Climate Change, Governance, and Risk Perceptions in Urban Contexts

by

Mahir Yazar

A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

Approved February 2021 by the
Graduate Supervisory Committee:

Abigail York, Chair
Shauna BurnSilver
Amber Wutich

ARIZONA STATE UNIVERSITY

May 2021

ABSTRACT

This dissertation provides a foundation for understanding who decides and proceed local climate change policymaking, how race and ethnicity, class, and political ideology inform climate beliefs, the role of personal exposure to heat-related illnesses in climate change beliefs, and finally differences in perceptions of local extreme heat and global manifestations of climate change.

The first focus examines urban climate governance, the influence of state policy, and stakeholders' climate agenda-setting in a state-centric urban governance structure. A new conceptual model is developed to explore climate governance in Istanbul, a Turkish megacity, under a unitary system of government, in a transcontinental country straddling Europe (in candidate status with the European Union) and Asia. The qualitative analyses show that swings in political leadership, the divergence between the existing laws and newly adopted urban climate agenda, and conflicting priorities between policy entrepreneurs generate barriers to long-run and tangible climate change actions in Istanbul.

The second focus unveils the influence of personal heat exposure and sociodemographic characteristics affecting climate change perceptions in a large American city facing substantial climate change impacts, Phoenix, Arizona. Using the 2011 Phoenix Metropolitan Area Social Survey, a two-level logistic model examines what factors influence a belief that "global warming and climate change are already occurring." The integrated econometric model of climate beliefs and justice shows that climate change and global warming are positively associated with non-white race and non-Latinx ethnicity, high levels of education, personal experience with heat-related illnesses, and liberal beliefs.

The last focus of this dissertation explores how threats of extreme local weather conditions and global climate change are perceived differently by individuals depending on their vulnerability and adaptive capacity to the changing climate. Using the 2017 Phoenix Social Survey, the individual-level regression models demonstrate that greenspace and tight-knit communities, aspects of adaptive capacity, serve as protective elements reducing the perception of climate risk. Factors such as ethnic identity and connection to place are more closely associated with local versus global risks. In contrast, political ideology and personal experiences moderate perception of both local and global risks.

ACKNOWLEDGMENTS

This dissertation is completed with the help of my advisor, Abigail York, in the midst of the COVID-19 pandemic. I owe her a great deal of thanks for her guidance and supervision.

I am very grateful for the encouragement provided by Shauna BurnSilver and Amber Wutich in the progress of writing this dissertation.

I owe special thanks to Georgios Kyriakopoulos who generously dedicated his time and thought to reading and discussing my research.

Special thanks to Fulbright Scholarships for given me the opportunity to pursue a PhD at Arizona State University. Many thanks also to SHESC and the Graduate College for providing funding for my field trips to Turkey; as well as the Central Arizona-Phoenix Long-Term Ecological Research Program (CAP LTER) for allowing me to use materials based upon work supported by the National Science Foundation under grant number DEB-1832016.

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

Figure Page

CHAPTER 1

INTRODUCTION

Human-influenced global environmental change, particularly anthropogenic climate change, is proceeding at an alarming rate (IPCC, 2014), resulting in the present geological age being referred to as the Anthropocene (Crutzen, 2006). Cities currently hold a central spot on the global stage of climate change response, hailed as key laboratories of change and spaces of opportunity to tackle with the current and foreseen impacts of the anthropogenic climate change (Bulkeley & Broto, 2013; Kuokkanen & Yazar, 2018). High population densities have implications for climate vulnerabilities, adaptation and mitigation potentials in cities, while their role as administrative and economic hubs tend to attract a variety of actors - from engineers to bureaucrats and academics (Folberth et al., 2015). Many cities take the lead in pledging to meet climate change goals, namely the Paris Agreement, that exceed national or regional government commitments (Revill & Harris, 2017; Figueres et al., 2017; IPCC, 2018).

There are growing number of studies focusing on mitigation strategies of cities, policies and actions to reduce the global effects of climate change. Cities account for 60-80 percent of energy consumption, for example, and produce up to 70 percent of human-induced greenhouse gas (GHG) emissions, mainly caused by fossil fuel consumption (UN-Habitat, 2016). A number of studies have reported increasing nitrogen dioxide (NO_2) levels in cities and the impact this has on air pollution and health issues within and beyond city boundaries (Sheng & Tang, 2016; Kennedy et al., 2015; Balkanov et al., 2010).

Researchers show that cities are able to modestly cut emissions from their operations, which can in turn significantly tackle with the global mitigation targets (Larsen & Hertwich, 2009). This movement lays down the transformation of infrastructure systems such as mass transit and electric vehicles (Nakamura & Hayashi, 2013), as well as energy efficiency standards for buildings (Ascione et al., 2013).

Researchers show that adaptation strategies have different political characteristics than global mitigation ambitions; as climate change adaption aims to address the likelihood of local environmental changes and respond their risks within socio-economic and political conditions of a given local context (Lee & Hughes, 2017). As cities are created in processes combining different political, economic, cultural, and material structures (McFarlane, 2011); and considering that cities even within the same national boundaries experience the impacts of climate change differently due to their geographical locations, infrastructure conditions, and socio-demographics (Rosensweig et al., 2010; Bulkeley & Broto, 2013); the risks from climate change is not only distributed disproportionately in spatial contexts, but also the impacts of climate change exacerbate the existing inequalities and increase socio-economically disadvantaged people's vulnerability (Eriksen & O'Brien, 2007; Taylor, 2014).

Vulnerability is multidimensional, including biophysical and social vulnerabilities; vulnerability to physical events (e.g., exposure to natural hazards, changing climate) and social vulnerability focuses on exposure to hazards, the sensitivity of systems or populations to absorb impact, and people's adaptive capacity to recover from the exposure (Turner et al., 2003; Adger 2006; O'Brien et al., 2007). That said, this dissertation does not use the term hazard interchangeably with risk. Hazard refers to "*the possible, future*

occurrence of natural or human-induced physical events that may have adverse effects on vulnerable and exposed elements; and it is a component of risk and not risk itself (Cardona et al., 2012, p.69)." Risk arises through deeply fused political, economic, and social processes. Researchers argue that there are three important factors that trigger risk and lead to vulnerability: First, the impact of economic growth on socio-economically disadvantaged population, as development can either hinder or foster risks from hazards (Adger, 2000). Second, the existing political economic structures and historical contexts on the cause of vulnerability and to what extend these contexts increase vulnerability over time (Blaikie et al., 1994; Adger, 1996; Adger, 2000). Lastly, the response structures of the multi-dimensional institutions towards hazards in order to mitigate their impacts (Kasperson, 1992; Adger, 2000).

The increasing scholarship in urban climate adaptation, for instance, attempts to better understand to what extend local climate adaptation plans and implementations either inhibit or foster vulnerability of urban populations (Rice et al., 2019; Anguelovski et al., 2016). Researchers urge that political elites' top-down urban climate adaptation and resilience planning approaches exacerbate spatial inequalities; adaptation plans and projects often protect wealthy communities while simultaneously increase the vulnerability of disadvantaged communities (Long & Rice, 2020; Yazar et al., 2020). In addition to the importance of governance structures in climate decision making; examining perceptions of climate change and extreme weather changes in local contexts is argued to be a central element in contextualizing vulnerability beyond the physical phenomena posing threats to socio-economically disadvantaged communities; but more importantly climate risk perceptions underline how individuals and communities are exposed to different objects of

vulnerabilities due to changing climate coupled with the existing social, economic, political, and historical structures (Adger 2000; Leiserowitz, 2005).

Together, these arguments provide fundamental reasons for analyzing climate change from the lenses of governance; as well as people's beliefs in and risk perceptions of climate change in urban contexts. Here, I refer governance as " a change in the meaning of government, referring to a new process of governing; or a changed condition of ordered rule; or the new method by which society is governed (Rhodes, 1996; 652-3)." Istanbul and Phoenix are selected as the foci of this dissertation. There are pervasive inequalities in the distribution of climate change impacts, especially related to urban heat exposure and flash floods, as well as to public spaces and environmental goods, such as trees and canopy (an especially important factor for heat) in both cities.

In **Chapter 2**, I develop an explanation of how climate change is governed under a unitary state structure, particularly focusing on how urban climate governance incorporates higher-level government policy and external stakeholders to set a climate agenda and actions in the megacity of Turkey, Istanbul. Four main themes are framed from the urban climate governance literature including agenda setting, divergence between the existing policies and urban climate agendas, the roles of policy entrepreneurs, and civil society organizations. The analysis focuses on the four themes with evidence from semi-structured interviews, field notes based on participant-observations, and existing official documents, my aim is to better understand how climate change is governed in Istanbul, under a unitary system of government.

In **Chapter 3,** I argue that the beliefs in climate change are influenced by personal experiences and sociodemographic characteristics, yet justice considerations are often

overlooked in climate beliefs models. Therefore, unveiling the influence of the aforementioned factors on climate change beliefs in a large American city facing substantial climate change impacts, Phoenix, Arizona becomes important. Using the 2011 Phoenix Area Social Survey (Harlan et al., 2017) that includes data collected from (n = 806) households across fourteen cities in the Phoenix metropolitan area, what factors influence a belief that *"global warming and climate change are already occurring"* is investigated. Engaging adaptive capacity and justice literatures, I propose an integrated econometrics model of climate beliefs and justice which is essential to understand climate adaptation in the context of one of the most climate change impacted cities in the USA, Phoenix, Arizona.

In **Chapter 4**, I argue that local extreme weather and global climate change are perceived differently depending on individuals' vulnerability and socio-political context. The role of green infrastructure, social capital, place attachment, socio-demographics (income, race and ethnicity, gender, education), heat exposure, and political beliefs are explored on residents' perception that extreme heat (local phenomena) or global warming and climate change (global phenomena) seriously affects their household or way of life. The scalar dimensions of beliefs about the aforementioned risks can bring into particularly sharp focus the ways in which inequalities are created and maintained by the existing urban planning, social and political processes. Using individual-level logistic regression models with 2017 Phoenix Area Social Survey (Larson et al., 2019), (n = 496) households across twelve cities in the Phoenix metropolitan area, I unpack the role of adaptive capacity, including infrastructure and social structures that affect the ability of households to cope with climate-related risks.

Finally, the findings in this dissertation and their theoretical and policy-oriented implications are synthesized and discussed in detail in **Chapter 5.**

References

Adger, W. N. (1996). Approaches to Vulnerability to Climate Change. Global Environmental Change Working Paper 96-05, Center for Social and Economic Research on the Global Environment, University of East Anglia and University College London.

