We sincerely appreciate the Referee 2 for the positive and constructive comments, which we have used to improve the quality of our manuscript. The referee comments are provided below in **bold font,** and specific concerns have been numbered. Our responses are given in normal font, and changes/additions to the manuscript are given in blue text.

General comments

1. **The paper aims to build a refined assessment model of direct economic losses for flood disasters. Taking the "8.20" flood event hitting Linshui City in 2014 as an example, the loss ratio and loss value of this disaster event was calculated based on the land use data. The topic is interesting, and the paper is well structured. I would recommend following suggestions to improve the manuscript:**

   Response: We greatly appreciate your kind help in the reviewing the manuscript and all constructive comments. And we have revised the manuscript based on these comments and suggestions.

Specific comments

1. **Line 14: please clarify what is the "flooding model".**

   Response: The "flooding model" in this sentence refer to "one-dimensional hydrodynamic model and geographic information system (GIS) analysis method", which we have modified in the revised manuscript.

   Line 12-14: First, based on a field investigation, the inundation data simulated by the one-dimensional hydrodynamic model and geographic information system (GIS) analysis method were verified.

2. **Line 16-17: "Then, the existing vulnerability curve database was summarized, and the curves were calibrated by disaster loss reporting." This sentence does not make it clear the process of constructing and checking the vulnerability function. I suggest that you rewrite this sentence.**

   Response: This suggestion has been adopted, and we have rewritten this sentence to make it clear.

   Line 16-17: Then, based on the previous depth-damage function, the vulnerability curves of 47 types of land use in Liandu district were fitted by the lognormal cumulative distribution function and optimized using disaster loss report data.

3. **Line 19: "high-precision spatial information" should be replaced by "high spatial resolution".**

   Response: We have corrected the phrase in the revised manuscript.

   Line 18-19: It is found that the constructed land use data has detailed types and value attributes as well as high resolution.

4. **Line 70: there is no legend in the light blue area in Figure 1 (b).**

   Response: The light blue area in Figure 1b refers to the Oujiang River Basin. In order to distinguish it from the sub basin, we set the fill color of the Oujiang River Basin as no color.

   Line 74-77:

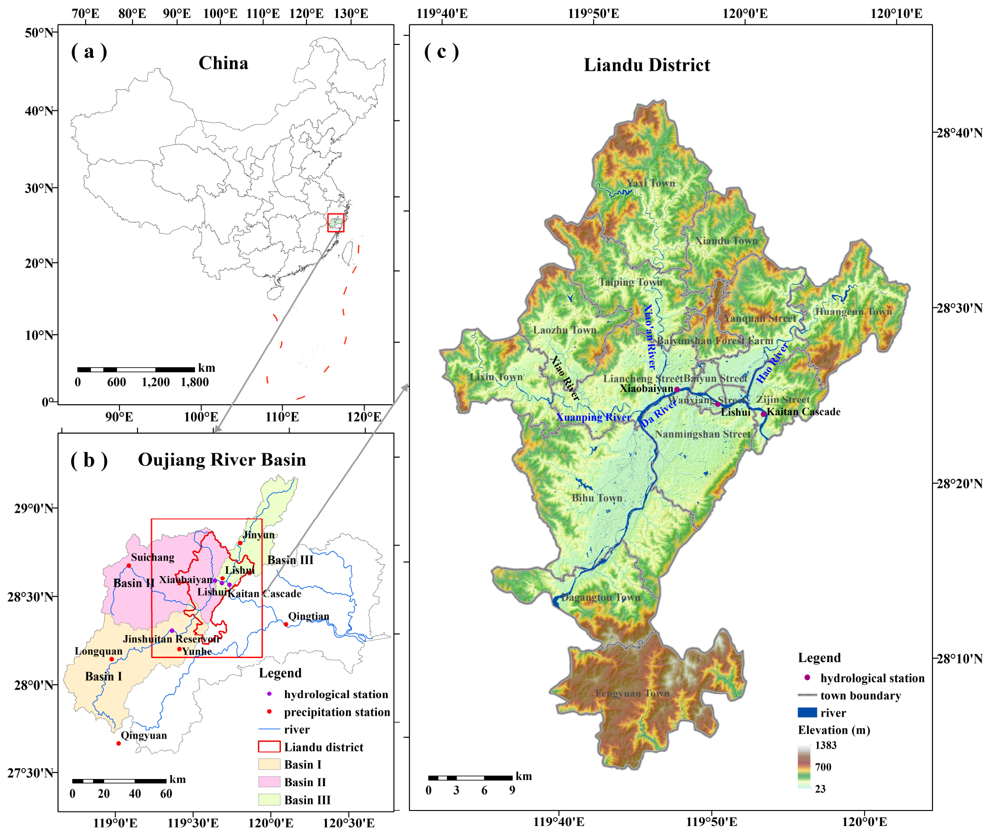

   Figure 1. Location of the study area. (a. The location of Oujiang River Basin in China. b. The distribution of hydrological stations, precipitation stations, rivers and sub basins in Oujiang River Basin, and the location of Liandu district in Oujiang River Basin. c. The terrain distribution and town boundary of Liandu district.)

