

Author response

We sincerely thank the Editor and both referees for their careful reading of our manuscript and for the constructive comments provided. We have addressed all points raised in the reviews and made substantial revisions to strengthen the clarity, structure, and analytical depth of the paper. In addition to the scientific revisions, we thoroughly proofread the manuscript to correct typographical and grammatical issues, and we carefully rechecked all figures and tables to ensure consistency, accuracy, and readability. All changes are presented in the tracked-changes version of the revised manuscript. Below, we provide a detailed point-by-point response to each referee comment and indicate the corresponding modifications introduced in the manuscript.

Response to Referee 1

We sincerely thank the reviewer for their thoughtful and constructive comments, which have significantly strengthened the clarity and analytical depth of our manuscript. Following the recommendations, we have made substantial revisions to the paper and have now uploaded the full dataset (574 observations) associated with this study to Zenodo, where it is publicly accessible. We also attach a tracked-changes version of the revised manuscript showing all modifications made throughout the text.

Below, we provide a detailed response to each comment and explain the corresponding revisions introduced in the manuscript.

1. Global South

Reviewer comment: Clarify the sense in which the term *Global South* is used.

Response:

To contextualise our use of the term *Global South*, we have added a definition directly supported by Quesada-Román (2022) in both the abstract and the introduction. These additions are underlined in the revised manuscript. The following passages were added:

Abstract (added text):

“These insights, grounded in a Global South context—characterised by rapid uncontrolled urbanisation, offer a valuable perspective for the development of inclusive and effective carbon dioxide diffuse degassing risk management strategies.”

Introduction (added text):

“The rapid growth of Goma, as several cities in the Global South (Quesada-Román, 2022), driven by intense migration due mostly to recurring armed conflicts in the region and professional opportunities seeking (Pech et al., 2018; Pech & Lakes, 2017), has extended the city to the west part highly concentrated in mazuku, exposing a large population.”

This clarifies the conceptual grounding of the term and reinforces the contextual positioning of the study.

2. Awareness campaigns and local knowledge

Reviewer comment: Discuss local knowledge and awareness in more detail.

Response:

We have added a photograph of the mazuku warning sign used locally, along with a full translation of the messages on the sign (see attached revised file). To further expand on the dimension of local knowledge, we introduced the following paragraph at the beginning of Section 3, drawing from interview and elder testimonies:

“The Mazuku-affected area under study, which is now inhabited, was unoccupied three decades ago. At that time, the region was covered by an open woodland typical of the area. According to testimonies gathered from local elders, people used to cross it at dusk to reach Lake Kivu for fishing, or early in the morning when returning with their catch. It also served as a hunting ground for Gambian rats and as pastureland for livestock before it was settled. These activities mostly took place in the evening or early morning when the mazuku concentration is high. Therefore, many people, as well as livestock, lost their lives asphyxiated, which was then regarded as an evil wind—one that had neither a smell nor a visible form. Today, the area is

inhabited by new residents with a more urban lifestyle than the earlier inhabitants and the term was kept (Pech et al., 2018; Vlassenroot & Büscher, 2009)."

This addition strengthens the historical and cultural interpretation of mazuku and situates awareness practices within long-standing local knowledge systems.

3. Temporality and population sensitisation

Reviewer comment: The manuscript should better address the temporal aspects of mazuku occurrence and the associated sensitisation strategies.

Response:

After revisiting the interview transcripts and focus group discussions, we incorporated detailed local testimonies that highlight seasonal patterns, daily timing, and household strategies for raising awareness among children and newcomers. The following testimonies were added to the results section and reinforced in the discussion:

"Mazuku incidents tend to be more frequent in the evening or early morning, and when the temperature is low during the rainy seasons. You cannot see the mazuku or detect any odour, but sometimes, on a path, you suddenly feel suffocated as though someone were pressing on your chest, and you cannot breathe. At that moment you must act quickly and leave the area while you still can..."

"Just after the dry season — at the beginning of September when children return to school — the first critical period begins and lasts until December. It is followed by a second critical period during the rainy season, from February to May every year. These periods are particularly hazardous because they coincide with the school term, when children have to leave home early for classes."

"In this context, we do our best to inform our children, newcomers or everyone in the neighbourhood, about the locations of these mazuku zones: we encourage them to identify them and to stay well away from them, especially when it is cold."

(A mother of four children at primary school, 13 years of residence in the area)

These additions significantly enhance the temporal dimension of mazuku risk and underline the importance of everyday awareness mechanisms within households and neighbourhoods.

4. Conclusion

Reviewer comment: Strengthen the conclusion and emphasise future research perspectives.

