# Author comment to Julia Crummy (Referee 2)

Dear Editor and Reviewer Julia Crummy,

I would like to express my sincere gratitude to Reviewer Julia Crummy for her thoughtful, constructive, and encouraging feedback on our manuscript. Her comments reflect a deep understanding of the topic and a commitment to strengthening the clarity, utility, and rigor of our work. We appreciate her recognition of the value of the dataset and methodology presented, as well as the manuscript's relevance to disaster risk management beyond the specific case of Tenerife.

Below, I provide a detailed, point-by-point response to each of the reviewer's comments. Changes made in response to the suggestions have been incorporated into the revised manuscript and are tracked accordingly. For clarity, each reviewer comment is restated, followed by our response.

**General Comments**

We are very pleased that the reviewer found the manuscript to be clearly written and the dataset well-structured, and we especially value the recognition of its wider applicability to other volcanic islands and contexts. We agree entirely with the importance of transparent multi-hazard analysis, and this manuscript aims to contribute toward the standardization and systematic use of such data for decision-making. The minor revisions suggested are welcome and have been addressed in full.

**Line 1** – *I would argue that it is not a database, but rather, a dataset.* - We agree with the reviewer's distinction. The manuscript now uses the term "dataset" throughout to describe the downloadable Excel file, as it is a static, curated collection of event records rather than a dynamic, relational database.

**Line 14** – *Having read through the manuscript, vulnerabilities haven't really been covered here.* – We appreciate this observation and would like to clarify the approach taken. While the manuscript does not perform a formal vulnerability assessment in the quantitative or model-based sense, the dataset captures qualitative expressions of vulnerability through documented economic losses, social impacts (e.g. , deaths, injuries, displacements), and environmental damage. These fields, together with entries related to emergency response and recovery, provide a multi-dimensional picture of societal fragility and resilience in the face of hazards. To better reflect this, we have modified the terminology in key parts of the manuscript to emphasize that we describe "impacts", which are valuable indicators of vulnerability. A full vulnerability analysis remains outside the scope of this dataset-focused paper but is facilitated by the data provided for future research. This clarification has been added in the Methods and Discussion sections.

**Line 34** – *forecasting – many of these hazards cannot be predicted.* – Agreed, the word has been corrected.

**Line 36** – *quantitative risk assessments.* – Agreed, the word has been added.

**Line 43** – *forecast.* – Agreed, the word has been corrected.

**Line 54** – *quantitative risk models. In the absence of reliable data, qualitative risk assessments can be done. The level of accuracy could be debated, but I think they are not inaccurate…* – Agreed, the word has been added.

**Line 62** – *Agreed, but robust exposure, vulnerability (physical, social, economic) and resilience data are also needed.* – Fully agreed. We have expanded this sentence to highlight the essential role of exposure, vulnerability, and resilience data.

**Line 64** – *I disagree with this – the full spectrum of impacts will depend heavily on exposure and vulnerability, which is dynamic and therefore very complex to quantify and measure. Past multi-hazard events will only give so much information and should be complemented with impacts studies, vulnerability, exposure etc data.* – The sentence has been reworded to reflect that while historical records provide a foundation, they must be complemented with dynamic data on exposure and vulnerability,

**Line 69** – *more accurate.* – Agreed, the word has been added.

**Line 89** – *Is this still debated or is it agreed that it is a mantle plume? Would it be better to state mantle hotspot?* – Unfortunately, this is still a matter of debate and it seems that it will still take quite long to reach a consensus on this issue. This is why in this paper we have preferred to not insist on it as it is not a relevant aspect for the purpose of our study. Anyway, we have slightly modified the text to clarify this point. The origin of Canarian magmatism, whether it is the result of a persistent mantle plume or active tectonics or a combination of both, is still a matter of considerable debate (Hernández-Pacheco 90 & Ibarrola, 1973; Anguita & Hernán, 1975, 2000; Schmincke, 1982; Araña & Ortiz, 1991; Hoernle & Schmincke, 1993; Carracedo et al., 1998; Fullea et al., 2015).

**Line 112** – *such as…* – Expanded to provide specific examples for clarity about different volcanic hazards.

**Line 148** – *delete (you're talking about hazards here, not risks).* – Done.

**Line 154** – *I would add "The PEIN" before "Risk assessment" here, as risk assessments usually include all components of risk not just the two parameters used here. I would argue that what they do is not a comprehensive risk assessment as, given what is described here, they do not include exposure, vulnerability or resilience.* – Done. The sentence has been corrected to "The PEIN risk assessment…".

**Line 155** – *The use of an index is normally considered a qualitative or semi-quantitative approach. I would just delete "quantitatively" here.* – Done.

**Line 186** – *This image is fuzzy for me.* – The image has been replaced.

**Line 234** – *Just wondering why drought isn't specifically included? This hazard has been a serious problem for Tenerife in recent years, and will surely worsen with the changing climate. Also, it is important in terms of multi-hazard cascades with resulting forest fires.* – Thank you for this pertinent comment. Drought is indeed a critical and increasingly relevant hazard for Tenerife, particularly given its cascading relationship with forest fires and water stress. In this section, we had listed a few illustrative hazards rather than presenting an exhaustive inventory. Nonetheless, in response to your suggestion, we have now explicitly added drought,

alongside other relevant underrepresented hazards such as heatwaves and ocean wave impact, to better reflect the full multi-hazard spectrum affecting the island.

