

# Chapter 17

## Conclusions and the Way Forward



Ayyoob Sharifi , Andreas Matzarakis, Bao-Jie He,  
and Ali Cheshmehzangi 

**Abstract** The growing trends of urbanization and climate change have increased urban heat exposure and challenges in the past few decades. Extreme heat conditions have become more common in the past few years, with climatic changes and extremes becoming more evident in the future. Even if the world can make progress on mitigating climate change by drastically reducing the emission of Greenhouse Gases (GHGs), these trends are projected to continue in the coming decades. This chapter first discusses natural- and human-made drives of extreme urban heat events. We then highlight major urban heat adaptation and mitigation measures and strategies that are explored in this volume. We argue that mitigation measures have received more attention in science and policy circles, and a more balanced approach is needed

---

A. Sharifi (✉)

The IDEC Institute, Hiroshima University, Higashi-Hiroshima, Japan  
e-mail: [sharifi@hiroshima-u.ac.jp](mailto:sharifi@hiroshima-u.ac.jp)

A. Matzarakis (✉)

German Meteorological Service, Research Centre Human Biometeorology, 79104 Freiburg, Germany  
e-mail: [andreas.matzarakis@dwd.de](mailto:andreas.matzarakis@dwd.de)

Chair of Environmental Meteorology, Faculty of Environment and Natural Resources,  
Albert-Ludwigs-University, 79085 Breisgau, Germany

B.-J. He (✉) · A. Cheshmehzangi (✉)

Network for Education and Research on Peace and Sustainability (NERPS), Hiroshima University, Hiroshima, Japan  
e-mail: [baojie.he@cqu.edu.cn](mailto:baojie.he@cqu.edu.cn)

A. Cheshmehzangi

e-mail: [Ali.Chesh@qdc.edu.cn](mailto:Ali.Chesh@qdc.edu.cn)

B.-J. He

Centre for Climate-Resilient and Low-Carbon Cities, School of Architecture and Urban Planning, Key Laboratory of New Technology for Construction of Cities in Mountain Area, Ministry of Education, Chongqing University, Chongqing 400045, China

Institute for Smart City, Chongqing University, Liyang 213300, Jiangsu, China

A. Cheshmehzangi

School of Architecture, Qingdao City University (QCU), Qingdao, China

to strengthen the adaptive capacity of communities. For this purpose, it is essential to adopt systemic approaches that are facilitated by decision-support tools enabled by advances in information and communication technologies and big data analytics. Such systemic approaches would also help promote justice in the context of urban heat adaptation and mitigation.

**Keywords** Urban heat · Climate change · Mitigation · Adaptation · Justice · Urbanization

## 1 The Urgency of Urban Heat Adaptation and Mitigation and the Contribution of This Volume

Urban heat challenges are products of the combination of extreme heat conditions and the urban heat island effect. Extreme heat conditions have become more common in the past few years, with the climatic changes becoming more evident with every passing year (He et al., 2023). According to the World Meteorological Organization (WMO), the past eight years have been the warmest years on record, with 2016, 2019, and 2020 being the top three (WMO, 2023). Even if the world can make progress on mitigating climate change by drastically reducing the emission of Greenhouse Gases (GHGs), these trends are projected to continue in the coming decades due to the historical emissions (IPCC, 2023). Indeed, the recent synthesis report of the Intergovernmental Panel on Climate Change (IPCC) makes it clear that extreme heat events can occur even at low global warming levels (IPCC, 2023). Needless to mention that under some future climate scenarios, the average temperatures can exceed 5° beyond the pre-industrial levels, with enormous consequences for the ecosystem, economy, infrastructure, and human health and well-being (IPCC, 2023).

In addition to climate change, the urban heat island effect is a key driver of extreme urban heat. It is a condition when temperatures in urban areas are higher than in the surrounding rural areas. Various factors, such as the physical design of cities, the albedo of urban surfaces, the type of materials used, the amount of heat exhaust from automobiles and air conditioners, etc., contribute to the urban heat island effect. Urban heat is not only limited to the Urban Heat Island (UHI). It includes several other factors, like humidity, air pollutants, and combined effects of atmospheric factors.

It is evident that measures aimed at addressing extreme urban heat challenges should address issues related to climate-induced extreme heat events as well as those associated with the urban heat island effect. The key point to keep in mind is, however, that the window of opportunity to take action in urban areas is narrow and will close in the coming decades. Currently, about 56% of the world's population lives in urban areas, and this share is expected to reach approximately 68% by 2050 and always keep in mind that the surface covered by cities is only 3% (UN, 2018). Most of the future world urban population growth will occur in the developing countries of Africa



## 2 The Way Forward

A recent study by He et al. (2023) has highlighted the thematic focus of the literature on urban heat adaptation and mitigation. The key thematic focus areas covered by the existing literature are shown in Fig. 2. Comparing Figs. 1 and 2 shows that this volume has covered most of the popular research themes. More specifically, issues related to urbanization and implications for land surface temperature and urban heat island effect, green and blue infrastructure for urban heat adaptation and mitigation, and design measures for improving outdoor thermal comfort are common between the two figures. The two figures also show that issues related to adaptation, health, and vulnerability have received relatively less attention from the scientific community.

While understanding the physical and climatological drivers of urban heat and exploring the effectiveness of different mitigation strategies is essential to address the issue, it can be argued that already a good amount of knowledge on these issues exists that can guide action plans. More research, however, is needed to address the implications of urban heat adaptation/mitigation measures for other urban issues such as justice, air quality, and vulnerability. Figure 3 indicates that some of these



Fig. 2 Major issues addressed in the literature on urban heat (He et al., 2023)



## References

- He, B.-J., Wang, W., Sharifi, A., & Liu, X. (2023). Progress, knowledge gap and future directions of urban heat mitigation and adaptation research through a bibliometric review of history and evolution. *Energy and Buildings*, 287, 112976.
- IPCC. (2023). Synthesis report of the IPCC sixth assessment report (AR6). The Intergovernmental Panel on Climate Change. <https://www.ipcc.ch/report/ar6/syr/>. Accessed 31 March 2023.
- Lwasa, S., Seto, K. C., Bai, X., Blanco, H., Gurney, K. R., Kilkis, S., Lucon, O., Murakami, J., Pan, J., Sharifi, A., & Yamagata, Y. (2022). Urban systems and other settlements. In: P. R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz & J. Malley (Eds.), *IPCC, 2022: Climate change 2022: Mitigation of climate change. Contribution of working group III to the Sixth assessment report of the intergovernmental panel on climate change*. Cambridge University Press. <https://doi.org/10.1017/9781009157926.010>
- Sharifi, A. (2021). Co-benefits and synergies between urban climate change mitigation and adaptation measures: A literature review. *Science of the Total Environment*, 750, 141642.
- Sharifi, A. (2022). Sustainability and resilience co-benefits and trade-offs of urban climate change adaptation and mitigation measures. In M. Lackner, B. Sajjadi, & W.-Y. Chen (Eds.), *Handbook of climate change mitigation and adaptation* (pp. 1369–1403). Publishing.
- Sharifi, A., Pathak, M., Joshi, C., & He, B.-J. (2021). A systematic review of the health co-benefits of urban climate change adaptation. *Sustainable Cities and Society*, 74, 103190.
- UN. (2018). *World urbanization prospects: The 2018 revision*, online edition. Department of Economic and Social Affairs.
- WMO. (2023). *Past eight years confirmed to be the eight warmest on record*. World Meteorological Organization. Accessed 31 March 2023.