RC1: Comment from Anonymous Referee #1:
The manuscript proposes a combined one-dimensional spectrum of ocean surface waves, with wavelengths ranging from swell to wind wave scales, to improve measurement predictions compared to existing models. The model is built using SWIM satellite measurements as input data, and validation is performed using buoy data and a separate set of SWIM measurements. Some parameters and comparison results should be revised.

Reply: We sincerely appreciate the thorough review and constructive suggestions. Below are our point-by-point responses to the comments:

1. **Page 5, lines 115 through 125: The authors compare G spectrum and E spectrum predictions of SWIM measurements and define specific wavenumber intervals where each estimation is in agreement with the observed data. Additional to that information, a visual inspection of the predictions against measurements would be helpful. While the method section describes the SWIM dataset (lines 185 - 200), it is unclear how the wavenumbers ranging from 31 m to 209 m were resolved. Providing a time series of SWIM measurements, along with sampling rate and Nyquist wavenumber and frequency, would clarify the analysis. Note that in the section 3.1.2 (line 205), the SWIM measurement range is stated as 0.01–0.2 rad/m^{-1}, but this comes much after than the initial description of the SWIM dataset.**

   Reply:

   Thanks for the suggestion! The different wavelengths of G and E spectra are determined by the detailed procedures of individual spectra, it would be lengthy to include the specific content of the existing literature on this, thus we put the features and cite the parameters of E and G spectra in references (Elfouhaily, T, et al, 1997) and (Goda, Y., 1983) for this manuscript. For SWIM measurement, we acknowledge the value of including radar time series, and we believe these instrument-specific details would be more appropriate in instrumentation-focused papers, as it would be impossible to clarify this in a few sentences and figures. Moreover, there is detailed introduction of how these measurements are made and inverted from measured NRCS in different incidence angles in the very detailed user manual, it would be also too long to include. Furthermore, inclusion of these content would make the manuscript somehow derive from its focus, especially in the method part, so following this suggestion, to make the description with more details, we include the following references introducing the principles with time variance (echo gates) and specific producing procedures of spectrum for readers who are interested to the data description section: (Hauser, D., Tison, C., Amiot, T., Delaye, L., Corcoral, N., and Castillan, P.: SWIM: The First Spaceborne Wave Scatterometer, IEEE Transactions on Geoscience and Remote Sensing, 55, 3000–3014, https://doi.org/10.1109/TGRS.2017.2658672, 2017.) and (**CNES: SWIM Products User Guide, Technical Report CF-GSFR-MU-2530-CNES, AVISO+, 2023.**). These references have been were added to the revised manuscript. Now the sentence in 3.1.1 has been modified from "SWIM products provide valuable wave spectrum details as well as wave parameter information in global coverage." to " SWIM version OP06 products provide valuable wave spectrum details as well as wave parameter information in global coverage, with

observed wavelengths ranging from 31 to 628 m (corresponding to wavenumbers from 0.01 to 0.2 rad.m-1) (Hauser et al., 2017; CNES, 2023) ". In addition, we have now supplemented the key parameters of SWIM observations (Including a range of observation wavelengths from 31 to 628m) in the revised manuscript in section 2.1, the last second paragraph, from "For the SWIM measurements, they provide the descriptions of real sea that is by nature of different states. Although it is focusing on longer waves in the spectrum," to "The SWIM measurements observe the descriptions of real sea that is by nature of different states. It is focusing on longer waves in the spectrum, corresponding to wavelength from 31 to 628m.".

2. Equation 20: It can be either written as $H_{1/3}$ or H_s, it is redundant to use both.

Reply: We have unified the notation for significant wave height as $H_{\frac{1}{3}}$ throughout the manuscript.

3. Equation 23 and 24: The coefficient fit formulas do not match with their corresponding graphs on Figure 2; are those reversed?

