# Response to Reviewers' Comments

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| Reviewer | Comment | Response | Action Taken |
| Editor | Please revise the ‘Strengths and limitations of this study’ section... | Acknowledged. We have revised the section to focus solely on the methods. | Revised the section to include five bullet points focusing on the methods. |
| Editor | Please include the planned start and end dates for the study in the methods section. | Acknowledged. We have added the start and end dates in the methods section. | Added the start and end dates in the methods section. |
| Editor | We have noticed that you have used a map in figure 2... | Acknowledged. We have removed the map as one of the figures | Acknowledged. We have removed the map as one of the figures |
| Reviewer 1 | 2 papers discussing heat-related health risks distribution among different socio-economic groups in Johannesburg... | Thank you for the suggestion. We have added references to these papers in the relevant sections. | Added references to the suggested papers. |
| Reviewer 1 | To characterize heatwaves, the authors limit themselves to temperatures... | Acknowledged. We have expanded our analysis to include Heat Indice UTCI. | Revised the methodology to include additional variables for heatwave characterization. |
| Reviewer 1 | With respect to a heat health early warning system in a developing country... | Thank you for the reference. We have incorporated insights from the Ahmedabad heat action plan into our study. | Added information on the Ahmedabad heat action plan and its relevance to our study in the description of the Early Warning System |
| Reviewer 1 | It must be noted that land surface temperatures are decoupled from heat stress... | Acknowledged. We have clarified the distinction between land surface temperatures and heat stress in our study. | Clarified the use of land surface temperatures in the context of heat stress measurement. |
| Reviewer 1 | It is not clear where the ‘geospatial climate’ data will come from... | We have provided additional details on the sources and spatial resolution of the geospatial climate data used in our study. | Specified the sources and resolution of the geospatial climate data in the methods section. |
| Reviewer 2 | The overall structure of the paper needs to be improved by numbering sections... | Acknowledged. We have improved the structure by adding numbered sections and subsections. | Improved the structure of the document with numbered sections and subsections. |
| Reviewer 2 | The introduction needs to be deepened to describe how this study differs from past work in Africa and worldwide... | Acknowledged. We have expanded the introduction to provide a more comprehensive overview of past work in Africa and worldwide, and to highlight the unique contributions of our study. | In response to the reviewer's comments, the introduction has been expanded to provide a more comprehensive background on the heat-health challenges faced in African cities, particularly Abidjan and Johannesburg. The revised introduction now includes a discussion of previous studies on heat-health impacts across Africa, with specific references to research conducted in the cities of interest. It integrates the concepts of exposure, vulnerability, hazard, and adaptive capacity in the context of heat exposure studies as defined by the IPCC framework. Additionally, the introduction better articulates the study's contribution in comparison to existing literature by emphasizing the development of an Early Warning System using data science and machine learning innovations, tailored for urban African contexts. This approach is aimed at building climate-resilient cities and protecting vulnerable populations from heat hazards. The new text effectively addresses the need for a longer, more detailed introduction and sets the stage for the study's objectives and methods. |
| Reviewer 2 | Some details on the potential use of administrative health data should be explained... | Acknowledged. We have provided more details on contingency plans if we cannot access enough clinical data | Added details on the contingency plans we will take if insufficient data is available for our analysis after integration of datasets |
| Reviewer 2 | The methods, particularly the type of machine learning models employed, should be better explained... | Acknowledged. We have provided a more detailed explanation of the machine learning models employed in our study, including their advantages and how they will be validated. | Expanded the description of machine learning models and their validation in the methods section. |
| Reviewer 1 | P7 L18: it must be noted that land surface temperatures are decoupled from heat stress & are probably not the best tool to measure or quantify heat stress. | Acknowledged. We have clarified the distinction between land surface temperatures and heat stress in our study. | Clarified by adding this text " It should be noted that while Landsat and MODIS data primarily measure land surface temperature (LST), statistical models can be employed to estimate air temperature from remotely sensed LST. Therefore, in this study, appropriate statistical models will be used to indirectly retrieve air temperature from the LST data provided by Landsat and MODIS." |
| Reviewer 1 | P7 L23: It is not clear where the ‘geospatial climate’ data will come from. | We have provided additional details on the sources and spatial resolution of the geospatial climate data used in our study. | While the Copernicus Climate Data Store (CDS) and Earth System Grid Federation (ESGF) provide valuable climate data, their spatial resolution may not be sufficient to distinguish different parts within the city. To address this limitation, we will employ downscaling techniques to enhance the spatial detail of our geospatial climate data. Specifically, we will explore the use of dynamic downscaling with high-resolution climate models such as the Weather Research and Forecasting (WRF) model and the UrbClim urban climate model. These models offer detailed results on heat stress for cities, allowing for a more precise analysis of intra-urban heat variations. By applying downscaling techniques, we aim to improve the accuracy of our heat risk assessments for Johannesburg and Abidjan. |
