Dung Duc Tran et al. Assessing impacts of dike construction on the flood dynamics in the Mekong Delta

Responses to Reviewer#2 comments

By Dung Duc Tran

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General comment: This paper is about assessing the impacts of dike construction on the flood dynamics in the Mekong Delta. This is an interesting topic, because the number of floods in this region is increasing. However, several aspects in this paper have to be thoroughly revised because it can be published. This is explained below. Therefore, I recommend a major revision before this paper can be published.

Response: We highly appreciate Reviewer#2 for the dedicated reviews and valuable comments on the manuscript. We will address all your comments and substantially revise the manuscript accordingly. Our revisions are described in detail below.

1. Comment Readability: The paper is not to-the-point. This paper is about a 1D-hydrodynamic model that has been calibrated and validated for floods in 2011 and 2013. However, the introduction in Chapter 1 is very long and contains many aspects that are not relevant for this study. The same holds for Chapter 2. Also the discussion in Chapter 5 is much too long and should be made to the-point. Please rewrite Chapters 1 to 6 in a to-the-point way, so that the number of pages will reduce significantly.

Response: We will shorten and rewrite the Chapters in to-the-point way in the revised manuscript as suggested by the reviewer.

2. Comment Description of model set-up: A crucial aspect is the flooding in cross-sectional direction in this 1D model. A quasi-2D approach is applied for the flood plains. This is explained very briefly and should be explained in detail, because it has a large impact on the model results.

Response: We agree with Reviewer#2 to describe more about the methodology of quasi-2D approach in the revised manuscript. We will add and revise text to explain more about the methodology and model technicalities. In addition, an additional figure (Figure S5) will be added to the Supplement 5 to illustrate the quasi-2D modelling method.

Added text: "*The 2D-quasi approach is combined with 1D modelling to simulate the hydraulic dynamics in the floodplains. In the quasi-2D model, the floodplains are described as a network of fictitious river branches and spills with the main rivers. The advantages of the approach include i) transferring characteristics of 2D flow calculations, flow directions into 1D hydrological model; ii) saving computation time due to less requirements on data input; and iii) representing the reliable physical processes in the model (Karl-Erich et al., 2008; Soumendra et al., 2010)*".

Revised text:

"Floodplains in Cambodia and Vietnam deltas were modelled using two different approaches. The Cambodia floodplain without channels and dikes is simulated by the wide cross-sections using the 1D method. The quasi-2D approach was applied to formulate the hydrodynamic interactions between floodplains, and rivers under dike construction scenarios in the LXQ. Although the Plain of Reeds was not itself the focus of this research, it was also included in the model with the constructed dike in 2011 because there are important hydraulic interactions between the Tien and the Hau Rivers through the Vam Nao River and their tributaries. In these floodplains, there are multitudes of compartments enclosed by dikes and channels. Therefore, each compartment was considered as a flood cell modelled by fictitious river branches with low and wide cross sections extracted from the digital elevation model (DEM) with 90mx90m resolution. These fictitious river branches were linked to real channels by the control structures. Weirs represented dikes and overflows, whereas the dike's height was adjusted by changing the sill-level of control structures. The approach referenced from Dung et al., (2011) is illustrated in Figure S5 in the Supplement."

Supplemen 5 and Figure S5:

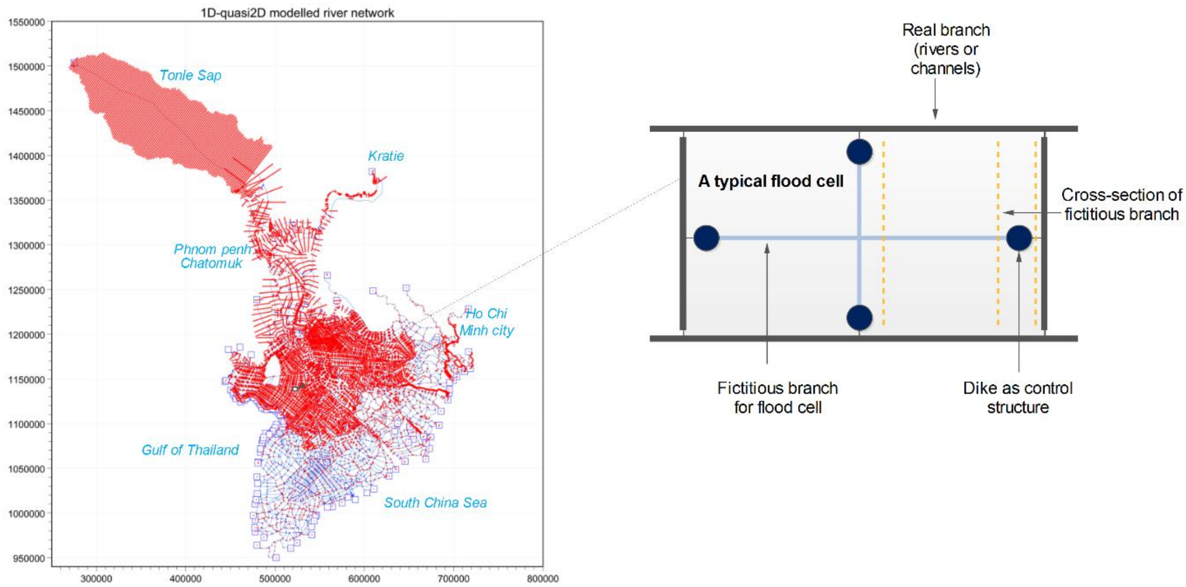

Figure S5: The left figure describes the 1D-quasi2D modelled river network of the VMD and the right figure show a representative typical floodplain compartment. The approach is based on Dung et al., (2011)

3. Comment Lack of validation data: In the abstract and in the conclusions is stated that there is a lack of validation data. However, in Section 3.2 is stated that hourly discharge and water levels are available at 15 locations, of which four locations are even in floodplains. This is a nice validation set. So, there seems to be no lack of validation data.

Response: We agree with Reviewer#2 about this point. We did not mean there is a lack of data for simulation and calibration for different locations on the main rivers, but we expected having more data in the floodplain of Cambodia and the downstream part of VMD floodplain. This would have helped us to validate the model performance in these areas as well as to improve accuracy in water balance calculations.

4. Comment Presentation of model results: One expects figures with time series of water levels and discharges that contain both numerical results and measurements. However, such plots are missing. Therefore, a reader does not have any insight whether the time behavior of the floods is simulated accurately. Instead, correlation numbers and maximum high water are presented in the figures. However, this is of secondary importance. The authors are strongly advised to add several time history figures with computed and measured results.

Response: We will add time-series of computed and measured water and discharges for several representative stations (Figure 3) in the revised manuscript. Besides, the Q-Q plots and time-series plots of all stations are presented in the Supplement.

Added Figure:

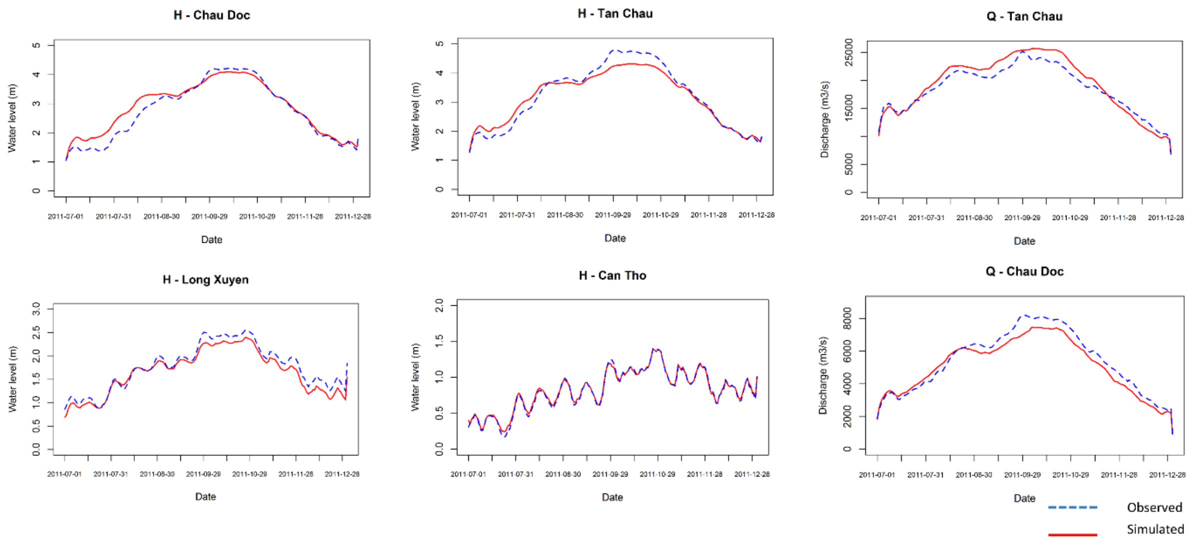

Figure 3: Time series of simulated and observed flows in 2011 at representative stations

