

Numerical simulation of downstream fining by selective transport in gravel bed rivers: Model development and illustration

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A numerical model has been developed for the routing of gravel-sized sediment along a river channel which is free to adjust both its long profile and surface texture. Hydraulic calculations use a step-backwater approach, and sediment transport is predicted with the method of Parker (1990a), which uses a low degree of size selectivity. Exchange of sediment between the surface and subsurface is described using the modified Exner equation of Parker and Sutherland (1990). The model is applied to an idealized channel based on the highly concave Allt Dubhaig, Scotland, in which fining by particle wear is minor. The rapid downstream fining observed in this river is closely matched by model predictions after a time equivalent to <102 years under the present flow regime of the river. The evolution of the fining pattern during the model run and associated changes in sediment transport and bed aggradation are described. It is concluded that strong profile concavity can force rapid downstream fining even though bed load transport is only slightly size selective. This run of the model serves as a basis for testing of the sensitivity of downstream fining to alternative choices of parameter values and boundary conditions, which are summarized here and will be described in a subsequent paper.