Nat. Hazards Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/nhess-2018-349-AC3, 2019

Natural Hazards and Earth System Sciences
Open Access
Discussions

Interactive comment on "Study of the threshold for the POT method based on hindcasted significant wave heights of tropical cyclone waves in the South China Sea" *by* Zhuxiao Shao et al.

Zhuxiao Shao et al.

szx0617@163.com

Received and published: 4 June 2019

Replies to comments by referee #1

Thank you for your comments on our manuscript entitled "Extreme significant wave height of tropical cyclone waves in the South China Sea" (Ref: nhess-2018-349). These comments are all valuable and very helpful for improving our paper. We appreciate that we have a chance to revise the manuscript as you suggested and to resubmit our manuscript after addressing all comments point by point. We hope that the improved manuscript will meet your approval. The main corrections in the manuscript and responses to comments are shown as follows:

General response: Thank you for your evaluation of our manuscript. As suggested, some of the contents in the manuscript have been rewritten to improve the quality of the manuscript, and the threshold selection method is described clearly in detail. In addition, we have rephrased the paper to present ideas more concisely and strictly. To further improve the manuscript, proofreading and language editing have been completed by American Journal Experts.

(1) Response: As suggested, the title has been changed to "Extreme significant wave height of tropical cyclone waves in the South China Sea". (2) Response: As suggested, the contents of the corresponding lines have been simplified. ïĄň See the manuscript P. 1, lines 13-15: "In this study, a 40-year (1975-2014) hindcast of tropical cyclone waves is used to analyse the extreme significant wave height, employing the peak over threshold (POT) method with the generalized Pareto distribution (GPD) model." (3) Response: As suggested, "initial sample" was renamed "sample", and "sample" was renamed "extreme sample" (i.e., peaks over threshold). (4) Response: As suggested, "the return levels in AM are unreasonable" was clearly described and explained in the manuscript. ïĄň See the manuscript P. 3, lines 19-22; P. 4, lines 1-10: "Shao et al. (2018a) compared the annual maxima (AM) method (Tawn, 1988) with the POT method. The AM method is an easy sampling method that does not require additional work, as the method directly extracts the annual maximal significant wave height for extrapolation. However, the AM method has limitations in a fixed time window (i.e., one year), which cannot guarantee the independence and number of samples. The annual maximal significant wave height obtained from neighbouring years may originate from the same extreme wave; some maximal significant wave heights may be neglected (i.e., the annual maximal significant wave height may be smaller than some unselected maximal significant wave heights in other years), resulting in an insufficient number of samples, especially for a relatively long return period. In a tropical cyclone, the AM method's limitation is further exacerbated, even if the return period is close to the database size. The annual frequency, intensity and track of recorded tropical cyclones greatly vary, and corresponding waves have obvious differences. Shao et

al. (2018a) found that the minimal sample may be much less than the maximal sample, and the minimal sample may be too small to represent the extreme wave (i.e., the minimal sample in the AM method is obviously smaller than the extreme sample in the POT method)." (5) Response: As suggested, the content in the corresponding line was rephrased. ïĄň See the manuscript P. 5, lines 5-6: "Thus, it is possible to study the extreme significant wave height in a tropical cyclone." (6) Response: As suggested, the contents in the corresponding lines were rewritten to clearly show our ideas. ïĄň See the manuscript P. 5, lines 6-9: "To achieve the assessment, a 40-year (1975-2014) hindcasted significant wave height of tropical cyclone waves is employed as the initial database. Considering that the hindcast is independently simulated during the tropical cyclone recorded in the SCS, the maximal significant wave height of the tropical cyclone wave can be directly extracted as the sample when the tropical cyclone influences the wave at the targeted location." (7) Response: As suggested, "peak significant wave height" was renamed "maximal significant wave height". (8) Response: As suggested, the contents in the corresponding lines were rephrased to avoid repetition. In addition, we rephrased the paper to present our ideas more concisely. ïĄň See the manuscript P. 4, lines 15-18: "Based on this conclusion, Shao et al. (2018a) defined the largest threshold within the common stable threshold range as the suitable threshold, and Liang et al. (2019) proposed an Automated Threshold Selection Method based on the characteristic of Extrapolated significant wave heights (the acronym is ATSME)." (9) Response: As suggested, the acronym ATSME was introduced. ïĄň See the manuscript P. 4, lines 15-18: "Based on this conclusion, Shao et al. (2018a) defined the largest threshold within the common stable threshold range as the suitable threshold, and Liang et al. (2019) proposed an Automated Threshold Selection Method based on the characteristic of Extrapolated significant wave heights (the acronym is ATSME)." (10) Response: As suggested, the contents in the corresponding lines were deleted. (11) Response: In the ATSME, the maximal threshold of the stable threshold range is used to extract the extreme sample. Considering that the selected threshold is within the stable threshold range, the influence of this def-

