Geophysical Research Abstracts
Vol. 12, EGU2010-9510, 2010
EGU General Assembly 2010

Neural Networks for Hydrological Modeling Tool for Operational Purposes

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Hydrological models are useful in many water resources applications such as flood control, irrigation and drainage, hydro power generation, water supply, erosion and sediment control, etc. Estimates of runoff are needed in many water resources planning, design development, operation and maintenance activities. Runoff is generally computed using rainfall-runoff models. Computer based hydrologic models have become popular for obtaining hydrological forecasts and for managing water systems. Rainfall-runoff library (RRL) is computer software developed by Cooperative Research Centre for Catchment Hydrology (CRCCH), Australia consisting of five different conceptual rainfall-runoff models, and has been in operation in many water resources applications in Australia. Recently, soft artificial intelligence tools such as Artificial Neural Networks (ANNs) have become popular for research purposes but have not been adopted in operational hydrological forecasts. There is a strong need to develop ANN models based on real catchment data and compare them with the conceptual models actually in use in real catchments.

In this paper, the results from an investigation on the use of RRL and ANNs are presented. Out of the five conceptual models in the RRL toolkit, SimHyd model has been used. Genetic Algorithm has been used as an optimizer in the RRL to calibrate the SimHyd model. Trial and error procedures were employed to arrive at the best values of various parameters involved in the GA optimizer to develop the SimHyd model. The results obtained from the best configuration of the SimHyd model are presented here. Feed-forward neural network model structure trained by back-propagation training algorithm has been adopted here to develop the ANN models. The daily rainfall and runoff data derived from Bird Creek Basin, Oklahoma, USA have been employed to develop all the models included here. A wide range of error statistics have been used to evaluate the performance of all the models developed in this study. The ANN models developed consistently outperformed the conceptual model developed in this study. The results obtained in this study indicate that the ANNs can be extremely useful tools for modeling the complex rainfall-runoff process in real catchments. The ANNs should be adopted in real catchments for hydrological modeling and forecasting. It is hoped that more research will be carried out to compare the performance of ANN model with the conceptual models actually in use at catchment scales. It is hoped that such efforts may go a long way in making the ANNs more acceptable by the policy makers, water resources decision makers, and traditional hydrologists.