# Response to Referee #2

Dear Reviewer:

Thank you very much for your careful review and valuable comments. We have studied your comments carefully and tried our best to revise the manuscript. The point to point responses to your comments are listed as following:

**Introduction:**

**Question 1:** Information about the main circulation features and tidal dynamics of the coastal Liaodong Bay from the literature would be nice (for example the tide is semi-diurnal close to the coast according to Hao et al., 2005).

**Response 1:** Thank you for your kind suggestion on citation about the main circulation features and tidal dynamics of the coastal Liaodong Bay, we have added the related reference in the manuscript.

**Question 2:** But my main concern is that there is nearly no mention to the paper by Qiao et al. (2018), entitled "Numerical study of hydrodynamic and salinity transport process in Pink Beach wetlands of Liao River Estuary, China", which shares co-authors with this paper. In their paper, Qiao et al. apply the Mike unstructured mesh model to the Liao River Estuary. They focus on the hydrodynamic characteristics and salinity transport processes in Pink Beach wetland of the Liao River Estuary, considering the effect of wetland plant on tidal flow. In the present paper, the authors should emphasize what is new in their study (scenarios with and without the port). Why do they use FVCOM instead of MIKE, is there a reason? In their conclusion, the authors of the present paper mention (Page 19) that runoff increases can decrease salinity in estuary waters due to the dilution of freshwater. Is this result really new? In Qiao et al., Figure 20 shows contour maps of salinity in the LRE under different runoffs during the period of highest saltwater intrusion, and the authors conclude that "the larger the river discharge, the stronger the runoff diluting effect", and "when the river discharge is low, less freshwater is mixed into the system and salinity is higher". Page 4 Line 20 : Sources of data and where they can be downloaded should not be in the introduction but in the Method part.

**Response 2:** Thanks for reminding. In this paper, we want to explore the potential influence of anthropogenic activities (runoff decrease resulting from river closure projects and shoreline changes resulting from the port construction) on degradation of *Suaeda heteroptera* in tidal wetlands in the LRE. The work by Qiao et al (2018) is of great reference value to our work, the innovation in our study is scenarios simulation with and without the port. We applied FVCOM instead MIKE 21 model because we want to investigate the three-dimensional distribution of salinity in the LRE. In mike model, Qiao et al. discussed the influence of runoff decrease on salt intrusion, in this study, we analyzed the influence of shoreline changes on salt intrusion in LRE. According reference's suggestion, we have revised the relevant content in the manuscript.

**Model description:**

**Question 1:** It would be nice to have more details about the model equations and how they are

solved. At least mention that it is a 3D primitive equation model.

**Response 1:** Thank you for your advice. Due to the limitation of the paper, the model equation and the solution method will not be discussed in this manuscript, however we add more introduction about the 3D primitive equation model.

The FVCOM was adopted to simulate tidal flow and salinity in the LRE. It is a three-dimensional ocean model which was originally developed by Chen et al. (2003) and improved by researchers at the University of Massachusetts-Dartmouth (UMASSD) and Woods Hole Oceanographic Institution (WHOI) (Chen et al., 2006).

**Question 2: Page 6 Line 17: please add details about the vertical coordinates (sigma?) and provide reference.**

**2:** Thank you for reminding, we will add some details about the sigma coordinates.

FVCOM is originally coded for sigma-coordinates in the vertical direction (Chen et al., 2006), the application of terrain-following coordinates results in an improved capacity to solve complex bathymetric conditions (Haney, 1990).

**Question 3:** Page 7 Line 1: "other existing models". As many other models use terrain following (sigma) coordinates, what do you mean? Is it models that use z coordinates? You should be more precise here.

**3:** Thank you for your correction, we have corrected it in the manuscript.

The application of terrain-following coordinates results in an improved capacity to solve complex bathymetric conditions.

**Model configuration:**

**Question 1:** Model initialization and forcing need to be more detailed. Please give the model initial condition and the boundary conditions for the tides, or add a reference. Also, explain your choices for open boundary salinity of 34 PSU, initial temperature of 15°C, and river discharge scenarios (are values chosen from observation, literature?).

**Response 1:** Thank you for your suggestion. We have added more details about model initialization and forcings. The open boundary condition for salinity was set to 34 PSU at the sea surface which was obtained from an unpublished document and interpolated between 34 and 32 PSU along the sigma layers. Considering that the average water depth of the LRE is relatively small, variation of temperature in horizontal and vertical directions can be ignored, the initial temperature field was set to a uniform value 15 ℃ across the whole domain accordingly.

**Question 2:** Page 7 Line 11: Please provide a reference for surface water model system. As you do not use the acronym SMS after, do not use it here.

**Response 2:** Thank you for your advice. We have revised this part and added a reference in this manuscript.

**Question 3:** Page 7 Line 18: A reference for the Bohai Sea Parent Model validation would be nice.

**Response 3:** As a matter of fact, the Bohai Sea Parent Model mentioned in the paper was an unpublished work of ours. We established a tidal model for the Bohai Sea using the MIKE 21 hydrodynamic model. We will correct our statement about the Bohai Sea Parent Model and

provide more details about open boundary elevation in the manuscript.

**Question 4:** Page 9 Line 4: You could add "by taking into account the bias and correlation between model and observation" to the description of skill sentence.
**Response 4:** Thank you for your correction.

