**Dear Editor and Reviewer,**

Thanks for your work and precious comments on this manuscript! We ‘ve made a thorough consideration and modification accordingly. We have highlighted the changes within the manuscript. Here is a explain of the author information and a point-by-point response to the reviewer’ comments and concerns, follow by some other changes in the English expressions following suggestions of the reviewer.

During the revision, Yihui Wang has graduated with her author information explained in this submitted manuscript: “The research contributions of Yihui Wang to this paper have been completed at the affiliation indicated by the authors. Her current affiliation is as follows: Jingwei Hirain Technologies Co.,Ltd.”. Meanwhile, Ziming Dong is taking part in this research duplicating the experiments and perform addition experiments necessary for replying reviewers’ comments for this research, thus included as another author for this manuscript.

**The comments from the reviewer:**

This paper combines the widely used Goda and elfouhaly spectra in order to improve the one-dimensional wave spectrumThe SWIM data are used for both model development and result verification. The NDBc buoy data is used for validation aswell. Based on the evaluation of Dl and $R^2$ parameters, it shows that the proposed spectrum (C spectrum) generally performsbetter than G/E spectrum in term of characterizing the wave energy distribution. The contents of this paper are clear, and the steps of the methodologies are well described. The manuscript is generally well written, though the English is not native and needs polishing.

Thanks a lot for your precious comments on this manuscript! We’ve improve the expression in this version and put the explanation of the changes after the replies to specific comments:

1. Title: “An Improved One-dimensional Ocean Wave Description based on SWIM Observations” may be more concise.

**Reply:** Thanks for your suggestion. We have modified the title.

2. Structure:

a). Keep concise on the description of G/E spectra, and highlight the C spectrum. Particularly, please clarify how you fit the (23)-(24) and (26) – (28).

**Reply:** The structure of the C-spectrum is a fusion of the partial structures of the E-spectrum and G-spectrum. We have now put the formulas and physical meanings of the C spectra related to the adopted from the G spectrum and E spectrum in the C spectrum description to

make the description of C spectrum concise. And for G and E spectra, we keep necessary descriptions. In details,, we modified the $L_{PM}$ in Eq. (3), $J_P$ in Eq. (4), and $Lim$ in Eq. (15) in the original version to Eq. (11), Eq. (13), and Eq. (18) in the revised manuscript, and the structure of the relevant text is also modified. Please see specifically the modification in the change-trackable manuscript.

For the fitting of equations mentioned in the comment, in order to study the relationship between spectral peak enhancement factor γ, wave steepness and inverse wave age, the data were divided into several subsets according to wave steepness with different binning numbers for with references to the inverse wave age. The wave steepness of the wave measurements are mainly distributed in the region of 0.004-0.0115, and for the SWIM measurement in this region, there are 41 bins with 0.0002 wave steepness and 0.04 inverse wave age as the set intervals. The rest of the measurements were divided with 19 bins in the wave steepness interval 0.001 and inverse wave age interval 0.04. The mean values of inverse wave age, wave steepness and γ in each grid were calculated respectively. For the calculation of γ-mean value, the number of wave cells in the set binning was counted at first, and it was considered that the statistical characteristics are weak when the binned grid is with less than 30 wave cells, where the γ-mean value is set to 0 and not applied in the regression, if the number of wave elements in the grid is more than 30, the γ confidence interval is set to be 0.5% ~ 99.5% , and the γ of the confidence interval is averaged for its value in the fitting.

Because the curve shapes of γ and inverse wave ages corresponding to the steep waves are closer to the trigonometric function, the Fourier series was chosen to fit the γ and inverse wave age in each steep interval.

At last, based on an appropriate function form, the coefficients a0, a1,a2 were fitted to the wave steepness.

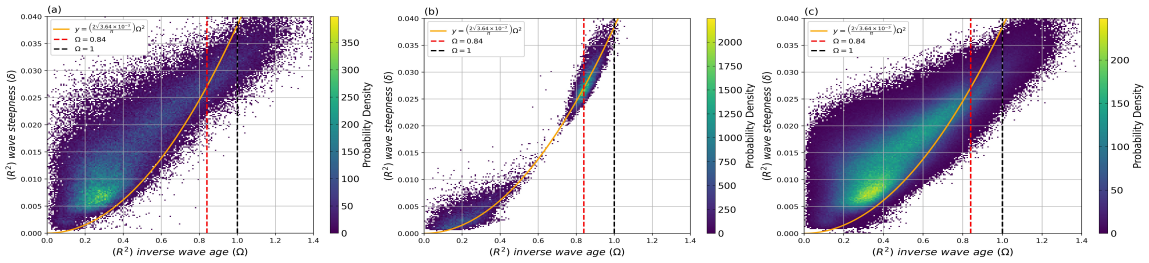
b). in the result section, you may present the case study (3.4.2) firstly and then illustrate the general verifications.

