Reply to the Reviewer

Re: Manuscript ID Preprint egusphere-2025-262
"Review article: Rethinking Preparedness for Coastal Compound Flooding: Insights from a Systematic Review"
Dina Vanessa Gómez-Rave, Anna Scolobig, Manuel del Jesus
Natural Hazards and Earth System Sciences - NHESS

Response to Reviewer 1
We would like to thank Professor Cosmina Albulescu for providing a rigorous and insightful review that helped us identify key areas for improving the focus and conceptual consistency of the manuscript. Each of her comments has been carefully considered, and we describe below how they will be addressed in the revised version.

Review Report

The review paper called *"Rethinking Preparedness for Coastal Compound Flooding (CF): Insights from a Systematic Review"* aims to explore how preparedness strategies are growing to be more integrative and how governance and stakeholder collaboration enhance adaptive approaches. The paper can contribute to the literature on coastal compound flooding preparedness upon undergoing some terminology corrections and restructuring. My main concern relates to the unclear differentiation between drivers and hazards, which results in considerable and recurring confusion in the manuscript. This issue may have introduced uncertainty into the search and filtering protocol in the literature review.
I commend the authors on their research efforts. Please find below the review comments aimed at enhancing the clarity and impact of the paper.

We acknowledge that some inconsistencies in wording may have previously led to confusion between "drivers" and "hazards." However, the revised manuscript now clearly articulates the conceptual distinction, grounded in the typology proposed by Zscheischler et al. 2020, where compound events arise from combinations of multiple climate drivers and/or hazards. In the case of coastal compound flooding, this distinction is now explicitly operationalized as the interaction of physical drivers (e.g., rainfall, storm surge) that give rise to a hazard (e.g., flooding).

Our revised study maintains its focus on climatic drivers, reflecting their growing relevance in the context of climate change and their central role in compound event analysis. As noted later in the manuscript, this scope also justifies the exclusion of events such as tsunamis, which are non-climatic in origin and fall outside the methodological foundation of the review.

The search and filtering protocol itself has not been modified; rather, the revised manuscript clarifies the underlying rationale behind it. To improve clarity and avoid ambiguity, terminology is now introduced early in the Introduction (from Line 32 onward), with appropriate citations, and has been carefully reviewed for consistency throughout the manuscript.

As now stated in the Introduction, the following passage defines the distinction more clearly:

"...Drivers encompass processes, variables, and phenomena in the climate and weather domain—such as precipitation, temperature, river flow, coastal water levels, atmospheric humidity, soil moisture or wind speed—that may operate across multiple spatial and temporal scales. Hazards, in contrast, denote the immediate physical phenomena—such as floods, heatwaves, or landslides—that may trigger impacts when they coincide with exposure—the presence of people, infrastructure, or ecosystems in harm's way—and vulnerability—their propensity to suffer damage or loss due to limited capacity to anticipate, cope with, or recover from the event (Koks et al., 2015; Zscheischler et al., 2020; IPCC, 2023). The interplay among these components can result in compound risks, arising from single extremes or co-occurring events affecting critical

systems or sectors (IPCC, 2023). This conceptual framing provides a basis for analysing how interacting climatic conditions can evolve into complex events—and how their consequences ripple through interconnected systems."

Abstract

- **The reader should be provided with the number of reviewed studies, as well as some details about them (time period, spatial scope, for instance).**
- **The findings noted at lines 13–20 should be reframed to be more coherent, as they currently miss a red thread.**
- **The aim noted in the Abstract differs from the one stated in the Introduction ("This review explores how preparedness strategies are evolving to integrate technical, environmental, and social dimensions while evaluating the role of governance and collaboration in enhancing adaptive approaches."). It is unclear to me what type of preparedness (against what) do the authors investigate. Adaptive approaches to what? The framing here is rather vague.**
- **Line 9: the drivers listed here are actually hazards (except for river discharge, which is not even a driver).**
- **Line 10: sectoral silos is an unclear term.**

The abstract has been revised to include the number of reviewed studies, their spatial and thematic focus, and to ensure consistency with the aim stated in the Introduction. It now specifies the type of preparedness addressed—strategies targeting compound flooding in estuarine and coastal areas—and explains that adaptive approaches refer to measures dealing with interacting climate-related drivers. The distinction between drivers and hazards has been refined to reflect current terminology in compound event literature. The findings have been reorganized to enhance coherence and narrative flow, and the term "sectoral silos" has been replaced with "limited cross-sectoral coordination," as commonly used in the literature to describe institutional fragmentation that hampers integrated responses (e.g., Oseland [2019]; Sakic Trogrlic and Hochrainer-Stigler [2024]).

The revised version, incorporating these adjustments, now reads as follows:

Tackling the growing risks of Compound Flooding (CF) requires transformative preparedness strategies, particularly in estuarine and coastal regions, where the interaction of drivers such as storm surges, rainfall, and river discharge exacerbates impacts. Despite progress, fragmented governance, weak cross-sectoral coordination, and the limited integration of scientific insights hinder effective responses. This systematic review draws on 49 studies to explore how preparedness strategies are evolving to integrate technical, environmental, and social dimensions while evaluating the role of governance and collaboration in enhancing adaptive approaches. Hybrid Early Warning Systems combining statistical and hydrodynamic models with real-time data are critical for forecast accuracy and timely decision-making. Similarly, balanced implementation of green, blue, and gray infrastructure provides sustainable responses, with Nature-based Solutions complementing traditional engineering. Our results also show that strengthening governance and communication is essential to improve preparedness. Involving communities in land-use planning, building regulations, and communication ensures that measures are both actionable and context-specific. Incorporating psychological and behavioral data into preparedness frameworks and models helps strengthening the link between awareness and behaviours. Enhanced coordination across sectors and levels of government is also vital to addressing the systemic nature of CF risks, moving beyond siloed, single-hazard responses.

