

Nat. Hazards Earth Syst. Sci. Discuss., author comment AC3
<https://doi.org/10.5194/nhess-2021-244-AC3>, 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Reply on RC3

Anna Pavlova et al.

Author comment on "Storm surges and storm wind waves in the Caspian Sea in the present and future climate" by Anna Pavlova et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2021-244-AC3>, 2022

Thank you very much for your comments.

you can find our responses to comments below:

"General comments and recommendation:

This paper aims at investigating storm surges and wind waves in the Caspian Sea over the last decades. It is based on a circulation model (ADCIRC) that can be coupled to a wave model (WAVEWATCH III and potentially another one named SWAN that is only briefly described). This article is scientifically well constructed and well presented. After the introduction, a description of the model and methods is included before the description of the results. More details could be included concerning the observational datasets used for model validation. The results and the discussion are sometimes merged in the same section. It could be clearer to separate the discussion from the results in another section. Interesting results are shown, with a quantification of the storm and wave intensities, their means, extreme values (including return periods) and potential trends. The results are innovative and merit publication. The manuscript should be rewritten with a strong attention to the grammatical form that limits the comprehension of the text. For more clarity, I would also recommend the use of tables to show the numbers directly included in the text, otherwise the text appears loaded with many numbers. The figure captions often lack information. Two other points need to be considered before publication: Figure 1 and 3 appear in a previous paper (Pavlova et al., 2020), with some text directly picked up from this publication. I would suggest summarizing the part common to this article already published. Second, the future prediction of storms based on CMIP5 only consider the storm changes related to changes of weather regimes frequency, in other words the dynamical changes related to atmospheric circulation. What about the thermodynamical changes impact on the storms? In other words, would it be possible to get stronger storms with the same frequency of weather type in a warmer climate? Maybe this question cannot be answered in this article, because it would require the use of a model chain using CMIP model output to force ADCIRC and WAVEWATCH in future projections, a work that has not been performed here if I understand well. Anyway, this should be discussed in the article.

After considering these general recommendations and the points presented below, a work that corresponds to major revisions, this article could be published in the journal."

Answer: The data and methods section will be supplemented and revised. Results and discussion will be split more neatly and tables of results will be added. In the introduction, we will describe our previous results from Pavlova et al. (2020)

We can say that launching marine models with CMIP5 climate projections is real, and even under different scenarios. The IPCC report from 2013 states that the thermodynamics of seawater with changes in air and water temperature will change (stratification of seawater, vertical mixing, currents, their intensity)

IPCC (2013). Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change / Edited by T. F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P. M. Midgley. - Cambridge University Press. Cambridge, United Kingdom and New York, USA. 2013.1535 p.

The same is confirmed in the forthcoming IPCC report for 2022. AR6 Synthesis Report: Climate Change 2022

<https://www.ipcc.ch/report/sixth-assessment-report-cycle/>

CMIP wind analysis has a 6-hour time step at best, which is not very good for simulating waves and surges, peaks are not captured there by the wind. Therefore, we chose the option with an indirect relationship between the frequency of storms and winds. But we can try direct calculations, perhaps in the future we will try to do this. In terms of thermodynamics, this means climate warming. The water temperature itself does not really affect the waves, only the wind speed. The question is very difficult whether there is a connection between an increase in air temperature and an increase in wind, climatologists believe that the climate will become more extreme with warming, but we have no concrete evidence in this work.

Point-by point list of comments:

Abstract:

- 12: SWH should be defined, for example in parenthesis after writing the corresponding words.

Answer: We will define all acronyms.

Introduction:

- 33: maximum depth to -> maximum depth of?

Answer: We will correct the mistake.

- 38: please reformulate

Answer: We will simplify and reformulate the sentence.

- 40 -> overlap other anthropogenic factors, knowing that the change of climate conditions is also attributable to anthropogenic factors.

Answer: That is right.

- 49: you could specify that circulation model refers to ocean circulation model here, and not to atmospheric models.

Answer: Thank you, we will specify this in the text.

