

# Chloride Concentration Forecasting in Urban Streams Using Deep Learning models

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De-icing road salts while applied for clearing icy roads can impact on urban stream water quality. The Stream Chloride Concentration (SCC) is a significant indicator impacting on the aquatic habitats, and encourage road salt management plans in salt vulnerable areas. This research aims to investigate the importance of advanced Deep Neural Network (DNN) learning techniques to develop a reliable and accurate SCC forecasting tool in urban rivers. Large volumes of the real time water quality dataset, including chloride concentration, river discharge, water temperature is considered to predict SCC time series with attention of spatial-temporal within the Don River, Ontario, Canada. This paper adopted a Convolutional Neural Network (CNN)-Long Short-Term Memory (LSTM) to predict the SCC parameter time series, to evaluate against four other comparative machine learning methods, LSTM, Convolutional-LSTM (ConvLSTM), Sequence-to-Sequence (Seq2Seq), and Wavelet neural network (Wavenet) models. The proposed CNN-LSTM produced the most accurate forecasts to LSTM, ConvLSTM, Seq2Seq, and Wavenet models using statistical metric such as the Mean Square Error (MSE) for the hourly SCC time series. Furthermore, the SCC forecasting is investigated for the different time-forecast periods. These results reveal that CNN-LSTM outperforms the proposed other models and create predictions closer to the true chloride concentration in the Don River case study.

**Keywords:** stream chloride concentration, deep neural network models, water quality