5. **Section 2.3: how to verify the results of flood inundation simulation? How accurate is the simulation of flooding? There is no detailed description of these in this paper, please give a brief description.**

   Response: Thanks for your comments. We have described in detail the process of hydrodynamic model construction and verification in the revised manuscript.

   Line 111-128: The flood inundation was calculated from the Yuxi to Kaitan Reservoir hydraulic model constructed by Zhejiang Design Institute of Water Conservancy & Hydro-Electric Power. In this study, the middle and upper reaches of the Oujiang River Basin were generalized into a mathematical model, the unsteady flow partial differential equations of the Saint-Venant open channel were used to describe the flood evolution process, and the implicit difference method was used to transform it into a difference equation. Newton iteration and Gaussian principal component elimination method were used to solve the problem time by time, so as to obtain the water level and discharge of each section (Kang and Chen, 2007). This model considered weirs, gates, water-blocking bridges, water exchange between intervals, and flood detention areas, etc., and can be applied to the quantitative analysis and calculation of the flood evolution of this section of the river.

In order to make the flood evolution calculation can better simulate the water depth of this basin, the measured river section and the flood in 2014 were selected for simulation calculation to verify the accuracy of the mathematical model of the flood evolution calculation, and determine the parameters of the model. The simulation result of the measured flood on August 20, 2014 was carried out. The upper boundary used the discharge process of each reservoir and the measured data from the hydrological station, and the lower boundary used the measured water level. Comparing the model result with the measured flood traces and the measured process at the hydrological station, the difference in water level between the two was 0 m - 0.09 m, which shows that the model parameters were reasonable. The flood volume was calculated based on the simulated water level and the elevation of the embankment (Table 1). Based on the overflow volume and topographic data, the submerged area and inundation depth were estimated by GIS tools. Through measured flood traces, field surveys and aerial photograph, it was found that the simulated submergence results can well reflect the actual flood.

6. **Line 140: it is recommended that you quote Table 2 in "47 categories" to indicate the specific classification.**

   Response: We have added a quote to Table 2 at "47 categories" in the revised manuscript.

   Line 153-155: The former data came from the urban and rural space development current status map of the Natural Resources and Planning Bureau in 2013, which was divided into 47 categories (Table 2) according to the *Code for classification of urban land use and planning standards of development land* (MHURD, 2011).

7. **Line 141: you have a reference for GB 50137-2011 here, but it is not in your reference list. Please add it.**

   Response: Thanks for your comment, and we have added the reference in revised manuscript.

   Line 153-155: The former data came from the urban and rural space development current status map of the Natural Resources and Planning Bureau in 2013, which was divided into 47 categories (Table 2) according to the *Code for classification of urban land use and planning standards of development land* (MHURD, 2011).

   Ministry of Housing and Urban-Rural Development (MHURD): Code for classification of urban land use and planning standards of development land, China., 2011.

8. **Section 3.3: the steps for fitting and optimizing the vulnerability function of land use are not clear, and it is recommended to describe them in detail.**

Response: In the revised manuscript, we have reorganized the process of fitting and optimizing the vulnerability functions of land use, and gave a detailed description of the steps that were not clear in the original manuscript.

Line 186-225: Therefore, based on the existing vulnerability curves in many countries and regions (Coto, 2002; FEMA, 2013; Mo and Fang, 2016; Shi, 2010), the fitting and optimization steps of vulnerability function are as follows.
1) According to the existing depth-damage database, the relationship between inundation depth and loss ratio of each land use in Liandu district was constructed. Since the HAZUS-FLOOD had a complete building occupancy class, this study mainly referred to it. First, we constructed the comparison table between the building occupancy class in HAZUS-FLOOD and the land use type in Liandu district. Second, based on the inundation depth in Liandu district and the water depth in HAZUS-FLOOD, the range of inundation depth in the depth-damage function was set and the unit of water depth was converted to meters. Finally, the HAZUS-FLOOD was summarized according to the building occupation class, and the average loss ratio of all samples for each building occupancy class under each inundation depth was calculated, which was used as the reference of the loss ratio of corresponding land use types under the same inundation depth in Liandu district. If there was no similar building occupancy type in HAZUS-FLOOD, other databases were referenced (Figure 2).
2) The appropriate function was selected to fit the curve of inundation depth and loss ratio for each land use type constructed in step 1. In the previous study, the vulnerability curve can be fitted by a polynomial, a power function (Büchele et al., 2006), or logistic regression (Cao et al., 2016), and it can also be smoothed by nonparametric forms such as the kernel density (Merz et al., 2004). In this paper, the lognormal cumulative distribution function (Limpert et al., 2001) was selected to fit the vulnerability curve. The formula is as follows:

$$y = F(x, scale, shape) = F(x|\mu, \sigma) = \frac{1}{\sigma\sqrt{2\pi}} \int_0^x \frac{1}{t} e^{\frac{-(\log t - \mu)^2}{2\sigma^2}} dt, \quad x > 0 \qquad (1)$$

where y is the loss ratio, x is the inundation depth, σ and μ are the standard deviation and mean of the $logx$, respectively. For lognormal cumulative distribution function F, the shape parameter $shape = \sigma$, which affects the shape of the distribution, and scale parameter $scale = e^{\mu}$, which affects the stretching and shrinking of the distribution.
3) Based on the vulnerability function fitted in step 2, the loss ratio and loss value of land use in Liandu district were estimated. First, the two raster layers of land use type and inundation depth were overlaid. Then, the loss ratio of each grid was calculated based on the vulnerability function. If the inundation depth of the grid was 0 m, the loss ratio was also 0. Otherwise, the corresponding vulnerability function was searched according to the land use type of the grid, and its loss ratio was calculated based on the inundation depth of the grid. Finally, the loss value of each grid was calculated by Eq. 2.

$$L = DR * V \qquad (2)$$

where L is the loss value of the land use, DR is the loss ratio of the land use, and V is the value of the land use.
4) The vulnerability function was optimized by disaster loss reporting data. First, the mapping table between the statistical indicators of disaster loss reporting and land use types in Liandu district was constructed (Table 2). Second, the simulated total loss of land

use in Liandu district corresponding to the loss reporting data of indicator k was calculated by Eq. 3. Then, the non-linear equation was established with the minimum error between the disaster reporting loss and the simulated total loss as the objective function, and the scaling factor a_k was solved by the least square method.

$$TL_k = \sum_{i=1}^{n_k} \sum_{j=1}^{m_{ik}} L_{ij} = \sum_{i=1}^{n_k} \sum_{j=1}^{m_{ik}} F\left(x_{ij}, shape_i, a_k * scale_i\right) * value_i \quad (k = 1,2, \dots ,5) \quad (3)$$

where TL_k is the simulated total loss, n_k is the number of land use types corresponding to the disaster loss reporting indicator k, m_{ik} is the number of grids of the land use type i corresponding to the indicator k, L_{ij} and $F\left(x_{ij}, shape_i, a_k * scale_i\right)$ are the loss value and loss ratio of the grid j of the land use type i, respectively. $value_i$ is the asset value or cost per unit area of land use type i, x_{ij} is the inundation depth of the grid j of the land use type i, $shape_i$ and $scale_i$ are the parameter of the vulnerability function of the land use type i, a_k is the scaling factor of the indicator k, and the initial value is 1.

9. **Line 173-174: please indicate which data source each type of land use refers to. You can quote the Figure 6.**

   Response: Thanks for your suggestion, and we have added a quote to Figure 6 at the end of the sentence in the revised manuscript.

   Line 196-197: If there was no similar building occupancy type in HAZUS-FLOOD, other databases were referenced (Figure 6).

10. **Line 186: "Based on the mapping relationships between the disaster statistical indicators and land use types". There are 41 statistical indicators for disaster loss reporting in Section 2.4. It is suggested to add this mapping table to determine which indicators are used in this study.**

    Response: Thanks for your suggestion. We established the mapping relationship between the land use types of the Liandu district and the statistical indicators of the disaster report data in Table 2 in the original manuscript, but we did not add a quote to Table 2 in this sentence. Therefore, we add a quote in revised manuscript.

    Line 214-215: First, the mapping table between the statistical indicators of disaster loss reporting and land use types in Liandu district was constructed (Table 2).

11. **Line 189: please clarify what is the "scale parameter".**

    Response: We have added the description of the "scale parameter" in revised manuscript. The calculation formula of scale parameter of lognormal cumulative distribution function is $scale = e^{\mu}$, and the scale parameter affects the stretching and shrinking of function distribution.

    Line 205-206: For lognormal cumulative distribution function F, the shape parameter $shape = \sigma$, which affects the shape of the distribution, and scale parameter $scale = e^{\mu}$, which affects the stretching and shrinking of the distribution.

12. **Line 193: "corresponding" should be replaced by "respective".**

Response: This word has been corrected in the revised manuscript.

Line 231-232: The fused land use type data effectively integrate the respective advantages of the current urban land use and land use classification results based on remote sensing images.

