

Prediction of groundwater levels from lake levels and climate data using ANN approach

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Abstract

There are many environmental concerns relating to the quality and quantity of surface and groundwater. It is very important to estimate the quantity of water by using readily available climate data for managing water resources of the natural environment. As a case study an artificial neural network (ANN) methodology is developed for estimating the groundwater levels (upper Floridan aquifer levels) as a function of monthly averaged precipitation, evaporation, and measured levels of Magnolia and Brooklyn Lakes in north-central Florida. Groundwater and surface water are highly interactive in the region due to the characteristics of the geological structure, which consists of a sandy surficial aquifer, and a highly transmissive limestone-confined aquifer known as the Floridan aquifer system (FAS), which are separated by a leaky clayey confining unit. In a lake groundwater system that is typical of many karst lakes in Florida, a large part of the groundwater outflow occurs by means of vertical leakage through the underlying confining unit to a deeper highly transmissive upper Floridan aquifer. This provides a direct hydraulic connection between the lakes and the aquifer, which creates fast and dynamic surface water/groundwater interaction. Relationships among lake levels, groundwater levels, rainfall, and evapotranspiration were determined using ANN-based models and multiple-linear regression (MLR) and multiple-nonlinear regression (MNL) models. All the models were fitted to the monthly data series and their performances were compared. ANN-based models performed better than MLR and MNL models in predicting groundwater levels.

Keywords: groundwater, surface water, interaction, artificial neural network