Comment on nhess-2021-329

Anonymous Referee #3

Referee comment on "Storm surge hazard over Bengal delta: a probabilistic–deterministic modelling approach" by Md Jamal Uddin Khan et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2021-329-RC3, 2021

The manuscript by Khan and co-authors addresses the problem of storm surge hazard assessment over Bengal delta. They propose a hybrid procedure that combines high resolution numerical simulations, ensemble modelling, and probabilistic analysis. Their results are of high interest for coastal risk planning in this region both for present-day and future climate conditions.

Main comment

The manuscript is well organized and the presentation of the methods and results are very clear. The conclusions are sound. I very much appreciate the efforts made by the authors to discuss their results with respect to existing studies and to the limitations of their work (Sect. 5). My background is mainly focused on statistics. Therefore I won't comment on the modelling part (Sect. 2). Regarding the statistical aspects, a few aspects should be clarified and further elaborated before publication. Therefore, I recommend additional corrections by incorporating, if possible, the following recommendations.

1) Return level estimates

1.1. The authors stress several times in the manuscript that the estimate of the return period of the water level is 'robust'. I agree with them that with a dataset representing more than 5000 years of cyclone activity, robustness should be achieved for estimating 100-year return levels. However, for a 500-year return level, some statistical uncertainty could still affect the result. This should be analyzed more carefully. As far as I understand the procedure, the authors calculate the empirical percentile using the results of the ensemble ('ranking-based statistical analysis' as indicated in line 321). I would expect the authors to calculate some confidence intervals, for example using bootstrap approaches; in particular, the results in Figure 8 should be further discussed in relation to this

additional uncertainty estimate. An additional interest is to support the discussion in Sect. 5.3, in particular for the comparison with the study of Leijnse et al. who provides such uncertainty estimates.

1.2. A second aspect is the comparison of return levels to observed surge levels during cyclones. Could the authors consider the relevancy of using the surgedat dataset to this aim? http://surge.climate.lsu.edu/data.html

2) Population exposure

I appreciate the efforts made by the authors to discuss the limitations of their approach. In addition to the limitations raised in Sect. 5.6, could the authors also consider / discuss the use of alternatives population dataset. For instance, the Global Human Settlement Layer - Population Grid r2019a has a spatial resolution of 9 arc sec, and the WorldPop Global High Resolution Population Denominators has a spatial resolution of 3 arc sec. See references below.

Florczyk, A. J., Corbane, C., Ehrlich, D., Freire, S., Kemper, T., Maffenini, L., Melchiorri, M., Pesaresi, M., Politis, 1715 P., Schiavina, M., and others: GHSL data package 2019, 29788, 290498, 2019

Lloyd, C. T., Chamberlain, H., Kerr, D., Yetman, G., Pistolesi, L., Stevens, F. R., Gaughan, A. E., Nieves, J. J., Hornby, G., MacManus, K., Sinha, P., Bondarenko, M., Sorichetta, A., and Tatem, A. J.: Global spatio-temporally harmonised datasets for producing high-resolution gridded population distribution datasets, Big Earth Data, 3, 108– 1780 139, https://doi.org/10.1080/20964471.2019.1625151, 2019.

3) Use of JTWC dataset

3.1. As far as I understand the use of JTWC dataset for Fig. 4 is not a validation per se but the objective is to show the consistency of the ensemble results. However we note some discrepancies in Fig. 4(b) and (c) that deserve some additional comments or clarifications. In particular, the frequency for April drastically differs between JTWC and the ensemble approach. Adding some errorbars to these histograms may here also help nuancing these differences.

3.2. Is JTWC dataset used to estimate the average annual frequency of 0.70314 (indicated in line 285)? If so, please specify.

3.3. On page 19, in line 400, the authors state that 'This landfall pattern corresponds to previous observations that the landfalling cyclones in the Bangladesh coastline tend to move north-eastward'. Is this result also confirm by the analysis of the JTWC dataset?