Reviews for MS #: hess-2024-9 Quantifying cascading uncertainty in compound flood modeling with linked process-based and machine learning models by Muñoz et al.

This paper deals with uncertainty quantification of compound flooding due to four primary sources of uncertainty (i) Initial condition (ii) forcing uncertainty and lastly (iii) model responses stem from model parameters and structures. For this, a set of hydrodynamic model scenarios were run to quantify the individual and total uncertainty sources. A few places, the analysis requires attention in terms of Methods implemented, otherwise it is written well. Therefore, I suggest major revisions for this manuscript. My comments on the manuscript are as follows:

A. General Comments:
1. Line 42: CF events in low-lying areas are typically associated with tropical or extra tropical cyclones for which rainfall-runoff, wind-driven storm surges, total coastal water level including wave set-up and tidal variations, or all of the events concurrently or in a close sequence contribute to the severity compound events (Ganguli & Merz, 2019a; Ganguli & Merz, 2019b).

2. Line 117: multi-model ensemble methods: Kodra et al. (2020) proposed empirical Bayesian model that incorporates skill and consensus based weighing framework to narrow down uncertainty associated with large ensemble of earth system models in the projected climate.

B. Typing errors:
3. Line 221: unstructured finite volume grid that consists of triangular 'elements' and not the 'cells'?

4. Line 228: The word, 'in' appeared twice.

5. Figure 6 caption: Effect of individual sources of uncertainty. (a,b) initial condition, (g,h) model structure

6. Line 578: both agrees well with slope of the regression estimate. A linear regression yields two: slope and the intercept terms.

C. Technical Comments:
7. Line 245-247: The discharge from the lake upstream and river gauge downstream are estimated simply the sum of two random variables. However, since both random variables are independent, the derived distribution can't be a simple sum – here convolution methods needs to be implemented to quantify sum of two continuous random variables: https://dlsun.github.io/probability/sums-continuous.html

8. Line 91: Chezy's formula that is dependent on surface roughness, Reynold's number of fluid in contact and the mean hydraulic depth.

9. Line 336: 1:1 fit line to be fit of the linear regression

10. Figure 5: In flowchart: Also shows assessment wrt other machine learning methods.

11. Lines 425-430: The comparative assessment with other machine learning methods should also be presented in supplementary.

12. Line 437: How outliers are identified?

13. Sub-section heading 3.1: Effects of Individual and Aggregated Uncertainty

14. Line 513: Why the results of scenario S5 is shown in the Supplementary? It should be presented in the main text. Instead of cascading effects of the sources of uncertainty, the correct term would be total uncertainty considering all four sources that propagate in the system

15. Figure 7: Simply Pearson's *r* would not be suffice given highly nonlinear relation between individual and total uncertainty, please consider Kendall's tau instead.

16. Table 4: No results shown for scenario S5. How the 95% confidence bounds are obtained in Table 4-please explain in Table footnote.

17. Line 544: Pearson's *r* doesn't give you rank. Only non-parametric methods are based on rank order transformation. For the former case, *r* is parameter.

18. One of the crucial steps in uncertainty quantification is narrowing down of uncertainty envelop & the identification of such method that can credibly narrow down the uncertainty. However, no such analyses were presented.

19. Line 613: A PB-ML to outperform ordinary linear MLR is pretty obvious. The assessment wrt other machine learning models should also be discussed.

References

Ganguli, P. Merz, B. (2019a). Trends in compound flooding in northwestern Europe during 1901-2014. Geophysical Research Letters. 46(19), 10810-10820.

Ganguli, P. Merz, B. (2019b). Extreme coastal water levels exacerbate fluvial flood hazards in northwestern Europe. Scientific Reports 9(1), 13165

Kodra, E., Bhatia, U., Chatterjee, S., Chen, S., Ganguly, A.R. (2020). Physics-guided probabilistic modelling of extreme precipitation under climate change. Scientific Reports 10(1), 10299.