Response to Reviewer 1

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

Considering the need to enhance predictions of ocean wave parameters, Ji et al. considered the adoption of a joint VMD-TCN-LSTM algorithm to forecast significant wave height and wave period with minor computational expense and using direct buoy observations. The paper is of use to the community and while I have no technical objections, there are, however, a few issues the authors should consider. They are as follows:

1. The introduction of the model and its settings is very detailed but far too long as it consumes the first 13 pages and 6 pages of the article. These can be either reduced significantly or placed within a supplement to join the manuscript. This will allow for readers to focus on the results section which should be the manuscript's centerpiece.
Reply:
1) We gratefully appreciate for your valuable comment.
2) We have simplified the model and its settings as suggested. We have given the detail information in the supplement.
On L128-L143, we have simplified the temporal convolutional networks model. On L157-L171, we have simplified the Bayesian optimization algorithm. We have given the detail information of the variational mode decomposition (VMD) algorithm and long short-term memory networks model in Appendix A and B, respectively. On L185-L187, we have simplified the parameter settings of the VMD algorithm.
2. On L32, the reference (P. et al., 2020) does not follow the format of the other references. Please revise.
Reply:
1) Thank you so much for your careful check. We are very sorry for our carelessness.
2) On L32, the reference (P. et al., 2020) revised to (Pushpam P. and Enigo V.S., 2020).

3. There is a space missing on L47 before Zhao et al., 2019.
Reply:
1) Thank you so much for your careful check. We are very sorry for our carelessness.
2) On L47, we added a space before the Zhao et al., 2019.

4. I don't understand why the SST or water temperature would directly affect wave activity. Indeed

WTMP and ATMP are negatively correlated with wave parameters in Figure 3. Please justify the usage of these variables and check if the forecast skill improves with their addition/subtraction in a new experiment. If forecast skill does not change with their removal, you'll have your answer on if its necessary to include it them in an already extensive list of predictands.

Reply:

1) We gratefully appreciate for your valuable comment.

2) We agree that the WTMP and ATMP do not directly affect the wave, physically. The ocean wave height and average wave period are mainly influenced by wind direction, wind speed, air pressure, previous wave height and wave period.

The wave prediction method used in this study is a data-driven method. Therefore, some variables that are not physically causally significant may also influence the prediction results. We focus on how VMD and TCN affect LSTM's ability to predict wave, without considering the effect of the data itself on the prediction skill. Using similar data-driven approaches (GRU network, LSTM) for wave prediction, some studies include temperature as one of the driving data (Li et al., 2022), but others do not (Fan et al., 2020). The suggestion is a good way to test the effect of SST or even all variables on the prediction skill. We did not carry out relevant experiments, but it will be carefully considered in future studies.

Li, X., Cao, J., Guo, J., Liu, C., Wang, W., Jia, Z., and Su, T.: Multi-step forecasting of ocean wave height using gate recurrent unit networks with multivariate time series, Ocean Eng., 248, 110689, https://doi.org/10.1016/j.oceaneng.2022.110689, 2022.

Fan, S., Xiao, N., and Dong, S.: A novel model to predict significant wave height based on long short-term memory network, Ocean Eng., 205, 107298, https://doi.org/10.1016/j.oceaneng.2020.107298, 2020.

5. The range of APD in Table 2 and in Figure 2 seem to indicate the occurrence of both wind waves and swell. Were wave forecasts done on both systems together, or individually? As swell is generally insensitive to wind information, using wind to predict swell may be ineffective.

Reply:

1) We gratefully appreciate for your valuable comment.

2) Table 2 and Figure 2 show that wind waves and swells occur simultaneously. Since the buoy data contains both wind and swell information, we use the buoy data directly as training data, and thus the predicted waves contain both wind waves and swells. Although swell is insensitive to wind, it is difficult to distinguish wind waves from swell from observed buoy data. With this data, our forecast models cannot predict wind waves and swell separately as the wave models such as SWAN or WAVEWATCH III do.

6. There should be a colon (:) instead of a period (.) at the end of the sentence on L130. Same for L206.

Reply:

1) We gratefully appreciate for your valuable comment.

2) On L130 and L206, the period (.) at the end of the sentence revised to colon (:).

7. There is a duplication of a comma on L372 after Table 7.

Reply:

1) Thank you so much for your careful check. We are very sorry for our carelessness.
2) On L372, we removed the duplicate comma.

8. It might be useful in the conclusion to discuss the implications of the research on, for example, ocean wave energy projects that would be heavily dependent on wave height and period forecasts.

Reply:

1) We gratefully appreciate for your valuable comment.
2) Implications and future work are discussed in the conclusion, which can be found in the last paragraph of the discussion.

Now that the short term SWH and APD can be accurately predicted using the hybrid VMD-TCN-LSTM, this method would be useful for some marine related activities which are highly dependent on wave height and period predictions, such as ocean wave energy projects, shipping, fishing, coastal structures, and naval operations. Future work will investigate the effect of different driving data on the prediction skill, or the use of VMD-TCN-LSTM to predict other marine environmental parameters (e.g., sea level or winds). The combination of numerical wave models and the VMD-TCN-LSTM for large-scale SWH and APD simulations will also be developed.

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)

Authors: Qiyan Ji, Lei Han, Lifang Jiang, Yuting Zhang, Minghong Xie, and Yu Liu

Correspondence:

Lei Han

s20070700026@zjou.edu.cn