The manuscript proposes a flexible framework for the attribution of the uncertainties associated with joint exceedance probability estimates of river discharge -coastal water levels. The framework is demonstrated at a case study site on the west coast of Sweden. Copula family and the dataset chosen to represent river discharge are found to exert the largest influence on the estimates. The manuscript is overall well written, topical, and the results are interesting, however, I do have several reservations about accepting in its present form. Key literature is missing, the discussion section is subpar, and the novelty of the study is debatable.

Thank you for your review and many helpful comments to improve our study. According to our knowledge, the novelty of this study comes from the sensitivity analysis focusing on the influence of using different data sources in this particular context of compound coastal flood. Our conclusion highlights the need for communicating uncertainties depending on datasets used in such analysis. For example, in places where local data are unavailable, the use of available global data as input can result in large results biases which therefore can lead to rather important impacts for coastal applications and management. We hope our responses given below marked in red as well as our changes in the manuscript have helped to address these issues.

Updated references for section 2.1.1 have been made due to final adjustments to the now published methodology presented in Dubois et al. (2024).

General comments

Title is misleading since no river mouth water levels are calculated.

We agree and have adjusted the manuscript by changing the title as follows: “Influence of data source and copula statistics on estimates of compound flood extremes in a river mouth environment”.

The first paragraph, although not incorrect, is odd in the sense that it stresses that heavy precipitation, storm surge and runoff can be caused by different weather conditions when a key rational for the statistical dependence is that the flood drivers are forced by the same large scale weather conditions.

We think, your comment relates to our miscommunication with this first paragraph as our communication aimed to introduce different processes that could result in floods while keeping in mind that we are further interested in compound events forced by the same large-scale weather conditions as you mentioned. We therefore adjusted it to clarify it (lines 25-30).

A more detailed description of the “Weighted Average” and a “Maximum Density” approach in the MhAST toolbox is required for readers unfamiliar with the toolbox.

The paragraph mentioning the description of those 2 approaches (Lines 223-231) has been extended for readers unfamiliar with the toolbox.

I do not understand why there is an entire section on univariate (oceanic and fluvial) flooding when the investigation is about compound events. The return levels in the boxplots (Figure 6) are not estimates of the 5- and 30- year fluvial events, they are the fluvial component in bivariate events with those return periods. I am unsure as to whether the bivariate and univariate return periods should be compared and whether

statements such as “Moreover, the RL uncertainties for the “Maximum Density” approach are all located within the 95th confidence interval of the univariate RL.” are meaningful.

As the common practice for stakeholders is based on univariate flooding, we believe it is important to implement it within this type of study. Moreover, we think it brings a certain understanding of the datasets and increases the readability of the paper when it comes to the framing of this study, especially when it later comes to comparing the different data source influences. We agreed and precise our caption (figure 6 and figure A.1) which was missing clarity.

We do not think the bivariate and univariate should, in this study, be directly compared (lines 251-253). However, we think both approaches provide important information especially when investigating uncertainty as presenting results from both can bring a more comprehensive idea of the role of uncertainties in that particular context.

The discussion should compare the findings with other similar studies, see Lucey and Gallien (2022) and Santos et al. (2021) for starters.

We agree with you that comparing our findings with other studies is relevant and we therefore followed your suggestion so we added sentences referring to previous work to stimulate the discussion (lines 279-280 -> Bevacqua et al. (2017) / lines 392-393 -> Santos et al. (2021) / 423-425 & 451-453 -> Lucey and Gallien (2022) / 426-428 -> Bai et al. (2020) / 453-456 -> Latif and Simonovic (2023)).

Specific comments

L13: Statistical copulas do not give a measure of flood risk (at least not directly).

We agree and have adjusted the manuscript by adding the word “indirectly”.

L35: There are a great many other studies that examine the dependence between river discharge and storm surge at sites in Europe that should be cited here (e.g., Hendry et al. 2019, Ward et al. 2018).

Thank you for your comment, we have adjusted the manuscript accordingly (lines 41-46).

L35, L71 and elsewhere: Be careful to specify that these “interactions” refer to their co-occurrence probabilities and not physical interactions. This would be a good place to introduce frameworks that link statistical and numerical models to account for joint exceedance probabilities and physical interaction to locate the stretches of river where compound flooding is an issue (e.g., Moftakhari et al. 2019, Gori et al. 2020, Jane et al. 2022). Studies such as Couasnon et al. (2020) and Moftakhari et al. (2017) only carry out statistical modeling and therefore only assess the “potential for compound flooding”, they do not determine “impacts from compound flooding” either in terms of estimating water level or computing inundation depths.

We agree and specified that these interactions refer to their co-occurrence probabilities, at least when we introduce this word the first time. We focused on the already introduced references as we only looked into the statistical approach and therefore the “potential for compound flooding” but we agree that such literature is relevant to add and can improve

the clarity to this study. We then have adjusted the manuscript to clarify this point (lines 87-92).

L46: Reference required.

