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Review and rebuttal of the paper

Lessons learned from the Katrina storm surge and the development of storm surge disaster prevention in Japan

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Editor handling the paper: Jeremy D. Bricker

The reviewers remain anonymous.

Review Round 1

Reviewer A

(Comment) This paper introduces briefly the concepts of disaster management of storm surges (and tsunamis) in Japan, which was learned from the hurricane Katrina in 2005 and the Great East Japan Earthquake in 2011. Re-examination of the strategy to protect lives and properties from such extreme waves considering the climate change and sea-level rise are of interest of potential readers of the journal.

Although I am not a native speaker, I think the English writing of the paper is not comfortable and sometimes quite confusing for readers. The texts need adequate translation from original language (Japanese) to English together with appropriate choice of words and phrases commonly used in this specific research field. I strongly recommend to send the manuscript to a professional proofreading service to polish the English writing.

(Answer) The authors would like to thank the reviewer for the time taken to review the manuscript, and the many constructive comments. The authors agree some expressions were at time not the best, and have thoroughly checked the manuscript again to ensure that the English is up to the highest academic standard.

The purpose, novelty and outcome of the research is not much clear (just to reflect lessons learned from Katrina and outline reconstruction philosophy after the 2011 Tohoku earthquake?). Readers may expect to find implications or future challenges emerged from the lessons learned from the hurricane Katrina and the Great East Japan Earthquake. Consider to explicitly describe concisely such key findings at relevant section or paragraph.

The authors would like to thank the reviewer for this comment. The authors added the following phrases to the abstract: *“The present short communication will reflect on lessons that were learned by Japanese coastal engineers and disaster risk managers from Hurricane Katrina, together with those from major Japanese disasters that have taken place in recent times, such as the 1959 Ise Bay Typhon and the 2011 Tohoku tsunami.”*

Please find the attached PDF for other specific comments (concerns). Sections related to coastal embankments, hazard maps, evacuation planning and reconstruction patterns need substantial improvement to enrich the content and value of the paper.

The authors would like to thank the reviewer for the comments given on the pdf. All comments were incorporated into the revised manuscript (in track changes mode, so that it is possible for the reviewer to check what was changed). Some of the comments from the pdf are further elaborated on below:

-Section 5 Please introduce more details about the understanding of failure mechanism of the levees due to the 2011 Tohoku tsunami and following technical improvements summarized in earlier documents and papers. (For my understanding, the general design has been summarized by the Ministry of the Land, Infrastructure and Tourism based on findings from coastal engineering papers).

The following sentence was added to the text: “further details about the failure mechanism regarding levees were investigated through laboratory experiments, which led to the designs of the improved levees, see Suwa et al., 2018”

-Section 6. I could not understand why the authors want to contrast prefecture with municipality using the words ‘however’ and ‘although’.

Indeed, that was incorrect phrasing. The sentences were changed to *“It is the role of municipal-level authorities to plan the evacuation of residents based on such estimates. For this reason, both of these administrative levels are supposed to publish forecast maps, and those by municipal-level authorities include the location of shelters and evacuation routes.”*

-Section 7. Please add some recent references related to the agent-based simulations of disaster evacuation.

Several references were added to that paragraph.

-Section 8. So far the subsections (8.1-8.4) just introduces some facts related to several different reconstruction approaches. Consider to summarize the advantages (success) and disadvantages (failure) of each approach, and derive implications from the comparison.

The reviewer indeed raises a very important point. However, such an evaluation is difficult to conduct at present, as there are no clear cases of success or failures at present. What is presented in these subsections is based on the results of consensus formation meetings in the specific areas. It will take another ten year or more to evaluate the success or failure of the various projects, and the true test will come when another significant tsunami affects the region, and a meaningful evaluation of how the interventions contributed to the long-term sustainability of the region can be made.

The following sentences were added to the text: *“It should be noted that the reconstruction philosophy was based on the results of consensus formation meetings in each areas. From a long-term development perspective it remains difficult to judge the long-term success of these projects, given the complex interaction between infrastructure development, socio-economic dynamics in a rapidly aging society, and the need to protect against future tsunamis (see Valenzuela et al., 2019). Likely, such interventions can only be truly judged the next time a major tsunami affects the region.”*

-Section 8.3. Readers may be interested in the relevance of this approach with the Katrina case.