Graphical abstract

- **What do the authors mean by "a primary hazard that triggers ripple effects"? Isn't this phrasing redundant with cascading impacts?**

- **I recommend reordering the outcomes based on their importance. The current order seems rather random.**

The expression "a primary hazard that triggers ripple effects" has been revised to avoid redundancy with the concept of cascading impacts and to improve terminological precision.

While we acknowledge the suggestion regarding the ordering of outcomes, we view these elements as interdependent pillars of preparedness rather than components of a strict hierarchy. Nonetheless, minor adjustments have been made to enhance the narrative flow and thematic coherence in the graphical abstract, as shown below:

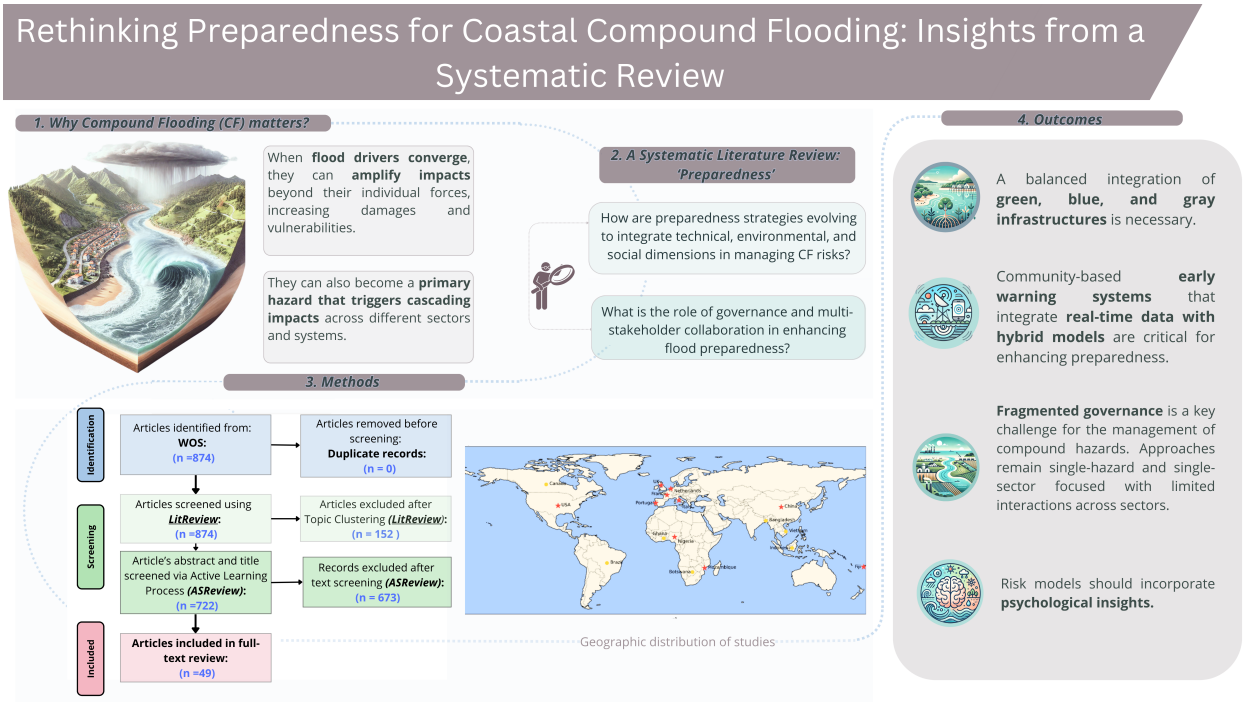

Figure 1: Graphical Abstract. Modified to reflect reviewer feedback.

Introduction

- **Line 26 ("The greatest risks from a changing climate may not come from individual impacts") contains a logical error considering the terminology of impact and disaster risk as proposed by UNDRR. Please revise the definitions of these terms and modify accordingly.**

  We have revised the sentence to align with the terminology used in the UNDRR framework and in recent compound event literature (e.g., Zscheischler et al. [2020]), which emphasizes the interaction of multiple drivers and/or hazards.

  The updated version reads (Line 25):

  "The greatest risks from a changing climate may not arise from single hazards, but from the interaction of multiple climatic drivers and/or hazards that intersect with diverse forms of exposure, intersectional socio-economic and geopolitical vulnerabilities, and multiple types of human response—often exceeding existing response capacities Simpson et al. [2023]"

- **Line 27: What are intersectional vulnerabilities? The term is rather confusing in this context.**

  The use of the term "intersectional vulnerabilities" follows the framing adopted by Simpson et al. [2023], where risks from a changing climate are described as emerging from the nexus between compound hazards, exposures, and overlapping forms of vulnerability. In this context, "intersectional" does not refer to a specific theory or framework, but rather captures the way in which multiple social, economic, and geopolitical factors combine to shape differentiated levels of risk. We use the term to emphasize that vulnerability to compound flooding is not evenly distributed, but it is often amplified for those at the intersection of disadvantage. To improve clarity, the revised manuscript now makes these forms of vulnerability explicit, while retaining the original terminology, which remains in line with the cited source and conveys a key dimension of risk complexity (see revision for Line 26 for context).

