

Report #1

Submitted on 01 Dec 2020

Anonymous Referee #2

Anonymous during peer-review: Yes No

Anonymous in acknowledgements of published article: Yes No

Recommendation to the editor

1) Scientific significance

Does the manuscript represent a substantial contribution to scientific progress within the scope of this journal (substantial new concepts, ideas, methods, or data)?

Excellent >>Good<< Fair Poor

2) Scientific quality

Are the scientific approach and applied methods valid? Are the results discussed in an appropriate and balanced way (consideration of related work, including appropriate references)?

Excellent >>Good<< Fair Poor

3) Presentation quality

Are the scientific results and conclusions presented in a clear, concise, and well structured way (number and quality of figures/tables, appropriate use of English language)?

Excellent Good >>Fair<< Poor

For final publication, the manuscript should be

>> accepted subject to minor revisions <<

Suggestions for revision or reasons for rejection (will be published if the paper is accepted for final publication)

Review of “The fate of upwelled nitrate off Peru shaped by submesoscale filaments and fronts” by Hauschildt e al.

General comment

The revised paper by Hauschildt e al. is more complete than the previous version and it is clear that the authors added quite some information to it and reorganized the results. I appreciate the new model evaluation section, and really like the new tables in the text, which help to understand the many results from the study.

However, I still find it difficult to read. The English is not polished and the new sections read badly. The structure of the paper is also odd, with the supplement consisting in one single plot without any commentary.

My suggestion is to publish the manuscript after minor revisions (especially on the writing) are done.

I will list below my comments.

Reply: The authors would like to thank the reviewer for another thorough review of the manuscript.

Major comments

1) English and length

- I acknowledge the overall improvement in the paper, but I still find several of its portions really difficult to read, especially the new paragraphs in bold. I really encourage all of the authors to re-read these paragraphs as well as the whole paper, and improve the quality of the writing. Otherwise, I suggest to have a mother-tongue read it and correct the writing, as this would help quite a lot to deliver the message.

I am not going to provide a full list of corrections to the writing, but I will focus on a few critical points in the detailed comments list. It is on the authors to improve the rest of the paper.

Reply: The new revision of the manuscript has been checked again by the co-authors and some more subtle grammatical questions were corrected by a native speaker. Beyond this, we believe that the recent restructuring of problematic sections has improved the readability of the paper.

- The manuscript is also really long, and much of the new text still includes numbers and many many details that are already provided in tables and plots. I strongly suggest that the authors make an effort to streamline and shorten the paper, where the information is already provided in plots and tables.

At the present moment, the combination of length and quality of the writing makes it very difficult to read through the entire manuscript.

Reply: We believe that it is important to have quantitative statements directly in the text, even if this leads to duplicate information as you described. However, we improved the readability of the sections you criticized by shortening and restructuring them (e.g. reducing the number of paragraphs). The model evaluation (section 2.8) has been rewritten and the discussion (section 4) now includes subsections with titles for better readability.

2) Model evaluation

I really appreciate that the paper now includes a model evaluation to give context to the results. This subsection may be moved to the Methods rather than the Results, so to keep the real results more in focus.

Reply: We have moved the model evaluation from the results (section 3.1) to the methods (section 2.7).

However, as the other “new” parts of the paper (bold parts), also this section is not quite well written and should be improved. As a general note about the content of the evaluation, the text could and should focus more on what is relevant for the present study (see comments below): it should constitute a reference to then discuss strengths and shortcomings of the model results in the discussion.

It is way more important to spend more words on these relevant aspects of the model performance, than to repeat in detail in the text all the numbers of the Taylor diagrams which already provide the information.

As the supplement consists in only one figure, I think this should rather be in an appendix to the main manuscript and not in a supplement. A supplement should be something more substantial than one spare plot.

Reply: To our knowledge, the use of a separate supplementary file for additional figures that cannot reasonably be included in the main manuscript is fairly common in Biogeosciences. Since there are now 6 supplementary figures with several panels, including them in an appendix to the main manuscript would lengthen it by several pages. We therefore decided to keep the supplementary material separate, but added a few sentences of explanation to improve readability and provide context.