13. **Line 231: it is recommended to specify what the black dots in the Figure 6 refer to. In addition, Figure 6(42) should add the index and title of the horizontal axis.**

Response: The black dots in the Figure 6 refer to the inundation depth and loss ratio constructed according to the corresponding reference, and we have added the description in the title of Figure 6. In addition, we have added the tick labels and title of the horizontal axis in Figure 6(42).

Line 266-269:

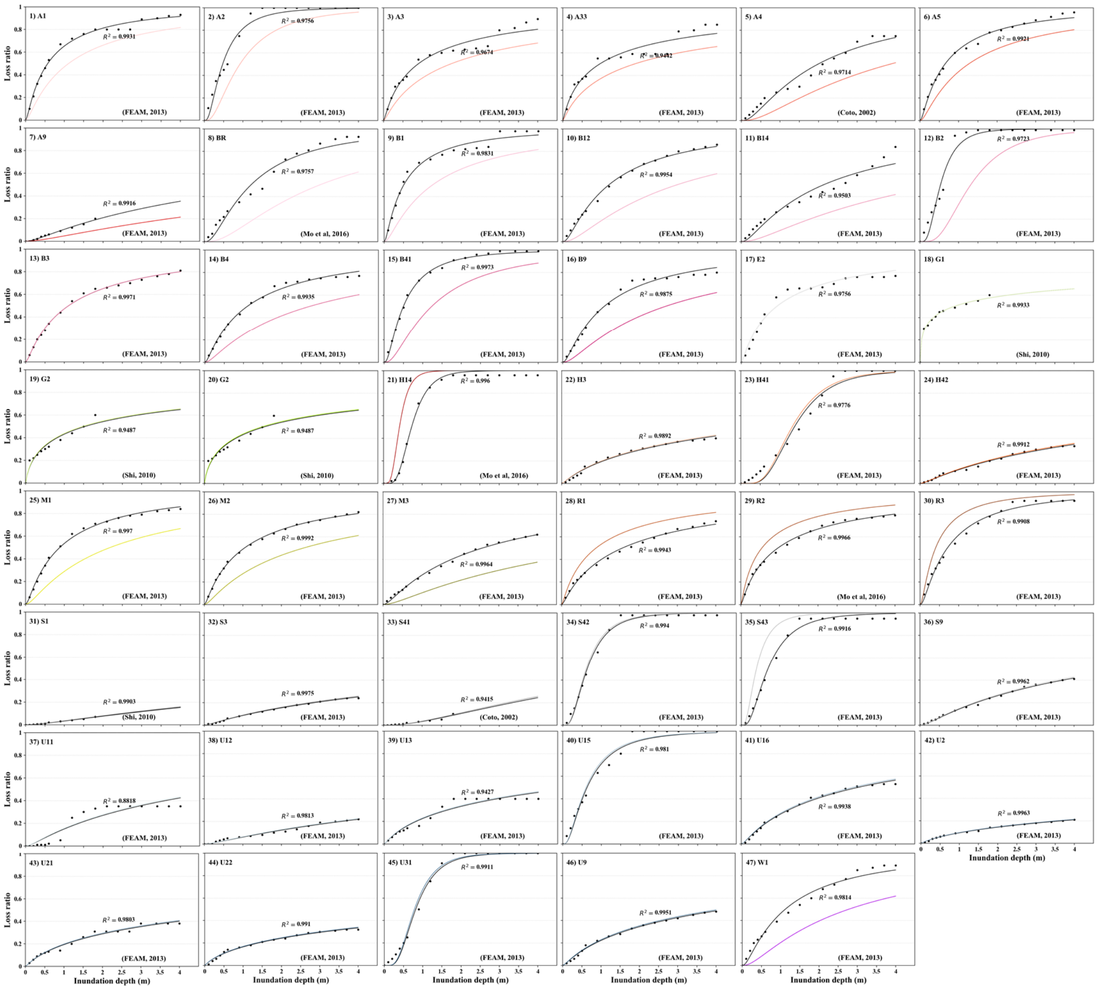

Figure 2. Fitting and optimization of vulnerability curves of land use in Liandu district (The black dots refer to the inundation depth and loss ratio based on the reference, the black curve is the fitting result of the black dots by the lognormal CDF, and the color curve is the optimized result based on the disaster loss reporting).

14. **Line 240: please clarify what is the "spatial analyst algorithm".**

Response: The “spatial analyst algorithm” actually refer to the method in step 3 of Section 3.3, and we have corrected this sentence in the revised manuscript.

Line 282-284: Based on the land use type and value data, the inundation depth distribution, and the optimized vulnerability functions of the land use, the distribution of loss ratio (Figure 7a) and loss value (Figure 7b) of Liandu district were estimated by the method in step 3 of Section 3.3.