Reviewer 1

1. The manuscript aims to synthesize "climate risks in African cities," but this is an extremely wide topic covering hazards, vulnerability, governance, EO, AI, urban growth, health, infrastructure, and planning. The paper identifies many gaps, but many are already well known: limited data, geographic imbalance, lack of multi-hazard studies, weak integration of social vulnerability, and few future-looking studies. The authors need to make clearer what this review adds beyond existing review papers, rather than mainly confirming broad and expected gaps. The abstract itself already lists many generic findings, such as underrepresentation of Central Africa, secondary cities, multi-hazard studies, urban modelling, and social vulnerability integration.

Response: We agree that our claim to cover climate risks is too broad, as the primary focus of the review is on climate hazards. We therefore propose to remove "risk" from the title, so it would become "Review article: Climate hazards in African cities – knowledge gaps and research needs."

It is also true that several of the gaps identified in our review (e.g. limited data availability, geographical imbalance, limited forward-looking research) have been highlighted in other studies. However, to the best of our knowledge, no previous review has provided a broad, hazard-centred synthesis specifically for African cities. Existing reviews such as those discussed in Section 4.1 (Meta-review) generally have differently oriented scopes, e.g. focusing on adaptation, bibliometric trends, multi-risk perspectives, climate vulnerability, or adaptation.

We believe our analysis provides more specific quantitative evidence, e.g. rather than simply mapping the geographical distribution of studies, we compare the Köppen-Geiger climate zones represented in the literature with the actual distribution of African urban populations across climate zones. Also, the review quantifies methodological characteristics (e.g. use of EO, numerical modelling) across a single hazard-centred body of literature, which is an aspect we haven't encountered in other review articles.

In the revised manuscript, we will therefore add the following in the Introduction:

"Despite a growing body of literature on climate change in African cities, existing reviews have generally addressed specific aspects, including adaptation (Hunter et al., 2020), research trends (Mhedhbi et al., 2023), multi-risk perspectives (Fekete and Subramanian, 2024), or climate vulnerability and adaptation (Ansah et al., 2024). To the best of our knowledge, a broad, quantitative hazard-centred synthesis across African cities remains lacking."

The review articles cited in this paragraph stem from Section 4.1 ('Meta-review'), which will further be enhanced by more explicitly comparing the scope and conclusions of the existing/cited review articles with those of the present study.

2. The authors used "urban* OR city OR cities OR metropol*" in the title and "climat*" as the only topical keyword, without hazard-specific or risk-specific terms. This may miss many relevant studies on flooding, heat, drought, landslides, coastal hazards, vulnerability, exposure, and adaptation that do not use "climat*" prominently. At the same time, the broad strategy created many irrelevant records, later filtered manually. The authors need to justify this design more rigorously and provide a reproducible PRISMA-style screening process, including exclusion criteria, reviewer agreement, and examples of included/excluded papers.

Response: The omission of hazard-specific terms was deliberate, as the hazards represented in the literature were intended to be an outcome of the analysis rather than categories prescribed a priori.

The same applies to methodological terms such as *modelling* or *remote sensing*, since the prevalence of these approaches was itself an intended outcome of the analysis. We agree, however, that both the rationale for this search design and the subsequent screening procedure were insufficiently documented. We will therefore expand Section 2.1 and add a literature search and selection flow diagram showing the search settings, number of records screened, principal exclusion criteria, and construction of the final corpus.

We will add the following clarification concerning the search strategy:

"No explicit hazard-related terms (e.g. heat, flooding or drought) or methodological terms (e.g. modelling or remote sensing) were prescribed in advance. This was deliberate, as the hazards and methodological approaches represented in the literature were intended to be outcomes of the analysis. Prescribing such terms at the search stage would have required defining these categories a priori and could have biased their observed representation in the resulting corpus. A consequence of requiring climat as a search term is that studies addressing individual urban hazards without explicitly referring to climate may not be retrieved. The resulting corpus therefore represents literature that explicitly connects hazards affecting African cities to a climate context, rather than the complete literature on urban hazards."*

We will also expand the description of the literature search and screening procedure as follows:

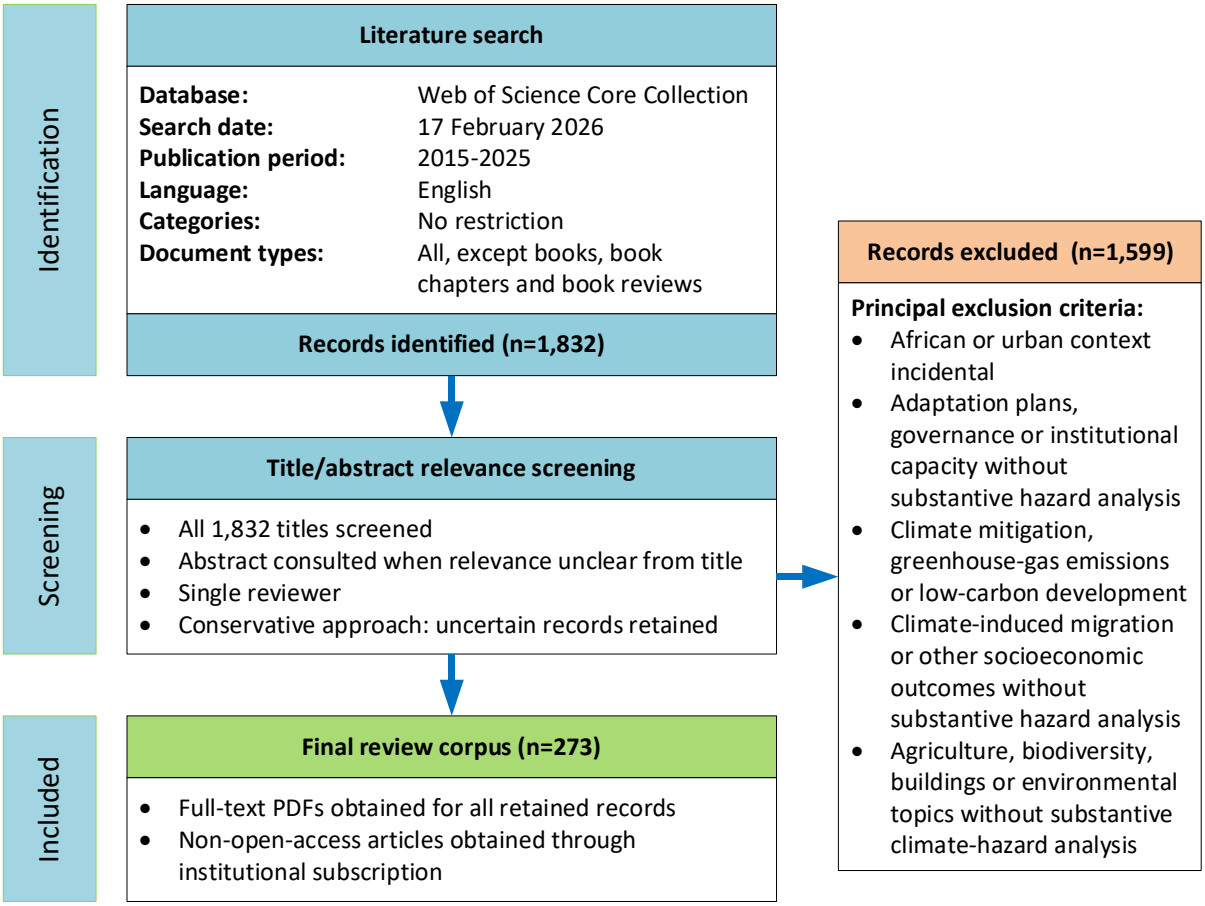
"The literature search was conducted on 17 February 2026 using the Web of Science Core Collection and was restricted to English-language records published between 2015 and 2025. No restrictions were applied by Web of Science Category, and all document types were considered except books, book chapters and book reviews. The search returned a list containing 1,832 records, which was subjected to manual relevance screening. Because the broad search deliberately omitted hazard-specific terms, a large proportion of the retrieved records were clearly outside the scope of the review, and the screening consisted primarily of removing these records. All titles were screened first, and where relevance could not be established from the title alone, the abstract was consulted. Records were retained where a climate hazard affecting an African urban setting constituted a substantive focus of the study. Records were excluded where the African or urban context was incidental, or where climate change or climatic hazards primarily provided context for another research topic without substantive analysis of the underlying hazard. Examples include studies focusing on urban crime or conflict following climatic shocks, climate-induced migration, adaptation planning and governance, greenhouse-gas mitigation, urban agriculture, building energy performance, and environmental issues such as pollution or waste management. The screening was conducted by a single author. We considered this appropriate for our semi-systematic review because the broad search retrieved a large proportion of clearly out-of-scope records, making most exclusion decisions straightforward. Where relevance could not be established from the title alone, the abstract was consulted, and where uncertainty remained after consulting the abstract, the record was retained, this conservative approach being intended to minimize the risk of excluding potentially relevant studies. Full-text PDFs were obtained for all papers retained in the final corpus, including through institutional subscriptions in case articles were not openly accessible."

A selection flow diagram (see below) will summarize these steps.