Adger, W. N. (2000). Institutional adaptation to environmental risk under the transition in Vietnam. *Annals of the Association of American Geographers*, *90*(4), 738-758.

Adger, W. N. (2006). Vulnerability. Global environmental change, 16(3), 268-281.

Anguelovski, I., Shi, L., Chu, E., Gallagher, D., Goh, K., Lamb, Z., ... & Teicher, H. (2016). Equity impacts of urban land use planning for climate adaptation: Critical perspectives from the global north and south. *Journal of Planning Education and Research*, *36*(3), 333-348.

Ascione, F., De Masi, R. F., de Rossi, F., Fistola, R., Sasso, M., & Vanoli, G. P. (2013). Analysis and diagnosis of the energy performance of buildings and districts: Methodology, validation and development of Urban Energy Maps. *Cities*, *35*, 270-283.

Baklanov, A., Lawrence, M., Pandis, S., Mahura, A., Finardi, S., Moussiopoulos, N., ... & Borbon, A. (2010). MEGAPOLI: concept of multi-scale modelling of megacity impact on air quality and climate. *Advances in Science and Research*, *4*, 115-120.

Blaikie, P.; Cannon, T.; Davis, I.; and Wisner, B. (1994). At Risk: Natural Hazards, People's Vulnerability and Disasters. London: Routledge.

Bulkeley, H., & Castán Broto, V. (2013). Government by experiment? Global cities and the governing of climate change. *Transactions of the institute of British geographers*, *38*(3), 361-375.

Cardona, O.D., M.K. van Aalst, J. Birkmann, M. Fordham, G. McGregor, R. Perez, R.S. Pulwarty, E.L.F. Schipper, and B.T. Sinh. (2012). Determinants of risk: exposure and vulnerability. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 65-108.

Crutzen, P. J. (2006). The "anthropocene". In Earth system science in the anthropocene (pp. 13-18). Springer, Berlin, Heidelberg.

Eriksen, S. H., & O'brien, K. (2007). Vulnerability, poverty and the need for sustainable adaptation measures. *Climate policy*, *7*(4), 337-352.

Figueres, C., Schellnhuber, H. J., Whiteman, G., Rockström, J., Hobley, A., & Rahmstorf, S. (2017). Three years to safeguard our climate. *Nature News*, *546*(7660), 593.

Folberth, G. A., Butler, T. M., Collins, W. J., & Rumbold, S. T. (2015). Megacities and climate change–A brief overview. *Environmental Pollution*, *203*, 235-242.

Harlan, S.L., R. Aggarwal, D. Childers, J.Declet-Barreto, S. Earl, K. Larson, M.Nation, et al. (2017). Phoenix Area Social Survey (PASS): 2011.

IPCC, 2018. (2018). Summary for Policymakers. *Global Warming of 1.5° C*.

Kennedy, H., E., Krahn, H., & Krogman, N. T. (2015). Are we counting what counts? A closer look at environmental concern, pro-environmental behaviour, and carbon footprint. *Local Environment*, *20*(2), 220-236.

Kasperson, R. E. (1992). The Social Amplification of Risk: Progress in Developing an Integrative Framework. In Social Theories of Risk, ed. S. Krimsky and D. Golding, pp. 153–78. Westport, CT: Praeger.

Kuokkanen, A., Yazar, M. (2018). Cities in sustainability transitions: comparing Helsinki and Istanbul. *Sustainability*, *10*(5), 1421.

Larson, K., York, A., Andrade, R., & Wittlinger, S. (2019). Phoenix Area Social Survey (PASS): 2017.

Larsen, H. N., & Hertwich, E. G. (2009). The case for consumption-based accounting of greenhouse gas emissions to promote local climate action. *Environmental Science & Policy*, *12*(7), 791-798.

Lee, T., & Hughes, S. (2017). Perceptions of urban climate hazards and their effects on adaptation agendas. *Mitigation and Adaptation Strategies for Global Change*, *22*(5), 761-776.

McFarlane, C. (2011). Assemblage and critical urbanism. *City*, *15*(2), 204-224.

Leiserowitz, A. A. (2005). American risk perceptions: Is climate change dangerous? *Risk Analysis: An International Journal*, *25*(6), 1433-1442.

Long, J., & Rice, J. L. (2020). Climate urbanism: crisis, capitalism, and intervention. *Urban Geography*, 1-7.

Nakamura, K., & Hayashi, Y. (2013). Strategies and instruments for low-carbon urban transport: An international review on trends and effects. *Transport Policy*, *29*, 264-274.

O'BRIEN, K. A. R. E. N., Eriksen, S., Nygaard, L. P., & Schjolden, A. N. E. (2007). Why different interpretations of vulnerability matter in climate change discourses. Climate policy, 7(1), 73-88.

Revill, C., & Harris, V. (2017). *2020: The Climate Turning Point*.

Rice, J.L., Cohen, D.A., Long, J., Jurjevich, J.R., 2019. Contradictions of the Climate-Friendly City: New Perspectives on Eco-Gentrification and Housing Justice. Int. J. Urban Reg. Res.

Rhodes, R. A. W. (1996). The new governance: governing without government. *Political studies*, *44*(4), 652-667.

Rosenzweig, C. Solecki, W. Hammer, AS. Mehrotra, S. (2010). ‘ Cities lead the way in climate–change action’, Nature. 7318, pp. 909-11.

Sheng, N., & Tang, U. W. (2016). The first official city ranking by air quality in China—a review and analysis. *Cities*, *51*, 139-149.

Taylor, M. (2014). *The political ecology of climate change adaptation: Livelihoods, agrarian change and the conflicts of development*. Routledge.

Turner, B. L., Kasperson, R. E., Matson, P. A., McCarthy, J. J., Corell, R. W., Christensen, L., ... & Polsky, C. (2003). A framework for vulnerability analysis in sustainability science. Proceedings of the national academy of sciences, 100(14), 8074-8079.

Yazar, M., Hestad, D., Mangalagiu, D., Saysel, A. K., Ma, Y., & Thornton, T. F. (2020). From urban sustainability transformations to green gentrification: urban renewal in Gaziosmanpaşa, Istanbul. *Climatic Change*, *160*(4), 637-653.

CHAPTER 2

URBAN CLIMATE GOVERNANCE UNDER THE CENTRAL GOVERNMENT SHADOW: EVIDENCE FROM ISTANBUL

Introduction

Cities constantly undergo changes in the local economy, demography, morphology, and land use due to large-scale factors such as globalisation and economic crisis (Seto et al., 2012; Gouldson et al., 2015). Rapidly urbanizing regions face significant challenges in relation to climate change and biodiversity (Bulkeley, 2013; Grimm et al., 2008; Betsill, 2001). Due to increasing urban population and material consumption including food, energy, water, and land, cities have huge impacts on the Earth system (Folberth et al., 2015). The effects of the changing climate have put pressure on cities to develop solutions for mitigation and adaptation actions with robust governance mechanisms and engagement of actors at multiple levels and scales (Ostrom, 2010; Johnson et al., 2015).

In the midst of challenges facing trans- and- multi-national climate agreements (e.g. Paris Agreement (UNFCC, 2015)), cities around the world set more ambitious climate targets than the national governments, and formed collaborations led by their local public and private leaders (e.g. municipal officers, urban planners, private sector actors) such as transnational municipal networks ICLEI[1] and C40[2] and networked cities, e.g. the World Resource Institute and 100 Resilient Cities; these networks generated both external and

[1] Local Governments for Sustainability, founded in 1990 as the International Council for Local Environmental Initiatives, is a global network of cities, towns and regions committed to building a sustainable future. Source: https://www.iclei.org

[2] C40 is a network of the world's megacities committed to addressing climate change. C40 supports cities to collaborate effectively, share knowledge and drive meaningful, measurable and sustainable action on climate change. Source: https://www.c40.org/about

internal pressure for taking climate actions (Bulkeley & Betsill, 2003; Rosenzweig et al., 2010), and their collaborations with local governments have been dedicated to enhancing climate change mitigation and adaptation capacities at local-scale (IPCC, 2018: Acuto & Rayner, 2016; C40, 2015).

Local governments have historically been involving in waste collection and utility provision (Burstrom & Korhonen, 2001), as well as land use and transportation planning (Niemeier et al., 2015); yet transnational municipal networks trigger member cities to converge around a common set of mitigation and adaptation practices to address climate-change related challenges in urban contexts within and outside these traditional local public services. In this regard, the literature on climate change governance uses the concept of multi-level governance (MLG), which is the combination of horizontal, vertical and hierarchical arrangements, and refers to mechanisms that guide connectivity between disparate domains of governance, such as government agencies operating at various scales, as well as private sector and civil society actors and global networks in promoting and advancing climate change actions and practices in local scale (Hughes et al., 2018; Bache et al., 2015; Anguelovski et al., 2014; Bulkeley & Broto, 2013). For example, transnational municipal networks and their horizontal influences are found important on setting climate agendas and diffusing local decisions makers' climate actions (Gordon & Johnson, 2017; Gordon, 2016; Lee & Koski, 2015).

The MLG paradigm in climate change literature emphasizes local governments' capacity to participate in policy processes that extend beyond city and national territorial boundaries (Westman et al., 2019). The conceptualizations of transnational municipal networks, therefore, are stimulating new scholarly and applied developments related to

transnational municipal networks' role in leveraging climate change policy discourses in cities beyond local and national administrative levels (Bulkeley, 2005; McDonald, 2013). On the other hand, the current MLG studies fail to fully capture the role of power structures and economic interests of urban elites in the adoption and implementation of climate policy (Westman et al., 2019; Lee & Koski, 2015).

Moreover, I argue that the existing literature focusing on MLP in climate change literature oversimplifies cities that are under highly centralized state structures, known as unitary states, where local governments are inextricably linked to national governments through laws and regulations (Hesse & Sharpe, 1991), which influence (or restrict) a city's climate agenda-setting, and gloss over the variation in civil society organizations' roles in urban contexts. For instance, even though cities are leading certain incremental changes in the urban space, such as renovation of municipal buildings with more energy efficient solutions or installation of solar streetlights, cities are still tied to their national governments to implement large-scale changes in urban contexts (Yazar et al., 2020b; Bednar et al., 2019; Markus & Savini, 2016; Hanssen et al., 2012). Glaeser (2012) highlights that even in the US, where federalism is much stronger, federal governments take the leading role in funding major urban infrastructure including transportation and public housing. Also, municipal power in the US is determined by the state, and many states restrict certain local actions (Glaeser, 2012). Therefore, achieving climate change actions in cities cannot be entirely reduced to transnational municipal networks and their strong role in the MLG framework.