In Supplement:

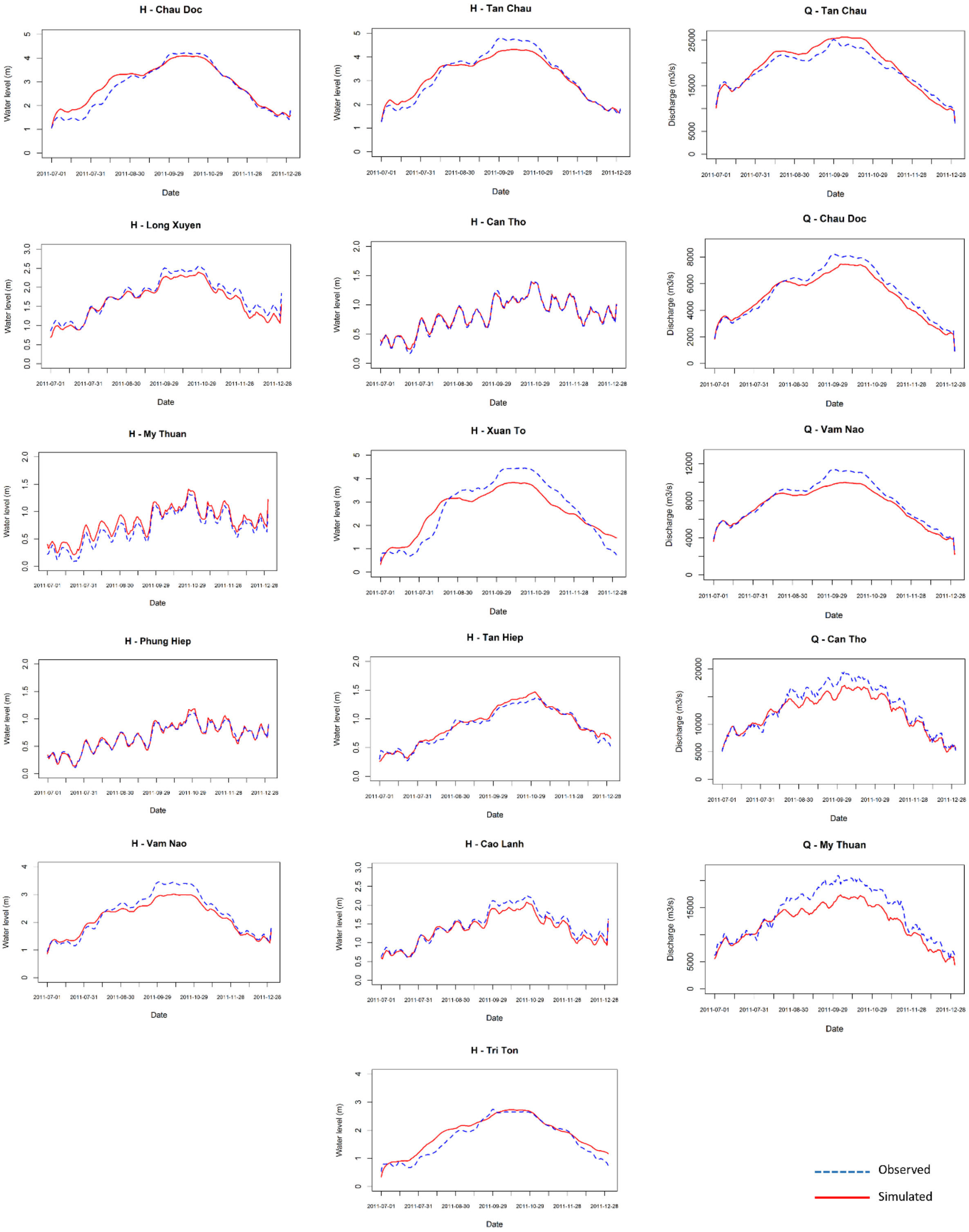

Figure S2: Time-series of daily simulated and observed flows in 2011 at all stations used for model calibration

