Dear Referee,

Thank for you for the comments and valuable feedback. Please find the attached document addressing each of your points and highlighting any corresponding modifications. We believe these changes greatly enhance the paper.

Regards,

Joshua Green on behalf of all authors

1) Figure 1 (a–b): very simple schematics is shown contributing pluvial and fluvial floods. The contribution from groundwater/baseflow in runoff generations are not shown. Also, there is no schematics for runoff generation mechanisms, such as Hortonian overland flow and the saturation excess overland flow that potentially controls runoff mechanisms.

In this review we consider pluvial, fluvial, and coastal flood processes as the three main drivers of flooding in coastal and estuarine environments; around which we have structured the introductory section. While groundwater/baseflow certainly plays a role, we assigned it to the category of 'other drivers' detailed in Section 3.2. The schematic diagram in Figure 1 is only intended to include the three main drivers (as introduced on page 5) and an example of their compound interaction.

2) Lines 143–148: All these examples show cases from the US. The review should have global coverage, including low-latitude and developing countries that are more vulnerable to such natural hazards due to low adaptive capabilities.

We assure the referee that this review does have global synthesis, and in numerous places (particularly Section 6.1) address flooding in low-latitude and developing regions. As an example, in the introduction (Section 1) we mention several recent devastating storm-induced compound flood events and event series that impacted developing countries, namely 2019 East Africa Tropical Cyclone Idai (Madagascar, Mozambique, Zimbabwe, and Malawi) as well as the 2019 Pacific Typhoon Season (East and Southeast Asia). Section 6.1 discusses hotspots and spatiotemporal patterns related to compound flooding for a number of low-latitude and developing regions, including southeast Africa as well as south, southeast, and east Asia.

The sentences referenced (lines 143-148) come in the middle of the introduction (Section 1) in which we highlight the growing public awareness of compound flood events in recent years. Here we chose to use Hurricane Harvey as an example of compound flooding due to its global recognizability with readers, the event's particular role in shifting perspective towards compound events, and finally the large volume of compound flood research dedicated to this particular event should the reader wish to look at additional literature. Only one example was provided here, and thus all the references were for this event, which so happens to be in the US.

3) Lines 158-163: Guan et al. (2023) have presented a synthesis paper on compound pluvial- fluvial model and highlighted the importance of including damage models for risk management.

Thank you very much for bringing this paper to our attention. We have included this paper in the introduction (Section 1) where we discuss any existing review-style literature on compound flooding.

4) Lines 257-259: A multivariate storm event with peak and volume also qualifies for compound event as they are tied together with dependence framework. Refer to Leonard et al. (2014) for details.

We agree that a multivariate storm may be considered as a compound event according to Leonard et al. (2014) as its components would exhibit dependence.

The lines referenced (257-259) are within the paragraph of Section 2 discussing the definition from the IPCC SREX (Seneviratne et al., 2012). Here we emphasize the aspect of 'event clustering' as this is explicitly stated in the IPCC definition (unlike Leonard et al. 2014).

The following paragraph (lines 268-277) addresses Leonard et al. (2014) within which we do discuss the requirement of dependence. An example 'non-compound event' is given involving independent atmospheric river rainfall and snow-melt induced river discharge. At your request, we will also provide a 'compound event' example' (according to Leonard et al. 2014) using a multivariate storm event involving dependent variables (line 275).

5) Line 320: its seasonal shifts rather than 'weather seasons'.

We have modified this sentence as advised.

6) Line 323: Fluvial flooding also depends on topography, urbanization controlling runoff and infiltration mechanisms due to impervious surfaces, soil texture and structures, catchment size.

Yes, we agree that topography and urbanization play an important role in controlling runoff and infiltration. We believe that the later mentioned properties have already been captured in the text, with land cover addressing 'impervious surfaces', soil type covering 'soil texture and structure', and the existing mention of catchment size.

We have now added in 'topography' and have changed 'soil type' to 'soil properties' to encapsulate all relevant soil characteristics.

7) Lines 330-339: Infiltration excess process - mostly results due to limited hydraulic capacity of drainage systems, which act as a weir or orifices, depending on the water depth surrounding the system. The urban flood duration depends on capacities of drainage systems, infiltration capacities of soil and evaporation of catchment & runoff volume. Refer to Mark et al., (2004).

We recognize that further citations could be provided for this paragraph. We have referenced Mark et al. (2004) and Bronstert et al. (2023), as well as further developed the discussion of rainfall-related saturation excess and infiltration excess.

8) Line 362: Groundwater flooding, 'a temporary rise'.

Flooding from groundwater can occur on a range of timescales. While groundwater flooding certainly has the potential to be a short-term process, water table levels may change seasonally over the span of several months. In many glacially-fed watersheds, groundwater rises for several months in the spring and only lower in the subsequent fall (e.g. glacial/coastal British Columbia, Melone 1985). Furthermore, given the ever-changing climate we cannot be certain that groundwater levels in a region will always return to previous levels. We do not feel that it is appropriate to suggest that groundwater flooding in general is 'temporary'.

