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Forecasting hourly water quality changes in urban streams using a hybrid linear and nonlinear model.

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In major streams located in Seoul, the capital of South Korea, water quality parameters have been monitored on an hourly basis to take prompt action in response to extreme pollution events. Such water quality data, accompanied with meteorological and hydrological data are now available for a period of ∼40 years, providing an opportunity to forecast water quality changes, with particular interest in sudden changes exceeding threshold levels. Although linear (ARIMA) models and more recently, nonlinear (neural network) models have been widely used to deal with time series data, previous findings report that individual linear or nonlinear models often fail to capture a trend, complex pattern of fluctuations, or irregularity of the time series. As an alternative, a combination of linear and nonlinear models has been proposed to improve prediction accuracy. In this study, a hybrid ARIMA-Deep Neural Network (DNN) model was developed; an ARIMA was used to characterize a trend and fluctuations, while a DNN was used to predict the time series preprocessed by the ARIMA. Dissolved oxygen, total organic carbon, and total suspended solids were selected as output variables. Water quality parameters, including water temperature, pH, and electrical conductivity, meteorological and hydrological factors, and point-source loads were used as input variables. Our results suggested that the hybrid ARIMA-DNN model increased overall prediction accuracy, as well as the prediction accuracy for extremely high or low concentration values, which are of significant importance to water quality management and decision-making.