Dear reviewer,

Thank you for your comments and suggestions and for the time dedicated to this detailed revision. We improved the manuscript according to them, and we accepted the suggestions to improve the figures. Below are the responses in red.

Review of "Recent changes in extreme wave events in the Southwestern South Atlantic"

This study investigates the wave mean and extreme climate in the South West South Atlantic ocean (SWSA) and the potential associated coastal hazards from 1993 to 2021, focusing on a portion of the Brazilian coast. To do so, the author first used the outputs of regional wave datasets from the CMEMS and a historical coastal hazards dataset from the Baixada Santista Coastal Hazards database (BDe-BS). The regional wave climate is investigated using several parameters (Significant wave height Hs, wave energy period Te, wave power, number of extreme events and intensity) for both mean regime and extreme wave climate (Hs 95th percentile). The seasonality is also investigated with a particular attention on the winter period during which most intense wave events occur.
Despite the limited period of study (29 years), significant and valuable results on trends are found for both the wave climate and coastal hazards, especially for the number of extreme events.
R. This manuscript is submitted for this special issue of the State of The Planet, as part of the Copernicus Marine Service (CMEMS) Ocean Science Report 7. As a request, we need to use CMEMS products, including 2021. Therefore, the study is restricted to 29 years. This is better explained in the specific comments below.

Overall, I found the general idea and workflow coherent, and the use of 2 different dataset very valuable. This study provides valuable results promoting the need of further research for coastal disaster prevention. Though, before publication, a significant number of clarifications on the methods is needed, extra efforts to link the wave climate to costal hazards is expected, along with an exhaustive review of the whole manuscript concerning Figures (both format and captions) and general writing.
R. Thank you for your comment. The method was clarified in the specific comments below. We also improved the discussion about the links between the wave climate and coastal hazards.

For the following reasons, I reckon that the manuscript should be considered for publication after undergoing major revisions.

General comments:

- Although not a native speaker, I suggest checking for the whole manuscript for syntax and English writing. Also, many times there is a lack of connection and logic between statements (that alone are generally very true) within the same sentence. Though the article is fully understandable, the high number of technical corrections needed results in a major revision. Related comments are enumerated below in the technical and small corrections part (corrections carefully noted only until line 160 of the article).
R. Many thanks for your efforts in correcting these technical and small mistakes. We implemented your suggestion and checked the writing and editing to ensure a better manuscript. We accepted most of your suggestions pointed out as small corrections, and there were made directly in the reviewed manuscript.

- In general, there is lack of clarity on the CMEMS data used and on the methods used to compute for instance Hs 95th percentiles (from hourly Hs time series or independent local events?), yearly time series of spatial average of specific areas (results showed in Figures 3 and 4), or trends from Sen's slope and parametric linear regression... Also, the comparison of the number of extreme events obtained from CMEMS database and BDe-BS (Figure 4c) is not very coherent, another analysis could be done, as further proposed. Related comments are

chronologically presented in the Specific comments section. In the case all clarifications solve my doubts or misunderstandings, this would be a minor comment, otherwise a major revision is expected.
R. We improved the explanation about the methods, focusing on the questions raised by you. Further explanations are in the specific comments section below.

Specific comments:

1. Line 55-71, 2.1 Datasets: What is the point using these 2 CMEMS dataset? Is it because WAVERYS misses the year 2021? You state, "so a more consistent analysis can be achieved despite using different sources", and further compute statistical indicators (such as the 95th percentiles) with no explanation of the actual data used (Figure 1, caption: "based on the CMEMS hindcasts", what data are you plotting?). Furthermore, combining data from a 1) global reanalysis and a 2) global analysis and forecast from the same service (CMEMS) is a bit redundant.
R. The use of CMEMS data, including 2021, is a requirement for the submission to the CMEMS Ocean State Report 7. In this way, we used the wave reanalysis of CMEMS (WAVERYS; Law-Chune et al., 2021) from 1993 to 2020 and added 2021 from the CMEMS Global Ocean Waves Analysis Near Real-Time product. The analysis is made as they are a consistent dataset from 1993 to 2021. We clarified this aspect in the reviewed manuscript.