- **The authors should clarify from the beginning what they call a driver. Is this term interchangeably used with hazard, as shown at lines 29 and 40? I do not recommend using them as synonyms, but to always clearly specify if they refer to a hazard or the driver (of what, of CF as a hazard)?**

  As Prof. Abulescu rightly points out, it is essential to distinguish between drivers and hazards. Following the terminology proposed by Zscheischler et al. [2020], we clarified in the revised manuscript that our work focuses on climatic *drivers*, as the underlying meteorological, hydrological, or oceanographic conditions—such as heavy rainfall, storm surge, and river discharge—that may act independently or in combination to give rise to a hazard. *Hazards*, in contrast, are the resulting events with the potential to cause damage—such as compound flooding in coastal and estuarine areas, where the multiple climatic drivers interact and exceed natural or built drainage capacities.

  Coastal areas encompass a wide range of geomorphological settings, including beaches, cliffs, estuaries, and deltas—zones where both marine and terrestrial processes converge. In such environments, the occurrence of flooding is not solely driven by marine conditions (e.g., storm surge or high tide), but also by land-based contributions such as river discharge.

  The distinction is now introduced early in the manuscript (from Line 32 onward), and terminology has been revised to ensure consistency throughout. As mentioned in our general response to the *Review Report*, the revised version incorporates a formal definition of drivers, hazards, and their interplay within compound risk settings.

- **I recommend rephrasing the research questions in a clearer way (1st question – dimensions of what?; 2nd question is rather blurred and it is not a question per se). Reaching the Methodology section, I see that the questions are clearly formulated here, but they should also be written like this in the Introduction.**

  We appreciate this observation regarding the formulation of the research questions. In the revised version, we reworded the questions in the Introduction to align with the more precise and structured version already presented in the Methodology. The first question now explicitly states which dimensions are being addressed, while the second has been reshaped into a proper interrogative form with a more defined scope. These changes contribute to a more consistent and well-structured narrative throughout the manuscript.

  The updated paragraph in the Introduction now reads as follows (Line 104):

  "This study presents a systematic literature review that critically examines how FRM practices are evolving to address the intricate challenges of CF in coastal areas—regions where the interplay of vulnerabilities and flood drivers increases risks. The analysis centers on two guiding research questions:

  i) *i. (RQ1) How are preparedness strategies evolving to integrate technical, environmental, and social dimensions in managing CF risks?*

  ii) *ii. (RQ2) What is the role of governance and multi-stakeholder collaboration in enhancing flood preparedness?*"

- **The authors do not specify how gaining answers to the 2 proposed research questions will contribute to the development of adaptive frameworks: "By addressing these critical issues,**

this study seeks to contribute to the development of adaptive frameworks that strengthen resilience and enhance preparedness in the face of complex and evolving CF risks".

This point has been addressed in the revised manuscript through a new paragraph that outlines how the two research questions contribute to the development of adaptive preparedness frameworks. The text emphasizes the conditions shaping preparedness and identifies key levers for more flexible, context-sensitive responses.

The revised paragraph now reads as follows (Line 110):

"By addressing these questions, the study advances the development of more effective preparedness frameworks by analysing how strategies are being reshaped in response to CF risks across diverse coastal contexts (RQ1), and by improving understanding of the role of governance and collaboration in these processes (RQ2). This approach offers a grounded understanding of the conditions that enable or hinder anticipatory action, not as abstract goals, but as practices embedded in specific institutional and socio-environmental settings. Rather than proposing prescriptive solutions, the paper identifies key levers and recurring patterns that can inform more flexible, integrative, and context-sensitive responses. In doing so, it helps bridge the gap between conceptual debates and the operational realities of managing climate-related threats in increasingly complex risk landscapes."

Methodology

- **Line 163–164: "By examining these integrations, we assess how well they address the complex and compounding risks associated with multiple flood drivers." – what does this assessment involve? Is there a clear framework for assessing the degree to which the listed elements address the CF risk involving multiple flood drivers?**

  The updated version now specifies that the assessment is interpretive, identifying recurring patterns and tensions in how integration is framed and how it responds to the complexity introduced by multiple interacting drivers, rather than relying on a predefined framework.

  The sentence now reads as follows (Line 193):

  "... It examines how this integration is framed and how it responds to the complexity introduced by multiple interacting drivers. Instead of evaluating these strategies against a predefined framework, the analysis identifies recurring patterns and tensions within the broader context of FRM."

- **Upon reading section 3.1., it is unclear to me the time period targeted by this literature review.**

  We acknowledge that the time period covered by the review was not clearly stated. The search did not impose a restriction on the starting year; all records available in the Web of Science (WoS) database up to September 2024 were considered. This clarification has been added to Section 3.1. The paragraph reads (Line 208):

  "... No start date limit was applied; all records available in the WoS database up to September 2024 were included in the review ..."

