Response to Referee #5

The authors would like to thank the Anonymous Referee #5 for the insightful and constructive comments. We have reviewed the comments and provided our responses herein. We truly believe that the changes suggested by Referee #5 will enhance the quality of the manuscript. A point-by-point response is presented below.

R1: Overall, this study is innovative to combine FLUS model with LISFLOOD-FP model to predict future flood in Shanghai. I have the following doubt: In the part of data and methodology, it is not clear to understand the data of storm surge and sea level rise. What is the time resolution (which year) and spatial resolution of the Global Tide and Surge Reanalysis (GTSR) dataset? Can you show some details/maps of GTSR in Shanghai? What is the predicted sea level in Shanghai in 2030 and 2050?

A1: Thank you for your comments. GTSR (Global Tide and Surge Reanalysis) is the global reanalysis of storm surges and extreme water levels simulated using hydrodynamic models based on water levels from global tide stations from 1979-2016, with the resulting data being **vector data covering the global coastline. Figure 1 shows some of the GTSR data used in our study.** The data contributors published it on the 4TU ResearchData in 2016 (http://data.4tu.nl/), and the data is widely used in worldwide.

The sea level rise data for 2030 and 2050 are the projected sea level rise data under the RCP future scenarios. Because there are also data such as land subsidence applied to the Lisflood-FP model (sections 3.3), we have explained this in the Line 201-203 of the manuscript.

We have added the above explanation in the corresponding section of the revised manuscript, and thank you again for your suggestions.

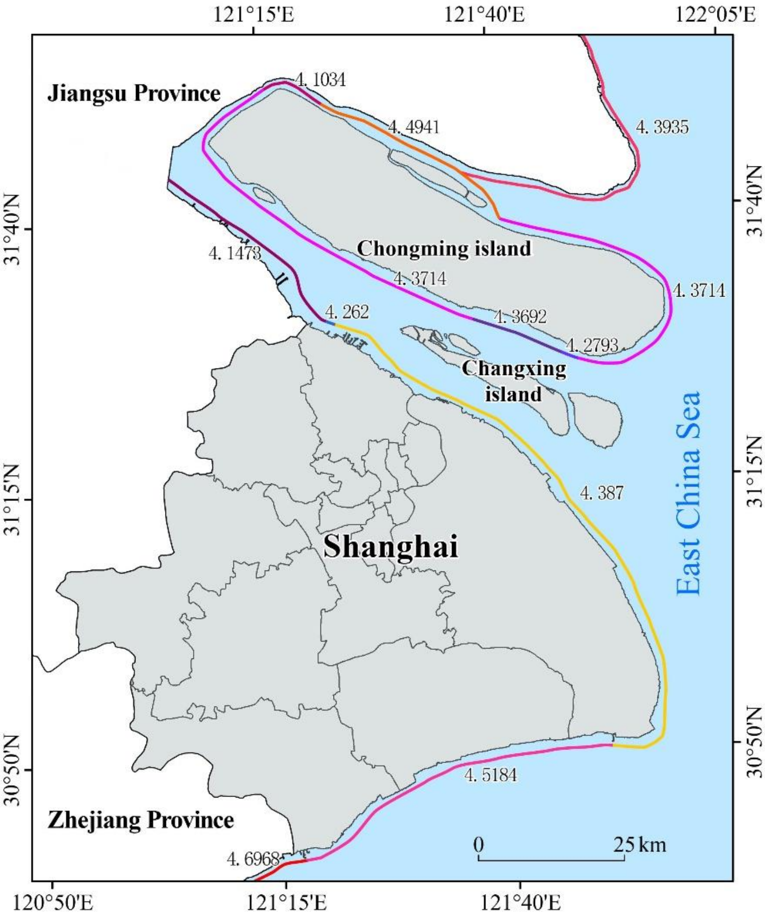

Figure 1. Visualization of GTSR data in Shanghai

R2: Question for line 180-181: What are the predicted river water level in Shanghai for 50-year return period under the RCP2.6 scenario and 100-year return period under the RCP8.5 scenario? River water level under extreme scenario is important to help the readers to understand the extreme flooding situation in Shanghai.

