“Flooding in the Mekong Delta: Impact of dyke systems on downstream hydrodynamics” by Vo Quoc Thanh et al.

Responses to Referee #2’s comments

Vo Quoc Thanh (t.vo@un-ihe.org, vqthanh07@gmail.com)

Dear Referee #2,

Thank you so much for taking time to review and comment. We will consider your comments to revising the manuscript. The following section is our responses to your comments.

Overview

The paper describes the effects of the high dykes structures on the complex interaction of the high flows and tides in Mekong Delta. The authors use 1D-2D model Delft3d Flexible Mesh model on unstructured grid to simulate the hydrodynamics at the river branches, canals and the adjacent ocean shelf with certain improvements compared to the previous studies done on Mekong Delta.

No major concerns about the language use, however the manuscript would benefit from the proofread by a native speaker. The research question is clearly stated and addressed in the Discussion section.

Authors’ response: Thank you so much for your suggestion.

The main concerns

The overall structure of the manuscript is sufficient, however the abundance of details (some of those are unnecessary in my opinion) makes it difficult to read. The modelling part of the study needs major revisions (see comments below). Moreover, the figures should be revised. Therefore, I suggest major revisions of content further on.

Authors’ response: Thank you for your suggestion. We will revise them.

General comments

Introduction*. This section is somewhat well-structured and clear, however some information which is repetitive or not directly related to the study objective should be removed. For instance, speaking of the soil quality or challenges in agriculture may confuse the reader in the beginning. One sentence should be enough for it.*

Authors’ response: Thank you for your suggestion. We will revise them.

Methods*. The following aspects need to be addressed:*

- *Input data. The authors use SRTM data to run the 2D part of the model. SRTM is known to have rather large vertical and horizontal errors, however, there is no overview related to the data pre-processing, resolution used and possible errors coming from the input data accuracy. Some of*

the simulated water level changes are far smaller than the vertical accuracies of the terrain and bathymetry data. This aspect should be deliberately described in the Methods and Discussion section. The following paper might be useful: Hawker, L. P., Rougier, J., Neal, J. C., Bates, P. D., Archer, L., & Yamazaki, D. (2018). Implications of simulating global digital elevation models for flood inundation studies. Water Resources Research, 54. https://doi.org/10.1029/2018WR023279.

Authors' response: We only use the SRTM data for the floodplains. The bathymetry of 2D part for rivers were extract from the 1D ISIS model. The floodplains of the Mekong Delta are flat (Tran and Weger, 2017). The floodplain topography only influence during high flow season when the floodplains are inundated. Another reason is that the SRTM data for the Mekong Delta was efficiently used to simulate flood inundation (e.g. Dung Duc Tran et al. 2017; Triet et al. 2017). Therefore, we believe that the SRTM data are efficient to simulate the floods in the Mekong Delta.

- *High dyke geometry should be described (design return period, crest elevation, precise location etc.) and how they were incorporated into the computational mesh.*

Authors' response: The dyke geometry is various, as presented in the Figure 4 in the manuscript. The dyke geometries depend on the canal network. According to the Department of Agriculture and Rural Development of An Giang province, the high dykes are built, with their crest levels are higher than the peak water level of the flood 2000. Thus a high dyke in computation is defined as 2D dry grids. This modelling approach of floodplains and canals is based on field observations, as presented in Figure 1 and Figure 2.

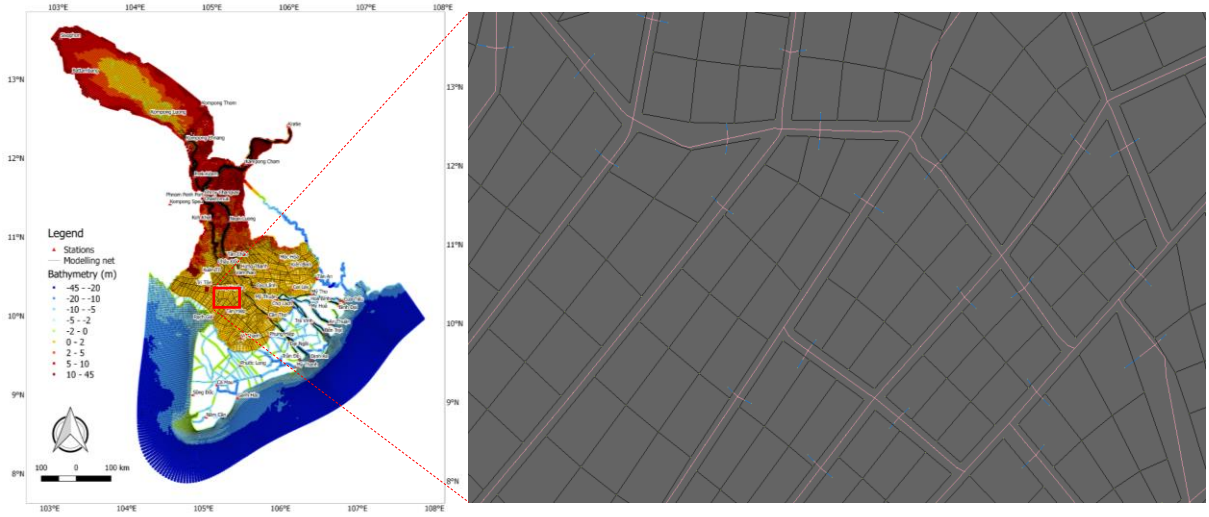

Figure 1. The modelling grid. The floodplains are defined as 2D grids (in black) and canals are defined as 1D networks (in pink). The connecting links of 1D network and 2D grids are in blue.