**Reply**: Thanks for the suggestion, however, the case is provided for a concrete view of the results based on the validated theory, then the verification and validation of the proposed theory is illustrated before the case, They are provided for convincing of the validation as well. We would like to keep the current order if it is also okay.

3. Regarding the combination of C spectrum, it's not a surprise that C spectrum generally agrees better with G spectrum than E spectrum. Is there any case showing that the old G/E spectra may be superior to C spectrum? Why?

**Reply**: Thank you for this comment, according to which, we make some new illustration and implement as new input of discussions in the conclusions part. Where we find cases that the G/E spectrum may be superior to the C spectrum for analysis.

Specifically, we find such data set with R-square index. Then the statistics in terms of density distributions of inverse wave age and wave steepness in the three cases: 1) the G spectrum is better than the C spectrum, 2) the E spectrum is better than the C spectrum, and 3) the C spectrum is better than the G and E spectra are investigated. During the procedure, we adopt the sea state classification metrics used in Section 2.1 of the reference article(Hauser et al., 2009; Xu et al., 2022; Hwang, 2009), which identifies measurements at $\Omega < 0.84$ and $\delta > \frac{2\sqrt{3.64\times10^{-3}}}{\pi}\Omega^2$ as a mixed sea state with swell-dominated feature, and $\Omega > 0.84$ and $\delta \leq \frac{2\sqrt{3.64\times10^{-3}}}{\pi}\Omega^2$ are as younger wind wave sea states, while $\Omega > 0.84$ and $\delta > \frac{2\sqrt{3.64\times10^{-3}}}{\pi}\Omega^2$ are classified as mixed sea states in which wind wave are dominant. It can be observed in the following figure where inverse wave age and wave steepness distributions are taken as measurement of the sea evolving features obtained with $R^2$ as reference, and the orange curve in the figure represents $\delta = \frac{2\sqrt{3.64\times10^{-3}}}{\pi}\Omega^2$, the red dashed line represents $\Omega = 0.84$ and the black dashed line represents $\Omega = 1.0$.That most measurement in (a) where G spectra is superior to C spectra is located in the region of swell-dominated mixed sea state. Meanwhile in (c), which illustrates the cases where G is superior to C according to $R^2$. This suggests that the G spectrum outperforms the C spectrum in the more mature swell sea state. As in the following figure:




(a) (b) (c)

Figure 1. Sea state distribution when the old G/E spectrum outperforms the C spectrum, using R2 as index for obtaining:as the validation index. (a) the G spectrum is better than the C spectrum, (b) the E spectrum is better than the C spectrum, (c) the C spectrum is better than the G spectrum and the E spectrum.

And when comparing (b) with (c), it can be found that the regions with higher density in t(b) are mainly concentrated in two regions distributed near the parabola, one with smaller inverse wave age and the other with larger inverse wave age, which demonstrates that the E spectrum perform better than the C spectrum most in steepness larger than 0.025 while inverse wave age larger than about 0.8, in accordance to youngerwind-wave dominated mixed sea states and wind-wave sea states. Corresponding content is included in the discussion of this submission. Thanks again for your comment.

**Minor comments:**

1. Do you fit the model using SWIM data, and then calculate R2 and DI for the same wavelength bin as SWIM? Please clarify the effective range of SWIM wavelength in the text, as well the range of integration in Eqs. (21) – (23).

   **Reply：** We fit the γ of the model using SWIM data. and calculate R2 and DI for the same wavelength bin as SWIM. The effective range of SWIM wavelength in the text is 30~600m (correspond on 0.01~0.25 rad/m) and the same wavelength used in the Eqs (21)-(23).

2. Page 1, lines 15-16: two “then” appears in the two sentences.

   **Reply:** We have adopted the first “then” to “and” and modified accordingly.

3. Page 1, lines 22-23: “The DI and R2 for the C …. 0.909 respectively”. It is not necessary to introduce the detailed numbers here. Lines 24-25, “Further research would … directions.” Remove this sentence.

