

Data assimilation application in unauthorized groundwater pumping estimation

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ABSTRACT

In this study, nudging data assimilation algorithm is used to estimate unknown pumping rate in a part of Shabestar plain. Nudging data assimilation algorithm uses the observed measured data of hydraulic head to physical interpretation in order to identify pumping rate. The additional sink and source term is added to the original equation in order to treat the unknown pumping rate. The algorithm identifies the unknown pumping rate and at the same time reduces the forecast error in hydraulic head. The constant pumping rate is the considered scenario in this study. In the case study it is sought to estimate the two unknown pumping rates using head measurements from three observation wells. The results show an excellent rate of convergence for pumping estimation.

Key words: groundwater modelling, Richard's equation, data assimilation, nudging algorithm, unknown pumping rate, physical interpretation

1. INTRODUCTION

Widespread water crisis makes hydrologists to optimize the use of resources. For the most parts, hydrology has been a data-limited science. If hydrologists are to make the best use of emerging remote and ground-based data sources they will need to devote more attention to intelligent methods for processing and interpreting large amounts of information [5]. Meteorologists and oceanographers have addressed these challenges by developing a set of so-called data assimilation techniques [1,2,3,4]. These merge information from multiple sources, including remote sensing instruments, ground-based sensors, and mathematical models. Data assimilation is also being applied with increasing frequency to hydrologic issues and is beginning to influence the way hydrologists think about both data collection and modelling. McLaughlin proposed that data assimilation considers three main problems interpolation, smoothing, and filtering and discussed methods [5]. The hydrologic data assimilation issue can be posed in a probabilistic framework in the case which there is not enough data but some different sources of information are available, assimilation different data would let to the best answer. Data assimilation is widely used in recent hydrological researches. A four-dimensional variational data assimilation approach was used for downscaling of radio brightness measurements for soil moisture estimation [6]. Reichle et al. used ensemble Kalman filter in hydrologic data assimilation [7]. Liu and Gupta worked on uncertainty in hydrologic modeling toward an integrated data assimilation framework [8]. Dechant and Moradkhani Improved the characterization of initial condition for ensemble stream flow prediction