Applying debris flow numerical simulations for disaster reduction and sabo works

Applying GUI equipped debris flow simulator KANAKO

〇Kana Nakatani (Kyoto Univ.), Yuki Okuyama (Kyoto Univ.)
Yoshifumi Satofuka (Ritsumeikan Univ.), Takahisa Mizuyama (Kyoto Univ.)

1. BACKGROUND

Debris flow disasters often cause huge damage to human life and the economy. Damage can be effectively reduced using numerical simulation, which can describe the debris flow process and determine the effects of sabo dams. We have developed KANAKO, a general-purpose debris flow simulation package equipped with an efficient GUI (*Nakatani et al., 2008*). The GUI-equipped system enabled users to prescribe the input data easily, and to understand the results instinctively from graphical animations. The integrated simulation system enabled users to run a high-quality debris flow simulations easily under wide-ranging conditions, providing better solutions for sabo engineering problems. In this study, we introduce 2 case studies of debris flow simulation, to see the construction such as sabo works and houses effect on disaster reduction.

2. CASE STUDY 1:DISASTER REDEUCTION AND SABO WORKS

We simulated a debris flow disaster that occurred on September 6, 2005 in Miyajima, Hiroshima Prefecture, Japan (*Kaibori et al., 2006*). In Miyajima historical heritage such as Itsukushima shrine exists, as shown in Fig.1 left. There was a failure at Mt.Misen and caused debris flow from upstream end. While debris flow was flowing downstream to residence and heritage existing area, it was surveyed that erosion from riverbed also developed the debris flow volume.
We consider the effective sabo works for this disaster applying KANAKO as shown in Fig.1 right and center. First, we simulated case without any sabo structures. Then we also simulated case with groundsill, and case with groundsill and sabo dam. The result shown in Fig.2 showed that not only constructing sabo dam but also the construction of groundsill in the steep area is effective to prevent this kind of debris flow disaster.

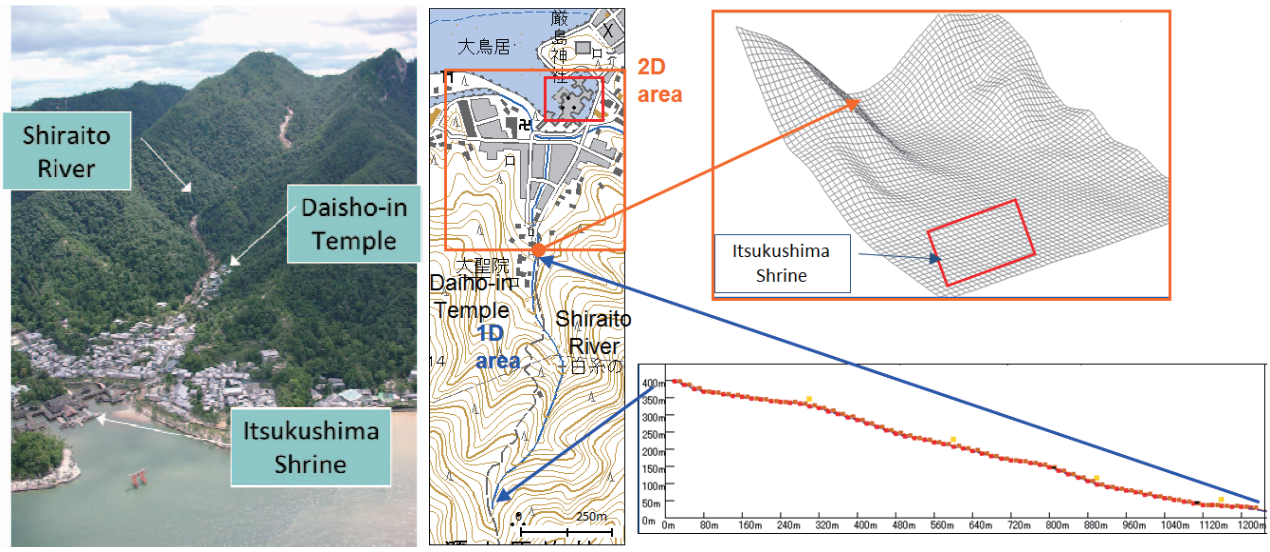

Fig. 1 Picture of Miyajima, provided by Hiroshima Prefecture Civil Engineering Office(left), Miyajima simulation area shown on KANAKO 2D (1D area in the lower right, 2D area in the upper right) and corresponding topography map (center)