- 55: The paper (Lopatuhin et al., 2003) -> unusual formulation

Answer: We will reformulate the text.

- 65: (Kudryavtseva et al., 2016) -> it is not needed to include this reference that is already used at the beginning of the sentence.

Answer: We will remove duplicates.

- 67-68: this sentence should be reformulated.

Answer: We will reformulate the sentence.

- 69-77: What is the limitation when using coarse gridded atmospheric data to force ocean and wave models? Is it possible to simulate wave with coarse gridded data, or is a downscaling approach required beforehand? More discussion about the model resolution would be welcomed.

Answer: Yes, we are doing linear interpolation of the rough wind to more detailed wave simulations and level simulations. To estimate the maximum wind waves - they are observed with the wind to the shore, that is, a rough description of the wind in the open sea is not so important a very detailed wind resolution of 20 km is normal. It's the same for extreme surges. For narrow bays less than 20 km wide with winds from the shore or along the shore, wind downscaling is needed, but this is a separate challenge, WRF must be used.

- 81: "The papers (Rusu and Onea, 2013)" could be replaced simply by "Rusu and Onea (2013)".

Overall, the word «paper» is a bit familiar whereas the use of study or article is more common.

Answer: We will correct this and use 'article' or 'study'.

- 93: «mean and extreme parameters» or «mean and extreme variables used to describe wind waves»?

Answer: Yes, We will correct this

Data and methods:

- 104: the use [of] the unstructured grids

Answer: We will correct this

- 139: GEN3 and KOMEN configurations with their parameters (cds, stpm, ect..) are not necessarily known by the reader. These should be explained in details, in the manuscript or in the supplement, or the text should be simplified excluding acronyms that cannot be understood by people that are not expert in these models.

Answer: We will simplify and reformulate the sentences.

- 158 to 169: the acronyms (e.g. ST6, IC0, JONSWAP, etc...) should be detailed or excluded. Another way to describe the model configurations would be to use a Table summarizing parameters, schemes, etc...

Answer: We will define all acronyms.

- 208: to investigating -> to investigate

Answer: We will correct this.

- 225: For these days sea level pressure -> For these days, the sea level pressure

Answer: We will correct this.

- 251 to 257: a table could be used to show the model considered in the study. More information related to these models could be shown, including the resolution for example. Is a spatial interpolation on a common grid is applied before the clustering analysis?

Answer: We will create a table for a more accessible understanding of the differences in models.

Results and discussion

- Where are the weather stations Teleniy Island and Makhachkala? their location could be shown on a map or at least their geographical coordinates should be given. The station measurements sampled at these locations should be described.

Answer: We will show the location of the stations on a map and describe the measurement data in more detail.

- Why only the years 2009 and 2015 are considered, and only for one of the station? Why not showing a scatter plots including all the years? The two correlation coefficients shown in Figure 3 are 0.87 and 0.88, so we do not understand where do come from the 0.79 in the text. Scatter plots for the Makhachkala station could be also shown.

Answer: We will show scatter plots for all years at both stations.

- Figure 1 and Figure 3 are already used in a previous publication (Pavlova et al., 2020), so this new article could be shortened with a reference to this previous article. Figure 1 might be reused because it shows the domain, but the evaluation shown in Figure 3 is exactly the same as the previous article, so the authors might consider excluding it from this new publication.

Answer: We will keep Figure 1 and remake Figure 3 for all years.

- How can we explain that the Figure 7 in Pavlova et al. (2020) show a 0.2 shift in the observation of the sea level as compared to those shown in Figure 4 of this new article?

Answer: In this new article, experiments with ADCIRC + SWAN were carried out separately for this case of surge occurrence, thus the average monthly reference level was taken in the experiments. In Pavlova et al. (2020), a conditionally average annual initial reference level was taken in the experiments. Due to the difference in the initial levels and the subsequent processing of the data in the case of annual experiments, a shift occurred.

- 283: it could be interesting to highlight the location of the Volga river in Figure 5.

Answer: It's a good idea, we will add the Volga river to the figures.

