Response to RC1

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 more clearly conveyed to the reader.

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 paper does not aim to determine at what stage tipping points occur or which pathways are most prevalent. As the reviewer rightly observes, addressing these questions would necessitate more detailed analytical and quantitative investigation beyond the scope of the present study.

We acknowledge that, if the paper is read with the expectation of providing analytical results, the broad range of topics covered may appear problematic in terms of analytical depth. However, we believe that the value of the paper lies in illustrating the complexity of recovery processes in the context of consecutive disasters, and in showing how recovery can be affected in many different ways within and across societal domains, spatial and temporal scales.

To clarify the framing and purpose of the paper, we propose several adjustments to the manuscript, which we will outline below and address in more detail under the respective comments.

I. First, we will move away from our framing around the Spaiser et al. (2024) tipping-point framework, as this may have suggested causal identification or quantitative analysis beyond the scope of the manuscript. Instead, more in line with the intended purpose of the empirical examples, we will present the different societal systems as a cross-section of society that illustrates how consecutive disasters can fundamentally increase the complexity of the recovery process across spatial and temporal scales, with potentially interrelated consequences across societal domains. We will clarify that these domains do not represent an exhaustive coverage and that additional (societal) domains could be considered. We believe that the strength of this paper lies in bridging the disciplinary silos. While people might already be aware of some of the complexities, we show how far-reaching the effects can be, within one aspect of society, but also connecting between the different societal domains.

II. Second, we propose to revise and restructure Chapters 6-7 into a single reflection chapter that provides a clear conceptual synthesis of recovery complexity in the context of consecutive disasters.

We understand how chapter 6 might have been interpreted as vague if the expectation was that it would provide analytical insights into e.g., which pathways are most likely to lead to tipping points, when tipping points are reached, etc. However, this chapter was intended as a conceptual discussion, highlighting that recovery is not always linear and that a system does necessarily return to a pre-disaster state, particularly under consecutive disasters.

Reassessing the discussion in light of the reviewers' comments, we also acknowledge that several of the recommendations included in the original manuscript, particularly those related to scientific research, were based on conceptual reflections of the concept of recovery in a consecutive disaster context. However, we see that these implicit conceptual reflections were not made sufficiently explicit, making the recommendations feel insufficiently grounded in relation to the rest of the manuscript

Therefore, rather than focusing on recommendations, the revised chapter will explicitly reflect on how recovery, consecutiveness, and outcomes are shaped by system definition and analytical choices. Integrating Chapters 6 and 7 into one combined new Chapter titled: "Reflecting on the complexity of recovery and consecutive disasters." This chapter will be structured around three interrelated reflection points that we will outline below.

Reflection point 1: System definition

- This reflection point will address how system definition (i.e., the choice of indicators, societal subsystems, spatial and temporal scales, and the interconnections considered) directly shapes how recovery is defined, how consecutiveness is interpreted, and what recovery outcomes are observed.
- We will reflect on how recovery may appear complete in some subsystems (e.g., physical reconstruction) while remaining incomplete in others (e.g., mental health, governance capacity, or financial buffers), thereby affecting whether subsequent events are classified as consecutive. We will further discuss how incorporating spatial, sectoral, and functional interconnections can reveal forms of consecutiveness that are missed when recovery is assessed for a system or region in isolation. Finally, we will reflect on practical challenges in defining recovery timescales and event boundaries in contexts of prolonged or incomplete recovery, highlighting limitations of existing definitions of consecutiveness and the need for transparent system boundary choices tailored to the research question.

Reflection point 2: Recovery trajectories and "the recovered state"

- This reflection point will integrate the conceptual reflections that were originally embedded in Chapter 6, focusing on the non-linearity in recovery trajectories under consecutive disasters, tipping points, and the definition of "the recovered state".
- We will discuss how consecutive disasters can increase the likelihood of non-linear responses and the occurrence of threshold effects leading to complex recovery

trajectories . Such complex trajectories potentially pushing systems toward alternative, new, or harder to reverse states, a process which may be conceptualized as tipping. Specifically, in this context, recovery does not necessarily imply a return to pre-disaster conditions. We will therefore reflect on how the definition of a “recovered state” is inherently system-dependent, and should encompass non-linear and complex responses, as well as alternative system states. Additionally, we will discuss how what constitutes recovery may differ substantially across systems, such as physical assets, financial systems, governance structures, or social well-being.

- We will also address that while recovery can, in principle, create opportunities for positive transformation, consecutive disasters often inhibit such change by shifting attention and resources from long-term development to short-term response. These reflections highlight why simplified or static recovery assessments are inadequate in consecutive-disaster contexts and motivate the need for more dynamic recovery and risk assessment approaches.

Point 3: Conceptualization of “disasters”

- This reflection point will address conceptual ambiguities surrounding what constitutes a disaster versus an impact or contextual/vulnerability factors, and how this becomes more difficult to separate when adopting an all-hazard, consecutive disaster perspective. This point is added in response to feedback from the second reviewer regarding the framing of disasters stemming from natural hazard events, in relation to e.g., health crises, political instability, and socio-economic disruptions. In addition to this reflection point, a clear definition of how we consider these concepts throughout the paper will be added to the introduction.

