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The application of neural network model to the simulation nitrous oxide emission in the hydro-fluctuation belt of Three Gorges Reservoir

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Nitrous oxide is much more potent greenhouse gas than carbon dioxide. However, the estimation of N2O flux is usually clouded with uncertainty, mainly due to high spatial and temporal variations. This hampers the development of general mechanistic models for N2O emission as well, as most previously developed models were empirical or exhibited low predictability with numerous assumptions. In this study, we tested General Regression Neural Networks (GRNN) as an alternative to classic empirical models for simulating N2O emission in riparian zones of Reservoirs. GRNN and nonlinear regression (NLR) were applied to estimate the N2O flux of 1-year observations in riparian zones of Three Gorge Reservoir. NLR resulted in lower prediction power and higher residuals compared to GRNN. Although nonlinear regression model estimated similar average values of N2O, it could not capture the fluctuation patterns accurately. In contrast, GRNN model achieved a fairly high predictability, with an R2 of 0.59 for model validation, 0.77 for model calibration (training), and a low root mean square error (RMSE), indicating a high capacity to simulate the dynamics of N2O flux. According to a sensitivity analysis of the GRNN, nonlinear relationships between input variables and N2O flux were well explained. Our results suggest that the GRNN developed in this study has a greater performance in simulating variations in N2O flux than nonlinear regressions.