Biogeosciences Discussions

Responses to Reviewer #1's comments

Thank you for checking our previous manuscript very carefully and in detail, and giving very helpful and practical comments that greatly helped us in further improving our manuscript. We have revised and re-submitted our manuscript based upon all your comments. Most of the previous figures have also been revised following your and a second reviewer's comments. The information about an English certificate in the previous manuscript has also been deleted in the revised manuscript.

Responses to major comments

1-1) The understanding of the seasonal variability in pH and Ω is important in this. I therefore recommend authors to calculate the seasonal pH and Ω sensitivities for T, S and DIC and ALK. The following reference are helpful for your revision. They use the Taylor expansions of pH and Ω derivatives and evaluate the T, S, DIC and Alk dependence of pH and Ω values.

DeJong et al. (2015): Equation (2) of the following article is about the talyor expansion of omega https://bg.copernicus.org/articles/12/6881/2015/bg-12-6881-2015.pdf

Hagens and Middleburg (2016): Equation (2) of the following article is about the talyor expansion of pH

https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2016GL071719

This calculation makes you discuss your results in detail qualitatively and the science quality for this paper improve much better.

➔ Thank you very much for this very useful comment. The authors have calculated monthly-mean contributions to pH and Ω_{arag} changes by temperature, TA, DIC and salinity, based on our model results, because monitoring results were often missing temporally. The analyzed results contain some interesting insights of similarities and differences between contributors and regions, as newly described in Section 3.2 (in Lines 345-373 of the revised manuscript).

Responses to minor comments

Figures and Tables

1-2) You need subsequent numbers (a, b, c..) in Fig. 1, 3, 4,5, 6, 7, 8, 9, 10, 11, 12 and 13 and add the subsequence figure number after your appropriate sentences, which is helpful for the readers to identify which figure we should see correctly.

➔ In Fig. 7, no numbering has been placed because one of the figures in Fig. 7 in the previous manuscript has been cut in the revised manuscript. The other figures have been modified following the reviewer's comment.

1-3) The sizes of the title and scale are too small in Figs. 3, 4, 5, 6, 8, 9, 10,11, 12, and 13.

➔ These figures have been enlarged following the reviewer's comment.

1-4) Figure 1: The topographic map is too rough. You can use the model topographic data. In addition, it is better to add the sea topography, the name of the river location and bays, you mentioned in the manuscript (in Section 2.1). If you cannot use the model topographic data, JOCD website provides the 500m-meshed topographic data (https://www.jodc.go.jp/jodcweb/index_j.html).

➔ The name of rivers and bays and the locations have been added to Fig. 1 in the revised manuscript. The topographic map has now been drawn using the GEBCO bathymetry dataset used to generate model bathymetry in this study (https://gebco.net/data_and_products/gridded_bathymetry_data/) which has data at 15 arc-second intervals (~500 meters near the equator).

➔

1-5) There are too many figures of time-series. Some of them are repeated in this manuscript. For example, Fig. 3, 4, 5 and 6 show the same black bars indicating hourly precipitation. I recommend you combine some of them into one figure, especially for the observation figures. And if you do so, you can make the bigger figures, which becomes reader's friendly.

➔ Considering the reviewer's comment, the authors have combined eight figures in Figs. 4 and 11 into two figures. On the other hand, although the 16 figures in Figs. 3, 5, 6, 10, 12, 13 consisted of four figures originally (when we first submitted the manuscript last year), we had split them to make one figure for each site in the previously revised manuscript, following the editor's comment to ensure that the color schemes used allow readers with color vision deficiencies to correctly interpret our findings. Therefore, we would prefer to keep these figures as is. However, it was not necessary to put hourly precipitation data in all the figures, so we have deleted those from Figs. 4, 5(i)-(p), and 6(i)-(p) in the revised manuscript.

1-6) There are no x-axis titles in Fig. 3, 4, 5, 6, 10, 11, 12, 13, 14, 15.

→ Following the reviewer's comment, the authors have added x-axis titles of the form "Year/Month" in Figs. 3, 4, 5, 6, 10, 11, 12, 13, 14, 15, 16 of the revised manuscript.

1-7) The resolution of Figure 7 is low. It is difficult to identify the yellow character inside the figure.

→ Thank you for the comment. The figure has been revised appropriately. Also, one figure was not necessary, so it has been removed.

1-8) Table 1 : Please add the html addresses for GEBCO, Japan Meteorological Agency website, Ministry of the environment website, respectively.

➔ The html addresses of the three references have been added.

1-9) Table 3 : Are the days when omega in Hinase and Shizugawa in the simulation with RCP8.5 opposite (365 and 216)? Please check it.

