應用時間序列分析模式與水井函數於地下水文地質參數推估

Estimation of Hydrogeological Parameters Using Time Series Analysis and Well Functions

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摘　要

地下水資源為台灣重要水源，了解含水層水力特性是地下水資源管理重要一環，而其中描述含水層透水與出水特性的水文地質參數分別為導水係數和儲水係數，一般可以透過複井抽水試驗獲得。然而受限於成本因素，自 1992 年台灣開始建置地下水位觀測站網以來，大部分觀測井完工後只進行定量試水試驗獲得導水係數資料，僅有部分觀測井進行複井抽水試驗，儲水係數資料數量非常有限，因此本研究嘗試利用時間序列分析模式結合常用水井函數提出一儲水係數推估方法。

本研究將地下水系統視為線性系統，地下水位變動則可視為不同物理因子(如自然補注、人為抽水等)產生之個別水位擾動疊加而成，個別物理因子產生之水位擾動則為物理擾動時間序列與其脈衝反應函數之摺積，而描述抽水對地下水系統之影響的反應函數即為水井函數，本研究將抽水時間序列與水井函數之摺積和抽水產生之水位擾動訊號進行擬合，最佳化水井函數中的水文地質參數以獲得儲水係數推估值。

關鍵詞：時間序列分析，水井函數，儲水係數

Abstract

Groundwater is one of the important water resources in Taiwan. Understanding the aquifer hydraulic properties is an essential step of groundwater resources management. Transmissivity and storage coefficient are the two parameters that characterize the permeability of the aquifer and the water released from aquifer compression and can be derived from pumping tests. In Taiwan, the transmissivity has been collected for most of the observation wells; however, storage coefficient has been derived only for a small number of observation wells due to the cost of the pumping test. This study proposes an alternative method to estimate storage coefficient using time series analysis and well functions. In this study, the groundwater system

is considered to be a linear system, and the groundwater head variation can be regarded as the superposition of the variations caused by different physical factors, such as natural recharge and pumping. Those variations can be described by the convolution between the stress time series and their corresponding impulse response functions. The corresponding impulse response functions for pumping are well functions. The storage coefficient is optimized to find the best fit between observed head variation and the convolution between the pumping time series and well function.

Keywords: Time series analysis, Well function, Storage coefficient