## Assessing Vulnerability: The Impact of Extreme Weather Events on Cultural Heritage Sites in Serbia

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#### 1. Introduction

Climate change is increasing the frequency of extreme weather events that significantly impact cultural heritage sites in Serbia. Despite efforts by stakeholders to define these events, progress has been limited. The IPCC defines an extreme weather event as one that is rare at a particular place and time of year (IPCC, 2007). Such events include thunderstorms, floods, and droughts, all of which have adversely affected cultural heritage sites in Serbia. Notable examples include the 2005 and 2023 storms that damaged church steeples and wooden structures. Fruška Gora monasteries. Sites like Gamzigrad -Romuliana and Studenica Monastery are showing signs of long-term erosion and structural stress. The primary aim of this article is to discuss the current state of vulnerability assessment as a key component of risk assessment and risk management. Using methodologies suitable for social research, we have found that, despite growing awareness among stakeholders and the European Union research community, there has been no significant improvement in addressing these issues. Despite recent advances in Serbia's climate governance, cultural heritage remains outside the scope of official adaptation policy. Recommendations for applying a proposed vulnerability assessment are insufficient, as stakeholders in Serbia need to develop a tailored approach to effectively tackle these challenges.

#### 2. Roadmap to the vulnerability assessment of cultural heritage sites

The devastating fire of Notre Dame de Paris in 2019 underscored the need for proactive vulnerability assessment to anticipate risks, demonstrating the fragility of even the most iconic cultural heritage sites. This event motivated us to address the urgent need for systematic and proactive vulnerability assessment tools that can anticipate risks before disasters occur. Vulnerability is defined as the likelihood of a system being negatively impacted, considering elements such as exposure, sensitivity, and adaptive capacity. As can be seen, vulnerabilities always have to be specified the answering which site is vulnerable to which type of hazard. As it was represented in Figure 1, the socioeconomic factors will be the main driver of vulnerability of cultural heritage sites. The sensitivity of sites to the impact of an extreme weather event, jointly with the exposure of the site, constitutes the susceptibility. Then the adaptation can be defined as a process of adjustment and plays a very important role when assessing social impacts of extreme weather events (Malte, 2015). Resilience can be defined as the capacity of social, economic, and environmental systems to cope with a hazardous event. So, there are close relationships between resilience, extreme weather events, adaptability, and vulnerability (Radovic and Inglesias, 2020).

The IPPC-based framework of exposure, sensitivity, and adaptive capacity may lack structured prioritization mechanisms that allow decision makers to determine which sites are most at risk and where adaptation measures should be directed first.

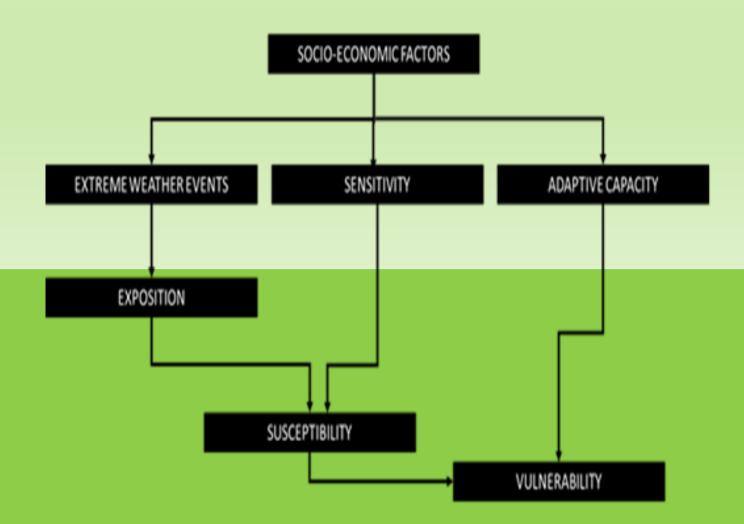


Figure 1: Concept of vulnerability to extreme weather events. (Adapted from Malte, 2015)

# 3. Prominent methodologies for vulnerability assessment of cultural heritage sites

When assessing vulnerabilities in cultural heritage sites, consider these essential dimensions:

- Physical/material vulnerability
- Structural/architectural vulnerability
- Environmental/location-related vulnerability
- Social vulnerability.

Significant research has focused on predicting future damage projections to specific heritage materials resulting from ongoing climate changes, including variations in temperature, relative humidity, and precipitation (Bonazza and Sardella, 2023).

The most important methodologies used in the literature on heritage vulnerability include:

- 1. Multi-criteria decision making (MCDM)
- 2. Integrated value model for sustainability assessment MIVES,
- 3. Climate Vulnerability Index (CVI),
- 4. Risk-mapping tool (STRENCH WGT), and
- 5. CARVER methodology (as an optional approach).

The first four methods are actively used and often employ indicators, participatory approaches, or GIS support, aligning closely with conservation planning. The author's proposal to adapt the CARVER methodology for assessing heritage vulnerability is innovative, as it shifts the focus from "targeting attractiveness" to "conservation priority/vulnerability severity." This idea serves as an explanatory framework to stimulate discussion rather than as a definitive solution, and it could be valuable in prioritizing protection measures. Academic work consistently highlights the vulnerability of cultural heritage sites to extreme weather events and institutional blind spots in Serbia's adaptation framework.

#### 4. Conclusion

Addressing the vulnerability assessment of cultural heritage sites (CHS) in Serbia is essential. While recent research and initiatives from civil society have highlighted the susceptibility of CHS to climate impacts, most discussions primarily focus on the legal gaps in general conservation guidelines. By integrating globally recognized principles with context-specific strategies, Serbia can develop a practical and actionable model for climate-resilient heritage management. This approach will ensure that CHS are not only preserved in theory but also actively protected during extreme weather events.

#### Reference

IPCC - International Panel for Climate Change (2007): Report of Summary for Policymakers, In Climate Change 2007: Impacts, Adaptation and vulnerability, Appendix I, Glossary, pg 875.

Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, (Edt.) M. L. Parry, O. F. Canziani, J. P. Palutikot, P. J. van der Linden, C. E. Hanson, Cambridge University Press, Cambridge, UK. https://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4\_wg2\_full\_report.pdf

IPCC - International Panel for Climate Change (2014). Synthesis report. Contribution of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (p 151).

M. Jahn (2015): Economics of extreme weather events: Terminology and regional impact models. Weather and Climate Extremes 10(B): 29-39.

Bonazza, A., and Sardella, A. (2023). Climate change and cultural heritage: Methods and approaches for damage and risk assessment addressed to practical applications. Heritage 6 (4):3578-3589 V. Radovic and I. Inglesias. (2020) Extreme Weather Events: Definition, Classification, and Guidelines towards Vulnerability Reduction and Adaptation Management. In: Leal Filho W., Azul A.M., Brandli L., Özuyar P.G., Wall T. (eds) Climate Action. Encyclopedia of the UN Sustainable Development Goals. Springer, Cham