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Prediction of Morphological changes for the Effective Riverbank Protection Measures Using 2D Numerical Model: A Case of Uji River Japan

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Understanding the morphological changes of a river channel is vital in the design and implementation of appropriate countermeasures against riverbank erosion. In this regard, the current study aims to investigate the changes in morphology of Uji River in Kyoto, Japan with an objective to identify the potential locations vulnerable to bank erosion. A 2D hydro-morphological model will be applied in the study reach for the prediction of river channel morphological changes and hence identify susceptible locations of bank erosion.

1. INTRODUCTION

River morphology is influenced by several factors: change in flow discharge, flood events, alteration in sediment supply and human interventions to name a few. Changes in river morphology directly impact the channel width adjustment process through riverbank erosion. Therefore, understanding the changes in river channel morphology is vital for maintaining stable channel sections and hence the long-term river management. In this context, this study intends to predict the changes in river channel morphology by using depth averaged 2D coupled model of flow and bed morphology.

2. STUDY AREA

The river reach selected for the current study is the Uji River beginning from the confluence with Yamashina River near Mukaijima to about 6km downstream. Within this reach, the curved portion near the Ujigawa Open laboratory is analyzed in detail. Analysis of the river bankline changes and the corresponding areas eroded for this particular location are presented in **fig.1.** It can be seen from the **fig.1** and **fig.2** that continuous erosion has occurred along the outer bank while the point bar has formed along the inner bank.

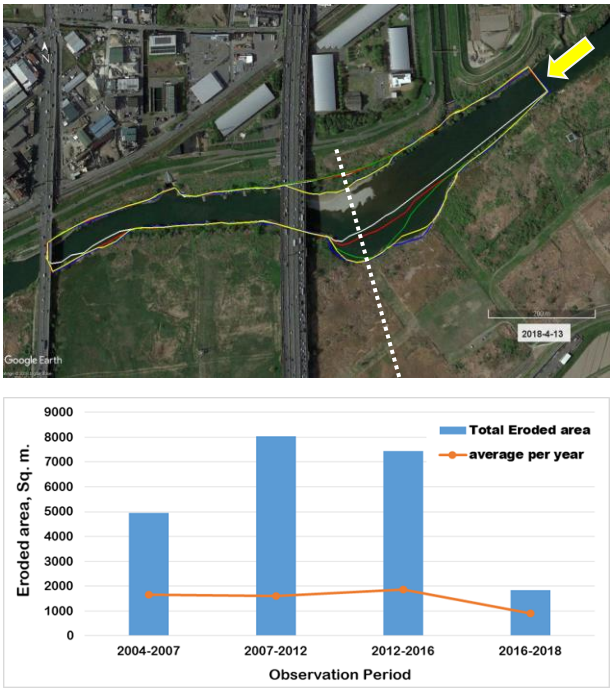

Fig.1: Change in the river bankline (top) and the corresponding eroded areas over the period (bottom).

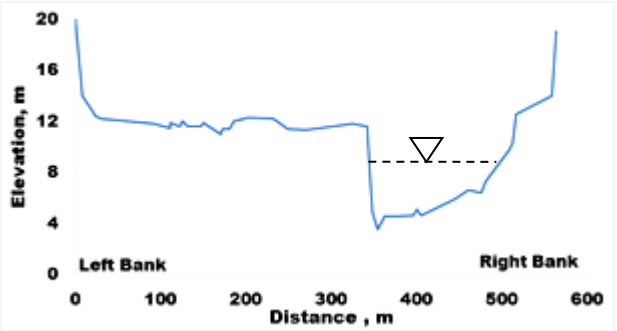

Fig. 2: Typical cross-section and water-level along the curved reach shown in white dotted line in **fig.1** (top)

