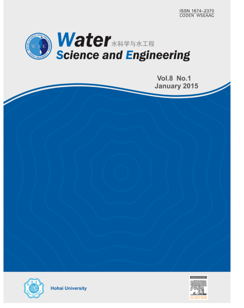

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Abstract

In this study, a statistical model was established to estimate the groundwater table using precipitation, evaporation, the river stage of the Liangduo River, and the tide level of the Yellow Sea, as well as to predict the groundwater table with easily measurable climate data in a coastal plain in eastern China. To achieve these objectives, groundwater table data from twelve wells in a farmland covering an area of 50 m × 150 m were measured over a 12-month period in 2013 in Dongtai City, Jiangsu Province. Trend analysis and correlation analysis were conducted to study the patterns of changes in the groundwater table. In addition, a linear regression model was established and regression analysis was conducted to understand the relationships between precipitation, evaporation, river stage, tide level, and groundwater table. The results are as follows: (1) The groundwater table was strongly affected by climate factors (e.g., precipitation and evaporation), and river stage was also a significant factor affecting the groundwater table in the study area ($p < 0.01$, where p is the probability value). (2) The groundwater table was especially sensitive to precipitation. The significance of the factors of the groundwater table were ranked in the following descending order: precipitation, evaporation, and river stage. (3) A triple linear regression model of the groundwater table, precipitation, evaporation, and river stage was established. The linear relationship between the groundwater table and the main factors was satisfied by the actual values versus the simulated values of the groundwater table ($R^2 = 0.841$, where R^2 is the coefficient of determination).

Keywords: Groundwater table; Precipitation; Evaporation; Climate factors; Regression statistics; Coastal plain

1. Introduction

Farmland groundwater, as a major water source, serves an important function in the farmland system. Shallow groundwater is closely related to soil water, and therefore its depth, i.e., groundwater table, significantly affects vegetation development and contaminant transport (Gong et al., 2006; Nayak et al., 2006). The upward movement of groundwater toward the crop root zone increases with the decrease in groundwater table, and the decrease in the amount of groundwater recharge to soil water will directly affect crop growth (Gong et al., 2006). Therefore, changes in the groundwater table can indicate effects of groundwater on agricultural land and public assets. Researchers have studied the rise in groundwater and have attempted to explain this phenomenon statistically (Ferdowsian et al., 2001). Furthermore, continuous monitoring of groundwater table is now technologically possible, and it is required for the effective use of any statistical water management model (Nayak et al., 2006). This continuous monitoring can also help administrators improve the utilization of groundwater.

Groundwater dynamics reflect a complex natural process, which is influenced by various factors, e.g., climate, geology, and topography (Wang et al., 2012). Climatological conditions cause temporal fluctuations of groundwater to exhibit periodic and seasonal cycling (Yu et al., 2016). Groundwater cycles mainly occur in a vertical direction, with climatic (precipitation and evaporation) and human factors (surface water irrigation and groundwater exploitation) being considered factors of groundwater dynamics (Du et al., 2013).

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