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Steady state scenario modelling of sediment delivery in a large catchment; some implications for reduced complexity modelling

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One strategy in the application of reduced complexity models is to simulate steady states rather than fully dynamic behaviour, to define scenarios, and compare their behaviours. Some implications of this are examined in this paper, using an application of the general SEDNET (Prosser et al.) approach to modelling sediment production and delivery processes in large catchments. This is based on case study research in the Xihanshui basin in South Gansu, China.

A first implication concerns the 'integration time' for the application to steady state scenarios. This should exceed the average time for transport of water and sediment along transport paths from sources to the catchment outlet. In catchments where the river is c.100km in length, the appropriate integration time scale is therefore likely to be between the monthly and annual timescales. For areally-distributed sediment sources, such as soil erosion by sheetwash and rill erosion, this suggests that reduced complexity methods comparable to the RUSLE are suitable, and that event-based modelling is inappropriate. Chinese adaptations of the RUSLE are based on fortnightly integration times for rainfall erosivity, cumulated over longer periods, and modelling of soil erosion using this approach is outlined for scenarios for the Xihanshui basin.

A second issue concerns the representation of sediment delivery by processes that are more localised and linear, such as gully erosion and mass movement. SEDNET includes the former, but only as gullies in fixed locations, and does not have an algo-

rithm for handling sediment supply by mass movement. Both of these processes are likely to be highly stochastic in timing and location, and this requires a break from the quasi-deterministic modelling that characterises most reduced-complexity modelling. In this paper, we suggest ways of allowing for the stochastic nature of both gully and mass movement sediment production, through off-line generation of different realisations of erosion by these processes. This allows SEDNET to provide an ensemble of simulations for each scenario, permitting assessment of the variance in sediment delivery associated with a range of variously-located erosion events dependent statistically on spatial variation in controlling environmental variables. This shift from deterministic to stochastic modelling has implications for the use of the SEDNET modelling framework in environmental management.