Finally, the study will continue to be described as a semi-systematic review, consistent with its broad research question and combination of quantitative mapping and qualitative synthesis (Snyder, 2019). We will clarify this at the beginning of Section 2:

"Given the broad scope of the research question, the study was designed as a semi-systematic review (Snyder, 2019), combining quantitative mapping of the literature with qualitative thematic synthesis."

The literature search and selection flow diagram is intended to improve transparency in reporting the selection process rather than to retrospectively characterize the study as a PRISMA systematic review.



3. The paper states that 1,832 records were reduced to 273 articles through title/abstract screening, with uncertain cases retained. However, it does not explain how many reviewers screened the papers, whether screening was independent, whether disagreements were resolved, or whether inter-reviewer consistency was checked. For a semi-systematic review, this is a major weakness. Without this information, the final corpus may reflect subjective judgement rather than a reproducible evidence base.

Response: We agree that screening by a single reviewer is a limitation of the study. As described in the previous response, the screening was not independently duplicated and inter-reviewer agreement was not assessed. This cannot be reconstructed retrospectively, and we will state this limitation explicitly.

In practice, we believe the effect of this limitation is reduced by the broad search strategy (see previous response): most excluded records were clearly outside the scope of the review, and uncertain cases were conservatively retained rather than excluded. This does not, however, remove the limitation of single-author screening. We will therefore ensure that the screening process is as transparent as possible by documenting the procedure and inclusion/exclusion criteria in detail and by adding the literature search and selection flow diagram described under the response to Comment 2.

4. The authors used SciSpace outputs and then processed more than 50,000 words with GPT-5.2 to generate knowledge gaps. This is potentially useful, but the manuscript does not provide enough information about validation, hallucination control, prompt sensitivity, reproducibility, or whether

outputs were checked against the original papers. This is a serious issue because AI-generated "research gaps" can easily reproduce generic language rather than extract evidence-based findings. The authors should either move this to supplementary material as an exploratory check or provide a much stricter validation protocol.

Response: We agree that the AI-assisted analysis was not supported by a sufficiently rigorous validation protocol to treat the resulting research gaps as an independent evidence base. In particular, we did not systematically validate the SciSpace/GPT outputs or assess prompt sensitivity, so the description of the analysis as a test of the robustness of the expert interpretation was overly strong.

We will therefore reposition this analysis as an exploratory comparison and move the full AI-assisted synthesis, including the methodology, prompts, results and current Table 2 to the Supplementary Material. The latter will explicitly discuss the limitations related to validation, hallucination, prompt sensitivity and reproducibility.

In the main manuscript, we will retain only a brief reference to this exploratory analysis, noting that it showed substantial thematic overlap with the expert-based synthesis but not using it as an independent basis for the study's conclusions. Research gaps retained in the main conclusions will be based only on the quantitative analysis and expert synthesis and not on the AI-generated output.

5. Figures on climate-zone representation, city-size representation, keyword networks, EO trends, and hazard frequency are useful, but the interpretation often remains surface-level. For example, the city-size comparison shows strong underrepresentation of small cities and overrepresentation of large cities, but the implications for bias in risk knowledge are not deeply analysed. The authors should connect these patterns more directly to what kinds of adaptation decisions may be distorted by this bias.

Response: It is correct that the manuscript currently identifies several important imbalances in the literature without really considering their implications. We will strengthen this aspect by discussing how the identified biases and knowledge gaps may affect the climate-hazard information available to support risk assessment, urban planning and adaptation.

For example, hazard knowledge derived from larger cities may not easily transfer to smaller cities, which may differ in physical development, infrastructure, data availability and institutional context. So, the observed city-size bias identifies not only a geographical gap in the literature, but also a limitation in the range of urban contexts for which local climate-hazard information is available.

More details regarding these aspects are provided in our response to Comment 9 below, which also explains that we will bring the implications of the identified imbalances together in the Conclusions and link them to priorities for future research.

6. Each article was assigned a dominant hazard, while many urban climate risks are compound by nature. This can artificially separate flooding, sea-level rise, water stress, heat, and LST, even when they interact. The manuscript itself criticizes the literature for studying hazards in isolation, but its own classification partly repeats this limitation. The authors should add a multi-label hazard classification and report how many papers address compound or cascading hazards.

Response: Multi-hazard, compound and cascading hazards are indeed important considerations. As suggested by the reviewer, we ran a multi-label hazard classification, presenting the results in the table below, together with context. We propose to add the following text to the manuscript:

"To examine whether the dominant-hazard classification obscures consideration of multi-/compound hazards, papers were additionally screened for substantive treatment of secondary hazard categories. Titles and abstracts were examined, with the full paper consulted when necessary. A secondary hazard was recorded only if it constituted a substantive component of the study, and incidental references to secondary climate hazards were not counted. The resulting cross-hazard matrix (Table 1) shows the distribution of multiple hazard categories across the dominant hazards.