9) Line 396: The role of catchment wetness for flood generation process was shown for a large tropical (Ganguli et al., 2019) and mid-latitude (Merz et al., 2018) catchments.

We have now included Ganguli et al. (2019) in this section.

10) Lines 397-400: Here relative humidity plays a role. Extreme dry heat beyond certain temperature often leads to moisture limitations/drying, leading to dry spell. Refer to Fig. 2 in Ganguli and Merz (2024).

We have now mentioned the role of relative humidity and increased precipitable atmospheric water.

11) Lines 400-402: Wildfire often triggers landslides due to changes in mechanical properties of the soil --> debris flows and flash floods. The complete event chain should be described. Refer to (Belongia et al., 2023; Monga and Ganguli, 2024).

Yes, we agree that wildfire often create conditions that are highly susceptible to landslide events (in addition to flooding). This is in fact mentioned in parts of Table 1 (De Ruiter et al. 2020; Gill and Malamud 2014).

We have cited Belongia et al., 2023; however do not feel that Monga and Ganguli, 2024 is appropriate given the scope of this section. We fully recognize the relationship between fires and landslides, however feel that this deviates too greatly from the flooding focus of this paper. There is no clear boundary at which point a flood becomes a debris flow and vice versa, and this review does not address the relationship between flooding and landslides. We do not wish to distract too greatly from the main topic of the review and therefore will not be discussing landslides.

12) Lines 509-513: South Asia in general and India as an example, is underrepresented here. Although a few recent studies have been available recently. For example, (Ganguli et al., 2019; Ganguli and Merz, 2024; Khatun et al., 2022; Mohanty et al., 2020).

Yes, despite flooding being a paramount issue in the region, the systematic literature search only uncovered 8 papers on coastal compound flooding specific to South Asia (6 India, 2 Bangladesh, 0 Nepal, 0 Sri-Lanka). As of present, the vast majority of published compound flood literature focuses on the Global North. This a key finding of this review, and the limited geographic coverage of research is highlighted in Recommendation 2. As this review was limited to English-written literature, it is unknown if there is substantial published research on compound flooding in South Asia in the respective local languages.

Ganguli et al., 2019 – While this paper addresses flooding, it is not primarily about compound flooding and thus does not adhere to the literature selection methodology outlined in Section 4.

Ganguli and Merz, 2024 – As detailed in the Section 4 methodology, the synthesis and analysis component of the review only considers papers for the literature database up to the year 2022. As this paper was published in 2024 it is not considered within the scope of this review

Khatun et al. 2022 – This study is already included in the review analysis.

Mohanty et al., 2020 – This paper was missed during the literature search process. It has now been added to the literature database and the analysis figures and statistics have been recalculated and updated throughout the paper. Thank you for sharing.

13) Lines 518-520: A few journals were not included, which regularly publishes articles on compounding flooding, Geophys. Research letters, Earth's Future, Environmental Research Letters, NpJ Climate & Atmospheric Sciences.

For the sake of brevity, the referenced sentence only lists the top 5 most frequent journals. Geophysical Research Letters, Earth's Future, and Environmental Research Letters are in fact all noted in Figure 4. One paper from Nature Climate & Atmospheric Science (Ridder et al. 2022) was included in this paper, but not listed, as Figure 4 was limited to publication sources with at least 2 papers to ensure readability.

14) From page 35: Line 627: Khatun et al. (2022) analyzed joint pluvial-fluvial compound flood extremes along the Mahanadi catchment, which is close to coast.

The line referenced (627) discusses pluvial-fluvial extremes in the 'North America' subsection of Section 6.1. We have instead correctly referenced Khatun et al. (2022) in the 'Asia' subsection following your suggestion in Comment 15.

15) Page 37: lines 679–688: pluvial–fluvial flood drivers are well established for Mahanadi River basin catchments (Ganguli et al., 2019; Khatun et al., 2022) and three geographically diverse flood-prone coastal catchments in western and eastern catchments of India (Mohanty et al., 2020).

We have included these references in the section discussing pluvial-fluvial findings. Furthermore, we have added several additional citations to papers focused on South Asia (Sampurno 2022, Pandey 2021, Ikeuchi 2017, Shahapure 2010, Vongvisessomjai and Rojanakamthorn 1989).

16) Line 836: … German dyke breach led to a compound inland pluvial – damming/…

Thank you for bringing this to our attention. This indeed appears to be a non-coastal paper as it focuses on interior central Germany. To ensure a consistent systematic review methodology, we have removed Thieken et al. (2022) from the literature database. Upon this finding, we have meticulously gone through the literature database and identified two addition papers (Mohor et al. 2020; Sui and Koehler 2001) that both focuses on compounding in interior/southern Germany. Thus we have removed three papers total.

