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Ocean Science Discussions

Interactive comment on "Estimation of extreme wave heights return period from short-term interpolation of multi-mission satellite data: application to the South Atlantic" *by* Julio Salcedo-Castro et al.

Anonymous Referee #1

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The paper "Estimation of extreme wave heights return period from short-term interpolation of multi-mission satellite data: application to the South Atlantic" by Julio Salcedo-Castro et al. addresses a vital problem of extracting more reliable information on extreme events from multi-mission satellite altimetry. The paper is reasonably well-organized and presented in a clear manner, but it should be proof-read, and the English language corrected before the publication. The paper presents a new way of merging satellite data using optimal interpolation (objective mapping) technique. However, the scientific approach is lacking integrity, and quite often the conclusions are

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based on insufficiently tested methods. The main concerns are using the data with filtered extremes for the analysis, lack of sufficient justification of the optimal interpolation method, estimation of the threshold data on the basis of in-situ data (not satellite data which were used in the analysis), and insufficient in-situ validation.

The paper is not suitable for publication in Ocean Science in its current form. The main concerns are listed below:

1. The problem with the pre-filtering of the extreme data in the Globwave data processing pipeline still remains. In the technical documentation on the Globwave data (ftp://ftp.ifremer.fr/ifremer/cersat/products/swath/altimeters/waves/documentation/altimeter_wave_merge__11.4.pdf, page 5) it is described that for each along track sample, a running window of 100 km was applied and within each window, the highest values (approximately 10% of the data) were discarded. Hypothetically, if one can observe a large scale anomaly in wave height with characteristic spatial scales larger than few hundreds of kilometers, then even after this type of filtering the data will still show an extreme event. However, if the extreme events in wave heights are $\sim$100 km or smaller, then the data will be either filtered out completely or show erroneous results. That means that the data can be in principle be used for some limited studies of the wave extremes, but with extreme caution. The authors showed some overall correspondence between the ERA-interim and satellite altimetry return periods, although the question still remains to what extent the Globwave dataset can be used for extreme value analysis. A detailed analysis of the effect of data filtering on the result should be performed before the paper can be published. For example,

a. Getting simulated wave data or model data with extreme events on various spatial scales, extracting data along with the position of satellite tracks, applying the Globwave filtering technique and demonstrating which extreme events can be reconstructed and which are lost during the processing.

b. Obtaining pre-processed along the track data and post-processed data from Ifremer

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and estimating a bias introduced by the Globwave filtering technique on the results of the extreme value analysis. Finding how the bias depends on the spatial extent of the extreme event and characteristic length of the event.

c. Comparing the extreme value distribution extracted from Globwave database with extreme value distributions from nearby in-situ data separating data into the duration of the extreme event and its spatial scale. Looking at the best matches with the in-situ data one can find what kind of extreme events can be extracted from the Globwave data.

2. The manuscript describes an interesting application of a new optimal interpolation (objective mapping) technique to satellite altimetry data, and it is written in the abstract and the conclusions section that this is one of the main objectives of the paper. The method is interesting and promising. However, a much more excessive analysis should be performed to test whether this type of interpolation improves the results compared to the previous techniques.

a. The method should be explained in much more details, what exactly is performed during the interpolation, what software package was used (including the version of the package).

b. The authors selected a mesh size of 2x2 degrees based on the estimates of other authors. However, the optimal mesh size found by other authors was found based on different analysis techniques and maybe not correct if additional steps are added in the analysis, such as the optimal interpolation. The optimal mesh size should be found specifically for this method following the techniques of the mentioned in the paper other authors, such as Vinoth and Young 2011 and Wilkin et al. 2002.

c. For each grid point, it should be checked how different are the results of the optimal interpolation and actual data at these points to investigate a bias introduced by the optimal interpolation. Also, the dependence of this bias on the mesh size should be checked. An ultimate test for data corruption by the optimal interpolation would be

to remove ∼20% of the grid points with satellite data, apply the optimal interpolation, restore the data at the locations of discarded points and see how different the values are from the actual measurements.

d. Figure 4 shows differences between the in-situ buoy data and interpolated satellite data. I would like to see non-interpolated data added to that plot and calculated biases and all parameters for non-interpolated data as well so that a reader can see that the optimal interpolation shows a better correspondence to the in-situ data.

e. The authors claim that the optimal interpolation results in a more detailed map (p.11, l10) compared to ERA-interim. It is important either find some additional data to show that these details are real or tell the reader that these details should be treated with caution. It should be proven with additional analysis that the optimal interpolation resolves more real structures in the data.

3. The authors applied a peak over the threshold method to the data; one of the main concerns is that all the tests for finding threshold were performed on in-situ buoy data and not on the actual data used in the analysis. I would like to see the results of the mean excess plot to the satellite altimetry data next to the buoy locations (interpolated and non-interpolated). An application of a different threshold can significantly affect the results of the manuscript.

4. The authors used just four in-situ measurement sites for the validation of the method with quite a short period of observations. There are more in-situ data available for that purpose, for example, the buoys used for the validation of Globwave dataset. I would recommend to get more in-situ data and validate the optimal interpolation method at larger scales so that the proposed method can be trusted not only next to the Brazilian coast, but for the whole South Atlantic.

Detailed comments:

1. p4, l3: "... we firstly added all satellite tracks occurring during two-day temporal win-

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dow..” please change the wording, the word “added” is confusing, it might be confused with the addition of all values of satellite tracks.

2. Figure 1: the right picture shows the results of interpolation overlapped with the land. Is it correct?

3. P5, l1: “root-mean-square” -> root mean square

4. P5, l9: “QQplot” -> “quantile-quantile plot”

5. Equation 5: the minus symbol should be outside the fraction, comma should be placed in the equation line, not at the start of the text

6. P8, Figure 3: The dotted lines are not explained in the caption

7. P8, Figure 3, also Table 1: there is an inconsistency between what is written in Table 1 and presented in Figure 3. In Table 1, the Reclife station is said to have data until March 2014 and Santos station data until April 2014. Although, examining Fig.3 the Reclife data are longer. What is the right period of observations?

8. P9, Figure 4: what is the dashed line on the plots? It should be described in the caption

9. P9, Figure 4: The Rio Grande station shows the highest discrepancy between the in-situ and satellite interpolated data. The authors argue that the location of the station is the main reason. I would recommend also investigating the fact that the Rio Grande is the closest station to the coast (48km) and that maybe some corruption of the altimeter data by irregularities in the coastline can be responsible for this discrepancy.

10. P11, Figure 6: The black dot showing the Reclife station is not visible in the printed version of the paper. Please consider changing the color of the symbols.

11. P15, l15: “Caires, S: Validation of ocean wind and wave data. . .” -> “Caires, S. and Sterl, A.: Validation of ocean wind and wave data. . .”

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