Reply: Thank you for catching this error. We confirm that coefficients a0 and a1 were mistakenly reversed in Figure 2 of our prior manuscript. In the revised version, we've corrected the coefficient labels in the original figure. **There is a new figure included from comments of aother reviewer, Figure 2 is now Figure 3,** with the left panel is now showing the correct coefficient a0 and the right panel the correct coefficient a1):

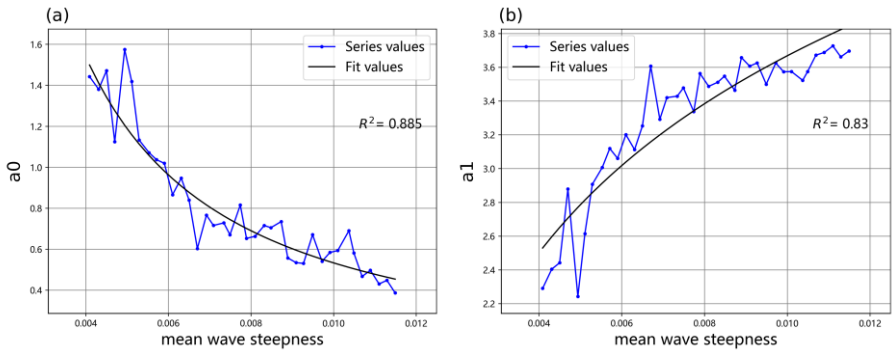


Figure 3: The fitness of a_0, a_1 with the wave steepness

4. Line 234: Wave steepness range should be 0.0115, not 0.015.

Reply: Thanks a lot for the correction! We have corrected the wave steepness range to 0.0115 in this sentence. .

5. Line 249: The variable should be denoted as k_p, not kp.

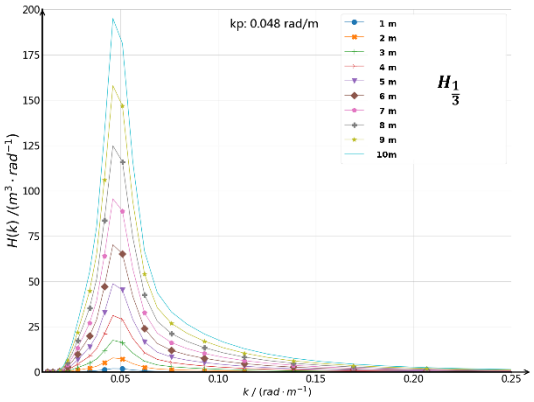
Reply: The notation has been corrected to k_p and we've verified this notation throughout the manuscript.

6. Line 252: What is the exact definition of a height spectrum? Is it wave height spectrum or wave elevation spectrum which is H/2?

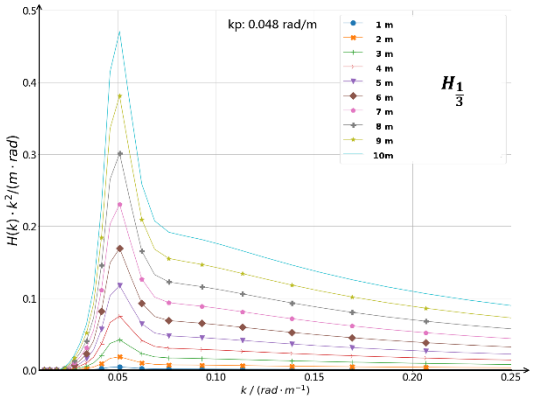
Reply: This refers to the wave height spectrum. For better clarifying, we modified the sentence in the second paragraph of section 3.3 from "Fig. 5 (a)~(c) depict respectively the C spectrum in height spectrum," to "Fig. 5 (a)~(c) depict respectively the C spectrum in wave height spectrum (height spectrum),"

7. Line 256 with relation to the Figure 4: It is written that "the trend of change is almost identical to the G spectrum, with the spectral peak in the C spectrum slightly smaller than that in the G spectrum" but the G spectrum results are not demonstrated.

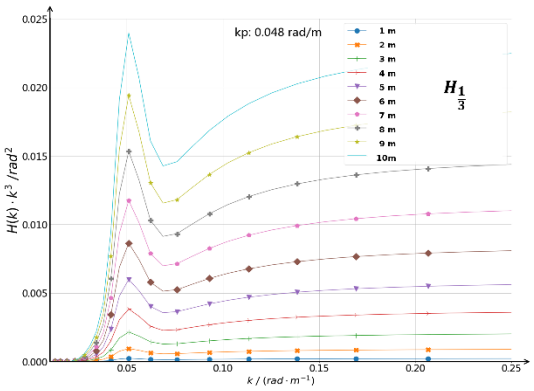
Reply: Considering that giving the G-spectrum and the associated description may lead to too much redundancy, we chose to cite the trend analysis of the G-spectrum changes given in Fig. 4 of a previous study (Wang et al., 2023), here specifically shown below:



Goda Wave Height Spectrum



Goda Wave Slope Spectrum

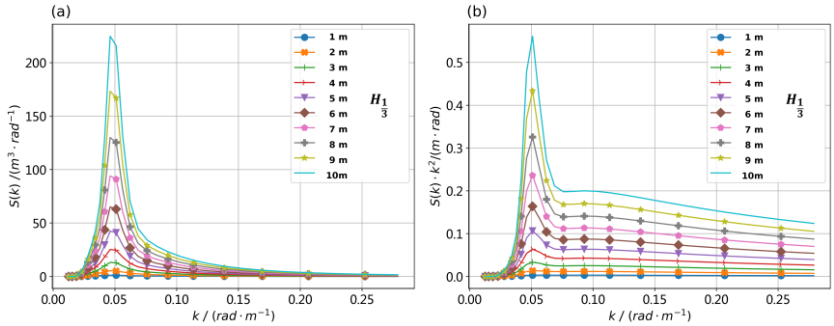


Goda Wave Curvature Spectrum

Comparison with the C spectrum (**Figure 5 now**) reveals that the variation trend of the C spectrum is almost identical to with that of the G spectrum in terms of the height and slope spectra, though the spectral peak intensity of the C spectrum is slightly lower than that of the G spectrum. In the curvature spectrum, the values of the C spectrum on the right side of the spectral peak gradually increase, contrasting with the trend in the G spectrum where the curve gradually flattens

8. The Figure 4 caption describes spectrum results at different significant wave heights, while the figure legends display wave steepness values and wave age. Although wave steepness is directly related to wave height, the caption and legend should use the same parameter for clarity. Additionally, since wave age remains constant throughout Figure 4, it does not need repetition in each legend entry.

Reply: Thanks for the suggestion. We have unified the presentation to use significant wave height consistently in both caption and legends, and removed redundant wave age information. Now **Figure 5** of the revised manuscript:



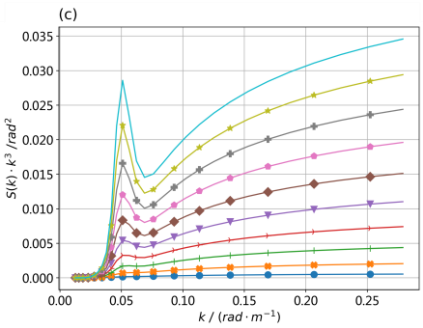


Figure 5: The C spectrum at different $H_{\frac{1}{3}}$, when k_p is 0.048 rad·m^{-1} and u_{10} is 10 m·s^{-1}, (a) is Combined height spectrum, (b) is Combined slope, (c) is Combined curvature. δ is wave steepness, and Ω is inverse wave age.

9. Figure 5: The previous comment applies to this figure as well. Both wave age and wave steepness change here due to variations in peak wavenumber, not wind speed. For clarity, the legend should show only the varying parameter (peak wavenumber or wave steepness) rather than listing all dependent variables such as wave age.

Reply: In a varied sea state, the parameters are linked with each other. For conciseness, following this suggestion, we now use peak wavenumber as the sole varying parameter in the legend. It is now **Figure 6** of the revised manuscript:

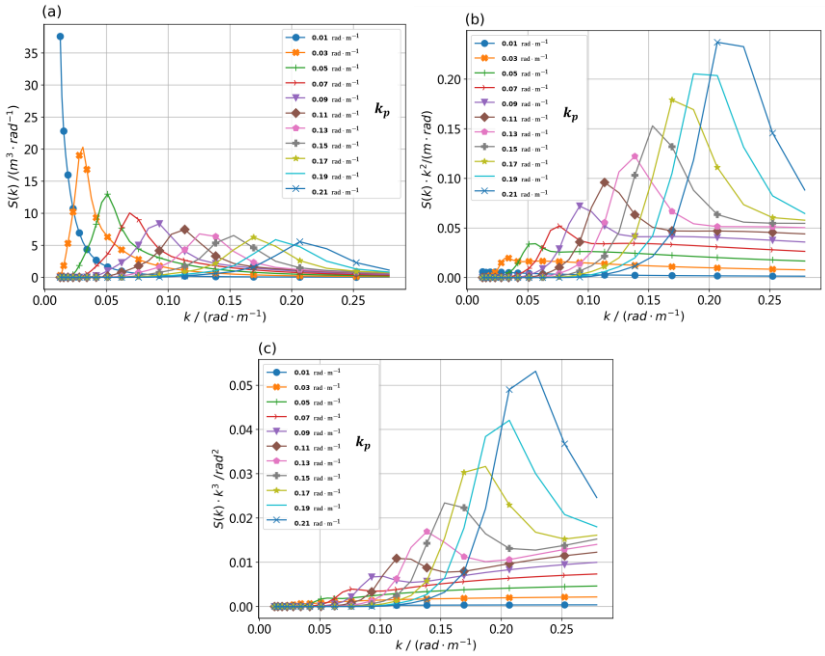


Figure 6: The C spectrum at different k_p, when $H_{\frac{1}{3}}$ is 3 m and u_{10} is 10 m·s^{-1}, (a) is Combined height spectrum, (b) is Combined slope, (c) is Combined curvature

10. Figure 6: The only varying parameter is wind speed yet the legend does not indicate any wind speed variation. Unlike Figure 5, where wave ages vary due to peak wavenumber changes, here they vary due to wind speed changes. The figure should clearly indicate which parameter is being varied.

Reply: Thanks for this good suggestion to make the figures clearer! We have modified the figure to clearly indicate wind speed as the varying parameter. Now **Figure 7** of the revised manuscript:

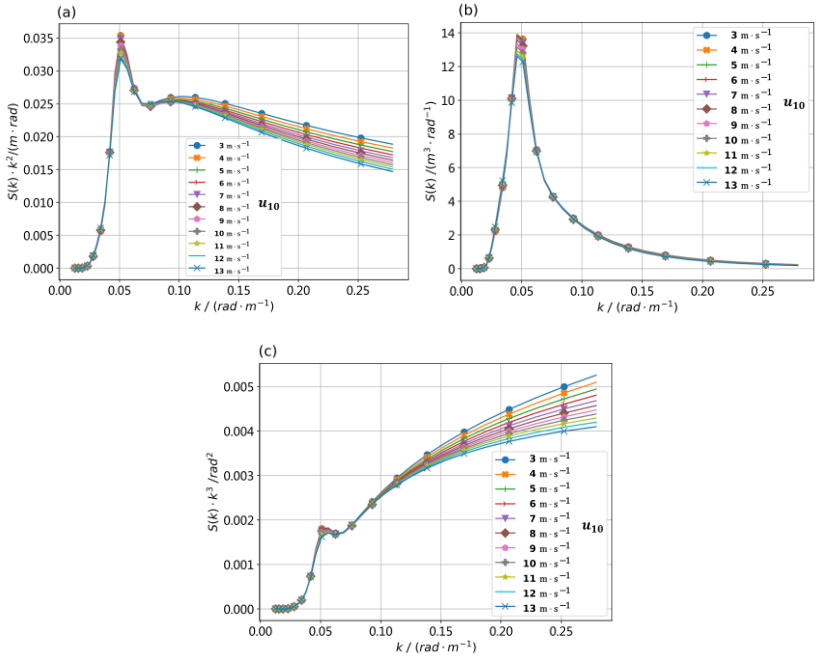


Figure 7: C spectrum at different wind speed, when significant wave height is 3m and k_p is 0.048 rad·m^{-1}, (a) is Combined height spectrum, (b) is Combined slope, (c) is Combined curvature

11. Figure 8a:It is hard to see the probability density variations. the colorbar for all plots of figure 8 should be in similar range so that we can better see the comparison.

Reply: We have adjusted the colorbars to use similar ranges for the same metrics (DI metrics in figure 8a and 8c and R^2 metrics in figure 8b and 8d in our revised manuscript), with optimized ranges to better show density variations. In addition, we also made the similar modifications to Figure 7 of the revised manuscript, they are now Figure 8 and 9 in the modified manuscript:

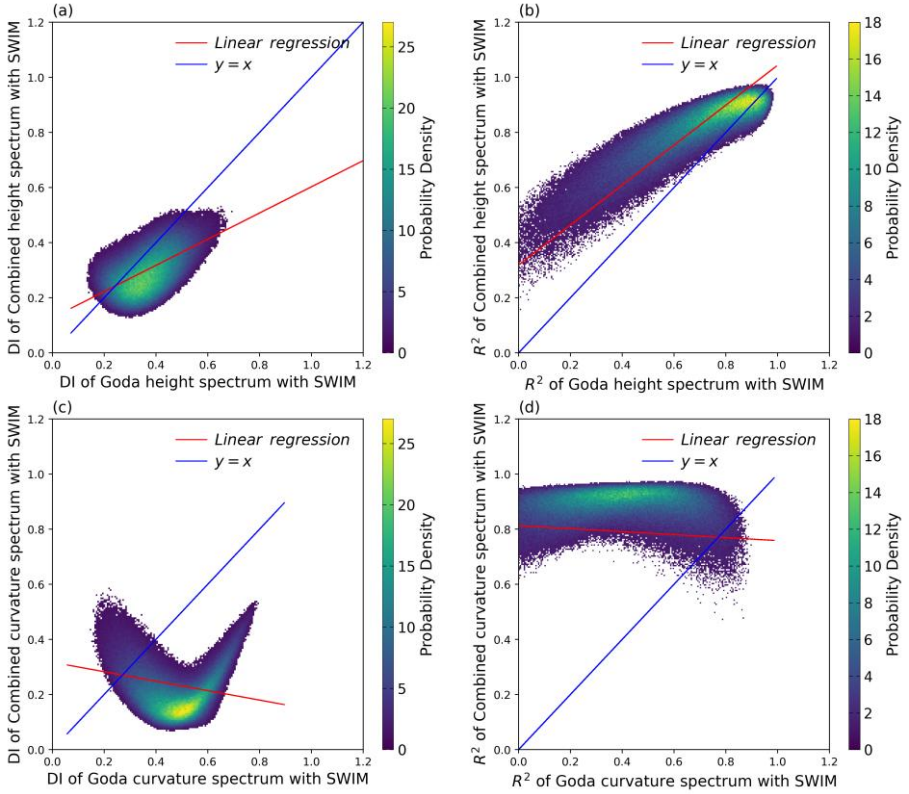


Figure 8: Validation of DI and R^2 Metrics from C and E Spectra with SWIM in 2022, (a), (c), is DI of height and curvature spectrum, (b), (d) is R^2 of height and curvature spectrum

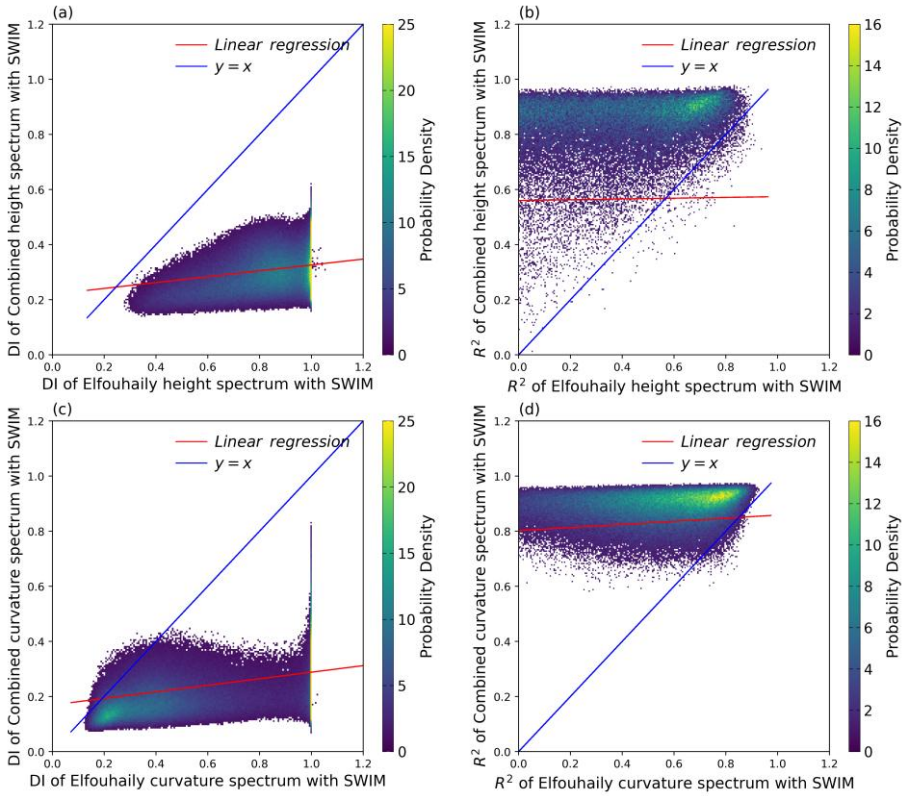


Figure 9: Validation of DI and R^2 Metrics from C and E Spectra with SWIM in 2022, (a), (c), is DI of height and curvature spectrum, (b), (d) is R^2 of height and curvature spectrum.

