An improved deep learning model for suspended sediment forecast

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Suspended sediment in river flows plays an essential role in water quality and aquatic environment. Its prediction is therefore of significance in river and dam engineering. However, conventional sediment rating curve (SRC) often fails to generate satisfactory results. Consequently, this paper develops a robust model for improved sediment forecasts using deep learning techniques. To this end, a novel framework (thereafter BLSTM) is established by coupling the long short-term memory (LSTM) model with the Bayesian Optimization (BO). The LSTM is a recurrent neural network suitable for time series modeling. The BO is applied to tune the multiple hyperparameters in LSTM, aiming to attain optimized model performance. As benchmarks, the commonly used multi-gene genetic programming (MGGP) and artificial neural network (ANN) are constructed for sediment estimation. To test the developed models, daily suspended sediment records (2010‒2015) at Datong hydrological station on the Yangtze River are used. The model performance is assessed using statistical measures: coefficient of determination (CD), root mean square error (RMSE) and mean absolute error (MAE). The proposed BLSTM gives the most accurate forecasts and outperforms all other methods evaluated. The BO is an effective approach to optimize model architecture. This paper offers a reliable approach for sediment prediction and provides reference for similar hydrological issues, e.g., streamflow and rainfall-runoff modeling.