Geophysical Research Abstracts,
Vol. 10, EGU2008-A-09695, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-09695
EGU General Assembly 2008

Metamodels: simple tools to explore complex models in the geosciences

Nicholas A. Odoni and Stephen E. Darby

(1) Department of Geography, Durham University, Science Laboratories, South Road, DURHAM, DH1 3LE, U.K (Nick.Odoni@durham.ac.uk); (2) School of Geography, University of Southampton, Highfield, SOUTHAMPTON, SO17 1BJ, U.K (S.E.Darby@soton.ac.uk)

Research in the geosciences is frequently augmented by application of numerical simulation models, which are used to make evident the consequences of theory, or to explore new ideas, or to demonstrate the outcome of possible human interventions in the environment. However, despite great advances in computing power and model functionality over the last 25 years, researchers wishing to use a model are confronted with many uncertain factors, typically 10 or more in hydrological models for example, or 20 or more in landscape evolution models. Any of these factors can be varied to alter output from a simulation, so a standard Monte Carlo or GLUE type method requires very large simulation run sizes to explore the factor space fully. These often entail a prohibitively high computational burden, even if powerful computers are available, thus usually making thorough examination of model output across the whole factor space quite impractical. Here we present a potentially highly efficient approach, based on statistically derived mediating functions called “metamodels”. Metamodels have been used extensively in engineering and operations research, and more complex “emulators” are increasingly applied elsewhere (e.g. in climate research), but these methods have seldom been tried in the geosciences. Using examples, we show how appropriate experiment design allows metamodels to be derived for any selected measure of model output. Each metamodel - essentially a regression equation, comprising mathematical functions of the model variables - can then be used as a full simulation proxy, and solved rapidly for any point in the model’s factor space. Output from dense

samples ($>$ 10^6 points) is therefore achieved rapidly, with estimates of associated error bands. The metamodels are also potentially shareable amongst researchers, yet retain the influence of the source model's complexity. The talk will also cover experiment design and related matters, and some examples of how the method can lead to surprising and interesting discoveries about modelled system behaviour will also be illustrated.