

Comparing Bayesian regularization and cross-validated early-stopping for streamflow forecasting with ANN models

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Abstract Two popular techniques for generalizing artificial neural network (ANN) models are the Bayesian regularization (BR) and the cross-validated early stopping (CVES) methods. The comparison between the two methods and the no-stop training method (NST, in which the training is stopped after 1000 epochs) for forecasting one-step ahead discharges based on univariate daily and monthly streamflow time series of three rivers (the Yellow River in China, and the Rhine and the Danube rivers in Europe), shows that both methods perform generally better than NST when the ratio (R) of training sample size to the number of weights in the network is less than 20. But the advantage of the two techniques over NST is not guaranteed. In several cases they fail even when the ratio $R \leq 10$, especially the CVES method. On the other hand, comparison between the BR and CVES method shows that BR outperforms CVES in most cases, and it even outperforms the NST method in several cases when the ratio R is larger than 30. Furthermore, the performance of BR is very stable, whereas the performance of CVES is highly unstable. The evaluation result for making 1- to 5-day ahead streamflow forecasts for the upper Yellow River based on multiple explanatory variables further confirms the advantage of the BR method.

Key words streamflow forecast; artificial neural network; Bayesian regularization; cross-validation
