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Application of Groundwater Level Data Mining in Aquifer Identification

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Abstract : Investigation and research are keys for conjunctive use of surface and groundwater resources. The hydrogeological structure is an important base for groundwater analysis and simulation. Traditionally, the hydrogeological structure is artificially determined based on geological drill logs, the structure of wells, groundwater levels, and so on. In Taiwan, groundwater observation network has been built and a large amount of groundwater-level observation data are available. The groundwater level is the state variable of the groundwater system, which reflects the system response combining hydrogeological structure, groundwater injection, and extraction. This study applies analytical tools to the observation database to develop a methodology for the identification of confined and unconfined aquifers. These tools include frequency analysis, cross-correlation analysis between rainfall and groundwater level, groundwater regression curve analysis, and decision tree. The developed methodology is then applied to groundwater layer identification of two groundwater systems: Zhuoshui River alluvial fan and Pingtung Plain. The abovementioned frequency analysis uses Fourier Transform processing time-series groundwater level observation data and analyzing daily frequency amplitude of groundwater level caused by artificial groundwater extraction. The cross-correlation analysis between rainfall and groundwater level is used to obtain the groundwater replenishment time between infiltration and the peak groundwater level during wet seasons. The groundwater regression curve, the average rate of groundwater regression, is used to analyze the internal flux in the groundwater system and the flux caused by artificial behaviors. The decision tree uses the information obtained from the above mentioned analytical tools and optimizes the best estimation of the hydrogeological structure. The developed method reaches training accuracy of 92.31% and verification accuracy 93.75% on Zhuoshui River alluvial fan and training accuracy 95.55%, and verification accuracy 100% on Pingtung Plain. This extraordinary accuracy indicates that the developed methodology is a great tool for identifying hydrogeological structures.

Keywords : aquifer identification, decision tree, groundwater, Fourier transform
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