As Thieken et al. (2022) and Mohor et al. (2020) were the two main examples of compounding involving damming/dam-failure, we have done considerable further literature searching and have identified two damming/dam-failure compound flooding papers that appropriately take place at the coast (Kim and Sanders 2016; Yang et al. 2021). These two papers have now been added to the literature database, and this paragraph of the review has been rewritten.

Following these changes, all the figures and literature database analysis have been recalculated and corrected throughout this review.

17) Page 44: Line 860: Lucey and Gallien (2022) showed that although annual maximum sampling is commonly used for characterizing multivariate events, annual maximum sampling may substantially underestimate marine water levels for extreme events.

We are unsure what the referee wishes us to address here. The referenced sentence (line 860) discusses the projected increased frequency of flood drivers due to climate change, while the referee's comment is about uncertainty associated with annual maximum sampling approaches.

As these two topics are unrelated, we wonder if the referee meant to address the Statistical Methodology Subsection (6.5.2) which mentions the use of maximum sampling. We have now discussed this finding in the appropriate section.

18) Lines 872: Using a time-dependent statistical model on tide gauge data along U.S. and Pacific Basin coastlines, Sweet et al., (2024) showed that extreme coastal water level probability distributions shift on an annual basis, with shift higher & lower with tide cycles, climatic pattern & SLR. Likewise, Hague and Talke (2024) showed that changes in tidal amplitudes generally have a much larger impact on flood frequencies than equivalent share of changes in storm surge magnitudes.

We have added in several additional references and further developed discussions around climate-driven shifts in flood seasonality and the changing roles of individual coastal components.

19) Line 880: … combination of heavy precipitation events, SLR, tidal cycles, and …

This sentence has been modified as advised.

20) Line 978: Heinrich et al., (2023) analyzed the joint occurrence of extreme river discharge events and storm surges in northern and central Europe. Likewise, in line 988: to identify rivers that show a higher number of compound flood events than expected by pure chance, Heinrich et al. (2023) utilised a Monte Carlo approach.

Thank you for sharing these publications. As detailed in the Section 4 methodology, this review only considers papers for analysis and addition to the literature database up to the year 2022. As both of these papers were published in 2023, they are not considered within the scope of this review.

21) Line 1002: at a standard significance level

This sentence has been modified as advised.

22) Lines 1002-1006: they can describe event coincidence analyses, including precursor coincidences.

We have added a few sentences on event coincidence analysis following the discussion of joint probability.

23) Line 1051: However, reanalysis records has their own limitations for not adequately capture several variables, such as specific humidity, windspeed and their directions, including extremes are often under-represented.

We have added further discussion, addressing the limitations of climate reanalysis and statistical event set generation.

24) Lines 1305 and beyond: recently, Feng et al. (2024) developed multi-scale coupling framework within the Energy Exascale Earth System Model (E3SM), integrating global atmosphere and land with interactively coupled river and ocean models using variable meshes to simulate tide and storm surges during the CF events.

Thank you for sharing this publication. As detailed in the Section 4 methodology, this review only considers papers for analysis and addition to the literature database up to the year 2022. As this paper was published in 2024 it is not considered within the scope of this review. However, there are two other appropriate compound flood publications that demonstrate the use of ocean-land-atmosphere coupled modelling systems that we will reference here (Saleh et al. 2017; Blanton et al. 2018).

25) Page 64: Recommendation 5: they should discuss about an ensemble forecast systems, considering river-ocean interactions, including coastal backwater effects. Refer to my comment above.

We have briefly mentioned ensemble forecasting and ocean-land-atmosphere coupled modeling systems in the subsections for Recommendation 4 and 5.

26) Table A.1 include recent references and as stated earlier in general Asia and Australia are under-represented in their write-up. Whole focus is on either US and Europe.

We are excluding more recent publications as the scope of this review paper was limited to the year 2022. Section 4 of this paper details the methodology used for literature search and literature database paper selection. While it would be nice to have included 2023/2024, this is sadly not feasible given the substantial amount of resources that would be required and the limited time constraints of the authors. We hope the reviewer can understand the need to maintain a consistent methodology. Note that this review does reference general papers published in 2023 for the purpose of supporting arguments, however none of these papers are part of the analysis or included in the compound flood literature database.

We assure the referee that there is considerable discussion on Asia and Australia throughout the review and considered in analysis. Nonetheless, we have gone through and provided a few more examples in several places. As of present, the vast majority of published compound flood literature focus on the Global North. This a key finding of this review, and the limited geographic coverage of research is highlighted in Recommendation 2. This review does not seek to emphasize any geographic region over another, and merely aims to provide an understanding of the current state of research.