The temporal dimension in climate adaptation and mitigation strategies and solutions aimed to increase urban integrated resilience

Maria Fabrizia Clemente
Dipartimento di Architettura,
Università di Napoli Federico II, Italia
mariafabrizia.clemente@unina.it
orcid.org/0000-0001-6114-2502

Sabrina Puzone
Dipartimento di Architettura,
Università di Napoli Federico II, Italia
sabrina.puzone@unina.it
orcid.org/0009-0000-7897-3521

Received: 15 June 2025 / Accepted: 28 October 2025 |
DOI: 10.36253/contest-16544

keywords
climate resilience
disaster risk management
temporal dimension
climate-resilient design

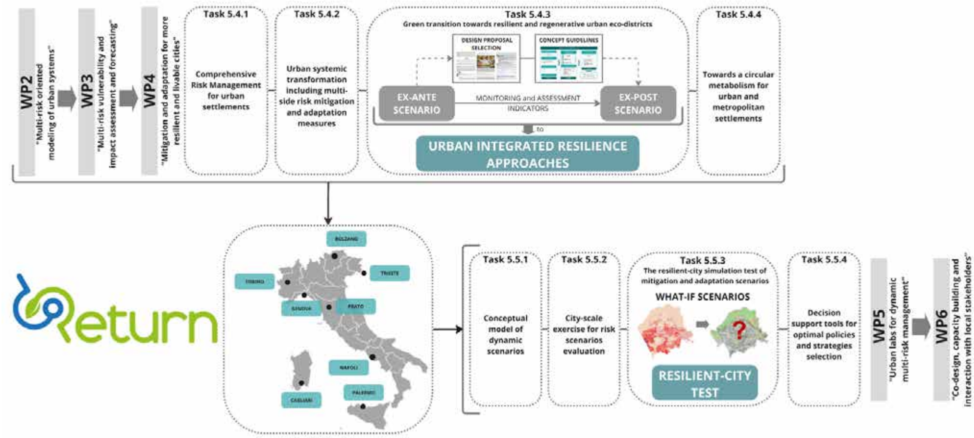
Climate change poses critical challenges to urban and metropolitan settlements' resilience, increasing their vulnerability and exposure to extreme events. The article proposes a conceptual and operational framework that integrates the assessment of climate-resilient strategies and solutions into the four phases of disaster risk management (DRM) cycle: preparedness, absorption, response/recovery, long-term adaptation. Emphasizing the temporal dimension of resilience,

Thematic framework

Climate change is one of the most urgent and complex challenges facing contemporary societies, with significant impacts at the global, regional, and local levels. Impacts such as rising average temperatures, changes in precipitation patterns, sea level rise, intensification of extreme events are not isolated events but act as "amplifiers" and multipliers of risk impacting on natural and anthropic habitats (IPCC, 2022b). In this scenario, urban and metropolitan areas assume strategic significance, as they are both particularly vulnerable to climate impacts and, at the same time, responsible for a significant part of human pressures that contribute to climate change. Settlements are in fact characterised by high population density, intense anthropisation processes, complex socio-technical systems, factors that amplify exposure to risks (UN-Habitat, 2022).

The growing complexity of climate risks, which are often interconnected, highlights the ineffectiveness of sectoral, linear design and *the study highlights the need for dynamic, multi-scalar and systemic design approaches that enhance urban capacity to anticipate, withstand and recover from climate-related impacts, also considering the long-term perspective. The framework aims to support decision-making processes for the development of climate adaptation and mitigation measures within the DRM phases, providing a basis for resilient and sustainable design of urban settlements.*

management approaches, requiring systemic and integrated models capable of managing the complexity of urban settlements and the interactions between environmental, social, technological, and economic dimensions. Within the scientific debate, the concept of urban climate resilience is a central concept for the definition and the implementation of risk reduction design measures. According to the IPCC's AR6 report, resilience represents "the capacity of interconnected social, economic, and ecological systems to cope with a hazardous event, trend, or disturbance, responding or reorganising in ways that maintain their essential function, identity, and structure" (IPCC, 2022a, p. 2929). However, in urban areas, scientific literature shows that climate resilience is treated in a fragmented approach and still presents several critical issues linked to the lack of systems for its implementation and assessment, due to the diffusion of sectoral and one-dimensional operational approaches that are unable to adequately consider the systemic and interconnected nature of urban challenges (Sharifi et al., 2020; Heinzlef, et al., 2022). Furthermore, there is a lack of attention to the temporal dimension of design processes in relation to critical event phases. In most applications, resilience is considered primarily in spatial and physical terms, while the time and temporality of actions are rarely assessed or discussed (Chelleri et al., 2015; de Herve, 2024). According to the scientific literature, the temporal dimension play a central role, as it allows measures concerning the different phases of the risk management cycle to be implemented and ensures their effectiveness not only in the short term but also in the medium/long term, in a context characterised by uncertainty and increasing complexity (Barroca & Serre 2013; Fisher et al., 2019; Alexander, 2021). Limited attention in literature to these aspects highlights research perspectives, since resilience objectives should not be limited to the ability to respond to impacts but should extend to the construction of urban, environmental, and social systems capable of addressing the entire disaster management cycle, integrating preventive measures, adaptive capacities, and regenerative processes in long-term scenarios. Design innovation therefore lies in the ability to integrate the temporal dimension into the



definition of resilient design measures. Adaptation, mitigation, and risk reduction actions must be evaluated not only in terms of their immediate effectiveness but also in terms of their sustainability and robustness through time. This implies the need to use conceptual models and operational frameworks to associate design solutions with the phases of the risk management cycle.

