

Response to Reviewer 1

Thank you very much for your excellent comments on our manuscript. We have carefully considered the comments and have modified the manuscript accordingly. The comments and detailed responses can be summarized as follows:

1 Comment: Water quality and aquatic ecology interact with each other. In the manuscript, MIKE21 was used to model the hydrology and water quality in lakes, and then these data were used for ecological model. This practice considered the effects of hydrology and water quality on ecology. However, the effects of ecology factors on hydrology and water quality were not considered. Why these effects are not considered?

Response:

MIKE 21 is a widely used model which includes many modules involving hydrodynamics, water quality and aquatic ecology. The water quality module in fact has been the effects of ecology factors on hydrology and water quality because we need input many water ecological parameters when we construct the model.

2 Comment: The manuscript attempts to couple environmental model and ecological model. In the manuscript, authors used environmental model (MIKE21) for hydrology and water quality, and then used these data obtained for ecology model (STELLA). However, the coupling process is not clearly described. More detailed description is required.

Response:

In section 2.4, we introduced the coupling process. As we use the box ecological model in each water area, the key of coupling process is identify Boundary conditions and movable state variables, which is described in detailed. Models coupling process is a pure physical process, which is described from equation (1) to equation (4).

3 Comment: At line 16 on Page 1698: Flow field distribution map was used to test the rationality of water areas zoning results. Where does the flow field distribution map come from?

Response:

The following sentence is added to clarify how the flow field distribution map is get:

Flow field distribution map generated by MIKE21 hydrodynamics model was used to test the rationality of water areas zoning results.

4 Comment: At line 18 on Page 1698: Zoning is one important highlight of the manuscript and authors thought that dividing the lake into four or five zones is suitable. I want to know why dividing lake into four or five zones is suitable? If we divide lake into more zones, I think the results will be more accurate.

Response:

We agree that the results will be more accurate if more zones are divided. However, we did not propose to divide the lake into more than 5 zones due to the following reasons:

1) The difficulty of models computation

The MIKE21 and STELLA models need to be run for each zone. In each model a series of parameters need to be calibrated, which requires substantial data and long computation time. All the zones are connected with each other. The increase of one zone will lead to substantial increase of computation time.

2) The difficulty of future lake management

In future lake management, different management measures need to be designed and implemented. More zones indicate more management work. In addition, if we divide the lake into 4-5 zones, the difference of physical and chemical characteristics among different zones will not be very significant. Thus, it is not quite necessary to further increase the zone number.

5 Comment: At line 1-3 on Page 1700: the manuscript made a hypothesis that all state variable concentrations and parameters in each compartment model were the

same. This is incomprehensible. One of the most important points of the manuscript is that space heterogeneity of hydrological and ecological parameters is considered. Why do you not consider space heterogeneity in this place? The state variable concentrations and parameters in these compartments are impossible to be the same.

Response:

We agree that it will be more accurate to consider the space heterogeneity within each zone. Most ecological models in existing integrating models regard the lake as a whole for analysis, i.e., considering the lake to be one well-mixed box. Such delineation is appropriate for small-scale shallow lakes. It is not sufficient to capture large spatial variations in hydrodynamics and constituent transport among different areas where the characteristics of soil, topography, water temperature, available nutrients and vegetation show spatial heterogeneity within middle-scale or large-scale lakes. This might exist a large margin of error.

In our research, we created a new ecological model which could take space heterogeneity into consideration. It constructs aquatic ecological model on the basis of aquatic ecological system characteristics in different water areas and flow field distribution. Be limited by technical condition, each ecological model is also a box ecological model, but we provide a new method and idea for future research, and we could further improve spatial resolution of the coupling models by more reasonable methods.

6 Comment: In Section 2.4, the connections between these water zones are considered. Equations 1-4 are used to handle the boundary conditions. Have these equations been used in former researches? If they have not been used before, authors need to show the derivation process to prove that the method is rational to be used here.

Response:

These four equations are all hydrodynamics equations, which are the basic equations in many hydrodynamics models. For example, MIKE21 model uses these equations when the model simulates hydrodynamics change for a study area. Some ecological

models also use these equations for simulation. For example, our former research has used these equations for ecological model constructing. We have added some references which you can gain more detailed information.

7 Comment: The language needs to be polished by a native speaker. For example, at line 21 on Page 1695, verb is missed in this sentence. At line 12 on Page 1696, “this” in this sentence is unclear.

Response:

We also realize the language problem. As suggested, we invited a professional English editor to polish the paper thoroughly. Accordingly the two sentences mentioned by the reviewer are changed to:

In fact, water quality and aquatic ecology interplay with each other, and it is essential to take both factors into consideration when constructing water environmental models.

Most ecological models in existing integrated models regard the lake as a whole for analysis, i.e., considering the lake as one well-mixed box (Wang and Mitsch, 2000; Jørgensen, 2010; Xu et al., 2013). Such delineation is appropriate for small-scale shallow lakes, but is not sufficient to capture large spatial variations in hydrodynamics and constituent transport among different areas where the characteristics of soil, topography, water temperature, available nutrients, and vegetation show spatial heterogeneity within middle-scale or large-scale lakes. The well-mixed box model might contain a large margin of error (Wang et al., 2012). It is essential to construct a lake ecological model that can simulate ecological change considering spatial variations.