Reproduction of Sediment / Flood Cases considering Fine Sediment Behaviors

(Study period: FY2013 to FY2019)
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1. Introduction

To prevent / mitigate sediment disasters, it is important to forecast accurately sediment movement phenomena that could occur in future. To this end, riverbed variation calculation is an effective tool. For example, in the July 2017 Kyushu Heavy Rain, a large amount of sediment was produced due to the frequent occurrence of slope failure and debris flow in the upstream of the Akatani River in the Chikugo River System (Asakura-shi, Fukuoka) and flowed down the river and caused flood and enormous damage in the downstream area. In this disaster, flow of a large amount of fine sediment is considered to have contributed to the expansion of damage. The Sabo Planning Division attempted to reproduce the riverbed variation with calculation considering the behaviors of fine sediment in the sediment flow / flood caused by the Northern Kyushu Heavy Rain.

2. Outline of the model used

Since part of the fine sediment moves in a turbulent state like water and contributes to the increase in fluid force, the model was designed to be able to consider this event. In addition, since the pattern of sediment movement (Fig. 1) changes according to riverbed slope and sediment concentration, the calculation model is designed to be able to consider flow resistance, conditional equation of exchange with the river bed of sediment (erosion / deposition speed equation), and variation by the sediment movement pattern in the equation of equilibrium concentration.

3. Result of model verification

We verified the model focused on the sediment dynamics in the Akatani River basin. We calculated two cases --- Case 1 is related to the control of the equation of erosion / deposition speed and the equation of equilibrium concentration only with riverbed slope, while Case 2 is related to the control of the same with riverbed slope and flow concentration. Fig. 2 shows the actual and calculated values of riverbed variation at each point, which was calculated with the difference analysis of LP data.

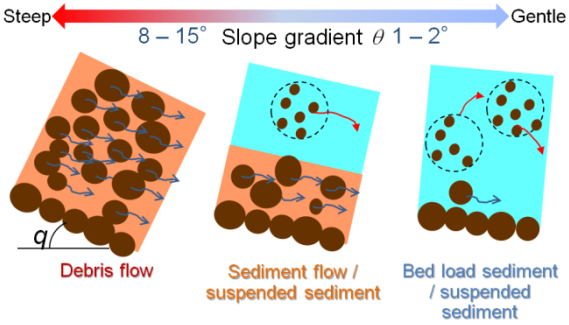

Fig.1 Image of sediment dynamics in a mountainous river

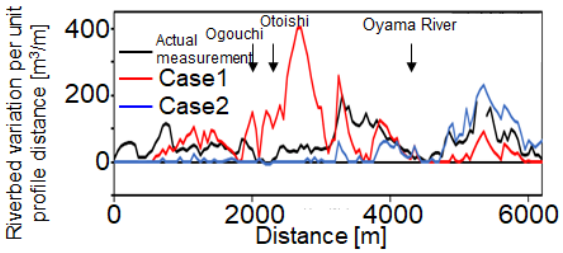

Fig. 2 Calculation result of reproduction of riverbed variation

In Case 1, abnormal deposit occurs at a point where the sediment movement pattern changes according to the calculation, while this will not happen in Case 2 and riverbed aggradation in the downstream can be reproduced close to the actual form.

4. Conclusion

It was found from the verification conducted that transition of the sediment movement pattern should be fully considered as well as the behaviors of fine sediment, to improve the accuracy of reproduction of the sediment dynamics model in mountainous rivers. For the future, we intend to verify the versatility of our findings above and improve the models for more accurate examination of the effect of sabo facilities so that the techniques can be utilized in practice.

☞See the following for details.

1) Nakamura et al. (2019): Calculation of sediment dynamics including a lot of fine sediment in a mountainous river under heavy rain, Collection of Summaries on the 2019 Japan Society of Erosion Control Engineering Research Presentation Meeting