

Referee 1

Dear authors,

The paper addresses an interesting topic and is generally well written. I agree with the authors that the recovery process has received comparatively little attention in the literature, especially when it comes to consecutive disasters.

[...]The paper is extremely broad[...]

[...]Perhaps presenting the paper as a conceptual piece would be more appropriate, as the title led me to expect something else.

[...]Due to the broad focus, most recommendations remain vague, and it is unclear how or why the authors arrived at these specific recommendations.

We thank the reviewer for their thoughtful and constructive comments. We found the review especially valuable in highlighting that the manuscript's current framing may create expectations that are misaligned with its intended contribution, and that both its added scientific value and its conceptual nature could be communicated more clearly.

In response, we have carefully reassessed the manuscript's framing. We agree with the reviewer that the paper is best understood as a perspective, conceptual contribution, rather than an analytical study. Accordingly, this manuscript does not aim to determine when tipping points occur, which pathways are most prevalent, or under what conditions specific recovery outcomes emerge. Addressing these questions would require dedicated analytical and quantitative investigation beyond the scope of the present study.

We believe that the value of the paper lies in illustrating the complexity of recovery processes in the context of consecutive disasters and in demonstrating how recovery can be affected in diverse ways within and across societal domains, as well as across spatial and temporal scales.

To better align the manuscript with its intended contribution, we have made the following changes:

- We have revised the framing throughout the manuscript to explicitly position it as a perspective and conceptual contribution rather than an analytical study, including corresponding revisions to the title, abstract, introduction, and conclusion.
- We have also strengthened the paper's consecutive focus, removing or reframing examples that assumed completed recovery between events and establishing a clearer framing from the start, or reframing examples for which this perspective was not described clearly enough.
- We have moved away from the tipping-point framework of Spaiser et al. (2024) as the central organising structure of the paper. Instead, the selected societal domains are presented as a cross-section of society through which different dimensions of recovery complexity under consecutive disasters can be explored, while tipping points are more clearly positioned as a conceptual lens.
- We have substantially revised the final sections of the manuscript, replacing the former tipping-point and recommendation chapters with a new reflection chapter (incl. the addition of Fig. 5) that synthesises the conceptual insights emerging from

the examples discussed throughout the paper (incl. the addition of Fig. 6). The new reflection chapter is organised around three interrelated themes:

- I. The implications of disrupted recovery for long-term societal resilience, discussing tipping points as one possible lens through which the long-term consequences of repeated disruptions and alternative recovery trajectories can be conceptualised;
- II. How system definitions shape interpretations of recovery and consecutiveness;
- III. The conceptual ambiguities surrounding the distinction between disasters, impacts, and underlying vulnerability and exposure conditions within an all-hazard consecutive-disaster perspective.

In doing so, we retained and expanded the underlying conceptual reflections on recovery trajectories, resilience, system definitions, and disaster conceptualisation that were previously embedded in the tipping-point and recommendation chapters, while removing recommendations that were not directly supported by the examples discussed throughout the paper.

The paper is extremely broad and examines four different societal subsystems: human settlements, human health, the economic system, and the socio-political system. In my view, each of these subsystems is already extremely complex in terms of recovery processes and challenging to address in a single paper, let alone when combining all of them. Moreover, the paper aims to explore the interactions between these systems, considering how they may lead to a deterioration of resilience or to transformative learning. This broad focus inevitably results in a superficial conceptual discussion with rather ad-hoc assembled examples.

We fully acknowledge that each of the four societal subsystems addressed in the paper entails complex recovery dynamics that would require in-depth analysis in dedicated studies to fully understand them. As explained in the overarching response, the aim of this paper is not to provide detailed subsystem-specific analyses, nor to comprehensively explain recovery processes within each domain. Rather, the paper adopts a broad, cross-sectoral perspective to illustrate different dimensions of recovery complexity under consecutive disasters and to highlight how recovery dynamics within different societal domains may interact across spatial and temporal scales.

Accordingly, the examples discussed throughout the manuscript are intended as illustrative cases that highlight different dimensions of recovery complexity, rather than as an exhaustive or representative overview of recovery pathways within each societal domain. We have revised the manuscript to make this intention more explicit. We hope that the revised framing, which more clearly positions the manuscript as a conceptual perspective, helps to clarify the added value of this broad perspective and addresses concerns regarding the paper's scope.

This issue is also reflected in Figure 1, which essentially indicates that recovery trajectories are diverse, unknown, and involve interactions. Overall, I question whether this approach truly provides many new insights.

In response to the repositioning of the paper, we have designed an alternative to Fig. 1 that provides a conceptual illustration of the scope of the perspective.

In this regard, while the authors accurately describe the examples as empirical, I would consider them anecdotal evidence to support the conceptual points the authors wish to convey. Perhaps presenting the paper as a conceptual piece would be more appropriate, as the title led me to expect something else.

