Uncertainty and Reliability Analysis of Integrated Water Resources Modeling Based on Probabilistic Input Parameters

Gholamreza Bahreini, Abbas Ghaheri, Hamid Reza Safavi

1- PhD Candidate, Dept. of Civil Engineering, Iran University of Science and Technology
2- Associate Professor, Dept. of Civil Engineering, Iran University of Science and Technology
3- Associate Professor, Dept. of Civil Engineering, Isfahan University of Technology
⋮
bahreini@iust.ac.ir

Abstract

Integrated water resources modelling is a management tool to deal with water shortage. Uncertainties in eavery model on the other hand, plays a big role in reliability and accuracy of the obtained results. In this research, this concept is used in a developed conjunctive surface and groundwater model using collected data in a case study. The study area consists of Najafabad plain and its passing Zayandeh-rood river, one of the major aquifers of the semiarid basins in central Iran. Satellite images and GIS technique was also used to simulate the input and calibration parameters. Using the Monte Carlo method as a part of a stochastic model, distributed GIS-based hydraulic conductivity was introduced as a normal distribution function to the model, the process during which a reliability analysis for the aquifer`s water levels was also performed. The results illustrated reliability of calculated water levels in each point based on the error encounters from a probabilistic input parameter.

Keywords: Reliability, Uncertainty, Stochastic modeling, integrated management, Conjunctive use.

1. INTRODUCTION

Integrated water modeling has obtained more and more popularity among scientists and regulatory agents in new decades, considering the climate change and projected future scenarios which mostly predict a considerable shortage in accessible water resources supplies. Interactions between each parts of a complicated physical model, in line with the natural uncertainty resources and elements makes such studies to be performed in a stochastic and non-exact environment. One major source of potential error observed in model results is certainly lack of knowledge about the basic parameters entered as model inputs. This is composed of human, tools, computation and measurement errors. However beside the source and mechanism which this kind of error should be regarded as and managed, it is also of great importance how to trace and follow the error propagation in model outputs. How reliable the results of a model are, is highly dependent on how much exact and reliable the input parameters and data are.

Conjunctive simulation of surface water and groundwater in many large-scale models are inevitable regarding either of the interaction of natural process or management objectives. Hydraulic connection between surface water and groundwater could be an applicable case to the former category, while optimized assignments and operation of water in hand is a good case for the latter one. Uncertainty could arise from each or both parts of a compound model. In our case we observe the uncertainty in hydraulic conductivity which contributes in groundwater characteristics of the model.

The remained part of the paper is organized as follows. In next section a brief on some literature in the field of uncertain conjunctive simulation which follows with introducing section describing the governing equations and Monte Carlo method is presented. The study area would be introduced then before the part in which developed conjunctive model is described together with model results and uncertainty analysis. Conclusion with the summary and reference section is the last section of the paper.

2. CONJUNCTIVE MODELING AND UNCERTAINTY ANALYSIS

To review some related models developed in recent decades briefly, THALES could be a good example. A model developed [1] to simulate the interaction between surface and groundwater systems in a two