It is good practice that, when using data (eg. AVHRR, CARS...), the authors also include the references to the relevant publications for that dataset.

Reply: We have added the requested references at the corresponding locations.

In terms of the content of the model evaluation:

- Please, indicate biases in absolute values rather than percentages. The plot that is currently in the supplement doesn't include difference plots, therefore this is even more important. How many degrees is the max positive SST bias, how many the negative? How many meters the MLD bias? And same for the other mentioned variables.

Reply: We now indicate absolute values and percentages in Fig.2. We have also added difference maps for all variables in the supplementary material. The bias values are now cited in the text.

- Given the focus of this paper is on the lateral and vertical transport, wouldn't it be appropriate to show a 2D map of the total velocity field and of the small scale variability of the flow (eg. standard deviation of SSH of the daily data or EKE)? This figure could also go in an appendix.

Reply: We have expanded the model evaluation to include both the mean bias of EKE (P.2 L.1) and the spatial pattern of this EKE bias (Fig. S5). The patterns and bias are now discussed in the "Model evaluation" section.

- The authors mention the upwelling being too strong in the model, and this is also visible in panels a,b,c of the supplement. This should be discussed in the model evaluation before than in the discussion.

Reply: We have now expanded the model evaluation, by comparing model fields to observed ones. However, this type of comparison cannot be done with vertical

velocity, as direct observations are not available. Thus, to remain consistent with the rest of the model evaluation section, we left this paragraph in the discussion.

- Regarding the figure in the supplement, I think comparison plots should show the difference plot (at least for the crucial 1/450 run), as without the difference the eye can easily be driven to find general similarities, but it's very difficult to see biases in a quantitative way.

Reply: The supplementary information was expanded into multiple figures and difference maps were added for all variables.

Detailed comments

Abstract: please add a comma after often in the second sentence "Often, studies..." or better replace with something more clear, such as "Most studies on this topic..."

Reply: We have implemented your suggestion.

P1L2-4: "Most studies on this topic are either based on observations or model simulations but seldom both approaches are combined quantitatively to assess the importance of filaments for primary production and nutrient transport."

Abstract: why are some sentences bold?

Reply: We marked changes to the previous version of the manuscript in bold to help the review process, following Biogeosciences guidelines. It was not clear to us that this type of "track changes" manuscript was not welcome at this stage. In this revised version we have uploaded a regular manuscript as well as a "track changes" manuscript, as it was clearly indicated on the upload form at this stage.

Page 2, line 5: the following sentence misses the verb in its second half “These Eastern Boundary Upwelling Systems (EBUS) are found in all major ocean basins and named after the Canary, Benguela, California, and Peru-Chile current systems.”

Reply: We now repeat the auxiliary verb “are” in the second half of the sentence for better readability.

P2L4-6: “These Eastern Boundary Upwelling Systems (EBUS) are found in all major ocean basins and are named after the Canary, Benguela, California, and Peru-Chile current systems.”

Why are some parts of the “manuscript version 3” in bold? The uploaded manuscript shouldn’t be the track changes manuscript. Also, for future use, it would be nice to have the track changes manuscript at the end of the “Author’s answers” file showing both what was added and what was removed from the previous submitted manuscript version. This can be obtained using latexdiff in latex, or the track changes in word. I strongly encourage the authors to use one of these methods in the future.

Reply: The bold formatting of added text was meant to aid the review process, but we should have included and marked the deleted text as well. In general, it was not obvious to us that this type of “track changes” manuscript was not allowed or appreciated at this stage of the review process.

Page 3, lines 6-8: The following sentence must be corrected, the English is not sound: “For instance, if the time scale of nitrate uptake by PP was shorter than that of subduction, mainly organic matter produced in the surface layer would be subducted. If it were longer, mainly nitrate would be subducted.” The subordinate doesn’t read correctly. One should write “... , more organic matter than nitrate would be subducted” and then “..., the opposite would be true”.