Lines 50 - 59*: "The main dataset used in this work was the Copernicus Marine Service (CMEMS) global hindcast, named WAVERYS (Table 2, Ref. No. 1; Law-Chune et al., 2021), available from 1993 to 2020. To include 2021 in the analysis, the WAVERYS was complemented with data from the CMEMS Global Ocean Waves Analysis Near Real-Time product (GLO-NRT; Table 2, Ref. No. 2). The combination (in time) of these two products is referred to hereafter as CMEMS hindcasts."*

2. It is not clear if you are using Hs independent events or hourly Hs time series when you compute Hs 95th percentiles and the number of extreme events above the 95th percentiles. Line 75: "... the Hs peaks ...", it could be easier to define a Hspeaks to further in the article refer to Hs independent events in an efficient way (e.g., line 77, "Hs distribution" is confusing), because percentiles computed from Hs time series or Hs peaks can give very different results... Another way would be to specify that further in the article, Hs 95th values will refer to percentiles computed from Hs independent events, while mean Hs corresponds to average computed from hourly Hs time series.
R. We computed 95th percentiles of significant wave height (Hs) from Hs-independent events using a time window of 48 h, i.e., a minimum distance of 16-time steps between the peaks. We adopted Hs_{peaks} instead of simply Hs to clarify the method, as you suggested. You can find a better explanation in the reviewed manuscript.

Lines 76 – 81: *"The selected Hs_{peaks} must be separated by a minimum of 48 hours to guarantee the independence of the peaks. This time window has been widely applied in past studies to ensure the collection of one peak per storm (e.g., Caires and Sterl, 2005; Meucci et al., 2020). Besides that, 48 hours is a suitable but not-so-restrictive time threshold for extreme wave analysis in the region, particularly considering the differences among the seasons."*

3. Lines 76-80: This part is not very clear, maybe you could give more details of the method used to eventually obtain the Hs 95th values used in Figures 1,2 and 3. From what I understood, you first compute the monthly Hspeaks 95th percentile at every grid point of the study domain. From these values, the average seasonal and annual percentiles are computed (here, you could precise how you defined your seasons, SON, DJF...). Finally, at every grid point, your time series (1993-2021, 29 values) are the yearly percentiles computed independently of the seasonal variability, and yearly percentiles for each season.

R. Thank you for your comment. It is correct what you have understood. In the revised version we provided more clear explanation of the method on percentiles, We used the averaged monthly 95th percentiles as the base for all percentiles fields presented in the manuscript. These monthly percentiles were used to build the annual (12 months) and seasonal (3 months) mean and trends. For the application of the Weisse and Günther (2007) method, we need a unique 95th percentile field to establish a SET value per grid point. Since all your trend analysis is based on the monthly 95th percentile, we used the average of these monthly values over the whole period (29x12 months) as SET.

Lines 81 - 85: *"The 95th percentile is computed based on the monthly Hs_{peaks} distribution in each grid point. Using these monthly 95th percentiles, we calculate the annual, seasonal, and whole-period means used for the trend and extreme events analysis. The seasonal mean of the 95th monthly percentiles is computed for the summer and winter, using the average December-January-February and June-July-August respectively, thus having one value per year. The annual percentiles are computed by the average of all monthly percentiles within the year. A whole-period average of the monthly 95th percentile is used as a reference for the wave event analysis (section 2.4)."*

Lines 98 - 99: *"Moreover, the use of averaged monthly percentile results in a smoothed field, especially due to the Hs_{peaks} variability among the year. In this way, for some locations, the exceedance of events above SET is large than 5%".*

4. Lines 83-89: I understand the method using Sen's slope to find trends and if they are statistically significant with a Mann-Kendall test. You have a trend +- error, and that is significant or not. Then, it is not very clear why and what are doing by computing a parametric linear regression analysis. First, as you mention lines 197-198, it assumes a normal distribution, which is not true for extreme wave event distribution. Then, you are for instance applying a bootstrap method (n = 1000) to a set of 29 yearly values of Hs 95th percentiles. How do you compute de confidence intervals (CIs)? Figure 3 shows constants errors but Cis not constant, with a narrowing at mid-term of the whole period.
R. We agree with you. We removed the parametric linear regression In the revised version of the manuscript since it presumes a normal distribution, which doesn't fit our analysis.

5. Line 97: Here, you explain how the duration of each event was computed, following Weisse and Günther (2007). Line 48, in the introduction, you also mention the duration, but you never further investigate this characteristic!
R. Thank you for your comments. We removed this part from the methodology section since this parameter was not shown in the results.

