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The quest for knowledge: to what extent can transparent modelling methodologies extract useful hydrological information?

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The capabilities of two transparent modelling methodologies to extract useful hydrological information is reported. Experimental emulators were constructed in a controlled environment that comprised digital inputs and outputs for a simple conceptual rainfall-runoff model: the Xinanjiang Rainfall-Runoff Model (Zhao et al., 1980; Zhao, 1992). This model was designed for use in humid or semi-humid regions and is based on the concept of runoff formation on repletion of storage i.e. runoff is not produced until the soil moisture content of the aeration zone reaches field storage capacity and thereafter runoff equals rainfall excess without further loss. It has been applied with success to large areas including all of the agricultural, pastoral and forested lands [except for the loess] of China (Zhao & Liu, 1995, p.230). The model has a small number of parameters, its structure and components have strong physical meaning, and these factors in combination make it a popular tool for hydrological modelling. Two methods were used to develop a set of transparent emulators: ANFIS (Adaptive Neuro-Fuzzy Inference System) and GEP (Gene Expression Programming). The simplest form of the conceptual model that required four inputs and had no temporal component was examined. Model inputs comprised a set of uniform random distributions that had been computed in a statistical package and the cloning operation facilitated a direct comparison with the exact equation-based relationship. The potential of each tool to perform simple non-linear hydrological transformations is evaluated as is the power of each individual method to capture and communicate important aspects of a recognised non-linear hydrological modelling equation.