Reply: The sentence has been changed according to the suggestion.

P3L1-3: “For instance, if the time scale of nitrate uptake by PP was shorter than the subduction time scale, more organic matter (produced in the surface layer) than nitrate would be subducted. If it was longer, the opposite would be true.”

Page 10, lines 22-27: This paragraph is really difficult to read, please correct the English, all of the three sentences are not clear.

Reply: We improved this section and hope it conveys its intended meaning more clearly now.

P10L26-29: “In this section, we verify that the two simulations realistically reproduce the annual mean physical and biogeochemical structures. The model

evaluation focuses here on the horizontal variability over a 2-year averaging period (2015 - 2016). The comparison of the most relevant physical and biogeochemical variables with observations is summarised in Taylor diagrams for both the 1/45° and 1/9° simulations (Fig. 2a,b). The corresponding mean horizontal fields are shown in Figs. S1-S6.”

The 2 year averaging period (last sentence here) corresponds to the analysis data, is this correct? The duration of spinup and analysis data can be mentioned in subsection 2.5 where the simulation is described, and here the authors can refer to the fact that they evaluate the mean of the 2 years of analysis data without need to mention the spinup.

Reply: In the new manuscript only the 2-year analysis period is analysed. The spin-up is no longer mentioned in this section.

Page 10 line 28: “The model fit of” is not a sound expression, this sentence should be rephrased.

Reply: This section has been re-written and the sentence has been removed.

Page 10, line 30: For me, it is not clear here what figure I should look at when the authors talk about “spatial patterns”. All the discussion on patterns and biases is not clearly referring to any figure. Please, refer to the right figure when discussing the patterns. If the figure is the one in the supplement, please move it to an Appendix and mention it in the evaluation where needed.

Reply: This section has been re-written and references to specific figures shown in the supplementary section have been added throughout.

Subsection 3.2: This subsection sounds like another model evaluation, especially given the beginning and the new final sentence. However, as far as I understand, the authors are focusing on one particular simulated event and not an average performance of the model. This is still not clear in the text, it is only mentioned in the figure caption.

The initial sentence “The characteristic structure of coastal upwelling in the physical fields is well reproduced in our simulations” refers to figure 4, and that one single figure doesn’t say much about the simulation as a whole, it only shows a particular event, therefore its description in the text shouldn’t be so general.

Reply: The sentence has been changed to reflect the fact that this statement only refers to the particular event that was compared.

P14L33-34: “The characteristic structure of coastal upwelling in the physical fields for this particular event is well reproduced in our simulations, but some differences exist (Figs. 4a-c,f-h).”

At line 32, when starting the discussion of the model data, the authors should state something like (please, rephrase better before using):

From the model simulation, we chose one particular event that reproduces physical conditions similar to those of the survey and assessed the ability of the model to reproduce the dynamics observed *in situ*.

Reply: We accepted the reviewers suggestion with slight changes. We would like to point out that indeed in this version of the manuscript we also compare the mean against reference datasets (section 2.8).

P14L32-33: “From the model simulation, we chose one particular event that reproduces physical conditions similar to those of the survey and assessed the ability of the model to capture the dynamics observed *in situ*.”

Page 25, line 4: “negative SST bias of $\sim -3\%$ ”, please, use absolute values in degrees. Same also a few lines after: there is a comparison between a percentage bias in nitrate and an absolute bias in previous literature. This is not good for readability. Please, include absolute values also for the biases in the present model.

Reply: We now mention the absolute values of the SST biases. Moreover, absolute values for all biases have been added to figure 2.

Page 25, line 30: Please, reverse the words order: “of the nitrate upwelling fluxes” or “of the upwelling fluxes of nitrate”

Reply: The sentence has been changed as requested.

P27L33-34: The positive nitrate bias suggests an overestimation of the upwelling fluxes of nitrate.