The research, developed as part of the Extended Partnership RETURN project and in particular as part of the activities of the Spoke TS1 – Urban and Metropolitan Settlements, is set within the international debate on the convergence between Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) approaches, proposing a conceptual and operational framework based on the centrality of the temporal dimension in climate risk adaptation, mitigation, and reduction strategies and solutions integrating the temporal dimensions of Disaster Risk Management (DRM) in an urban integrated resilience perspective. The concept of urban integrated resilience is, in fact, can be declined as the ability of the settlement, or parts of it, to cope with and adapt to potential stresses, disruptions and crises, ensure the core functionalities effectiveness, preserve and promote the wellbeing of communities, and foster the integration of resource management, security, risk assessment and active participation of local communities into urban planning and design. The activities are developed within the context of Task 5.4.3 "Green transition toward resilient and regenerative urban eco-districts" (Fig. 1), and concern the proposal of a conceptual and operative framework to integrate the temporal dimension articulated in the four phases of the disaster management cycle - preparation, absorption, response/recovery, and adaptation - into the climate-resilient design strategies and solutions.

The evolution of the concept of Disaster Risk Management

The growing impacts of climate change, the increase in the frequency and intensity of extreme weather events have gradually highlighted the need to reconsider risk management models, traditionally focused on emergency and reactive phases, towards more integrated and proactive approaches aimed not only at immediate response but also at

Research framework. The Extended Partnership RETURN and the activities of the Spoke TS1 – Urban and Metropolitan Settlements.
Source: Elaboration by the authors.
Fig. 1

prevention, adaptation, mitigation of exposed systems (Goklany, 2007; Tucci, 2021b), promoting a systemic vision of urban resilience. In this context, resilient strategies and solutions acquire a central role, as they combine urban requalification with environmental risk reduction and sustainable resource management, defining a systemic approach that integrates physical, technological, social, and environmental components.

Climate resilience thus becomes a key element of urban design through the combination of Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) approaches. DRR is defined in the scientific literature as the set of policies, strategies, and practices aimed at reducing vulnerabilities and risks related to disasters, preventing the development of new risks, and reducing existing ones, with the aim of increasing the resilience of settlements and communities (Twigg, 2015; IPCC, 2022c; UNDRR, 2022). CCA is intended as a process of adapting natural, social, economic systems to climate change and its impacts, with the aim of reducing vulnerability and increasing the adaptive capacity of urban systems (IPCC, 2022b). In recent decades there has been a gradual convergence between DRR and CCA approaches, recognising the need to set up climate and environmental risk management processes based on systemic, integrated, and resilient approaches (Mitchell & van Aalst, 2008; Dias et al., 2018; Zuccaro & Leone, 2018; Wen et al., 2023).

Within this scenario, Disaster Risk Management (DRM) has emerged as a dynamic risk management system that includes prevention (DRR), adaptation (CCA), response and recovery from impacts in a circular perspective aimed at building resilience. Resilience, in this context, is understood as the ability of impacted systems to anticipate, absorb, adapt, and transform in response to critical events, maintaining essential functions and developing the ability to learn from perturbations (Linkov et al., 2014; Barroca, 2018). DRM therefore involves the implementation of policies and strategies aimed at preventing new risks, reducing existing hazards and managing residual risks, thereby contributing to strengthening resilience and reducing impacts in a long-term perspective, configuring as a continuous and synergistic process (Toseroni, 2017; UNDRR, 2022).

The relevant scientific and technical literature, both at European and national level, highlights how resilience must be integrated into urban risk management strategies, acting on multiple levels – physical, environmental, social, and institutional – and focusing not only on the prevention of human losses but also on the sustainability of interventions from a socio-cultural, environmental, and economic perspective (D'Alençon et al., 2021). In this context, urban and environmental-technological design becomes the main tool for imple-

Evolution and comparison between Disaster Management, Risk Management, and Resilience Management and the policy frameworks.

