Response to Reviewers

Title: Understanding the Compound Flood Risk along the Coast of the Contiguous United States

Author Response 2nd revision

Reviewer 1

Reviewer Comments:

R1C1:

L39-42: I think the definition of the now-called statistics and dynamics-based approaches is still not clear enough from the outset. Specifically, the authors write that statistical-based CFRA defined the CF hazard as the frequency of a CF event. Could the authors clarify the difference with how dynamics-based CFRA would define CF hazard? Additionally, dynamics-based CFRA is defined to represent spatiotemporal variabilities of CF drivers -> what 'spatiotemporal variabilities' are meant that cannot also be captured with a statistical analysis is also unclear. As these definitions play an important role in the paper, I think it is important that they are made more clear. Perhaps the denominators 'statistical' and 'dynamic' are not 100% satisfactory after all as the authors also contrast the methods in terms of them considering only the CF hazard v.s. the CF risk.

Author Response:

We appreciate the reviewer comment. In the revision, we rephrased "dynamics-based" to "hydrodynamics-based", which is a more accurate (despite less generalized) term representing the method based on numerical model simulations and fits better for this manuscript.

The hydrodynamics-based CFRA is used to assess the CF exposure. This is mentioned later as (L78-79): "The CF hazard and exposure evaluated separately by the aforementioned statistics-based or hydrodynamics-based CFRAs may produce inconsistent results (K. Xu et al., 2022)." We apologize for the confusion and have rewritten this sentence to improve clarity.

"Hydrodynamics-based CFRAs use numerical simulations that can represent human exposure to CF events with considering the spatiotemporal variabilities and interaction of CF drivers."

R1C2:

L395-396: "The choice of a specific CFRA depends on the local characteristics of the study area and the specific requirements of local flood planning and management." Could the authors please give some examples to substantiate this remark?

Author Response:

Thanks for the comment. The discussion of flood planning and management is a separate topic and is not the focus of this manuscript. To avoid confusions, we decided to remove this sentence.

R1C3:

L438: "The broader definition of CF can be expanded to include the interaction between CF drivers and climate drivers" I am unclear why the definition of compound flooding needs to be expanded to study changes in CF due to climate change. Could the authors please clarify this in the text?

Author Response:

We apologize for the confusion. We were trying to explain that CF is affected by climate change with its drivers interacting with climate drivers. This sentence is rephrased to improve clarity.

"CF hazard and exposure can also be impacted by climate change as CF drivers interact with climate drivers."

R1C4:

L439-441: "Global warming will likely increase the frequency of extreme precipitation (Alfieri et al., 2016), the intensity of river discharge (Bermúdez et al., 2021) and storm surge (Camelo et al., 2020), and the duration of the fluvial and coastal flooding (Feng et al., 2022)" - please specify in which regions, as this is not true everywhere?

Author Response:

We agree that this may cause confusions and have added "in many regions" and an example of US east coast to generalize the impact of global warming:

"Global warming will likely increase the frequency of extreme precipitation (Alfieri et al., 2016), the intensity of river discharge (Bermúdez et al., 2021) and storm surge (Camelo et al., 2020), and the duration of the fluvial and coastal flooding (Feng et al., 2022) in many regions, such as the US east coast (Ting et al., 2019)."

R1C5:

L445-447: why necessarily using ESMs? Or do you mean that more research on the impact of climate change on CF is needed?

Author Response:

Yes. We rephrased this sentence to

"Given the uncertainty of climate change, more attention should be paid to understand the potential impacts of different socioeconomic pathways on the CF risk."

R1C6:

L454-455: "The reanalysis forcing typically covers a shorter period (e.g. from 1979 to 2018) and thus may underestimate extreme events, such as TCs." -> I think this needs some rephrasing to say that statistical

analyses based on such periods may lead to unreliable estimates of the return frequency/probability of TCs

Author Response:

Thanks for the suggestion. This sentence is rephrased as suggested.

R1C7:

L457-L64: this discussion is about the quality of ESMs which isn't obviously connected to the limitation of your study in terms of period length. Do you mean that you would use ESMs to analyze historical CF risk as these offer simulations with longer periods than reanalysis data? Please clarify.

Author Response:

Thanks for your comment. This is exactly one advantage of running ESMs that offers longer-period simulations. This is clarified in the revised manuscript:

"ESMs, which can simulate CF drivers for longer periods than reanalysis data, can be used to analyze historical CF risks."

The other advantage is that ESMs with enhanced capabilities at resolving the extreme events at the coastal zone could potentially provide improved simulations than the available reanalysis dataset. This was mentioned as "Moreover, high-resolution cloud-resolved ESMs show promising performance in representing extreme events (Caldwell et al., 2021), which can help the hydrodynamics-based CFRA quantification."

Textual comments:

R1C8:

L7: 'statistics-based statistical analyses': double statistic, suggest to reword

Author Response:

Agree. This is rephrased to "statistics-based analyses".

R1C9:

L116: 'at the basin to global scales': replace with "which can be applied at basin to global scales"?

Author Response:

This is corrected as suggested.

R1C10:

L123: 'and archives daily output are archived for analysis': needs to be reworded

Author Response:

Sorry for the typo. This is corrected to "and daily outputs are archived for analysis".

Caldwell, P. M., Terai, C. R., Hillman, B., Keen, N. D., Bogenschutz, P., Lin, W., Beydoun, H., Taylor, M., Bertagna, L., and Bradley, A.: Convection‐permitting simulations with the E3SM global atmosphere model, Journal of Advances in Modeling Earth Systems, 13, e2021MS002544, 10.1029/2021MS002544, 2021.

Ting, M., Kossin, J. P., Camargo, S. J., and Li, C.: Past and future hurricane intensity change along the US East Coast, Scientific reports, 9, 7795, s41598-019-44252-w, 2019.