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Editorial

Modeling of Water Quality, Quantity, and Sustainability

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For decades, water shortage, flooding, and water deterioration problems have led to a variety of adverse impacts on socioeconomic development and human life. Challenges of water quality and quantity management adhering to the principle of sustainable development have been of significant concerns to many researchers and decision makers [1–6]. These issues are highly complicated, involving a large number of social, economic, environmental, technical, and political factors, coupled with complex spatial variability and cascading effect [7, 8]. Climate change and human interference could affect the related management systems at a regional scale and lead to more significant spatial and temporal variations of water quantity and availability as well as the associated environmental and ecological conditions. Such complexities force researchers to develop more robust mathematical methods and tools to analyze the relevant information, simulate the related processes, implement mitigation strategies, assess the potential impacts/risks, and generate sound decision alternatives. Therefore, it is desired that mathematical techniques be developed to aid decision makers in formulating and adopting cost-effective and environment-benign water management plans and policies.

The paper "*River flow estimation from upstream flow records using support vector machines*" by H. Karahan et al. proposed a novel architecture for flood routing model and validated the model efficiency on several problems by employing support vector machines. The results showed that the proposed architecture advances the model performance under noisy and missing data conditions and the support vector machines can be powerful alternative in modeling flood routing.

The paper "*Mathematical modeling and simulation of SWRO process based on simultaneous method*" by A. Jiang et al. developed a spiral-wound model for simulating seawater reverse osmosis (SWRO) process. The model was described by differential and algebraic equations with some inequality and equality constraints of equipment and water quality. A case study of a SWRO plant was used to validate the formulated model and solution method. The study work was helpful to gain an in-depth insight into the mechanism of SWRO process and had a significant potential for helping in energy saving through the optimized operation.

The paper "*Water demand forecast in the Baiyangdian Basin with the extensive and low-carbon economic modes*" by T. L. Qin et al. analyzed the effects of extensive and low-carbon economic modes on water demand of the Baiyangdian Basin, China. Results can support generation of ecoenvironmental conservancy target and water resources allocation scheme under many conflicting factors being balanced due to complexities of the real-world problems.

The paper "*A conjunction method of wavelet transform-particle swarm optimization-support vector machine for streamflow forecasting*" by F. Zhang et al. developed a wavelet transform particle swarm optimization support vector machine (WT-PSO-SVM) model to forecast monthly streamflow of Tangnaihai hydrology station in the Yellow River.

The model integrated the advantages of the best versatility, robustness and effectiveness of SVM, the best global searching ability, and the simple implementing procedure of PSO for parameter selection. The results demonstrated that the advanced model could forecast monthly streamflow in situations without formulating models for the internal structure of the watershed compared with the conventional SVM model.

The paper "*Identification of contamination control strategy for fluid power system using an inexact chance-constrained integer program*" by Y. Q. Huang et al. developed an inexact chance-constrained integer programming method for planning contamination control of fluid power system. The model is good at examining the reliability of satisfying (or risk of violating) system constraints under uncertainties expressed as probability distributions and discrete intervals. The results can be used for generating decision alternatives and thus help designers identify desired strategies under various environmental, economic, and system-reliability constraints.

The paper "*Accurate simulation of contaminant transport using high-order compact finite difference schemes*" by G. Gurarslan carried out numerical simulation of advective-dispersive contaminant transport by using high-order compact finite difference schemes combined with second-order MacCormack and fourth-order Runge-Kutta schemes. Numerical experiments were conducted for the aim of demonstrating efficiency and high-order accuracy of the current methods. It was exhibited that the methods are capable of achieving high accuracy and efficiency with minimal computational effort, by comparisons of the computed results with exact solutions.

The paper "*Numerical simulation of flow and suspended sediment transport in the distributary channel networks*" by W. Zhang et al. presented a 1D flow and suspended sediment transport model to simulate the hydrodynamics and suspended sediment transport in the distributary channel networks and applied it to the Pearl River networks. The model was extensively calibrated and validated against field measurements to provide an accurate representation of water level and discharge, as well as suspended sediment transport in the networks, demonstrating that the model could simulate the hydrodynamics and suspended sediment concentration in the distributary channel networks.

The paper "*Calculation of the instream ecological flow of the Wei River based on hydrological variation*" by S. Huang et al. analyzed the variation of instream ecological flow of the Wei River Basin, through employing the heuristic segmentation algorithm, the law of tolerance and ecological adaptation theory, and a modified Tennant method. This study suggested that the heuristic segmentation algorithm is suitable to detect the mutation points of flow series and minimum instream ecological flow can be identified by the modified Tennant method. The results are helpful for the manager to reasonably allocate water resources and support the river's ecosystem sustainability.