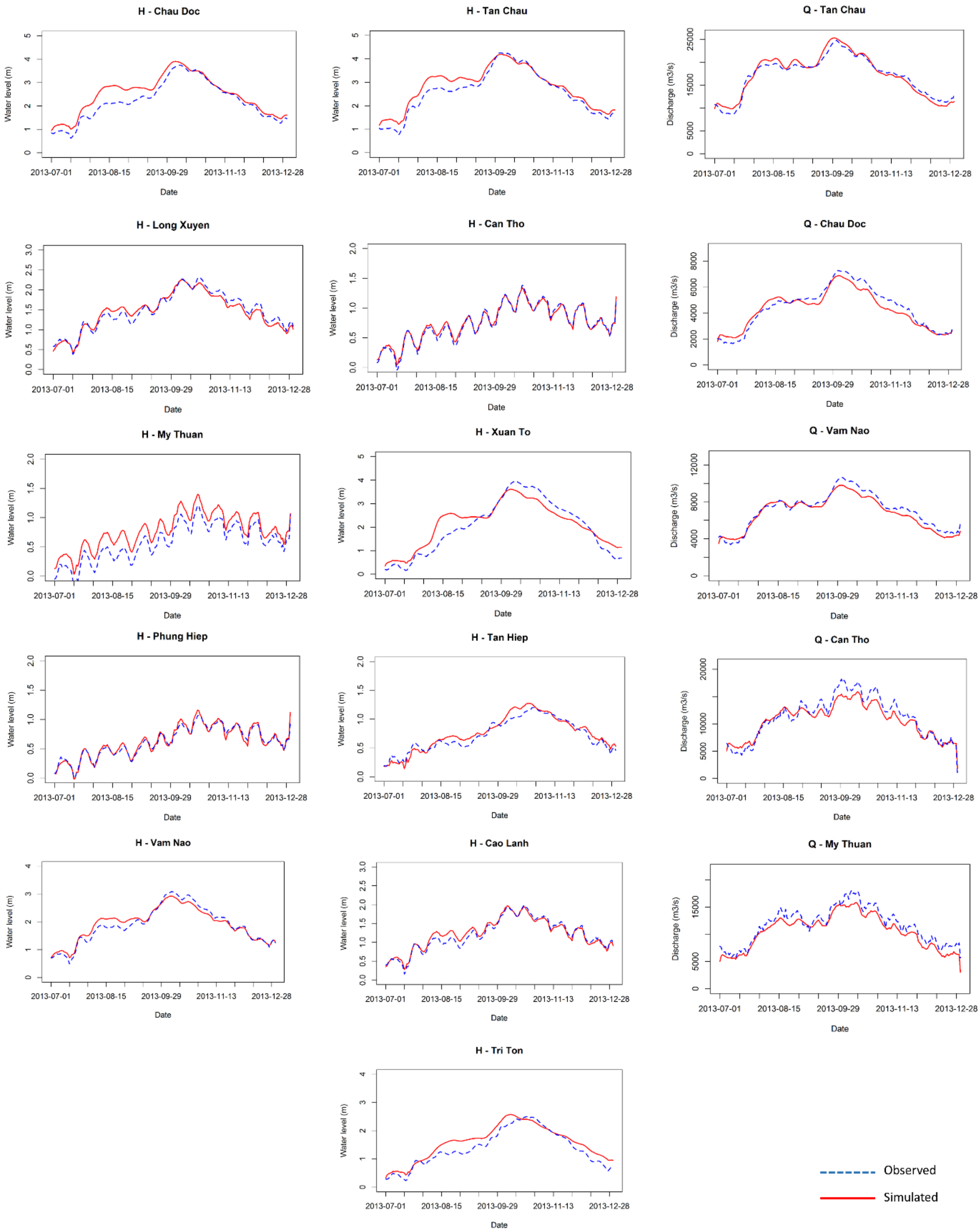

Figure S3: Time-series of daily simulated and observed flows in 2013 at all stations used for model calibration

5. Comment Description of dykes: Please clarify the differences between the dyke types (semi-dyke, August dike, high dyke) that are mentioned in this paper.

