# 2D numerical modelling of short-term morphological change in meander bends

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## Introduction

Prediction of morphological changes in meander bends is important to assess the performance of river-training works and channel navigability. With use of a groyne field, both sufficient navigable depth improvement and bank erosion protection are possible in meander bends. The hydraulic performance of a groyne field depends mainly on its layout and dimensions and local hydraulic and morphological conditions. To optimize groyne field design, either a physical or a numerical river model study is required Several studies have been carried out to predict groyne field morphological changes in a river reach using physical river models (e.g., Klingeman et al. 1984; Kuhnle et al. 1999). On the other hand, several 2D river models have been used by many investigators for hydrodynamic and morphological simulation. Abad et al. 2008 and Papanicolaou et al. 2010 well validated the two and three-dimensional numerical models with groyne field performance in straight or meandering physical river model studies for river bank protection or flow diversion. Lotsari et al. (2014) studied morphological changes in the braided lower Tana River using numerical simulations. Very recently Karmaker and Dutta, 2016 conducted a study to predict the short-term morphological change in large braided river using 2D numerical model.

Based on the physical model experiments carried out for the typical meandering section of Vamanapuram river, this study developed a MJKE 21 C numerical model to predict the short-term morphological changes in the selected section, under different groyne field layouts, for the better understanding of the flow, scour and sediment deposition patterns associated with implementing the groynes.

## Materials and Methods

A physical model of a typical section of Vamanapuram River was constructed in the Coastal Engineering Laboratory at the College of Engineering Trivandrum (Figure 1). Experiments were conducted with and without groynes to identify the critical regions of erosion. For each set of experiments velocity is measured at 14 different sections of physical model using ADV instrument. The eroded bed levels after experiments were measured at the different points in 14 sections. Different layout designs for a series of groynes were tested to determine the optimal design for the given situation, in terms of the projection lengths of the groynes, the spacing between the groynes as a factor of the projection length (S/L ratio), and the orientation of the groynes with regard to a constant discharge condition. A mathematical model, MIKE 21 C is used to simulate the physical model numerically. Simulated flow depth and velocity were calibrated with the observed data from the physical model, and predicted bed levels were validated with observed bed levels, under no groyne condition and with groyne condition for 45, 90,135 degree orientation respectively for a S/L ratio 2.5 Later calibrated numerical model is used to evaluate the behaviour of model morphology, under all possible orientation and S/L ratio of the groynes that are difficult to carry out by physical model experiments.

## Results and Concluding Remarks

This study reveals that a 2D morphological model with appropriate sediment functions and boundary conditions can be used for adequately predicting short-term morphological changes in a meander bends. From the 7 sediment transport formula available in the numerical model it was found that Engelund and

Hansen formula with 90% bed load and 10 % suspended load is optimum for the present situation. Calibrated numerical model showed the same trend of erosion as in the physical model. Numerical model successfully simulate the effect of groyne field with 45, 90,135 degree orientation (Figure 2). From the results obtained from the physical and numerical models, it was found that groynes with a S/L ratio 2.5 with 10 cm projection is optimal. Higher S/L ratio makes more erosion near the groyne tip and in some situations model became unstable in higher S/L ratio.

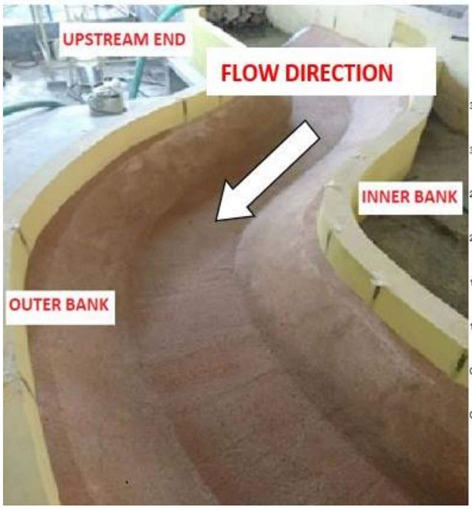


*Figure 1. physical model*

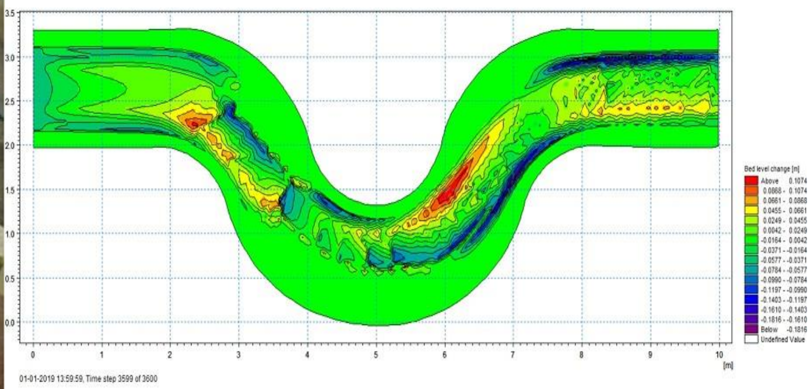

*Figure 2. bed level change simulated for 45 degree groyne with S/L ratio 2.5*

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