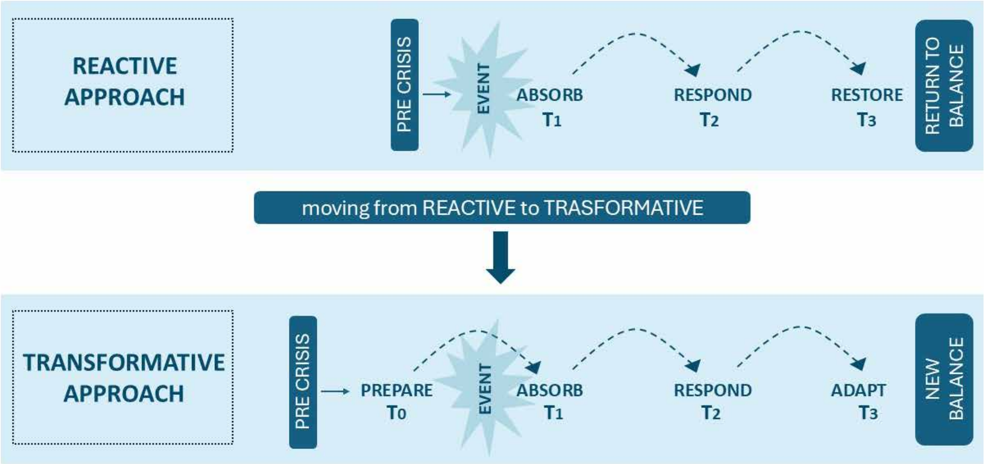
Source: Authors elaboration starting from: Wen, J., et al (2023).

Fig. 2

menting DRM-oriented strategies, facilitating the synthesis of the various dimensions of risk into operational and integrated design solutions.

DRM becomes part of a paradigm shift that has affected emergency management in recent decades, undergoing a significant evolution both in concept and in practice, in parallel with the evolution in how the scientific and political communities have addressed risks and disasters management. This process can be attributed to three key moments, linked to the first three World Conferences on Disaster Reduction, which resulted in three strategic action documents: the 1994 Yokohama Strategy, the 2005 Hyogo Framework for Action, and the 2015 Sendai Framework (Stanganelli, 2008; Mal et al., 2018; Rajabi et al., 2022; Graveline, 2022; Wen et al., 2023) (Fig. 2):

1. Disaster Management (DM) – 1990s – an international debate emerged that focused mainly on DM, understood as the management of emergencies and post-event phases, where the approach was reactive and attention was concentrated on preparedness and immediate response to disasters. This period coincided with the first World Congress on Disaster Reduction, held in Yokohama in 1994, which represented the first moment of global awareness of the need to initiate disaster management processes worldwide, establishing the foundations for a more coordinated disaster management system while maintaining an event-centered approach;
2. Risk Management (RM) – 2000s – the focus shifted to risk management: with the Hyogo Framework for Action 2005-2016, 168 countries gathered in Hyogo for the second world conference on disaster reduction, drawing up an action document that stated the importance of moving beyond an emer-



Shift from reactive to transformative approach.
Source: Elaboration by the authors.
Fig. 3

gency-based approach and recognizing the importance of prevention and reduction of existing risks, which became the most important phases compared to the response phase;

3. Resilience Management (RM) – since 2010 – has consolidated a further new paradigm shift: the integration of the concept of resilience into DRM. In 2011, the third World Conference on Disaster Reduction was held to formalise a new global framework for the development of resilient communities and countries, resulting in the Sendai Framework for Disaster Risk Reduction (2015–2030), a globally recognised strategic document. In this perspective, risk management is no longer limited to reducing vulnerabilities and preventing disasters but includes the ability of systems to adapt, transform, and learn over time.

This conceptual transition reflects a paradigm shift from a reactive to a transformative, proactive and integrated approach (Fig.3), in which urban risk management considers the entire cycle of critical events and emphasizes preparedness and resilience. In this perspective, the convergence between DRR and CCA within DRM allows the implementation of design measures that reduce vulnerability, increase adaptive capacity, and promote an ecological and sustainable transition of urban and metropolitan settlements (McCormick et al., 2013).

The integration of the temporal dimension within DRM therefore enables a more accurate assessment of the effectiveness of design measures for climate mitigation and adaptation throughout the entire risk management cycle, promoting the construction of resilient urban settlements capable of responding effectively to climate impacts and maintaining essential functions and services in the short,

T_0	Prepare	prevention and preparedness strategies and solutions
T_1	Absorb	ability of a system to withstand damage while maintaining its performance unchanged
T_2	Recover	emergency and rapid response actions aimed at minimizing damage and restoring essential services
T_3	Adapt	system's ability to recover lost functions by re-establishing a state of equilibrium

medium, and long term perspectives.