12. The headings of Table 1: "The C spectrum better than the G/E spectrum" is unclear. What does DI and R values for C spectrum better than E spectrum mean?

Reply: We have revised the table to clearly indicate that the values represent the percentage of cases where the C spectrum outperforms the G/E spectrum across different evaluation metrics (DI of curvature/height and R^2 of curvature/height). For example, Combined with the "DI of curvature" row of the table, we can understand that The proportion of curvature and height spectrum in DI about the C spectrum better than the G spectrum is 82.9% and 78.0%, which means the C spectrum fits more the SWIM measurements. Specifically the content in Table 1has been modified from "The C spectrum better than the G spectrum " to "Percentage of the C spectrum better than the G spectrum".

13. Table 2: The previous comment applies to this table as well.

Reply: Similar to Table 1, we have modified the presentation to prevent misinterpretation. Specifically the content has been modified from "The C spectrum better than the G spectrum " to "Percentage of the C spectrum better than the G spectrum".

14. Figure 11: Height spectra (Elevation spectra?) y label units are missing. Is it normalized?

Reply: Thanks for the correction, it should be clarified that no normalization has been operated here. We have added the missing y label units to Figures 11-and 14 (Now 12 and 15) in the revised manuscript:

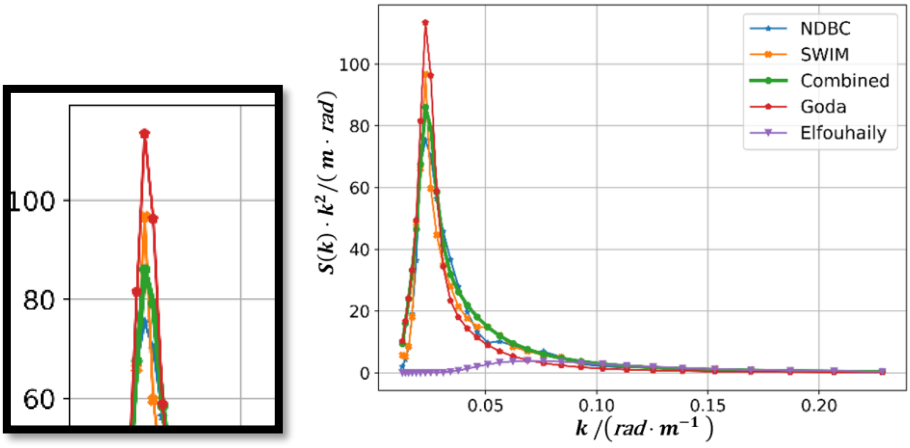


Figure 12: Comparison of the SWIM, G, E and Combined height spectra when wave steepness is 0.02, and inverse wave age is 0.479.

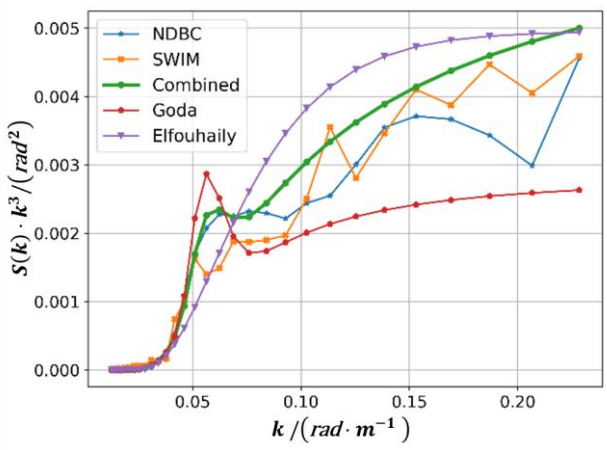


Figure 15: Comparison of the SWIM, G, E and Combined curvature spectra when wave steepness is 0.026, and inverse wave age is 0.803.