A2: Thank you for your comments. The river water levels predicted in this study are referred to the article on Shanghai flood published by Yin et al. (2020) on *Earth's Future*. In this study, the river levels selected for the 50-year return period under RCP2.6 and 100-year return period under RCP8.5 are 5.87 m and 6.04 m, respectively. Meanwhile, the explanations have been added in the corresponding section of the revised manuscript after discussion by the research team.

[1] Yin, J., Jonkman, S., Lin, N., Yu, D., Aerts, J., Wilby, R., Pan, M., Wood, E., Bricker, J., Ke,

Q., Zeng, Z., Zhao, Q., Ge, J. and Wang, J.: Flood Risks in Sinking Delta Cities: Time for a Reevaluation?, Earth's Future, 8(8), doi:10.1029/2020EF001614, 2020.

R3: To be honest, I am not familiar with the LISFLOOD-FP model. However, according to the introduction by the University of Bristol, the model is to simulate the propagation of flood waves along river channels and across floodplains. Considering that Chongming Island is surrounded by the sea, I suspect that this model is not applicable to Chongming Island.

A3: Thank you for your comments. LISFLOOD-FP is a 2D hydrodynamic model capable of simulating the amount of discharge between cells. Bates et al. (2005) extended the model's capability to apply it to coastal floodplain inundation. Hence, the model can simulate the dynamic propagation of flood waves over fluvial, coastal and estuarine floodplains (http://www.bris.ac.uk/geography/research/hydrology/models/lisflood/), and have been widely used for flood simulation in many coastal areas around the world. For example, Purvis et al (2008) used LISFLOOD-FP to simulate the risk of extreme coastal flooding due to sea level rise in coastal cities in southwest England; Irawan et al (2021) used LISFLOOD-FP to simulate extreme coastal storm flooding in Jakarta, Indonesia; Karamouz et al (2019) used LISFLOOD-FP to simulate flood inundation in the New York Brooklyn area flood inundation, which is an area surrounded by the sea in its entirety. And in our study Chongming Island region was also mainly simulated for coastal storm flooding. In addition, Bates et al (2021) used LISFLOOD-FP as the core model to simulate combined river, storm surge, and rainfall floods throughout the United States under current and future climate conditions. **Thus, related studies demonstrate that the LISFLOOD-FP model performs well in simulating extreme coastal storm floods and that the LISFLOOD-FP model is not influenced by regional geographic location.**

[1] Purvis M J, Bates P D, Hayes C M: A probabilistic methodology to estimate future coastal flood risk due to sea level rise, Coastal Engineering, 55(12): 1062-1073, 2008.

[2] Irawan A M, Marfai M A, Munawar, et al: Comparison between averaged and localised

subsidence measurements for coastal floods projection in 2050 Semarang, Indonesia, Urban Climate, 35: 100760, 2021.
[3] Karamouz M, Fereshtehpour M: Modeling DEM errors in coastal flood inundation and damages: A spatial nonstationary approach, Water Resources Research, 55(8): 6606-6624, 2019.
[4] Bates P D, Quinn N, Sampson C, et al: Combined modelling of US fluvial, pluvial and coastal flood hazard under current and future climates, Water Resources Research, 57(2): e2020WR028673, 2021.

R4: Following the question 3, from 2006 to 2020, according to the BULLETIN OF FLOOD AND DROUGHT DISASTER IN CHINA (http://www.mwr.gov.cn/sj/#tjgb), flooded cropland area was decreasing even though the decreasing trend was not significant, which should be related to the construction of water conservancy facilities, and flood control through dams and reservoirs in the upper stream. In this study, Chongming island is predicted to be almost drowned in 2030 and 2050, which I think it is not consistent to the flooded area data published by Ministry of Water Resources of the People's Republic of China. Please check the applicability of LISFLOOD-FP model for Chongming Island.

