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Sensitivity analysis of network structure in missing streamflow data complementation using Bidirectional Short-Term Memory network

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Streamflow data based on the observation may be partially missing due to flood or malfunction of the measuring equipment. Here, it is important to complement the missing flow rate with high accuracy for water resource management and flood risk management. Various statistical approaches such as linear regression and multiple regression models have been proposed as methods for complementing missing flow rates. Among the statistical methods, deep learning has been rapidly evolved with the improvement of computational equipment. Then, deep learning methods have achieved remarkable success in various fields. It may indicate that there is a possibility that the missing flow rate can be complemented with high accuracy by using the deep learning method. Therefore, this study implemented deep learning for missing streamflow complementation. In addition, because the network structure of deep learning may have a great influence on estimation accuracy, this study conducted a sensitivity analysis of the network structure. Among the deep learning methods, Bidirectional LSTM (Bi-LSTM) was implemented in this study. Bi-LSTM is a kind of LSTM that can learn long-term dependence of time series data. Bi-LSTM learns data in both forward and backward directions, compared to Unidirectional LSTM which learns data forward directions. As for the input data, both hourly streamflow and precipitation data were used. For model learning and evaluation, missing streamflow data were artificially generated. The results show that Bi-LSTM can complement the flow rate with high accuracy. It also showed the importance of optimizing the network structure.