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# Trusting explanatory and exploratory models in computational geomorphology

Marco Van De Wiel (1), Eric Desjardins (2), Yannick Rousseau (1), Tristan Martel (1), and Peter Ashmore (1)

(1) Department of Geography,University of Western Ontario, London, Canada (mvandew3@uwo.ca, 519 661 2111), (2) Rotman Institute of Philosophy, Department of Philosophy, University of Western Ontario, London, Canada

Computer simulations have become an increasingly important part of geomorphological investigation in the last decades. Simulations can be used not only to make specific predictions of the evolution of a geomorphic system (predictive modelling), but also to test theories and learn about geomorphic form and process in a timely and non destructive way (explanatory and exploratory modelling). The latter modes of modelling can be very useful for discovering spatial and temporal patterns, developing insights in the relation between form and process, and for understanding the causal structure of the physical landscape. But before we can have any hope that these type of simulations can effectively accomplish these tasks, simulationists must make the case that their computer modelling goes beyond mere numerical computation of theoretical idealization; that geomorphic investigation through computer modelling can play a similar role as field observation or laboratory experiment.

Many of these explanatory and exploratory models are reduced-complexity models which exhibit a high degree of idealization and simplification. Moreover, they are often uncalibrated and untested on real geomorphic systems. Indeed, they are often used on idealized hypothetical landscapes, and sometimes are acknowledged not to be suitable for simulation of real systems. Does it make sense then to conceive of this type of computer modelling as a form of investigation capable of providing reliable knowledge about actual geomorphological phenomena?

In this analysis it is argued that the traditional notion of establishing reliability or trustworthiness of models, i.e. a confirmation of predictive ability with regards to observed data, is not applicable to explanatory or exploratory modelling. Instead, trustworthiness of these models is established through broad qualitative conformity with known system dynamics, followed by a posteriori field and laboratory testing of hypotheses generated from the modelling. This analysis thus provides support to the view that explanatory and exploratory computer simulation in geomorphology (and many other sciences) complement field observation and laboratory experiment as part of a scientific inquiry of complex phenomena.