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Groundwater levels estimation and forecasting by integrating precipitation-based period-dividing algorithm and response surface methodology

Yongsun Choi[a], Youngik Choi[b], Tuan-Ho Le[c], Sangmun Shin[c,*], Daeyoung Kwon[d,*]

[a]*Department of Industrial and Management Engineering, Inje University, 197 Inje-ro, Gimhae, Gyeongnam 621-749, South Korea, Tel. +82 55 320 3117; email: yschoi@inje.edu*
[b]*Department of Environmental Engineering, Dong-A University, Busan 604-714, Republic of Korea, Tel. +82 51 200 7675; email: youngik@dau.ac.kr*
[c]*Department of Industrial and Systems Management Engineering, Dong-A University, Busan 604-714, Republic of Korea, Tel. +82 51 200 6977; email: letuanhoqnu@gmail.com (T.-H. Le), Tel. +82 51 200 7688; email: sshin@dau.ac.kr (S. Shin)*
[d]*Department of Civil and Urban Engineering, Inje University, 197 Inje-ro, Gimhae, Gyeongnam 621-749, South Korea, Tel. +82 55 320 3855; email: dykwon@inje.ac.kr*

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ABSTRACT

Groundwater is one of the major sources of water supply for domestic, industrial, and agricultural purposes. Intensive water resources constructions in past decades have had huge impacts on hydrological systems. Recently, groundwater dams have received consistent attention as alternative water supply systems with minimal environmental destructions. Groundwater dams are usually of smaller capacity and costs much less compared with river dams. Therefore, it can be a very attractive solution especially for those small provincial cities suffering severe months-long drought every year. As an application of computer science technologies develops, a number of information systems are utilized for the sustainable development for water resources. Recently, groundwater dams have received consistent attention as alternative water supply systems with minimal environmental destruction. Since groundwater dams are constructed at the height close to sea level, optimal water-pumping strategy based on accurate forecasting of groundwater levels is critical to prevent seawater intrusion. However, there exist few methodologies that provide the operation guideline considering groundwater amount and quality. For this reason, the main objective of this paper is to develop a new integrated forecasting system to provide a guideline for sustainable groundwater management. To achieve this objective, the main purpose of this paper is fourfold: First, a new precipitation-based period-dividing algorithm is proposed. This algorithm can effectively apply to forecast the groundwater levels directly interacted to precipitations with high accuracy for a short-term period by using the concept of exponential smoothing and simulation. Second, an advanced estimation method for groundwater level forecasting by using response surface methodology is then proposed, which is a useful statistical tool for

*Corresponding authors.

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modeling and analysis in situations where the groundwater levels are affected by several factors, such as precipitation, temperature, and altitude. Finally, a case study for Sangchun watershed in Eastern South Korea is conducted for verification purposes.

Keywords: Groundwater level; Groundwater dam; Forecasting; Response surface methodology; Optimal water pumping strategy