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Application of data-driven ANN and K-NN techniques for lead-time forecasting for two Irish catchments

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In this application-based study, non-linear data-driven Artificial Neural Networks (ANNs), which depend on available data for their 'training', and the K-nearest-neighbour (K-NN) approach are used, the latter following a non-parametric regression methodology for pattern recognition that exploits the nearness of the most recent observations to K similar sets of past observations chosen from an adequately large training data set. In the context of their application to the hydrometeorological data from two Irish catchments, the efficiency of these techniques in yielding lead-time river-flow forecasts, within the framework of rainfall-runoff modelling, is discussed. Different Quantitative Precipitation Forecast (QPF) scenarios are adopted for assessing the relative merits of these forecasting techniques. Also demonstrated is the application of the series of residuals/errors, derived from a substantive model, as inputs to Neural Networks, and also the flow data series along with exogenous inputs, making use of recently observed data in both cases. As a '*multi-model*' approach, Neural Networks are additionally employed to combine lead-time forecasts obtained from a number of other forecasting models to produce '*consensus*' forecasts, and their efficiencies are compared to two other more primitive forecast combination techniques, namely, the simple average and weighted average methods. The artificial Neural Networks are generally found to produce high forecasting efficiency, both in individual application and in their combination role. The software package called the 'Galway Flow Modelling and Forecasting System (GFMFS)', developed by the present authors at the Department of Engineering Hydrology of the National University of Ireland, Galway, which incorporates a suite of deterministic rainfall-runoff models, was used for the applications of the neural network and combination techniques described here.

Keywords: Neural Network, nearest neighbourhood, QPF, lead-time forecast, consensus forecast, multi-model approach