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Investigating sensitivity of flow parameters and uncertainty analysis of nutrient transport and dispersion model in shallow water. (Case study: Peer-Bazar River and Anzali Wetland)

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ABSTRACT

Accurate modeling of runoff in watersheds requires calibration and uncertainty analysis of effective flow parameters and identifying of their statistical characteristics based on inter-parameter relationships and model inputs. In this research, the transport and diffusion of pollution (nutrients) in the river were simulated through the two-dimensional finite-volume method using the shallow water equations. To numerically solve these equations, the governing equations were converted into linear equations. Uncertainty and sensitivity of the prepared pollution model were analyzed to achieve better results in estimating pollution concentrations in rivers within a reliable range. In this study, the likelihood weight (LW) method was used for each parameter in which the ratio of sensitivity and probability density function for the sets of good and bad parameters are computed. To this end, 6,000 iterations of the uncertainty domain for 3 calibration parameters of the pollution transport and dispersion model were carried out using a modification of the general likelihood uncertainty estimation (GLUE) method prepared by the authors. The three considered parameters were n (manning coefficient), S_x, and S_y (riverbed slope parameters in x and y directions) since they were more prone to measurement errors compared to the other hydraulic parameters. In the next step, the eutrophication issue and transport and diffusion of the nutrients (TDN model) in the estuaries of the Peer-Bazar River and Anzali Wetland were analyzed. A total of 1,500 simulations were considered as efficient simulations by applying the acceptable threshold values to the sum of squared errors indicator for all the simulations. The corresponded set of parameters was considered as good set parameters and the others as bad set parameters. By extracting the diagrams of the posterior probability distribution for the parameters included in the efficient simulations, parameter n with an optimal value of 0.2502 was recognized as the sensitive and influential parameter of the model. S_x and S_y with the optimal values of 0.0169 and 0.0776 were recognized as the less sensitive parameters due to their larger level of uncertainty. Assuming a confidence interval of 95% for the upper and lower bounds of uncertainty, p- and d-factors were, respectively, obtained as 0.78 and 0.73, indicating the high level of observational concentrations for the considered confidence interval. It can be concluded that the GLUE approach has been successfully applied to the TDN model. Also, the comparison of sensitivity analysis of parameters based on the LW methods and variation coefficient of parameters indicated that LW is an efficient method for sensitivity analysis of model parameters.

Keywords: Sensitivity measurement, Anzali watershed, Calibration, TDN model, GLUE algorithm

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