Response: In the revised version of the manuscript, we will clarify differences between the semi-dike and high-dike in the Section 2 (last paragraph). The differences between these two dike types were also described in the original manuscript, however in the revision we will move the explanation forward in the revised version to help readers understand these types of dike. In addition, we will change “semi-dike” into “low-dike” to help reader understand the term. We will also use the term throughout the manuscript, instead of using “August dike” at some points in the text.

6. Comment Hinge response: What is a hinge response? Please clarify.

Response: With the Hinge response we want to explain the differences of model results in water level variability between upstream and downstream locations. Water level fluctuations are much higher upstream compared to downstream locations. However, we realize based on the reviews that the use of the term “hinge response” is confusing; therefore, in the revised version of the paper we will not use the term “hinge response” anymore. We will also rename this term in Section 4.

7. Comment What is new in this paper? In the discussion (P. 21) is stated that the results are consistent with earlier studies with 1D hydrodynamic models. What is new in this paper? Please add the references of the other studies.

Response:

We thank reviewer#2 for his/her suggestions on strengthening the paper’s innovation and contribution to current knowledge body. Our study’s main innovation and contributions are in assessing changes in floodwater regimes and flow volumes under multiple dike construction scenarios and in adding the water balance component to our modelling analyses. While many previous studies focused on assessing impacts of historic dike developments (Duong et al., 2014; Hoa et al., 2007; Tri et al., 2012), we present one of the first study assessing possible impacts of future dike developments in the Mekong Delta. In addition, our water balance analyses help to better understand the mechanisms of changing flood dynamics due to dike construction. To the best of our knowledge, there are no previous studies reporting results on water balance analyses. Although we agree that our main results are consistent with previous studies, we think that our findings for future dikes development impacts and water balance calculation represent important new contributions. We will revise the result and discussion sections to better highlight these aspects in the manuscript.

8. Comment Validation for 2000 flood. Suddenly in the paper the authors start with a validation of the 2000 flood. The results are not very accurate because the geometry of the Mekong Delta was somewhat different in 2000. What is the purpose of this validation? Should this be left out?

Response: We agree with Reviewer#2 on differences between the Mekong Delta geometry in different time periods, however we would like to clarify that we do not intend to use the 2000 flood for model validation. We calibrated the model with the 2011 flood and the 2013 flood was used for model validation. We used the flood of 2000 to understand how the model behaves using the historical extreme flood hydrograph in this year. This was done for two main reasons. First, the 2000 flood is one of the major floods happened in the year when very few high-dikes for triple rice production existed in the floodplains. We therefore assumed S1 (the baseline scenario without any high-dike compartment), as similar to as the physical conditions in 2000, to compare the dike impacts with other large-scale dike construction scenarios (S2, S3, and S4). Second, we aim to explore how the model handles the correlation between upstream and downstream water levels (Tan Chau and Can Tho) in the 2000 and 2011 when the boundary conditions of the 2000 flood were put into the model with existing conditions in 2011. Due to abovementioned reasons, we would like to include the 2000 flood for the comparisons in the manuscript.

9. Comment Accuracy of model results. In the discussion (P. 25) is stated that the model results are in line with other studies with 1D model, but that that 2D (and possible) 3D modeling is required for an in-depth understanding of the flood behavior in the Mekong Delta. In other words, do the authors conclude that 1D modeling with a quasi-2D approach for flooding is not suitable for this?

Response: It is clear that our model with 1D-quasi2D approach could simulate peak water levels in the dike scenarios of the floodplains, based on good model fitness of calibration and validation results. However, the quasi-2D was just applied to simulate the floodwater interactions mainly for the floodplains of Plain of Reeds and Long Xuyen Quadrangle instead of the context of whole Mekong Delta. We think that the model results could become more accurate if 2D or 3D models will be used for solving complex interactions in the floodplains with the whole river system. Although we acknowledge the potential added values of such 2D and 3D approach, at the moment it is very difficult to pursue such modelling exercise for the whole Mekong Delta due to limited data availability and high computational demands.

Reference

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