L 293: the sentence need to be reformulated.

Answer: We will reformulate the sentence.

- 305: please, reformulate the sentence (grammatical construction)

Answer: We will reformulate the sentence.

- 302 to 308: the sensitivity experiments used to differentiate the contribution of wind and pressure changes to sea level change should be detailed (maybe with a table), including information like the experiment lengths (several years? Full period, one event?) as well as the complete protocol.

Answer: We will revise this part of the text and make it more detailed and visual.

- 321: 1 point -> point 1

Answer: We will apply this change in the whole manuscript.

- 335: I would replace climate change by climate variability here, since this statement is verified both for long-term changes and variability at higher frequency.

Answer: We will correct this.

- 340: from 12 to 41 in the east (Fig.8) -> At point 6, the blue and green curves go below 5, isn't it?; « In the north, the values do not exceed 26. In case of surges of more than 1 meter, the maximum number of surges of up to 15 cases per year » -> It is not clear, which point are considered here?

Answer: We will reformulate the sentence and make it more clearly.

- 343: the discussion on intra-annual variability should be based on numbers, included in the text or preferably included in a Figure or a Table.

Answer: We will provide a more detailed discussion of the intra-annual variability.

Page 9: A table describing the mean numbers of surges of different magnitude (>0.5 , >1 , >2) for the different points, including variability, seasonal contrast and maximum/minimum values would be helpful in this manuscript.

Answer: We will create a table to describe the results more clearly.

Page 9: when including the Gumbel law for the distribution, the variable V should be defined as the parameters A and B. Same remark for "T" "m" and « где N » that need to be explained when giving in the relationship between the period of the frequency and the number of values.

Answer: We will define all parameters.

Page 9 and 10: The equations should be numbered as previously.

The equation considered to build the curves in Figure 10 should be mentioned in the text and maybe in the caption.

Answer: All equations for building 10 and 11 plots are mentioned. We will number the equations and link to them below in the text.

- 372: on the west – 2.6 m -> on the west + 2.6 m, isn't it?

Answer: This is a dash. We will correct this.

Figure 11: is the Gumbel law has been also used to build these maps?

Answer: Both figures 10 and 11 were plotted according to Gumbel law.

- 391: please reformulate the sentence.

Answer: We will reformulate the sentence.

- 409-410: "In our results, we have a maximum value of SWH 8.2 m, which can be transformed to 10.8 m of 3% probability of exceedance. » -> How is get this result?

Answer: The wave heights of 1% and 3% probability of exceedance were calculated as $1.51 * \text{SWH}$ and $1.32 * \text{SWH}$, respectively. We will add some comments to the manuscript.

L435: « the significant linear trend » -> how is estimated the level of significance?

Answer: The significance of trends was assessed by the F-test. The F-statistic is the standard significance test of the linear model. We will add some comments to the manuscript.

- 454: « Fig.16) » -> (Fig.16)

Answer: We will correct this.

- 456-457: This statement is not clear.

Answer: We will reformulate the sentence.

- 460: In he present climate -> In the present climate : I suppose that this refers to 1961-1990? That's not clear.

Answer: We will correct and clarify the sentence.

- 460-462: this statement is not clear.

Answer: We will clarify the sentence.

Conclusion:

- 476-477: please reformulate the sentence.

Answer: We will reformulate the sentence.

- 487: "The number of storms with the SWH ≥ 3 m » -> for more clarity, you could write "the annual number of storms..."

Answer: We will reformulate the sentence.

- 507: SWH o about 8.9 m -> SWH of about 8.9 m

Answer: We will correct this.

L 510: overestimates of the SWH.

Answer: We will correct this.

Data availability: following the FAIR protocol, the data should be available on an open platform, without the need to contact the authors.

Answer: At the moment, the data is on a closed server, but in the future we plan to transfer it to an open server.

References: please homogenise the format of the references

Answer: We will correct and homogenize all references.

Figures: all the Figures are well presented, but the figure captions should include more explicit details about the data and the methods used to build the curves and maps.

Answer: We will add details to the figure captions.