Geophysical Research Abstracts, Vol. 7, 09204, 2005
SRef-ID: 1607-7962/gra/EGU05-A-09204

A physically based bedload transport model

R. Hodge, K. Richards, J. Brasington

Department of Geography, University of Cambridge, UK (rah67@cam.ac.uk / Fax: +44 (0)1223 333392 / Phone: +44 (0)1223 330241)

This paper presents a physically based bedload transport model. It also describes how this model will be upscaled and coupled to a cellular flow model to provide predictions of grain sorting and channel morphodynamics at the reach scale. This approach aims to identify a compromise between the computational complexity of alternative physical approaches such as discrete element methods, and the poor predictive capability of more traditional empirical bedload formulae.

Alternative reduced complexity approaches of reach scale sediment transport have been developed, but are limited by their use of empirically calibrated bedload equations, which are unreliable and difficult to transfer between contrasting environments. This research instead uses a discrete element model approach to provide a physical basis for bedload transport.

This bedload model is based on probabilistic erosion of grains from a static model of the sediment bed. The bed is created from spherical grains, conforming to a given grain size distribution (GSD). This permits the bedload model to be applied flexibly to any GSD. Comparison with field data suggests that the modelled bed is a robust first-order representation of non-spherical grains, although fails to reproduce the properties of platy, imbricated river gravels.

Surface grains are identified, and the probability of erosion is weighted by the inverse of the force required to remove each grain. As grains are removed, the list of available grains is updated. Grain removal is treated as a transport limited processes and continues until a dynamic equilibrium rate of entrainment and deposition is reached. Initial results show bedload coarsening as bedload mass increases, a result that is benchmarked against the well-known and commonly applied, grain size specific Parker equation.