Hydrol. Earth Syst. Sci. Discuss., 4, S227–S229, 2007
www.hydrol-earth-syst-sci-discuss.net/4/S227/2007/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Neural network emulation of a rainfall-runoff model" *by* R. J. Abrahart and L. M. See

Anonymous Referee #2

Received and published: 4 May 2007

The origin of the paper is two earlier studies by Gaume and Gosset (2003) and Han et al. (2007), which questioned the ability of neural network solutions for hydrological modeling. The authors took a simple conceptual rainfall-runoff model called Xinanjiang model to generate synthetic data to develop neural network models. Different levels of information was provided (or not provided) to the neural networks that resulted in four different neural network solutions (called experiments in the paper). The results of four experiments are compared with multiple input single output linear regression models on the same data set. The results obtained demonstrate the superiority of neural networks in modeling the non-linear equation of Xinanjiang model. The paper is very nicely presented, and is easy to follow. The insights into the key issues related to hydrological modeling using neural networks presented in section 6 (Discussion)

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

EGU

are particularly very interesting. A response by the authors to the following comments would help the research community in understanding their work.

1) Neural networks have been established to be superior to the conventional models of linear kind (including regression, uni-variate time series models, and multi-variate time series transfer function models) and some other non-linear kind, one can find abundance of literature not only in hydrology but in many other fields of science and engineering on this. The conclusions drawn by the authors in this study are well established already. I am not convinced about the need of a study (being presented) to refute the conclusions drawn by the earlier two studies.

2) A major flaw in the paper is with the model chosen. The non-linearities in hydrological process are due to some of its components e.g. infiltration, evapotranspiration, sub-surface flow, etc., which are not considered in the Xinanjiang model. The earlier studies in question modeled the flow hydrograph in time domain (with higher lead times in some cases); whereas the Xinanjiang model converts rainfall into storm runoff without considering time distribution. The results obtained in this study would be able to say that how good or bad NN solutions are in modeling the trivial nature of non-linearities in equations (1) to (4) in comparison to MLIN models, and not much can be said about hydrological modeling in general.

3) The Xinanjiang model represents a simple equation with only non-linearity in its parameter b. Moreover, the range of b chosen by the authors (0.1-0.5) is a very small fraction of the range that could be possible, which further raises doubts about the trivial nature of the problem taken by the authors to challenge studies based on real data.

4) Were WLTF regression models or time series linear models of Box-Jenkins type? If latter, the comparison of BPNN with MLIN may not be fair.

5) NNs are powerful tools capable of capturing the relationships among same inputs and outputs, if optimal models are developed. NN models 2 and 3 have same input information (P, Wo, and Wm) although in different forms. Why is their performance

HESSD

4, S227–S229, 2007

different? It is probably because the final NN models are not optimal and not because of loss of hydrological information.

6) The two arguments presented in section 4 for not attempting optimal solutions are for non-parsimonious and two-hidden layer NN models. The authors could have used different number of epochs and learning rate to achieve SSEs of similar order.

7) It is said that most of the earlier studies make three assumptions (presented in section 6). It is well established that the hydrological process is highly non-linear in nature. Any modeling effort is important from operational point of view wherein actual hydrological data are needed for making management decisions. The validity of the assumptions can not be questioned. The Xinanjiang model is also based on a few assumptions, one of which is mentioned by the authors (lines 1-5, pp 294). Another assumption used by the authors is that the initial soil moisture is never less than half-full. The genesis of using three assumptions to select a simple non-linear equation is not clear.

8) In Figure 7, modeled outputs are always greater than 0.1. Why? (Not the case in other BPNN models).

9) The authors may consider reducing the lengths of sections 4 and 5, if possible.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 4, 287, 2007.