**Line 243** – *repetition, not needed.* – Deleted.

**Line 252** – *Was it just cascading, or were coincident and compounding hazards also considered?* – This is a key distinction, and we appreciate the opportunity to clarify it. The dataset, as presented, is primarily descriptive and compiled from documented historical events, with an emphasis on capturing direct cascading relationships (i.e. secondary hazards triggered by a primary one). At this stage, we have not explicitly classified or interpreted events as "coincident" or "compounding", given the objective was to provide a reliable, objective record of events, rather than to perform a systems-based analysis of interactions. However, this classification is indeed possible using the dataset, and we are currently exploring such typologies in follow-up work.

**Line 374** – *Needs the reference: Newhall and Self, 1982.* – Citation added. Thank you for this correction.

**Line 377** – *urban fires.* – We respectfully clarify that the fires described occurred predominantly in forest contexts, especially in canarian pine forests, and not in urban areas. We have corrected the term from "wildfires" to "forest fires" to more accurately describe the events.

**Line 377** – *These should also be included with ballistics.* – We understand your concern, but our dataset includes only those scenarios supported by historical evidence for the studied time range (1496–2020). No documented cases in Tenerife during this period link volcanic ballistics with subsequent fires. While we agree such scenarios are theoretically plausible and may occur in many volcanic scenarios, including in Tenerife, their inclusion here would be speculative and outside the empirical scope of this study. Nonetheless, the revised Discussion section now clarifies that this dataset does not capture all possible hazard interactions, but rather those that are documented, with room for expanding future scenario modelling based on additional literature and regional analogues.

**Line 379** – *Not all possible. This would be assuming that the record you have is 100% complete and that what happened in the past is what will happen in the future. There are other events that can happen in the future that may have never happened before here. You talk to this further down, so I suggest just rewording this.* – Totally agreed, we have reworded to acknowledge the limits of historical completeness, and the fact that future scenarios may differ, especially under changing environmental. However, some explanations is given below that sentence.

**Line 382** – *also under-reporting, missing records etc.* – We fully agree that under-reporting and missing records are critical limitations in most historical hazard datasets. However, in the specific case referenced (volcanic eruptions on Tenerife since 1496), the documented events have been corroborated by stratigraphic and petrological studies, giving us confidence that no historical eruptions during this period have been missed. That said, we acknowledge that this level of certainty does not apply equally across all hazard types (e.g., landslides, floods). However, that statement referred only to volcanic eruptions.

**Line 383** – *I disagree with this statement. Just because something has happened before doesn't mean it will happen again. This statement might be true for some of the events you have listed*

*(e.g. flooding) but with the changing climate, other multi-hazard scenarios not listed here, might well be more likely in the future.* – We agree with the reviewer that recurrence does not imply certainty, especially in a changing climate. Our intention was never to imply determinism, but to stress that historically recurring scenarios can inform probabilistic planning. We have revised the sentence to clarify that the dataset enables the identification of plausible, historically grounded scenarios, while also acknowledging that emerging hazards and changing system dynamics may generate new or previously unrecorded interactions.

**Line 384** – *There is no inclusion of this in the text – it would be nice to see some sort of discussion on risk management.* – We appreciate this comment and recognize that more could be said. The scope of this paper is centered on the creation and structure of the multi-hazard dataset. Therefore, we have not wanted to devote much more space to risk management, something that we will address later in a step-by-step process, moving from the most objective and scientific aspects to the more social and management-related aspects. Even so, several mitigation measures are proposed within the scope of the multi-hazard management in Tenerife, in accordance with the scenarios and impacts compiled. Moreover, several entries in the dataset include descriptions of emergency response and recovery, which provide valuable lessons for disaster risk management. We also indicate areas where future research can deepen the integration between empirical event data and risk governance practices.

**Line 386** – *Where is this presented and discussed in the text? Vulnerability is key and inherently difficult to assess, so any insights on vulnerabilities is valuable for DRM.* – The sentence in question referred to the identification of patterns of vulnerability, based on recorded impacts. These include location-specific trends (e.g., recurrent flood damage in low-elevation coastal settlements), severity of impacts (displacement, fatalities, infrastructure damage), and systemic weaknesses in recovery. While we acknowledge that no formal vulnerability index was computed, these descriptive fields offer valuable qualitative insights. We have clarified this in the revised manuscript by explicitly stating that patterns of vulnerability were inferred from observed impacts, not calculated through structured indices.

**Line 388** – *Yes! This is what this paper provides, which is so valuable – possible scenarios, not all scenarios.* – Statement retained and now reinforced with a clearer explanation: this is a scenario-support tool, not a predictive one.

**Line 401** – *hazard not risk.* – Corrected.

**Line 427** – *Is this no. 7 in the list?* – Good point, thank you.

**Line 467** – *Delete – repetition.* – Deleted.

**Line 484** – *It feels a little bit out of place to go into so much detail on citizen science here. Why are you focusing on this in particular? Do you have example where this has really helped? I would prefer to see more focus on community engagement to raise awareness of natural hazard events, potential multi-hazard events that could impact them, and shared learning on how individuals, communities, organisations could increase their own resilience to such events. Also, an important aspect of learning from past events, is local wisdom – learning from people through the stories they share and pass down through generations.* – This is a helpful distinction. Our intention was to refer broadly to citizen participation in the observation, documentation, and interpretation of hazard events—both through formal channels (e.g., intensity questionnaires, landslide reporting apps) and informal, culturally embedded practices (e.g., oral histories, traditional knowledge). To clarify, we have separated "citizen science" (in

the scientific project participation sense) from "community-based engagement", which includes local wisdom, shared learning, and participatory resilience-building. Both are vital, and we now emphasize the complementarity between structured initiatives and community-rooted knowledge systems.

Once again, we thank the reviewer for her insightful and encouraging review. We believe these changes significantly improve the manuscript's clarity, completeness, and utility, and we hope it now meets the high standards expected by the journal.

With kind regards,

**Marta López-Saavedra**
Corresponding author on behalf of all co-authors
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