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Numerical study on tidal currents and bed morphology in Sittaung River estuary, Myanmar

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Summary

Present study describes tidal currents, sediment transportation, sand bar migration and bank erosion of the Sittaung River estuary in Myanmar based on analysis of satellite images, field investigation and numerical simulation. Stream channels and sand bars move dramatically leading to severe bank erosion at a rate of around 1 km every year at the most active areas. Numerical tool is provided for prediction of drastic morphological changes and probable countermeasures against sediment induced disaster like bank erosion are recommended. Contents of this study are organized in five chapters.

Chapter 1 briefly describes the background, challenges and issues associated with estuary morpho-dynamics of the study area, necessity and position of the present study through literature reviews. Understanding sediment transport processes in estuaries composed of very fine sediment is justified and probable contribution of the study in scientific field are described here.

Chapter 2 discusses the geo-morphological and hydrological features of the study area, intensity and severity of bank erosion by means of satellite images and data collected during field investigation. Tidal bores, strong tidal currents and presence of very fine particles with mean diameter of 0.02 to 0.04 mm as bed and bank materials impact erodibility and transportability of such materials so actively.

Chapter 3 describes the weakness of existing formulas in treating fine sediments. To solve this issue, a new model is proposed for treating sediment transport process of very fine sediment and combined it with the depth-averaged two-dimensional Reynolds equations to simulate tidal

bores, associated tidal currents, sediment transportation and active morphological changes. The proposed model is tested for validity, by being applied to the estimation of suspended sediment concentration and particle sizes. Computed results show that tidal bores and associated tidal currents are reproduced well where the bore is identified as a discontinuous water surface configuration and that the particle sizes of suspended sediment are predicted well.

Chapter 4 describes numerical results on stream channel pattern and sand bar evolution using the numerical tool proposed in the previous chapter. Such results are compared with available satellite images and data obtained during field investigation. Channel bifurcation and channel closing are also reproduced. It is understood that such channel-change elements are responsible for the development process of sand bars and that the cyclic change of the bank line shifting may be caused by stream channel bifurcation. In addition, spur dykes are employed on the created morphology for channel-change and sand-bar control purposes. The analysis results show that such control structures can be effective as hard countermeasures to control severe erosion in the estuary. The periodicity of a decadal scale is simulated on smaller temporal and spatial scales. The results show that stream channel bifurcation characteristics is the governing factor behind the periodicity of the channel change. The lifetime of one channel can be quantified as a ratio of the cumulative volume of suspended sediment discharge and suspended sediment discharge along the channel. Long term morphological changes are discussed based on experimental study and necessary indication is provided for future prediction.

Such tool can be employed for the prediction of channel change and sand bar deformation, identification of vulnerable locations to bank erosion and probable countermeasures for combating sediment induced natural disasters in the estuaries composed of such fine particles around the world. Dissemination of such outputs to the policymakers and stakeholders are discussed for future planning of socio-economic development of the estuary region.