   **Reply:** We have removed the sentence “and values are 0.780 and 0.0909 respectively” in line 23 and “ Further research would … directions” In line 24-25.

4. Introduction, there are many other wave spectra not reviewed in this section, such as Huang’s model.

   **Reply:** The Goda and Elfouhaily spectra are the major theoretical models used in the research. We have included more wave spectra, for example Hwang, and Kareav

spectra in the revision in the introduction part for a better background according to this comment.

5. Page 2, lines 57-58, “validation of the C spectrum … of the sea surface.” Conclusion should go to the conclusion section.

   **Reply**: Thanks for this suggestion. Anyhow, this is mainly an introduction to the data in the validation and we modified the sentence to clarify. So could we keep in this way.

6. Page 3, lines 73-74: “… describing the inverted transfer of wave …”. This sentence is vague, please rephrase.

   Reply: This sentence is actually redundant and not related with the topic, we have removed it.

7. Page 5, lines 127-132. “In comparsion …. observations well.” Are the descriptions the results of this manuscript or previous studies?

   Reply: Thanks for this suggestion. This can be referred to a previous study (Wang et al., 2023), which is mentioned in the previous sentence of the original manuscript.

8. Page 7, line 185, “the Surface Waves Investigation and Monitoring (SWIM) carried”. Not necessary to write abbreviation again here. BTW, which version of SWIM data is used in this study.

   Reply: The version is OP06, and we have added the version in the text.

9. Page 8, lines 200 – 201, informal numbers in the text.

   **Reply:** We have modified it according to your suggestion

10. You may use SWH instead of H1/3 in the text.

    **Reply:** H1/3 expression is now mainly used for formula.

11. Page 11, figure 4, I don’t see the variation of H1/3 in the caption or in this figure. Please clarify.

    **Reply:** Eq. (18) in our manuscript illustrates the relationship between significant wave height $H_{\frac{1}{3}}$ and wave steepness $\delta$, If the significant wave height changes and the

wind speed and spectral peak number are fixed, then the wave steepness changes, while the inverse wave age is a fixed value. The larger the significant wave height, the steeper the wave, and the larger the integral area of the curve. We have added detailed information near line 8 on page 12 of the revised manuscript.

12. Remove “This is” in the captions of Figures 7-10.

    **Reply**: We have removed the two words “This is” in the captions of Figure 7-10.

13. Page 15, line 325, this sentence is vague, please rephrase.

    **Reply**: “ Fig. 9 (a), most DI of the C height spectrum are lower than those of the G height spectrum, but the proportion of superiority is not as significant, and the C spectrum has a superiority proportion with DI concentrated in the region where $y < 0.5$.” has been changed to: “Fig. 9 (a), most DI of the C height spectrum is lower than those of the G height spectrum, but the proportion of superiority is not as significant. The C spectrum has a superiority proportion with DI concentrated in the region where $y < 0.5$.”

**Other modifications:**

1) On page 5, line 5 of the revised manuscript, We have adjusted the writing of this paragraph to make the meaning clearer.
2) In section 3.4.1, subsection B, the subsection name has been modified, We replace "measurements" with "references".
3) Removed "This is" from the name of Table I.
4) The "Author contributions" section has been supplemented.
5) Minor revision to the last sentence of "Conclusions and discussions", advancing the words "In this research" to the end of the sentence.
6) Removed the last sentence in the abstract "Further research would …. Azimuthal direction"

7) Modification to the equations:

After the modification, the changes in the positions of some equations are shown in the following table:

| previous manuscript's | revised manuscript's |
|---|---|
| Eq. (3) | Eq. (11) |
| Eq. (4) | Eq. (13) |
| Eq. (5) | Eq. (15) |
| Eq. (6) | Eq. (3) |
| Eq. (7) | Eq. (4) |
| Eq. (8) | Eq. (5) |
| Eq. (9) | Eq. (6) |
| Eq.(10) | Eq. (17) |
| Eq. (11) | Eq. (12) |
| Eq. (12) | Eq. (7) |
| Eq. (13) | Eq. (14) |
| Eq. (14) | Eq. (16) |
| Eq. (15) | Eq. (18) |
| Eq. (16) | Eq. (8) |
| Eq. (17) | Eq. (9) |
| Eq. (18) | Eq. (10) |

In addition, in the "Conclusions and discussions" section of the revised manuscript, Eq. (31) and Eq. (32) have been added, equations not mentioned above have not been modified.