Longitudinal and Continuous Water-sediment Monitoring and Related Monitoring Methods in the Jo-Gan-Ji River

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INTRODUCTION

Information of sediment and water runoff has been tried to collect by continuous measurement for bed load, suspended load, wash load, water level and so on in mountainous torrents in Japan for the sediment control and management in a basin. Relations between bed load and wash load and water runoff have been shown through the field monitoring (Mikami et al., 2014), and it is found that there is discontinuous relationship between sediment and water runoff in mountainous region. Through reviews of passive and direct sediment monitoring in Japan and abroad, a set of pipe hydrophone for bed load, pressure sensor for flow depth and turbidity meter for wash load, and electromagnetic velocity meter on the bed for shear velocity is selected for preferable monitoring tools, and it is installed at several sections along the Jo-Gan-Ji River to evaluate longitudinal and temporal changes of water and sediment runoff (e.g., Mikami et al., 2014). Present study shows typical monitored data for water, bed load and wash load runoff via rainfall during recent 2 years after installation of sensors.

BED LOAD AND WASH LOAD MONITORING ALONG THE JO-GAN-JI RIVER

In the Jo-Gan-Ji River, the monitoring tools and data collection systems for evaluating sediment runoff have been tried to prepare since continuous monitoring started in 2001, and concentrated management for hydro and sediment information can be conducted from a view of sediment control and detection of sediment movements in mountainous basin. Monitored data have been integrated concentratedly from every observation station to the sabo office through the optical line in 2015. Tsunoura-Karyu sabo dam (T.-K., slit dam) has two slits, in which watershed area is 139.49 km^2, bed slope near the dam is 1/56 (= 1.02 deg.) in 2007, slit width is 16 m, slit height is 7 m and there are several sensors, which are including flow depth, pipe hydrophone, robust type hydrophone, bed load sensor (Itoh et al., 2016), Reid type bed load slot and so on for monitoring sediment runoff.

Bed load discharge rate is calculated by a linear correlation between impulses of hydrophone and submerged weight of sediment in the slot, and wash load discharge rate is also calculated by a linear correlation between voltage of turbidity meter and volumetric sediment concentration. Wash load is

Table 1 Estimated sediment volume of bed load and wash load during one year in 2016 (T. -K.)

Month, Year	Bed load (m^3)	Wash load (m^3)	Month, Year	Bed load (m^3)	Wash load (m^3)	Month, Year	Bed load (m^3)	Wash load (m^3)
1, 2016	0	5062	5, 2016	140	5487	9, 2016	741	3
2, 2016	16	6	6, 2016	40	3509	10, 2016	124	0
3, 2016	0	0	7, 2016	225	665	11, 2016	1	0

defined as finer particles which can be measured by turbidity meter (less than 0.1mm in diameter). Table 1 shows one example of estimated sediment volume of bed load and wash load during one year in 2016 (at T.-K.). Temporal changes of bed load and wash load can be estimated using those correlations. **Fig. 2a and b** show observed data of bed load by pipe hydrophone and wash load via the flow depth in floods on 26th to 28th July in 2016, and turbidity meter at Karatani sabo dam (K.T., close-type dam), which is at just upstream of the T.-K.. The loop of wash load is anticlockwise, and however the loop of bed load is clockwise in observed data at the K.T.. While, the loop of bed load observed at the T.-K. was anticlockwise. The loop of wash load is well-known, and while hysteresis of bed load is recently repeated through monitored data using hydrophone. The loop of bed load is newly found, and the reasons need to examine theoretically.

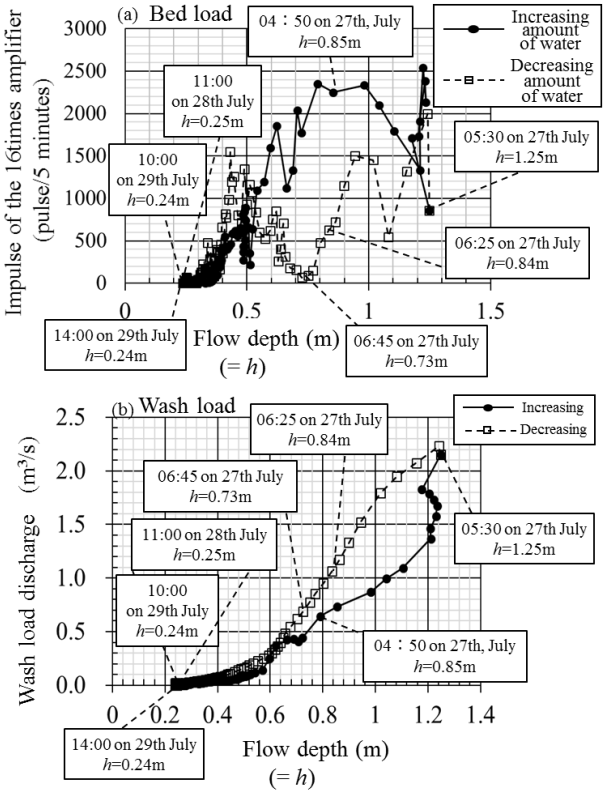

Fig. 2a and b Relation between flow depth and bed load by pipe-hydrophone and wash load in floods on 26th to 28th July in 2016 (at K.T.)

CONCLUSIONS

Sediment control and management in a basin can be carried out through water and sediment-runoff information and those related data obtained by several kinds of sensors in mountainous torrents. Flow depth, bed load and wash load were continuously measured at several sections along the Jo-Gan-Ji River, and the related data became concentratedly recorded at the sabo office. Attempts to evaluate water and sediment runoff will be continued through those monitoring, because of a basin management and alert detection.

REFERENCES

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