

Hydrol. Earth Syst. Sci. Discuss., author comment AC2
<https://doi.org/10.5194/hess-2022-236-AC2>, 2022
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Reply on RC2

Xiaoying Zhang et al.

Author comment on "Advance prediction of coastal groundwater levels with temporal convolutional and long short-term memory networks" by Xiaoying Zhang et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2022-236-AC2>, 2022

Reviewer 2:

This manuscript presents an innovative and practical approach to predict the coastal groundwater levels. The authors developed a TCN-based model to predict coastal groundwater levels and compared the results to the existing popular LSTM model. These methods have promising application in real-time prediction of hydrogeological data. As the authors argue, it is essential to achieve single step real-time prediction. The novelty part is the discussion of advanced prediction, which is necessary as sometimes we are more concern about the variation in a longer time. The work presented in this manuscript can have a substantial contribution to the studies of coastal groundwater levels' prediction. Overall, the contents of the manuscript are interesting. Logicality of the paper is clear, and the results are well discussed and explained. However, there are some issues should be better explained after I had read through the paper.

RESPONSE: Thanks very much for the overall positive comment on this manuscript.

Major comments:

R2_1: Are BH01 and BH05 predictions using the same TCN and LSTM models? Or the prediction models for different wells need to be trained separately, and each well needs to use the model trained on its own data for prediction. It is recommended that the authors clarify this point to help the reader better understand the overall forecast implementation process.

RESPONSE: Thanks for the comment. Yes, the TCN and LSTM were trained separately for the two wells. The framework of the models was the same, but the hyper-parameters were different such as epochs, filters and batch size. We will clarify this in the Method section in line 285.

R2_2: During the hyperparameter comparison process, different models are evaluated based on the training set or the test set. If the evaluation is based on the training set, whether the performance of the test set is consistent with the training set under different hyperparameters.

RESPONSE: Thanks for the comment. The hyper-parameter set was evaluated with the prediction dataset. We will add this in the line 331. Meanwhile, the corresponding label of

figures and tables will be adjusted as well. Further, the performance of the test set is consistent with the training set.

R2_3: The conclusion should be careful on the comparison results of LSTM and TCN.

RESPONSE: Thanks for the suggestion. We will carefully compare the results from TCN and LSTM. In the revised manuscript, the efficiency and accuracy are separately compared. Meanwhile, we will add the running time of the advance prediction in Table 4. Further, we will revise the corresponding parts in lines 439-442 and in lines 436-468.

Minor comments:

R2_4: Abstract: The full name of TCN should be defined before using this abbreviation.

RESPONSE: Thanks for the suggestion. The full name will be added in line 27 in the abstract.

R2_5: Line 42-43: "... localized groundwater prediction..." should be "... localized groundwater level prediction..."?

RESPONSE: Suggestion will be followed. It will be added in line 42.

R2_6: Line 94, Here the BP neural network is first mentioned. An explanation is needed here or add the relationship between BP and other networks that mentioned before.

RESPONSE: Thanks for the suggestion. Different from the RNN that has a recursion in evolution direction, the BP is flows one way and uses error backpropagated from the last to the first time step to adjust the weights of neural. The property of BP will be added in line 95.

R2_7: Line 123, a reference is need before "Therefore"

RESPONSE: Suggestion will be followed in line 124.

R2_8: Line 123, have the longer periods prediction have been used in other area?

RESPONSE: Thanks for the suggestion. Researches on the application of TCN have been mainly adopted in climate science and we will add the information line line 122-124.

R2_9: Line 317, typo ")"

RESPONSE: Thanks for pointing this out. Suggestion will be followed.

R2_10: The detailed form of the data that the neural network used is needed to further illustrate the structure of the network.

RESPONSE: Thanks for the suggestion. In the manuscript, y represents the output, groundwater level, and x represents the input, including tidal, precipitation and groundwater levels. The information will be clarified in line 161 and 188.

R2_11: In the methodology, the tidal, precipitation and groundwater level are corresponding which variables in the equation.

RESPONSE: Thanks for the suggestion. We will adjust the variables in Eq.1, the y is

changed to x' to eliminate the confusion between the output and normalized input.

R2_12: Figure 6: The author needs to add the legends corresponding to the different colors to avoid confusion to the reader

RESPONSE: Thanks for the suggestion. The legend will be added in Fig. 10 to show the different markers from TCN- and LSTM-based model.