inition is small for the return significant wave heights. As mentioned, the content in corresponding lines may mislead readers. Thus, we have deleted the corresponding contents. (12) Response: As suggested, the contents in the corresponding lines were rewritten. ïĄň See the manuscript P. 5, line 16: "In Section 4, the sampling method is described." (13) Response: As suggested, the content in the corresponding line was rewritten. ïĄň See the manuscript P. 5, lines 16-17: "In Section 5, the characteristics of tropical cyclone waves are discussed." (14) Response: As suggested, the technique used by the authors was summarized in Section 2. ïĄň See the manuscript P. 6, Background. (15) Response: As suggested, the content in the corresponding line was rewritten. ïĄň See the manuscript P. 9, lines 10-11: "From 1975 to 2014, waves are simulated only during 974 independent tropical cyclones." (16) Response: As suggested, a figure with the positions of the 22 sample locations is presented in subsection 3.2. ïĄň See the manuscript P. 10, Fig.1. (17) Response: As suggested, "initial sample" was renamed "sample", and "sample" was renamed "extreme sample" (i.e., peaks over threshold). (18) Response: As suggested, the content in the corresponding line was rewritten. (19) Response: Yes, high return periods are extrapolated. The corresponding content is emphasized in the manuscript. (20) Response: As suggested, the ATSME was summarized in subsection 2.2. ïĄň See the manuscript P. 7, subsection 2.2. (21) Response: The stable threshold range shows a pattern associated with the return period. As suggested, this phenomenon was explained in subsection 2.2. In the ATSME, the suitable threshold is defined as the maximal threshold of the stable threshold range to guarantee design security. ïĄň See the manuscript P. 8, lines 10-11: "Suitable threshold. Determine the suitable threshold within the stable threshold range, such as the maximal threshold." ïĄň See the manuscript P. 8, lines 12-18; P. 9, lines 1-2: "By the ATSME, a unique threshold is determined within a uniquely stable threshold range for a specific return period. Liang et al. (2019) found that the stable threshold range shows a pattern associated with the return period. The minimal threshold of the stable threshold range controls the representativeness of the extreme sample; thus, the samples over the minimal threshold can represent extreme waves well, and the minimal thresholds for different return periods remain constant. The maximal threshold of the stable threshold range controls the number of extreme samples, and a longer return period requires more extreme samples; thus, the maximal thresholds gradually decrease when the return period increases. Consequently, excluding the sample within the stable threshold ranges does not obviously influence the return significant wave heights, and a suitable threshold should be determined within the stable threshold range." (22) Response: As suggested, "peak significant wave height" was renamed "maximal significant wave height". (23) Response: As suggested, we have rephrased the content in Section 5 to present our ideas more concisely. The initial database and characteristics of tropical cyclones determine a bimodal shape. During a tropical cyclone, when the track is close and the intensity is strong, the maximal significant wave height can represent the extreme wave at the targeted location. However, it is difficult to determine the extreme sample through track threshold and intensity threshold. In this study, we use a fixed distance to identify the initial database at the study site. When the distance between the centre of the tropical cyclone and the study site is within 300 km, hourly significant wave heights simulated during this tropical cyclone are adopted as the initial database at the study site. This fixed distance allows some small samples (the corresponding track is far, or the intensity is weak) to be extracted. Thus, other analyses are needed to identify the extreme sample from the sample, such as the sample distribution with the sensitivity of the return significant wave height. At the 22 study sites in the SCS, a bimodal shape exists. We think that this bimodal shape is obvious in the tropical cyclone-dominated area when a fixed distance is used. In this area, the tropical cyclone always drives the storm wave, and the number of tropical cyclones is sufficiently large (the annual mean number is greater than 5 (Mazas and Hamm, 2011)). ïĄň See the manuscript P. 19, lines 11-14: "Based on further analysis of this distribution, the initial database and characteristics of the tropical cyclones determine a bimodal shape. A fixed distance is used to identify the initial database at the study site. This fixed distance allows some small samples (the corresponding track is far, or the intensity is weak) to be extracted. Thus, other analyses are needed

