Geophysical Research Abstracts
Vol. 19, EGU2017-13857-1, 2017
EGU General Assembly 2017

Integrating a Storage Factor into R-NARX Neural Networks for Flood Forecasts

Po-Kai Chou (1), Li-Chiu Chang (2), Fi-John Chang (3), and Ban-Jwu Shih (1)

(1) Department of Civil Engineering, National Taipei University of Technology, Taipei 10617, Taiwan, (2) Department of Water Resources and Environmental Engineering, Tamkang University, New Taipei City 25137, Taiwan, (3) Department of Bioenvironmental Systems Engineering, National Taiwan University, Taipei 10617, Taiwan

Because mountainous terrains and steep landforms rapidly accelerate the speed of flood flow in Taiwan island, accurate multi-step-ahead inflow forecasts during typhoon events for providing reliable information benefiting the decision-makings of reservoir pre-storm release and flood-control operation are considered crucial and challenging. Various types of artificial neural networks (ANNs) have been successfully applied in hydrological fields. This study proposes a recurrent configuration of the nonlinear autoregressive with exogenous inputs (NARX) network, called R-NARX, with various effective inputs to forecast the inflows of the Feitsui Reservoir, a pivot reservoir for water supply to Taipei metropolitan in Taiwan, during typhoon periods. The proposed R-NARX is constructed based on the recurrent neural network (RNN), which is commonly used for modelling nonlinear dynamical systems. A large number of hourly rainfall and inflow data sets collected from 95 historical typhoon events in the last thirty years are used to train, validate and test the models. The potential input variables, including rainfall in previous time steps (one to six hours), cumulative rainfall, the storage factor and the storage function, are assessed, and various models are constructed with their reliability and accuracy being tested. We find that the previous (t-2) rainfall and cumulative rainfall are crucial inputs and the storage factor and the storage function would also improve the forecast accuracy of the models. We demonstrate that the R-NARX model not only can accurately forecast the inflows but also effectively catch the peak flow without adopting observed inflow data during the entire typhoon period. Besides, the model with the storage factor is superior to the model with the storage function, where its improvement can reach 24%. This approach can well model the rainfall-runoff process for the entire flood forecasting period without the use of observed inflow data and can provide reliable and accurate inflow forecasts.