- **Please check Table 1 for typos.**

  Table 1 has been carefully reviewed, and all typos or inconsistencies have been corrected in the revised version.

- **Why were studies on tsunamis ("disasters such as tsunamis and earthquakes, which were beyond the scope of this work") beyond the scope of this work, if they related to preparedness for such hazards?**

  The revised manuscript explicitly states that research on tsunamis were excluded because they fall outside the analytical scope of this review.. As noted by Hendry, Alistair [2021], tsunamis are of geophysical origin

and do not result from the interaction of climate-driven processes, which is the core focus of CF events considered here. Their exclusion is not based on relevance to preparedness in general, but on the need for conceptual consistency: the review targets flood risks arising from the conjunction of meteorological, hydrological, and oceanographic drivers linked to climate variability and change. Including tsunamis would compromise the coherence of the framework and the comparability of the selected studies.

This clarification has been added to the revised manuscript as follows (Line240):

"Beyond the dominant themes aligned with flood preparedness, the word cloud also revealed peripheral clusters related to ecological studies—particularly those focused on seed banks, germination processes, and plant propagation—as well as hazards of tectonic origin, such as earthquakes and tsunamis. While thematically adjacent, these topics fall outside the scope of climate-related flood dynamics (Hendry, 2021). Our focus is on CF events arising from the interaction of meteorological, hydrological, and oceanographic drivers under climate variability and change, in coastal settings."

- **Is the exclusion process described at lines 205–210 mainstream for literature reviews in flood preparedness? Is this method sound enough to correctly identify the papers that did not align with the objectives of the review? To me, the procedure sounds rather inconsistent and relevant studies may have been removed from the pool. Perhaps list this as a methodological limitation.**

  The exclusion process is now more explicitly justified and methodologically detailed. It combined topic modeling with expert judgment to refine the initial pool of articles. Using the Python-based tool Litstudy for trend visualization, we generated word clouds to identify prominent terms across the dataset. This strategy helped pinpoint thematic clusters that, despite matching the search strings, were conceptually misaligned with the scope of the review. For example, terms such as "oil" and "surfactant" were associated with studies on petroleum extraction, while others like "seed bank" and "germination" pertained to plant physiology research in coastal ecosystems. Upon further inspection, these terms were excluded as they did not address CF or preparedness strategies.

  To ensure transparency, we now include the complete refined search query along with the list of terms excluded from the Topics (TS) field due to their lack of relevance to the review's objectives, as cited (Line 246):

  "The following keywords were removed from the search in the Topic (TS) field: earthquake, species, tsunami, seed bank, habitat, germination, mangrove, irrigation, lake, soil, bank, food insecurity, organic matter, trees, sediment, dam, ice jam, drought, groundwater, energy."

  The exclusion process is acknowledged as a methodological limitation, as it involved some interpretive judgment. This is always the case for scoping and systematic literature reviews. Moreover, we argue that tools like Litstudy are highly effective when managing large bibliographic datasets, helping to identify thematic inconsistencies that may not be easily detected through manual screening alone. This approach ensured that the analysis remained focused on the central themes of CF risk and preparedness strategies.

- **What were the relevant and irrelevant records that served as the foundation for training the first machine learning model?**

  The relevant and irrelevant records used to train the first machine learning model in ASReview were initially identified through random selection, as built into the tool. For the training phase, 34 abstracts were manually labeled by the researchers. Only abstracts were shown—titles were intentionally withheld to ensure that classification was based on substantive content rather than potentially misleading or overly general titles.

  Following this initial labeling, the model began suggesting additional texts for review based on active learning. As more abstracts were classified, the algorithm progressively improved its ability to distinguish relevant studies, enabling the screening process to focus on the most promising publications. Overall, approximately 40% of the records retrieved from WoS were screened through this iterative process.

Results

- **Line 261: Social Sciences should also be written with capital letters.**

  Thank you for pointing that out. *Social Sciences* has been corrected to uppercase in Line 315.

- **Figure 3: I recommend replacing this polar chart with another type of representation. Such charts are harder to read, and the same information can be conveyed in more classical and clearer ways.**

  The figure has been revised to replace the polar chart with a more accessible representation. The updated version presents the same information in a more straightforward and readable format to improve interpretability.

- **I would like to see a more extensive explanation of this point: "This notable growth in scientific attention after 2012 aligns with a broader shift in natural hazard research paradigms, particularly following significant developments in climate risk frameworks."**

  As requested, this point has been elaborated to note that the post-2012 increase in scientific attention coincides with the introduction of *compound events* in the IPCC's SREX report, reflecting a broader shift in climate risk and hazard research paradigms.

  This idea is expressed in the manuscript as follows (Line 356):

  "Consistent with these trends, the post-2012 period is characterised not only by a quantitative expansion in CF and preparedness research, but also by a gradual diversification of its conceptual and methodological landscape. This growth aligns with a broader reconfiguration of natural hazard studies, catalysed by the formal introduction of compound events in the IPCC's SREX report (IPCC, 2012)..."

