

Point by point reply to RC2: We would like to thank the referee for the positive and very constructive evaluation of our manuscript and for the helpful comments to improve the manuscript. Requested changes were taken into account.

Point 1: In the title, the authors mention “high-resolution”. But I didn’t see any high resolution descriptions in the manuscript. Do you mean spatial resolution or time resolution?

Response 1: We mean both spatial and time resolutions. Previous studies have generally focused on the macro-scale of a region, in which the most refined scale is at the community level, and there are few dynamic studies. The time resolution of our study is half an hour and can be set to even finer time intervals. Spatially, irregular vector units are used, and the area of the minimum block is 2731.64 square meters.

Point 2: The authors used the well-known LISFLOOD-FP as the flood model. However, many details are missing about this model. For example, what are the spatial and temporal resolutions of this model? How was this flood model calibrated and validated?

Response 2: In the flood simulation, the time resolution is unified with other output results for half an hour. Spatially, it is based on the most refined topographic data which are regular square grids with five meters resolution in the study area. We indirectly validate the simulation results by using water accumulation points (refer to Section 4.1).

Point 3: I don’t understand why the authors used synthetic rainfall data for the 2014 flood. If the authors used synthetic rainfall data, how can the flood model be validated? This kind of synthetic rainfall generation method is often used for urban planning. I propose the use of actual rainfall data. There are too many assumptions behind this synthetic rainfall generation method. For example, is Chicago hyetograph valid in this region? Is the rainfall from 6am-12 pm reasonable?

Response 3: The hypothetical rainfall data is used because we only have the daily precipitation data at that time in the study area, and there is no hourly rainfall observation data. The total volume of the hypothetical rainfall is fitting to the actual rainfall estimate at the coarser resolution. Flood model results are indirectly validated by water accumulation points. The Chicago hyetograph is applicable to this region as it has been used by Hangzhou Municipal Planning Bureau who provided the relevant parameters. Rainfall duration is designed according to the flood information in 2014.

Point 4: Actual flow and water level data in 2014 were used. Then why synthetic rainfall data?

Response 4: Please refer to Point 3.

Point 5: Line 151: what is “r” here? I didn’t find this variable in the equations. Please explain.

Response 5: The “r” refers to the relative rainfall peak time, i.e., the value from zero to one. Zero means the maximum rainfall at the beginning of rainfall and one means the maximum rainfall at the end of rainfall. It does not appear in

the formula, but is one of the input parameters in simulating rainfall data. We have revised the manuscript to clarify this part. The following text has been added in Section 3.1:

“The “r” refers to the relative rainfall peak time, i.e., the value from zero to one. Zero means the maximum rainfall at the beginning of rainfall and one means the maximum rainfall at the end of rainfall.”

Point 6: Line 162-163: please provide references to these methods.

Response 6: The value of r was set according to the related news reports of the flood in 2014.

Point 7: Line 165-167: please provide evidence to this sentence “ABM is considered most suitable to address challenges associated with simulating the complexity and dynamic variability of population exposure to flooding due to its capacity to capture interactions and dynamic responses in a spatial environment”.

Response 7: The following text has been revised in the manuscript:

“ABM is considered most suitable to address challenges associated with simulating the complexity and dynamic variability of population exposure to flooding due to its capacity to capture interactions and dynamic responses in a spatial environment (*Dawson et al., 2011*).”

Dawson, R. J., Peppe, R., and Wang, M.: An agent-based model for risk-based flood incident management. *Natural hazards*, 59(1), 167-189, <https://doi.org/10.1007/s11069-011-9745-4>, 2011.

Point 8: Line 222-223: please specify the GIS tools or software the authors used in this study.

Response 8: Intersection and editing tools of the ArcGIS software are used in block generation. As shown in the following figure, the centerlines of the rivers and main roads are applied to split the study area into cells with the GIS intersect tools. Second, the cells obtained by the first step are subdivided or modified by the boundaries based on land use data. Finally, the cells obtained by the second step are modified by the boundaries based on buildings.

