Response to the questions of reviewer one

First of all I would like thank the referee for his/her thoughtful comments, time and interest in the manuscript. I have put the referees comments in italics and my answers are given in plain text.

Hieronymus presents the sea level simulator v1.0 following the first official public release of the source code. The sea level simulator aims at providing the joint probability of mean sea level rise and sea level extremes which is crucial for coastal planning and future adaptation. This tool could be particularly useful for engineering purpose and decision-making.

The manuscript acts as a technical reference publication as stated by the author. The framework behind the sea level simulator is not new and studies using previous versions of it have previously been published (Hieronymus, 2021; Hieronymus and Kalén, 2022). This version offers some updates such as new mean sea level projections (based on Fox-Kemper et al., 2021) and the implementation of uncertainty in the GEV parameters for the extreme sea levels.

The second part of the paper focus on a particular site and shows how the model behaves based on different parameter choices. More importantly, the manuscript discusses what one can infer from the model outputs. For example, which physical process is the dominant at different time horizons; this has direct impact when designing new structures and their planning periods.

The code is written in Matlab and released under MIT licence. Having no access to a Matlab licence, I have not tested the code directly, but the Gitlab is easily accessible. Users could potentially adapt and change the routines thanks to the use of Matlab. The different functions seem relatively straightforward to read though some users might find difficult to follow due to the lack of comments and descriptions inside each Matlab file.

GMD seems to be a good fit for the manuscript considering the author aim to publish a reference technical publication on the sea level simulator. Considering the previous two peer-reviewed papers on the framework, the comments below are mostly minor but would make the paper easier to digest by readers.

General Comments:

A significant part of the paper looks at what one can infer from the simulator (is the extreme level or SLR level the key driver, at which time horizon, etc), but it's not mentioned in the abstract. I think it is a very interesting capability and a key aspect of the simulator as it will be part of the decision-process a user might look at. It should be a bit more highlighted.

Clearly this is an omission on my part. I will make sure to include a better description of the simulator's capabilities in the revised abstract.

As this paper should be viewed as a technical documentation, I think it would highly benefit from an extended Figure 2 where each step is associated with a sub-figure showing the raw time serie data, the GEV fits for extreme levels, the SLR scenarios, the sampling etc. It would really guide the reader. (I would also use more the word components / modules instead of nodes).

I will include such a figure in the revised manuscript, and use modules instead of nodes.

"An example probability range is shown in Tab. 1" line 138; it might be good to have some guidelines for a user in how to choose these probabilities. As shown in the second part of the paper, they do have an impact.

I will add a discussion and some references about how one can think about these probabilities.

I wonder if having another site with a potentially different behaviours or with different probability for the scenarios could be useful for a reader.

This is the only reviewer suggestion that I object to. The primary reason for this is that I believe it would be very hard to keep the article as a technical reference publication. I think it would almost certainly drift towards discussing interesting questions about how regionally varying oceanographic conditions affect flood risk. This is, of course, an interesting topic, but one that in my opinion deserves its own article. A secondary reason is that in the Swedish context this has already been done in Hieronymus & Kalén (2022), where six sites with very long observational records were simulated.

More extensive comments in the source would be beneficial to the users (mainly in emulator_ringhals_par.m, example_plot.m which seems to be the drivers); the associated set of functions are much more commented.

I will update both these scripts with additional comments.

The figures could be improved for better readability: none have a grid, the labels, ticks, and legends have generally small font size. I also believe showing the y-axis in term of return period would be more intuitive to a user / reader. This could be done on the right side with a twin axis for an example. The return period is stated in the text but shown in figure would be appreciated: "For example, a frequency of 104 means that one in ten thousand planning periods contain a sea level of this height."

I will update all figures in the revised version following the reviewers suggestions.

Specific Comments:

Line 80: "very close to the ideal"; does the model keep its scaling skills for 16, 32 cores?

My test computer only has four cores, but the answer is nonetheless almost certainly yes. That is, as long as you make a large amount of simulations so that each worker can get a significant workload. As mentioned in the manuscript the problem of running these simulations is, in fact, embarrassingly parallel so simulations can be run simultaneously on different computers and averaged afterwards. The overhead related to initialization, loading data and such is really small when millions of simulations are run.

Figure 2 caption: "is goes"; remove "is"

this will be fixed.

Line 100: "that reliably captures high frequency sea level variability"; maybe precise for the reader what "high-frequency" means so they do plug the right data to the model.

I will add a sentence about this.

Line 127-128: "These two scenarios have also low confidence projections, where the contribution from the Greenland and Antarctic ice-sheets to sea level rise is taken from some of the highest projections in the published scientific literature." A citation would be helpful here.

Citations will be added.

Line 145-147: I find this sentence not very clear.

I will rewrite it.

Line 157: it could be useful to precise which other distributions have been tested to know what does and doesn't work.

I expect that what works might be both site and scenario specific, so I am not sure one can generalize all that much from my experience. Especially since Swedish mean sea level projection are quite atypical. I will add some more details regardless.

Line 161: "This script is easily edited for use with different mean sea level projections"; can easily be edited ?

The sentence will be rewritten according to the suggestion.

Line 179: "For example, a frequency of 10^{-4} *mean that one in ten thousand planning periods contain a sea level of this height." Replace mean by means*

this will be fixed.

Line 183: maybe more "sea" than "ocean".

Indeed.

Line 186: It would be good to reference here some previous studies when discussing the stratification in the North Sea / Baltic Sea regions. A recent study I found that could help finding the most appropriate references https://esd.copernicus.org/articles/13/373/2022/

I will add some references.

Figure 8: what is the colorbar for? or is it lost in the middle of the dark dots.

I forgot to turn on the shading. The figure will be redrawn of course.

Figure 8: I might misread the figure but why the extreme levels impact reduces with longer sea level maximum for different length of planning periods? Why not constant.

You are reading it correctly. The reason is simply that when the planning period is short the joint sea level (i.e. mean+extreme) is almost equal to the extreme contribution. The mean sea level simply does not change that much in any projection between 2020 and 2050 and the only way to get say a 3 m joint sea level event is to have an extreme sea level of almost 3 m (a very unlikely extreme at Ringhals). Conversely, when your planning period is very long, mean sea level change can be sizeable in many different projections and percentiles. Therefore, there are many more combinations of mean and extreme in the 2020-2150 planning period that gives a 3 m joint sea level that contain a large mean sea level contribution and a more average extreme contribution than the opposite.