We'd like to thank the reviewer for this observation and agree that the conceptual nature of the manuscript was not sufficiently reflected in its original framing. As explained in the overarching response, we have therefore revised the framing throughout the manuscript to explicitly position the paper as a perspective and conceptual contribution rather than an analytical study, adjusting the abstract, introduction, conclusion, and title accordingly.

We also agree that the examples presented throughout the manuscript should be understood as illustrative rather than systematic evidence. Their purpose is not to provide a comprehensive empirical assessment of recovery dynamics, but rather to ground and exemplify the conceptual arguments developed throughout the paper. We believe that the revised framing makes the role of these examples considerably clearer and better aligns the manuscript with reader expectations.

Although the paper largely focuses on the potential negative impacts of consecutive disasters, considerable evidence suggests that disasters can serve as "windows of opportunity" leading to transformative learning (see e.g., Kreibich et al. 2017). This is rather briefly addressed in sections 5.3 and 4.2, but many more examples could be provided for each of the subsystems discussed. For instance, in Section 2, I am sure you can find numerous examples where disasters have led to revised spatial planning policies and/or building codes, significantly reducing the impact of subsequent disasters.

We thank the reviewer for this observation and agree that disasters can create opportunities for transformative learning, adaptation, and vulnerability reduction. Following the revision of the manuscript and the strengthening of its focus on recovery under consecutive-disaster conditions, we reconsidered the role of several examples included in the original version. In particular, a number of the examples presented in Section 5.3 primarily illustrated learning, adaptation, and vulnerability reduction processes that occurred after recovery from a previous disaster had largely been completed. As such, these examples were less directly related to the central focus of the paper, namely the complexities that arise when recovery is interrupted by subsequent disasters before it has been completed. A similar reasoning led to the removal of section 4.5 from the revised manuscript.

At the same time, we acknowledge that recovery trajectories are not inherently negative. The revised reflection chapter (Section 6.1) explicitly discusses both the potential for positive transformation and the ways in which repeated disruptions may inhibit vulnerability reduction and resilience-building efforts.

Section 6 also remains vague, offering little insight into what leads to tipping points in terms of deterioration or enhanced learning. The conclusion that these are linked to disaster intensity and frequency seems quite evident based on existing literature and cannot be derived directly from the empirical approach provided in the paper. We gain limited understanding of which discussed pathways are important or common.

We thank the reviewer for raising this point. As discussed in the overarching response, the manuscript is not intended to identify dominant recovery pathways or determine the conditions under which tipping points occur. We believe that the original framing of the manuscript, particularly the prominent role given to the tipping point literature in the introduction, may have created a different expectation regarding the purpose of the discussion on tipping points and recovery trajectories.

In the revision, we have therefore reframed the introduction to position tipping points less centrally and have substantially revised the final chapters of the manuscript into a reflection chapter on the conceptual complexities of recovery under consecutive disasters. Rather than presenting tipping points as a central analytical framework, we now discuss them as one possible lens through which the long-term implications of disrupted recovery can be conceptualised, which is more in line with the original intended contribution.

Due to the broad focus, most recommendations remain vague, and it is unclear how or why the authors arrived at these specific recommendations. For example, the authors state, "...to support efficient and equitable recovery after disasters, countries need more reliable and proactive financing solutions. These may also include pre-arranged recovery financing mechanisms such as forecast-based financing, where funds are automatically released for humanitarian actions that are agreed upon in advance (IFRC & RCCC, 2020) or parametric insurance, which offers rapid, flexible payouts based on pre-defined parameters, such as certain rainfall or wind speed, ensuring rapid payments in post-disaster settings (Ocampo & Moreira, 2024)." (lines 631ff). While I do not disagree with the recommendation itself, I question how this particular suggestion is derived from section 4, and why it was chosen as one of four key recommendations among potentially many others?

We thank the reviewer for this comment and agree that several recommendations in the original discussion section were insufficiently grounded in the preceding sections. While these recommendations were intended to illustrate potential avenues forward for addressing the challenges we identified across societal domains in Chapters 2–5, we acknowledge that selecting specific policy instruments (such as particular financing mechanisms) can give the impression of prioritization that extends beyond the conceptual scope of the paper.

To improve coherence and better align the manuscript with its conceptual and perspective-oriented contribution, we have substantially revised the final chapters of the manuscript, moving away from a recommendation-focused discussion. Instead, we have formulated broader reflections regarding the conceptual complexities of recovery under consecutive disasters and their implications for disaster risk assessment and management, as outlined in the overarching response.

In the concluding paragraph, we have integrated only those recommendations that are directly grounded in the preceding discussions, concerning the scientific understanding and conceptualisation of recovery under consecutive disasters. In particular, we conclude by emphasising the need for more dynamic approaches to disaster risk assessment and management that explicitly account for evolving recovery trajectories, vulnerability, and exposure, rather than advocating for specific funding mechanisms or policy interventions.

