Numerical experiment of tsunami deposits related to fault parameters by sediment transport model

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Large tsunamis cause extensive damage to coastal areas. Underestimation of the tsunami risk can increase the extent of damage and delay reconstruction. To improve tsunami estimation requires review of many records of tsunami cycles and sources (i.e., geologic faults). Sand deposits from tsunamis provide many paleo tsunami records; however, the relationship between tsunami sand deposits and the magnitude of tsunamis is not understood. Takahashi et al. (1999) proposed a sediment transport model for tsunamis. This model was adapted using data from the 1960 Chilean tsunami in Kesennuma Bay, although the amount of sand transportation was underestimated due to the local topography. Takahashi et al. (2011) improved the model based on a hydraulic experiment using three types of sand grains, although verification using other grain sizes and mixed sand compositions has not been conducted. Furthermore, numerical analysis focusing on tsunami sand deposits in inundation areas has fewer verification examples. Yamamoto et al. (2017, 2018) carried out a hydraulic experiment to validate the sediment transport model. This experiment used three types of sand grains, which had sizes different from those used by Takahashi et al. (2011). The model of Takahashi et al. (2011) was confirmed to be very accurate for medium sand. However, the relationship between the tsunami sand deposits and fault parameters has not been verified.

To clarify the relation between tsunami sand deposits and fault parameters, we carried out numerical experiments of sediment transport in a simple topography. The numerical experiments consisted of two steps. The first step investigated the influence of fault conditions on the tsunami waveform. The fault condition was changed according to fault width, length, slip, and position. The waveform observed in this experiment was used as the boundary condition for the second step of the experiment. The second step investigated the effect of the tsunami waveform on the sand deposits in the land area. The topography conditions were changed by changing the slope of the sea area and land area. Furthermore, we investigated the effect of setting a structure in the land area on the sand deposits. Numerical experiments confirmed the points at which the nature of sediment deposits changes according to fault and topography conditions.

Keywords: Tsunami deposit, Numerical experiment, Fault parameter

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