

AN ARTIFICIAL NEURAL NETWORK APPROACH IN THE ESTIMATION OF SEDIMENT AMOUNT IN RIVERS

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The sediment transport processes of streams have been the subject of research for many years. Sediment amount carried by a river depends on the river's flow rate and sediment concentration. In this study, sediment amount estimations of the Göksu River, which is located in the Eastern Mediterranean region of Turkey, are studied. The data are obtained from Turkish General Directorate of Electrical Power Resources Survey and Development Administration (EIE), and included daily flow and monthly sediment amount and concentration data for nine years, between years 1999 and 2010. The aim of this study is to evaluate the effectiveness of Artificial Neural Network (ANN) modelling in the estimation of sediment amount carried by river flow. The classical and commonly used method in the estimation of sediment amount is based on the relation between measured suspended-sediment concentration values and measured water discharge, which can be represented by the below formula:

$$Q_s = Q_w C_s k$$

where Q_s is the sediment amount (ton day^{-1}), Q_w is the flow-rate ($\text{m}^3 \text{s}^{-1}$), C_s is the sediment concentration (ppm) and k is a coefficient.

ANN models are inspired by the mechanism of the neurons in the brain, and are based on recognizing patterns of system behaviour by drawing information out of a sufficient amount of data. In this study, a backpropagation algorithm is used, because of its simplicity and its capability to learn (Bhattacharya et al., 2005). Furthermore, the backpropagation algorithm is amongst the most commonly used configurations in modelling of environmental systems, such as river transport processes. In the model, 50% of the data are used as the training set. The learning rate of the training algorithm is set to 0.30, and the initial weight range is chosen as 0.50. The configuration of the network and associated parameter settings are provided in Fig(s).1a and 1b, respectively.

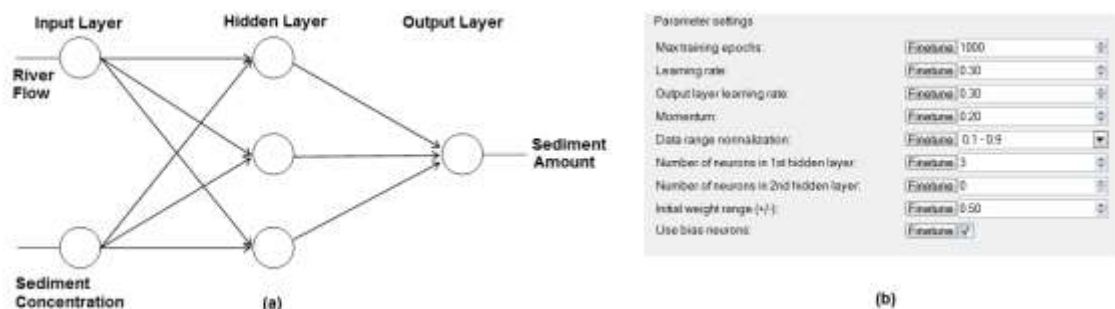


Figure 1: A schematized representation of the ANN model (a) backpropagation configuration (b) Parameter settings.

As Fig. 2 depicts, the ANN simulation provides a good linear relationship between the observed sediment amount and predicted values by ANN, with a Pearson's correlation coefficient (r^2) of 0.95.

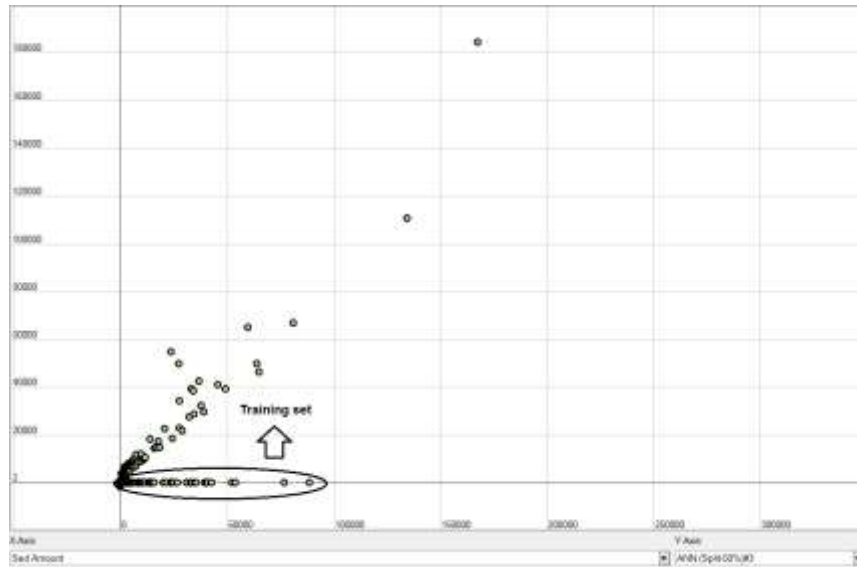


Figure 2: Simulation results: Observed vs. simulated sediment amount.

Although physically-based models have always been useful tools to interpret the processes between environmental variables, models developed by ANN are advantageous mainly because no *a priori* information is required to determine the model structure or estimate parameters, and their predictive capability is quite high. Furthermore ANN based models are flexible and adaptable to alternative scenarios to account for the spatio-temporal changes in natural environments.

Keywords: Artificial Neural Networks, Backpropagation, Modelling, Sediment Amount, Sediment Concentration, River Flow.

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