Response to comments

We thank all referees and editors for their important advices. Based on the new comments, we make a revision, hope it will improve our manuscript. A point-by-point responses to the comments are marked in blue and presented following.

Referee 1

1. **The innovation of this paper still shows somehow weakness. The methods and modelling work seem sound but it's still not clear what this paper would like to convey in a scientific sense; in addition, it is not clear what research questions have been answered. It's not a simply first time of study on levee breach flooding and rainstorm induced flooding (many papers have studied on combined consequence of the fluvial and pluvial flooding). The levee breach flooding is caused by high water level in the river in this case. The authors should examine the high water level is contributed by high runoff from upstream or high tide level coming from the estuary, or the combination. I think the 'introduction' part should be largely improved.**

   Thank you very much for your comments. This manuscript mainly focused on simulating and verifying the hydrodynamic process of the levee breach-induced flooding and the rainfall-runoff. Although many previous articles have paid attention to the occurrence probability and impact of levee breach flooding and rainstorm-induced flooding, there are few articles that verify the results based on historical events. Therefore, to deeper digging the dynamic multiple flooding processes, in this manuscript, a real-life case of historical flooding events has been adequately investigated. Our results not only provide a comprehensive view of the spatial patterns of the flood evolution but also verifies the model.

   We have stressed more the novelty of this paper in the Introduction (**Line 59**)

   "In addition, the co-occurrence or subsequent occurrence of multiple flood drivers such as coastal high tide, storm surge, extreme precipitation, and high river flow resulting in large runoff may cause compound flooding. The compound effect is much greater than the effect of individual flood events (Wahl et al., 2015; Ghanbari et al. 2021). For instance, typhoon Fitow in 2013 brought torrential rain and caused high storm surges, resulting in record-breaking riverine water levels in the upstream region of the Huangpu River, Shanghai, China. As a result, the floodwall along the upstream Qianbujing Creek could not withstand the high water level, leading to a breach in a 15-m long section at 14:30 on 8 Oct 2013. Although the broken section was repaired after about 8 hours, the levee breach combined with heavy precipitation resulted in extensive flood inundation in the rural areas.

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   The above studies contributed significantly to the modeling and evaluation of dike failure-induced flooding, as well as compound flood risk. However, most previous studies have paid attention to the occurrence probability and final impact of compound flooding, but few of them investigated the complete compound dynamic hydrological process of these extreme cases. Moreover, historical compound flooding events were not adequately investigated in previous

articles, these real-life cases play an important role to demonstrate the feasibility and robustness of study results. To address the research gaps, this case study seeks to examine the changing nature of levee breach-induced compound flooding. A 2D hydro-inundation model Floodmap is used to simulate the process of the compound flood event that occurred in Qianbujing Creek to improve our understanding of the evolution of flood inundation. The results of the approach are validated by field measurements, including the inundation depth and the flood extent over time. The findings can provide support for decision-makers to develop flood adaptation measures."

2. **I suggest not mention compound effects, use 'dynamic multiple (or combined) flooding processes' instead. The compound flooding process is caused by the interaction of multiple physical or human-being induced drivers. While in this paper the levee breach flooding is the same cause of heavy rain which causes high runoff (and water stage) in the river during typhoon.**

   Thanks for your suggestion, compound flooding refers to a phenomenon in which two or more flooding sources occur simultaneously or subsequently within a short period of time. actually, the compound flooding process mentioned in our manuscript were caused by high precipitation, and high river flow. Typhoon Fitow in 2013 brought torrential rain and caused high storm surges, resulting in record-breaking riverine water levels in the upstream region of the Huangpu River, Shanghai, China (Line 62). So that the interaction among these flood drivers caused a compound flood event.

3. **refer to the answers to the major comment (3), what are the differences of formation mechanism of inundation in rainstorm flooding and fluvial flooding separately? please explain it in details in the text.**

   Thanks for noting us, we have added the further explain in the text (**Line 359**)

   Interestingly, there are differences in the sensitivity to the roughness before and after the levee breach for the flood inundation extent. The inundation area increases as the roughness rise during the rainstorm. However, the inundation area decreases slightly with the growth of the n value during the levee breach when the river flow is the major cause of the flooding. As a result, the rainfall is more likely to cause ponding with high roughness, as it drops the flow velocity. Whereas, when the river flow is the main force, the decline of roughness value leads to an increase in flood velocity which accelerates the spread of flood. These results demonstrate the sensitivity of the model to the roughness.

4. **Refer to the answers to the minor comment (7), there is an assumption of sudden collapse of levee breach during the breaching process. I suggest the authors should mention it and explain it in the section 2.3.**

Thanks for noting us, we have added the explain in the section 2.3.(**Line 191**)

"Due to the model cannot change the topography boundary during the running time, so we control the levee height by changing the relative water level, namely before the levee breach, the relative water level is 0 because there was no flooding, while during the levee breaching period, the relative water level is the historical river water level, so that the flood spread from the breach section."