to identify the extreme sample from the sample." ïĄň See the manuscript P. 19, lines 15-19: "Consequently, the results of this study present a concept linking the assessment of extreme significant wave heights with the characteristics of tropical cyclones in a tropical cyclone-dominated area. The sample at the targeted location is affected by the track and intensity of the tropical cyclone. Future studies are suggested to promote the assessment of extreme significant wave heights in a tropical cyclone. For example, the threshold may be determined directly through a combination of track threshold and intensity threshold." (24) Response: As suggested, "waves" was removed. (25) Response: As suggested, the content in the corresponding line was rewritten. (26) Response: As suggested, the list of values was removed. (27) Response: As suggested, the meaning of Fig. 6 was clearly described in the manuscript. The quantile plot was discussed by Coles (2001) and produced by a free package running in R. The term "empirical" represents "empirical quantile", and "model" represents "model quantile". ïĄň See the manuscript P. 15, lines 14-16: "The asymptotic tail approximation can be estimated by the quantile plot, which is discussed by Coles (2001) and produced by a free package running in R." (28) Response: As suggested, the method of threshold selection was clearly described in Section 5. In the ATSME, the maximal threshold of the stable threshold range is used to extract the extreme sample. In the tropical cyclone, the track and intensity affect the sample at the targeted location. To assess the extreme significant wave height, we use a fixed distance to identify the initial database at the study site. This fixed distance allows some small samples (the corresponding track is far, or the intensity is weak) to be extracted. Thus, other analyses are needed to identify the extreme sample from the sample. In the sample distribution, a separation distinguishes the high sample from the low sample. In addition, this separation is within the stable threshold range. Thus, this separation can be used to extract the extreme sample. We think that this method is suitable in the tropical cyclone-dominated area when a fixed distance is used. In this area, the tropical cyclone always drives the storm wave, and the number of tropical cyclones is sufficiently large (the annual mean number is greater than 5 (Mazas and Hamm, 2011)). To guarantee design security, a sensitivity analysis is suggested to supplement the threshold selection in the distribution. (29) Response: As suggested, a map with the 22 sample locations is shown in Fig. 1. In addition, the 100-year return level is presented in Tables 1 and 2. (30) Response: As suggested, we have rephrased the conclusion to present our ideas more concisely and strictly. ïĄň See the manuscript P. 18, conclusions and discussions. (31) Response: As suggested, we have carefully reviewed the conclusion. To further improve it, proofreading and language editing have been completed by American Journal Experts. (32) Response: The initial database and characteristics of tropical cyclones determine the bimodal shape. A fixed distance is used to identify the initial database at the study site. This fixed distance allows some small samples (the corresponding track is far, or the intensity is weak) to be extracted. Thus, other analyses are needed to identify the extreme sample from the sample, such as the sample distribution with the sensitivity of the return significant wave height.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2018-349, 2019.

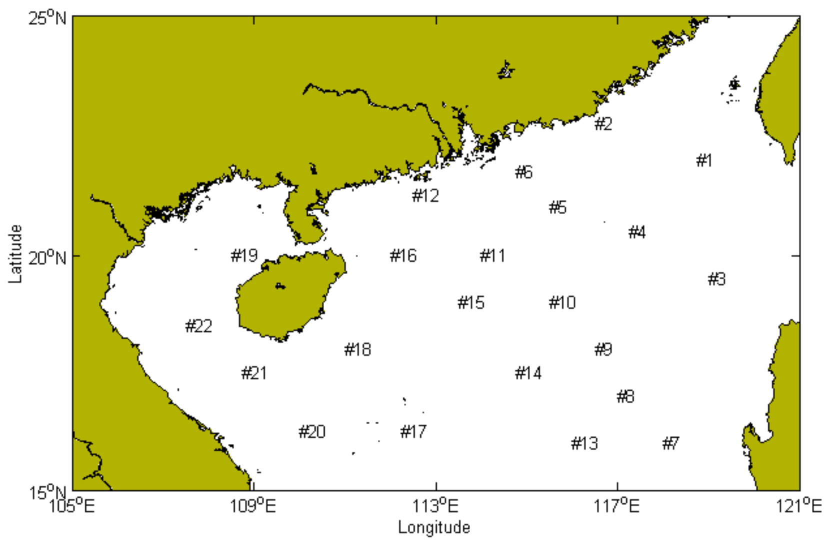

Fig. 1. The study sites in the study region.