World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:18, No:01, 2024

Forecasting Nokoué Lake Water Levels Using Long Short-Term Memory Network

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Abstract : The prediction of hydrological flows (rainfall-depth or rainfall-discharge) is becoming increasingly important in the management of hydrological risks such as floods. In this study, the Long Short-Term Memory (LSTM) network, a state-of-the-art algorithm dedicated to time series, is applied to predict the daily water level of Nokoue Lake in Benin. This paper aims to provide an effective and reliable method enable of reproducing the future daily water level of Nokoue Lake, which is influenced by a combination of two phenomena: rainfall and river flow (runoff from the Ouémé River, the Sô River, the Porto-Novo lagoon, and the Atlantic Ocean). Performance analysis based on the forecasting horizon indicates that LSTM can predict the water level of Nokoué Lake up to a forecast horizon of t+10 days. Performance metrics such as Root Mean Square Error (RMSE), coefficient of correlation (R^2), Nash-Sutcliffe Efficiency (NSE), and Mean Absolute Error (MAE) agree on a forecast horizon of up to t+3 days. The values of these metrics remain stable for forecast horizons of t+1 days, t+2 days, and t+3 days. The values of R^2 and NSE are greater than 0.97 during the training and testing phases in the Nokoué Lake basin. Based on the evaluation indices used to assess the model's performance for the appropriate forecast horizon of water level in the Nokoué Lake basin, the forecast horizon of t+3 days is chosen for predicting future daily water levels.

Keywords : forecasting, long short-term memory cell, recurrent artificial neural network, Nokoué lake
Conference Title : ICUHH 2024 : International Conference on Urban Hydrology and Hydraulics
Conference Location : Paris, France
Conference Dates : January 18-19, 2024