- **"The surge in publications, particularly after 2015, coincides with the growing recognition of the need for integrated approaches that address the complexities of compound flooding and other interconnected hazards" – this can be linked with the Sendai Framework.**

  Thank you for your comment. The link between the post-2015 surge in publications and the growing recognition of integrated approaches to compound hazards has been made explicit in the revised manuscript. This is captured in the revised text, which notes that (Line 359):

  "...A notable consolidation of this trend is evident after 2015, coinciding with the adoption of the SFDRR, which marked a strategic shift from disaster management to disaster risk management. By prioritising anticipatory action, early warning, and systemic resilience, Sendai advanced a multi-hazard and risk-informed approach that aligns closely with the emerging discourse on CF. This convergence between policy and scientific agendas likely contributed to the increased academic focus on CF and preparedness as interdependent concerns..."

- **I advise the authors to draw another timeline figure identifying the key trends discussed in section 4.1. The 0x is temporal, and the rest includes the emergence of key trends (start and end points). This figure can help the reader identify the diversification tendencies and the introduction of new terms (e.g., compound events, compound effects, multi-hazard) more readily, and it would make a valuable addition to the already rich and high-quality material in this paper. The figure can also include a similar design for the details in sections 4.2.**

  Thank you for the suggestion. Taking this advice into account, the figure has been revised to better reflect the emergence and evolution of key concepts discussed in Section 4.1, including shifts in terminology and thematic focus.

- **Table 2: there is no need to separately provide the year. The reference alone looks neater. I also think the caption of the table should provide some details on the methodology of eliciting the key topics.**

  The inclusion of the year in the reference format has been corrected to follow the appropriate style. The caption of Table 2 has also been revised to include a brief description of the methodology used to elicit the key topics.

- **Figure 6: I recommend replacing the pie chart with another type of chart. It is well known that pie charts are misleading and harder to read for most people. Also, on the bar chart, please replace the Count on Y with a more appropriate label.**

  The pie chart in Figure 6 has been replaced with a more suitable visualization. Additionally, the Y-axis label in the bar chart has been updated to *Number of Studies* to more accurately reflect the data.

- **Figure 7: Please improve the readability of the text in this picture. Providing some contrasting background for the text would be beneficial to the reader.**

  The readability of Figure 7 has been improved by increasing the font size and adjusting the text formatting. The text is now clearly contrasted against the background to ensure better legibility.

Conclusions

- **What is understood here by systemic vulnerability and systemic risk? The authors should clearly define these terms (also used in the Conclusions and throughout the text) in the introductory part.**

  Definitions of systemic vulnerability and systemic risk have been added to the Introduction (Line 46):

  "At a more structural level, the concepts of systemic vulnerability and systemic risk offer a complementary lens. Systemic vulnerability refers to the susceptibility of interdependent systems—such as infrastructure networks, governance structures, or social services—to suffer disruption under external stress, due to the cascading effects that arise from their internal linkages (Weir et al., 2024). Systemic risk, in turn, captures the potential for these disruptions to propagate across sectors and scales, resulting in widespread and often unforeseen consequences (Armaș et al., 2025). This can further exacerbate systemic vulnerability as a persistent condition that can amplify future impacts or obstruct adaptive responses, even in the presence of mitigation efforts. Such a perspective situates compound risk within the broader dynamics of interdependence, where systemic conditions shape not only the onset of these impacts but their amplification and persistence."

- **Line 551: complex interactions of what?**

  The original sentence—"Cascading impacts, non-linear climate feedback, and systemic vulnerabilities demand adaptive frameworks capable of anticipating complex interactions."—referred to the interplay among physical processes, socio-institutional dynamics, and evolving conditions within coupled human–natural systems. This formulation was removed in the revised version and replaced with a more explicit and distributed discussion of these interactions in the Section 7 (Future Research and reflections). The revised text now unpacks these dynamics through concrete examples, emphasizing how institutional fragmentation, behavioural responses, and technical constraints interact in shaping CF preparedness.

Additional comments

I recommend adding a dedicated Reflections section to consolidate the paper's key contributions. It can be placed after Results. This section should include clear answers to the two research questions and compare insights on CF preparedness with preparedness for other hazards influenced by climate change (in terms of frequency, intensity). By critically discussing these findings, this section would serve as the intellectual "heart" of the paper.

As suggested, Sections 5 (Discussion) and 7 (Future Research and Reflections) have been added. These sections revisit the two research questions and consolidate the main findings of the review, highlighting persistent challenges such as governance fragmentation, limited integration of behavioural dimensions, and the gap between conceptual frameworks and operational practice. They also outline implications for future research, including the need to develop more context-sensitive, participatory, and actionable preparedness strategies.

References

Hendry, Alistair. *Compound Flooding in the UK: Past, Present and Future Co-occurring Extreme Flooding Hazard Sources*. PhD thesis, University of Southampton, 2021.

Stina Ellevseth Oseland. Breaking silos: can cities break down institutional barriers in climate planning? *Journal of Environmental Policy & Planning*, 21(4):345–357, July 2019. ISSN 1523-908X, 1522-7200. doi: 10.1080/1523908X.2019.1623657. URL https://www.tandfonline.com/doi/full/10.1080/1523908X.2019.1623657.