Climate adaptation and mitigation measures towards a resilient perspective

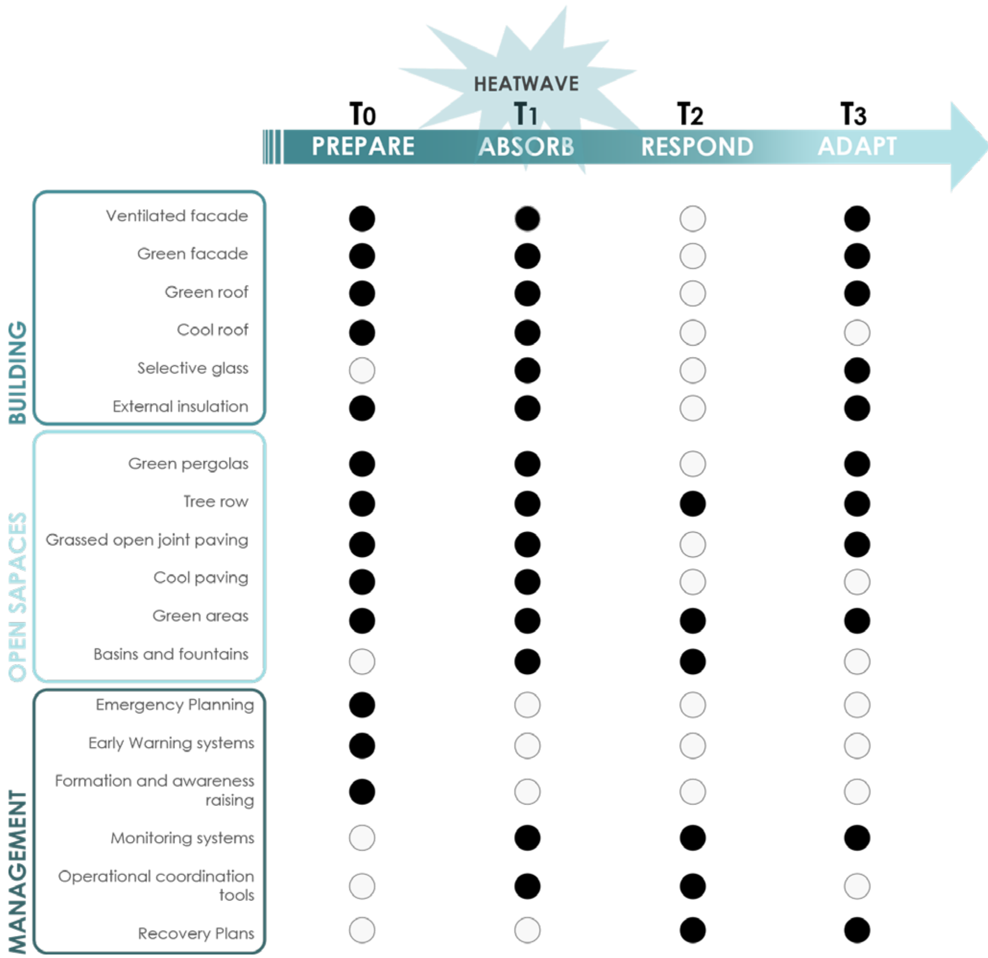
The growing complexity of climate risks in urban and metropolitan settlements requires the definition and adoption of strategies and solutions to ensure resilience, sustainability, and adaptability in the medium to long term. In climate change scenarios, climate proof strategies represent an integrated approach aimed not only at reducing the direct environmental impacts of climate phenomena, but also at mitigating the indirect consequences on urban ecosystems and local communities, based on a principle of multi-level and multi-scale integration that aims at actions that not only reduce the immediate impacts of disasters, but also determine the conditions for a sustainable and regenerative evolution of urban settlements.

The impacts on exposed elements and the vulnerabilities of systems are characterised as site-specific and hazard-specific factors. Therefore, design solutions and their effectiveness assessment must be aimed at defining methodologies, procedures, and operational tools designed to guide interventions, taking into account the complexity of urban settlements and the environmental and socio-economic consequences of interventions (Losasso, 2017; Tucci, 2021a), through *downscaling* and *upscaling* approaches (Musco et al., 2016). Urban resilience, understood as the ability to absorb, adapt and transform facing multiple disruptions, must therefore be interpreted in relation to a climate-resilient perspective that requires efficient strategies and design solutions that even consider future scenarios by uncertainty and complexity, combining actions aimed at climate adaptation, mitigation and risk reduction (D'Ambrosio et al., 2023b). Climate-resilient strategies and solutions are more effective if integrated into a dynamic decision-making framework that combines the temporal dimension of DRM. In this perspective, the temporal variable assumes a crucial role: if risk is defined by the dynamic interaction between hazard, exposure, vulnerability, adaptation and mitigation strategies must

The resilient disaster management cycle.
Source: Elaboration starting from: Linkov et al. (2014) e Wen, J., et al (2023).
Fig. 4

