Geophysical Research Abstracts,
Vol. 11, EGU2009-3254, 2009
EGU General Assembly 2009

Integrating Computational Models of Bedform Development with Reach-Scale Models of Flow, Sediment Transport, and Bed Evolution in Rivers

J.M. Nelson (1), Y. Shimizu (2), R.R. McDonald (1), and B.L. Logan (1)

(1) Geomorphology and Sediment Transport Laboratory, US Geological Survey, Golden, CO, USA (jmn@usgs.gov), (2) Department of Civil Engineering, University of Hokkaido, Sapporo, JAPAN (yasu@eng.hokudai.ac.jp)

Predicting the morphologic evolution of erodible channels during flood events depends on accurate characterization of the coupling between the flow field, sediment transport, and channel bed topography, including both small-scale bedforms and larger bars and bank features. Typically, models of river morphodynamics are directly coupled to large-scale topography, but smaller scale topography is only included indirectly through the specification of roughness. For situations where bedform morphology is roughly constant throughout the flood event of interest, this method is sufficient. However, for cases where bedforms adjust in a complicated manner to time-varying flows, inaccurate estimation of form drag can produce poor predictions of the velocity and water-surface elevation fields and even less reliable predictions of morphologic change. Over the past several years, models for the initiation, growth and adjustment of bedforms in rivers have improved dramatically, but directly incorporating bedform dynamics in large-scale models of flow and morphodynamic change in river reaches remains computationally impractical. In this talk, we present a methodology for integrating computational modeling of bedform dynamics with river-reach scale modeling of flow, sediment transport and bed evolution. Our approach allows for the occurrence of disequilibrium in the bedform field and incorporates both the initiation and destruction of bedforms. For an example from the Kootenai River, results show that this process produces much better predictions for the flow field relative than simpler approaches, including more accurate predictions of the water-surface elevation, and both velocity and bed stress fields. This method also explains certain aspects of the morphologic evolution of the channel that existing models cannot, as these aspects depend critically on the temporal variation of the bedform field.