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## **Comment on nhess-2022-215**

Anonymous Referee #2

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Referee comment on "Freak wave events in 2005–2021: statistics and analysis of favourable wave and wind conditions" by Ekaterina Didenkulova et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2022-215-RC2>, 2022

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### ***Freak wave events in 2005–2021***

#### **General Comments**

The manuscript presents a catalogue of freak wave events that caused damage and/or harm to structures and people as reported in the media in the period 2005–2021. These notable events were not captured by in-situ measurements. The authors use ERA5 reanalysis to characterise the conditions in which these events occurred and define favourable conditions that might lead to these dangerous wave events.

I believe that an updated database of freak wave events is valuable to inspire more detailed studies on the physical mechanisms that lead to these events, but the manuscript falls short in many regards.

The database is only a marginal improvement compared to previously published literature. A similar database by the same group authors covers events up to 2018, I therefore don't think it is worth dedicating a full manuscript to this slightly extended period. I feel that maintaining a public accessible database would be more valuable.

How the database is compiled is not described/detailed. At line 86 authors mention "search engine", it would have been more helpful making the search engine publicly available, so that the output can be used and improved. However, no details on how the data mining process is conducted has been presented in the manuscript.

The analysis is poor, both in terms of statistical analysis of the dataset and possible biases in the search engine (i.e. how the dataset might be skewed towards "English-speaking" media, and how coastal areas and highly populated areas where more people might be likely to experience freak events) and the description of the results. For example the authors should have explored more the dataset. For example the high number of events in 2006 that exceed the mean yearly value by a large margin is statistically significant? Are these events clustered in a particular region? Or associated with a particularly strong system?

I also think that the explanation of the physical mechanisms likely to lead to freak events is not scientifically sound and consistent. The authors identify 20m depth as a threshold for freak waves events. If results are used to inform the analysis, this value should have been used to separate deep water and coastal areas.

For these reasons I think the manuscript does not satisfy the standard for publication. Specific comments are provided below.

### **Specific Comments**

In the abstract the authors claim that freak waves "occur without specific reasons", there is a very extensive research on the physical mechanisms that contribute to the formation of these events, and the authors later cite many of these works. The statement is therefore misleading.

The author states that all reported events resulted in ship or coastal/offshore structure damage and/or human losses. Isn't it obvious that events reported in the media are the ones that have had a high impact on human activities? And therefore only those that have caused damage and losses are reported. In summary there is a bias towards these events.

I wonder why the search engine has been extended to include media in other languages. Chinese and Spanish are the languages most widely spoken in the world, I think inclusion of these would have greatly improved the general purpose of the manuscript.

The year 2006 was an exceptional year, I would have expected a more detailed analysis. The deviation from the long term mean seems statistically significant.

At the end of section 2 authors state that most of the fatalities are in the open ocean. A more detailed analysis of fatalities per accident would have been carried out. In other words, how many of the accidents resulted in fatalities would have been a better representation. As the authors hint, most of the fatalities are associated with single

accidents that took many lives.

Authors discuss modulational instability focussing on wave steepness alone, the Benjamin Feir Instability (BFI) is also affected by the shape of the spectrum (bandwidth in both frequency and directions).

The threshold  $kh=1.363$  separates the focussing to the defocussing regime in unidirectional sea state; it has been shown that crossing seas instead lead to the formation of rogue waves below the threshold (and directionality stabilises modulational instability in deep water).

A correlation between freak events and wind speed is presented. Waves are not locally generated but their amplitude is better correlated to the fetch (in time and space).

No formula or discussion is presented for the gusts, but its obvious that if the formula is linear with respect to the wind speed, the correlation would be the same as for the wind speed. Moreover, correlations in deep and shallow water seem identical. Error bar on the coefficients should have been added and R2 value reported.

### **Technical Comments**

First line of the abstract a definition of rogue waves is provided and the authors state that "and cause human loss..." but this should be "and can cause ...". A definition of rogue waves is provided later on as twice the significant wave height, not all these waves have caused damage or loss. Only the reported ones.

The definition of the significant wave height, particularly in spectral wave models, is given as 4 times the square root of the zero-th order moment of the spectrum. The definition based on the mean of the highest third is now a bit outdated, and often substituted by the 4 times the standard deviation of the surface elevation.

Dates are not consistent across the manuscript.

References are needed (and quotation marks as well as well) when quoting media and reports [around line 70 and 100].

Line 132, why is an error of 10% accepted?

I also want to note that ERA5 reanalysis performs poorly in coastal areas with complicated bathymetry. The resolution is approximately 1degree, and therefore does not accurately reproduce coastal areas.

Individual waves can break well below the steepness 0.44, indeed sea states with a characteristic steepness of 0.12 have frequent breaking.

Line 141 and 142, dotes -> dots.

The authors refer to the kurtosis, but the one they report is the excess kurtosis.

The Conclusions do not provide any insight, critical comments. It reads a lot like a repetition of the previous sections.

Figures with shading limit readability (e.g. Fig 5 and 6). Color palette choice is not color-blind friendly.

Figure 7 would have benefitted from lines at various steepness to immediately identify the steepness of the event.