Heat Waves Risk Assessment Of Historic Areas. Development Of A Multicriteria Methodology And Its Application In A GIS Model Of Naples.

AUTHORS

Laura Quesada-Ganuza1, Leire Garmendia1 , Ane Villaverde1, Irantzu Alvarez2, Estibaliz Briz1 and Ziortza Egiluz1

AFFILIATIONS

1 Department of Mechanical Engineering, Faculty of Engineering in Bilbao, University of the Basque Country UPV/EHU, Plaza Torres Quevedo 1, 48013 Bilbao (Spain)
laura.quesada@ehu.eus

2 Department of Graphic Design and Engineering Projects, Faculty of Engineering in Bilbao, University of the Basque Country UPV/EHU, Plaza Torres Quevedo 1, 48013 Bilbao (Spain)

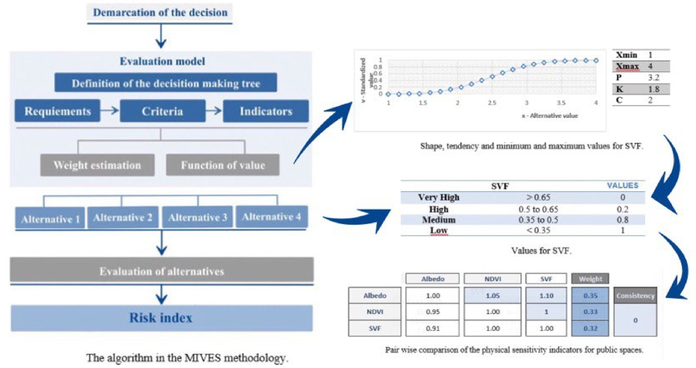
INTRODUCTION

Climate change poses significant threats to the preservation and viability of urban cultural assets. **Extreme weather and ongoing global warming can lead to the degradation of historic urban systems and heritage assets**. In order to promote the **resilience and sustainability** of social and constructed environmental systems, it is essential to understand climate hazards to heritage and consider them in planning and policy decision-making processes. This study focuses on assessing **heatwave risks to historic urban areas using a multicriteria risk assessment methodology.**
This poster presents a novel and replicable approach for **assessing and visualizing the interaction between heat waves and historic urban areas,** using a comprehensive multicriteria risk assessment methodology and a **GIS-based model**. By identifying key performance indicators and criteria, this study aims to promote the resilience and sustainability of urban cultural assets in the face of climate change, while addressing the knowledge gap regarding the hazards in historic urban settings

OBJECTIVE

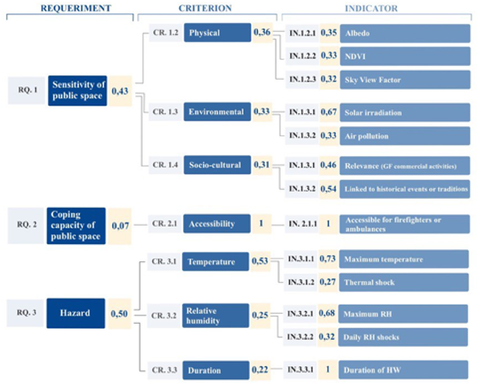
To assess and visualize how the historic built environment and heat waves interact, taking into account how vulnerable both historic urban systems and heritage assets are considering the system's socioeconomic, cultural, environmental, and physical aspects.

METHODOLOGY

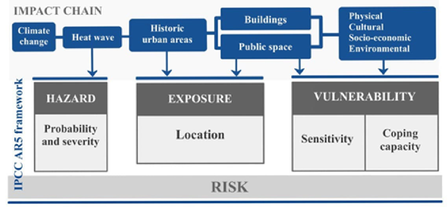


The algorithm in the MIVES methodology.

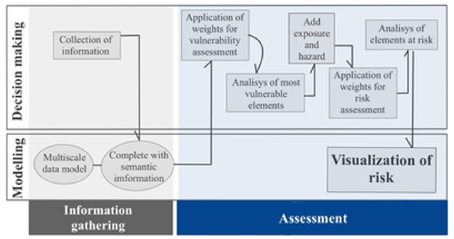
The MIVES methodology , a Multi Criteria Decision Making Methodology (MCDM), **is used to value and weight the resulting decision-making tree to achieve the final risk index of each asset.** The MIVES methodology ensures that data from various sources can be measured comparably in an objective and easy way. The resulting decision making-tree is then valued and weighted **i**n order to achieve the final risk index of each asset.The risk assessment methodology is carried out using the most accepted **IPCC AR5 framework to develop the impact chain.** According to the AR5 definition, vulnerability, along with hazard and exposure, defines the risk.



Final requirement tree for public spaces with weights.



Relation between IPCC AR5 framework for risk assessment and the proposed impact chain for historic urban areas.