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Nicholas P. Simpson, Portia Adade Williams, Katharine J. Mach, Lea Berrang-Ford, Robbert Biesbroek, Marjolijn Haasnoot, Alcade C. Segnon, Donovan Campbell, Justice Issah Musah-Surugu, Elphin Tom Joe, Abraham Marshall Nunbogu, Salma Sabour, Andreas L.S. Meyer, Talbot M. Andrews, Chandni Singh, A.R. Siders, Judy Lawrence, Maarten Van Aalst, and Christopher H. Trisos. Adaptation to compound climate risks: A systematic global stocktake. *iScience*, 26(2):105926, February 2023. ISSN 25890042. doi: 10.1016/j.isci.2023.105926. URL https://linkinghub.elsevier.com/retrieve/pii/S2589004223000032.

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Dina Vanessa Gómez-Rave, Anna Scolobig, Manuel del Jesus
Natural Hazards and Earth System Sciences - NHESS

Response to Reviewer 2

We thank the reviewer for the thoughtful and detailed feedback on our manuscript. Below we provide point-by-point responses addressing each comment.

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1. General Comments

The preprint titled *"Rethinking Preparedness for Coastal Compound Flooding (CF): Insights from a Systematic Review"* provides an insightful examination of strategies for managing compound flooding (CF) risks based on a structured literature review. The authors address the need to consider the multiple aspects of compound flooding risk including solutions that combine technical, environmental, and social dimensions, as well as the critical role of governance and multi-stakeholder collaboration.

Strengths of the paper include illustrating the evolution of CF research—from hazard-specific technical approaches to more holistic frameworks, while offering a critical lens on the shortcomings of current governance structures and participatory strategies. However, clear definitions and use of flood risk and disaster management terms are lacking. As a result, the paper framing lacks clarity and accurate use of terms which are well defined in the scientific literature. In particular the use of the term "preparedness" seems to be applied to more than just the preparedness phase of the disaster management cycle but rather flood risk and adaptation more broadly. The definition and use of this term, which also appears in the title should be clear.

Thank you for this valuable observation.To clarify the scope of the term *preparedness*, the revised manuscript now explicitly states (Line 69):

"Preparedness plays a central role in this shift. As defined by the UNDRR, preparedness refers to the knowledge and capacities developed by institutions, communities, and individuals to anticipate, respond to, and recover from likely, imminent, or ongoing hazard events [UNDRR, United Nations Office for Disaster Risk Reduction, 2017]. It includes early warning systems, contingency planning, and the institutional arrangements required to support timely and coordinated action."

Expanding on this definition, the manuscript further explains how the term is understood in this study, adopting a broader perspective (Line 118):

"We adopt a broad understanding of preparedness that goes beyond its conventional role in the DRR cycle—typically associated with EWS, contingency planning, and emergency readiness. Instead, it is framed as a multidimensional process encompassing anticipatory governance, infrastructural and ecosystem-based measures, and behavioural strategies aimed at reducing vulnerability prior to the manifestation of hazardous conditions. This perspective aligns not only with emerging literature on integrated FM [Bark et al., 2021], [Konami et al., 2021], [De Silva et al., 2022], [Sánchez-García et al., 2024], but also firmly grounded in Priority 4 of the SFDRR, which advocates for preparedness actions that include inclusive governance, resilient infrastructure, public education, psychosocial support, and the incorporation of risk reduction into develop-

ment planning and post-disaster reconstruction UNDRR, United Nations Office for Disaster Risk Reduction [2015].”

This definition supports the analytical focus of the study and ensures consistent use of the term throughout the manuscript.

Additionally, the integration of case studies based on the most relevant papers (e.g., China’s Sponge City Program, the Netherlands’ Delta Plan) adds depth to the analysis. However, the paper would be improved with a more explicit discussion of the limitations of the reviewed studies, particularly in terms of data availability and transferability. In addition, a more cohesive discussion section which distills and structures the findings for future research and practical applications would improve the impact of the paper.

Overall, this preprint makes a valuable contribution to the literature on disaster risk reduction and climate adaptation. With major revisions, it has the potential to contribute meaningfully to the scientific literature on compound flood risk management.

We have addressed this point by acknowledging the limitations of the reviewed case studies, particularly in terms of data availability and transferability. These aspects are now discussed in the revised manuscript, especially in the new section on Future Research. The final section was also reorganized to highlight key insights and reflect on their implications for research and practice.

2. Specific Comments

Framing

The flood risk and disaster management terms used are not defined and therefore the framing is unclear. For example, the stated focus is on preparedness, however, Blue & Green Infrastructure for example is more connected to adaptation or mitigation of hazards rather than preparedness.

I would encourage the authors to clearly define the risk equation they are using (hazard, exposure, vulnerability) and the disaster management cycle (preparedness, event/disaster, response, recovery, mitigation/adaptation) and cite relevant literature (for example Koks et al., 2015).

It seems that the intended focus is more risk reduction strategies across the disaster risk management cycle for compound floods in coastal areas. The conclusion does not mention the coastal context at all which is supposed to be the focus of this study. The findings should connect back to the focus area and provide an outlook related to that context.

