使用基於物理的數值模型 WASH123D 模擬地下水位對降雨和地下水的反應

報告者：張子寬

指導教授：陳瑞昇 老師

報告日期：2024/05/17

摘要

　　調查地區：位於台灣南部之高雄市的四個區(美濃、旗山、大樹與大寮)。研究重點：從地下水位對降雨的反應了解含水層補注對地下水系統管理至關重要而且已做出各種努力利用降雨資料計算補注量。本研究的目的為估算地下水位對降雨的反應，並定義淺層含水層的補注潛能。我們展示一個簡單的逼近法來估計比出水量(S_y)與水力傳導係數(k)作為降雨和水位資料的函數。對於該區域水文學的新見解：相關法被應用在調查地下水位對相關降雨量的反應並且發現地下水位的線性抬升視每次雨量而定。結果顯示每年的補注量 244-1472mm/年，表現出研究區域 12-43%的降雨量。估計出的 k (10^{-4} 到 10^{-5}ms^{-1} 的量級) 與 S_y (0.20-0.51) 用來作 prior values 使用 WASH123D 建立地下水數值模擬。即時案例情境模擬使用抽水與降雨資料指出地下水位對降雨的合理水文反應。長期模擬應該使用 WASH123D 以處理持續抽取地下水的主觀性和含水層的可持續性以便更好地進行地下水資源計畫與管理。
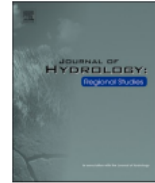
關鍵字: 地下水位變化、衰退分析、比出水量、水力傳導係數、地下水建模、WASH123D

Water table response to rainfall and groundwater simulation using physics-based numerical model: WASH123D

Fiaz Hussain [a,b], Ray-Shyan Wu [a,*], Dong-Sin Shih [c]

[a] *Department of Civil Engineering, National Central University, Chung-Li 32001, Taiwan*
[b] *Department of Agricultural Engineering, PMAS-Arid Agriculture University Rawalpindi, 46000, Pakistan*
[c] *Department of Civil Engineering, National Yang Ming Chiao Tung University, Hsinchu City 30010, Taiwan*

ARTICLE INFO

ABSTRACT

Study region: Four districts (Meinong, Qishan, Dashu, and Daliao) of Kaohsiung city, Southern Taiwan

Study focus: The understanding of aquifer recharge in terms of water table response to rainfall is of critical importance to groundwater systems management and various endeavors have been made to estimate the amount of recharge using rainfall data. The purpose of this study is to evaluate the groundwater level response to rainfall and determine the recharge potential for shallow aquifers. We showed a simple approach to estimate specific yield (S_y) and hydraulic conductivity (k) as functions of rainfall and water level data.

New hydrological insights for the region: Correlation method is applied to investigate groundwater level response to associated rainfall and it was found that the rise in water table linearly depends on the rainfall amount per event. Results show the annual recharge rates of 244–1472 mm year^{-1}, which represent 12–43% of rainfall in the study area. The estimated k (order of 10^{-4} to 10^{-5} m s^{-1}) and S_y (0.20–0.51) were used as prior values to setup groundwater numerical modeling using WASH123D. The real-time case scenario simulation using pumping and rainfall data indicated the reasonable hydrological response of groundwater levels to rainfall. The long-term simulations should be performed with WASH123D to deal with the subjectivity of sustained groundwater pumping and sustainability of aquifers for better groundwater resource planning and management.