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Multivariate synthetic streamflow generation using a hybrid model based on artificial neural networks

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Abstract. A model for multivariate streamflow generation is presented, based on a multilayer feedforward neural network. The structure of the model results from two components, the neural network (NN) deterministic component and a random component which is assumed to be normally distributed. It is from this second component that the model achieves the ability to incorporate effectively the uncertainty associated with hydrological processes, making it valuable as a practical tool for synthetic generation of streamflow series. The NN topology and the corresponding analytical explicit formulation of the model are described in detail. The model is calibrated with a series of monthly inflows to two reservoir sites located in the Tagus River basin (Spain), while validation is performed through estimation of a set of statistics that is relevant for water resources systems planning and management. Among others, drought and storage statistics are computed and compared for both the synthetic and historical series. The performance of the NN-based model was compared to that of a standard autoregressive AR(2) model. Results show that NN represents a promising modelling alternative for simulation purposes, with interesting potential in the context of water resources systems management and optimisation.

Keywords: neural networks, perceptron multilayer, error backpropagation, hydrological scenario generation, multivariate time-series.

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