Referee 2

- General Comments

Dear Authors,

Thank you for this very interesting and timely manuscript. The paper addresses an important and still underexplored gap in the multi-hazard and multi-risk literature, an area that is rapidly expanding. I believe this work represents a valuable contribution and has the potential to become an influential reference in the field.

My main overarching suggestion is to strengthen and clarify the paper's focus on consecutive disaster recovery. While I provide a detailed set of comments below, these are intended to be constructive rather than discouraging. On the contrary, I believe the authors have conducted a valuable and insightful study, and that further clarification and refinement would significantly enhance its impact and readability.

We would like to thank the reviewer for the thorough review and constructive feedback. We greatly appreciate the encouraging words and the recognition of the manuscript's relevance. Based on the detailed comments provided by the reviewer, we have carefully reassessed the manuscript and implemented several substantial revisions, as well as smaller changes, that, together, refine the framing, scope, clarity, and conceptual contribution of the paper. Overarching adjustments are outlined below, with individual comments addressed in more detail under the respective points.

- We have strengthened the focus on consecutive disasters throughout the manuscript, removing or reframing examples that assumed completed recovery between events and establishing a clearer framing from the start, or reframing examples for which this perspective was not described clearly enough.
- We clarified key terminology and concepts in the introduction and ensured more consistent use throughout the manuscript, including the definitions of consecutive disasters, critical systems and services, societal recovery, and the relation between natural-hazard-induced disasters and other disruptive events such as health crises, economic shocks, and political instability.
- We reassessed the overall framing of the paper based on the reviewers' feedback. We recognise that the main value of the manuscript lies in illustrating the complexity of recovery processes in the context of consecutive disasters, and in showing how recovery can be affected in diverse ways within and across societal domains, as well as across spatial and temporal scales. The paper is therefore best understood as a perspective and conceptual contribution. Accordingly, we revised the framing throughout the manuscript to explicitly position it as such, including corresponding revisions to the title, abstract, introduction, and conclusion.
- We moved away from the tipping-point framework of Spaiser et al. (2024) as the central organising structure of the paper. Instead, the selected societal domains

are presented as a cross-section of society through which different dimensions of recovery complexity under consecutive disasters can be explored, while tipping points are more clearly positioned as a conceptual lens.

- Finally, we have substantially revised the final sections of the manuscript, replacing the former tipping-point and recommendation chapters with a new reflection chapter that synthesises the conceptual insights emerging from the examples discussed throughout the paper (incl. the addition of Fig. 6). Rather than prescribing a single definition or framing, the reflections highlight the need for transparency and reflexivity in analytical framing, recognizing that multiple valid interpretations may exist depending on the research question. The new reflection chapter is organised around three interrelated themes:
 - I. The implications of disrupted recovery for long-term societal resilience, discussing tipping points as one possible lens through which the long-term consequences of repeated disruptions and alternative recovery trajectories can be conceptualised;
 - II. How system definitions shape interpretations of recovery and consecutiveness;
 - III. The conceptual ambiguities surrounding the distinction between disasters, impacts, and underlying vulnerability and exposure conditions within an all-hazard consecutive-disaster perspective.

We believe these changes, made based on the reviewers' elaborate feedback, have resulted in a more coherent manuscript with a clearer conceptual contribution.

Introduction

The introduction opens with a real-world example, and the manuscript as a whole makes extensive and effective use of empirical illustrations. Given this, I would suggest that the introduction focus less on additional examples and instead prioritize clearly framing the problem, introducing key definitions, and establishing the conceptual focus of the paper.

In particular, the scope of the paper would benefit from greater clarification. For example, in line 74 the authors state: "Even when recovery is completed between events, decisions made during the recovery process... can fundamentally shape a society's resilience to subsequent events." At this point, it is unclear whether the paper focuses specifically on consecutive disaster recovery, recovery processes more generally, or whether the concept of "consecutive disaster" itself still requires clearer definition. I encourage the authors to explicitly clarify this distinction early in the paper.

We thank the reviewer for this suggestion and agree that the empirical example in the introduction distracted from establishing the broader framing and scope of the paper. We have therefore removed this example from the revised manuscript and instead use the introduction to more clearly define the scope of the paper, introduce key concepts and terminology, and clarify the paper's conceptual focus.

Specifically regarding scope, we recognise that the inclusion of examples in which recovery was largely completed between events may have created ambiguity regarding the paper's focus. We have therefore revisited the manuscript and applied the consecutive-disaster focus more consistently, in line with the definition introduced in the revised introduction. In particular, we removed or reframed sections and examples that assumed recovery to be

completed between events (i.e., Sect 2.5, Sect. 2.6, Sect. 4.5, and Sect. 5.3 as well as individual examples from Sect. 2.1 and Sect 3.4) and clarified that the primary focus of the paper is on situations in which recovery trajectories are interrupted, reshaped, or otherwise influenced by subsequent disasters. We also agree that the statement in line 74 was too broad in the context of this revised focus and have removed it from the manuscript, as it does not fit this clarified and more consistent framing.

