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Hydrology and Earth System Sciences Discussions

Interactive comment on "A novel approach to parameter uncertainty analysis of hydrological models using neural networks" *by* D. L. Shrestha et al.

Anonymous Referee #1

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This paper introduces a ANN approach to estimate the uncertainty in modelled discharge based on the HBV model. Interestingly, the paper aims at modelling prediction intervals rather than estimating a standard deviation as proxy for uncertainty. Latter is only relevant if the pdf is Gaussian, however, as is clear from the results, the predicted uncertainty in discharge is not Gaussian.

I regret somehow that the paper only discusses briefly on the current literature on uncertainty estimation techniques as a whole range of techniques exists and during the last years, many papers have been published that compare (or introduce) techniques for uncertainty propagation or estimation.

Furthermore, the paper lacks a profound discussion: in current version, the results and discussion part is extremely short, and I believe that a more in depth discussion on when the model is making the largest or smallest errors could be given (this is not summarized in one sentence). In the whole discussion part (and basically the setup of the paper) different ANNs could have been compared, where each ANN is based on different input data. This is currently only restricted to R_{t-9a}, Q_{t-1} and ΔQ_{t-1}. Maybe other input variables may have been a better choice (this may be learned from an in-depth study of the results of the proposed ANN: where did it really get off, and what variables may have reduced this error?).

Further minor remarks (XXX.yyy stands for Page XXX, line yyy):

1678.1-2: "... developed to replicate **a** time consuming Monte Carlo (MC) simulation by using an Artificial Neural Network (ANN) for **the** assessment ..."

1679.6: "...still lack**s** a well-established convergence criteri**um** to ..."

1679.10: "In addition, **the** MC based ..."

1680.1: "estimating two quantiles" instead of "estimating the two quantiles"

1684.5: "... MC simulations, **an** ANN will..."

1686.1: "... values lie within..." instead of "... values lies within ..."

1687.4: adding a table that summarizes these statistical properties would be beneficial

1687.13-14: it is not clear to me why you first use an automatic calibration procedure after which you manually fine tune the parameters.

1687.18: "... Nash and Sutcliff**e** ..." . Please add reference to the Nash and Sutcliffe paper (in references, Sutcliffe is also misspelled)

1689.12: typo: sensitivity instead of sensitive

1689.16: "learn **the** functional relationship..."

1689.25: "**a** predictive ANN model."

1690.9: define (formula) the average mutual information

1690.6-19: not clear what exactly should be seen and interpreted from figure 6

1690.27: ". . . Furthermore, **the** derivative of . . ."

1691.12: ". . . verification of **the** HBV model . . ."

1691.17-23: mention that number of hidden layers is one.

1692.7: "**The** ANN based . . ." (also remove the dash between ANN and based as everywhere in the paper this is not written)

1692.10-16: according to the text, the ANN reproduces the MC simulations 'reasonably well'. I do not agree: errors of 15 m^3/s are found!. Also figure 9 is not convincing: if one looks at this figure (and also looks at the differences between ANN and MC prediction intervals), one sees large differences. I would appreciate that the figure goes with additional information such as an average error. Furthermore, a more detailed analysis could reveal some of the shortcomings (when are the errors large?, can this be contributed to one of the input variables to the ANN? What if alternative input would have been given to the ANN?)

Figure 3: this figure is too small. The difference between observed and simulated cannot be seen in detail. I would suggest to at least break the figure down in two panels: one for the calibration period, the other for the validation period.

Figure 4: no need for a coloured y-axis.

Figure 6: no need for colours

Figure 9, top panel: figure is too small to recognize anything. Observed dots are masking too much. Again I would suggest to break figure down in several panels.