A4: Thank you for your comments. After reading the BULLETIN OF FLOOD AND DROUGHT DISASTER IN CHINA, I found that it focuses on inundation caused by rainfall and flooding of rivers and lakes in China, but less on storm surge flooding. According to Chongming Yearbook, Chongming is mainly affected by typhoons and coastal storm surges, and there have been many major historical storm surge disasters since the 1990s. The most severe were the storm surge floods caused by Typhoon "Prapiroon" in 2000 and the extreme storm floods caused by Typhoon "Fitow" in 2013, which caused severe damage to crops and residential properties.

Our manuscript focuses on simulating flooding caused by extreme coastal storm surges in the Chongming Island and predicts future extreme storm surge flooding under climatic and non-climatic (land subsidence) influences. **In response to the reviewer's questions, we rechecked the parameters of the LISFLOOD-FP model for Chongming Island and performed the model simulations again. We obtained the same simulation results** at the GTSR 100-year extreme water level superimposed on the effects of sea level rise, etc., and considered the effects of seawall of Chongming Island in the simulation process.

In addition, **we found that the simulation results of Chongming Island were more similar to other literature that studied flood inundation by extreme storm surges in Shanghai.** For example, Yin et al (2020) used a 2-D flood inundation model (FloodMap-Inertial) to simulate and predict flood inundation in Shanghai under different scenarios and found that the low-lying waterfront area of Chongming Island was inundated without a high-standard seawall under a 100-year flood level (Figure 2). It was also demonstrated that the most vulnerable area in Shanghai to severe flood hazards is Chongming Island, and it was suggested to upgrade the low-lying seawalls on Chongming Island. Yin et al (2021) used the 2D hydrodynamic model Floodmap to simulate coastal flooding in Shanghai due to typhoons and obtained coastal flood inundation scenarios for extreme scenarios in Shanghai, where Chongming Island was severely affected due to low-standard levees (Figure 3). Yan et al (2016) used the 2D hydrodynamic model Mike21 to study the socioeconomic vulnerability of Shanghai under the influence of sea level rise and storm surge, which also produced more severe impacts in Chongming Island (Figure 4).

The reason for this is that, as described by Yin et al, Chongming Island is the most vulnerable area to severe flood hazards under extreme coastal storm levels due to the low seawall design standard, and therefore it is recommended to upgrade the seawall design standard for Chongming Island.

[1] Yin, J., Jonkman, S., Lin, N., Yu, D., Aerts, J., Wilby, R., Pan, M., Wood, E., Bricker, J., Ke, Q., Zeng, Z., Zhao, Q., Ge, J. and Wang, J.: Flood Risks in Sinking Delta Cities: Time for a Reevaluation?, Earth's Future, 8(8), doi:10.1029/2020EF001614, 2020.

[2] Yin J, Lin N, Yang Y, et al: Hazard assessment for typhoon-induced coastal flooding and inundation in Shanghai, China, Journal of Geophysical Research: Oceans, 126(7): e2021JC017319, 2021.

[3] Yan B, Li S, Wang J, et al: Socio-economic vulnerability of the megacity of Shanghai (China) to sea-level rise and associated storm surges, Regional environmental change, 16(5): 1443-1456, 2016.

