Responses to Reviewers

Reviewer #2:

This paper proposes a logistics planning framework for flood relief tailored to coastal cities, with Shanghai serving as a case study. The authors integrate GIS network analysis and resource allocation optimization models to investigate emergency management strategies under different flood scenarios. The framework offers valuable support for decision-making by incorporating geographic and resource allocation data to enhance flood relief efforts. However, the manuscript requires significant revisions. The main concerns are outlined below.

We greatly appreciate the invaluable and constructive feedback provided by Reviewer #2. Our responses are highlighted in blue italic. We have acted upon all the points raised. The comments were very useful in improving the overall quality and readability of the manuscript.

Comment 1: The paper does not include a description of the flood models used, referencing only Yin et al. (2020). The referenced study covers various flood scenarios across different years. Why does this paper focus solely on the 2030 scenarios with 100- and 1000-year return periods?

Thank you very much for your valuable comment. We provide a more detailed explanation of the flood models used and justify the selection of these specific scenarios in the revised manuscript.

We have added some sentences as follows:

Line 265-270: 'In addition, FloodMap-Inertial developed from FloodMap (Yu & Lane, 2006), has been thoroughly tested and applied in in Shanghai (Yin et al., 2015, 2019), showing reliable performance in flood prediction. This model utilizes a computationally efficient inertial algorithm to solve the 2-D shallow water equations (Bates et al., 2010), using the Forward Courant-Friedrichs-Lewy (CFL) Condition for the calculation of time steps. A complete description of the model structure and parameterization can be found in Yu and Lane (2011).'

Line 271-274: ' In this study, we focused on the 2030 scenarios with 100- and 1000-year return periods under the RCP 8.5 scenario. The RCP 8.5 scenario represents high radiative forcing and worst-case climate impacts. Thus, these two future scenarios represent extreme flood inundation. The 2030 projections are the closest to the present, making them relevant for near-term planning.'

The flood inundation results used in this study are shown in the following figure.

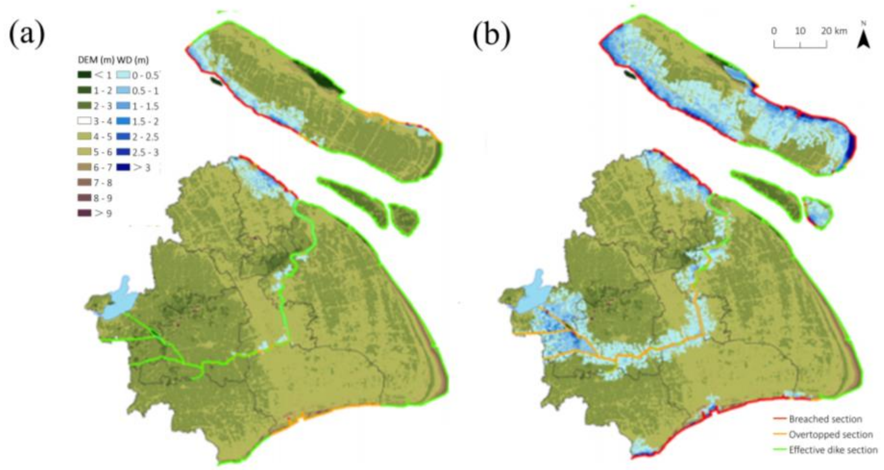

Figure. Projected flood inundation under future scenarios (RCP 8.5) in 2030. One hundred－year flood (a) and One thousand－year flood (b). (Yin et al. ,2020).

Comment 2: The population data utilized in the analysis is from 2010. Given the aging population trend between 2010 and 2030, how might this demographic shift affect the analysis results? Would it significantly impact the findings?

Thank you very much for your valuable comment. Considering the aging trend between 2010 and 2030, demographic shifts could affect the analysis results. In fact, we do not have specific projections data of the elderly population at the community level. We only can refer to the overall projections provided by the Shanghai Statistics Bureau. According to their reports, the projected elderly population in Shanghai for 2030 is expected to reach 4.8 million, an increase of approximately 106% compared to 2010.

Assuming the elderly population in affected communities grows at the same rate, under a 100-year flood event, the number of affected elderly individuals would be approximately 299,138 and under a 1000-year flood event, it would rise to around 1.1 million—more than double the number affected in 2010. When comparing these figures with the current capacity of emergency flood shelters (EFSs) and the supplies stored in emergency reserve warehouses (ERWs), we find that while the capacity of EFSs is adequate for a 100-year flood event, ERWs would not be sufficient. For a 1000-year flood event, neither EFSs nor ERWs would suffice to meet the needs of the elderly population.

While the simple analysis as mentioned suggests that an increase in the elderly population could affect the results, it assumes that the growth rate of the elderly population in affected communities is the same, which may not be the case in reality. Due to the lack of detailed spatiotemporal projections of the elderly population in affected communities, we cannot draw *definitive conclusions about the impact. Consequently, the final results can only suggest a high probability that the increase in the elderly population by 2030 will lead to greater shortages in shelter resources and supplies in two costal flood scenarios.*

As a result, in the revised manuscript, we have added a discussion section to address these limitations. Specifically, we propose that future research should focus on obtaining more detailed spatiotemporal data on the elderly population to better understand the spatial distribution and temporal changes in the affected elderly population. This would be beneficial to refine the social vulnerability component of the risk assessment and further optimize resource allocation strategies.