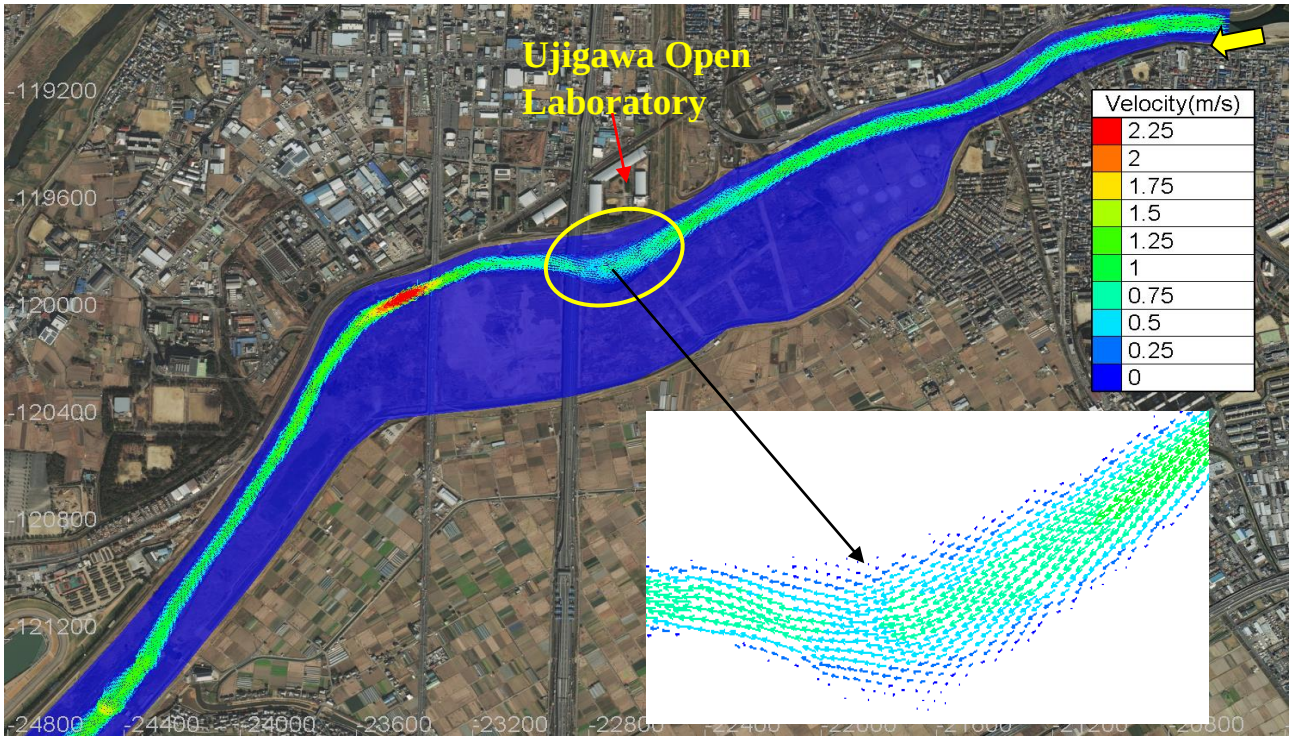

Fig.3: Velocity distribution along the channel

3. MODEL AND HYDRAULIC CONDITION

An open source TELEMAC-2D model which solves the Saint-Venant equations using the finite-element or finite-volume method in a computation mesh of triangular elements is used for the simulation. The effect of secondary flow in curved channels has been included. Non-uniform sediment transport based on active layer concept has been applied and Exner equation is solved for bed evolution.

The model will be simulated for a period of three years from 2013-2015. River cross-section data at 200m interval obtained from MLIT has been used for generating channel bathymetry whereas measured discharge and water-level data near Kumiyama-cho, Ohashiberi, Kyoto observing station has been used as the inflow-outflow boundary condition. Similarly, analysis of the particle size distribution based on sediment samples from two different location was done which showed D_{mean} of approximately 10mm.

4. PRELIMINARY RESULTS

First the model was run under fixed bed case in order to calibrate the model. **Fig.3** shows the velocity distribution along the channel for a flow of 257m^3/s on the first day of simulation. Similarly, **fig.4** illustrates the water-surface profile along the channel. The outflow discharge and water-level closely matched with the observed values. In the next step, bed and bank morphological change will be simulated.

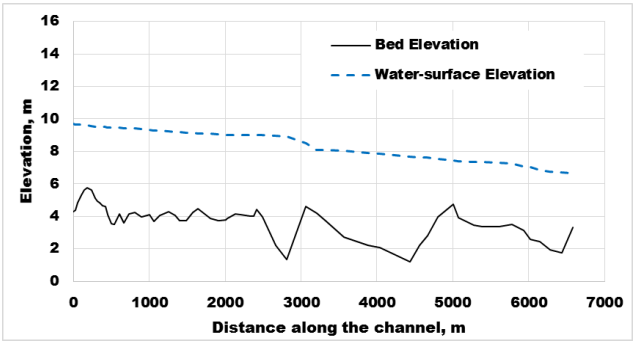

Fig.4: Water-surface profile along the channel

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