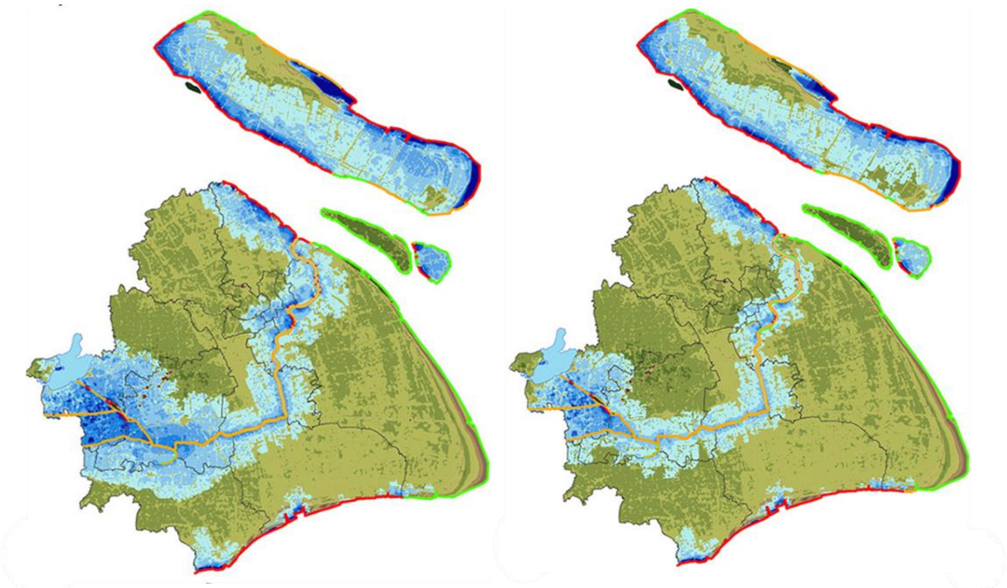

Figure 2. Flood Risks in Sinking Delta Cities: Time for a Reevaluation? (Yin et al 2020)

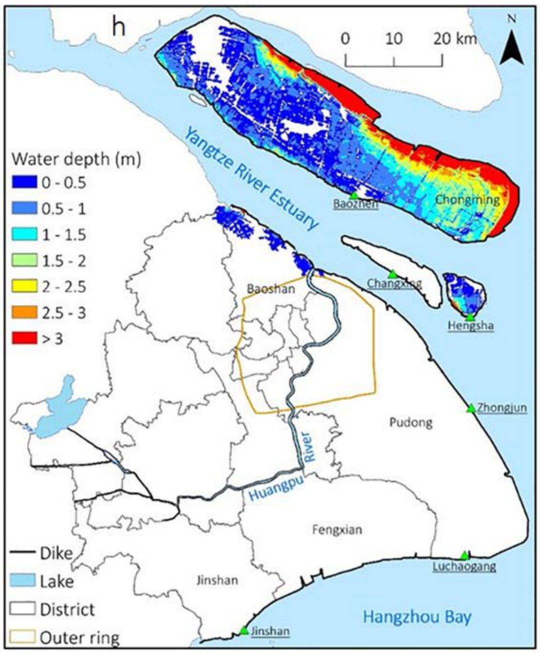

Figure 3. Hazard Assessment for Typhoon-Induced Coastal Flooding and Inundation in Shanghai, China. (Yin et al 2021)