necessarily consider the temporal dimension, understood not only as the urgency of action but also as the articulation of risk management phases and cycles (Cardona, 2013), going "behind the barriers" spatial and temporal of the events (Barroca & Serre, 2013).
The implementation of resilient climate proof actions requires effective strategies and actions across the different temporal and spatial scales of critical events (Serre et al., 2012; Sawalha, 2020). In this perspective, the temporal dimension becomes an essential driver in urban and building-scale projects, to make the recovery phase more efficient and sustainable, in order to understand the most efficient and effective measures in the prevention and mitigation phases of impactful phenomena from a resilient perspective with reference to natural environmental, natural, or anthropogenic hazards (Linkov et al., 2019). This allows us to distinguish between rapid response design actions, medium-term interventions and long-term transformation strategies, avoiding the risk of maladaptation (Magnan et al., 2016) and ensuring the ability of urban communities to maintain their adaptive capacity over time.
The integration of resilience into conceptual and operational approaches to disaster management must therefore be characterised by systemic and integrated approaches in order to enable urban settlements to anticipate, resist and recover from critical events. In order to understand and analyse the effectiveness of climate proof design measures from a climate resilience perspective, it is therefore necessary to adopt a model that takes into account the temporal dimension of risk and the capacity of urban systems to respond, adapt, and transform according to the temporal evolution of critical events. In the scientific literature several studies, such as Barroca & Serre (2013), Linkov et al. (2014), and Wen et al. (2023), highlight the need for a change in the design paradigm, moving from linear and reactive approaches to dynamic and cyclical approaches that allow the integration of prevention, response, adaptation to potential impacts within a perspective of integrated urban resilience. In this scenario, a conceptual and operational framework is proposed to integrate the temporal dimension into the climate-resilient design of strategies and solutions. The framework is structured in four phases (Fig. 4):

- time T_0 (before the impact event occurs): corresponds to the prepare phase and includes all prevention and preparation strategies and solutions, identifying the role of the adopted measures also in a long-term perspective;
- time T1 (during the impact event): corresponds to the absorb phase, which identifies a system's ability to withstand damage while maintaining its performance unchanged or partially operational, without limiting the entire capacity of the system;
- time T_2 (immediately after the impact



event): corresponds to the recover/respond phase in which the system's recovery and response capabilities are identified, with emergency and rapid response actions aimed at minimising damage and restoring essential services;

- time T_3 (following the impact event): corresponds to the medium- to long-term adaptation phase and represents the system's ability to recover lost functions by re-establishing a state of equilibrium, transforming itself in order to maintain its ability to adapt in the long-term perspective.

Linking climate proof strategies and solutions to the risk management cycle means that they cannot be reduced to a single phase but must constitute an integrated and cyclical approach in which each action is closely linked to the previous and subsequent ones, with a view to a multi-temporal and multi-scale approach that allows the design of effective climate-resilient interventions in the short, medium, and long-term scenarios.

Climate-resilient strategies and solutions to heatwaves

Climate-resilient strategies and solutions are effective when integrated into a dynamic de-

Examples of strategies, solutions and their effectiveness in relation to the four phases of risk management.
Source: Elaboration by the authors.
Fig. 5

cision-making framework that combines the temporal dimension of DRM with design and technological solutions, allowing for continuous assessment of the impact of interventions through verification using metrics, parameters, and indicators, review of operational priorities and adaptation of urban policies in response to climate change. Adopting this approach is key to building resilient urban settlements that can ensure quality of life, sustainability and safety.

Among the critical events that are becoming increasingly significant on a national and European scale, heatwaves are one of the most impactful phenomena, with particularly significant effects especially in densely urbanised contexts characterised by high population density and intensive anthropisation, that are vulnerable to extreme temperature changes (Spano et al., 2020; Naheed & Eslamian, 2022). In recent decades, international studies have highlighted a significant increase in the frequency, duration, and intensity of such events, with direct consequences for public health, energy consumption and urban functionality. Managing these phenomena requires the implementation of specific climate-resilient strategies and solutions that are capable, on one hand, of combining prevention, mitigation, and adaptation, in line with the principles of DRM and urban resilience; and, on the other hand, of operating on multiple levels through a multi-scalar perspective (Tersigni & Leone, 2018) that considers functional, technical, environmental, and social critical factors, also taking into account local communities (Boeri, 2020).

In this scenario, the technological and environmental design of public spaces plays a crucial role in increasing urban resilience, capable of relating to the various phases of managing impactful events, such as prediction/prevention, adaptation to impacts, reduction of vulnerabilities, and planning measures for long-term risk mitigation (Coaffee, 2008; Losasso, 2018; D'Ambrosio et al., 2023a).

In reference to the conceptual and operational framework proposed for the analysis of climate-resilient design strategies and solutions from a resilience perspective, an example is developed, analysing the main strategies and solutions aimed at countering the impacts of heatwaves in relation to the four temporal phases of hazard occurrence (Fig. 5).

At Time T_0, before the critical event occurs, all preventive and mitigation measures are focused on improving the physical characteristics of buildings,urban spaces and the preparedness of communities. For example, interventions on the building envelope are based on the use of innovative techniques and materials with high thermal capacity, solar shading, reflective paints, which contribute to increasing comfort conditions by acting on transmittance and phase shift indicators. These measures are also effective in the medium to long term, limiting the need for cooling and the associated energy consumption, reducing emissions of climate-changing agents, thus mitigating the causes of rising temperatures. Phase T_0 also includes the development of monitoring and early warning systems for extreme events, enabling proactive risk management, all population training and education activities.