On the other hand, for global challenges such as climate change policymaking, governance structures that concentrate on single issues confined to regional and

bureaucratic processes are no longer functional (Kettl, 2002). As a result, multifaceted, cross-jurisdictional, and long-term development are needed in addressing global challenges in public administrations at state and local levels globally (Fiorino, 2010).

Building upon prior analyses of cities' interplay with national rules and regulations (Scholten, 2013; Dupuis & Knoepfel, 2013; Fünfgeld, 2015; Markus & Savini, 2016), and more bottom-up strategies generated with the civil society organizations in order to accelerate climate actions (Jalali, 2002; Neebe & Reusswig, 2012; Forrest et al., 2017; Cheon, 2020), this research aims to develop an explanation of how climate change is governed under the unitary states, particularly focuses on how urban climate governance incorporates higher-level governments and external stakeholders to set a climate agenda and actions. Arguments from four theoretical perspectives on climate governance literature: agenda setting; divergence between policies and adopted urban climate agendas, policy entrepreneurs, and civil society, respectively, are examined through an exploratory case study of megacity, Istanbul.

Istanbul was selected due to its unitary governance structure and vulnerability to climate change. Turkey remains a highly centralized, unitary system with two levels of government, central and local, although governance reforms associated with European Union admission have led to the development of regional development agencies but failed to increase autonomy of local administrations as these agencies are established under the jurisdiction of the central government (Tan, 2020). Climate vulnerability is associated with the expected increase in average annual temperature in Istanbul is between 1 to 4.5 ^{o}C, which will be coupled with additional 1-2 ^{o}C increase due to the heat-island effect triggered by the urban density (ICCAP, 2018). Istanbul is part of the transnational municipal

networks and recently adopted a climate change action plan through one of these networks, C40, in 2018.

This research draws on the four different framings of climate governance to examine the institutional and organizational factors affecting the urban climate governance structure of Istanbul. The proposed approach allows us to explore the role of urban governance structures under a unitary system on setting agenda, policy adoption, and implementation of climate actions. Given the global crisis of climate change, it is imperative that scholarship expands to include more cases under unitary systems (van der Heijden et al., 2020; Westman et al., 2019). This research demonstrates that even in governance systems under unitary states, there is significant interplay between national and subnational government entities (and often divergence in policies), critical roles for transnational municipal networks in agenda-setting, active policy entrepreneurs at the local levels, and opportunities for civil society and NGOs to engage in the municipal policymaking process.

1. Theoretical Context

Much of the literature on urban climate governance separately focuses on cities' climate change governance and policies with less attention paid to the national governance context (Dupuis & Knoepfel, 2013; Fünfgeld, 2015; Markus & Savini, 2016). Other research examines cities' interactions with transnational municipal networks on agenda setting (Gordon & Johnson, 2017; Gordon, 2016) and the roles of climate entrepreneurs and civil society organizations on climate policymaking (Neebe & Reusswig, 2012; Herweg et al., 2017; Green, 2017; Forrest et al., 2017). Building on this foundation in the climate governance literature, I bring these disparate themes together (see Table 2.1

below). I argue that they are key to analyse the broader institutional and organizational factors in explaining urban climate governance and these factors should not only be studied in isolation.

Table 2. 1

The assessment of urban climate governance.

Themes	**Descriptions**	**Literature Review**
1.Agenda Setting	How are the negotiations between the transnational municipal networks and local governments arranged, and to what extent do such arrangements inform national governments for potential policy change or adaptation to climate change.	Bache & Flinders, 2004; Torenvlied & Akkerman, 2004; Birkland, 2006; Jones & Baumgartner, 2005; Mintrom & Norman, 2009; Kingdon, 2011; Zahariadis, 2016; Gordon & Craig, 2017; Fünfgeld, 2015
2. Divergence between the Existing Policies and Urban Climate Agendas	Existing national policy and regulations that hinder the implementations of newly set local climate change agendas through the transnational municipal networks.	Tsebelis, 1995; Pressman & Wildavsky, 1984; Schreurs, 2008; Hanssen et al. 2012; Scholten, 2013; Dupuis & Knoepfel, 2013; Fünfgeld, 2015; Markus & Savini, 2016
3.Policy	State and non-state actors' awareness, openness and willingness to learn, to relate and to take actions in order to introduce climate change actions, especially when there is an	Rabe, 2004; Greenwood, 2007; Ugur & Yankaya 2008; Lovell, 2009; Mintrom & Norman, 2009; Ostrom, 2014; Termeer et al., 2011; Schroeder et al.,

Entrepreneurs	absence of national / federal government rules.	2013; Timmermans et al., 2013; Boasson & Huitema, 2017; Herweg et al., 2017; Green, 2017
4.Civil Society and NGOs	Focus on formal and informal organisations, such as NGOs, community-grassroots organisations, and neighbourhood associations. Their capacities to address climate change related challenges, their involvement or conflict with the local and/or local governments' climate agenda.	Jalali, 2002; Aldrich & Crook, 2008; McIlwaine, 2009; Neebe & Reusswig, 2012; Forrest et al., 2017; Cheon, 2020

1.1.Agenda Setting

In multi-level governance structures, it is important to understand how urban climate change agendas are set and whose agendas inform national governments potentially influencing policy change. Agendas are important as they can open "windows of opportunity in the policy system" (Kingdon, 2011) and allow a radical change. The existing literature on governance contextualizes agenda setting as a multifaceted process, especially in the multi-level governance context (Bache & Flinders, 2004; Birkland, 2006; Jones & Baumgartner, 2005). Agenda setting and policy change intertwine with actors in the policy arena; these socio-political processes often involve informal and formal spaces and state and nonstate actors (Kingdon, 2011).

Agenda setting, therefore, relies on shifts from publicly supported issues to tangible government policies (Zahariadis, 2016). Mintrom & Norman (2009) argue that elected officials are the prime decision makers for agenda items with substantial capacity to affect policy change. Even though the roles of the transnational municipal networks are praised for urban climate agenda settings (Gordon & Craig, 2017; Fünfgeld, 2015), little is known about to what extent organizations outside of transnational networks, namely national governments or civil society organizations influence the climate urban agenda setting processes. More importantly, local climate agendas, which are soft policies whose binding force is weaker than existing hard regulations, typically leading to incoherence between the newly introduced goals and hard policy instruments (Torenvlied & Akkerman, 2004). Thus, it is important to look closely at the negotiations between the transnational municipal networks and local governments and the emergence of inter-local regional alliances [if they exist] (Monoley & Funfgeld, 2015). To understand the adoption and implementation of urban climate action plans and policy change, it is imperative to carefully examine interactions and arrangements of these transnational municipal networks, national and local governments, NGOs and civil society actors.

1.2. Divergence between policies and adopted climate agendas

Socio-institutional dynamics, referring to the decision-making, agency of actions, actions, relations, and processes (North, 1990), combined with the existing laws and regulations affect the adoption urban climate agendas. Using a socio-institutional perspective, Aylett (2013), for instance, argues that municipal institutions fail to meet urban climate goals due to their complex internal socio-institutional dynamics, such as the role of municipal bureaucracy in implementing existing policies. Existing regulatory

mechanisms inhibit or foster the implementation of the adopted climate change actions in cities and the influence of regulations play out differently depending on the multi-level governance structures.

Using a case study of migrant integration policy in the Netherlands as an example, Scholten (2013) argues that local level policy practices in the multi-level governance system can differ significantly from nationally formulated policies. Even though multi-level governance is contextualized as a best practice in implementing climate change agendas in urban context, critiques from the policy implementation literature argue that complex multi-level governance systems with multiple administrative levels can hinder governance effectiveness as various actors have veto rights allowing action to stall (Tsebelis, 1995) and opposite interests and misinterpretation of the original policies may decrease the efficacy (Pressman & Wildavsky, 1984).

The key argument I follow here is that there should be a meaningful linkage between locally adopted agendas and the existing regulatory framework to increase the likelihood of climate change policy adoption, action, and impact. According to Schreurs (2008), how climate change action is interpreted at the national level shapes local action. Local governments, on the other hand, can also produce a wide range of mitigation and adaptation strategies (Fünfgeld, 2015; Schreurs, 2008).

I argue that the existing regulatory frameworks in the national level influence the ability of local governments to adopt and effectively implement climate change agendas set by transnational municipal networks. Hanssen et al. (2012) find that without coordination of different government institutions operating at different scales for climate actions in Norway, local governments could not address climate change adaptation issues

by themselves; similarly Markus & Savini (2016) find that the "loose and flexible regulatory frameworks" in the water security and green buildings policy domains limit the implementation of climate change adaptation policy objectives. Dupuis & Knoepfel (2013) use the term "implementation deficit" for the cases in which governments show little interest in addressing certain issues, such as climate change, or those that adopt non-binding policy instruments which are ineffective in solving climate change related problems. Thus, it is important to identify potential conflicts in local and national governments' climate visions and unveil any divergence between the existing regulations and the adopted urban climate agendas.

1.3.Policy Entrepreneurs

As climate change actions happen in a multi-level governance space including different jurisdictions and districts in cities and different levels of formal and informal agencies and agents, policy entrepreneurs are needed to address climate change challenges (Green, 2017; Ostrom, 2014; Termeer et al., 2011; Lovell, 2009). Policy entrepreneurs are identified as a small group of individuals in and outside of the state organizations, exerting distributed leadership in collectively steering policy processes (Mintrom & Norman, 2009; Ostrom, 2010; Green, 2017). Advancing cooperation around a common vision allow effective interactions and negotiations among different actors to build joint strategic agendas; this may limit policy divergence from national levels and catalyse policy change through coordination (Boasson & Huitema, 2017; Herweg et al., 2017; Schroeder et al., 2013; Mintrom & Norman, 2009; Rabe, 2004).

Policy entrepreneurs are widely active in democratic countries with multi-level governance structures, yet they are also effective, especially in the form of businesses

associations, in authoritarian regimes (Greenwood, 2007; Ugur & Yankaya 2008). The literature on climate governance argues that policy changes on the ground depend on the existence of climate entrepreneurs (Green, 2017; Mintrom & Luetjens, 2017), as they are "crucial agents of change in the policy process (Timmermans et al., 2013, p.97)", and "distinguish themselves through their desire to significantly change current ways of doing things in their area of interest (Mintrom & Norman, 2009, p.650)."

