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Hydrology and Earth System Sciences Discussions

Interactive comment on "Generalized versus Non-Generalized Neural Network model for multi-lead inflow forecasting at Aswan High Dam" *by* A. El-Shafie and A. Noureldin

Anonymous Referee #2

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This paper compares a standard (non-generalized) artificial neural network (ANN) model with a generalized ANN model for inflow forecasts at multi-lead times. The models are tested using inflow data from the Aswan High Dam located in Egypt. Overall, I think the paper is well written and the authors address an important topic in hydrology (inflow forecasts) that is of keen interest of the Hydrology community. However, based solely on the paper results, I am not fully convinced that the proposed model has much advantage (if any) over the classical AR and ARMA (including periodic AR) classes of inflow forecast models. Some results are also very confusing and may lead to wrong conclusions. Moreover, the apparent higher forecast skill of the generalized

ANN based model over the standard ANN model obtained by the authors is somehow expected and do not bring anything new to the hydrology community. Hence, I do not recommend this paper as it is for publication at the Hydrol. Earth Syst. Sci. Journal. I think the paper needs major revisions in order to be considered for publication. Major and minor comments to support my view are listed below.

Note: Once I finished this review I realized there was another review posted by Referee #1 and a reply from the authors. As expected, there are some overlapping comments in this review and I decided not to remove them.

Major Comments

Eqs. (1), (2) and (3):

a) Historically, the function f in these equations has been well represented by linear functions (just look at the success of the classical auto-regressive based models). In general, the inflow at time t is linearly related with past flows as shown by the (periodic) auto-correlation function of several inflow series. Hence, the authors do not take advantage of the main feature of Artificial Neural Network (ANN) models, which is their ability to map non-linear, complex relationships between input and output data.

b) I am not convinced that a third order model (i.e., the inflow at time t-3 still has some influence on the inflow at time t) is physically plausible for this problem, especially for the wet period months. Unfortunately, ANN models are black boxes and cannot show whether such persistence relationships expressed by model parameters are significant or not.

c) If the interest is to predict Q(t+1)- Eq. 2, why not just use (Qm(t-1), Qm(t-2), Qm(t-3)) as predictors rather than first predict Qf(t) with (Qm(t-1), Qm(t-2), Qm(t-3)) predictors then use (Qf(t), Qm(t-1), Qm(t-2)) to predict Q(t+1)? I think the recursive (or plug-in, iterated) approach employed by the authors is more appropriate for AR based models and the authors may get much better results if they use a direct approach as suggested.

I think they should at least compare both approaches.

Figures 7, 8 and 9:

a) The authors should clearly identify the lead time of the forecasts (I presume it is one month) – Lines 19-26, page 7969.

b) There are clear evidences of a strong bias in their models. Figures 7a, 7b, 7c, 8c, 8d, 9b and 9d show that the model is constantly overestimating the observed values while Figs. 7c and 8b show evidences of underestimations. What might be the cause of that?

c) In addition to these figures, it would be interesting to see some figures of actual forecasts versus observed values.

Lines 9-18, page 7972 and Table 4:

a) The ARMA model and associated parameters used by the authors should be better explained. ARMA models are usually referred as ARMA(p,q) to indicate the number p of autoregressive terms and the number q of moving average terms – What did the authors use?

b) Since inflow series are usually marked by a distinguished seasonality, it is common in the literature to employ periodic auto-regressive models in order to better address the seasonal variation in the auto-regressive parameters (usually dry period flows show a slow decay in the periodic autocorrelation function whereas wet period flows have a faster decay in the periodic autocorrelation function). The authors themselves fit 12 ANN models (one for each month) in order to better capture such seasonality. Hence, I do not think it is a fair comparison (12 ANN models versus an ARMA model) and I am very confident that the authors would obtain much better skills in their forecasts if they had used a periodic ARMA or periodic AR model rather than an ordinary ARMA model.

c) The relative error RE is for only two hydrological years (1998-2000), which is a too short period and has not enough data to draw solid conclusions on model forecast

skills.

Table 5: This table as well as the conclusions associated with it (lines 19-27, page 7972 and lines 1-5 on page 7973) are very confusing and hard to understand. The authors should either clarify or completely change it.

Minor Comments

- Line 15, page 7958. Where is Lake Nasser? The authors should mention where it is located.

- Line 1, page 7959. The acronym ANN should be defined here.

- Lines 2-3, page 7964. What is the range in the number of hidden layers and in the number of neurons tested?

- Line 3, page 7966. Is really Eq. (10)? Maybe Eq. (4)?

- Lines 2-3, page 7970 and Table 2. December and June do not show small RMSE values.

- End of Line 18, page 7970. Replace Column 3 by Column 5.

- Line 8, page 7972. As far as I understand, the results do not refer to forty years of data.

- There are a few typos in the text that the authors should address.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 7957, 2010.