Time T_1 refers to all actions capable of absorbing climate impacts during a heatwave event, corresponding to the immediate response during the event; all emergency measures aimed at protecting vulnerable groups and immediately reducing the impact are included. This refers to temporary, reversible, rapidly implementable operational strategies that are flexible and adaptive, including the distribution of essential resources and the activation of mobile urban cooling systems, accompanied by communication and alert actions capable of quickly reaching individuals most at risk. The measures already planned will also contribute to this phase, such as green infrastructure and nature-based solutions, including extensive tree planting, green walls and roofs, and shading systems. These solutions, integrated with existing urban infrastructure, play in fact a crucial role in improving urban microclimate, also mitigating thermal stress on inhabitants.

In Time T_2, i.e., the period immediately after the heat peak, in addition to the structural measures already planned in phases T_1 and T_2, the efficiency of urban management becomes crucial in terms of the coordination capacity between local authorities, health services, public infrastructure, communities, highlighting the role that social and organisational factors cover in urban resilience.

Finally, at Time T_3, after the event, the adaptation phase aims to consolidate the resilience of the urban system through the integration of permanent and structural solutions. An example is the implementation of climate shelters, physical and social urban infrastructures essential for supporting adaptation to extreme weather conditions by offering safe and temperate spaces, both indoors and outdoors ensuring the prospect of adaptation even in the long-term perspective (Amorim-Maia et al., 2023).

The implementation of strategies and solutions within an integrated framework guarantees the effectiveness of projects aimed at reducing the impact of heatwaves in urban areas. Once the interventions have been identified, their effectiveness in relation to the temporal phases must then be verified through the use of specific performance indices and indicators such as the LST (Land Surface Temperature) reduction, the UTCI (Universal Thermal Climate Index), or the NDVI (Normalized Difference Vegetation Index) to monitor the quantity and health of green vegetation. These tools enable dynamic and continuous monitoring, which is essential for proactive adaptation in order to design effective interventions in a climate-resilient perspective, combining safety, well-being, and environmental sustainability, integrating physical, ecological, and social dimensions and enhancing the temporal dimension in the risk management cycle.

Conclusions and research perspectives

Urban settlements resilience requires the introduction of conceptual and operational approaches aimed at implementing systemic, integrated design strategies and solutions that combine adaptation, mitigation, and risk reduction. The proposed conceptual framework emphasises the temporal dimension of risk management, highlighting how it is a critical variable for assessing the effectiveness in climate-resilient design and highlighting the need for measures that are effective not only in the immediate term but also in the medium and long term perspective.

The innovation in defining these strategies and solutions lies in their ability to act proactively, anticipating and mitigating risks, enabling urban systems to respond resiliently during potential climate events, maintaining their adaptive capacity in the long-term perspective. Considering the risk management four-stage cyclical process – preparation, absorption, recovery/response, adaptation – the assessment of design strategies and solutions in relation to the temporal dimension is a critical issue for understanding the evolution of the system's response capacity and adaptability over time, allowing the management of the complexity of design alternatives, through proactive approaches.

The framework proposal highlights how urban resilience cannot be conceived exclusively as a static characteristic of settlements and must be treated as a dynamic and cyclical process that integrates knowledge, design tools, governance capabilities. Consequently, resilient design strategies and solutions must be evaluated in relation to their effectiveness in reducing the exposure and vulnerability of exposed elements, considering future risk scenarios and possible climate developments. This approach enables not only an effective response to extreme events but also increases the adaptive capacity of urban systems, promoting the transition to more sustainable and resilient cities. Furthermore, the temporal perspective makes it possible to overcome the dichotomy between prevention and response, integrating short-term interventions with long-term strategies and transforming urban resilience from a theoretical concept into an operational criterion for urban design.

The framework represents a conceptual and practical basis for future applications. The possible developments of this approach lie in the construction of a design decision support catalogue that identifies the contribution of strategies and technical solutions to increasing resilience regarding the four temporal dimensions of risk management and the related indicators/indices for verifying effectiveness, with the aim of testing to validate the proposed approach.

Acknowledgements and Attributions

The contribution was developed as part of the Extended Partnership PE3 research project, RETURN (multi-Risk sciEnce for resilienT commUnities undeR a changiNg climate) (MUR Project Number: PE00000005), within the framework of Spoke TS1 activities - Urban and metropolitan settlements.

In terms of the unity of the contribution to the concept, methodological approach and research activities, the paragraphs 'Thematic framework', 'Climate adaptation and mitigation measures towards a resilient perspective' and 'Conclusions and research perspectives' are attributable to Maria Fabrizia Clemente, while the paragraphs 'The evolution of the concept of Disaster Risk Management (DRM)' and 'Climate-resilient strategies and solutions to heatwaves' are attributed to Sabrina Puzone.

References

Alexander, D. E. (2021). *On evidence-based practice in disaster risk reduction,* «International Journal of Disaster Risk Science », 12(6), pp.919-927.

Amorim-Maia, A. T., Anguelovski, I., Connolly, J., & Chu, E. (2023). S*eeking refuge? The potential of urban climate shelters to address intersecting vulnerabilities*. «Landscape and Urban Planning », 238, 104836.

Barroca, B. (2018). *Vulnerability, Urban Design and Resilience*. «Natural Hazards: Risk Assessment and Vulnerability Reduction», 1.

