Geophysical Research Abstracts
Vol. 12, EGU2010-3039-1, 2010
EGU General Assembly 2010

Modelling complex geomorphic systems: the example of fluvial obstacle marks

Thomas Euler
University of Bonn, Department of Geography, Germany (euler@giub.uni-bonn.de)

Obstacles in fluvial environments cause local flow separation and the emergence of three-dimensional flow fields that can lead to scour and deposition around an obstacle, even well before the initiation of general particle movement at the bed. Resulting forms are commonly denoted as 'fluvial obstacle marks'. Typically, fluvial obstacle marks consist of an upstream scour hole and a downstream depositional sediment ridge. However, the specific morphology of these forms is depended on the interaction between obstacle-, flow- and sediment characteristics. Dynamic interrelations between hydraulic and sedimentary processes lead to non-linear patterns of form genesis.
As observation and analysis of form genesis and formative processes is difficult in the field, laboratory flume experiments were conducted, which allowed to directly observe obstacle mark development under controlled boundary conditions. For the individual experimental set-ups cylinders of different sizes and shapes were used, each placed in a layer of coarse sand and exposed to steady currents of different magnitudes for at least 20h. Under these conditions quasi-equilibrium obstacle marks developed. The turbulent flow field around the obstacles was analysed by injecting special dye-tracers and by conducting three-dimensional velocity measurements. Bed form morphologies and dynamics were recorded using a laser distance sensor. Although this type of (physical) modelling accompanies complexity-reduction, it helped to systematically identify and quantify order and control parameters as well as thresholds, phase transitions and emergent form features.
For utilisation of the experimental results, the values of major order (e.g. maximum depth of scour) and control parameters (e.g. obstacle Reynolds number) were incorporated into different statistical models (non-linear regression curves and artificial neural networks) and finally validated against data from other lab and field studies. Validation showed that the present method works well in comparison to other data attained in the laboratory and to a certain extend in comparison with field data.

The overall results of this study suggest that research approaches based on intertwined experimental, field and mathematical methods with a specific focus on on formative processes might smooth the way from the vast theoretical construct of complex systems theory to applicable model building in (fluvial) geomorphology.