Machine Learning Models Evaluation for Predicting Dam Filling Rates: A Case Study of AL Massira Dam, Morocco

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Abstract:

Dams are key infrastructures in regulating water resources through their flood control, water supply, and sustainable management solutions. The study proposes a structured approach for selecting the best machine learning models that can be used in the prediction of filling rates in dams using daily hydro-meteorological data. It targets the AL Massira Dam in Morocco's Oum Er-Rbia basin and uses various machine learning techniques such as Auto-Regressive Integrated Moving Average (ARIMA), Support Vector Machine (SVM), eXtreme Gradient Boosting (XGBoost), and Multilayer Perceptron (MLP).

The methodology involves two distinct modeling approaches: (1) time series forecasting using ARIMA for one-day-ahead predictions with lagged data and (2) multivariate modeling integrating variables such as rainfall, temperature, soil moisture, and potential evapotranspiration for seven-day-ahead projections. Using a meticulously preprocessed dataset from 2018 to 2022, preliminary findings revealed that Support Vector Regression (SVR) and Multilayer Perceptron (MLP) models delivered the most robust multi-day predictions. The SVR model showed the best performance for AL Massira, with a root mean square error of 0.90, mean absolute error of 0.51, and a correlation coefficient of 0.84. The MLP model also realized relatively robust predictions, with an RMSE of 0.95, MAE of 0.71, and a correlation coefficient of 0.83. These will be useful for dynamic water resource management and adaptive dam operations, especially in view of changing climatic conditions.

It integrates machine learning techniques with socio-hydrological considerations; hence, both technical accuracy and societal impact go side by side for better reservoir management and supporting the downstream communities.

Keywords:

Dam filling rates, Machine learning, Time series forecasting, Hydrological modeling, Weather data analysis, Adaptive water management.