以資料為基礎於密集抽水區域之抽水量推估方法－以濁水溪沖積扇為例

A data-based method for groundwater withdrawal estimation in intensive pumping area – A Case of Choushi river alluvial fan

國立臺灣大學

碩士	教授
曾華廷	余化龍
Hua-Ting Tseng	Hwa-Lung Yu

摘　要

濁水溪沖積扇位於台灣的中西部，長年來因時空間上密集的超抽地下水而深受地層下限所苦。且此區的抽水井多為私有井，使得管理單位很難有效的掌握其抽水的位置與量級，導致地下水管理的難度增加。然而，雖然很難掌握抽水井的位置，但此區具有全台灣數一數二密集的地下水位觀測網，由於地下水位是許多不同刺激源的綜合反應，如降雨、抽水等，故本研究嘗試自的下水位中擷取抽水訊號並推估抽水量。

不同的水位刺激源具有其不同的空間趨勢以及時間頻率，本研究首先以經驗模態分解(Empirical Mode Decomposition, EMD)將地下水位觀測站切分成的不同頻率的訊號成分；再以經驗正交函數(Empirical Orthogonal Function, EOF)調查相近頻率訊號成份的主要空間趨勢與時間趨勢，判斷出補注訊號後將其自水位中移除，而後同樣以 EMD 分解已去除補注訊號的水位，將其頻率過高與過低的訊號移除後獲得抽水訊號。根據儲水係數的定義，將已經完成校正的 MODFLOE 模型中之儲水係數乘與由抽水訊號計算出來之抽水趨勢，即獲得抽水量之時間序列，最後透過空間推估方法推估研究區全區的抽水量，本研究結果顯示在 2008 至 2019 年間，濁水溪沖積扇年平均抽水量為 16.3 億噸。

關鍵詞：抽水量推估，經驗模態分解，經驗正交函數

Abstract

Choushi river alluvial is located on western-east of Taiwa. Since intensive over-pumping in spatial and temporal, it has suffered from land subsidence for several decades. Furthermore, the pumping wells here are mostly uncensored, give rise to more obstacle for competent authority to manage groundwater use. However, there are fine groundwater observed network in this area. Base on the idea that groundwater fluctuation is the combination of several different stimuli e.g., rainfall, and pumping. This research is aim to extract pumping signal from groundwater level observed data and estimating groundwater pumping amount。

Different stimuli have different spatial patterns and frequencies. First, this research applied empirical mode decomposition (EMD) to separate each water level signals from same layer's groundwater observed wells into different frequency. After that, empirical orthogonal function (EOF) was used to investigate primary spatial pattern and corresponding temporal pattern of similar frequency decomposed from each observed well's data. The frequency has a wide-range spatial pattern and the corresponding temporal pattern has a similar path with rainfall will be considered as recharge signal. The recharge signal will be removed from water level data. For extracting pumping pattern, EMD was applied on de-recharged signal to eliminate too high or too low frequency components. According to the definition of storage coefficient, the storage coefficient that already has been calibrated by MODFLOW model was imported and multiply it with pumping pattern for getting each observed point's groundwater withdrawal time series. Finally, a conventional spatial interpolation method was included to estimate other unobserved location's groundwater withdrawal. The results show that between 2008 and 2019, groundwater was withdrawn at an average of 1.63 billion tons per year。

Keywords: Groundwater withdrawal estimation, Empirical Mode Decomposition, Empirical Orthogonal Function.