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Neuroevolution methodologies applied to sediment forecasting

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Neuroevolution (NE**)** is the application of a genetic algorithm to the development of neural networks. This approach is advantageous in situations where the performance of a model can be measured in terms of a specified set of straightforward outcomes, but difficult or impossible to create the correct syllabus of teaching and learning patterns for use in a supervised learning environment. The NE approach is starting to be applied to neural network hydrological modelling; the findings of Dawson et al. (in press) has demonstrated the potential benefits of using the relevant software packages and customisable technological toolboxes. NE has several advantages including the use of different target functions and optimisation procedures or measures of fitness such as relative error and the application of a timing error correction factor. This paper will report on the application of NE to sediment forecasting.

The need to obtain accurate estimations of suspended sediment quantities is of great importance for both watershed management operations and environmental impact assessment. However, suspended sediment forecasting and prediction presents a significant modelling challenge, two fundamental problems being that suspended sediment transfer and throughput is 'source limited' and subject to 'hysteresis effects'. Previous modelling attempts have focused on the use of conceptual models with empirical foundations that attempt to approximate the physical processes in a catchment. More recent suspended sediment explorations have started to exploit the potential advantages and opportunities related to the use of neural networks.

Cigizoglu & Kisi (2005) used 'k-fold partitioned' and 'range dependent' neural network solutions to perform a series of suspended sediment forecasting operations. Their

results showed improvements in the estimation of sediment volume when compared to regression approaches and individual neural network solutions. Two important issues can nevertheless be highlighted. The modelling process had to be deconstructed into a set of simpler modelling operations and negative sediment outputs were sometimes observed

This work extends the earlier suspended sediment explorations of Cigizoglu & Kisi (2005). Forecasting comparisons with their findings are presented using identical datasets and a customised version of the NE software package JavaSANE (Moriarty and Miikkulainen, 1998)**.** NE has been used to evolve more complex solutions that were optimised on total sediment load. Severe penalties were also applied in the case of negative sediment predictions. Further planned experiments are discussed.