PROBABILISTIC APPROACH FOR PREDICTING THE DRIFT OF BODIES BY TSUNAMIS

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INTRODUCTION

The Great East Japan Earthquake of 2011 triggered a massive tsunami, and most of the dead and missing were killed by the tsunami. About 12 years after the disaster, search activities for missing persons are still ongoing. So far, the drift behavior of drifting debris (Nistor et al., 2017) has been studied. However, the human body's drift behavior and area due to tsunamis have not been studied. It is important to establish a prediction method for the drift behavior of the human body in order to quickly rescue people who are drowned by tsunamis. On the other hand, according to Mateus et al.(2020), probabilistic and statistical approaches are important. Therefore, in this study, it is clarified that the drifting behavior of the human body based on the results of the interview survey in Otsuchi Town, Iwate Prefecture, and performs reproduction calculations to verify the validity of the method and to examine the influence of the initial configuration of the drifting position of the human body.

NUMERICAL MODEL

In this study, a quasi-three-dimensional model Storm surge and Tsunami simulator in Oceans and Coastal areas (STOC)-ML (Tomita et al., 2009, named ML) used hydrostatic pressure approximation for fluid calculations. STOC-DM (DM) coupled with a drifting object calculation model was used for drifting calculations. The fluid forces acting on the object were evaluated using drag and inertia force coefficients. The water level and flow velocity of ML were input into DM to determine the drifting behavior.

RESULTS AND DISCUSSION

Figure 1 shows the missing person rate in the Great East Japan Earthquake. From this figure, Otsuchi Town, Iwate Prefecture, which has a high rate of missing persons, and Sendai City, Miyagi Prefecture, which has a low rate of missing persons, are covered. Drifting objects were placed within the inundation area, and drifting calculations were performed by varying several parameters to observe differences in drifting trends. An example of drifting behavior is shown in Figure 2. When we performed calculations to reproduce the hearing results, we found that the drifting trend was generally reproduced even when the height was changed. Therefore, we focused on the initial height. Figure 3 shows the difference between the final drift position and the initial position in Otsuchi Town when only the height was changed while the horizontal position remained the same. It can be seen that the higher the initial height, the greater the drifting velocity in the offshore direction. A similar trend was also observed in Sendai City. The difference in the height of the tsunami encounter may be one of the reasons for the difference in the rate of missing persons by region.

CONCLUSION

To demonstrate the validity of our computational method, we reproduced the drift record of a human body. Various parameters were varied and the drifting tendency was observed. The results showed that the probability of drifting offshore increased with the height of the tsunami encounter. These results indicate that it is necessary to construct a database that takes into account not only the horizontal direction but also the height direction.

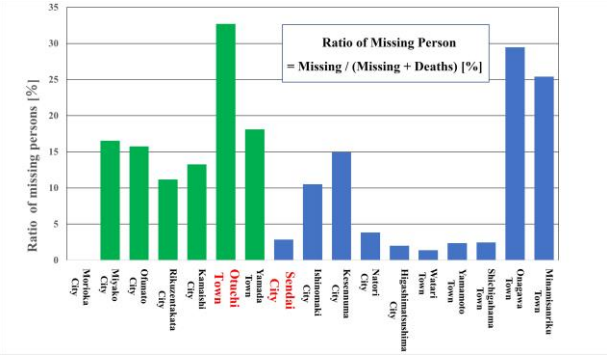

Figure 1 – Ratio of missing persons
(green : Iwate Prefecture , blue : Miyagi Prefecture)

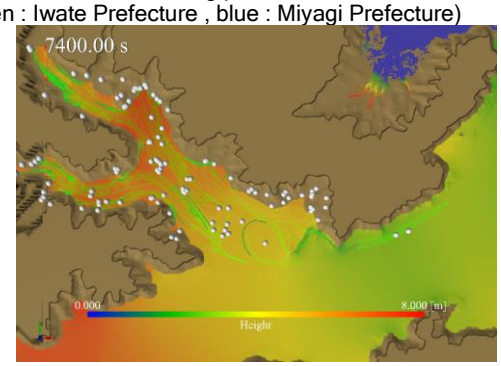

Figure 2 – Drifting behavior by using numerical simulation

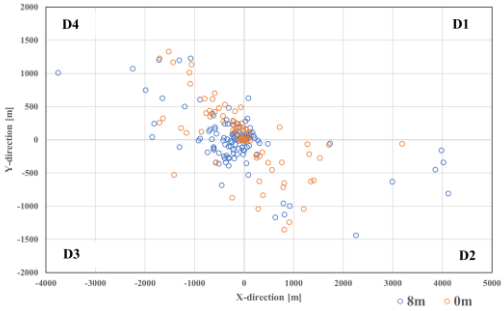

Figure 3 – Differential drifting position
(D2: offshore direction, D4: land direction)

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