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Groundwater Pollution Source Identification Using Trained ANN Model

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Remediation of groundwater contamination is one of the foremost challenges for the present generation. Exact knowledge of the location of the pollution source is essential to tackle this problem. Pollution sources have several important characteristics – location, strength and release period – that can be employed to single out a specific source.
Breakthrough curves, which are the temporal distribution of concentration data at a given location, can be utilized to identify the location of an unknown pollution source. However, there is a lag between the time when the readings are taken at the observation well and the time when the source becomes active. In real field situations there is little or no information about this lag. We develop a methodology to identify the location of a pollution source, without using the lag time or the source strength as known parameters, by using an Artificial Neural Network (ANN) based technique.
Breakthrough curves are primarily dependent on four variables, namely, source location, strength, release period and lag time. To develop an ANN model, the impact because of strength and lag time has been eliminated in a step-wise fashion. First, the breakthrough curve is normalized, between 0 and 1, by dividing concentration data by the maximum concentration value observed. Then, only the portion of the breakthrough curve near the peak is used as an input to train the ANN model. It has been shown that the breakthrough curve under these conditions is only dependent on the source location and release period, and is unique for a given combination of source strength and release period.
An ANN model with one hidden layer is trained using the Levenberg-Marquardt algorithm. The modified breakthrough curve is used as an input to the ANN model while the source strength and release period constitute the output. The number of neurons in the hidden layer has been selected by minimizing the mean squared error for different number of hidden neurons. Performance of the model has been evaluated for a one dimensional case with error-free data. Results obtained indicate that the proposed ANN model is capable of solving the pollution source identification problem without requiring the lag time or source strength to be pre-specified.