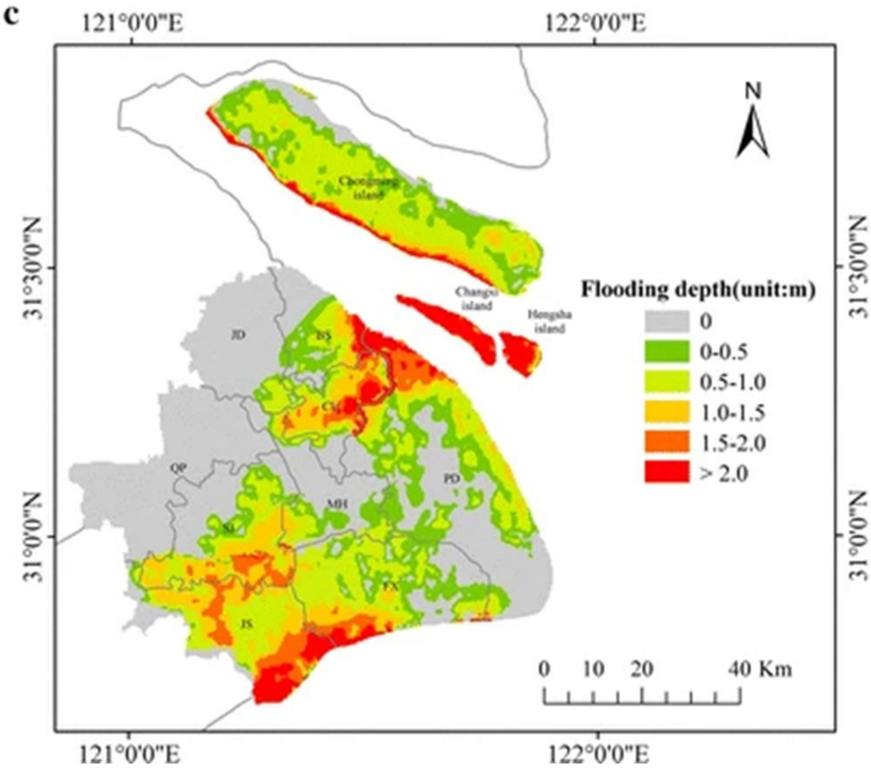

Figure 4. Socio-economic vulnerability of the megacity of Shanghai (China) to **sea-level rise and associated storm surges**. (Yan et al 2016)

Minor comments

R1: Lines151: Change “which” with “in which”

A1: Done.

R2: Lines152: Delete “the”

A2: Done.

R3: Lines153: Change “at” with “in”

A3: Done.

R4: Lines173: Delete “of”

A4: We are sorry that we may not have expressed this sentence clearly. This sentence is intended to express the boundary control condition of model, i.e., the LISFLOOD-FP model requires input model boundary conditions to control the water level. Therefore, here we change “control” to “condition” to better express the meaning.

That is, the changed sentence is “In the boundary condition of model”.

R5: Lines178: Add “the”

A5: Done.

R6: Lines239: Add “with flood wall”

A6: Done.

Response to Referee #6

R1: This paper designed different simulation scenarios to model urban flood risks under different climatic conditions, and proposed a methodology to assess future urban flood risk. These scenarios are carefully well-chosen and help to assess the different challenges in future urban management. However, there are few critical points that should be addressed in the revised manuscript:

A1: We really appreciate the comments and suggestions. Below are our point-by-point responses to the comments.

R2: Line 84-86: The expression is unclear. It is easier for readers to understand if it is modified to the following expression: The reasons for Shanghai's greater vulnerability maybe include the multiple effects of sea level rise due to climate warming, ground subsidence and storm surge water gain.

A2: Thanks for your suggestions. We have modified in the revised manuscript

R3: Line 121-122: Please explain how the Markov chain model is related to the other two models. This sentence refers to three models, and the article topic uses two models, please clearly express their relationship.

A3: Thanks for your comments. The Markov chain model is mainly used to support the FLUS model for land use change prediction, that is, "Markov chain model is used to predict land-use demand…which is one of the crucial data inputs in the FLUS model. (Line 130-132 in the revised manuscript) ". Moreover, after communicating with the research team, we have modified the content of this sentence and provided additional explanations to better clarify it to the readers (See Lines 127-132 in the revised manuscript).

R4: Figure 2 shows in part the friction coefficient of LISFLOOD, which is not embodied in the manuscript. It may be of better help to the reader to have this explained in the manuscript.

A4: Thank you for your suggestions. In this manuscript, our friction coefficients are set according to different land use types referring to Dabrowa et al (Dabrowa et al., 2015) values of 0.05, 0.15, 0.035 and 0.2 are assigned to cropland, woodland, grassland and urban land respectively. We have added this explanation to Line 191-193 of the revised manuscript.

[1] Dabrowa, A., Neal, J. C., and Bates, P. D.: Chapter 8 - Floods and Storms Practical Exercises, in: Hydro-Meteorological Hazards, Risks and Disasters, edited by: Shroder, J. F., Paron, P., and Baldassarre, G. D., Elsevier, Boston, 213-229, https://doi.org/10.1016/B978-0-12-394846-5.00008-4, 2015.

R5: Section 5.1 discusses the uncertainty around the data aspects. Have the authors considered the physical design of the model itself, which is also part of the source of uncertainty?

A5: Thank you for your suggestions. In this section we mainly discussed the data sources that affect the accuracy of the model and evaluated the simulation performance of the model. Each model itself has its own strengths and weaknesses, and with your suggestions we have added a discussion of the model itself in lines 305-308 of the revised manuscript.