Following this, the subsystems proposed by Spaiser et al. (2024) are introduced, and a systemic definition is developed. However, the rationale behind adopting and adapting this framework remains unclear. I recommend explaining in greater detail why this particular framework was selected, how it relates to other existing approaches, and how the authors arrived at the proposed system definition.

As outlined in the overarching response, we have reconsidered the role of the Spaiser et al. (2024) framework in the manuscript. While it was initially introduced because we considered tipping-point theory conceptually relevant to recovery under consecutive disasters, we recognise that its use as the organising framework of the paper may have created expectations regarding the purpose of the discussion on tipping points and recovery trajectories that extend beyond the intended scope of this work.

We have therefore moved away from this framework as the central organising structure of the manuscript. Instead, the selected societal domains are now presented as a cross-section of societally relevant domains through which different dimensions of recovery complexity under consecutive disasters can be explored. This framing is more consistent with the purpose of the illustrative examples, namely to demonstrate how consecutive disasters can affect recovery in diverse and interconnected ways across societal domains, as well as across spatial and temporal scales.

Rather than presenting tipping points as a central analytical framework, we have integrated them into the revised reflection chapter, as outlined earlier, where they are discussed as one possible lens through which the long-term implications of disrupted recovery can be conceptualised. Specifically, we reflect on how consecutive disasters may contribute to reinforcing feedbacks associated with negative tipping, while simultaneously constraining opportunities for positive transformation.

Additionally, the introduction refers to “health crises” alongside “disasters.” It would be helpful to clarify whether health crises are conceptualized as disasters within the framework of this paper, or whether they are treated as distinct phenomena.

We thank the reviewer for raising this point. We have clarified this issue in the revised introduction. We adopt a broad interpretation of consecutive disasters, also encompassing sequences involving other disruptive events as they interact with, occur alongside, or influence recovery from natural-hazard disasters. This all-hazard perspective is consistent with the UNDRR (2021) Hazard Information Profiles, which recognise biological and societal hazards alongside natural hazards. Nevertheless, for conceptual clarity, we use the term disaster as a standalone term throughout this paper to refer to disasters resulting from natural hazards. Health crises, conflicts, and economic shocks are therefore primarily discussed in relation to their interactions with natural-hazard disasters and their influence on

recovery processes under consecutive disasters. We have ensured this distinction is applied consistently throughout the paper.

At the same time, we recognise that such classifications are not always clear-cut, particularly in the context of consecutive disasters. Health crises, political instability, and economic shocks may be framed as independent disasters, as impacts resulting from prior disasters, or as underlying vulnerability and exposure conditions that shape subsequent recovery trajectories. Rather than prescribing a single interpretation, we explicitly acknowledge these conceptual ambiguities and discuss them in the third reflection point of the revised Chapter 6.

Regarding Figure 1, since uncertainty in recovery outcomes is a central theme of the paper, it is unclear why uncertainty is not visually represented in the recovery phase following the first event. As currently presented, the figure seems to associate uncertainty only with the recovery from the second event.

We thank the reviewer for this observation. We agree that Fig. 1 did not fully capture all dimensions of recovery uncertainty and complexity discussed throughout the manuscript. Following the broader revision and reframing of the manuscript, we have designed a new Figure to replace Fig.1, which provides a conceptual illustration of the scope of topics included in the perspective paper.

Between lines 90 and 100, the authors introduce the concept of societal recovery. It would be beneficial to clearly define this term and explain how it differs from “recovery” more generally.

We thank the reviewer for this helpful suggestion. We have now explicitly addressed this point in the introduction, explaining that the term “societal” is added before recovery simply to delimit the scope of the paper to various recovery processes within human systems, as similar dynamics are relevant in non-human systems as well but outside the scope of this paper:

“Here, we explore the complexity of recovery under consecutive disasters through illustrative empirical examples and insights from the scientific literature across four selected interrelated societal domains: human settlements, human health, the economic system, and the socio-political system. We use the term societal recovery throughout this paper to clarify that we focus on recovery processes within human systems.”

Furthermore, I recommend clarifying the criteria and process used for selecting the recovery events and cases discussed in the paper. Although the authors note that this is not a systematic review, a more transparent methodological explanation would add rigor and clarity.

