INTERNATIONAL JOURNAL OF SEDIMENT RESEARCH

国际泥沙研究

Volume 21 Number 2 June 2006

Technical Papers

Impacts of Dimension and Slope of Submerged Spur Dikes on Local Scour Processes - an Experimental Study
Daxian FANG, Jueyi SUI, Ronald W. THRING and Hongya ZHANG 89-100

Depth-Average Analysis of Hysteresis between Flow and Sediment Transport under Unsteady Conditions
Weiming WU, Mustafa ALTINAKAR and Sam S. Y. WANG 101-112

Retrogressive Erosion and Longitudinal Profile Evolution in Noncohesive Material
Lien-Kuang CHEN and Su-Chin CHEN 113-122

Spatial and Temporal Changes in the Brahmaputra River Bed
Prabhata K. SWAMEE, Barham PARKASH, and Santanu SARMA 123-131

Spatial Distribution and Morphological Features of Gullies in an Agropastoral Area in Sardinia, Italy
Claudio ZUCCA, Annalisa CANU and Raniero DELLA PERUTA 132-144

Experimental Investigations and Numerical Simulations of Reducing Secondary Flows around a Spur Dike
Xuelin TANG, Xiang DING, Zhicong CHEN and Wenlong WANG 145-157

Technical Notes

Channel Evolution after the Construction of the 1st Phase of the Deepwater Channel Project of the Yangtze Estuary
Hualin WU, Huanting SHEN and Yonghong WANG 158-165

Live-Bed Scour in Long Contractions
Subhasish DEY and Rajkumar V. RAIKAR 166-170

IMPACTS OF DIMENSION AND SLOPE OF SUBMERGED SPUR DIKES ON LOCAL SCOUR PROCESSES - AN EXPERIMENTAL STUDY

Daxian FANG1, Jueyi SUI2, Ronald W. THRING3 and Hongya ZHANG4

ABSTRACT

In this experimental study, the impacts of the slope of the upstream face of submerged spur dikes on scour patterns in the vicinity of the submerged spur dike have been investigated. Associated hydraulic parameters for scour initiation have been studied. The dependence of the criteria for scour initiation and scour patterns on the dike dimensions such as the dike length and height has been assessed. It is found that the maximum depth of a scour hole is localized upstream of the spur dike end. The location of the maximum scouring depth, the end of the spur dike, and the spot with the maximum deposition are nearly aligned and form a line approximately parallel to the flume wall. Results show that the proper selection of a sloped upstream face of the spur dike can significantly reduce the maximum scour depth and scour volume in the vicinity of the submerged spur dike. Equations have been established to describe the dependence of the criteria for scour initiation and the maximum depth of the scour hole on the Froude number of the flow, the blockage of the cross section by the spur dikes, the slope of upstream face of the spur dike, and the grain size of the bed material.

Key Words: Spur dike dimensions, Froude number, Local scour, Scour depth, Slope of upstream face (SUF) of spur dike, Submerged spur dike

DEPTH-AVERAGE ANALYSIS OF HYSTERESIS BETWEEN FLOW AND SEDIMENT TRANSPORT UNDER UNSTEADY CONDITIONS

Weiming WU5, Mustafa ALTINAKAR2 and Sam S. Y. WANG3

[1] Assoc. Prof., Department of Civil Engineering, Hefei University of Technology, Anhui 230009, China

[2] Assit. Prof., Environmental Science and Engineering, University of Northern British Columbia, Prince George, BC, Canada, V2N 4Z9, Corresponding author, E-mail: sui@unbc.ca

[3] Prof., Environmental Science and Engineering, University of Northern British Columbia, Prince George, BC, Canada, V2N 4Z9

[4] Assoc. Prof., Anhui Institute of Architecture and Industry, Hefei, Anhui 230022, China

Note: The original manuscript of this paper was received in June 2005. The revised version was received in Nov. 2005. Discussion open until June 2007.

[5] Res. Assoc. Prof., [2] Res. Prof., [3] Prof., National Center for Computational Hydroscience and Engineering, The University of Mississippi, MS 38677, USA, E-mail: wuwm@ncche.olemiss.edu

Note: The original manuscript of this paper was received in Nov. 2004. The revised version was received in March 2005. Discussion open until June 2007.

ABSTRACT
A depth-averaged two-dimensional model has been established to simulate unsteady flow and sediment transport in streams. The difference in flow and sediment velocities is considered. It has been found that the depth-averaged suspended-sediment velocity and the bed-load velocity are smaller than the depth-averaged flow velocity, inducing a time lag between water and sediment transport. The significance of this time lag increases as the sediment size increases. The exchange between the moving sediment and the bed material, which may induce a spatial lag, is modeled by a non-equilibrium transport approach. Tests using laboratory and field measurements have shown that the established model is capable of capturing the hysteresis between flow and sediment transport under unsteady conditions. It is demonstrated that the hysteresis is larger when the hydrograph has steeper rising and falling limbs, and the time delay increases downstream.