We appreciate the reviewer’s insights regarding conceptual framing and terminology. We agree that a clearer articulation of the underlying risk framework would strengthen the manuscript. In response, the revised version now incorporates a dedicated paragraph that defines the main components of risk and clarifies the distinction between drivers, hazards, exposure, and vulnerability. As included in the manuscript (Line 33):

“Risk is commonly conceptualised as the potential for adverse consequences for human or ecological systems resulting from the interaction between hazard, exposure, and vulnerability Intergovernmental Panel On Climate Change (Ipcc) [2023]. Within this framework, compound events are defined as the combination of climatic drivers and/or hazards that jointly contribute to societal or environmental risk Zscheischler et al. [2018]. Drivers encompass processes, variables, and phenomena in the climate and weather domain—such as precipitation, temperature, river flow, coastal water levels, atmospheric humidity, soil moisture or wind speed—that may operate across multiple spatial and temporal scales. Hazards, in contrast, denote the immediate physical phenomena—such as floods, heatwaves, or landslides—that may trigger impacts when they

coincide with exposure—the presence of people, infrastructure, or ecosystems in harm's way—and vulnerability—their propensity to suffer damage or loss due to limited capacity to anticipate, cope with, or recover from the event Koks et al. [2015], Zscheischler et al. [2020], Intergovernmental Panel On Climate Change (Ipcc) [2023]. The interplay among these components can result in compound risks, arising from single extremes or co-occurring events affecting critical systems or sectors Intergovernmental Panel On Climate Change (Ipcc) [2023]. This conceptual framing provides a basis for analysing how interacting climatic conditions can evolve into complex events—and how their consequences ripple through interconnected systems."

This addition helps keep the terminology consistent throughout the manuscript and places the review within a commonly used risk framework. It also contributes to linking preparedness with a broader understanding of CF risk in coastal areas.

Methodology

The use of ASReview and BERT model is innovative and the steps are clearly explained. It is mentioned that the ASReview model is based on their textual features to prevent author name and citation network biases. However, other biases can exist while using machine learning screening (e.g., keyword selection, training data). If these were addressed or at least identified this could be added.

Also, a clearer explanation of how subjective decisions were minimized would enhance reproducibility. The PRISMA flowchart (Figure 2) is clear but it would be helpful to add more detail on how the 49 articles were assessed to align with the research questions.

These aspects are now addressed in Section 3.2 and the limitations section. The screening process was structured to reduce subjectivity and enhance reproducibility by combining a fine-tuned BERT model for initial relevance scoring with active learning via ASReview. Predefined inclusion criteria guided the human-in-the-loop validation process, with iterative updates ensuring consistency in decision-making. To minimize bias, author names and citation data were excluded, and only titles and abstracts were used during the initial screening. Final inclusion decisions were based on full-text analysis using consistent criteria aligned with the research questions. Remaining sources of interpretative uncertainty—such as borderline cases and varying definitions of "compound"—are acknowledged as methodological limitations.

Thematic Gaps

While the paper acknowledges underrepresented themes like governance and behavioral dimensions, it stops short of proposing specific pathways for addressing them. The conclusion hints at the need for co-production and hybrid strategies but could be more explicit in offering guidance for implementation, especially in varied socio-political contexts.

The discussion on fragmented governance (Figure 8) and the challenges is valuable but could be strengthened by referencing mechanisms known in the literature to improve cross-sectoral coordination such as policy incentives or joint funding programs.

In addition, it may be helpful to look at the broader literature on several points. For example, it is mentioned that nature-based solutions are rather implemented in middle income countries but there are many projects that incorporate NbS in all income levels. For example, green dike and making room for the river projects in the Netherlands and Mangrove restoration in many countries globally. In addition, Indigenous Knowledge is integrated into preparedness and adaptation in high income countries (e.g. New Zealand, Australia, Canada). Perhaps rather than classification based on income, the approaches could be referenced (eg: NbS, Indigenous Knowledge) with some reference to regional strengths and challenges.

We revised the governance results section to address the reviewer's concerns by incorporating concrete coordination mechanisms—such as joint planning incentives, inter-agency funding schemes, and formal cooperation platforms—alongside a critical discussion of fragmentation and actor interactions (Lines 676 to

685). We also expanded the income-based framing with a regional analysis in Section 4.2 (from line 510 onward) that highlights institutional maturity, sociocultural dynamics, and environmental priorities, including examples of nature-based solutions and Indigenous Knowledge across diverse contexts.

Figures and Visualizations

Figures are generally helpful and relevant, however, the design of some visuals (e.g., Figures 6 and 7) are dense and would benefit from simplification or improved legends to enhance readability.

Figures 6 and 7 have been revised to improve readability. The visual structure has been simplified, font sizes increased where necessary, color contrasts adjusted (particularly for backgrounds and node/link elements), and legends clarified. These changes enhance accessibility while preserving the level of complexity needed to convey the information accurately.

Integration of Social Dimensions

The paper identifies a gap in social science research within the reviewed literature (Figure 3). It would be helpful to discuss why this gap exists and how it might impact the effectiveness of preparedness strategies. For example, are there biases in funding or publication trends that favor technical over social studies? Are there challenges with data collection or availability?

We have expanded the discussion around Figure 3 to briefly reflect on the limited presence of social science perspectives in the reviewed literature.