We agree with the reviewer that the process behind developing the pathways and identifying the shared examples could be better explained to the reader. In the revised introduction, we have therefore added the following paragraph:

“The pathways discussed throughout this paper were developed through an iterative expert-driven and literature-informed process. Initial examples and pathways identified through interdisciplinary discussions among the authors were subsequently refined,

expanded, and grouped through targeted literature searches and repeated rounds of collective discussion. This process was repeated as new examples and insights emerged from the literature, resulting in the final set of illustrative pathways and examples presented in this paper.”

Finally, briefly outlining the key issues addressed in each section at the end of the introduction with their related section numbers could greatly improve readability and guide the reader through the manuscript.

We appreciate the reviewer's suggestion to guide the reader more explicitly through the manuscript already in the introduction. However, following the broader revisions to the manuscript and its reframing as a perspective and conceptual contribution, we considered it more appropriate not to introduce the individual recovery pathways in detail at this stage, as the pathways discussed throughout the paper are intended as illustrative examples rather than a fixed taxonomy. In the revised manuscript, we have, therefore, added a brief overview of the main sections and their corresponding section numbers at the end of the introduction, including the subsections of the revised reflection chapter (Section 6).

Impacts within Human Settlements

In the opening of this section, human settlements and critical systems are defined; however, health is not included among the listed critical systems unlike in section 2.3. This omission raises questions and should be either justified or clarified.

We thank the reviewer for noting this point. In the revised introduction, we have added a clearer explanation of how critical systems are positioned in relation to the different societal domains, explicitly recognising that *“the distinction between societal domains is not always clear-cut, as many critical systems and services are interconnected and support multiple societal domains simultaneously.”*

While the list of critical systems at the start of Section 2 was not intended to be exhaustive, we understand how the omission of healthcare systems may create unnecessary confusion, particularly as human health is explicitly treated as a societal domain in the paper. We have therefore revised the opening of the human settlements section to explicitly include healthcare systems among the relevant critical systems.

I also suggest shortening the sentence in lines 105–107 for clarity and readability.

We thank the reviewer for this suggestion and have revised the sentence in lines 105-107 to:

“This section explores how recovery within these settlements can become a prolonged struggle rather than a linear process when efforts to rebuild homes, infrastructure, and livelihoods are repeatedly disrupted. In this chapter, we discuss different pathways where inadequate or incomplete recovery can increase vulnerability and exposure to future risks (Fig 2).”

In the first pathway, the authors discuss increased exposure and vulnerability through displacement and relocation. However, the connection between this argument and the discussion in lines 114–117 is not entirely clear and could be strengthened.

The sentences in lines 114–117 mainly provided general background on the importance of housing for livelihoods and the long-term burden of housing loss for households. As these statements were not directly supporting the argument developed in the subsection, we have removed them to improve the flow of the section.

In lines 139–144, the manuscript refers to the lack of critical services such as WASH infrastructure. Here, it would be useful to clarify whether health-related impacts are considered disasters in their own right, and whether this example is intended to illustrate a consecutive disaster.

We thank the reviewer for raising this point. As mentioned in an earlier response, we have clarified the relation between natural-hazard induced disasters and other societal disruptions like health crises by adding a section addressing this in the introduction. We adopt an all-hazard approach that is consistent with the UNDRR (2021) Hazard Information Profiles, recognising biological and societal hazards alongside natural hazards.

In line with this, regarding the specific lines highlighted by the reviewer, we do not consider the lack of access to WASH infrastructure to be a disaster in its own right, but rather an underlying vulnerability condition that may increase susceptibility to biological hazards. To clarify this in the text in lines 139-144, we revised it to:

“Moreover, people staying in displacement camps and temporary shelters often lack adequate access to critical services, such as WASH infrastructure. This increases their susceptibility to biological hazards, which may result in subsequent emergence of new health crises”

This specific example is also reflected upon in the third section of the new reflection chapter (Section 6.3), where we discuss the ambiguities in the interpretation of impacts, vulnerability and exposure factors, and disasters in a consecutive disaster context:

“For example, a cholera outbreak following a flood may be interpreted as an impact of the flood resulting from disruptions to WASH services (Sect. 3.1). However, when considering the outbreak itself as the event of interest, the flood-induced WASH disruptions may instead be viewed as factors increasing vulnerability and exposure to the biological hazard, while the outbreak itself can be conceptualised as a disruptive event, with its own impacts, response, and recovery process.”

If WASH is considered part of the health subsystem, human settlement subsystem, or both, this should be explicitly stated.

We thank the reviewer for noting this point. As mentioned earlier, in the revised introduction, we have added a clearer explanation of how critical systems are positioned in relation to the different societal domains, explicitly recognising that *“the distinction between societal domains is not always clear-cut, as many critical systems and services are interconnected and support multiple societal domains simultaneously.”*

In this context, WASH infrastructure is explicitly recognised as a critical system that is relevant within both the human settlements and human health domains:

“For example, access to water, sanitation, and hygiene (WASH) is discussed primarily within the human health domain, but is closely linked to the living conditions, housing quality, and displacement dynamics considered in relation to human settlements.” (Introduction)

In Section 2.3, healthcare is identified as a critical system. This highlights the importance of clearly defining what constitutes a “critical system” and how these systems relate to the societal subsystems introduced earlier. Such clarification would also help explain why food systems are treated as critical systems rather than as considering ecosystems as critical system or why the issue of the food is not addressed economy societal subsystem section.

