Morphological Changes due to the Peak Flow and Seasonal Flow of Babame River

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１．Introduction

Morphological change is a natural event that depends on numerous parameters and its adjustments in rivers and their correlation with natural and some controlling factors can be determined by the analysis of morphological parameters, such as channel length, width, depth, braiding, sinuosity, shifting, and patterns as proposed by various researchers (Clerici et al.,2015). Erosion processes during the high flow event can affect substantial topographic changes along with the river systems (El-Dairi and House, 2019). A two-dimensional model has been used for simulating the riverbed evolution and the model consists hydrodynamic equations, sedimentological and bed deformation equations (Zhang et al.,2014). Nays2DH software which is for the calculation of flow, sediment transport and morphological changes and hydrological and hydraulic data are using in this study. Assessing the channel geometry changes with flow variations in past and present evaluating the measurement of instantaneous discharge support not only the historical changes but also present morphological change (Mossa, 2016). The high flood happened in 2017 August caused by the heavy rainfall that led to the damage of the revetment in Babame River (Ueki and Watanabe,2017). The location of the Babame River is as shown in the fig1. The previous study explored the behavior of sandbar formation grasped from the aerial photographs (Fujisawa et al.,2019). The present investigation focuses on river morphological changes due to the seasonal flow and peak flow in the Babame River and the understanding of flow effects and various cross section changes become more important (Hooke, 2007). Therefore, the determination of the impacts of seasonal flow and peak flow is important not only for the river morphological studies but also for the river management systems.

２．Methodology

Analyzing the flow patterns and sediment transport is one part of the river engineering. It is necessary to have a model that can simulate the dynamics of rivers. One of the two-dimensional numerical models that can applied to hydrodynamic cases in Nays2DH model from iRIC. It can complete calculations of flow patterns, sediment transport, riverbed changes and erosion modeling simulation in the river. The purpose of this modeling is to analyze the distribution of flow patterns and sedimentation that occur in the Babame River. The basic equations are used such as depth-integrated equation for flow analysis and momentum equation for the flow analysis shows in the equation (1), (2) and (3). For the bedload consideration, Meyer-Peter and Muller formula in equation (4).

$$\frac{\partial \mathrm{h}}{\partial t}+\frac{\partial \mathrm{uh}}{\partial x}+\frac{\partial \mathrm{uh}}{\partial y}=0 \tag{1}$$

$$\frac{\partial(uh)}{\partial t}+\frac{\partial(hu2)}{\partial x}+\frac{\partial(huv)}{\partial y}=-\mathrm{gh}\frac{\partial H}{\partial x}-\frac{\tau_x}{\rho}+D^x+\frac{F_x}{\rho} \tag{2}$$

$$\frac{\partial(vh)}{\partial t}+\frac{\partial(huv)}{\partial x}+\frac{\partial(hv2)}{\partial y}=-\mathrm{gh}\frac{\partial H}{\partial y}-\frac{\tau_y}{\rho}+D^y+\frac{F_y}{\rho} \tag{3}$$

$$q_b=8(\tau^*-\tau*c)^{1.5}\sqrt{s_{\mathrm{g}}gd^3}\gamma_b \tag{4}$$

Where, h is depth of water, t is time, x and y are the coordinate along the longitudinal and transverse directions, g is gravitational due to acceleration, H is surface water elevation, u and v are depth-averaged flow velocity in x and y direction, τ_x , τ_y are the component of shear stress of bed in x and y direction, F_x and F_y are components of drag force by vegetation in x and y direction s_g is specific weight of bed material in fluid, d is grain size of bed material, ρ is density, τ_{*c} is the critical shield stress and q_b is total bedload transport, r_b is the function of exchange layer thickness.

By applying those equations, the flow analysis and sediment supply is calculated. After simulation, the results output as the visualization of river morphological changes and produced the sets of parameters values along the river such as elevation changed, velocity, water surface elevation and so on.

Keywords morphological change, peak flow and seasonal flow, Nays2DH
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３． Results and Discussion

The morphological change in channel bed elevation in varying cross sections as shown in the fig2. Bedload sediment consideration used for this study. Erosion and deposition occurred after a high flow event. The outcome results are highly dependent on the relations of sediment supply from upstream. The thresholds for morphological changes can be compared in the flood events with the seasonal flood.