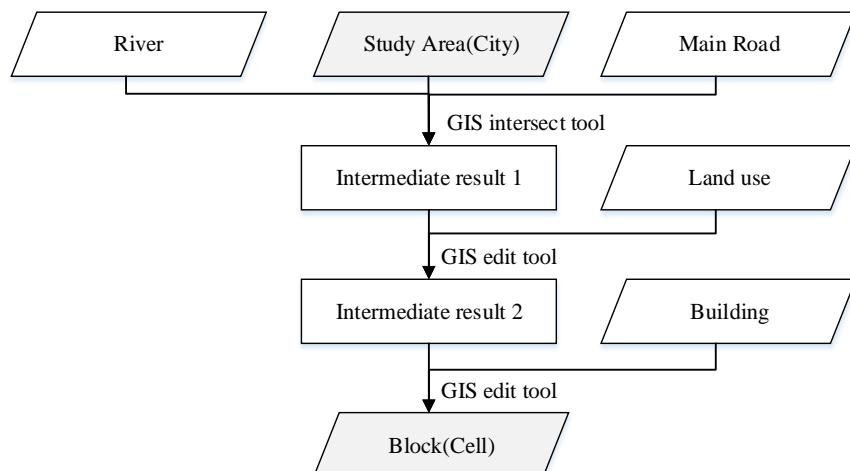


Figure 1. Spatial discretization based on geographic information system (GIS) techniques.

Point 9: I didn't see many details of the agent model the authors used. Is this only a meta model or kind of simulation model? I expect more details about this model.

Response 9: We developed the prototype system with the agent model concept as shown in Section 4.1, using the Visual Studio Code software and Python programming language.

Point 10: There are many assumptions and simplification when the authors assess the dynamic exposure. Therefore it is also very difficult to verify the model the authors set up.

Response 10: Indeed. We can only verify indirectly in this early prototype. In the future, we will enrich the types of agents and activities, and add a traffic model to make the simulation results more realistic and improve the accuracy of the evaluation results.

Point 11: Many details of the agent model are referred to the experiences of other countries. Can the authors add discussion about this? Are these experience applicable in China?

Response 11: There are also many relevant studies based on the agent model in China. *Kang et al. (2012)* proposed an agent-based urban population distribution model. *Huang et al. (2015)* proposed a multi-agent-based theoretical model for dynamic flood disaster risk assessment. *Ling (2014)* and *Guo et al. (2015)* carried out flood disaster risk simulation research and population risk dynamic assessment research based on an agent model respectively. We also refer to the above literatures when designing our agent model. Based on the survey data, we designed simplified activity patterns, which are consistent with the actual situation of the study area. The classification of agent types is based on several main social characteristics. In the future, we will also conduct more surveys in the study area in order to make the modeling results more realistic.

Kang, T., Zhang, X., Zhao, Y., Wang, Y., and Zhang, W.: Agent-based Urban Population Distribution Model. *Scientia Geographica Sinica*, 32(7): 90-797, <https://doi.org/10.13249/j.cnki.sgs.2012.07.003>, 2012.

Huang, H., Fan, Y., Yang, S., Li, W., Guo, X., Lai W., and Wang H.: A multi-agent based theoretical model for dynamic flood disaster risk assessment. *Geographical Research*, 34(10):1875-1886, <https://doi.org/10.11821/dlyj20151006>, 2015.

Ling, H.: *Simulation of Flood Disaster Risk based on Multi-Agent*. University of Science and Technology of China: Hefei, China, 2014.

Guo, X., Li, W., Wang, H., Lai, W., Shi, Y., and Sun, B.: Population Risk Dynamic Simulation for Rainstorm Flood Disaster Based on ABM and ABS. *Computer Systems & Applications*, 24(12):10-17, 2015.

Point 12: Again, I didn't understand why the authors use the traffic data of 2017 for validation of the agent model instead of those of 2014?

Response 12: Due to the lack of traffic data during the flood period in 2014, the existing data can only be used to

verify. The available data are the traffic flow of four intersections, which lasted for two weeks, from June 24 to July 7, 2017.

Point 13: How was the flood model validated?

Response 13: Please refer to Point 2.