We thank the reviewer for raising this point. As outlined earlier, we have clarified in the revised introduction how critical systems and services relate to the societal domains discussed in this paper. Specifically, we now explicitly introduce critical systems and services on which societies depend, including housing, healthcare, governance structures, infrastructure, and food systems:

“Together, they [these societal domains] encompass a range of critical systems and services on which societies depend, such as housing, healthcare, governance structures, infrastructure, and food systems.”

Food systems are discussed at multiple points throughout the manuscript. In Section 2.3, we discuss how consecutive disasters can threaten food system redundancy and food security at local and regional scales. In Section 4.4, we further examine how disruptions may propagate through interconnected global food systems and trade networks, for example through breadbasket failures and supply-chain dependencies. We hope that explicitly introducing food systems as a critical system in the revised introduction makes these examples easier to identify within the broader conceptual framing of the paper.

With regard to ecosystems, we clarify in the revised introduction that the scope of the paper is explicitly focused on societal recovery within human systems. While ecosystems are undeniably essential to societal functioning, the recovery dynamics of ecological systems under consecutive disasters constitute an important but distinct field of study that lies beyond the scope of this perspective.

In Section 2.4, it is unclear whether the focus is on resource shortages, unworkable environments, or response capacity. I suggest maintaining a clear focus on one dimension and addressing others in relevant subsections. For example, maybe resource depletion could be discussed more comprehensively within the economic system section.

We thank the reviewer for raising this point. We have revised section 2.4 to focus more explicitly on the unworkable environments, by keeping only the labour-resource example and rephrasing is as follows:

“Ongoing hazardous conditions can also affect reconstruction, for instance, when labour efficiency is significantly reduced extreme heat conditions (Alshebani & Wedawatta, 2014).”

The statement in lines 184–185 regarding emergency systems remaining functional also requires clarification. If emergency workers are unable to perform their duties, it is difficult to consider the system functional.

We thank the reviewer for this helpful observation and have reviewed lines 184-185. The systems mentioned there mainly served as a textual connection to the critical systems discussed in the previous section. However, to avoid ambiguity as to what these systems might entail and whether or not they are functional, as it does not contribute to the argument that is central to this section, we have removed this part of the sentence from the revised manuscript.

Sections 2.5 and 2.6 appear to address similar concepts related to “Build Back Better” and could potentially be merged to reduce redundancy.

In line 198, the discussion refers to situations where recovery is completed, which may fall outside the paper’s stated focus on consecutive disasters. Some examples in Section 2.6 similarly refer to completed recovery and may introduce ambiguity.

We thank the reviewer for pointing out these sections. Upon revising the manuscript with a stricter focus on ongoing recovery processes between events, we believe that Sections 2.5 and 2.6 primarily discuss recovery dynamics in a broader sense in between events, rather than specifically in the context of consecutive events. While these sections were originally included because reconstruction and building back better influence the potential impacts of subsequent disasters, we agree with the reviewer that this falls outside the scope of the perspective and might result in ambiguity. Therefore, these sections have been removed from the revised manuscript. We also have revised Fig. 2 to reflect these changes.

- Health-Related Pathways

Section 3 presents four pathways, three of which focus on outbreaks, epidemics, and pandemics, and one on mental health impacts. In my view, these topics could be more effectively integrated into earlier sections. For example, health-related impacts could be framed as disasters shaping a consecutive disaster environment, with health systems treated consistently as critical systems. Changes in working environments due to outbreaks could also be discussed within Section 2.4.

Please consider this as a suggestion. In my view, this section could be structured differently and, rather than being framed around the health system, it could be presented with a stronger focus on human health as shown in figure 1. I recognize that this would require substantial changes to the overall structure of the paper; however, I encourage the authors to reflect on this possibility and to consider alternative conceptual frameworks beyond the current organization around four societal subsystems. There is also an easy solution to partially address this confusion: just change the title of the section to impact on the human health! and keep it consistent through the section.

We thank the reviewer for this thoughtful suggestion and for recognising that alternative ways of organising the examples discussed in this paper are possible. We acknowledge that there is some overlap between the pathways discussed in Sections 2 and 3, particularly given the cross-cutting nature of healthcare systems as critical systems. However, following the broader revisions to the manuscript and the clearer distinction now introduced between societal domains and critical systems, we believe that the current structure remains the most suitable for the purpose of this perspective.