This paragraph was focused on the study from Bevacqua et al. (2019). I then added the reference there too and added some precision to the physical processes studied.

L73: Sentence implies there is a single annual maximum value for each year but of course each year will possess a different annual maximum value.

Thank you, you are correct. We added a sentence to clarify and report the range of variation in annual maximum values.

L76: Technically since the distributions are continuous this would be an “exceedance probability”.

Thank you for your comment, we then adjusted the manuscript accordingly.

L79: “variable” or “driver” is potentially more accurate language than “factor”.

We agree and have adjusted the manuscript changing “variable” by “driver”.

L81: Is “potential for compound events” more accurate than “a potential compound event”.

We agree this is more accurate and have adjusted the manuscript.

L98: What was the other dataset used in the correlation analysis? Also change “statistically insignificant” to “not statistically significant”.

We agree and have adjusted the manuscript. The other dataset used in the correlation analysis is primarily the observations river discharge and then the E-Hype and S-Hype models. This is introduced later in the paper.

L167 & 169: Could say “paired” instead of “used” as the latter is “used” a lot throughout the paper!

We agree and have adjusted the manuscript.

L170: Move references to the end of the sentence.

We agree and have adjusted the manuscript.

L185: Null hypothesis in such tests is usually that the correlation coefficients are zero indicating it is reasonable to assume the variables are independent.

Indeed but we still think it is interesting to briefly check the Null hypothesis when possible.

L213: “Adopting the “AND scenario” (see above) permitted us to investigate the dependency between sea level and river discharge during extreme events.” The “OR” HS also allow this!

We agreed and therefore clarified this point that we have been interested in looking into the risk of compound events only (AND scenario) and used this opportunity to look into the dependency between both variables. We rewrote this sentence as follows “Adopting the “AND scenario” (see above) permitted us to investigate the risk of compound events only highlighting the dependency between sea level and river discharge during extreme events.”.

L237: “In the following, we mainly focus on the “OR scenario” yet in the next paragraph, only the “AND scenario” is discussed! Justification for the “OR scenario” is poor here. By “compound flood risk driven regardless of the situation (oceanographic or hydrological)” I believe you mean you’re interested in compound risk and risk from the oceanographic only and hydrological only events.

We agreed and rewrote to clarify it as follows “In the following subsection 3.1, we look into the “AND scenario” as we investigate the compound risk only. In the subsections 3.2 and 3.3, we mainly focus on the “OR scenario” (see above) as we … ”.

L245, 337: The term “superposed” implies a decision taken by the practitioner “do not overlap” maybe a clearer description.

We agree and have adjusted the manuscript.

L272: “The BB1 copula fit has a 5-year RL of 220 m3/s.” is not correct the BB1 copula fit will have many discharge values associated with a 5-year RL, that depend on the corresponding sea level.

We agreed and rewrote as follows “The BB1 copula fit has a 5-year RL “most likely scenario” of 220m^3/s”.

L272: What copulas are you referring to here?

We are here referring to all the copulas fits we have tested for. We slightly rewrote the sentence to clarify this point as follows “Among all tested copulas, their 5-years RLs …”.

L296: Please explain what the higher return levels are being compared with.

We agreed this sentence is somewhat vague and lacks clarification, we decided to delete “with higher RLs when considering the compound effects” from it as our goal is to highlight that the copulas and uncertainties present similar behaviour.

L335: “more significant effect on estimated RLs” more significant effect than what?

This refers to switching data sources that may have a more significant effect on estimated RLs than switching method approaches but we agreed it can lead to confusion and we deleted the word “more” to avoid such confusion.

L339: Consider re-writing: “This similarity stresses the idea that river discharge predominates over sea-level inputs.” Since the phrase “stresses the idea” is sort of ambiguous furthermore I wonder whether “dominates” is more suitable than “predominates”.

We agreed and rewritten this sentence as follows “This similarity emphasizes that river discharge dominates over sea-level inputs”.

L349: “This study focuses on extreme hydrological events associated with oceanographic conditions and, therefore, concentrates on the RLs of river discharge.” I do not understand the point trying to be made here!

This point might create confusion but aims to direct the reader towards the fact we are looking into RLs of river discharge “only” even though we are studying compound events and we could look into its associated sea level component as well but because we only noticed a significant correlation for annual river discharge and associated sea level (table A1),.we consider the river discharge as the main variable to focus on.

L371: “results” is ambiguous. Is this the “most likely” event?

We are here relating the word “results” to the fact that the choice of sea level records has a lower influence than the one of river discharge. We therefore decided to change the word “results” by the word “findings”.

L417: “The opposite dependency” is a strange turn of phrase.

We agree and deleted the word “opposite” which might create confusion.

L424: Consider changing “The choice of copula has a similar magnitude of its influence on return period statistics as the choice of river discharge input for most of the twelve sets tried” to “Copula choice has a similar influence on return period statistics as the river discharge input for most of the twelve sets tried”.

We agree and have adjusted the manuscript accordingly.

Appendices: Change “,” to “.” (decimal places).

We agree and have adjusted the manuscript.

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