Numerical modeling and applications of river fluxes in large basins under changing environmental conditions

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Fluvial systems in large river basins exhibit temporal variations in flow discharge, which creates unsteady changes in the flow field and sediment fluxes. The sediment-water interface responds and organizes to these changes over a wide range of spatial and temporal scales, primarily through adjustment of a variety of bed roughness elements. These roughness elements are the key component of overall flow resistance and the magnitude of their form drag significantly influences river stage levels for given discharge and determines the state and functioning of river systems and sediment fluxes.

Here we present three dimensional numerically predicted flow results to demonstrate the importance of complex morphology on flow and sediment fluxes. Model boundary conditions and validation data were taken from two sources. Initially, they were collected from a field campaign on a 1.5 by 0.3 km stretch of the Mississippi near Alton, Illinois. Secondly, a series of flume experiments were undertaken that applied unsteady hydraulic conditions to generate a series of quasi-equilibrium three dimensional bed forms, which were scaled on the data collected in the field. The numerical flow results show that superimposed bed forms can cause changes in the nature of the classical separated flow region in particularly the number of locations where vortices are shed and the point of flow reattachment, which may be important for sediment flux dynamics during bed form adjustment.

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bedforms in unsteady flows