Specifically, the section on human settlements focuses primarily on recovery processes related to the physical and built environment, including housing and critical infrastructure

systems, including healthcare infrastructure, while Section 3 focuses on human health more broadly, encompassing not only disruptions to health-related critical systems, but also physical and mental health outcomes. We agree with the reviewer that health-related impacts may themselves constitute disasters and thereby shape a consecutive-disaster environment, and that health systems can be treated consistently as critical systems, as discussed in earlier responses.

At the same time, we recognise that the original title of the section may have created confusion between health systems as critical systems and human health as a societal domain. To reduce this ambiguity, we have revised the title of Section 3 to *“Impacts on human health”*, in line with the reviewer’s suggestion.

- Economic System

Section 4 is, in my opinion, one of the strongest parts of the paper. One aspect that could be further strengthened is a clearer definition of economic recovery. Specifically, what does it mean for an economic system to be considered “recovered”?

We thank the reviewer for requesting this clarification. We agree that what it means for a societal domain to be considered “recovered” is not self-evident and depends on the scale and indicators through which recovery is assessed. Rather than prescribing a single definition of recovery for each societal domain, we now explicitly acknowledge this conceptual ambiguity and discuss it in the new reflection chapter, where we reflect on how system definitions shape interpretations of recovery.

To make this clearer throughout the manuscript, we have also added a brief introductory paragraph to each of Sections 2–5 outlining how recovery may be operationalised within that specific societal domain. For the economic domain, we now explain that recovery may be reflected through indicators such as household finances and debt levels, business revenue, government budgets, and gross domestic product (GDP).

Section 4.4 raises important questions about the scale of analysis. I suggest explicitly incorporating scale into the definition of consecutive disasters, clarifying at which spatial and temporal scales events are considered consecutive.

We thank the reviewer for highlighting the importance of scale in defining consecutiveness. We agree that spatial and temporal scales play a fundamental role in shaping how recovery and consecutiveness are understood. However, similarly to the question of when recovery can be considered complete, rather than prescribing a fixed definition or threshold for determining recovery and consecutiveness across contexts, we believe that a more appropriate contribution of this perspective is to highlight how analytical choices regarding system boundaries, indicators, and spatial and temporal scales influence both recovery trajectories and the definition of consecutiveness itself.

The illustrative examples discussed throughout the paper demonstrate the broad range of interpretations and framings that may emerge depending on these choices. We have therefore explicitly addressed this in Section 6.2 of the revised reflection chapter, where we reflect on how different system definitions and analytical framings shape our understanding of recovery and consecutive disasters.

In Section 4.5, the relevance to consecutive disaster recovery is less evident and may require further justification or reframing.

We thank the reviewer for this observation. In line with other comments, we have sharpened the manuscript's focus on consecutive disaster recovery specifically. As a result, we decided to remove Section 4.5, as the link with consecutive disasters was less apparent. Additionally, we question the potential for positive effects specifically under consecutive disasters. We reflect on this within the new reflection chapter, Section 6.1.

- Socio-Political System

A key issue in this section is whether political instability is conceptualized as a disaster. This point should be clarified explicitly. If political instability is considered a disaster, then it would be useful to apply a similar logic across other societal subsystems (e.g., economic instability as a disaster interacting with other hazards).

We thank the reviewer for raising this important point. This concern is closely related to earlier comments regarding the conceptualisation of health crises and economic shocks as potential disasters. In the revised introduction, we have therefore clarified that we adopt an all-hazard perspective that recognises biological and societal hazards alongside natural hazards, while using the term *disaster* as a standalone term to refer to disasters resulting from natural hazards, for conceptual clarity.

At the same time, we explicitly acknowledge that the distinction between disasters, impacts, vulnerability and exposure conditions is not always clear-cut, particularly in the context of consecutive disasters. Political instability, health crises, and economic shocks may be framed as independent disasters, as impacts resulting from prior disasters, or as contextual conditions that shape vulnerability and recovery trajectories. Rather than prescribing a single interpretation, we discuss these conceptual ambiguities explicitly in Section 6.3 of the revised reflection chapter.

We have revised the manuscript to ensure that this conceptualisation is clearly explained and applied consistently throughout the paper.

I recommend revisiting page 18 with a strong focus on consecutive disaster recovery dynamics.

In response to the reviewer's earlier suggestions, we have clarified the conceptual framing of societal- and health-related hazards as disasters throughout the manuscript. We believe that this revised framing more clearly situates the examples in Section 5.1 within the consecutive disaster context. We have moved the conceptualisation of political instability as a disaster to the introduction of Section 5, ensuring that the understanding of these concepts is established before the examples are presented.

Additionally, the issue mentioned in line 474 would benefit from a concrete example.

We thank the reviewer for this suggestion. We reviewed the available literature for a suitable empirical example but found that the evidence is primarily discussed at a more general level rather than illustrated through well-documented case studies. Therefore, we have chosen to remove this argument. We believe that the remaining examples in the paragraph sufficiently

illustrate the key point regarding the implications of political instability for disaster response and recovery.

