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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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Dear Professor Roberto Greco,

We are very glad to learn reviewers' recognition on the value of our study and sincerely thank the constructive comments and suggestions to our manuscript (Ref: hess-2017-457). This revision focused on highlighting the paper's contribution and originality. Responses were made to each and every comment raised by the reviewer, and revisions were incorporated into the revised manuscript. Changes made in the revised manuscript were colored in blue. Modifications in the revised manuscript were made to meet the publication standards required by the HESS.

As known, accurate and robust multi-step-ahead flood forecast during flood season is extremely crucial to reservoir flood control. A modified hybrid learning algorithm, which fuses the Least Square Estimator (LSE) with Genetic Algorithm (GA), is proposed for optimizing the parameters of recurrent ANFIS (R-ANFIS) model to overcome the instability and local minima problems as well as improve model's generalization and robustness. We wish to have an opportunity to share our research methodology and findings with readers through the HESS.

Best Regards,

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Responses to Referee #1: The paper is well written. The significance of the result is not very high, since in some cases only a small improvement is obtained by using the proposed approach with respect to existing approaches. However, the paper is technically correct.

Reply: We deeply appreciate you for your encouragement and recognition on the value of our study. The constructive comment is sincerely appreciated. We have added the following statements and Fig. 10 to enhance our presentation regarding the significance and reliability of the results obtained by our proposed models (M-ANFIS).

To demonstrate the significance and effectiveness of the proposed methodology that fuses the LSE with Genetic Algorithm (GA) for optimizing the parameters of R-ANFIS. Fig. 10 further shows sensitive analysis of the three models at horizon t+4, t+8 and t+12 in the testing period with cross-validation (exchanging one-year dataset between

training and testing periods, see Fig. 2). Fig. 10 clear indicates that the forecast accuracy and robustness of M-ANFIS (Model 3) are significantly superior to the others (Model 1&2), as all of the indicators (MAE, RMSE, CE, CC, Reliability, Vulnerability and Resilience) in Model 3 have smaller boxplots and are insensitive to cross-validation process at different horizons. This analysis suggests that there is great capable for overcoming the local minima and instability problems of the original hybrid learning algorithm (coupling steepest descent algorithm with Least Square Estimator) as the proposed methodology is implemented.

Some suggestions to improve the paper follow.

1. There is a typo at line 143 (Fig. 2 should be Fig. 3).

Reply: We thank you for taking time to read our manuscript and give valuable comments for it. Sorry for such mistake. We have changed Fig.2 into Fig.3.

2. Actually, all the part from line 143 to line 157 is standard and can be replaced by a very simple description of the well-known structure of the ANFIS. (actually, this is an issue for the Associate Editor handling the submission. If she/he thinks that the audience of the journal is acquainted with fuzzy systems, then he can suggest to remove the part, otherwise, keep as it is).

Reply: Thank you for your valuable comment. We agree and replace the part (Lines 143-157) by a simple description as follow:

The ANFIS consist of five layers (see Fig.3). The Gaussian function and linear function are selected as the member function for Layer 1 and consequent function for Layer 4, respectively. The T-norm operator is applied to fuzzy-AND operation in Layer 2. For a full description of the well-known structure of the ANFIS, please refer to Jang (1993).

The authors would like to thank the editor and anonymous reviewers for their review and valuable comments related to this manuscript.

Please also note the supplement to this comment:
https://www.hydrol-earth-syst-sci-discuss.net/hess-2017-457/hess-2017-457-AC1-supplement.pdf

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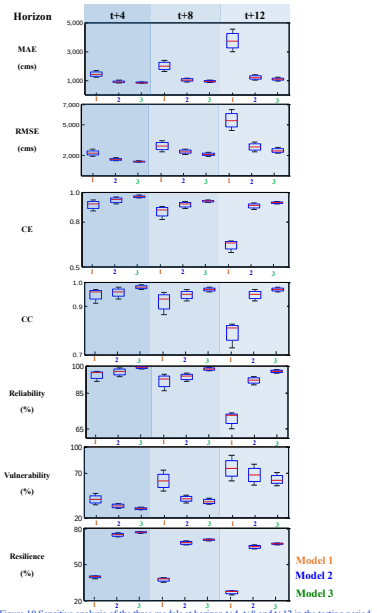

Figure 10 Sensitive analysis of the three models at horizon t+4, t+8 and t+12 in the testing period with cross-validation

Fig. 1.

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