Agreed that this section was a little short. The following sentences were added to reflect on this: *“The permanent conversion of low-lying urban areas into open, non-residential spaces exemplifies a form of managed retreat (Esteban et al., 2015), which openly contrasts with the post-Katrina emphasis on large structural defenses. When thinking about the regions affected by Hurricane Katrina, retreating from highly vulnerable areas would have reduced reconstruction costs by removing assets from the most flood-prone locations, while creating multifunctional buffer zones (such as parks or areas designated for open field sports).”*

-Section 8.4. Readers may be interested in the relevance of this approach with the Katrina case.

The authors provided a bit more thought on lessons learned about this, and added the following sentences: *“The deliberate withdrawal of residents from a large residential area is not something that is easy to do, and in the context of Katrina would have required careful advance planning, equitable buyout and compensation schemes, and strong community engagement to overcome legal, social and political barriers tied to property rights and place attachment. Given that following a disaster it is typically difficult for communities and political leaders to take any course but that of rebuilding, it can be useful to conduct pre-disaster recovery workshops, which can prepare plans on how an area would be rebuilt following a major event (Florentin et al., 2021).”*

-References. Almost all references seems to be the works by the author’s group. I’m not sure whether this is appropriate for a short communication.

Indeed, this is certainly true. This manuscript was an invited short communication.

Reviewer B

General comments:

The authors present a communication on lessons learned purportedly from Hurricane Katrina (20 years on) for the development of storm surge protection. Lessons learned from storm surges in Japan (namely 1959 Ise Bay) and the 2011 Tohoku-oki tsunami are also presented, which I feel tend to overwhelm the lessons learned from Katrina. This may not be surprising that Japan learnt more their own disasters than one in the U.S., however, since the title, abstract and introduction mostly focuses on Katrina, it's a bit strange to read through the rest of the paper and not find that many references to Katrina. Of course, I understand that this a special issue on Katrina, so the narrative is being forced somewhat.

(Answer) The authors agree that the focus is indeed a bit more on Japanese disasters. Nevertheless, a couple of extra paragraphs were added to section 8.3 and 8.4, adding some extra reflections:

“The permanent conversion of low-lying urban areas into open, non-residential spaces exemplifies a form of managed retreat (Esteban et al., 2015), which openly contrasts with the post-Katrina emphasis on large structural defenses. When thinking about the regions affected by Hurricane Katrina, retreating from highly vulnerable areas would have reduced reconstruction costs by removing assets from the most flood-prone locations, while creating multifunctional buffer zones (such as parks or areas designated for open field sports).”

“The deliberate withdrawal of residents from a large residential area is not something that is easy to do, and in the context of Katrina would have required careful advance planning, equitable buyout and compensation schemes, and strong community engagement to overcome legal, social and political barriers tied to property rights and place attachment. Given that following a disaster it is typically difficult for communities and political leaders to take any course but that of rebuilding, it can be useful to conduct pre-disaster recovery workshops, which can prepare plans on how an area would be rebuilt following a major event (Florentin et al., 2021).”

I would suggest to the authors to try to refocus the article on the development of storm surge disaster prevention in Japan *and* lessons learned from disasters. The Japanese disasters should be at least on equal footing to Katrina in the front narrative. As well, I suggest to be more explicit about the truly unique features of Katrina that influenced storm surge disaster prevention in Japan in ways that the Japanese disasters did not.

Agreed that the framing of this short communication was not the best. The authors modified the abstract slightly, which now reads: *“The present short communication will reflect on lessons that were learned by Japanese coastal engineers and disaster risk managers from Hurricane Katrina, together with those from major Japanese disasters that have taken place in recent times, such as the 1959 Ise Bay Typhoon and the 2011 Tohoku tsunami.”*

Similarly, some sentences were added to the end of the introduction: *“What made Hurricane Katrina particularly instructive to Japanese engineers, beyond Japan’s own historical typhoon and tsunami experience, was the systemic failure of urban flood protection and emergency response within a highly engineered (albeit maybe not properly maintained infrastructure) but socially complex setting. This highlighted the importance of levee robustness, redundancy in defense systems, maintenance of infrastructure, and equity considerations in evacuation and recovery—issues from which Japanese engineers gained many lessons.”*

Specific comments:

1. Page 2 L27-30: Sea level rise is surely also relevant to add here as a contribution to higher water levels from climate change.

Agreed, this was added to the sentence.

