Analyzing House Damage from Mudflow and Flood Inundation through Two-Dimensional Riverbed Change Calculations

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1. Introduction

In recent years, the increased frequency of mudflow and flooding, attributed to climate change, has led to the release of muddy water containing a large amount of sediment from the river channel. This has resulted in damage to numerous houses and the loss of many lives. This study seeks a detailed understanding of the factors contributing to damage from mudflow and flood inundation. We first conduct calculations to reproduce mudflow and flood scenarios. Subsequently, we analyzed the correlation between these scenarios and the extent of damage sustained by houses.

2. Outline of investigation

We examined the watershed of the Gofukuya River, a tributary of the Uchi River in the Abukuma River system. This investigation focused on areas where mudflow and flood inundation took place as a result of the rainfall from Typhoon Hagibis in 2019. The analysis utilized the degree of house damage, as determined by the findings of Sakai et al.[1] The two-dimensional (2D) riverbed change calculation model, employed in the reproduction calculations, was developed based on Wada et al.[2]

3. Investigation findings

Figure 1 displays the final sedimentation depth obtained from the reproduction calculations and the actual riverbed changes recorded through aerial laser surveys conducted before and after the disaster. The sedimentation trends overall showed a close similarity with the reproduced calculations depositing within approximately 90% of the sediment compared to the actual sediment deposited as determined through differential analysis of the aerial laser survey. This implies that the reproduced calculations accurately replicate the actual conditions of sediment discharge and deposition.

Figure 2 illustrates the relationship between the hydrodynamic force and the degree of house damage as calculated through the reproduction calculations. As the hydrodynamic force increases, the extent of house damage also rises, indicating that the reproduction calculation can reasonably capture the occurrence of damage caused by mudflow and flood inundation.

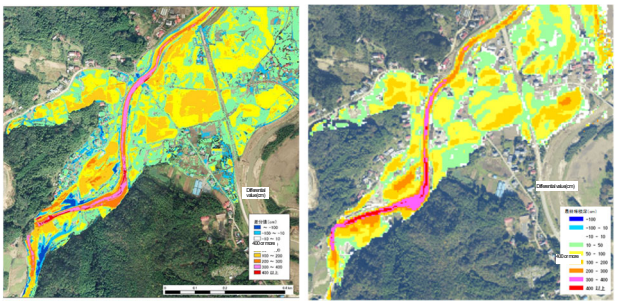

Figure 1. Actual riverbed change (left) and reproduced calculation results (right)

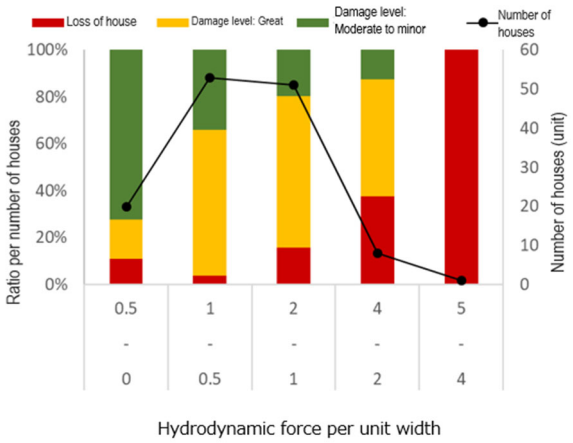

Figure 2. Hydrodynamic force and extent of house damage

4. Summary

In future studies, we plan to conduct more detailed investigations to understand the causes of house damage during mudflow and flood inundation events, the influence of sediment on this damage, and indicators for accurate estimation.

[References]

(1) SAKAI Yusuke et al. (2021). "Understanding the Actual Conditions of House Damage Caused by Mudflow and Flood Inundation: A Terrain Analysis (in Japanese)." *Civil Engineering Journal*, **Vol. 63, No. 1, pp. 30–35.**

(2) WADA Takashi et al. (2008). "Integration of 1D and 2D Simulation Models in Debris Flow Calculations (in Japanese)." *Japan Society for Erosion Control Engineering*, **Vol. 61, No. 2, pp. 36–40, 2008**