Rather than prescribing a single definition or framing, all of these reflections highlight the need for transparency and reflexivity in analytical framing, recognizing that multiple valid interpretations may exist depending on the research question.

We believe these changes will result in a more coherent manuscript with a clearer conceptual contribution, better aligned with the reviewer’s expectations and concerns.

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 entail complex recovery dynamics that would require in-depth analysis in dedicated studies to fully untangle 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. Instead, the purpose of the paper is to illustrate how the consecutiveness of disasters adds multiple layers of complexity to recovery processes across societal domains, and how recovery dynamics in different subsystems can interact across spatial and temporal scales. We hope that the revised framing of the manuscript, which explicitly clarifies its conceptual nature and intended contribution, will help to better understand the added value of this high-level perspective and to address concerns regarding the paper's broad focus.

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 line with the observation of the reviewer, the figure indeed aims to convey the complexity in recovery trajectories across societal domains, and that interactions are involved. We believe that through the adjusted framing of the paper, clarifying its conceptual nature, the added value of the figure becomes clearer to the reader. It is a visual aid that helps the reader to understand the different dimensions of complexity that are involved and that will be illustrated through examples in the paper. We further will in addition improve the figure based on the concrete suggestion from RC2.

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 agree with the reviewer that the paper has a conceptual nature that should be conveyed more clearly to the reader. As outlined in the overarching response, we will therefore 1) adjust the framing of the paper in the abstract and introduction to clarify that the purpose of the paper is to illustrate and discuss the different dimensions of complexities of the recovery process involved and highlighted in the context of consecutive disasters, and 2) rewrite the discussion section to be a more conceptual discussion of the complexities involved in recovery dynamics in a consecutive disaster context.

In line with this reframing, we will also revise the title of the manuscript to avoid misleading expectations, to "A perspective on the complexity of recovery dynamics in the context of consecutive disasters" or something similar.

With respect to the reviewer's comment on the empirical examples, we acknowledge that these should be understood as illustrative rather than systematic evidence. The examples in Chapters 2–5 are used non-exhaustively to support and ground the conceptual discussion, illustrating the diversity of recovery dynamics and pathways that can arise under consecutive disasters. The pathways presented were developed through iterative interdisciplinary discussions among the co-authors, informed by both the empirical examples and the existing literature, rather than being pre-defined. We expect that the revised framing will make the role of these examples clearer and align expectations accordingly.

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 agree with the reviewer that the paper includes more negative rather than positive examples and that there are more positive effects on transformative learning that can take place after a disaster.

However, based on a comment provided by the second reviewer, we have decided to take the opportunity to strengthen the consecutive event focus of our paper.

After careful consideration, we recognise that some of the pathways and examples that were provided in the first version of the manuscript, particularly those related to positive change, are actually beyond the scope of consecutive disasters, addressing instances where recovery was able to finish between events (e.g., Section 5.3 on societal learning and adaptation action).

With this refined focus, we find limited evidence of positive transformation occurring during unfinished recovery phases (e.g., in the example of spatial planning policies and/or building codes, while the measures are designed and implemented already during the recovery process, they only become relevant in practice once you have rebuilt in a new location or using improved building guidelines, so after recovery is done). Instead, consecutive disasters often appear to inhibit positive change by redirecting attention and resources from long-term planning to short-term response.

We will go over the text in detail to sharpen our consecutive focus, which will result in the removal of some examples of positive change that are now present in Chapters 2-5, such as section 5.3, and integrate “consecutive disasters as inhibitors of positive change” into reflection point 2 as described above.

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.

This concern is addressed under Revision II in the overarching response. In short, identifying which pathways are most important or common, or determining the conditions under which tipping points occur, was not the intended aim of this paper, as such questions would require dedicated analytical and quantitative studies beyond the scope of this conceptual contribution. In the revision, Section 6 will be integrated into the new reflection chapter and explicitly reframed as a conceptual discussion of non-linear recovery trajectories and alternative recovered states under consecutive disasters, clarifying what insights this section intended to provide.

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 discussion section may appear insufficiently grounded in the preceding sections. These recommendations initially aimed to provide potential avenues forward that could address the challenges we identified across societal domains in Chapters 2-5. However, we acknowledge that selecting specific policy instruments (such as particular financing mechanisms) can give the impression of prioritization that goes beyond the conceptual scope of the paper.

As outlined in the overarching response, to improve coherence and better align the manuscript with its conceptual and perspective-oriented contribution, we will move away from a recommendation-focused discussion. Instead, Chapters 6 and 7 will be integrated and revised into one reflection chapter that explicitly synthesizes conceptual insights on recovery complexity under consecutive disasters. In this process, policy-oriented recommendations will be removed, as they do not fit well within the revised framing.