Critiques also argue that due to their investment preferences and local economic development goals, political-economic leaders often jeopardize national decision-making processes such as protecting the existing high-carbon regulations (Khan, 2013) or carrying on fracking activity (Arnold, 2020). To understand urban climate change governance, it is important to identify the policy entrepreneurs, assess their activity at different levels of governance, and their impact in fostering or inhibiting climate change related policy decisions due to their positions in structures of power, and roles in political-economic coalitions active in national or local contexts.

1.4.Civil Society and NGOs

Civil society and NGOs influence urban climate agenda setting and their engagement in local policy negotiations are also important to understand how urban climate governance functions in practice. Aldrich & Crook (2008) define civil society as "networks of trust and reciprocity among citizens (p. 379)" at different scales. These organizations can enable certain issues (such as global climate change) to be aired in a public arena and may also pressure public authorities, businesses and academia to take further actions including changing policy. For instance, the civil society organizations' extensive

involvements in the relief efforts after the massive earthquake in Turkey in 1999 forced changes at the state level pressing for authorities to take actions (Jalali, 2002).

Aldrich & Crook (2008) focus on how well-mobilized civil society organizations with strong social bonds influence public authorities' willingness to engage in policy change. Based on this, when exploring civil society's contributions to climate change agenda setting, we understand civil society as grassroots and neighbourhood organizations, as well as informal groups (McIlwaine, 2009) involved in climate change actions. In terms of urban climate policy, communities with higher levels of civil society participation perform better (Neebe & Reusswig, 2012).

Forrest et al. (2017) show that a shift from government to governance through increasing the involvement of non-state actors to the flood-risk management in England, civil society groups introduced new knowledge and skills that local communities leveraged to manage the potential flood risks in their neighbourhoods. Bromley-Trujillo & Poe (2020) find that a high degree of the public issue salience plays important role in influencing climate change related actions, and civil society organizations predominantly in the Western Europe and North America are especially mobilizing local communities towards climate justice movements to pressing local and national authorities to take climate-related actions (Cheon, 2020).

Here, my aim is to understand the interactions or conflicts between local governments, civil society, and NGOs in terms of information sharing or knowledge co-creation for climate actions.

2. Methodology

The analysis focuses on the megacity of Turkey, Istanbul. The empirical data used in this study was gathered through interviews conducted in Istanbul during field research in 2019. The study's approach, including the reasoning for case study selection and data collection process, is presented in the sections below.

2.1. Case Study Selection

Istanbul is a coastal megacity of Turkey and the urban landscape in the city is changing due to economic development, urban sprawl and population growth. In terms of urban governance structure, Istanbul is part of a unitary system of government. There are 39 district municipalities in Istanbul, and each district has its own governing structures and locally elected mayors. The Istanbul Metropolitan Municipality (IMM) is run by the Mayor of the Metropolitan Municipality and in charge of overseeing all of the districts, organizing and monitoring their operations such as selecting solid waste disposal contractors and constructing and maintaining city roads. The IMM is also in charge of the city's strategic and master plans with the approving authority for the 39 districts' budget and zoning plans. In this sense, the district municipalities manage municipal services under the supervision of the IMM—a system that has been characterized as having "a powerful mayor and weak councils" (Türkün, 2011). In addition, as funds come from the central government in the form of tax-sharing arrangements, long-term credit, and direct cash transfers; municipalities in Turkey are financially dependent on the central government (Akıllı & Akıllı, 2014; Güney & Çelenk, 2010).

In the mid-2018, Turkey's long-standing parliamentary system shifted to centralized presidential parliamentary system which drastically affected cities by regressing urban governance mechanisms in the local governments. For instance, the national government withdrew local governments' electoral power since the elected Mayors of the major cities in Turkey were replaced with trustees by the national government after the 2016 a coup d'état attempt. This "re-centralisation" (Tansel, 2019) process dominated by the national government infringes on communications between urban decision-making actors preventing local actors from creating a secure long-term strategic vision for climate actions (Krellenberg & Turhan, 2017) due to a lack of political and financial autonomy.

In terms of climate change, over the long duration of 1912–2016, Istanbul's average annual temperature rose by 0.94 degrees Celsius as a result of anthropogenic climate change. (Toros et al., 2017). The increase in temperature coupled with urban density increases its vulnerablility to the urban heat island, heat waves, and flash floods. The long-term effects of the changing climate are potentially devasting to the 14,6 million residents' (TurkStat, 2016), as well as the national economy, as the city produces 30.5% of the country's total GDP (857.57 billion USD) (OECD, 2018). MLG dynamics between the city (IMM), state (Turkey), and international community (C40) persist, and change, in the climate change domain.

In generating Istanbul's 2018 Climate Change Action Plan, for instance, the IMM worked with a transnational municipal network, C40, through prescribed participatory planning and policy models (ICCAP, 2018) to implement mitigation and adaptation goals. To assess the role of a strong state in the MLG structure together with climate-related risks

and recent collaboration with international networks in climate planning, I selected Istanbul as the principal of our study enabling a reflection on urban climate governance mechanisms under the shadow of a unitary state system.

2.2. Data Collection Methods and Analysis

In order to understand urban climate governance within a unitary state case, semi-structured interviews were conducted to ensure maximum diversity of views on the four identified themes for Istanbul. The snowball sample interviews were conducted from June to August, and throughout December of 2019. Fieldwork involved interviewing 19 political elites, including three from the national government; seven from the local government; two from the professional organizations; four from civil society groups and NGOs, and one person from global networks, regional networks, and academia respectively, in the climate change field covering national and local governments, academic and civil society actors.

Brief anonymized details of respondents' professions and initiated organizations are provided in Appendix B. Interviewees were asked about their involvement in climate change actions and agenda setting in Istanbul. I asked questions based on the four themes identified in the literature earlier including interviewees' involvement to the climate change agenda setting processes in Istanbul and whether any transnational municipal networks inspired or guided their works; their level of interactions with the other national or local government institutions and organizations, as well as civil society and NGOs; whether there are tensions between the different aforementioned organizations and institutions in climate change policy and actions.

I designed codes to identify statements about: involvement in the climate change agenda setting processes in Istanbul and whether any transnational municipal networks

inspired or guided their works; their level of interactions with the other national or local government institutions and organizations, as well as civil society and NGOs; whether there are tensions between the different aforementioned organizations and institutions in climate change policy and actions.

Once the coding was complete, I performed a systematic comparison between coded interviews across groups (Bernard et al., 2016) in order to identify emerging themes that are best suited to the four themes identified in the literature earlier. In the results, I present exemplar quotes from the interviews – each respondent is assigned a code using Bernard et al. (2016) coding methods – augmented with field notes based on participant-observations as needed to provide a more complete picture of mutual understandings and values.

Complementing the qualitative interview data, I reviewed the existing official documents: the 2011 Turkey's Climate Change Action Plan, the 2015 Istanbul Air Quality Strategy, the 2018 Climate Change Action Plan of Istanbul to understand the vision and pathways to climate change actions, as well as policy documents and regulations: The law no.3194 on Land Development Planning and Control, the Law no.5216 on Metropolitan Municipality, the 2007 Energy Efficiency Law, the 2011 Energy Efficiency Regulations for Buildings. These secondary data documentary sources allowed us to see if there are any divergence between the existing regulations and the climate change action plans, and also ensured a more robust data set enabling stronger interpretations about the socio-institutional dynamics.

3. Results

3.1.Agenda Setting

Turkey built an energy efficiency regulatory framework in 2007 to implement climate change mitigation at national and local levels, as part of the country's European Union (EU) accession processes. The largely EU-influenced 2007 Energy Law was nationally endorsed resulting in mitigation targets that inform the IMM's actions for climate change agenda setting; the 2007 law made the city visible on the international climate governance stage.

The interviewees from the IMM indicated the former elected Mayor of Istanbul's, Kadir Topbaş, "*role in re-branding the city in the international arena* – LG4." While the former Mayor was the President for United Cities and Local Governments (UCLG)[3], "*the IMM began to be presented at the international conferences and events, promoting Istanbul as a sustainable megacity* – LG5". This interaction also brought C40 to the Municipality's agenda, where the IMM became a member in 2013 and started to collaborate with C40 Europe office based in London. Implementation of climate change mitigation policies also began in Istanbul in 2013. A small group of public officers from the IMM's Directorate of Environmental Protection (DoEP), who are environmental engineers, prepared air quality report for Istanbul in 2013. The same group began to prepare a climate action plan including mitigation and adaptation targets for Istanbul. The IMM sent a delegation to the 2015 United Nations Climate Change Conference (COP21), and also participated in the

[3] an international organization aiming international cooperation between cities and their associations, and facilitates programs, networks and partnerships to build the capacities of local governments (Source: https://www.uclg.org/en/organisation/about).

C40 GHG inventory preparation workshops in London in 2016 and 2017. An interviewee said, "*The workshop was based on a newly developed model for GHG calculations for member cities* – LG3." Another interviewee stated that "*the COP21 was a milestone solidifying the political will to create climate actions for the city* – LG2", where the roles of cities were given a prior role to tackle with the effects of climate change. After the Mayor's approval, in 2017, İSTAÇ, the IMM-owned environmental management company financed the DoEP to organize local workshops in order to create a climate change action plan.

Guided by C40, the Istanbul Climate Change Action Plan (ICCAP) is approved by the IMM in 2018 demonstrating the IMM's efforts to comply with the transnational network requirements (C40, 2015). Moreover, the Plan shows the city's willingness to take tangible steps to tackle current and future climate change impacts. When asked about the role of the national government in the IMM climate change agenda setting, one interviewee described the emergence of tensions between officials from the local government and the goals of top officials from the national government,*"we invited many people from the district municipalities to our workshops, and their participation was really low since there is not any requirements by law to implement climate actions in their districts* – LG1." Respondents from the local municipality also pointed out that the lack of knowledge in addressing climate change challenges among the municipal officers reduced the local government's potential to develop their own climate agendas, *"The district municipalities are doing incredible job in solid waste management, but they don't know how to link their work to climate change mitigation and adaptation* – LG7.*"*

The data gathered from the national government suggest that the Ministry of Environment and Urbanization (MoEU) started to draft legislation for municipalities in Turkey to compel preparation of GHG inventory and adaptation and mitigation plans[4]. The Ministry collaborated with intergovernmental organizations, especially the regional NGO - Regional Environmental Centre (REG) *"a trusted partner that has been a long-term collaborator with the Ministry* – NG3,*"* to create a guideline and enforcements for local governments. Two interviewees stated that the "*REG has been the pioneer institution providing technical assistance to the Ministry for GHG calculations and roadmaps for climate mitigation* – NG1*", "the majority of the municipalities are willing to collaborate with REG for climate agenda setting as well* -NG2.*"* Thus, a regional NGO provided the primary connection for agenda setting between the IMM and the Ministry with no explicit, direct relationship between the IMM and Ministry for climate change action.