➔ Thank you for the comment. The authors have recalculated and found the number was wrong although the model results shown in Figs. 14 and 15 were correct. Therefore, we have corrected the values in Table 3 and relevant sentences in the main text (Lines 407-420 in the revised manuscript). However, the modification does not affect the purport of this study.

1-10）The caption about DIC has been forgotten in Figure 5.

➔ Thank you for the comment. The caption about DIC has been added to Fig. 5 in the revised manuscript.

Chapter 1

1-11) In Chapter1, author explains the mechanisms how global warming occurs and ocean uptake carbon in the second and third paragraphs. I recommend you add the equation such as (CO2 + H2O -> H2CO3 etc) after the appropriate sentences (2nd and 4th paragraphs).

➔ Based on the comment, the following equation has been added to the revised manuscript (Line 49 in the revised manuscript):

$$CO_2 + H_2O \rightarrow H_2CO_3 \rightarrow HCO_3^- + H^+. \quad (1)$$

1-12) 4th paragraph: Is the word "CaCO3 saturation state (Ω) values" is general word?

→ The term "values" is not necessary, so has been deleted (Line 65 in the revised manuscript).

1-13) 5th and 10th paragraph: "① However, it is not clear when and where these effects occur in the ocean. Therefore to assess the acidification impact on commercially …… and evaluate the impacts on each species" "② Although the ecological effects of coastal warming, acidification…..clearer, when and how these effects will occur at oyster-farming sites are unknown." These are duplicated. I think you can delete one of them (①).

→ The authors have deleted ① in the revised manuscript. Thank you for the suggestion.

Section 2.1

1-14) The 4th paragraph can be deleted, judging from the contents and balance of the manuscript.

➔ We have deleted the paragraph following the reviewer's comment.

1-15) 5th paragraph: If you revise the figure, I recommend you to add the location name "Chikusa River", "Katakami Bay", "Genju bay", and "Hachiman River", respectively.

→ The location name has been added to Fig. 1 in the revised manuscript.

Section 2.4

1-16) 2nd paragraph: The model domain area can be shown in Figure 1 with observational sites.

➔ The model domain area has been shown in Fig. 1(b), (d) in the revised manuscript.

1-17) 3rd paragraph: Please add number in km for "15 arc-second".

➔ 15 arc-second corresponds to around 500 m, so this information has been added to Line 216 in the revised manuscript.

Section 2.4.1

1-18) Section 2.4.1 can be combined into Section 2.4, which results in deleting Section 2.4.1.

➔ Following the reviewer's comment the paragraph has been merged into Section 2.4 and Section 2.4.1 has been deleted (in Lines 220-225 in the revised manuscript).

Section 2.5 and Table 2, 3, and 16

1-19) I couldn't understand how the end date of the spawning season of pacific oysters with RCP 8.5 senario is determined, judging from your sentence in Section 2.5 "Pacific oysters reach sexual maturity when the accumulated water temperature reaches 600 degree based on a water temperature of 10 degree, and that at water temperatures of 20 degree or higher they spawn ocean and then mature and spawn again". Is it possible to find the end of the spawning day, although we cannot find the start day with RCP 8.5 senario in Sizugawa?

➔ The previous manuscript did not clearly describe the end of spawning assumed in this study. Therefore, the authors have added the following description in the revised manuscript (in Lines 231-233 in the revised manuscript): *"In this study, based on Oizumi et al. (1971), spawning was assumed to start when the accumulated water temperature reaches 600 (℃ day) based on a water temperature of 10 (℃) and to end when the water temperature drops below 20 (℃)."*

Section 3.1

1-20) Please correct typo "oin" in the 1st paragraph in Section 3.1.

→ Corrected ("*on August*") (in Line 247 in the revised manuscript). Thank you for the comment.

1-21) 2nd paragraph can be combined into the 1st paragraph.

→ Combined.

1-22) Please add figure numbers after your sentence, which makes more readers friendly.

➔ Following the comments, the authors have added figure numbers after sentences in the entire text.

1-23) 4th paragraphs: you write "a statistically significante relation between the rainfall and salinity was not idfentified" and "the relation between the salinity and rainfall was not statistically significant at any of the sites in Hinase and Shizugawa, and future studies are necessary". I think that the reason why you cannot find the significant relationship is because you compared the total records when you compared. Please try to analyze with some ingenuities. For example, comparison of the short-term data, individually. When we see the time-series of salinity and precession visually, we can see that they seemingly have some relationships.

