INVESTIGATING THE APPLICABILITY OF BOULDER/SAND SEDIMENT TRANSPORT MODELS FOR PORT RISK ASSESSMENT

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INTRODUCTION

Tsunami-induced damage to urban infrastructure is poorly constrained globally since tsunami are infrequent events and therefore, there are limited damage observations. Tsunami-borne debris can contribute significantly to structural damage. This issue is particularly prevalent in port areas, where containers, mobile equipment, and concrete objects can impact on structures. The modeling of boulder and sand sediment transport by tsunami could be used to model the transport of a variety of urban structures. In this study, we introduce various sand and sediment transport models and examine their accuracies. We conclude by proposing a model that is valid for the modelling of urban structures. Some of the findings in this work have already been reported in Watanabe et al. (2021; 2022) and readers are encouraged to refer to these publications.

ACCURACIES OF BOULDER/SAND SEDIMENT TRANSPORT MODELS

Here we consider a numerical phase-resolving wave model - in this case, the Boussinesq Ocean and Surf Zone (BOSZ) model (Roeber and Cheung, 2012; Roeber et al., 2010) for the numerical computation of tsunami inundation. For sand sediment transport and boulder transport modeling, we used the models of Takahashi et al. (1999) and Watanabe et al. (2022), respectively. To validate the numerical simulation models, we use results of the experiments conducted by Yoshii et al. (2017; 2018) for comparison, as discussed in Watanabe et al. (2021; 2022). Here, we compare between the accuracies of the models of boulder and sediment transport by tsunami, and discuss about current problems and possible improvements of these models.

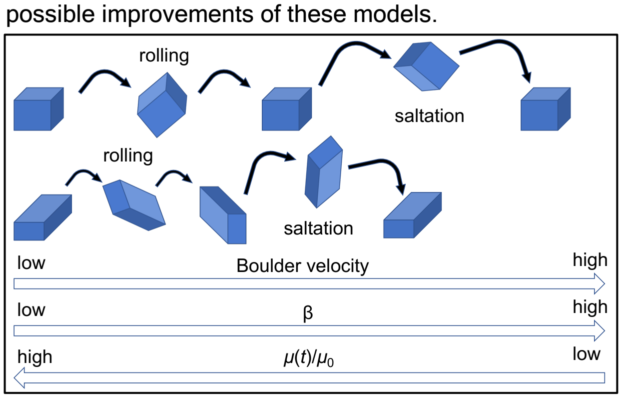

Figure 1 - Schematic diagram showing varying modes of boulder transport. When the boulder velocity increases, the ground contact time of the boulder reduces, so that the effect of bottom friction also become small. β is the degree of contact between the block and the floor, $\mu(t)$ is a variable coefficient of friction, μ_0 is the coefficient of dynamic friction during sliding. Cube shape boulders roll easily compared to rectangular shaped boulders, so that the bottom friction force become small, which leads to an increase in transport distance (Watanabe et al., 2022).

APPLICATION TO DEBRIS TRANSPORT AND PORT RISK

We use a model that is constrained and validated against coastal boulders to model the transport of a variety of built environment features commonly found in ports including containers, mobile offices and small buildings. We demonstrate the utility of the model for examining port damage and for the analysis large-scale structures (buildings) to inform the upper end performance of the model in natural settings where mega clasts of more than 20t are transported.

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