Table 1. Cross-hazard occurrence within the dominant-hazard classification. Rows indicate the dominant hazard assigned to each paper, and columns indicate hazards additionally considered as a substantive component of the study. Values show the percentage of papers within each dominant-hazard category considering the respective hazard. Note that cross-hazard consideration does not necessarily imply compound or cascading hazards.

Dominant hazard	**Flooding**	**Sea-level rise**	**Water stress**	**Extreme heat**	**LST**	**Slow-onset**	**Wind-storms**
Flooding (n=65)	**100%**	1.5%	1.5%	-	3.1%	-	-
Sea-level rise (n=6)	16.7%	**100%**	-	-	-	-	-
Water stress (n=19)	15.8%	10.5%	**100%**	5.3%	-	-	-
Extreme heat (n=52)	-	-	1.9%	**100%**	-	3.8%	-
LST (n=63)	1.6%	-	1.6%	6.3%	**100%**	-	-
Slow-onset (n=60)	6.7%	3.3%	3.3%	8.3%	-	**100%**	1.7%
Windstorms (n=2)	50.0%	-	-	-	-	-	**100%**

Cross-hazard consideration varies considerably between the hazard categories:

- ***Slow-onset changes** frequently consider changes in temperature and precipitation together to characterize gradual climatic change, e.g. in the context of agriculture or disease vectors. The rather broad scope of this category also creates links with climatic extremes (flooding, heat), since changes in extremes may be examined alongside changes in mean climatic conditions.*
- ***Extreme-heat** studies generally have a comparatively narrow hazard focus. Some studies consider air temperature together with humidity and wind, but these variables are typically combined to characterize human heat stress or thermal comfort rather than treated as separate hazards.*
- ***Flood** studies also generally keep a rather narrow focus. Only a small number substantively consider another hazard category. These include studies linking flooding with longer-term climatic trends or other hydrological hazards, as well as one study considering tidal effects.*
- *The **LST** literature shows a different form of overlap. Several studies naturally connect LST with extreme heat by translating remotely sensed surface-temperature information into human heat indicators related to thermal comfort or heat exposure.*
- ***Sea-level-rise** studies have an obvious relationship with coastal flooding. However, since flooding in the present classification primarily represents pluvial and fluvial flooding, overlap between the two categories in the matrix is limited.*
- ***Water-stress** studies show broader connections with other hazard categories. This reflects their wider hydrological perspective rather than a narrow focus on drought alone. Examples include studies linking high-precipitation events and water capture to flood reduction and water availability, and relationships between water scarcity and high temperatures.*
- ***Windstorms** were the primary focus of only two studies identified in the corpus. One of the two papers in this category also considers flooding, in line with the connection between storms*

(cyclones) and flood generation. The resulting 50% overlap should therefore be interpreted cautiously, as it represents only one paper.

This additional screening shows that consideration of multiple hazards occurs across the corpus but is limited and uneven between hazard categories (Table 1). The nature of this overlap varies: in some studies, different hazard categories are considered within a broader climatic or hydrological analysis, whereas others explicitly examine the impacts of two distinct hazards. For example, two closely related studies in Accra and Tamale examine both flooding and extreme heat and their impacts on healthcare provision and on water and electricity services (Codjoe et al., 2020[1]; Kayaga et al., 2021[2]). An analysis of interactions between hazards was considerably rarer. One study in Maputo specifically addressed compound flooding by analysing the combined influence of rainfall and tidal conditions on urban flooding (Matos et al., 2023[3]).”

7. Some thematic sections read like mini-literature reviews with many citations but limited synthesis. The flood section, for example, contains many claims and examples, but the writing becomes dense and sometimes repetitive. Other hazards, such as windstorms, receive much shorter treatment. This imbalance weakens the review. The authors should reduce citation-heavy narrative and replace it with clearer synthesis tables: key methods, geographic focus, limitations, evidence strength, and research needs for each hazard.

Response: We agree that parts of Section 4.2 are too citation-heavy and would benefit from stronger synthesis. This was also a concern in our own revision of the manuscript. We will reduce the number of individual studies discussed and restructure the thematic subsections to focus more clearly on common findings, methodological patterns and limitations.

We do not, however, consider the differences in length between the hazard sections to be a weakness. These differences reflect differences in the volume of literature available for each hazard. For example, substantially fewer studies address windstorms than flooding. We consider it appropriate that the thematic synthesis reflects these differences rather than giving each hazard equal coverage.