2. Page 3 L11: some references on long-term sea level rise expectations for Japan would be relevant to add. And sea level rise is not really because of increased SSTs, it's because of overall increased heat content of the ocean and glacial ice melt etc.

Agreed. The sentence was modified to *“Firstly, it is known that as the climate warms, sea level will rise (due to thermal expansion of the oceans and glacial melt) and typhoons are likely to become more intense, mainly due to the rise in sea surface temperatures around the Japanese islands (Nakamura et al., 2020).”*

References were also added (Hirchsfeld et al., 2023, 2024)

3. Page 3 L13: additional references should be added. For example, Shimura et al. (2022) actually show a decreasing trend of storm surge due to projected reduced frequency of typhoons, and large variability in trends of 50-yr return water levels.

Ref: Shimura, T., Pringle, W. J., Mori, N., Miyashita, T., & Yoshida, K. (2022). Seamless Projections of Global Storm Surge and Ocean Waves under a Warming Climate. *Geophysical Research Letters*, 49(6), e2021GL097427. <https://doi.org/10.1029/2021GL097427>

The authors would like to thank the reviewer for this insight. The following sentence was added to the text: “Nevertheless, it should be noted that some simulations show a projected reduced

frequency in typhoons, and large variability in the trends of 50-yr return water levels. (Shimura et al., 2022)."

4. Page 3 L18-24: This paragraph needs references.

The paragraph was rewritten, with additional references being provided.

5. Page 3 L25-26: "various typhoon paths are being modeled based on past experience and recent cases, and numerical forecasting calculations are being used to predict future storm surges and high waves": being modeled and used by whom?

This sentence was rephrased to *"To address this, Japanese researchers have modelled various typhoon paths are being modeled based on past experience and recent cases, and numerical forecasting calculations are being used to predict future storm surges and high waves."*

6. Page 3 L34: "engineers are required to prepare": required by whom? Can point to relevant documents on this?

This sentence was rephrased to *"Nowadays, engineers are required need to prepare for unforeseen disasters by utilising numerical forecasts, which should include future consequences of global warming and the application of imaginative judgment to anticipate conditions beyond past experiences or what is written on disaster manuals."*

7. Page 4 Figure 2: I don't see the "three sides" of the coastal embankment. Isn't this just a photo of the landward side?

The top of the photo shows a little bit of the forward side, but the authors agree that these words are slightly misleading. Hence "the three sides" was deleted from the text.

8. Page 5 L9-16: It would be useful to add a figure illustrating the hazard map and a hypothetical on how it could differ slightly in reality.

The authors agree that it would be good to conduct to compare hazard map and real result, for example for the case of the Noto tsunami. However, the authors could not find any such research conducted to date. The authors will endeavor to conduct such research in the future.

Recommendation: Revisions Required

Review Round 2

Reviewer A

The added paragraphs to introduction and sections 8.3, 8.4 on Hurricane Katrina specifics are nice. Other comments are well-addressed. I recommend accept based on these revisions.

Recommendation: Accept Submission

Reviewer B

The authors revised the manuscript considering the comments provided by the reviewers. Most modifications made are appropriate, and the manuscript has much been improved. I added some very minor comments and corrections. The manuscript is ready for acceptance with considerations of these comments.

Recommendation: Revisions Required

The authors would like to thank the second reviewer for the careful revision of the revised manuscript. All modifications made by the reviewer (in track changes mode) were accepted. Many of these were minor changes, and only those with the more significant comments will be explicitly addressed below.

Page 4. Glue is an adhesive material. It is not relevant to the context. I guess this is a mistranslation of a Japanese word 'omote-nori' used in the field of civil engineering. [omote: front, nori: adhesive material (glue)]

The words “front glue” were deleted from the manuscript.

Page 5. I think assumptions are introduced when people develop a numerical model and prepare input parameters to the model. Results (simulations) reflect the assumptions. I suggest to remove this phrase.

The phrase was amended as per the suggestions by the reviewer.

Page 8. A comment on the nuance for 'deliberate'. As far as I know, the relocation happened on Arahama was decided by the city government. After that, local people organized an assembly to discuss how to respond. The assembly finally broke up into two, due to confrontation between people who wanted to move and who didn't. It looks the course was not deliberate.

https://www.huffingtonpost.jp/entry/news_jp_6045b411c5b69078ac6c637c

Agree with the reviewer that actually the reality is always quite complicated. The authors thus felt it better to delete the word “deliberate” from the manuscript.