Response:

We reworked the final paragraph of the conclusion to highlight future research avenues and operational implications. The following has been added and refined:

“This study offers novel insights into the implementation of risk mitigation practices addressing volcanic gas emissions in active volcanic zones—such as heating courtyards or blocking gas with household waste—examined through a Global South perspective characterised by rapid and largely uncontrolled urbanisation. It reinforces the call, made by other scholars, for the co-creation of mitigation strategies with local communities, rather than the imposition of externally derived solutions that may not be effective in the local context. Future research could complement these findings by assessing the actual effectiveness of such mitigation measures through physical measurements of mazuku concentrations—not only in public spaces but also within buildings—and by further examining local risk perception. Moreover, volcano monitoring programmes in Goma and the surrounding areas should diversify their focus to include systematic monitoring of mazuku and recognise it as a significant public risk requiring sustained attention.”

This revised conclusion better articulates the scientific and practical contributions of the study while outlining concrete directions for future work.

End

Referee 2

Dear Referee,

We sincerely thank you for your thorough and constructive review of our manuscript, as well as for your encouraging assessment of the study's relevance to NHESS and the quality of the mixed-methods data collection. We highly appreciate your suggestions on improving the paper's structure and presentation. We have carefully considered each point and revised the manuscript accordingly. Below we provide our point-by-point responses.

1) Scope and limitations

Thank you for this helpful recommendation. We agree that clearly stating the scope and limitations early strengthens the framing of the manuscript and makes explicit that the core focus is on analysing population perceptions. In response, we revised the introduction to clearly emphasise that the study assesses household representatives' perceptions of local mazuku mitigation measures (PDF, lines 81–83), as follows:

“In this perspective, this study seeks to examine household representatives' perceptions regarding the implementation of local mazuku mitigation measures, focusing on their perceived efficacy, associated costs, extent of implementation, and motivations for adoption.”

2) Study area and scope of the study

We thank the referee for this important suggestion regarding clarity for readers unfamiliar with the Goma region. We modified the text as suggested (lines 43–44 and 59) and reformulated the relevant sentences to ensure the introduction remains focused on the purpose of the study.

Following your recommendation, we strengthened the contextual clarity by introducing a clearer definition of *mazuku* while keeping the more detailed description of the human, geological, and geographical context in a dedicated Study Area section placed immediately after the Introduction, to improve readability and avoid repetition across sections.

In addition, in line with Referee 1's recommendation, we added the following sentence to clarify the local meaning of mazuku:

“Locally in Goma, the term mazuku is derived from Swahili and translates as ‘evil wind’ or ‘evil wind that spreads and kills during the night’. It is used to refer both to the diffused CO₂-rich gas and the areas where it is emitted.”

3) Methodology clarification and figure request

Thank you for this helpful suggestion. We agree that the methodological sequence and the respective contributions of the three approaches should be made explicit. We therefore revised the methodology section to clarify: (i) the key questions addressed through the interviews, (ii)

the role of focus groups in validating and categorising measures, and (iii) how these qualitative findings informed questionnaire development and distribution.

To support this clarification, we added a new figure (Fig. 2) illustrating the sequential mixed-methods design and the intersections between the three approaches. We also reformulated the introductory paragraph of the Methods section accordingly. In addition, we included a brief contextual clarification regarding *street leaders*, to support international readers unfamiliar with local governance structures in Goma.

4) Flow of the paper / Results and Discussion structure

Thank you for this constructive and thoughtful suggestion. We agree that improving the paper's flow is essential to highlight the strength of the mixed-methods dataset and to reinforce the logic of the research process.

In response, we improved the flow in two key ways. First, we revised the Methods section and added Fig. 2 to make the chronological methodological sequence explicit (interviews → focus groups → questionnaire). Second, in Section 5.2, when describing the 12 mitigation measures, we now include their **reference numbering in brackets** throughout the text. This allows readers to clearly identify the 12 measures early, before moving to the quantitative evaluation, which strengthens coherence across the Results section. We also integrated additional clarifications suggested by Referee 1 to improve readability and progression.

With regard to merging Results and Discussion into a unified section and presenting findings strictly in chronological order, we carefully considered this restructuring. However, we decided to retain separate Results and Discussion sections, because presenting findings fully approach-by-approach would likely introduce substantial overlap and repetition—particularly since interview and focus-group insights are strongly intertwined and are repeatedly reinforced by the questionnaire findings. Since the main objective of the paper is to assess **perceptions of mitigation measures**, we found it clearer to structure Results thematically, while ensuring that the chronological logic is fully transparent through the revised methodology section and Fig. 2.

We hope these revisions have significantly strengthened the flow of the manuscript, while preserving clarity and avoiding redundancy.

5) Local knowledge in other contexts

Thank you for this valuable suggestion. We agree that providing examples of how local knowledge has been incorporated into risk-reduction strategies in other contexts—highlighting both successful and unsuccessful experiences—adds strength to the discussion and clarifies when strategies may be transferable versus location- and culture-specific.

In response to this comment (also raised by Referee 1), we expanded the manuscript by adding relevant comparative examples and supporting discussion (pp. 454–466 and 480–483).