3.2.Divergence between the existing policies and urban climate agendas

Many interviewees indicated the Law no.3194 on Land Development Planning and Control, and the Law no.5216 on Metropolitan Municipality do not recognize and obligate environmental and urban planning related to climate change (e.g. stormwater management, upgrading energy efficiency standards for buildings). An interviewee from the local government said, *"the lack of climate change recognition in the land development planning*

[4] In April 2020, a new regulatory framework, accepted by the Ministry of Environment and Urbanization, requires establishing Zero Waste and Climate Change Departments and branch offices for all the local governments in Turkey [https://csb.gov.tr/belediyelerde-sifir-atik-ile-iklim-degisikligi-mudurlukleri-kurulacak-bakanlik-faaliyetleri-29738]

and the metropolitan municipality law inevitably inhibit municipalities to require budget from the municipal council and the national government to implement tangible climate change actions – LG4.*"*

Indeed, there is a little evidence of hard national regulations to guide the local governments in Turkey for climate actions. The 2011 Turkey's National Climate Change Adaptation Strategy and Action Plan for 2011-2023 was critiqued by scholars due to its refusal to acknowledge the existence of maladaptive policies, deal with institutional incoordination and lack of technical capacity, and lack of comprehensive analyses to achieve these goals in urban context (Turhan et al., 2016). The 2007 Energy Law and the following 2011 Energy Efficiency Regulations for Buildings are the only policies that motivating the mitigation of climate change in urban areas. The 2011 bill targets climate mitigation (low-carbon actions) and requires a minimum C level energy standard for all the buildings built after 2011 and is a prerequisite for new buildings to be permitted.

The Ministry of Energy and Natural Resources (MoENR) authorized local governments to prerequisite energy efficiency certification while licencing the new buildings. Meanwhile, the existing buildings' energy efficiency levels are monitored and certified by the private companies (consultancy fee must be paid by the homeowners) contracted by the national government. Yet, the bulk of the energy efficiency gains are focused on a few newly developed urban renewal projects[5] in Istanbul; rent-seeking

[5] Urban renewal in Istanbul is analysed by the Turkish scholars along with the shift from populist to neoliberal governance, which saw undervalued and unplanned public and private lands integrated into the formal economy to institutionalize private property regimes (Kuyucu & Ünsal, 2010). In addition, addressing to the earthquake risk, enactment of the 2012 "Law of transformation of Areas under Disaster Risks no. 6306" aided in the expansion and consolidation of Turkey's building industry, and accelerated to

behaviours associated with the ongoing renewal projects by the state-owned construction companies limit the impact of climate change mitigation (Kuokkanen & Yazar, 2018; Yazar et al., 2020a).

The 2007 Energy Law and the 2011 Energy Efficiency Regulations for Buildings aim to increase energy efficiency levels in the country such as investing renewables and increasing energy efficiency for buildings. The 2018 ICCAP mentions road maps for the reduction of energy consumptions from the residential buildings and generating GIS-based design strategies for climate-resilient urban planning in Istanbul (ICCAP, 2018). Yet, there is a lack of integration of these climate mitigation and adaptation strategies and energy efficiency plans with existing laws such as the Law no.3194 on Land Development Planning and Control and the Law no.5216 on Metropolitan Municipality. This divergence between the 2007 Energy Law and the Laws no.3194 and no.5216 put mitigation and adaptation targets - indicated in the national and local climate change action plans - in limbo. That said, the local governments' climate change mitigation targets are constrained by the national government since the laws and regulations that determine local actions are still not updated in accordance with the climate change related issues.

Similar concerns are mentioned by the Chamber of Urban Planners Istanbul office, especially in the cases in which the chamber sues local governments or residential projects that do not comply with the Law no.3194. Two members from the chamber stated, "…*once we open a lawsuit, the court limited our actions within the boundaries set by the Law*

institutionalize private property regimes particularly in Istanbul, where the number of unplanned public and private lands and seismically vulnerable buildings are highest (Karaman, 2013; Yazar et al., 2020a).

no.3194 – U1", *"… if we claim something related to climate change, the case could easily be dropped by the judge as climate change is not a concern of the land development planning and control* – U2.*"*

3.3.Policy Entrepreneurs

The interview data suggest that the pro-climate change policy entrepreneurs in Turkey and Istanbul mainly focus on energy efficiency in buildings and large-scale renewable energy infrastructure projects. The 2007 Energy Efficiency Law created space for policy entrepreneurs to lobby to pass the 2011 bill that requires energy efficiency certification for the newly built building stocks in the country. These entrepreneurs are mainly representatives of business associations that already had close ties to actors in the national government. *"The 2011 bill could carry huge potential for the mitigation of GHG in Istanbul considering that the city hosts the country's biggest housing stock* – R1.*"*

According to our interviewees from energy efficiency and green building associations [N1 & N2] after the 2011 bill passed, these entrepreneurs signed contracts with public and private banks to provide energy efficiency loans to customers purchasing energy efficiency equipment, labeled under their business association, enabled certification of their properties following the 2011 bill. Meanwhile, a collection of financial schemes through the European Bank for Reconstruction and Development (EBRD) and the World Bank (WB) launched to aid in the creation of an energy efficiency market in the manufacturing and construction sectors. One interviewee from a global network said, *"Energy efficiency carries the biggest investment portfolio for the mitigation of the climate change compared to large-scale climate adaptation strategies in national and local levels* – G1."

In Istanbul, the enforcement of the energy efficiency law has inevitably concentrated big and emerging businesses in the city's housing sector. Globally known energy certification schemes like BREEAM (the BRE Environmental Assessment Method) and especially LEED (Leadership in Energy and Environmental Design) have proliferated in Istanbul's building sector (Ünal, 2014) and the number of certified buildings continued to increase.

I find that the policy entrepreneurs in Istanbul who are internationally connected have created associations for energy efficient buildings and transportation to capture economic opportunities created by the regulatory change. One of these associations collaborated with the MoENR to develop a national energy certification scheme to compete with BREEAM and LEED in the domestic market. However, such initiation did not succeed in incentivizing a national certification and our qualitative data present two contrasting reasons explaining this failure.

The association that promotes green buildings has blamed the MoENR for using their energy certification criteria, developed during their collaboration, without their approval to assess efficiency standards following the 2011 Energy Efficiency Regulations for Buildings [N1 & N2]. The interviewees from the national government blamed the aforementioned association for misinformation and claimed that the association agreed to create energy efficiency standards in the first place, but then the association insisted to license buildings in Turkey through their brand, an idea rejected by the Ministry [NG1 & NG2].

3.4. Civil Society and NGOs

The interviews with the IMM show that before the 2018 Climate Action Plans, the municipality organized two workshops and invited stakeholders from different sectors, including NGOs and civil society. The organizer of the workshops and lead author of the 2018 climate change action report, as well as faculty member at a technical university in Istanbul, described how the participants were selected; *"I selected each of the invited stakeholders through my personal knowledge about their work and stance for climate change* – A1*."*

The invited NGOs and civil society organizations are either globally linked and have the skills to access foreign financial channels aimed at the green building and energy efficiency sectors in Istanbul, or founded in the last ten years with the aim of launching a local energy efficiency market and capitalizing on the new energy efficiency regulatory opportunities.

I also find that grassroots organizations in Istanbul are emerging in terms of supporting climate change mitigation actions (e.g. energy efficiency in buildings and transportation) and disseminating knowledge among the community members by organizing municipality-based workshops, or public events.

There are a few examples in Istanbul, for instance, Kadıköy District Municipality, where regularly organized seminars open to the public provided a forum for discussion with locals about climate change, sustainability, and energy efficiency (Kadıköy Belediyesi, 2016). Two interviewees from civil society organizations mentioned their work with the IMM to unveil new zero emissions electric buses.

These organizations also partner with district municipalities and arrange bike-sharing-events to expand zero emission transportation, yet they seem sceptical about their long-term potential impacts. The founder of a bike-sharing organization said, "it *seems impossible to fix the old urban planning in this city and we are doing our best available model with the existing infrastructure, but it is challenging* – C1." Another interviewee from a civil society organization indicated that "*the local government has to position itself above politics and we should be part of the IMM Council in order to represent citizens and protect their rights to use public space* – C2."

It is also well documented by scholars that the professional and grassroots organizations in Istanbul have focused on urban agriculture, urban ecology and biodiversity, and urban greening that are highly related to mitigation of risks caused by flash floods and urban heat island effects (Connelly & Bal, 2016; White et al., 2015; Kaldjian, 2004).

Youth climate strikes also emerged in Istanbul to put pressure on the national government to adopt climate resiliency plans and declare climate emergencies. Some of the well-established NGOs and civil society groups in Istanbul encourage and support these strikes. Yet, none of these civil society groups were invited to the climate change action workshops organized by the IMM. The summary of results by applying the identified four themes to Istanbul case are also listed Table 2.2 below.

Table 2.2

The assessment of urban climate governance & results for Istanbul case.

Themes	Descriptions	Results for Istanbul case
1.Agenda Setting	How are the negotiations between the transnational municipal networks and local governments are arranged, and to what extent such arrangements inform national governments for potential policy change or adaptation to climate change.	The climate change agenda for Istanbul is introduced by the transnational municipal networks and adopted by the Istanbul Metropolitan Municipality.
		The collaboration between the local government and the transnational network did not inform the national government on potential policy change or adaptation to climate change.
		The external bodies of urban governance (e.g. civil society & NGOs) are not included in the climate agenda setting processes.
2.Divergence between the Existing Policies and Urban Climate Agendas	Existing national policy and regulations that hinder the implementations of newly set local climate change agendas through the transnational municipal networks.	There are conflict potentials between the existing regulations & laws and the local governments' climate change agenda.
		Persistent barriers to require funding from the national government to implement the climate actions in the city.
3.Policy Entrepreneurs	State and non-state actors' awareness, openness and willingness to learn, to relate and to take actions in order to introduce climate change actions, especially when there is an absence of national / federal government rules.	Climate entrepreneurs involved in promoting climate change related decisions, mostly for energy efficiency.
		There is weak manoeuvring space that climate entrepreneurs have in order to mediate between state and local actors for climate policy change.
		Potential future swings in political leadership affects the existing climate change plans in the city
4. Civil Society and NGOs	Focus on formal and informal organisations, such as NGOs, community- grassroots organisations, and neighbourhood associations. Their capacities to address climate change related challenges, their involvements or conflict with the local and/or local governments' climate agenda.	The professional and grassroots organizations, and well-known international and local NGOs in Istanbul have been doing works related to urban agriculture, urban ecology and biodiversity, and climate mitigation.
		The current urban climate governance is selectively formed following the energy efficiency regulations and emerging businesses. Therefore, there are less opportunities for NGOs and civil society organizations in terms of information sharing, and co-creation of knowledge with the local government.