Finally, the term “socio-political system” may be too broad to capture the concepts discussed in this section. Alternative framings such as disaster risk governance, institutional capacity, or disaster risk management may be more precise.

We carefully considered the suggested alternatives. However, we believe that each of these terms captures only part of the pathways discussed in this section. As the chapter also addresses broader societal processes, such as conflict and inequalities, we decided to retain the broader term. We did revise the framing to “socio-political domain” to remain consistent with the rest of the manuscript, where we avoided the term “system” in the section headings for conceptual clarity. We have also expanded the introduction to the section to provide a clearer definition of the socio-political domain and its scope.

Section 5.3, in particular, appears only loosely connected to consecutive disaster recovery dynamics. The ideas presented here may be more effectively integrated into the next sections like in section regarding the tipping point that leads to increase societal resilience.

We thank the reviewer for this observation and agree that the arguments presented in the former Section 5.3 discussed instances that were not sufficiently within the scope of consecutive disasters, as recovery was largely finished between events. In line with earlier comments regarding the scope of this perspective, we have revisited the manuscript to sharpen the focus on consecutive disaster contexts only, excluding examples and pathways in which recovery is completed between events.

Importantly, and in response both to this comment and to earlier remarks from RC1 regarding the limited discussion of positive examples, we have reassessed the potential for positive change in the context of consecutive disasters. While disaster recovery may in principle create windows of opportunity for positive transformation, we recognise that the examples of positive change presented in the original manuscript predominantly concerned instances in which recovery was completed between events.

As a result, Section 5.3 has been removed as a standalone section and some of the discussion on potential for positive change has been reused in Section 6.1. There, we integrated the discussion of how recovery processes can create windows of opportunity, but, after reassessing the scope and role of positive examples, we place greater emphasis on how consecutive disasters act as inhibiting factors, limiting opportunities for positive change by interrupting recovery processes and reinforcing negative feedbacks. In line with these changes we have revised Fig. 5.

Implications

Section 6 has the potential to be a core contribution of the paper; however, in its current form it reads more as a summary of previous sections. I encourage the authors to deepen the analytical discussion, particularly by strengthening the link between their findings and the framework proposed by Spaier et al. (2024).

Specifically, clarifying what constitutes tipping points within each societal subsystem and what is meant by “system transformation” would greatly enhance the paper’s theoretical

contribution. Examples discussed earlier in the paper, or new illustrative cases, could be used to demonstrate how societal resilience may be improved.

We appreciate the suggestions of the reviewer regarding Section 6. Based on the combined feedback from both reviewers, we have reassessed the role of the Spaiser et al. (2024) framework as well as the broader tipping point discussion. We believe that the original framing of the manuscript, particularly the more prominent role given to the tipping point literature in the introduction, may have created confusion regarding the purpose of the discussion on tipping points and recovery trajectories. We would like to emphasize that identifying specific tipping points, or determining specific conditions under which tipping points occur, was not the aim of this paper. Addressing such questions would require dedicated analytical and quantitative studies beyond the scope of this perspective. Rather, the tipping point literature was intended as a potential lens through which the long-term implications of disrupted recovery can be conceptualised.

In the revision, we have therefore reframed the introduction to position tipping points less centrally and have substantially revised the final chapters of the manuscript into a reflection chapter on the conceptual complexities of recovery under consecutive disasters, supported by examples discussed earlier in the paper. We have integrated former Section 6 into this new reflection chapter, specifically into Section 6.1, where we reflect on how consecutive disasters may contribute to reinforcing feedbacks associated with negative tipping, while simultaneously constraining opportunities for positive transformation.

Finally, in line 557 migration is described as a negative feedback loop. I would caution that migration is not necessarily negative and can also be understood as an adaptive strategy, particularly for populations facing adverse or uninhabitable conditions.

We thank the reviewer for this important point and agree that migration should not be framed as inherently negative. We have revised the respective section (now in Section 6.1) to clarify that migration can also function as an adaptive strategy:

Spaiser et al. (2024) describe similar reinforcing dynamics in displacement-related tipping processes, where feedback mechanisms such as disrupted livelihoods, cultural heritage loss, and weakened social networks can contribute to prolonged displacement and eventually outmigration after disasters. Under consecutive disasters, such dynamics may be further amplified, as repeated disruptions can prolong displacement, and displaced populations often face increased vulnerability (Sect. 2.1) and reduced access to disaster preparedness and recovery efforts (Sect. 5.1). While migration can also function as an adaptive strategy under changing risk conditions, outmigration may also be forced by a situation in which recovery is no longer being feasible or desirable in the original location (Thorn et al., 2023; Wiederkehr et al., 2018).