Evaluation of Meta-heuristics Hybrid Models for the River Flow Simulation Case Study: The River Kashkan, Lorestan, Iran

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1-Introduction

Predicting the river flow is one of the most important issues relating to effective management of water resources, especially during the flood and drought. Although there are several hydrological methods to predict flow of rivers, intelligent models are more efficient. In this study, daily data obtained from the Kashkan basin in Lorestan, Iran was used to evaluate the accuracy of the models. Furthermore, in order to simulate its daily flow, three models were applied, including vector-wavelet regression, support vector-regression-gray wolf and support vector-regression-bat. Then the results were compared for accuracy. Each of the models has been often used to predict daily discharge of different rivers in previous studies. However, the present research aimed to examine them simultaneously in the same basin to predict the daily flow of the River kashkan.

2-Method

In this study, the River Kashkan in Lorestan, Iran was selected as the studied region and data relating to its daily flow recorded in the Poldakhtar Hydrometric Station was used to calibrate and validate the models. To this end, first 80% of data concerning the daily flow of the river (2018-2020) was used to calibrate the models and the rest were applied for validation. Support vector machines are an efficient learning system based on the theory of constrained optimization using the inductive principle of structural error minimization in order to achieve a general optimal solution. Wavelet transform is an alternative to short-time Fourier transform, and aims to overcome problems related to frequency resolution in short- time Fourier transforms. In a wavelet transform, namely a short-time Fourier transform, the signal is split into windows, and so the wavelet transform is performed on each of these windows one by one. The Gray Wolf Optimizer (GWO) refers to a meta-heuristics optimizer inspired by the hierarchical structure and social behavior of gray wolves during hunting. This population-based optimizer has a simple process which can be easily generalized to a large scale. The Bat Algorithm (BA) is a metacognitive

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algorithm inspired by the collective behavior of bats in the environment and was introduced by Yang in 2010. It is based on the sound echoed back by bats. To put it simply, bats find the exact position of the prey by sending sound waves and receiving echoes. When sound waves return beck to the transmitter (bat), it draws an acoustic image of the obstacles up ahead, and thanks to this ability bats can see well even in complete darkness.

3-Results and discussion

The results suggest that all three models in a structure consisting of 1 to 4 time delays showed better performance than other models. Moreover, R = 0.960, RMSE = 0.045, MAE = 0.024, NS = 0.968, and PBIAS =0.001 obtained from validation of the wavelet-support vector machine.

4-Conclusion

Taken together, these results suggest that increasing the number of effective parameters in different models for simulation improves performance on evaluating the daily flow of the river. In addition, the support vector-wavelet regression delivered better performance among others.

Keywords: River flow, Simulation, Hybrid model, Kashkan-Lorestan