4. Discussion

This study explored how urban climate governance is operationalized in the Istanbul Metro Area under the strong unitary state of Turkey. Based on the four themes identified in the climate governance literature: 1) agenda setting through transnational municipal networks, 2) divergence between the existing policies and adopted agendas, 3) the roles of policy entrepreneurs and 4) NGOs and civil society organizations in climate actions, I found opportunities and obstacles for operationalizing multi-level urban climate governance mechanisms in Istanbul.

From an *agenda setting* perspective, Istanbul collaborates through global municipal networks and international NGOs and finds maneuvering space to take independent actions, from the national government, to create an agenda climate change action. The qualitative data show that the national government is willing to cooperate with the organizations in global and regional levels, but reluctant to transfer bottom-up knowledge from the local governments to inform national policy. Therefore, the locally set climate agenda in Istanbul does not trigger a policy change at the national level. Yet, climate change could open an opportunity space for local governments in Turkey to co-create new governance mechanisms with the national government in the future, as the country currently fails lead and guide the development of new and innovative policies for local governments in the midst of the observable effects of climate change.

The need for new multi-level governance structures for climate actions is recognized by the national government through its collaboration and knowledge-exchange with the regional NGOs and intergovernmental organizations. A lack of capacity hinders local engagement; requirements to create a climate change department in all the

municipalities in the country could allow more multi-level governance collaborations with global city networks, local civil society groups and businesses. More importantly such collaborations can open up learning opportunities for the existing municipal officials advancing their knowledge for climate actions, which, potentially, would feedback into stronger and more substantive climate actions.

In terms of *divergence between policies and agendas,* our empirical study shows that in a centralized administrative system that directly limits and directs local governments' climate actions via hard regulatory national policies. The national government has direct policymaking authority in urban development, which is implemented through the IMM, and the state operationalizes this policy through funding for financially lucrative infrastructure projects, and new spaces of consumption (Kuyucu & Ünsal, 2010; Karaman, 2013; Adaman et al., 2017; Yazar et al., 2020a).

One reason for the reluctance of hard regulatory policies in climate change, according to our qualitative data, is that the political elites have still not realized the long-term financial returns of the projects related to climate change mitigation and adaptation. In addition, the divergence between the existing laws and newly adopted regulations limit action by the need to secure funding from the national government. Even though Istanbul has some local authority which is best seen in their ability to generate own-source revenue and rights granted by the municipal law, as the city can own and run companies, I was not informed about any city tax revenues specifically allocated for climate actions. Local budget allocations largely focus on energy efficiency for the municipality-owned building stocks and electrical vehicles while more climate change related issues trigger extreme weather events such as heatwaves and floods are not allocated resources through city

budgets. Therefore, we argue that the city's domains of action for climate change is too narrow to address the significant climate change impacts facing the city.

I find that there are learning mechanisms between *policy entrepreneurs* inside and outside of the national government in Turkey. Despite their entrepreneurial responses in pushing the national government to establish energy efficiency regulations and lobbying for efficiency materials and certifications for buildings, the entrepreneurs at higher levels of the multi-governance system fail to understand the deeper impacts of climate change for society such as increase in morbidity and mortality due to heatwaves, and loss in personal funds due to flash floods. The swings in political leadership also affect the future climate change agendas in the city. The formerly elected Mayor Topbas supported the vision to make Istanbul visible on the global stage, therefore he encouraged climate entrepreneurs in the IMM to take low carbon actions and provided a safety net for them to participate in the transnational city-network activities. He was a member of and elected from the current ruling party (AKP) in Turkey. In this context, the duration of climate actions and the roles of local climate entrepreneurs in Istanbul are highly dependent on the power relations between the national government and the political majority in the City Council. Since the 2019 local elections, the ruling party lost control of Istanbul and the newly elected Mayor of Istanbul, Ekrem İmamoğlu, came to the office with a new vision for the city that also includes climate change actions, such as investing green infrastructure and renovating vulnerable sewage systems. As the power relations between the national and local governments in Turkey depend on the mayor's party affiliation vis-a-vis the national party, and ability to leverage these relations to gain support from the national budget. Because Mayor Imamoglu is a member of and elected from the main opposition party (CHP) in

Turkey, seeking financial support from the national budget to implement climate change actions remain challenging.

From *NGOs and civil society* perspective, I observe that the urban climate governance in Istanbul reproduces significant power asymmetries limiting the influence of some formal and informal groups aiming to address ecological and climate change related challenges in the city. The asymmetries between different formal and informal organizations have been widely recognized since the 2013 Gezi Park revolt, where thousands of people in Istanbul protested the local and national governments due to their arbitrary decisions that affected the green areas in the city.

Since 2013 the professional organizations with historical and political influence over the city, have been stigmatized by the local and national government and their involvement to the meetings and decisions have been gradually phased out due to their participation in the 2013 Gezi Park protests (Özkaynak et al., 2015; Şahin, 2019; Yazar et al., 2020a). The exclusion of the important professional unions and civil society organizations inevitably inhibited the knowledge exchange between these organizations and local governments which put urban green infrastructure and ecology in limbo during the climate change agenda setting.

The current urban climate governance in Istanbul is selectively narrow focused on energy efficiency regulations and emerging businesses to support energy efficiency markets. Swings in climate change leadership and divergence between the existing laws and regulations generate barriers to climate change actions and inhibit the implementation and potential impact of the adopted climate change plans in the city. When collaboration with the transnational municipal networks emerged in the IMM, these networks engaged

in setting the climate agenda and introduced a methodology to measure and identify mitigation and adaptation actions, rather than promoting in-situ mitigation and adaptation goals specifically for Istanbul.

Meanwhile, the civil society groups in the city paved the ground for climate action through leveraging their own capacities and supporting efforts to engage local governments and citizens in workshops and seminars. Similar to Westman et al. (2019)'s findings in a Chinese city, I argue that MLG ideas, which are based on vertical and horizontal interplay in democratic systems with legitimate, and effective collaboration among multiple institutions and organizations, cannot be fully applied to semi-authoritarian political systems, where decision-making remains clustered among powerful national political-elites and not diffused across a large number of local actors. Nevertheless, due to the lack of climate change regulations from the national government, the IMM has an opportunity to co-create new governance structures for climate change, especially if the local government can enhance collaboration with multiplicity of local actors. Consequently, informed by a lineage of climate change related grassroots and civil society organization, citizens could (re)gain agency to face challenges in urban ecology and climate change. The public dialogue for climate resiliency is also important in terms of the visibility of and creating supports for urban climate governance and collective bottom-up action.

4. Conclusion

Despite the rapidly growing urban climate governance literature, studies that focus on different urban governance structures, especially unitary states and semi-authoritarian regimes, are still lacking. Cities with strong ties to their national governments in climate change governance in unitary systems have received limited explicit attention in the literature. Employing the four themes identified from the climate governance literature: 1) agenda setting, 2) divergence between the existing policies and urban climate action plans, 3) the roles of policy entrepreneurs, and 4) civil society organizations, I bring a novel approach to the analysis of a megacity outside of Western Europe and North America. As cities are a set of systems with interconnected actors operating multiple levels of organizations and governance structures, I argue that urban climate governance must be analyzed through multiple lenses that identify interactions between and across various institutions and organizations. This study provides a means to conceptualize multi-level governance of climate change in diverse cities, especially in political-geographically dissimilar contexts.

In unitary state structures, national governments have strong roles in climate change based on their power to transfer and enforce policies through laws and regulations, but still cities play a major role in accelerating these policies and regulations, especially when powerful political elites, such as mayors from the ruling party, provide the policy space and political support for action. Even through, Istanbul's capacity is enhanced through their collaboration with the transnational municipal networks, which bring knowledge sharing and technical assistance, transnational municipal guidance and involvement remains highly technocratic; while local climate entrepreneurs and emerging

local civil-society groups exert pressure to develop locally relevant climate action. Nevertheless, civil-society groups have capacity to address what the city needs through their daily-life experiences, such as the reducing flash flood and urban heat island risks; in contrast, I highlight the challenges of climate action limited to climate policy entrepreneurs in well-connected, formal organizations and entities who largely focus on rent-seeking, e.g. new green buildings, certification schemes, and development of energy efficiency markets, for themselves and their organizations.

The four themes identified from the climate governance literature provide a means to understand how climate change is governed in different political contexts, such as those of powerful centralized states; this effort pushes us beyond the dominant MLG perspective developed largely in European and North American contexts. Future work will leverage this study's findings to understand how the production and reproduction of inequitable urban environments may be exacerbated by climate change agendas and actions, specifically when there is divergence between national and local scales and political elites and civil society, as well as whether collaborations with the transnational municipal networks reflect on in-situ and just climate change adaptation imaginaries.

6. References

Acuto, M., & Rayner, S. (2016). City networks: breaking gridlocks or forging (new) lock-ins?. *International Affairs*, *92*(5), 1147-1166.

Adaman, F., Akbulut, B., & Arsel, M. (Eds.). (2017). *Neoliberal Turkey and its discontents: Economic policy and the environment under Erdogan*. Bloomsbury Publishing.

Akilli, Hüsniye, & Akilli, H. Serkan. (2014). Decentralization and recentralization of local governments in Turkey. *Procedia Social and Behavioral Sciences*, 140, 682–686

Aldrich, D., & Crook, K. (2008). Strong civil society as a double-edged sword: Siting trailers in Post-Katrina New Orleans. Political Research Quarterly, 61, 379–389.

Anguelovski, I., Chu, E., & Carmin, J. (2014). Variations in approaches to urban climate adaptation: Experiences and experimentation from the global South. *Global Environmental Change*, *27*, 156-167.