6. Lines 98-100: You just defined the duration of each event, and the intensity associated to this event, that is the difference between the SET value and the maximum value during this event. Following Weisse and Günther (2007), you should clarify that you will then use the mean intensity, i.e., the average of the intensity of all individual events (above SET) within a year, both independently of seasonal variability and for each season.
R. The reviewed manuscript has a better description of the parameters of the wave, such as intensity, mean wave direction, etc.

Lines 100 - 104: *"Following Weisse and Günther (2007), the intensity is equal to the difference between the maximum Hs of the event and the SET at that point. The wave event statistics, such as the number of events, intensity, mean wave direction, and peak period, are presented herein as annual and seasonal means to build the spatial distribution and trends, as well as to obtain the spatial-averaged time series. The intensity and wave parameters were calculated by averaging all individual events (above SET) within the year or season."*

7. Line 182-185: "The extreme event ... warning subareas (Fig. 3)." I assume that you want to point out the benefits and limitation of such approach to perform coastal hazards assessment,

to introduce the complementary focus on specific subareas (A, B, C, D) where you have a "terrain" database from the BDe-BS. Instead of "Due to that", I think it should be "Therefore". Moreover, it is not because of reanalyses derived- sparse results that you analyse the trends in A, B, C, D (previous results do not show higher statistical significance there), but because you have data there!! Finally, for each area, I assume that you work with spatially averaged trends (you should also explain it along with the associated spatially averaged errors), but what do you mean by "most relevant trends"? You compute spatial trends for each area and parameter and then find if they are statistically significant, but ALL trends are analysed. It is therefore quite hard to understand the reasoning here and I recommend modifying these lines to be clearer.
R. Thank you for your comment and suggestion. By using "show most relevant trends" we meant to show the parameters that presented a significant trend in at least one region and season. We modified the term and improved the explanation in the reviewed manuscript.

Lines 188 - 190: *"Therefore, the trends in some event parameters were analysed for each Brazilian Navy's monitoring and warning subareas (Fig. 3). We focus this analysis on the parameters that had significant trends at least in one region and season, although both winter and summer are presented in Fig. 3 for consistency."*

8. Lines 213-231: The trends calculated (from the reanalyses and the BDe-BS) are indeed similar in the subareas C. But as you say, yearly number of events from both databases often differ with a clearly higher number of wave event for the reanalyses-derived data than coastal hazards from the BDe-BS. This result raises the same concern than the comment 35 ("because percentiles computed from Hs time series or Hs peaks can give very different results"). Let's assume that for the number of extreme wave events over the Hs 95th percentile, you used the distribution independent events (2 days' time-window), Hspeaks. Therefore, in theory, the maximum number of independent events within one year is roughly 183. This is the distribution of wave independents events. However, you are working with EXTREMES wave events corresponding to events with Hs values higher than the SET value (Defined by the 95th percentile). So, from 183 events, 5% are above de 95th percentile, ≈ 9 extreme event per year at most, when Figure 4c shows that the number of extreme wave events ranges from 23 to 36. So, it means that, though you used the independent events distribution (Hspeaks) for the 95th percentile Hs values, the number of extreme events was computed from the 95th percentile of hourly Hs time series.
So, to conclude: 1) I think that it is confusing and, in agreement with comment 35, you should clarify whether Hs hourly time series are used or Hspeaks. 2) except for trends, the number of extreme events obtained from the 2 the reanalyses and BDe-Bs are not comparable with this method. For instance, if you would chose the 99th percentile instead of the 95th, the number of extreme wave events detected would be lower and more like the number of extreme events given by the BDe-BS (you actually say that you could use any percentile between 90 and 99, Lines 94-95). In my opinion, I would only compare trends with this method. However, it could be interesting to assess the capacity of the reanalyses to reproduce extreme wave events that are documented by the BDe-Bs, giving an idea of the typical wave forcing leading to coastal hazards in the subarea C. I am aware of the extra work that it represents, but it is an opportunity to make the link between "the regional wave climate and with coastal hazards" (Line 201).
R. (1) The SET applied in this study is based on the average of the monthly 95th percentile for the whole period (29 years x 12 months). This threshold is fixed for evaluating the trends throughout the period (as also explained in comment 3). The averaging smoothed the percentile, particularly due to seasonal variability among the year. The result is the pattern shown in Fig. 1a, which presents lower values than the percentile computed using the Hs_{peaks} in a 29-years time series. The exceedance of the average percentile is larger than 5% for some locations. The choice of using e of the average of the monthly percentiles is to ensure consistency in the analyses. Otherwise, we would have several period-based percentiles, and the evaluation of the results would be inconsistent. We clarified the use of the averaged monthly 95th percentile in lines 98 - 99, as presented in comment 3. (2) The number of events in subarea C is not comparable with the events in the coast due to several factors, such as

