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Hydrology and Earth System Sciences
Discussions

Interactive comment on "A robust recurrent ANFIS for modeling multi-step-ahead flood forecast of Three Gorges Reservoir in the Yangtze River" *by* Yanlai Zhou et al.

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Review of the paper hess-2017-457: A robust recurrent ANFIS for Modeling multi - Step Ahead flood forecast of Three Gorges Reservoir in the Yangtze River

General comments

The paper deals with the forecasting of the flood of the TGR using ANFIS model with three versions of this solution. Generally the paper is not extremely rigorous. For example the goal is to predict the flood of the dam. But what is the flood of the dam: the flood of the input river (how long upstream to not being influenced by the level in the reservoir)? The flood at the output of the reservoir (to be able to managed flood downstream)?

For the same lack of accuracy, the following sentence has no meaning, mathematically speaking "Vulnerability represents the incompetence of a model to resist the effects of a hostile environment (e.g., the stochastic nature of hydrological variable". It should be better to correct this sentence and to be more accurate and more mathematical in several occasions in the paper (please, see technical comments). Moreover, in my opinion being stochastic is not the real problem. The real problem comes from the ungaussian property of hydrologic signals.

Suffering from the same cause, it is not so easy to know if the models are recurrent or no recurrent. This question is essential because the design of a really recurrent model, where the input is the previously calculated output, is more difficult. It seems to appear that the models are not recurrent (the input seems to be the previous measured discharge plus upstream measured discharges and rains, see table 2). If the model uses previous observed discharge (using Qo(t) to forecast Qf(t+i)) then it is mandatory to evaluate the quality using the persistency criteria in order to appreciate if the model has an added value or not (please see technical comments). Also, all along the paper the variable Q(t) is used. Nevertheless the variables Qf (forecasted discharge) or Qo (observed discharge) are also defined. Thus what does Q represent?

The procedure of training is not accurately described (p6 L13: "After implementing an intensive trial-and-error procedure). Let me recall that the paper must be sufficiently accurate to could be reproduced by other people. It is evident that it is not the case. P11, what is "the recurrent learning mechanism"? The same applies to the procedure of variable selection: the method is not described. But variable selection is essential in data driven models.

Finally, the section presenting results is quite confuse and difficult to read. Maybe some Tables and example of predicted signals, at each lead time, should be better to compare the models than the proposed indirect representations. Usually indirect representations (Fig 6, Fig 7) hide the defect of flood prediction when the peak is not good but the rest of the hydrograph quite well represented. For this reason it is

essential in case of flood prediction to provide an accurate measurement of the quality of the predicted peak, or a representation of the signals.

In conclusion, this lack of rigor must be corrected. The question about the kind of model (recurrent or not) must find a response. Only after this response it will be possible to evaluate the quality of the evaluation of the results. Flood forecasting is very difficult and I encourage the authors to deal with more accurately.

Specific comments

- Title: could you justify why the model is qualified of "robust" in the title?

- Abstract

It is not evident, reading only the abstract to know what are the criteria CC and CE, it is thus necessary to provide, at least, the name of the criteria in the abstract: for example Ce is the Nash-Sutcliff criterion or the coefficient of determination. And CC is the linear coefficient of correlation.

- Section 3.3. Evaluation criteria.

The aim of the paper is to provide prediction. Usually, in this case it is necessary to use a criteria specific to prediction, for example du persistency criteria (Kitanidis, P. K. and Bras, R. L.: Real-time forecasting with a conceptual hydrologic model: 2. Applications and results, Water Resour. Res., 16(6), 1034–1044, doi:10.1029/WR016i006p01034, 1980.). We suggest to authors to calculate also this criteria.

This criteria is mandatory when previous measured discharges are used to calculate future discharges, but it is no clear in the paper if previous observed discharges are used or only previous simulated discharges: having exact equations should remove the question. In table 2 it is not so clearly indicated if the Q(t) of TGR refers to observed or simulated discharge (Qf or Qo)? If it is Qo, then the model is not recurrent at al. The model can simulate a dynamic basin but it is static (finite impulse response). To verify if the model has a utility it is also possible to calculate the Nash criterion of the signal

Qo(t+lag). If the Nash criterion of the prediction Qf(t+lag) has a better Nash criterion than the previous one (on Qo), then the predictor is useful; in the contrary case, the model has no interest at all, it is only a model that duplicate, at its output, the received input. This behavior is easy to detect when predicted signals are provided, but it is not the case in this paper. This is a shame.

Technical corrections

P5L15: correct in Fig 3.

Notations in eq 3 are nor fully coherent: i, which is the number of a considered example, appears sometimes in index, sometime in parenthesis. P6L1-2 parameters are not linear or nonlinear. They are used in a linear combination or in a nonlinear function.

P6L8: it is necessary to add the equation of the 3 models to express clearly the inputs and outputs variables of the models. Unhopefully there is a great confusion in the literature about the concept of recurrent (infinite impulse response) and static (Finite impulse response). Could you add the equations?

Eq 9 the criteria RAE is not so good because it could be very high in case of low discharge. It is thus not good when there is very low and very high discharges? In the case of the 3 rivers it is not possible to have our own idea as signals are not provided. In P9 and others, please used accurate notation: not Q but Qf or Qo. To be consistent with your own notations.

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