

## Spatio-Temporal Assessment of Tsunami Vertical Evacuation: A Case Study of the Shizuoka Metropolitan Area

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- (1) Introduction:** The city of Shizuoka is located in central Japan and has a population of approximately 690,000 people. It faces the Nankai through which is known for large earthquakes of M 8 or higher. There is a strong tsunami presence in the area both in historic times and also during the Holocene. This makes safe evacuation of local residents during a tsunami, a critical component that reduces life loss.
- (2) Approach:** Given the tsunami presence in the area, a number of different tsunami scenarios can be considered as possible to affect Shizuoka City. Under those scenarios, it is imperative to use GIS methods to find vertical evacuation sites as many as possible within the existing urban structure and within the tsunami flood zones.
- (3) Method:** Four tsunami scenarios are utilized. These scenarios have run-ups of 34, 20, 10 and 5 meters. For each of these scenarios the inundation ratio for every building that is affected is calculated. Buildings with 50% or less inundation is considered potential evacuation sites in case of a tsunami.
- (4) Temporal building population estimation:** Buildings that are not flooded can be heavily populated. However, the population of a building is not static within a day. By using the 2001 person trip data for the city of Shizuoka this study is able to estimate the population of buildings in the study area and how it varies over the course of 24 hours of

a day. This allows for identification of times where buildings can accept less or more people that are evacuating.

- (5) Synthesis:** Buildings that are not flooded are investigated as per their population in different times of the day. Criteria are introduced for different tsunami severities and the amount of people that can be accepted for evacuation is estimated based on the introduced criteria

- (6) Findings:** The inundation ratio analysis shows 1,643 potential evacuation sites in the 5 m run-up scenario, 20,145 sites in the 10 m run-up scenario, 10,426 sites in the 20 m scenario, and 3,204 sites in the worst case 34 m run up scenario. By allocating 6 m<sup>3</sup> per person the morning hours show the highest capacity to accept people in buildings with maximums of 304,747 people for the 5 m run-up scenario, 873,537 people for the 10 m scenario, 1,441,496 people for the 20 m scenario, and 932,657 people for the 34 m run-up scenario. The spatial distribution of these potential evacuation sites is variable per tsunami scenario. For example, the 10 m run-up scenario has five clusters of potential evacuation sites while in the worst case 34 m run-up scenario, the Central Business District (CBD) of Shizuoka is the lone cluster with potential evacuation sites able to accept people.

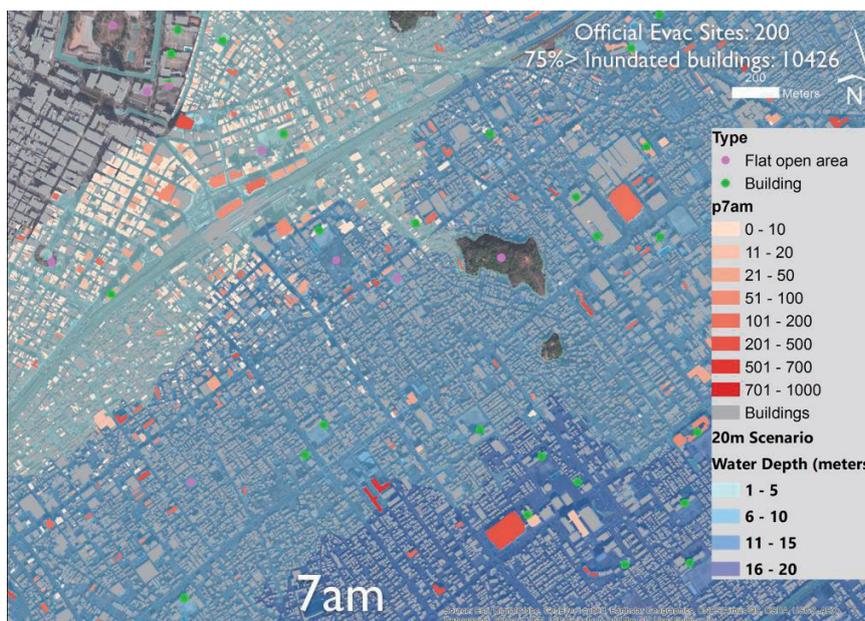


Figure 1: Building population estimation at 7AM (p7am) for potential evacuation sites over a 20m run-up inundation scenario for the City of Shizuoka. Basemap source: Bing