Referee 2

5. **I still have several comments and would suggest the authors to make a minor revision. Title of the paper is not well worded. I would suggest the authors to consider "Modeling of a compound flood induced by the levee breach at Qianbujing Creek, Shanghai during Typhoon Fitow".**
I don't think it is necessary to use quotation marks for Fitow.

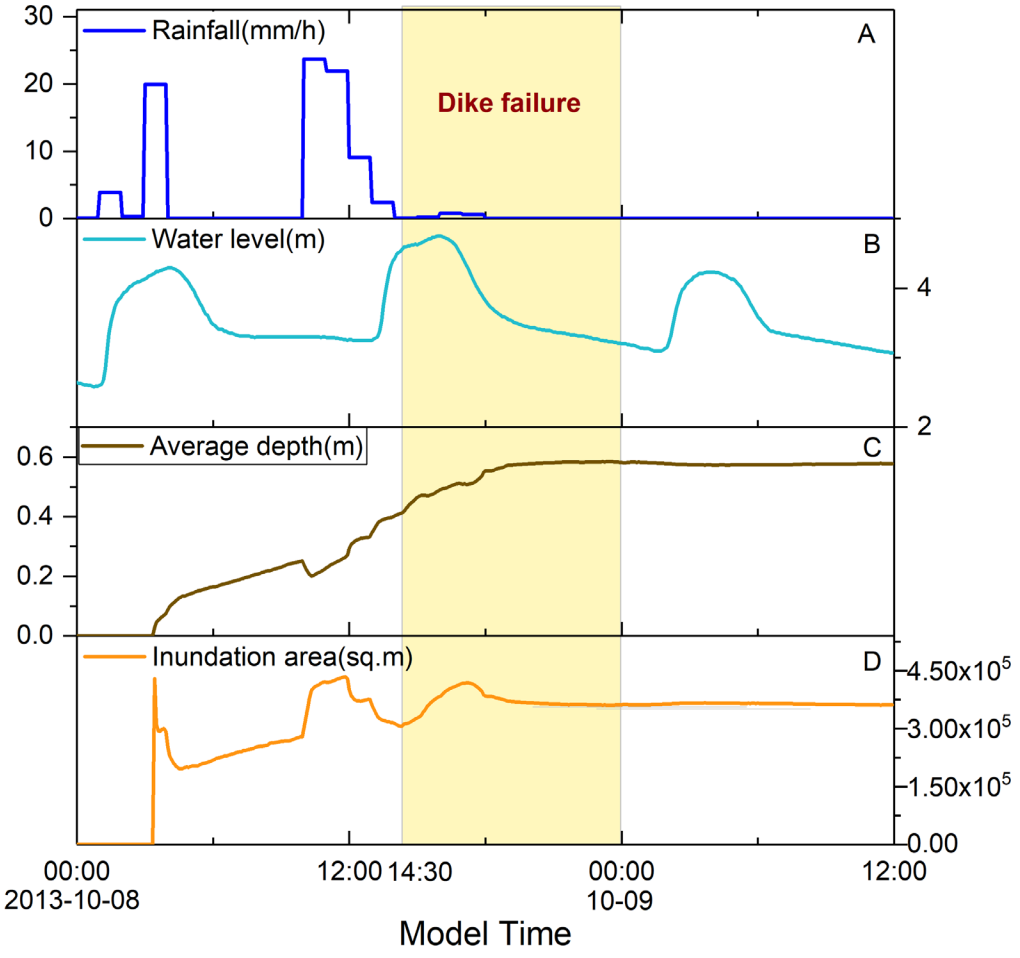
Thank you very much for your suggestion, the title has been changed as below:
"Modeling of a compound flood induced by the levee breach at Qianbujing Creek, Shanghai during Typhoon Fitow"

6. **In 2.2.1, a DSM of 6m resolution is the original data source of elevation of the study area. I suppose the 6m is horizontal resolution. Then how is the resolution at vertical direction? I mean if your elevation data has only one-meter vertical resolution, you are not able to model the precise inundation less than 1m.**
Thanks for noting us, the vertical resolution was 0.1-0.2m, we have added the description as below (**Line 127**):
"we use a high resolution digital surface model (DSM) with 6-m horizontal resolution, 0.1-0.2m vertical resolution"

7. **Figure 2 curves are repeated in figure 5. I think you can delete figure 2, and you better improve figure 5. You may consider re-edit figure 5 similar to the style and layout of the "Figure 4 in Zhang, et al., 2011" https://www.pnas.org/content/108/42/17296**

Thank you very much for your suggestion, we have improved figure 5 and deleted figure 2 (**Line 528**)

We also revised the format of figure 6,7a,7b, please find them in Supplement



8. Section 4, the heading shall be "Discussion and conclusion". It is often discussion first then make conclusions.

Thanks for your comments, we have changed the structure of manuscript according to the content, section 3 is changed as "Results and Discussion" and section 4 is changed as "Conclusion"

9. Still the language is not of good quality, with many uncommon wording and sentence structures. Some sentences are very long. It is certainly necessary to further improve this.

We feel sorry for the language problems in manuscript. We have revised the whole manuscript with the assistance from a colleague whose English is good. The revised version should be more readable.