Geophysical Research Abstracts, Vol. 7, 04784, 2005
SRef-ID: 1607-7962/gra/EGU05-A-04784
© European Geosciences Union 2005

Simplicity, self-organization, and soil erosion by water on hillslopes

D.T. Favis-Mortlock (1)
(1) Queen's University Belfast (d.favis-mortlock@qub.ac.uk)

"Nature is pleased with simplicity, and affects not the pomp of the superfluous causes." Isaac Newton's mellifluous words express a hope which is probably shared, at some level, by all geomorphological modellers: that we are not doomed to ever-more-complicated models. Somehow, we would like to believe that elegance and simplicity underlies the systems which we model, somewhere 'beneath' the empirical fudge factors and the need for calibration. Yet the practical experience of model-building and model-using points us in the opposite direction. Models of soil erosion by water, for example, have grown more and more complicated in recent decades, with a corresponding increase in data needs (and such models still have notable difficulties in predicting the spatial patterns of erosion).

Is this rather depressing trend inevitable, or can we derive hope from Newton's aphorism?

This paper describes the development and validation of a markedly simple model of rill initiation and development, RillGrow 2. The modelling approach considers that pre-existing hillslope microtopography determines the spatial pattern of overland flow and hence of surface lowering, and thus modifies the path of subsequent flow. This iterative relationship generates rill networks 'emergently', i.e. as a collective whole-system response to many local interactions. The approach retains a strong physical orientation, but removes a requirement of earlier erosion models: the need to 'pre-specify' rill characteristics even for an unrilled surface.

In a series of validation studies, DEMs of the microtopography of real soil surfaces were used as inputs to the RillGrow model. Simulated rill networks were compared with those which developed on these surfaces during laboratory and field experiments. Results from these studies demonstrate that, given suitable information on initial con-

ditions including microtopography, the RillGrow 2 model is able to realistically predict the eventual pattern of erosion's impacts on small hillslope areas.

Thus it seems that, in the domain of soil erosion models at least, choice of an appropriate conceptual framework (self-organisation) and spatio-temporal scale (microscale) renders it possible to develop an improved model which, while physically-oriented, is also simple. However, such simplicity does come at a cost. The model's computational requirements are considerable, and data needs also pose some problems.