The added text reads as follows (Line 323):

"The observed asymmetry may reflect how research trajectories have developed over time, shaped by differing priorities as well as methodological, theoretical and disciplinary challenges. Historically, flood risk has been addressed through technical and hazard-centered frameworks, with a strong emphasis on hydrometeorological drivers, modelling, and structural measures, leaving less space for analysing how societies perceive, experience, and respond to flood events Lechowska [2022]. Socio-political dimensions are often treated as secondary, rather than central to how risks are understood and managed. Furthermore, inconsistent terminology and conceptual ambiguity, especially in definitions of multi-hazard and compound events, have contributed to the "fragmentation of the literature," generating redundancy and confusion that hinder interdisciplinary collaboration Serinaldi et al. [2022], Green et al. [2025]. Methodological constraints such as limited data availability, lack of standardization, and the context-dependence of social indicators also restrict their integration Girons Lopez et al. [2017], Vanelli et al. [2022]. Importantly, social and behavioural science research on these topics has been underfunded until the last decade. This undermined not only the theoretical but also the disciplinary development of risk perception, preparedness and communication studies. A more integrated approach is needed to inform preparedness strategies that reflect both the physical dynamics of CF and the ways in which societies experience and respond to them."

Regional Disparities

The analysis of high-, middle-, and low-income countries is useful but somewhat generalized. More nuanced comparisons (e.g., within middle-income countries) could reveal additional insights about contextual factors influencing preparedness.

We expanded Section 4.2 (from line 510 onward) to go beyond broad income categories, illustrating contextual differences within and across income groups through regionally specific examples of preparedness strategies.

3. Technical Corrections

TC#	Line #	Comment and Response
1	Throughout	**Consider rephrasing long or complex sentences to improve readability, especially in the methods and discussion sections.** Long or complex sentences in the Methods and Discussion sections were revised to improve readability and flow.
2	Throughout	**With the term "compound flooding" you sometimes abbreviate as "CF" and sometimes don't. This should be standardized throughout the paper.** The use of "compound flooding" and the abbreviation "CF" was made consistent throughout the manuscript.
3	Line 8 to 22	**Abstract should mention the methods used and highlight key results.** The abstract was updated to briefly describe the methods and highlight key findings, in line with the paper's focus (Line 8 to 21)
4	Lines 55, 103, and 297	**Sendai Framework is introduced twice (Lines 55 and 103).** Mentions of the Sendai Framework were revised to avoid redundancy. It is now introduced only once, at Line 82, and referred to consistently thereafter.
5	Lines 155–157	**You mention "storm surges, river flooding, and extreme rainfall" create heightened risk.These are all related to the hazard component of risk. If you only focus on hazard then this should be clearly stated. However, you later specify that you are looking at how strategies integrate technical, environmental, and social dimensions which suggests you look at drivers related to multiple components of risk. Be clear about how you define a use risk and hazard terminology.** Key terms such as hazard, drivers, and risk were defined early in the manuscript (Lines 32 to 45). The scope of the analysis was clarified to reflect a focus on hazard-related drivers, while recognizing that preparedness strategies may touch on broader dimensions (Lines 118 to 125).
6	Line 194	**What is meant by "reflecting the diverse strategies employed to address flood risk and preparedness". Flood risk is something exists due to a combination of hazard, exposure, and vulnerability. Risk reduction measures can target each of these components. Actions for risk reduction can also be framed as targeting particular phases of the disaster management cycle including preparedness.** The sentence was rephrased to specify that the review focuses on strategies addressing hazard-related drivers during the preparedness phase of the disaster management cycle (Lines 225 and 226).
7	Line 224	**Researcher-In-The-Loop (RITL) is mentioned in full twice with the abbreviation. Just include this once and then use the abbreviation.** The term Researcher-In-The-Loop (RITL) is now written in full only once (Line 266), with the abbreviation used consistently throughout the rest of the manuscript.

(Continued on next page)

TC#	Line #	Comment and Response
8	Lines 273–276	**The two sentences starting with "In parallel, it is important to acknowledge. . . " are a bit awkward. Consider rephrasing.** The entire paragraph was revised to improve phrasing and remove repetition. The updated version appears in Lines 349 to 355.
9	Table 2	**Clarify that the years listed are publication years, and ensure consistent formatting across entries.** **Possible double entry error for year with (Chan et al., 2023).** **The years and references with years are also somewhat redundant.** **Consider reformatting and perhaps only include the reference.** Table 2 was adjusted. Formatting inconsistencies were corrected and the duplicate entry for Chan et al. (2023) was removed.
10	Line 307	**Reference to the literature would fit here at the end of the sentence.** A reference was added at the end of the sentence, as suggested (Line 359).
11	Lines 246–247	**". . . this nuanced aspect of preparedness. . . " It is unclear what this refers to.** Revised to clarify that the phrase refers to preparedness for simultaneous or interacting flood drivers, and to explain why this topic is only recently gaining attention (Lines 286 to 294).
12	Line 544	**You mention "cognitive bias" here for the first time in the conclusions. While cognitive simplification is mentioned earlier in the article with regards to CF "cognitive bias" is not clearly addressed in the article. Be clear about what you mean in the conclusions and/or reference how you use the term earlier in the article.** Revised to use "cognitive simplification" instead of "cognitive bias," ensuring terminological consistency with earlier sections (Lines 508, 706)
15	Line 422	**Typo with extra period.** The extra period was removed.
16	Lines 281 to 284	**Provide reference and quantification of increase in publications on natural hazard research.** Selected references and brief quantification were added to support the observed increase in hazard-related publications (Lines 336 to 344).

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