**Question 5:** Page 9 Line 11: you claim that "significant errors are observed between the simulated high and low tide levels and observed values". If this is from figure 4, it is not very clear to me. Also, T1 and T2 are very close to the boundary, what is the tidal forcing at the boundary? You explain the poorer fitting results at spring tide by the choice of open boundary conditions, so you may definitely give them in the model description/configuration part. It would be great to have this kind of comparison close to the LR, can we assume that there is no data there?
**Response 5:** The water elevation was chosen as the open boundary condition. What we want to express was that the cause of the simulation error was objectively related to the open boundary condition. We will make a more precise explanation in the manuscript.
Unfortunately, in this study area, only the observed data given in this paper are available during the simulated period, and no other data are available for model validation.

**Results and discussion:**
**Question 1: Page 12 Line 6: Why did you choose 50 hours for averaging?**
**Response 1:** We chosen an average salinity value of 50 hours to reflect the irregular semi-diurnal tidal characteristics of the LRE.

**Question 2: Page 17 Line 13-19: Figure 15 is not clear and should be reworked, as this part is not very clear for the moment.**
**Response 2:** Thank you for your advice. We will redraw Figure 15 and make it clear for reading. See fig.14.

**Question 3: Page 17 Line 13-19: Figure 15 is not clear and should be reworked, as this part is not very clear for the moment.**
**Response 3:** Thank you for your kind suggestion. We will adjust the relevant content in the manuscript. See fig.14.

**Question 4:** Page 18 Line 1-4: As this part deals with the effect of shoreline change on tidal flow, all the text beginning by "In summary" could be moved to the conclusion, or the link with salinity could be added in the subtitle.
**Response 4:** We mainly focus on residual flow analysis.

**Conclusions:**
**Question 1:** Page 18 Line 10: what is a well-validated model? Maybe you could use a term that refers to the robustness of the model ("proven model"?).
**Response 1:** We will delete the word 'well-validated'.

**Figures:**

**Figures 1 and 2** Could be merged to give the location of the area at first, and the names of big cities could be added (at least Dalian) to facilitate the reading by foreign scientists.
**Response:** Thank you for your suggestion, we have merged two figures into one, the big cities were added into this manuscript.
See fig. 1.

**Figure 2:** Blue triangles are not visible on the plot. Please add a Table with the coordinates of the stations.
**Response:** Thank you for your suggestion, we have revised this question, please see table 2.

**Figure 4:** It would be nice to have the amplitude and phase for the main tidal components for the comparison in an additional Table or in the text.
**Response:** The harmonic analysis was also performed in this study, the model results are in good agreement with the observations for the main component M2 in the two stations. Where the differences between the model and field data are smaller than 9 percent for the amplitude and 10 degrees for the phase.

**Figure 6:** Why did you choose the scale 18-24 PSU? Is it possible to zoom in?
**Response:** this problem has been revised.

**Figures 8 and 9:** Is it necessary to show both surface and bottom maps, as they look very similar? You do not comment the differences in the text so I suggest to remove bottom plots.
**Response:** Thank you for your suggetion, we have removed the bottom plots and replaced by vertical averaged plots.

**Figure 15:** This figure has to be reworked, as it is very hard to see anything, especially the direction of arrows. Perhaps reducing the number of arrows and zooming in areas of interest could help?
**Response:** Thank you very much for your careful advices about modifications of Figures 1, 2, 4, 6, 8, 9 and 15. We truly think your suggestions are very helpful and we will make relevant alterations to these figures.

**Minor comments and Typos:**
**Page 3 Line 14: What are ELCIRC and COAWST? Models?**
**Response:** This problem has been revised. The two models should be the Environmental Fluid Dynamics Code (EFDC) and the Coupled-Ocean-Atmosphere-Wave-Sediment Transport (COAWST).
**Page 7 Line 11: Please write "digital elevation model" instead of DEM.**
**Response:** this problem has been revised.

**Page 7 Line 12: "elements were respectively".**
**Response:** this problem has been revised.

**Page 8 Line 11-12: Delete Â n comprehensive model validation was performed using the**

**observation data", as it has already been said at Line 8.**
**Response:** this sentence has been deleted.

**Page 12 Line 23: Please write "Liaodong Bay" instead of LDB.**
**Response:** this problem has been revised.

**Page 15 Line 5: I suggest to replace "above" with "upstream".**
**Response:** thank your for your suggestion, we have replaced the word.

**Page 15 Line 5: Replace "Figure 12" by "Figure 13".**
**Response:** this problem has been revised.

**Page 17 Line 15: By "its", do you mean "the port"?**
**Response:** this problem has been revised.
Following the port establishment, ……

**Page 17 Line 19: Add "(not shown)" for the comparison of results at neap and spring tides.**
**Response:** this problem has been revised.

**Typos:**
**Page 2 Line 21: "to understand"**
**Page 8 Line 7: "In order to"**
**Page 9 Line 14: "Figure 5 and Figure 6"**
**Page 12 Line 7: "Figures"**
**Page 12 Line 9: "decreases"**
**Response:** thank you for your suggestion, this problems have been revised.

We sincerely appreciate your kind suggestions and corrections on our manuscript. The authors would like to revise this manuscript if reviewers have any other questions.
Sincerely
authors