The paper "*Monthly optimal reservoirs operation for multicrop deficit irrigation under fuzzy stochastic uncertainties*" by L. Zhang et al. proposed an uncertain monthly reservoirs operation and multicrop deficit irrigation model under conjunctive use of underground and surface water in Shiyang River Basin, China. Uncertainties in reservoir management shown as fuzzy probability were treated through chance-constraint parameter for decision makers. The results of reservoir operation policy, irrigation scheme, and water resources allocation could be used to provide decision support for local managers.

The paper "*Spatial and temporal variation of annual precipitation in a river of the Loess Plateau in China*" by C. Shen and H. Qiang analyzed the spatial and temporal patterns of annual precipitation in the Weihe Basin, where Mann-Kendall method was used to discriminate the variation points of precipitation series. The results indicated that there was an overall reduction in annual precipitation across the basin and there were two spatial patterns during the study period. The findings have significant implications for the variations research of runoff in the basin, as variation points in the annual precipitation series at each meteorological station in the basin were detected.

The paper "*A physically based runoff model analysis of the Querétaro River Basin*" by C. J. V. Alvarado et al. used a physically based model to analyze water balance by evaluating the volume rainfall-runoff using SHETRAN and hydrometric data measurements in 2003. The results were compared with five ETp different methodologies in the *Querétaro* River Basin in central Mexico. This study work can be a strong base for sustainable water management in a basin, the prognosis and effect of land-use changes, and availability of water and also can be used to determine application of known basin parameters, basically depending on land-use, land-use changes, and climatological database to determine the water balance in a basin.

The paper "*Study on spacing threshold of nonsubmerged spur dikes with alternate layout*" by X. Cao et al. built a numerical model combining the standard k-ε model, finite volume method, and rigid lid assumption to investigate the spacing threshold of nonsubmerged double spur dikes with alternate layout and the same length in straight rectangular channel. The results of four sets of additional conditions illustrated that the generalization of empirical formula is satisfactory and the precision of interpolation is higher than that of extrapolation.

The paper "*Mathematical modeling for water quality management under interval and fuzzy uncertainties*" by J. Liu et al. proposed an interval fuzzy credibility-constrained programming method for supporting river water quality management. The model is good at dealing with different types of uncertainties (i.e., interval numbers and possibility distributions) in water quality management and can also be used to analyze reliability of satisfying system constraints. A real-world case (i.e., Xiangxi River in the Three Gorges Reservoir Region) was used to demonstrate the methodology's applicability. The solutions are useful for managers in making decisions of water quality management, considering tradeoffs between system benefit and environmental requirement.

The paper "*Testing a conceptual lumped model in Karst area, Southwest China*" by P. Shi et al. used Xin'anjiang model for modeling hydrological response of Sancha River Valley (a typical karst area located in the southwest of China).

The performance of the model was evaluated based on the model's ability to reproduce the streamflow and baseflow. Suitable parameters such as percentage of bias (PBIAS), Nash-Sutcliffe efficiency (NSE), coefficient of determination (R^2), and standard deviation (RSR) which could reflect the hydrological and geomorphic condition were calculated between the simulated and measured flow for both calibration and validation period. The results suggested that the model structure and parameters are of reasonable validity and are feasible to describe the hydrologic processes in this region.

The paper "*Detecting runoff variation of the mainstream in Weihe River*" by Q. Huang and J. Fan analyzed the variation change in runoff through using the Mann-Kendall method. The results indicated that runoff variation changes point is 1990 for most of the catchments. The attribution analysis showed that the primary drivers of the shift in runoff variation changes are human activities rather than climate change, as water consumption increased sharply in the 1990s.

The paper "*Uncertainty analysis of multiple hydrologic models using the Bayesian model averaging method*" by L. Dong et al. employed the Bayesian model averaging (BMA) method to construct a three-member predictions ensemble and a nine-member predictions ensemble for ensemble hydrologic prediction as well as for uncertainty analysis. Compared with the previous studies of the BMA, this study focused on the comparison of the prediction uncertainty interval generated by BMA with that of each individual model under two different BMA combination schemes. It was found that BMA is useful for dealing with two issues: (1) assessing the relative performances of multiple competing models for the same problem and (2) handling uncertain control variables.

In summary, the effective mathematical methods for modeling water quantity, quality, and sustainability are becoming one of the most important goals pursued by governments, industries, communities, and researchers. These 16 papers submitted to this special issue mainly focus on exposition of innovative methodologies for tackling problems in fields of hydrologic prediction, water resources allocation, pollution mitigation, flood/drought control, and climate change impact assessment and adaptation planning. These research works will enhance the capability of decision makers in exploring comprehensive and ambitious plans for managing water systems, with an aim of achieving better sustainability.

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