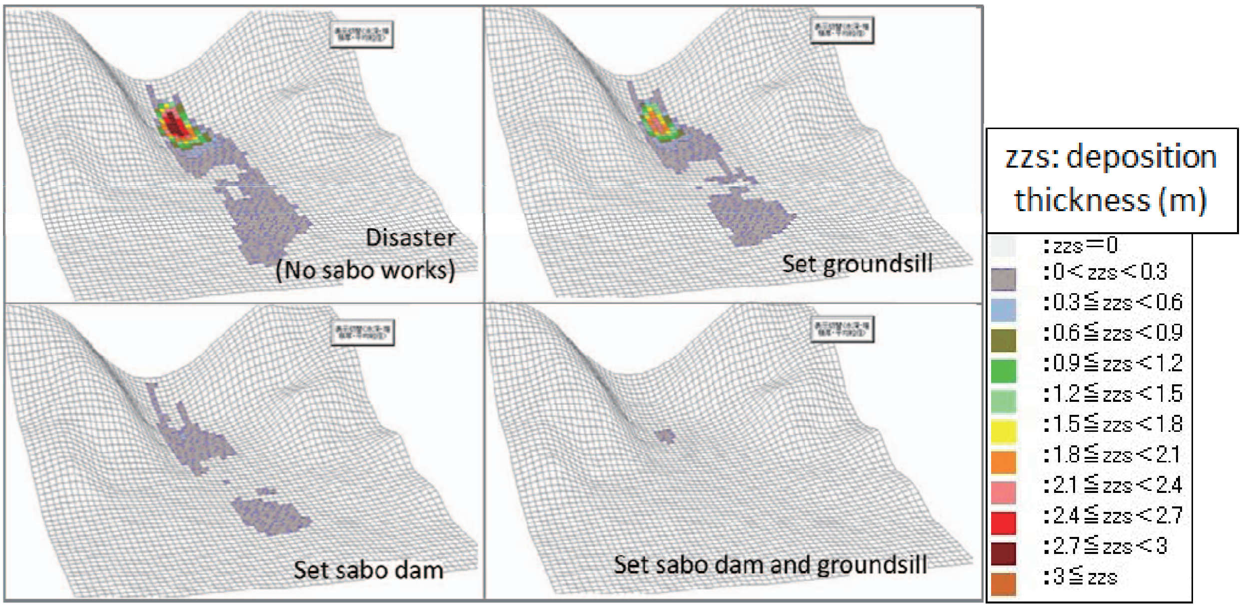

Fig.2 Results of Miyajima debris flow simulation

3. CASE STUDY 2:INFLUENCE OF HOUSES EXISTENCE ON ALLUVIAL FANS

Debris flow stops and deposits when it reaches an alluvial fan. There are often many houses on the fan, and they seem to influence the debris flow flooding and deposition process. However, there are few studies considering house existence on debris flow flooding and deposition. Therefore, we conducted numerical simulations KANAKO to confirm the influence of houses. The results show that when there are houses, debris flow spreads widely in the cross direction just upstream of the houses, shown in Fig.3. Existence of houses on the alluvial fan, also changes the deposition area. Some places cause damage as flooding and deposition because there are houses. Some places reduce damage because of the houses existence. We can see that house existence will change the flooding area and deposition area.

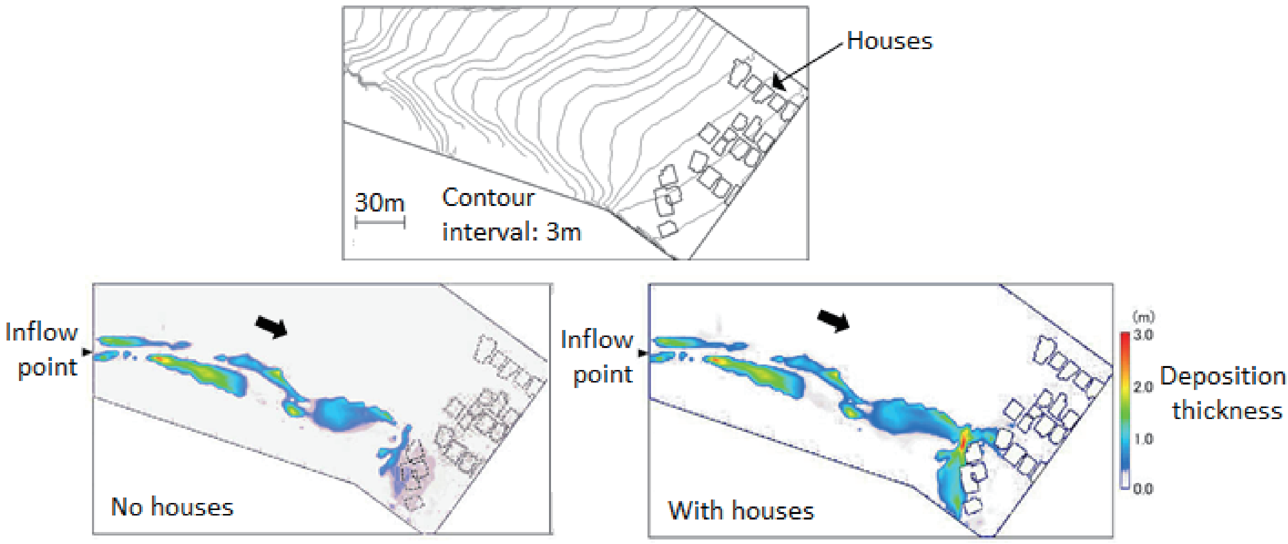

Fig.3 Contour of alluvial fan, data provided by Civil Engineering Research Laboratory (upper figure) and simulation results (left figure: without houses, right figure: with houses)

References

Nakatani, K., Wada, T., Satofuka, Y., Mizuyama, T. (2008): Development of "Kanako 2D (Ver.2.00)," a user-friendly one- and two-dimensional debris flow simulator equipped with a graphical user interface, International Journal of Erosion Control Engineering, Vol.1, No.2, pp.62-72.

Kaibori, M., Ura, M., Yoshimura, M., and Fujimoto, E. (2006) :Debris flow disaster on September 6, 2005 in Miyajima, Hiroshima Prefecture, Journal of the JSECE, Japan Society of Erosion Control Engineering , Vol. 58, No.5, pp. 18-21.