Workflow process for the risk assessment.

The methodology involves using **Geospatial Information Systems (GIS) data to develop a holistic approach that considers the system's socioeconomic, cultural, environmental, and physical aspects.**

The study addresses the system from the twofold perspective of an urban area and a historic area, and takes a **multiscale approach that considers both the building and the public spaces**. Even if the main receptors are the buildings/urban spaces themselves, **not only their physical degradation from heat wave conditions will be considered but also the thermal comfort** will be a main consideration.

CONCLUSIONS

Heat waves present a challenge in the field of risk assessment, especially when considering historic urban areas, as there is a gap in knowledge. As climate change and the derived hazards become more relevant, planning and conservation strategies will need to guide the adaptation of historic areas to face a more challenging future. Hence, the **proper understanding of vulnerability and risk is a mayor necessity to prioritize and use adaptation resources**. This study seeks to be **replicable and serve as a resource for future global studies of the dangers of heatwaves in historic urban areas.** By using GIS data and a multicriteria risk assessment methodology, we can better understand the vulnerabilities of historic urban systems and heritage assets to climate hazards and promote their resilience and sustainability.

The proposed methodology and approach can inform planning and policy decision-making processes, promoting the resilience and sustainability of social and constructed environmental systems in the face of climate change.

RELATED PUBLICATIONS

Do we know how urban heritage is being endangered by climate change? A systematic and critical review.
Laura Quesada-Ganuza; Leire Garmendia Arrieta; Eduardo Roji; Alessandra Gandini. *International journal of disaster risk reduction.* Elsevier, 01/11/2021. **Q1**

Chapter 4: The Risk of Heat Waves to Historic Urban Areas. A GIS-Based Model for Developing a Risk Assessment Methodology
Laura Quesada-Ganuza, Leire Garmendia, Irantzu Alvarez, Estibaliz Briz, Alessandra Gandini, and Marta Olazabal
The Future of Heritage Science and Technologies. (**Book**) Springer. 2022

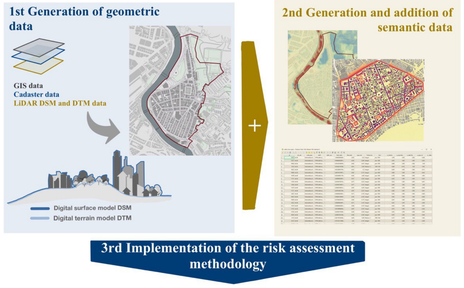
ACKNOWLEDGMENTS

The researchers would like to acknowledge the SAREN research group (IT1619-22, Basque Government) and the European Commission for their support and funding of the SHELTER project (GA 821282).

RESULTS

For the **validation of the methodology in Naples, 1,358 buildings were modelled along with the network of open spaces** that comprises the historic area. The application of the methodology resulted in an accurate representation of the vulnerability that could help the future prioritization of adaptive interventions, making possible the localization of the areas most at risk.

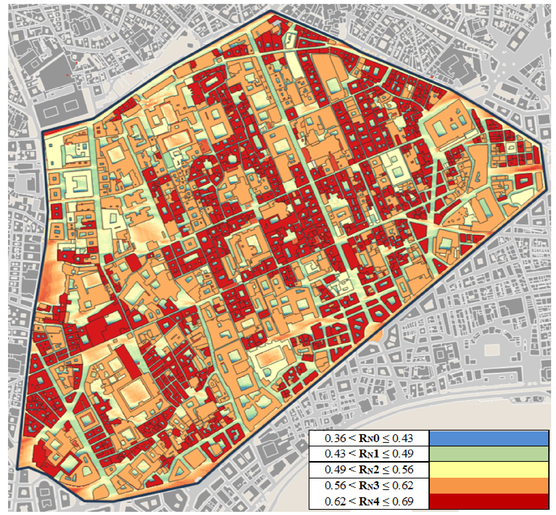
The resulting **GIS-based model** provides a framework to structure and process information in a coherent and interoperable way, and the MIVES methodology ensures that data from various sources can be measured comparably in an objective and easy way. **Open source and accessible data from municipal and national databases, as well as EO sources such as Copernicus,** are used to develop the data model.



For this analysis, the **heat wave of the end of June 2022** was used as an example, as it was the most recent recorded for the area. This heat wave lasted 3 days andpresented a maximum temperature of 38°C on the 27th of June.

The analysis of the results show that a 95.73% of the 1,358 building have a risk higher than 0.5, **23.19% of them higher than 0.7**. In contrast, only 1 building is lower than 0.3, with the 0.5% being lower than 0.4.

The assessment for the public spaces was developed through raster images, for this reason, the results cannot be assigned to each element, but are displayed with **a gradient of colours for the whole network of public spaces.**



Results for the risk assessment in Naples, Italy