Key Words: Hysteresis, Temporal and spatial lags, Unsteady flow, Sediment transport, Depth-averaged 2-D model, Non-equilibrium transport

RETROGRESSIVE EROSION AND LONGITUDINAL PROFILE EVOLUTION IN NONCOHESIVE MATERIAL

Lien-Kuang CHEN[6] and Su-Chin CHEN[7]

ABSTRACT
Retrogressive erosion plays a significant role in soil erosion and in channel morphology evolution. Retrogressive erosion occurs and migrates when the flow conditions and/or channel bed slope change. This study investigates through a series of experiments, the migration behavior of retrogressive erosion and the longitudinal profile evolution of a channel consisting of noncohesive sediment. Experimental results indicate that retrogressive erosion can be categorized into two types, stepped and rotating. In stepped erosion a nearly parallel erosion surface migrates upstream at a constant speed. The migration speed in rotating erosion is a function of the square root of time. The experimental results reveal that the discharge does not affect the migration speed of stepped erosion. However, the migration speed of rotating erosion

[6] Dr., Department of Soil and Water Conservation, National Chung Hsing University, Taichung, Taiwan 402, China, E-mail: steven_chen@ncdr.nat.gov.tw
[7] Prof., Department of Soil and Water Conservation, National Chung Hsing University, Taichung, Taiwan 402, China, E-mail: scchen@nchu.edu.tw
Note: The original manuscript of this paper was received in Aug. 2004. The revised version was received in Sept. 2005. Discussion open until June 2007.

increases with rising discharge. The crucial difference between rotating and stepped erosion, i.e. the threshold value separating the two forms of erosion is a function of the initial channel bed lowering and critical water depth. A model of retrogressive erosion in a noncohessive channel is developed based on the experimental results.

Key Words: Headcuts, Retrogressive erosion, Knickpoint, Stepped and rotating

SPATIAL AND TEMPORAL CHANGES IN THE BRAHMAPUTRA RIVER BED

Prabhata K. SWAMEE[8], Barham PARKASH[9], and Santanu SARMA[10]

ABSTRACT

A mathematical model based on data for the period 1957-1988 representing changes in space and time in the bed morphology of the 623 km long alluvial reach of the Brahmaputra River in Assam State, India has been developed. This model reveals that in the upper reaches the bed level decreases downstream exponentially with distance from a reference point, while in the lower reaches the exponential decrease is at a smaller rate probably due to differences in tectonic setting. The lower reach is marked by sinusoidal oscillations with a time period of about 9 yr. High runoff in 1977 seems to have caused a significant change as the maximum, average, and minimum bed level were decreasing before 1977 and these increased just after 1977 and then started decreasing at a lower rate than before. Smaller changes in shorter reaches governed by input of discharge and sediment from tributaries are superimposed on the overall degradation/aggradation character. The variation in degradation/aggradation with time is sinusoidal with a wavelength of 4,450 km before 1977 that reduces to about 1,038 km after 1977.

Key Words: Alluvial stream, Brahmaputra River, Cross section, Depth, Morphology, Riverbed level, Mean discharge

[8] Emeritus Fellow, Dept. of Civil Engrg., Indian Inst. of Tech. Roorkee, Roorkee 247 667, India. E-mail: swamifce@iitr.ernet.in.

[9] Emeritus Fellow, Dept. of Earth Sciences, Indian Inst. of Tech. Roorkee, Roorkee 247 667, India. E-mail: bparkfes@iitr.ernet.in.

[10] Lecturer, Department of Geology, Cotton College, Guwahati - 781 001, India

Note: The original manuscript of this paper was received in Feb. 2005. The revised version was received in July 2005. Discussion open until Sept. 2007.

SPATIAL DISTRIBUTION AND MORPHOLOGICAL FEATURES OF GULLIES IN AN AGROPASTORAL AREA IN SARDINIA, ITALY

Claudio ZUCCA11, Annalisa CANU12 and Raniero DELLA PERUTA3

ABSTRACT

According to the United Nations Convention to Combat Desertification soil erosion is one of the main causes of desertification in the northern Mediterranean. Recently the role of channel erosion in sediment delivery has become better understood by experimental research. The aim of the present work is to set up a simplified experimental methodology to study the relations between gully erosion, land types, and land use. The experimental area (about 720 ha) is located in a hilly region threatened by desertification in central eastern Sardinia, Italy, and is characterised by uneven morphology with steep slopes, where agropastoral activities, particularly tillage with heavy machinery and overgrazing, are causing severe soil erosion and compromising agricultural productivity. Previous studies carried out in the same area highlighted the need to quantify and monitor soil erosion to be able to give management guidelines to decision makers and to farmers. In this study, carried out in May 2003, an inventory of gullies of the area was made through an integrated use of aerial photographs and field surveys. The degree of activity and morphological features of gullies were assessed in the field using simple criteria. The approach applied included the measurement of the position and shape of gully heads and their width and depth at specific points. Relations were studied among distribution, frequency, and morphological characteristics of gullies and geomorphological features and land use.