In response to the reviewer’s suggestion for a synthesis table (also see a similar suggestion from Reviewer 2), we will add a new Section 4.3 summarizing the findings of the expert-based thematic reviews in a table. The table will provide, for each hazard, a concise synthesis of the main findings and the main characteristics and limitations of the available evidence. Conversely, we do not propose to include an assessment of “evidence strength”, as this would require a separate assessment that was not part of our methodology. The new Section 4.3 will replace the current AI-assisted synthesis, which will be moved to the Supplementary Material as described in our response to Comment 4.

8. Currently, many gaps are repeated in different forms across the abstract, results, thematic review, AI synthesis, and conclusion. The final message would be stronger if the authors organized the contribution around a clear framework: hazard evidence, exposure/vulnerability evidence, future scenario evidence, modelling/EO evidence, and decision-use evidence. This would make the review more useful for researchers and urban planners.

[1] Codjoe, S. N. A., et al. (2020). Impact of extreme weather conditions on healthcare provision in urban Ghana. Social Science & Medicine, 258, 113072. https://doi.org/10.1016/j.socscimed.2020.113072

[2] Kayaga, S. M., et al. (2021). Cities and extreme weather events: impacts of flooding and extreme heat on water and electricity services in Ghana. Environment and Urbanization, 33(1), 131–150. https://doi.org/10.1177/0956247820952030

[3] Matos, J. P., et al. (2023). Evaluating Compound Flooding Risks in Coastal Cities under Climate Change—The Maputo Case Study, in Mozambique, Sustainability, 15, 14497, https://doi.org/10.3390/su151914497

Response: It is true that some research gaps are repeated more than needed, and we will revise the manuscript to reduce that. Moving the AI-assisted synthesis to the Supplement (see comment 4 above) will already remove a source of repetition. At the same time, some recurrence across the quantitative analysis, the qualitative expert analysis and the Conclusions is intentional: convergence between the quantitative and qualitative findings is informative, and the Conclusions necessarily summarize them.

Regarding the suggested framework, it is not clear to us whether the reviewer is suggesting that the manuscript should be substantially restructured around the five proposed categories (hazard evidence, exposure/vulnerability evidence, etc.), or rather that these categories could provide a framework for presenting the main research gaps more clearly. As the proposed categories cut across the current analytical structure of the review, we prefer to retain the current overall structure.

9. The conclusion states that research has grown but remains limited by data scarcity, high-resolution modelling gaps, geographic imbalance, and weak integration of social and forward-looking dimensions. This is reasonable, but not sufficiently novel. The authors should end with a more actionable research agenda, including specific datasets, minimum reporting standards, recommended cross-city comparison designs, and priority regions/city types.

Response: We will provide a more specific research agenda. Building on our response to Comment 5, we will expand the Conclusions by linking the main biases and knowledge gaps to implications for the evidence available to support planning and adaptation, and from there to corresponding research priorities. We will develop the following points:

- ***City-size bias****: the strong representation of large cities means that current knowledge may be disproportionately shaped by metropolitan contexts. Where local evidence is lacking, smaller cities may have to rely on hazard information derived from substantially different urban settings, which may not adequately reflect their local conditions and adaptation needs. This provides a clear rationale for enhanced research attention to small and secondary cities.*
- ***Climate-zone bias****: uneven representation of climate zones affects which manifestations of hazards are best understood. For example, strong representation of dry climates in heat-related research may favour an understanding of heat stress dominated by high-temperature & dry-heat conditions, while humidity becomes an important component of human heat stress in more humid climates. Hence, research in currently underrepresented climatic zones is needed to broaden the range of hazard conditions represented in the evidence base.*
- ***Hazard bias****: the predominance of flooding and heat in the literature is not a sign for their relative importance across African cities. Imbalanced research attention across hazards may influence which hazards are most visible in the evidence available to support risk reduction and adaptation. This supports more research to understudied hazards, especially if their importance may increase under climate change.*
- ***Bias towards present & historical urban conditions****: the limited number of studies combining future climate change with urban growth is highly important given the major anticipated urban expansion across Africa. Future cities may differ substantially in spatial extent, land cover, population, etc. Hazard assessments that account for future climate while disregarding future urban growth may provide an incomplete basis for long-term decisions on urban adaptation. This points to a need for studies that jointly consider future climate and urban growth.*

These examples will allow making the research agenda more specific while maintaining a link to the findings of the review. We are more cautious about proposing specific datasets, minimum reporting standards or cross-city study designs, as these were not assessed in our review.