Aylett, A. (2013). The socio-institutional dynamics of urban climate governance: A comparative analysis of innovation and change in Durban (KZN, South Africa) and Portland (OR, USA). *Urban Studies*, *50*(7), 1386-1402.

Arnold, G. Does Entrepreneurship Work? Understanding What Policy Entrepreneurs Do and Whether It Matters. *Policy Studies Journal*.

Bache, I., & Flinders, M. (2004). Themes and issues in multi-level governance. In I. Bache & M. Flinders (Eds.), Multi-level Governance (pp. 1–11). Oxford: Oxford University Press.

Bache, I., Bartle, I., Flinders, M., & Marsden, G. (2015). Blame games and climate change: Accountability, multi-level governance and carbon management. *The British Journal of Politics and International Relations*, *17*(1), 64-88.

Bednar, D., Henstra, D., & McBean, G. (2019). The governance of climate change adaptation: are networks to blame for the implementation deficit? *Journal of Environmental Policy & Planning*, 1-16.

Bernard, H. R., A. Wutich, and G. W. Ryan. 2016. *Analyzing qualitative data: systematic approaches*. SAGE, Thousand Oaks, California, USA.

Betsill, M. M. (2001). Mitigating climate change in US cities: opportunities and obstacles. *Local environment*, *6*(4), 393-406.

Birkland, T. A. (2006). Lessons of disaster: Policy change after catastrophic events. Washington, DC: Georgetown University Press.

Boasson, E. L., & Huitema, D. (2017). Climate governance entrepreneurship: Emerging findings and a new research agenda. *Environment and Planning C: Politics and Space*, *35*(8), 1343-1361.

Bulkeley, H. (2013). Cities and climate change. Oxon/New York: Routledge, Abingdon.

Betsill, M., & Bulkeley, H. (2003). *Cities and climate change*(Vol. 4). Routledge.

Bromley-Trujillo, R., & Poe, J. (2020). The importance of salience: public opinion and state policy action on climate change. Journal of Public Policy, 40(2), 280-304.

Bulkeley, H., & Castán Broto, V. (2013). Government by experiment? Global cities and the governing of climate change. *Transactions of the institute of British geographers*, *38*(3), 361-375.

Burström, F., & Korhonen, J. (2001). Municipalities and industrial ecology: reconsidering municipal environmental management. *Sustainable Development*, *9*(1), 36-46.

Cheon, A. (2020). Advocacy, social movements, and climate change. In *Handbook of US Environmental Policy*. Edward Elgar Publishing.

C40. *Climate Action in Megacities 3.0* (2015). available at http://cam3.c40.org/#/main/home

Connelly, R. I., & Bal, P. G. (2016). Local networks of resilience and climate adaptation: the case of Istanbul. In *Climate Change Adaptation, Resilience and Hazards* (pp. 109-123). Springer, Cham.

Dupuis, J., & Knoepfel, P. (2013). The adaptation policy paradox: the implementation deficit of policies framed as climate change adaptation. *Ecology and Society*, *18*(4).

Fiorino, D. J. (2010). Sustainability as a conceptual focus for public administration. *Public Administration Review*, *70*, 78-88.

Folberth, G. A., Butler, T. M., Collins, W. J., & Rumbold, S. T. (2015). Megacities and climate change–A brief overview. *Environmental Pollution*, *203*, 235-242.

Forrest, S., Trell, E. M., & Woltjer, J. (2017). Flood groups in England: Governance arrangements and contribution to flood resilience. In *Governing for resilience in vulnerable places* (pp. 92-115). Routledge.

Fünfgeld, H. (2015). Facilitating local climate change adaptation through transnational municipal networks. *Current Opinion in Environmental Sustainability*, *12*, 67-73.

Glaeser, E. L. (2012). The challenge of urban policy. Journal of Policy Analysis and Management, 31(1), 111-122.

Gordon, D. J., & Johnson, C. A. (2017). The orchestration of global urban climate governance: conducting power in the post-Paris climate regime. *Environmental Politics*, *26*(4), 694-714.

Gordon, D. (2016). The politics of accountability in networked urban climate governance. Global Environmental Politics, 16 (2), 82–100.

Gouldson, A., Colenbrander, S., Sudmant, A., McAnulla, F., Kerr, N., Sakai, P., ... & Kuylenstierna, J. (2015). Exploring the economic case for climate action in cities. *Global Environmental Change*, *35*, 93-105.

Green, J. F. (2017). Policy entrepreneurship in climate governance: Toward a comparative approach. *Environment and Planning C: Politics and Space*, *35*(8), 1471-1482.

Greenwood, S. (2008). Bad for business? Entrepreneurs and democracy in the Arab world. *Comparative Political Studies*, *41*(6), 837-860.

Grimm, N. B., Faeth, S. H., Golubiewski, N. E., Redman, C. L., Wu, J., Bai, X., & Briggs, J. M. (2008). Global change and the ecology of cities. *science*, *319*(5864), 756-760.

Güney, Aylin, & Çelenk, Ayşe Aslıhan. (2010). Europeanization and the dilemma of decentralization: Center-local relations in Turkey. *Journal of Balkan and near Eastern Studies*, 12(3), 241–257.

Hanssen, G. S., Mydske, P. K., & Dahle, E. (2013). Multi-level coordination of climate change adaptation: By national hierarchical steering or by regional network governance? Local Environment, 18(8), 869–887.

Herweg, N., Nikolaos, Z.,& Reimut, Zohlnhöfer. (2017). The Multiple Streams Framework: Foundations, Refinements, and Empirical Applications. In Theories of the Policy Process, 4th ed., ed. Christopher Weible, and Paul Sabatier. Boulder, CO: Westview Press, 17– 53.

Hesse J and Sharpe L (1991) Local government in international perspective: Some comparative observations. In: Hesse J (ed.) Local Government and Urban Affairs in International Perspective: Analysis of Twenty Western Industrialized Countries. Baden-Baden: Nomos, pp. 603–621.

Hughes, S., Chu, E. K., & Mason, S. G. (Eds.). (2018). Climate change in cities, the urban book series. Cham: Springer International Publishing. International Council for Local Environmental Initiatives. 2010. *ICLEI's five milestones for climate mitigation* Retrieved July 11, 2019, from http://www.icleiusa.org/action-center/getting-started/iclei2019s-five-milestones-for-climate-protection/

ICCAP (2018) Istanbul Climate Change Action Plan 2016–2018. https://www.iklim.istanbul. Accessed 21 July 2018

Intergovernmental Panel on Climate Change. (2018). *Global Warming of 1.5° C: An IPCC Special Report on the Impacts of Global Warming of 1.5° C Above Pre-industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*. Intergovernmental Panel on Climate Change.

Jalali, R. (2002). Civil Society and the State: Turkey after the Earthquake. Disasters, 26, 120–139.

Jones, B., & Baumgartner, F. (2005). The Politics of Attention. How Government Prioritizes Problems. Chicago: Chicago University Press.

Johnson, C., Toly, N., & Schroeder, H. (Eds.). (2015). The urban climate challenge: Rethinking the role of cities in the global climate regime, cities and global governance. Oxon/New York: Routledge, Abingdon.

Kadıkoy Belediyesi. (2016). *Citizens' Participation in the 2015-2019 Strategic Plan of Kadikoy Municipality: All in People's Power, All Discussed and Decided by the People*. Available at:
http://www.kadikoy.bel.tr/Documents/file/GeneralContent/Stratejikplan-f54d06ff-ed36-482c-8e9f-b137af23c336.pdf (Accessed 11 March 2019).

Kaldjian P. (2004). İstanbul's bostans: A Millennium of market gardens. *Geographical Review*. 94 (3). 284-304.

Karaman, O. (2013). Urban Renewal in Istanbul: Reconfigured Spaces, Robotic Lives. International Journal of Urban and Regional Research 37:715-33.

Kettl, D. F. (2002). Managing indirect government. *The tools of government: A guide to the new governance*, 490-510. In (eds) Elliott, O. V., & Salamon, L. M. *The tools of government: A guide to the new governance*. Oxford University Press.

Khan, J. (2013). What role for network governance in urban low carbon transitions?. *Journal of Cleaner Production*, *50*, 133-139.

Kingdon, J., W. (2011). Agendas, Alternatives, and Public Policy. New York: Longman.

Krellenberg, K., Turhan, E. (2017). 'How to respond to climate change at the local level: A guideline for Turkish cities', UFZ Report no.03/2017, Helmholtz Centre for Environmental Research.

Kuokkanen, A., Yazar, M. (2018). Cities in sustainability transition: comparing Helsinki and Istanbul. Sustainability 5:1421

Kuyucu, T., Ünsal, O. (2010). 'Urban transformation' as state -led property transfer: an analysis of two cases of urban renewal in Istanbul. Urban Studies 47:1479– 99.

Lee, T., & Koski, C. (2015). Multilevel governance and urban climate change mitigation. *Environment and Planning C: Government and Policy*, *33*(6), 1501-1517.

Lovell, H. (2009). The role of individuals in policy change: The case of UK low-energy housing. Environment and Planning C: Government and Policy. 27: 491–511.

McIlwaine, C. (2009). Civil society. In R. Kitchin, & N. Thrift (Eds.), International encyclopedia of human geography (pp. 136–141). Amsterdam, The Netherlands: Elsevier.

Markus, M., & Savini, F. (2016). The implementation deficits of adaptation and mitigation: Green buildings and water security in Amsterdam and Boston. Planning Theory & Practice, 17(4), 497–515.

Mintrom, M., & Norman, P. (2009). Policy entrepreneurship and policy change. *Policy Studies Journal*, *37*(4), 649-667.

Mintrom, M. & Luetjens, J. (2017). Policy entrepreneurs and problem framing: The case of climate change. Environment and Planning C: Politics and Space 35(8): 1362–1377.

Moloney, S., & Fünfgeld, H. (2015). Emergent processes of adaptive capacity building: Local government climate change alliances and networks in Melbourne. *Urban Climate*, *14*, 30-40.

Neebe, M., & Reusswig, F. (2012). Chapter 4 Climate Protection and Civil Society: Does Effective Local Climate Policy Need the Participation and Engagement of Citizens? A Comparison Between the Cities of Potsdam and Muenster. In *Urban Areas and Global Climate Change* (pp. 75-104). Emerald Group Publishing Limited.

