The manuscript by Pianosi et al. proposes a framework to analyse the sensitivity of large-scale flood models, taking into account the most relevant sources of uncertainty. In particular, the framework aims at reducing the complexity of the analysis while maintaining the significance of results.

I appreciated the opportunity to review this work. It's good to see a collaboration between academic and private sectors and I believe the topic is of high interest for the scientific community working on large-scale flood models.

Having said so, I have some remarks mainly regarding the application of GSA to the two case studies.

Reply: Thanks for appreciation of our paper and constructive criticisms that are very useful to improve our manuscript.

Main points

- *The authors do not describe the JBA flood loss model but do provide some references to past works. However, my impression is that the outcomes of the application examples might be influenced by some modelling assumptions (see my following points) and therefore I would suggest including at least a short description of the JBA model.*
- *Uncertainty in hazard maps: previous studies have shown that hazard maps from large-scale flood models might show limited changes in flood extent and depths across return periods. For example, the 1-in-50-year and 1-in-100-year flood maps might be similar (see Bernhofer et al. 2018, and Aerts et al. 2018). If this is the case for JBA model, this might explain why this parameter has a limited importance in GSA outcomes. Moreover, the authors should explain how flood protection standards are considered in the model, given that they are a major component of hazard map uncertainty (Paprotny et al 2025).*

Reply: Thanks for raising these important points, which we will add to the case study discussion in the revised manuscript.

In brief, an uncertainty analysis and GSA of flood hazard maps was conducted internally, though not yet published, which guided our thoughts on the return period (RP) uncertainty bounds. The key result from the internal study was that maximum flow rate and DTM uncertainty were the biggest contributors to flood map depth uncertainty. Hazard maps also varied in extent with RP. How much the depths and extents increase with RP is largely determined by the underlying topography, but also other parameters play a role, including the hydrological inputs and surface roughness. As for the flood protection standards, these are taken into account within the model calculations. Specifically, if an asset falls behind a flood defence and is affected by an event with return period lower than the standard of protection (SOP) of the defence, the asset is considered fully protected and no flooding is expected to occur. If instead the return period exceeds the defence SOP, the flood model calculates the volume of water that exceeds the flood defence and can cause flooding via a growth curve approach (Kjeldsen, Jones and Bayliss, 2008).

In the revised manuscript, we will improve the description of the model with these clarifications, we will highlight (particularly in Table 1) that our analysis does not consider uncertainty in the representation of flood defences, we will discuss how these choices may have led us to underestimate flood hazard uncertainty and its influence on risk estimates, and put in context of literature, including the references suggested by the reviewer.

Kjeldsen, T.R., Jones, D. A. and Bayliss, A.C. (2008) Improving the FEH statistical procedures for flood frequency estimation. Science Report SC050050, Environment Agency

- *- Uncertainty ranges in Table 1: the ranges of exposed values and damage functions applied in GSA come from a previous work by Sarailidis (2023). This is fair enough, however, the assumptions and limitations of the study by Sarailidis should be better explained. For instance, my understanding is that Sarailidis obtained the range of damage ratio reported in table 1 by perturbing the values from multiple damage functions found in literature, which in my opionion might lead to overestimate the uncertainty associated to this parameter. Given the outcomes of GSA for the Rhine case study, it is important to communicate that these outcomes might be influenced by this and other assumptions.*

Reply: Thanks for this point and we can surely extract some more details from Sarailidis (2023) and expand the description of the ranges in the manuscript. We also agree that the definition of these ranges is critical and having used very large ranges (which, however, are reflective of the high level of uncertainty in vulnerability curves!) makes it somewhat unsurprising that vulnerability comes out as the most influential source of uncertainty. This is also why we explored the idea of answering an “inverse” question: how much should we reduce uncertainty ranges of the vulnerability functions in order to see other factors become important? This is what Fig. 5b attempts to do. We can reinforce this discussion in the Outlook and Conclusion

Minor points:

- *Abstract: The authors begin with "Flood loss models are increasingly used in the (re)insurance sector to inform a range of financial decisions." I would add that flood loss models are increasingly important also in research, (for instant, to understand present and future risk trends as discussed in Ward et al., 2015), as well as in policy support (see for instance the PESETA programme, https://joint-research-centre.ec.europa.eu/projects-and-activities/peseta-climate-change-projects/jrc-peseta-iv/river-floods_en). This would highlight the relevance of the present study beyond the insurance sector.*

Reply: Thanks, an important point that we should add in the Abstract and the Introduction.

- *One of the main outcomes is the relevance of vulnerability functions in driving model uncertainty, I believe this should be mentioned in the abstract.*

Reply: The Abstract was focused on the methodological contribution of the paper, and applications are only mentioned as 'proof-of-principle' illustrations though we agree that the fact that vulnerability functions consistently emerge as key driver of uncertainty is per se an interesting result and could be highlighted in the Abstract.

- *Reference list: missing title for Galloway et al (2025)*

Reply: Thanks for spotting! The title is "Catastrophe risk models as quantitative tools for climate change loss and damage: A demonstration for flooding in Malawi, Vietnam, and the Philippines". We will correct the reference.

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