We have revised some sentences as follows:

Line 457-461: 'However, to arrive at more robust conclusions, future studies could be directed to the following aspects: 1) Demand Estimation: Given the aging issue in Shanghai, the elderly population is likely to increase significantly by 2030, leading to a high probability of greater scarcity in shelter resources and supplies. Therefore, future research should focus on obtaining more detailed data on the elderly population to better understand the spatial distribution and temporal changes in the affected elderly population.'

Comment 3: In Equation 1, the number of affected individuals is estimated based on the proportion of flooded areas. However, is there a valid linear relationship between the number of people affected and the flooded area? Further justification or discussion of this assumption is needed.

Thank you very much for your valuable comment. Currently, the available data is at the community level, and we do not have more detailed the elderly population data. Therefore, to estimate the number of affected elderly individuals within each community, this study assumes a uniform spatial distribution of the elderly population. The number of affected elderly individuals is calculated using Equation 1.

In the revised manuscript, we have further clarified this assumption as follows:

Line 155-158: 'Additionally, due to the lack of more detailed spatial distribution data for the elderly population, this study assumes a uniform distribution within the community. The number of elderly individuals in each affected community can be calculated using Equation 1.'

Comment 4: Line 90 mentions that previous studies did not consider flood scenarios under climate change. Does the 2030 flood scenario used in this study genuinely reflect a climate change scenario, and if so, how?

We thank the reviewer for pointing out the need for clarity regarding the consideration of *climate change in the flood scenarios used in our study. The 2030 flood scenario employed in this study reflects a climate change scenario, as it incorporates projections of sea level rise under the RCP 8.5 scenario. Specifically, the flood inundation scenarios are derived from Yin et al. (2020), which included climatically driven absolute sea level rise projections provided by Kopp et al. (2014). These projections consider factors such as ice sheet melting, glacier and ice cap melting, and ocean thermal expansion.*

To further clarify this point, we have revised the manuscript to explicitly state that the flood scenarios considered in our study incorporate climate change impacts. We have revised some sentences as follows:

Line 257-263: 'Future flood inundation scenarios in Shanghai are derived from Yin et al. (2020). In their previous work, coastal flood inundation caused by overtopping and dike breaching was simulated using a 2-D flood inundation model (FloodMap-Inertial) with a fine-resolution DEM for three representative return periods (10, 100, and 1000 years) under current and future climate scenarios (RCP 8.5). And, the study considered climatically driven absolute sea level rise (SLR) by using the probabilistic, localized SLR projections at the Lvsi gauge station located in the Yangtze River Delta, provided by Kopp et al. (2014). This projection takes into account climatic factors such as ice sheet melting, glacier and ice cap melting, and ocean thermal expansion.'

Comment 5: The application of the bi-objective model in multi-objective optimization is central to this paper. However, the background description of the model is insufficient, particularly regarding the implementation of the NSGA-II algorithm. It is recommended to provide more details on the algorithm's steps and discuss its advantages in practical applications.

Thank you very much for the suggestion. We agree that a more detailed explanation of the NSGA-II algorithm is necessary. We have added some sentence as follows:

Line 363-373: 'This biobjective mathematical model is solved by the NSGA-II (Non-dominated Sorting Genetic Algorithm II) algorithm which is used to obtain Pareto optimal solution in multi-objective optimization problems (Deb et al., 2002). NSGA-II is an advanced multi-objective evolutionary algorithm that maintains population diversity across generations through non-dominated sorting and promotes uniform distribution of solutions along the Pareto front using a crowding distance measure. NSGA-II algorithm is widely used in selected combinatorial optimization problems, with the advantages of fast convergence speed, low computational complexity, and high robustness (Ma et al., 2023; Verma et al., 2021). The corresponding algorithm settings for the solution in this study are shown in Table4.'

Table 4. Optimization parameter settings for NSGA-II

Parameter	*Population Size*	*Maximum Number of Iterations*	*Pareto Fraction*	*Crossover Probability*
Value	*500*	*3,000*	*0.4*	*0.8*

Comment 6: For extreme flood scenarios, does the model account for time constraints associated with emergency response? How does the model ensure that supplies can be delivered to affected areas in a timely manner?

Thank you very much for your valuable comment. The model does not explicitly account for time constraint. According to the '14th Five-Year National Comprehensive Disaster Prevention and Mitigation Plan' in China, it is required that basic living needs of affected individuals be met within 12 hours after a disaster occurs. In this study, we primarily consider the city scale, assuming supplies can be delivered within 12 hours. Moreover, in Shanghai, supplies can be distributed within 3 hours. This timeframe is considered acceptable, so no specific time parameters were set.

We have also clarified our assumptions in the paper:

Line 147-148: 'A8: Any resource allocation within the city can be completed within 12 hours. Notably, the '14th Five-Year National Comprehensive Disaster Prevention and Mitigation Plan' in China stipulates that affected individuals' basic living needs will be met within 12 hours'