The results of riverbed elevation changed in fig.2 shows the visualization results after high flow in 2017. Comparing these results with the seasonal flow and high flow descried in fig3 a, b and c by dividing with three cross sections. According to the results of fig.2, erosion happened in the left bank of the upstream part and right bank in the middle part and downstream part. Deposition occurred mostly in the inner part of the river bend. Based on the results of cross sections, bed elevation changed slightly in the upstream and middle part of seasonal flow but changed significantly in 2017's flow. In the downstream part, both results are more changed than the upstream and middle parts. By comparing all the sections, the simulated results of elevation changed in high flow more changed than the seasonal flow. Therefore, 2017's flow or high flow is more impacted than seasonal flow or average year flow.

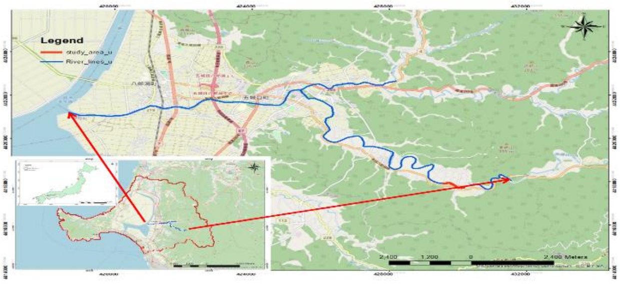

Fig1. Location of the Babame River

4. Conclusions

Morphological changes play an important role in the rivers. Seasonal flow is still important to know the morphological changes in the river. Long term analysis of river morphological changes will be more effective for the river management system. Therefore, determining the morphological changes due to the seasonal flow and peak flow important make more understanding of river issues. Moreover, it will support the decision support system of river management issues.

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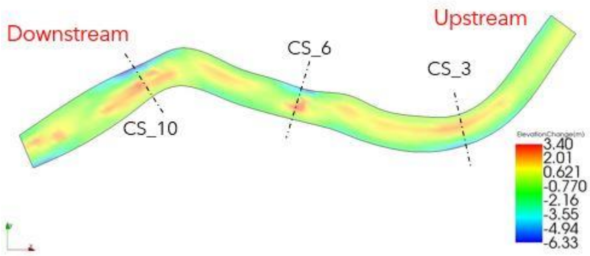

Fig2. The elevation changed after high flow.

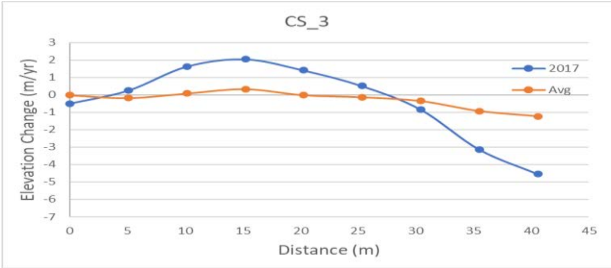

Fig3a. Elevation changed in CS-3

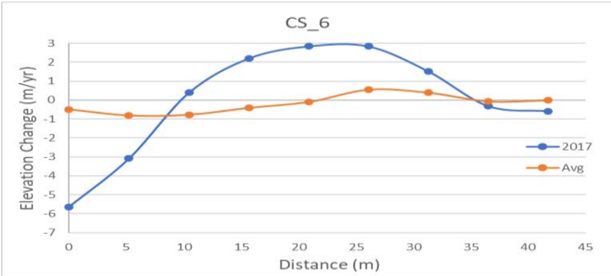

Fig3b. Elevation changed in CS-6

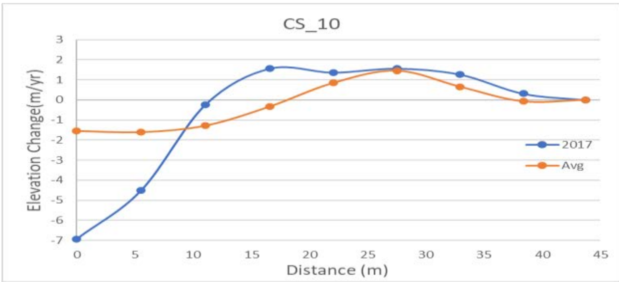

Fig3c. Elevation changed in CS-10

Reference

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