| Reviewer 1 | P9 L53: the following datasets might be of interest as input for the study. | Thank you for the suggestion. We have reviewed the suggested datasets and incorporated relevant data into our study. | Added information on the incorporation of the suggested datasets in the Methods section. |
| Reviewer 1 | P10 L37: again, it must be noted that Landsat and MODIS are land surface temperature tools and should not directly be used for air temperature retrieval. | Acknowledged. We have addressed this concern by clarifying the use of Landsat and MODIS data in our study. | For instance, Gudmundsson and Seneviratne (2021) demonstrated the use of such models to predict air temperature from LST data. Therefore, while Landsat and MODIS data are not direct measures of air temperature, they can be indirectly used for air temperature retrieval through the application of appropriate statistical models. |
| Reviewer 2 | P2 L22: How will data during the 2020-2022 COVID-19 pandemic be handled? | We have outlined our approach to handling data during the COVID-19 pandemic, ensuring the robustness of our analysis. | Added information on handling COVID-19 pandemic data in the Methods section. In response to the shifts in mortality and morbidity during the 2020-2022 COVID-19 pandemic, we will analyze data separately for pre-pandemic, pandemic, and post-pandemic periods. Additionally, we will include COVID-19 related variables as covariates in our models to control for the pandemic's impact on health outcomes |
| Reviewer 2 | P4 L19: Elaborate on the different socio-demographic groups affected by heat. | We have expanded our discussion on the various socio-demographic groups affected by heat and their respective vulnerabilities. | Elaborated on the different socio-demographic groups affected by heat in the Introduction section. |
| Reviewer 2 | P4 L47: It would be interesting to add some context on why these two cities were selected for this study. | We have provided a detailed rationale for selecting Johannesburg and Abidjan as the focus cities for our study. | Added context on the selection of the two cities in the Study Setting section: Abidjan and Johannesburg were selected for this study due to their unique characteristics and availability of data. Both cities have a high population density and are experiencing rapid urbanization, making them representative of the challenges faced by many African cities in the context of climate change and heat-related health impacts. Additionally, these cities have access to detailed health data from clinical trials and cohort studies, which is crucial for our analysis. The selection of these cities allows for a focused examination of heat-related health risks in urban African settings, with the potential to inform broader regional strategies for climate adaptation and public health. |
| Reviewer 2 | P4 L55: The background/rationale section should be presented before the “Study setting”. | Acknowledged. We have restructured the manuscript to present the background/rationale section before the study setting. | Restructured the manuscript to present the Background/Rationale section before the Study Setting section. |
| Reviewer 2 | P5 L3-21: How do these definitions relate to the hazard-vulnerability-exposure framework of IPCC? | We have clarified how our definitions relate to the hazard-vulnerability-exposure framework of the IPCC. | Clarified the relationship between our definitions and the IPCC framework in the Background/Rationale section: The definitions used in this study align with the hazard-vulnerability-exposure framework of the Intergovernmental Panel on Climate Change (IPCC). According to the IPCC, 'hazard' refers to the potential occurrence of a natural or human-induced physical event that may cause harm to human health, livelihoods, assets, or ecosystems. 'Vulnerability' is defined as the propensity or predisposition to be adversely affected, which encompasses a variety of factors including sensitivity and adaptive capacity. 'Exposure' refers to the presence of people, livelihoods, species, or ecosystems in places that could be adversely affected by the hazard.  In our study, we apply these concepts to the context of urban heat stress, where the 'hazard' is the occurrence of high temperatures, 'vulnerability' includes factors such as age, health status, and access to cooling resources, and 'exposure' relates to the degree of contact individuals have with the heat hazard. Our use of these terms is consistent with the IPCC framework, which provides a comprehensive approach to understanding and addressing the impacts of climate-related hazards on various socio-demographic groups. |
| Reviewer 2 | P5 L41-L44: This should be mentioned in the Introduction while adding past studies conducted in Africa. | Acknowledged. We have incorporated this information into the Introduction, along with references to past studies conducted in Africa. | Incorporated information on past studies conducted in Africa into the Introduction section. |
| Reviewer 2 | P5 L49: This section may be included as the final paragraph of a broader Introduction. | Acknowledged. We have integrated this section into the final paragraph of the Introduction to provide a more cohesive overview. | Integrated the section into the final paragraph of the Introduction. |
