100 m depth.*

SC8) *Page 20, Figure 12 – The footnote is not coherent with the figure.*
Answer:
Thank you for pointing this out. We will correct the caption removing the reference to the subregions.