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Multi-model forecasting: using gene expression programming to develop explicit equations for rainfall-runoff modelling combinations

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Two previous studies have evaluated eight multi-model forecasting strategies that combined hydrological forecasts for contrasting catchments: the River Ouse in Northern England and the Upper River Wye in Central Wales. The level and discharge inputs that were combined comprised a mixed set of independent forecasts produced using different modelling methodologies. Earlier multi-model combination approaches comprised: arithmetic-averaging, a probabilistic method in which the best model from the last time step is used to generate the current forecast, two different neural network operations, two different soft computing methodologies, a regression tree solution and instance-based learning. The nature and properties of past combination functions was not however explored and no theoretical outcome to support subsequent improvements resulted. This paper presents a pair of counterpart mathematical equations that were evolved in GeneXproTools 4.0: a powerful software package that is used to perform symbolic regression operations using gene expression programming. The results suggest that simple mathematical equations can be used to perform efficacious multi-model combinations; that similar mathematical solutions can be developed to fulfil different hydrological modelling requirements; and that the procedure involved produces mathematical outcomes that can be explained in terms of minimalist problem-solving strategies.