Barroca, B., & Serre, D. (2013). *Behind the barriers: A resilience conceptual model*. « SAPI EN. S. Surveys and Perspectives Integrating Environment and Society », (6.1).

Boeri, A. (2020). *Politiche di indirizzo per modelli progettuali sostenibili e resilienti in ambito urbano.* In D'Ambrosio, V., Rigillo, M., & Tersigni, E. (a cura di) *Transizioni: Conoscenza e progetto climate proof* . Clean edizioni, Napoli., pp. 191-198

Cardona, O. D. (2013). *The need for rethinking the concepts of vulnerability and risk from a holistic perspective: a necessary review and criticism for effective risk management*. In Bankoff G, Frerks G & Hilhorst D (a cura di) *Mapping vulnerability.*Routledge. pp. 37-51

Chelleri, L., Waters, J. J., Olazabal, M., & Minucci, G. (2015). *Resilience trade-offs: addressing multiple scales and temporal aspects of urban resilience*. « Environment and Urbanization », 27(1), pp. 181-198.

Coaffee, J. (2008). Risk, resilience, and environmentally sustainable cities. «Energy Policy», 36(12), pp. 4633-4638.

D'Alencon, R., Moris, R., & Visconti, C. (2021). *Progettare per la resilienza in chiave multidimensionale: apprendendo dalle esperienze di rischio climatico in Cile e Italia*. In D'Ambrosio, V., Rigillo, M., & Tersigni, E. (a cura di) *Transizioni Conoscenza e progetto climate proof* . Clean edizioni, Napoli.. pp. 170-179

D'Ambrosio, V., Di Martino, F., & Miraglia, V. (2023a). *A GIS-based framework to assess heatwave vulnerability and impact scenarios in urban systems*. Scientific Reports, 13(1), 13073.

D'Ambrosio, V., Di Martino, F., & Tersigni, E. (2023b). *Towards climate resilience of the built environment: A GIS-based framework for the assessment of climate-proof design solutions for buildings*. Buildings, 13(7), 1658.

de Herve, M. D. G. (2024). *Near or distant time horizons? The determinants of the integration of long-term perspectives in disaster risk management evaluation*. « Progress in Disaster Science », 100365.

Dias, N., Amaratunga, D., & Haigh, R. (2018). *Challenges associated with integrating CCA and DRR in the UK-A review on the existing legal and policy background*. « Procedia Engineering », 212, pp. 978-985.

Fisher, D. M., Ragsdale, J. M., & Fisher, E. C. (2019). *The importance of definitional and temporal issues in the study of resilience*. « Applied psychology », 68(4), pp. 583-620.

Goklany, I. M. (2007). *Integrated strategies to reduce vulnerability and advance adaptation, mitigation, and sustainable development.* « Mitigation and Adaptation Strategies for Global Change «, 12(5), pp. 755-786.

Graveline, M. H., & Germain, D. (2022). *Disaster risk resilience: conceptual evolution, key issues, and opportunities*. «International Journal of Disaster Risk Science», 13(3), pp. 330-341.

Heinzlef, C., Barroca, B., Leone, M., & Serre, D. (2022). *Urban resilience operationalization issues in climate risk management: A review*. « International Journal of Disaster Risk Reduction », 75, 102974.

IPCC (2022a). Annex II: Glossary [Möller, V., R. van Diemen, J.B.R. Matthews, C. Méndez, S. Semenov, J.S. Fuglestvedt, A. Reisinger (eds.)]. In: *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 2897–2930, doi:10.1017/9781009325844.029.

IPCC (2022b). *Climate Change 2022: Impacts, Adaptation, and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. Cambridge University Press, Cambridge, UK and New York, NY, USA, 3056., doi:10.1017/9781009325844.

IPCC (2022c). *Climate Change 2022: Mitigation of Climate Change*. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M.

Linkov, I., Bridges, T., Creutzig, F., Decker, J., Fox-Lent, C., Kröger, W., ... & Thiel-Clemen, T. (2014). *Changing the resilience paradigm*. « Nature climate change », 4(6), pp. 407-409.

Linkov, I., Trump, B. D., Linkov, I., & Trump, B. D. (2019). *Resilience and governance*. «The Science and Practice of Resilience», pp. 59-79.

Losasso, M. (2017). *Progettazione ambientale e progetto urbano*. «Eco Web Town », 2(16).

Losasso, M. (2018). *Progetto, ambiente, resilienza*. TECHNE J. Technol. Archit. Environ, 15, pp. 16-20.

Magnan, A. K., Schipper, E. L. F., Burkett, M., Bharwani, S., Burton, I., Eriksen, S., ... & Ziervogel, G. (2016). *Addressing the risk of maladaptation to climate change. Wiley Interdisciplinary Reviews: Climate Change*, 7(5), pp. 646-665.

Mal, S., R.B. Singh, C. Huggel, and A. Grover. (2018). *Introducing linkages between climate change, extreme events, and disaster risk reduction*. In *Climate change, extreme events and disaster risk reduction*, ed. S. Mal, R.B. Singh, and C. Huggel, . Cham, Switzerland: Springer, pp. 1–14.