Figure 2. A high dyke and non/low dyke in An Giang province and their schematization in modelling. Photos by Vo Quoc Thanh 2012.

- *Simulation time, if possible, should be increased to more years. One year is not sufficient enough to track the system behaviour in given setting and may cause biases.*

Authors' response: As the literature review, the major factor influences seasonal variation of fluvial flows is the Tonle Sap Lake storage. This feature is considered by using initial conditions which is simulated water levels of the previous flood.

- *The authors mention and illustrate throughout the manuscript high dyke as both, a flood protection measure and a dyke protected floodplain at the same time. This causes ambiguity and should be further specified/changed.*

Authors' response: We will correct it.

- *More details about the developed scenarios need to be added (see the dyke geometry).*

Authors' response: We will add more information about the developed scenarios.

***Results**. The calibration/validation outcomes description should be substantially reduced, as it overloads the section. Computational time should be mentioned.*

Authors' response: Thank you. We will revise it.

***Discussion**. I would recommend restructuring the discussion by answering the research questions in the same order as outlined in the Introduction section. It should be pointed out how the study benefited from using 2D code compared to 1D (MIKE11 or ISIS). The limitations related to data and methods used have to be put in a separate sub-section.*

Authors' response: Thank you for recommendations. We will revise it.

***Conclusion**. Implications and future work should be added.*

Authors' response: Thank you for recommendations. We will revise it.

***Figures**. Geographical names and symbols should be consistent throughout the manuscript.*

Authors' response: Thank you for recommendations. We will correct them.

P.2 line 17 – the sea level rise and land subsidence is an important point in the study area, the data about the future projections can be mentioned. However, it is important to point out why they are not considered in the paper (complexity, uncertainty, etc.).

Authors' response: Thank you for comments. We will revise it.

P.3 line 4 – sentence "These outcomes… " belongs to Conclusion

P.3 line 15- Figure 4 comes right after Figure 1

P.4 line 3 – the reference seems to be outdated

P.4 line 12 – return period of the event should be specified

P.4 line 14 – sentence "The water…" is ambiguous

P.4 line 31 – units should be specified

Authors' response: Thank you for comments. We will correct them.

P.7 line 21 - the grid density is mentioned to be sufficient, however the grid cell sizes seem to be quite large in fact. It would be useful to have some more explanation for the readers who are not familiar with Delft3DFM model.

Authors' response: Thank you for comments. We will revise it.

P.7 line 32 – floodplain bathymetry topography

Authors' response: Thank you for comments. We will correct it.

Table 1 can be removed

Authors' response: Thank you for comments. We will correct it.

Figure 1. The map is hard to read. I would recommend changing the following: reduce thickness of canal network, make the flood zones boundaries and fill more pronounced. The outline of municipalities (the faded orange line) should be removed. It is better to avoid overlap of green and red colours if possible

Authors' response: Thank you for suggestion. We will edit the figure.

Figure 2 and 3. What is meant here by high dykes? Dyke protected floodplains or flood defence? Should be clearly stated. Is there a way to combine two figures in one or incorporate in the Figure 4?

Authors' response: We will clarify. The figure 2 and 3 present floodplain areas protected by high dykes until 2011.

Figure 4. One of the north arrows should be removed. Region boundaries are not visible

Authors' response: Thank you for comments. We will correct it.

Figure 7. Everything that is above the sea-level (0m a.s.l.) is topography

Authors' response: Thank you for comments. We will correct it.

Figure 8 and 9. In legend the sign ">=" should be corrected

Authors' response: Thank you for comments. We will correct it.

Figure 10 and 11. The legend which specified the thickness of red arrows should be added

Authors' response: Thank you for comments. We will correct it.

References

Tran, D. D. and Weger, J.: Barriers to implementing irrigation and drainage policies in An Giang Province, Mekong Delta, Vietnam, Irrig. Drain., doi:10.1002/ird.2172, 2017.

Tran, D. D., van Halsema, G., Hellegers, P. J. G. J., Phi Hoang, L., Quang Tran, T., Kummu, M. and Ludwig, F.: Assessing impacts of dike construction on the flood dynamics in the Mekong Delta, Hydrol. Earth Syst. Sci. Discuss., 22, 1875–1896, doi:10.5194/hess-2017-141, 2017.

Triet, N. V. K., Dung, N. V., Fujii, H., Kummu, M., Merz, B. and Apel, H.: Has dyke development in the Vietnamese Mekong Delta shifted flood hazard downstream?, Hydrol. Earth Syst. Sci., 21(8), 3991–4010, doi:10.5194/hess-21-3991-2017, 2017.