wave direction, storm clustering, storm tide. Some waves above the percentile in subregion C do not reach the coast and/or do not have the right incidence direction to penetrate the shoreline with strength enough to be recorded as extreme coastal events. This matter is also complemented in comment 9. The absence of a straightforward agreement is also a valid result in our manuscript since we discuss these several factors, including the higher increase trend in the coastal events. We added this discussion to the reviewed manuscript.

Lines 253 – 256: *"For instance, these additional elements to coastal erosion can explain the total increase of wave-forced events recorded on the coast in 29 years (145%) is much larger than the increase in the C subarea (20%). In this case, the human use of modifying the shoreline may intensify the damage effects of the extreme wave events increasing (Muehe, 2018)."*

9. Lines 223-231: On the assumptions of differences observed between reanalyses-derived extreme wave events and coastal hazards from the BDe-BS. "Maybe these wave events would not become a hazard if the local sea level rises did not allow waves to reach further into the continental area": this is indeed a potential consequence of sea level rise. However, the hypothesis of sea level rise explaining the difference observed only from the absence of peaks in 2002 and 2009 in the reanalyses-derived number of extreme wave events is off topic. It is a long and large-scale effect that has a low impact one year to another. Also, it occurs over the whole period, not only during two isolated years, and the provided data here to make such assumption is simply not enough. Finally, the number of extreme events is not necessarily related to the intensity of these events. A year with a low number of extreme wave events but powerful ones can lead to a higher number observed extreme event at coast than a year with a high number of relatively weaker extreme wave events.
R. By "sea level rise", we meant the elevation of sea level due to the storm or astronomical tides. However, we understand that using this term may be confusing in this context and we changed it to sea level elevation. This is explained further in the revised manuscript to avoid misunderstandings (lines 247 and 250). In this way, we addressed the differences in the peaks and troughs of the oceanic and coastal series to the coupled effect of storm waves and storm tides. In some situations, energetic waves can arrive on the coast, but a low sea level doesn't allow the penetration of the wave further into the continent to cause enough damage or erosion, thus not being included in The Baixada Santista Coastal Hazards database (BDe-BS). The effect of sea level elevation, in this case, can be caused both by astronomical and atmospheric tides since the database doesn't differentiate them (Linhares et al., 2021).

10. The results show significant and high trends. Line 220: for the subarea C, maybe you could take advantage of giving an example of the consequence over 29 years, in order to give more weight to your findings. For instance, 0.20 event/year increase looks small, but over 29 years it represents 5-6 more events per year in the subarea C that shows between 24-34 events per year (~20% increase !!).
R. Thank you for your suggestion. In the revised version we added a better description of the results in Fig. 3, highlighting the consequences of these trends in 29 years:

Lines 199 - 201: *"The trend of 0.2 and 0.28 events/year represents an increase of ~20% in the C and D subareas in 29 years (based on the increase of the annual mean of their series). Together with sub-area B, these regions also showed an increase in the mean power wave despite no significant change in the peak period. In winter, the A and D subareas demonstrate significant trends in the number of events per year, representing a 27.2% and 37% increase, respectively."*

Lines 229 - 231: *"The results show an increase of 120% and 145% of total events and wave-forced events on the coast in 29 years, considering the mean over the whole period."*

Lines 242 - 245: *"Moreover, it is possible to compare the trends in the coastal hazards forced by waves (0.22 ± 0.07 events/year, Table 1) with the trends of the number of extreme wave* *events in the C subarea (Fig. 4c); 0.20 ± 0.06 events/year in Fig. 3a). However, considering the mean number of coastal events forced by waves (4.4 events/year) the increase in the coast corresponds to 145% in 29 years."*

Lines 253 - 256: *"For instance, these additional elements to coastal erosion can explain the total increase of wave-forced events recorded on the coast in 29 years (145%) is much larger than the increase in the C subarea (20%). In this case, the human use of modifying the shoreline may intensify the damage effects of the extreme wave events increasing (Muehe, 2018)."*

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