Meerow, S., Newell, J. P., & Stults, M. (2016). *Defining urban resilience: A review*. «Landscape and urban planning », 147, pp. 38-49.

McCormick, K., Anderberg, S., Coenen, L., & Neij, L. (2013). *Advancing sustainable urban transformation.* « Journal of cleaner production »,, 50, pp. 1-11.

Mitchell, T., & van Aalst, M. (2008). *Convergence of disaster risk reduction and climate change adaptation. A review for DFID,* 44, pp. 1-22.

Musco, F., Maragno, D., Magni, F., Innocenti, A., & Negretto, V. (2016). *Padova Resiliente: linee guida per la costruzione del piano di adattamento al cambiamento climatico*. Corila, Venezia.

Naheed, S., & Eslamian, S. (2022). *Urban vulnerability to extreme heat events and climate change*. In Disaster Risk Reduction for Resilience: Disaster Risk Management Strategies . Cham: Springer International Publishing. pp. 413-434

Rajabi, E., Bazyar, J., Delshad, V., & Khankeh, H. R. (2022). *The evolution of disaster risk management: historical approach*. « Disaster medicine and public health preparedness », 16(4), pp. 1623-1627.

Sawalha, I. H. (2020). *A contemporary perspective on the disaster management cycle*. foresight, 22(4), pp. 469-482.

Serre, D., Barroca, B., & Laganier, R. (2012). *Resilience and urban risk management* . FL: CRC Press, Boca Raton, . 83

Sharifi, A. (2020). *Urban resilience assessment: Mapping knowledge structure and trends*. « Sustainability», 12(15), 5918.

Spano D., Mereu V., Bacciu V., Marras S., Trabucco A., Adinolfi M., Barbato G., Bosello F., Breil M., Coppini G., Essenfelder A., Galluccio G., Lovato T., Marzi S., Masina S., Mercogliano P., Mysiak J., Noce S., Pal J., Reder A., Rianna G., Rizzo A., Santini M., Sini E., Staccione A., Villani V., Zavatarelli M., (2020). *Analisi del rischio. I cambiamenti climatici in Italia*, Report CMCC, 125 . Available online: doi.org/10.25424/CMCC/ANALISI_DEL_RISCHIO

Stanganelli, M. (2008). *A new pattern of risk management: The Hyogo Framework for Action and Italian practise*. « Socio-economic planning sciences », 42(2), pp. 92-111.

Tersigni, E., & Leone, M. F. (2019). *Progetto resiliente e adattamento climatico: metodologie, soluzioni progettuali e tecnologie digitali*. Clean edizioni, Napoli.

Toseroni, F. (2017). *Valutazione della Resilienza territoriale ai disastri: una nuova metodologia multicriterio. Evaluating Territorial Disaster Resilience: a novel multi-criteria methodology*. Università Politecnica delle Marche.

Tucci, F. (2021a). Esiti della ricerca, valutazione delle sperimentazioni, sviluppi di metodo| Outcome of the Research, Evaluation of the Experimentation, Methodological Development. In Bologna R., Losasso, M., Mussinelli, E., Tucci, F. (a cura di) *Dai distretti urbani agli eco-distretti. Metodologie di conoscenza, programmi strategici, progetti pilota per l'adattamento climatico| From Urban Districts to Eco-districts. Knowledges Methodologies, Strategic Programmes, Pilot Projects for Climate Adaptation* . Maggioli Editore, Santarcangelo di Romagna, pp. 342-346.

Tucci, F. (2021b). *Metodi e strumenti del progetto ambientale/ Environmental Design Methods and Tools*, in Bologna, R., Losasso, M., Mussinelli, E., Tucci, F. (a cura di), *Dai distretti urbani agli eco-distretti. Metodologie di conoscenza, programmi strategici e progetti pilota per l'adattamento climatico / Form Urban Districts to Eco-districts. Knowledge Methodologies, Strategic Programs and Pilot Projects for Climate Adaptation*, Maggioli Editore, Santarcangelo di Romagna (RN), pp. 11-10.

Twigg, J. (2015). *Disaster risk reduction.* « Overseas Development Institute », 2015, 368.

United nations human settlements programme - UN-habitat (2022). In Citaristi I. (a cura di) *The Europa directory of international organizations 2022* . Routledge, pp. 240-243.

UNDRR (United Nations Office for Disaster Risk Reduction). 2022. « Disaster risk management ». UNDRR terminology. https://www.undrr.org/terminology/disaster-risk-management Accesso: maggio 2025.

Wen, J., Wan, C., Ye, Q., Yan, J., & Li, W. (2023). *Disaster risk reduction, climate change adaptation and their linkages with sustainable development over the past 30 years: A review*. «International Journal of Disaster Risk Science », 14(1), pp.1-13.

Zuccaro, G., & Leone, M. F. (2018). *Building resilient cities: A simulation-based scenario assessment methodology for the integration of DRR and CCA in a multi-scale design perspective*. « Procedia Engineering », 212, pp.871-878.