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ANFIS: analysis of transparent components in ten time series models developed on four sets of observed river level records for the River Ouse in England

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Modern techniques offer alternative solutions for the efficient modelling of complex nonlinear hydrological relationships e.g. Neural Network (NN), Fuzzy Set (FS) and Fuzzy Logic (FL). ANFIS (Adaptive Neuro-Fuzzy Inference System) supports a merger of such items and is asserted to be a superior product since it: (i) combines in a transparent manner the linguistic representations of FS and FL with the learning capabilities of a NN; (ii) provides an automated rule generation and parameter optimisation procedure that simplifies the complex process of model development; and (iii) creates a transparent solution that is expected to offer useful insights into either the physical processes involved or the resultant modelling mechanisms. Limited hydrological reporting of membership functions, decision rules and equations has so far however failed to capitalise on the transparent nature of each individual solution. The final product is in most cases presented as a 'black box' model - no different from a standard NN. This paper in contrast investigates the internal mechanisms of some simple models that are compared and contrasted in terms of their 'transparent components'. Ten one-step-ahead forecasting solutions were developed using six-hour winter period datasets collected at four river level gauging points on the River Ouse in England: comprising upstream recording stations for its tributaries at Crakehill on the River Swale (EA-27071), Skip Bridge on the River Nidd (EA-27062) and Westwick Lock on the River Ure (EA-27007); and one downstream station at Skelton on the River Ouse (EA-27009). The selection of modelling inputs was restricted to a consideration of different permutations of two past observed records after Firat & Gungor (2008).