

SI: Survivability under Overheating: The Impact of Regional and Global Climate Change on the Vulnerable and Low-Income Population

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Received: 19 October 2020; Accepted: 21 October 2020; Published: 24 October 2020



Abstract: The present special issue discusses three significant challenges of the built environment, namely regional and global climate change, vulnerability, and survivability under the changing climate. Synergies between local climate change, energy consumption of buildings and energy poverty, and health risks highlight the necessity to develop mitigation strategies to counterbalance overheating impacts. The studies presented here assess the underlying issues related to urban overheating. Further, the impacts of temperature extremes on the low-income population and increased morbidity and mortality have been discussed. The increasing intensity, duration, and frequency of heatwaves due to human-caused climate change is shown to affect underserved populations. Thus, housing policies on resident exposure to intra-urban heat have been assessed. Finally, opportunities to mitigate urban overheating have been proposed and discussed.

Keywords: climate change; urban heat island; mitigation; resilience; survivability; low-income population

1. Introduction

The so-called urban heat island (UHI) phenomenon has been known for decades, and many studies have been developed worldwide to address urban overheating. However, rapid urbanization, combined with a continuous increase in the anthropogenic heat in cities, has intensified the phenomenon's magnitude and aggravated its impact on energy, environment, comfort, and health. Further, global climate change has caused a significant increase in the frequency, magnitude, and duration of extreme heat events intensifies UHI's magnitude, especially during heat waves because of the critical synergetic effects.

An increase in the ambient temperature and more frequent heat waves significantly impact the energy consumption and environmental quality of buildings and increase the vulnerability of the local population [1]. Energy poverty refers to the conditions where households cannot afford their basic energy needs. In other words, it refers to the “inability to adequately meet household energy needs” [2]. Research has shown a strong correlation between energy poverty and building performance and the local climate change [1]. Houses with high energy consumption are a severe burden to low-income populations who can hardly afford to satisfy energy needs for proper indoor temperature and environmental conditions. In parallel, low-income populations mainly live in quite deprived and degraded urban areas, where the phenomenon of the urban heat island is quite strong. Exposure to higher summer outdoor temperatures considerably increases the low-income population's vulnerability and puts their health conditions under stress, leading to increased mortality rates.

Heat mitigation and adaptation technologies to upgrade the environmental and climatic conditions in deprived urban zones and improve the energy performance and indoor environmental quality of low-income households are essential technological responses to the problem. This special issue aims to discuss and present the problems and highlight the need to develop heat mitigation plans to counterbalance the impacts of overheating.

2. Special Issue Content

Five papers have been published in this special issue discussing several topics related to climate change, UHI, heat mitigation technology, survivability, resilience, and low-income population. Climate change and urbanization affect the thermal-energy balance of the built environment. This is a primary environmental concern, as it has negative impacts on energy, environment, comfort, and health. The UHI can raise the temperature in cities, which is a significant problem worldwide. In the first paper by Mohammed et al. [3], the UHI magnitude and its association with the main meteorological parameters (i.e., temperature, wind speed, and wind direction) in the hot arid climate of the United Arab Emirates have been discussed. Several studies have been developed to examine the impacts of different urban heat mitigation technologies and evaluate their effectiveness. Among all, trees are useful for the mitigation of urban overheating via transpiration and shading. The paper by Gao et al. [4] explores the transpiration cooling of large trees in urban environments where the sea breeze dominates the climate. This study highlights the importance of considering synoptic conditions when planting trees for mitigation purposes.

Global climate change increases the frequency, magnitude, and duration of extreme heat events. Low-income populations typically live in degraded urban areas, where the phenomenon of the urban overheating is strong. Higher summer outdoor temperatures increase the vulnerability of the low-income population and adversely affect their health.

Longer and more frequent heat waves due to human-caused climate change put historically underserved populations in a heightened state of precarity, as studies observe that vulnerable communities are disproportionately exposed to extreme heat. The paper by Hoffman et al. [5] explores how historic policies of redlining help to explain current patterns of intra-urban heat and the extent to which these patterns were consistent across 108 US urban areas. It reveals that historical housing policies may be directly responsible for disproportionate exposure to current heat events.

The increased frequency of temperature extremes is concerning as they are associated with increased morbidity and mortality. The relationship between hot and cold conditions and mortality from respiratory and cardiovascular causes is well established. Pyrgou and Santamouris [6] examined the heat and cold-related mortality risk of different age groups subject to cold and heat extremes and compared them between the two genders.

Further to the above, drought and extreme temperature forecasting is essential for water management and the prevention of health risks, especially in a period of observed climatic change. A large precipitation deficit and increased evapotranspiration rates in the preceding days contribute to exceptionally high temperature anomalies in the summer, above the average local maximum temperature for each month. The study by Pyrgou et al. [7] investigated droughts and extreme temperatures in Cyprus and suggested a different approach in determining the lag period of summer temperature anomalies and precipitation.

3. Conclusions

This special issue aims to highlight the issues related to local climate change and extreme heat, to enhance survivability against the effects of insecurities in climate change and energy poverty. The papers presented here cover different climatic contexts and discuss several issues related to changing climate. This knowledge is vital to develop appropriate strategies for managing and preventing health risks caused by extreme temperatures. The substantial impact that energy poverty can have on population health highlights the need to adopt policies and practices that protect people

from energy insecurity and climate change. Many countries have recognized the importance of energy-efficient techniques, adaptation, and mitigation technologies to drastically improve energy poverty. Therefore, the use of energy-efficient technology will help to reduce vulnerability to the changing climate and revitalize the low-income households' economic situation.

Author Contributions: Conceptualization, M.S.; writing—original draft preparation, A.S., S.H., P.R., and M.S.; writing—review and editing, A.S., S.H., P.R., and M.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Acknowledgments: Authors thank editors for reviewing submitted manuscripts.

Conflicts of Interest: The authors declare no conflict of interest.

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