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Verification of STIV analysis of flood discharge at Nakano Observatory in the Ota river by flow analysis using ALB data

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Introduction

Background: Recent severe flood conditions that surpass planned severity pose new challenges for the earlier type of flood river discharge measurement using floating rods. For such practical issues, non-contact type measurement methods including space-time image velocimetry (STIV, Fujita *et al.*, 2007) using cost-efficient devices and improved algorithms for flow analysis have been developed and attracting hydraulic engineers. Nevertheless, their applicability must be verified and improved for various river conditions.

Objective: We conducted flow measurements using STIV analysis at Nakano Observatory in the lower Ota River in Japan (Fig.1, Fig.2). Our targeted flood occurred during the heavy rainfall event in early July 2018. Then, we examined the accuracy of the discharge hydrography by means of the present STIV analysis, comparing observations of flooded water levels with numerical simulations results that used the discharge hydrograph.

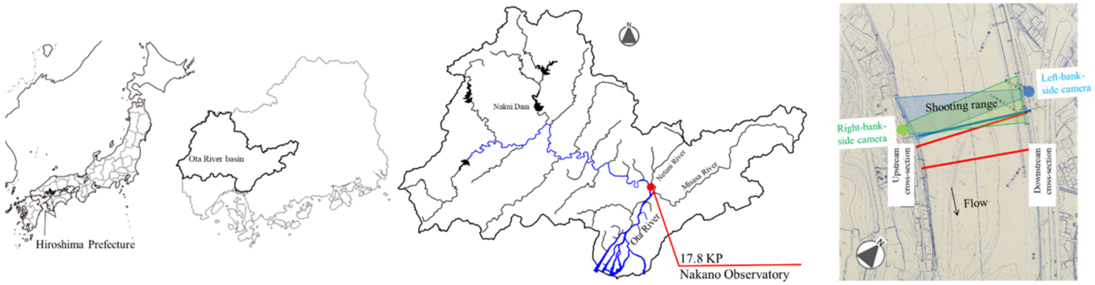

Figure 1. (left)Study site: Nakano Observatory and Ota River basin in Hiroshima, Japan.
(right) Targeted cross-section and observation setup at Nakano Observatory (17.8 KP).

Methodology

- We obtained data of river bed elevation, land-cover classification using airborne laser bathymetry (ALB) data (Fig.3) for flooded river simulations.
- We measured water levels at four locations during flooding (Fig.4).
- We set up two cases for numerical simulations (Table 1).

Key Results

- Longitudinal profiles of the simulated water levels using the present discharge hydrograph are approximately consistent with the observations (Fig.5).
- Simulated water levels in Case 1 (H-Q relation) are overestimated by an average of approximately 50 cm compared with observations. Simulated results obtained for Case 2 (present STIV-derived hydrograph) are consistent with observations (Fig.6).

Reference

Fujita *et al*. (2007). Development of a non-intrusive and efficient flow monitoring technique: The space-time image velocimetry (STIV). *Intl. J. River Basin Management*, 5(2):105-114.

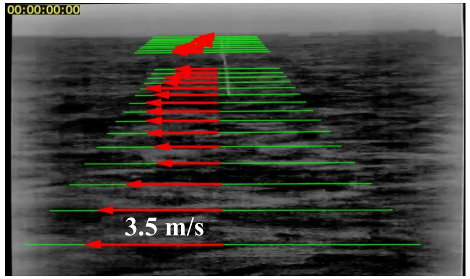

Figure 2. Left-side infrared camera image superimposed with corresponding STIV result at 19:00 on July 6 at the targeted cross-section: green lines, searching lines for STIV analysis; red vectors, surface velocity vectors.

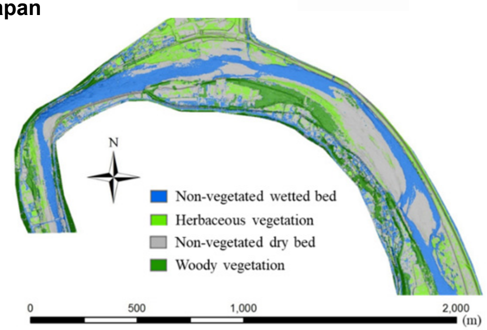

Figure 3. Land cover classification for the targeted river reach using the ALB data obtained after flooding in 2018.

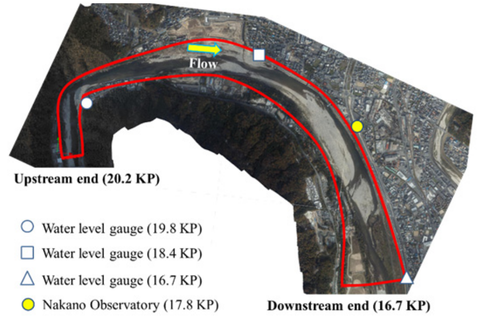

Figure 4. Targeted river reach and water levels measured at four points during flooding.

Table 1. Discharge conditions for numerical tests.

	Discharge hydrograph	Approximate value of peak discharge during flooding
Case 1	Stage–discharge relation (*H*-*Q*)	3000 (m3/s)
Case 2	STIV	2600 (m3/s)

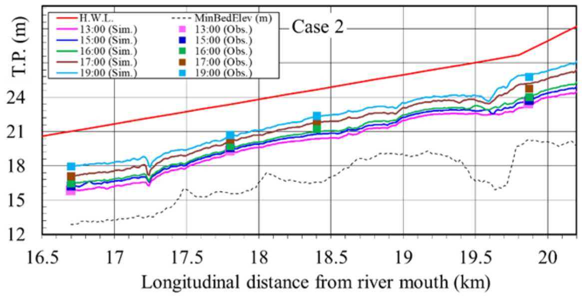

Figure 5. Longitudinal distribution of simulated water levels along the reach for Case 2 with observation: H.W.L., high water level; MinBedElev, minimum bed elevation; Sim., simulation results; Obs., observation results.

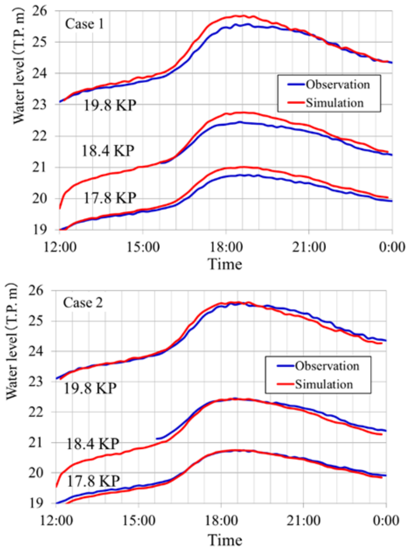

Figure 6. Time variation of observed and simulated water levels along the reach: left, Case 1; right, Case 2.