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Study on Tsunami Evacuation Building Demand through the Agent Based Simulation of Tsunami Evacuation in La Punta, Peru

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Erick Mas[1*], Fumihiko Imamura[1], Shunichi Koshimura[1]
MAS, Erick[1*], Fumihiko Imamura[1], KOSHIMURA, Shunichi[1]

[1]Graduate School of Engineering, Tohoku University
[1]Graduate School of Engineering, Tohoku University

La Punta in Peru is a peninsula in the western part of the Callao province and is almost entirely surrounded by the Pacific Ocean, except on its northeastern side, where it is bordered by downtown Callao. It is one of the smallest districts in Peru, however with nearly 5,000 inhabitants it is exposed to a high risk due to tsunami. La Punta is a long peninsula with a narrow neck connection to the inland area. this connection is the entrance and exit of the district, therefore the only way out of the inundation area. Based on this constraint, authorities encourage their population to decide for the vertical evacuation to high buildings in the area. This community has a high awareness of tsunami despite the lack of experience of real tsunami events in the last decades. Risk information and education by the local authorities had played an important role. Among the countermeasures available for tsunami evacuation process, Tsunami Evacuation Buildings (TEBs) were pointed out in the evacuation plans as the official structures for vertical evacuation in case of tsunami. The total capacity of TEBs reported in the evacuation plan (7,130), far exceeds the number of residents in the area (4,370). Apparently the demand of capacity for a future evacuation is fulfilled, however the spatial location of these TEBs might affect the distribution of preferences and individual demand at the moment of the tsunami event. Therefore, to understand this issue, we developed an integrated tsunami evacuation simulator at the micro scale level. A stochastic analysis of several numbers of different simulated scenarios of population spatial distribution were conducted. Evacuation on foot and car is considered. Agents were given simple rules of goal and route selection, while the start time of evacuation is based on a random assigned value out of several possible distributions of evacuation for the population. It was observed that 5% of residents who were supposed to evacuate to the closest TEB in the available 20 minutes of arrival time of tsunami, were trapped in the flow due to a late evacuation decision. Moreover, the average number of evacuees in each building at the end of simulations versus the real capacity, shows that almost half of the available TEBs present an over demand. More evacuees than the expected capacity will end up at this locations. However, the other half of TEBs remained with available space in a range of 11% to even 95% of its available capacity. Future measures to avoid the disparity of shelter demand must be taken to ensure that a safe evacuation and an optimal use of resources for the support in shelters are obtained.

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