➔ Based on the reviewer's helpful comment, the authors have checked the salinity and precipitation data again. As we have already found and the reviewer also pointed out, there was no significant relation found statistically. However, if we focused during the low-salinity and rainfall events, we found that rainfall does not always result in a significant decrease in salinity, but when there is a significant decrease in salinity, it always tends to be after rainfall events. Therefore, the authors have modified this paragraph by adding the information and rephrasing sentences in the previous manuscript (in Lines 270-274 in the revised manuscript).

1-24) 5th paragraph: Is there no figure we should see? If so, please add the sentence "not shown".

➔ Added (ine Line 276 in the revised manuscript).

Section 3.2

1-25) 1st paragraph: Please add some description about the horizontal distributions more.

➔ Some description has been added as follows (Lines 314-321 in the revised manuscript): "*The model successfully reproduced the spatio-temporal variations of each parameter in Hinase and Shizugawa (Figs. 8 and 9), such as significant seasonal fluctuation of water temperature (Figs. 8(a)-(d), 9(a)-(d)). The modeled salinity was relatively uniform in space and season. However, the salinity was lower in coastal regions in Hinase, especially near rivers in summer where and when freshwater discharge from rivers are dominant (Fig. 8(e)-(h)). The spatio-temporal variability was less in Shizugawa, although the seawater flowing into the bay is likely influenced by freshwater discharged from the Kitakami River, the fifth longest river in Japan (Fig. 9(e)-(h)). The modeled DO is in direct contract with water temperature, higher in winter and lower in summer (Figs. 8(i)-(l) and 9(i)-(l)), primarily caused by higher and lower solubility of oxygen in cooler and warmer water, respectively.*"

Section 4.2

1-26) 2nd sentence "Our model results imply that the number of … in Hinase will increase from .. to 365 days with the RCP8.5 scenario in the 2090s". Is this sentence correct? Please check it.

→ As mentioned above (1-9), the authors have recalculated and found that the values shown in the previous manuscript were incorrect. Therefore, we have corrected the numbers in Table 3 and in this sentence (Lines 407-412 in the revised manuscript). Again, the modification does not affect the purpose of this study and figures.

Section 5.1 and 5.2

1-27) These sections are written about the mitigation and adaption. I think that it may not include them in the scientific paper. I recommend you delete these sections.

→ These sections have deleted following the reviewer's comment.

Biogeosciences Discussions

Responses to Reviewer #2's comments

Thank you for all your comments that greatly helped us in improving our manuscript. We have revised and re-submitted our manuscript based upon all your comments. Most of the previous figures have also been revised following your and another reviewer's comments. The information about an English certificate in the previous manuscript has also been deleted in the revised manuscript.

(Line 170) The calculation of pH using CO2SYS requires the total boron concentration, bisulfate dissociation constant, and hydrogen fluoride dissociation constant in addition to the acid dissociation constant of Lueker et al. [2000] used by the authors. Please describe the values used here.

→ Thank you for the helpful comment. The authors have modified the relevant sentence by adding the necessary information as follows (in Lines 161-164 in the revised manuscript): *"The pH (total scale) values at the in situ temperatures were calculated from the carbonate dissociation constants in Lueker et al. (2000), the total boron concentration in Lee et al. (2010), the bisulfate dissociation constant in Dickson (1990), and the hydrogen fluoride dissociation constant in Perez and Fraga (1987), and temperature, salinity, TA, and DIC using CO2SYS (Pierrot et al., 2006)."*

(Figure 8 and 9) It is recommended to include isopleths in the figures, such as at intervals of 2 °C for water temperature. This inclusion can facilitate comprehension in individuals with color vision deficiencies.

→ Thank you for the comment. The authors have modified Figs. 8 and 9 accordingly.

(Figure 14 and 15) Modifying the range of the vertical axis would enhance the comprehension of seasonal variations and the distinctions between current and future projections. For instance, a range of 25-35 for salinity and 2000-2400 μmol kg-1 for TA would provide an adequate representation.
It is recommended to overlay Figure 14(g) and 15(g) with the respective current and predicted spawning periods shown in Figure 16 under each scenario. This visualization would facilitate readers' comprehension of the overlap between the extended spawning period and the period of low aragonite saturation. Additionally, the number of figures is too large and can be reduced by this aggregation.

→ Former Figs. 14 and 15 have been modified accordingly and former Fig. 16 has been deleted, based on the comment. However, to respond to another reviewer's major comment, the authors have added one figure (Fig. 14 in the revised manuscript). Therefore, former Figs. 14 and 15 have been renumbered as Figs. 15 and 16, respectively, and therefore, the total number of figures remained the same.