| Reviewer 2 | P6 L38: Using numbered sections and subsections will help the reader understand the structure of the paper. | Acknowledged. We have implemented numbered sections and subsections throughout the paper to enhance readability. | Implemented numbered sections and subsections throughout the paper. |
| Reviewer 2 | P6 L40: A summary table with all data sources related to each of the three objectives would be useful here. | Thank you for the suggestion. We have included a summary table listing all data sources related to each of the three objectives. | Included a summary table listing all data sources in the Methods section. |
| Reviewer 2 | P6 L50-L51: I am curious if there is any administrative health database available. | We have provided information on the availability and use of administrative health databases in our study. | These datasets are available but vary in quality, and therefore, we care about doing our best to use clinical trial or robust clinical trial data where possible. Contingency plans have been outlined if twe cannot gather sufficient data from the clinical trials and cohort data |
| Reviewer 2 | P7 L10 and L14: What about the other city? | We have ensured that both cities, Johannesburg and Abidjan, are covered in terms of socio-economic data | We have ensured that both cities, Johannesburg and Abidjan, are covered in terms of socio-economic data |
| Reviewer 2 | P7 L38-39: If health trials and cohort data are used, they need to be introduced in the Introduction. | Acknowledged. We have introduced the use of health trials and cohort data in the Introduction section. | Introduced the use of health trials and cohort data in the Introduction section. |
| Reviewer 2 | P8 L37-52: I understand the point of looking for available datasets, but what if the trials and cohort data are not available/shareable? | We have addressed this concern by outlining our contingency plans and strategies for data access and availability. | Outlined contingency plans and strategies for data access in the Methods section. |
| Reviewer 2 | P9 L47-55: This is somewhat of a repetition of what was introduced in the Data section of the method. | Acknowledged. We have revised the manuscript to eliminate redundancy and ensure a clear presentation of information. | Revised the manuscript to eliminate redundancy in the presentation of the Data section. |
| Reviewer 2 | P9 L44: Please add “First objective” to this section name. | Acknowledged. We have added "First Objective" to the section name to clearly delineate the objectives. | Added "First Objective" to the section name in the Methods section. |
| Reviewer 2 | P9 L58: Please elaborate on why only PCA will be used. | We have elaborated on the rationale for using PCA and its advantages in the context of our study. | Elaborated on the use of PCA in the Methods section. |
| Reviewer 2 | P10 L7-10: Please add “Second objective” to this section name. | Acknowledged. We have added "Second Objective" to the section name to clearly delineate the objectives. | Added "Second Objective" to the section name in the Methods section. |
| Reviewer 2 | P11 L3-4: More details should be given related to the cross-validation and how models will be trained/calibrated/validated. | We have provided additional details on the cross-validation process and the training, calibration, and validation of models. | Provided detailed information on the cross-validation process and model validation in the Methods section. |
| Reviewer 2 | P11 L9: References 53 and 56 are out-of-scope for the proposed application. | Acknowledged. We have reviewed and updated the references to ensure they are relevant to the proposed application. | Reviewed and updated references to ensure relevance to the proposed application in the References section. |
| Reviewer 2 | P12 L8-L11: Add “Objective 3” to this section title. | Acknowledged. We have added "Objective 3" to the section title to clearly delineate the objectives. | Added "Objective 3" to the section title in the Methods section. |
| Reviewer 2 | P12 L19-L26: Please develop here how the models developed in objectives I and II can be used jointly for the third objective. | We have provided a detailed explanation of how the models developed in Objectives I and II are integrated and used jointly for Objective III. | Provided a detailed explanation of model integration for Objective III in the Methods section. The EWS integrates high-resolution heat hazard maps and a forecast model to generate alerts for areas with predicted adverse heat-health outcomes. This integration involves: 1. Downscaling the Forecast Model: Adjusting the model's resolution to match the detailed heat hazard maps. 2. Combining Data Sources: Merging the forecast model outputs with the heat hazard maps to create a comprehensive dataset. 3. Generating Alerts: Using the dataset to generate timely alerts for specific areas at risk. Additionally, the EWS incorporates heat hazard predictions to enable proactive risk management. It offers tailored guidance for at-risk individuals, suggesting strategies like adequate hydration and activity scheduling. Drawing inspiration from the Ahmedabad Heat Action Plan, our EWS will emphasize inter-agency coordination and community outreach for effective heat risk mitigation[87]. While our EWS aims to provide advanced warnings, we acknowledge the challenges of long-term forecasting. The accuracy of predictions depends on data reliability, model complexity, and weather variability. Continuous model refinement is essential for improving predictive capabilities. |
| Reviewer 2 | P12 L31: Projection weeks in advance seems optimistic. Please nuance. | We have nuanced our language to reflect the realistic expectations and limitations of projection weeks in advance. | We have nuanced our language to reflect the realistic expectations and limitations of projection weeks in advance. |