Response to Anonymous Referee #3

Many thanks for reviewing our manuscript. Your comments and suggestions are very helpful and constructive. We have addressed all of your concerns in the revised manuscript.

The issues proposed by the reviewers have all been addressed.

Please notice:
Reviewer comments in quotations; our responses in blue;
Main changes are:

Comments and Suggestions for Authors

The manuscript proposes a VMD-TCN-LSTM hybrid model to predict significant wave height and average wave period. The theoretical innovation of this article is not remarkable. However, before considering publishing in this top journal, this study lacks an in-depth comparative analysis of the data. The issues listed below should be addressed by the authors.

1. In the introduction, much more references related with wave period prediction are expected to cite for overall literature review.
Reply:
1) We gratefully appreciate for your valuable comment.
2) Wave prediction models based on machine learning are more likely to predict wave height and less likely to predict period. There have been a few studies in recent years that have attempted to predict both wave height and period. We added some explanation and references related with wave period prediction. In Line 59-61.
For example, Hu et al. (2021) used XGBoost and LSTM to forecast wave heights and periods. Based on multi-layer perceptron and decision tree architecture, Luo et al. (2023) realized the prediction of effective wave height, average wave period, and average wave direction.

Hu, H., van der Westhuysen, A. J., Chu, P., and Fujisaki-Manome, A.: Predicting Lake Erie wave heights and periods using XGBoost and LSTM, Ocean Model., 164, 101832, https://doi.org/10.1016/j.ocemod.2021.101832, 2021.

Luo, Y., Shi, H., Zhang, Z., Zhang, C., Zhou, W., Pan, G., and Wang, W.: Wave field predictions using a multi-layer perceptron and decision tree model based on physical principles: A case study at the Pearl River Estuary, Ocean Eng., 277, 114246, https://doi.org/10.1016/j.oceaneng.2023.114246, 2023.

2. It is recommended to set a threshold to distinguish whether the center frequency has changed significantly.
Reply:
1) We gratefully appreciate for your valuable comment.
2) In Line 190 of the revised manuscript, we set the change threshold of the center frequency set to

1e-8 Hz to distinguish whether the center frequency has changed significantly.

3. Have other wave parameters such as MWD or WSPD been decomposed by VMD for prediction? If they are decomposed, please add their K values, otherwise explain the parameter composition of input.

Reply:

1) We gratefully appreciate for your valuable comment.

2) Other wave parameters are not required to be decomposed by VMD. In Lines 196-198 of the revised manuscript, we add the explanation of the input parameters to the model.

3) The input parameters to the model includes 13 SWH IMFs and residual, 12 APD IMFs and residual, original MWD, WSPD, PRES and ATMP, recoded WDIR.

4. Are the hyper-parameter optimization results in Table 4 obtained from these search intervals? Are they obtained from search spaces containing several specific values? Much more explanation are suggested to provide.

Reply:

1) We gratefully appreciate for your valuable comment.

2) The hyper-parameter optimization results in Table 4 obtained from search set spaces containing several specific values. We have revised Table 4 for a clearer explanation.

5. What's the maximum epochs set for each model during training?

Reply:

1) Thank you for your comment.

2) The maximum epochs set for each model during training is 500. Meanwhile, we use the Early Stopping method to reduce the wasted training time, so the final value of the epochs of each model will be less than 500.

6. Please check all bold metrics values. It seems that the MAE, RMSE, MAPE and R2 of VMD-TCN-LSTM in SWH prediction at 51101 given in Table 6 are not the best.

Reply:

1) Thank you so much for your careful check. We are very sorry for our carelessness.

2) We have corrected the bold metrics values in Table 6 on the revised manuscript.

7. What are the lags of each input variable chosen for prediction?

Reply:

1) Thank you for your question.

2) The lags of each input variable chosen for prediction are 3 hours. in Line 198 of the revised manuscript., we add the explanation.

8. Compared with previous methods, the properties of the proposed method should be summarized to describe clear findings of this study.

Reply:

1) We gratefully appreciate for your valuable comment.

2) We add some discussion in the section 5.5 line 348~357 to summarize the properties of the

proposed method.

LSTM has advantages in solving the prediction problem by using time series data, and has been widely used in many fields. However, due to the strong nonlinear effects in the generation and evolution of wave, the wave prediction model that only uses LSTM will weak in the ability of generalization. As a result, both the model's ability to adapt to new samples and its prediction accuracy will be reduced. The VMD signal decomposition method can effectively extract the features of the original wave data, which can enhance LSTM's ability to capture the long-term dependence of the time series data and further improve the performance of the wave prediction model. This study shows that the VDM can significantly reduce the model's MAE, RMSE and MAPE and improve the model's R^2. TCN introduces multiple residual blocks to speed up the forecast model and can retain historical wave change information over long periods. This study also shows that TCN's impact increases as the forecast period lengthens. The proposed hybrid VMD-TCN-LSTM shows its advantage in predicting both the wave height and the wave period. This method could also be used in other fields which have similar nonlinear features as waves.

The manuscript has been revised carefully according to the reviewer's comments. We are appreciated for the reviewer's constructive comments and kind help. The quality of the revised manuscript has been improved under the help of the reviewer, and hope that the correction will meet with approval.

Once again, thank you very much for your comments and suggestions.

Yours sincerely.

Manuscript title: Short-term Prediction of the Significant Wave Height and Average Wave Period based on VMD-TCN-LSTM Algorithm. (egusphere-2023-960)

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