Automatic Calibration of Semi-Distributed Conceptual Rainfall –Runoff Model Using MOSCEM Algorithm

H. Rouhani[1], D. Gorissen[2], I. Couckuyt[3], J. Feyen[4]

1. Gonbad Higher education, Natural resources division, Iran

2. Department of Information Technology, Ghent University, Belgium

3. Department of Mathematics and Computer Science, Antwerp University, Belgium

4. Department of Erath and Environmental sciences, Faculty of Bioscience Engineering, Katholieke Universiteit Leuven, Belgium

rouhani.hamed@yahoo.com
dirk.gorissen@ugent.be
ivo.couckuyt@ua.ac.be
Jan.Feyen@ees.kuleuven.be

Abstract

We explore the effectiveness of multi-objective an evolutionary optimization algorithm to calibrate rainfall-runoff model. The Multi-objective Shuffled Complex Evolution Metropolis algorithm is used to find Pareto solutions. Log-Efficiency (LogE) of the observed vs. simulated flows which gives more weight to low flow and Nash and Sutcliffe (1970) defined the coefficient of efficiency (EF) which tends to give stronger emphasis on fitting the higher or peak output values are used as objective functions. The catchment model applied in this study is the Soil and Water Assessment Tool (SWAT). The case study area is Grote Nete basin located in the north-eastern Belgium.

Keywords: Rainfall-Runoff model; MOSCEM algorithm, SWAT Model; Pareto-optimal solution**.**

1. INTRODUCTION

A catchment model can be used to better understand the relationship between physical characteristics and meteorological factors and the complex system of the hydrologic cycle occurring within a catchment. Effective catchment management requires knowledge of hydrologic processes in the catchments. But most hydrologic models are characterized by complex functional relationships and a large number of parameters that are usually conceptual representations of the catchment. In most cases, these parameters cannot be directly measured in the filed or are not exactly known because of spatial variability and measurement error, here require calibration – i.e. "tuning" of the parameters to provide a good fit to observations [7, 6 and1].

For models with several parameters (such as SWAT [1]), manual calibration is cumbersome for large-scale studies. A successful and efficient manual calibration requires a detailed understanding of the model [16] and significant amount of time and effort. Moreover, manual calibration involves subjective decisions and therefore it is difficult to assess the confidence of model simulations [11]. Therefore, development and use of automated calibration procedures are gaining importance [10].

Local search methods have been applied successfully in calibration of simple hydrological models, but might fail in locating the optimum for models of increased complexity, due to the more complex shape of the response surface. Global search algorithms have been demonstrated to perform well for these types of models, although at a more expensive computational cost. During the last decades, a variety of probabilistic schemes have been developed for solving intrinsically nonconvex and multimodal problems. These methods involve the evaluation of the objective function at a usually random sample of points, followed by subsequent evolutions of the sample using a combination of random and deterministic rules. An example of this approach is the Shuffled Complex Evolution Metropolis global optimization algorithm, SCEM, developed at the University of Amsterdam [15].

Advances in computational capabilities have led to more complex hydrologic models often predicting multiple hydrologic fluxes simultaneously (e.g. surface and subsurface flows, energy) [12]. In addition, the