8th International Congress on Civil Engineering,
May 11-13, 2009, Shiraz University, Shiraz, Iran

Groundwater level estimation using radial basis function artificial neural network

G. R. Rakhshandehroo and H. Damangir

Dept. of Civil and Environmental Engineering, Shiraz University, Shiraz, Iran.

rakhshan@shirazu.ac.ir
hooman_d77@yahoo.com

Abstract

In this study, RBF neural network was utilized to estimate groundwater level in an unsampled piezometric well. Six scenarios were performed using the data collected from piezometric wells distributed around the unsampled well to estimate the missing groundwater level. The results showed that the estimated groundwater level time series closely follows the entire fluctuation trend in water table with a mean absolute error of 0.13 meter. The distance between the sampled zone and unsampled area affected the correlation in the data drastically. Besides the distance, station elevation played an important role in correlating groundwater changes in adjacent stations.

Keywords: Groundwater level estimation, Empirical models, Artificial neural network, Radial basis function.

1. INTRODUCTION

Groundwater is the most widely used source of domestic and drinking water in semiarid and arid regions. Due to high potential of evaporation and evapotranspiration in these regions, groundwater is the most economic and reliable source of water supply. Due to this reason, and also because of being far away from other sources of water, it has been found that approximately fifty percent of the people in the world use groundwater as their only water resource [1]. Increasing population density and their related water demand in urban regions, besides increasing industrial and agricultural water demand due to the development of the countries in the world, lead to huge and relatively unplanned use of groundwater. This is more critical in developing countries such as Iran.

In many real situations there would be many piezometric wells in which the information is lost in a limited time period. Many manual or instrumental reasons could lead to this situation. It would be useful to find an approach by which these lost data and information could be estimated in a systematic manner. Since prediction of lost data in a limited time period is categorized as an interpolation problem, Radial Basis Function (RBF) neural network model could be an appropriate choice in development of such a prediction model due to its capability in addressing multidimensional interpolation problems.

Neural network models, which are categorized as nonlinear empirical models, have attracted increasingly more interest in prediction and modeling various hydrological processes. The reason is that the neural networks can ordinarily model nonlinear relationships without making any attempt to solve any partial differential equation, which is a common characteristic of physically-based models [2]. The capability of neural networks in modeling the nonlinear dynamic nature of the system, without making any assumptions regarding the process involved, is their most useful advantage [3].

Many studies were reported in application of ANN for groundwater level estimation. In these studies, the performance of ANN models was compared with various regression-based models and, in general, ANN models were found to be better estimators [4, 5 and 6]. RBF neural network was applied by Han and Felker in soil water evaporation prediction and it was compared with a model based on multiple linear regression technique and was selected as the better predictor [7]. Ioannis et al. used seven different types of network architectures and training algorithms for groundwater level forecasting and compared their prediction efficiencies and accuracies [8]. Multi-Layer Perceptron (MLP) neural network was also used in prediction of dispersion coefficient, the parameter which strongly influences the satisfactory application of advection-dispersion equation [9].