Key Words: Gully erosion, Land use, Overgrazing, Desertification

EXPERIMENTAL INVESTIGATIONS AND NUMERICAL SIMULATIONS OF REDUCING SECONDARY FLOWS AROUND A SPUR DIKE

[11] Dr., Post-Doc Researcher, [3] Dr., Young Researcher, Nucleo Ricerca Desertificazione, Università di Sassari, Italy, Tel. 39 0792111016, Fax: 39 079217901 E-mail: nrd@uniss.it

[12] Dr., Senior Researcher, CNR - IBIMET, Via Funtana di lu colbu 4/A, 07100 Sassari, Italy, E-mail: a.canu@ibimet.cnr.it

Note: The original paper was received in Oct. 2004. Discussion open until Sept. 2007

Xuelin TANG13, Xiang DING14, Zhicong CHEN15 and Wenlong WANG16

ABSTRACT

To better understand the flow patterns near Jiuling Hill in the approach navigation channel of the Three Gorges Project and to improve the navigation channel, a physical flume model was constructed with a non-submerged spur dike placed as a barrier. An approach of sucking a small amount of water from the upper flume at the convex side of the spur dike and spouting it out again into the lower flume at the downstream side of the spur dike, so-called "sucking-spouting" water method, was proposed to improve navigational conditions. The flows around the spur dike for this method are experimentally investigated, and are compared to those in the no "sucking-spouting" water case. Based on the rigid lid assumption and a Dynamic Smagorinsky Model, all the vortex flows around the spur dike are numerically simulated, and the data are analyzed systematically. By applying "sucking-spouting" method, the recirculation zone caused by the spur dike reduced greatly and the transverse velocity decreased. At the same time, the flow behind the spur dike is much more complex, and materials and momentum substantially exchange between the dead zone and the main flow because of spouting action. The finite volume method is used to discretize the governing equations together with a staggered grid system, where the second-order difference is applied for the diffusion terms and the source terms while the upwind difference QUICK is used for the convection terms. The computational results are in fairly good agreement with the experimental data.

Key Words: Three Gorges Project, Non-submerged spur dike, Three-dimensional flow, Vortex flow, Rigid lid assumption, Dynamic large eddy simulations

CHANNEL EVOLUTION AFTER THE CONSTRUCTION OF THE 1ST PHASE OF THE DEEPWATER CHANNEL PROJECT OF THE YANGTZE ESTUARY

[13] Assoc. Prof., College of Water Conservancy & Civil Engineering, China Agricultural University, Beijing 100083, China; Dept. of Hydraulic Engineering, Tsinghua University, Beijing 100084, China, E-mail: tanglin99@mails.tsinghua.edu.cn

[14] Doctoral Student, Dept. of Hydraulic Engineering, Tsinghua University, Beijing 100084, China

[15] Prof., Dept. of Hydraulic Engineering, Tsinghua University, Beijing 100084, China

[16] Prof., Dept. of Hydraulic Engineering, Tsinghua University, Beijing 100084, China; State Key Laboratory of Soil Erosion and Dryland Forming on the Loess Plateau. Institute of Soil and Water Conservation, Chinese Academy of Sciences and Ministry of Water Resources, Yangling 712100, China; Northwest Sci-Tech University of Agriculture and Forestry, Yangling 712100, China

Note: The original manuscript of this paper was received in Sept. 2004. The revised version was received in May 2005. Discussion open until June 2007.

Hualin WU[17,18], Huanting SHEN[19] and Yonghong WANG[20]

ABSTRACT

In order to deepen the navigation channel, the Chinese government authorized the construction of the Yangtze Estuary Deepwater Channel Project in 1997. The project is divided into three phases, increasing the navigation channel depth to 8.5, 10.0, and 12.5 m stage by stage. The evolution of the North Passage after the construction of the first phase of the deepwater channel project is analyzed, based on surveyed topographic data. Then, the paper summarizes the comprehensive effect of the first phase of the project. Regarding hydrologic data monitored during the constructing process, the effects of the training dikes and groins on the riverbed erosion of the North Passage is studied. Finally, the evolution mechanism is analyzed and summarized. The evolution mechanism found can be helpful for regulation of other braided rivers or estuaries.

Key Words: Yangtze Estuary, Training dike, Groin, Channel evolution

[17] Res. Assoc. Prof., Hohai University, College of Traffic and Ocean, Nanjing, 210098, China, E-mail: wuhualin@sina.com

[18] Res. Assoc. Prof., Shanghai Estuarine and Coastal Science Research Center, Shanghai, 201201, China

[19] Prof. State Key Laboratory of Estuarine and Coastal Research, East China Normal University, Shanghai, 200062, China

[20] Res. Assoc. Prof., Ocean University of China, Qingdao, 266003, China

Note: The original manuscript of this paper was received in Jan. 2005. The revised version was received in Oct. 2005. Discussion open until June 2007.