Niemeier, D., Grattet, R., & Beamish, T. (2015). "Blueprinting" and climate change: Regional governance and civic participation in land use and transportation planning. *Environment and Planning C: Government and Policy*, *33*(6), 1600-1617.

North DC (1990) Institutions, institutional change and economic performance. Cambridge University Press, Cambridge

OECD. (2018). *Gross domestic product (GDP) (indicator).* Available at:. https://data.oecd.org/gdp/gross-domestic-product-gdp.htm. (Accessed 28 January 2019).

Ostrom, E. (2014). A polycentric approach for coping with climate change. *Annals of Economics and Finance* 15(1): 97–134.

Ostrom, E. (2010). Polycentric systems for coping with collective action and global environmental change. *Global environmental change*, *20*(4), 550-557.

Özkaynak, B., Aydın, C. İ., Ertör-Akyazı, P., & Ertör, I. (2015). The Gezi Park resistance from an environmental justice and social metabolism perspective. *Capitalism Nature Socialism*, *26*(1), 99-114.

Pressman, J. L., & Wildavsky, A. (1984). Implementation: How great expectations in Washington are dashed in Oakland; Or, why it's amazing that federal programs work at all, this being a saga of the Economic Development Administration as told by two sympathetic observers who seek to build morals on a foundation. Univ of California Press.

Rabe, B. (2004). State House and Greenhouse: The Emerging Politics of American Climate Change Policy. Washington, DC: Brookings Press.

Rosenzweig, C., Solecki, W., Hammer, S. A., & Mehrotra, S. (2010). Cities lead the way in climate–change action. *Nature*, *467*(7318), 909.

Seto, K. C., Güneralp, B., & Hutyra, L. R. (2012). Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools. *Proceedings of the National Academy of Sciences*, *109*(40), 16083-16088.

Schneider, M., & Teske, P. (1992). Toward a theory of the political entrepreneur: evidence from local government. *American Political Science Review*, *86*(3), 737-747.

Scholten, P. W. (2013). Agenda dynamics and the multi-level governance of intractable policy controversies: the case of migrant integration policies in the Netherlands. *Policy Sciences*, *46*(3), 217-236.

Schreurs, M. A. (2008). From the bottom up: local and subnational climate change politics. *The Journal of Environment & Development*, *17*(4), 343-355.

Schroeder, H., Burch, S., & Rayner, S. (2013). Novel multisector networks and entrepreneurship in urban climate governance. *Environment and Planning C: Government and Policy*, *31*(5), 761-768.

Şahin, S. Z. (2019). The urbanization policy of Turkey: an uneasy symbiosis of unimplemented policy with centralized pragmatic interventions. *Turkish Studies*, *20*(4), 599-618.

Tan, Evrim. "Quo vadis? The local government in Turkey after public management reforms." *International Review of Administrative Sciences* 86, no. 1 (2020): 115-133.

Tansel, C. B. (2019). Reproducing authoritarian neoliberalism in Turkey: Urban governance and state restructuring in the shadow of executive centralization. *Globalizations*, *16*(3), 320-335.

Termeer C, Dewulf A, van Rijswick H, et al. (2011). The regional governance of climate adaptation: A framework for developing legitimate, effective, and resilient governance arrangements. *Climate Law* 2(2): 159–179.

Timmermans, JS, van der Heiden, S, Born, MP. (2013). Policy entrepreneurs in sustainability transitions: Their personality and leadership profiles assessed. Environmental Innovation and Societal Transitions 13: 96–108.

Torenvlied, R., & Akkerman, A. (2004). Theory of 'Soft' Policy Implementation in Multilevel Systems with an Application to Social Partnership in the Netherlands. Acta Politica, 39, 31–58.

Toros, H., Abbasnia, M., Sagdic, M., & Tayanç, M. (2017). Long-term variations of temperature and precipitation in the megacity of Istanbul for the development of adaptation strategies to climate change. *Advances in Meteorology*, *2017*.

Turhan, E., Cerit Mazlum, S., Şahin, Ü., Şorman, A. H., & Cem Gündoğan, A. (2016). Beyond special circumstances: climate change policy in Turkey 1992–2015. *Wiley Interdisciplinary Reviews: Climate Change*, *7*(3), 448-460.

Türkün, A. (2011). Urban regeneration and hegemonic power relationships. *International planning studies*, *16*(1), 61-72.

Tsebelis, G. (1995). Decision making in political systems: Veto players in presidentialism, parliamentarism, multicameralism and multipartyism. British journal of political science, 25(3), 289-325.

Turk Stat (Turkish Statistical Institute) (2016) Address Based Population Registration System Results. http://www.turkstat.gov.tr/PreTablo.do?alt_id=1059. Accessed 18 January 2019

Ugur, M., & Yankaya, D. (2008). Policy entrepreneurship, policy opportunism, and EU conditionality: The AKP and TÜSİAD experience in Turkey. *Governance*, *21*(4), 581-601.

UNFCC, C. (2015). Paris agreement. FCCCC/CP/2015/L. 9/Rev. 1.

Ünal, B. (2014). Sustainable Development of Istanbul Built Environment.

Van der Heijden, J., Luckmann, O., & Cherkasheva, A. (2020). Urban climate governance in Russia: Insights from Moscow and St. Petersburg. *Journal of Urban Affairs*, *42*(7), 1047-1062.

Westman, L. K., Broto, V. C., & Huang, P. (2019). Revisiting multi-level governance theory: Politics and innovation in the urban climate transition in Rizhao, China. *Political Geography*, *70*, 14-23.

White C., Shopov A., & Casson A. (2015). Heritage under threat: saving the ancient gardens of Istanbul, Turkey. *The SAA Archaeological Record*. 15 (1), 7-9.

Yazar, M., Hestad, D., Mangalagiu, D., Saysel, A. K., Ma, Y., & Thornton, T. F. (2020a). From urban sustainability transformations to green gentrification: urban renewal in Gaziosmanpaşa, Istanbul. *Climatic Change*, 1-17.

Yazar, M., Hestad, D., Mangalagiu, D., Ma, Y., Thornton, T. F., Saysel, A. K., & Zhu, D. (2020b). Enabling environments for regime destabilization towards sustainable urban transitions in megacities: comparing Shanghai and Istanbul. *Climatic Change*, 1-26.

Zahariadis, N. H. (2016). Handbook of Public Policy Agenda Setting. Cheltenham, UK and Northampton, MA: Edward Elgar.

CHAPTER 3

HEAT EXPOSURE AND THE CLIMATE CHANGE BELIEFS IN A DESERT CITY: THE CASE OF PHOENIX METROPOLITAN AREA

Introduction

More than 70% of the world's population will live in cities by 2050 (UN, 2014), and climate change related events, such as heat and droughts, have huge impacts on the socio-ecological and technical systems in cities including increased risks of mortality (Klinenberg et al., 1999; Gasparrini et al., 2017). The IPCC Report (Stocker et al., 2013) shows that the effect of climate change coupled with urbanization increases heat exposure per capita. Critically, the impacts of heatwaves are not equally distributed among people living in urban areas, with some populations and communities more exposed and more vulnerable to climate change impacts or with less capacity to adapt (Balbus & Malina, 2009; Costello et al., 2009; Friel et al., 2011; Zografos et al., 2016). Climate change related weather events disproportionately affect the urban poor and aggravate socio-economic inequalities and environmental injustices in the cities of the US (Harlan et al., 2006; McCarthy et al., 2010; Hartz et al., 2013; Harlan et al., 2014).

Cities in the US have experienced severe weather events triggered by climate change for decades (Curriero et al.,2002; Madrigano et al., 2018; Hayden et al., 2011). Leiserowitz (2005) finds that most Americans continue to see climate change as a moderate risk and a future threat that will impact people and places that are geographically and temporally distant. Because of a lack of political will and intransigence of existing institutions and systems, the capacity for local adaptation has been questioned (Adger, 2006; O'Brien et al., 2007; Cutter & Finch, 2008; Krellenberg, 2017; Kuokkanen & Yazar,

2018; Yazar et al., 2020b). Some climate measures and actions perpetuate structures and systems that increase vulnerability, cause maladaptation, and increase climate injustices (Barnett & O'Neill, 2010; Kates et al., 2012; Hughes, 2013; Shi et al., 2016; Yazar et al., 2020a). There are feedbacks between local communities' capacity to adapt, proposed climate actions, and individual awareness and perceptions of climate change (Moser & Ekstrom, 2010).

Climate belief modelling often reveals a "white-male effect" (Albright & Crow, 2019; McCright & Dunlop, 2011; Kahan et al., 2007; Satterfield et al., 2004), providing some of evidence of the racialized and gendered aspects of climate change beliefs. Yet, the modelling literature often does not engage with justice considerations. Building on a rich literature of environmental behaviour, I explore the role of race, ethnicity, gender, parenthood, and education (Kollmuss & Agyeman, 2002; Cottrell, 2003; Scannell & Gifford, 2010), while integrating perspectives of environmental justice and political ecology, such as socio-environmental conditions' uneven distribution across temporal and spatial scales (Cutter, 1995; Escobar, 1998; Heynen et al., 2006; Cole & Foster, 2011). The majority of climate change analyses and beliefs models are based on flood-related events (Spence et al., 2011; Walker & Burningham, 2011; Ogunbode et al., 2017; Albright & Crow, 2019) and I argue that this study makes an important contribution by using personal exposure data to analyse the effects of extreme heat on individuals' perceptions of climate change and global warming.

To analyse the factors influencing climate change beliefs, I use the 2011 Phoenix Area Social Survey (N=806) part of the Central Arizona Phoenix Long-Term Ecological Research (CAP LTER) efforts (Harlan et al., 2017). I propose an integrated model of

climate beliefs and justice which is essential to understand climate adaptation in the context of one of the most climate change impacted cities in the USA, Phoenix, Arizona.

1. Theoretical Context and Hypotheses

Cities that are unable or unwilling to advance climate adaptation exacerbate power asymmetries and perpetuate climate injustice for vulnerable populations (Leiserowitz, 2005; Weber & Stern, 2011; Zografos et al., 2016). Adaptive capacity has its roots in vulnerability framework that include the key elements of exposure to hazards, sensitivity of populations or systems to absorb impacts, and adaptive capacity to cope with climate hazard (Turner et al., 2003; Adger, 2006; O'Brien et al., 2007; Cutter & Finch, 2008). Climate justice research focuses on reducing unjust adaptation policy (Paavola & Adger, 2006; Brulle & Pellow, 2006), such as by incorporating procedural, distributional and recognitional justice in the determination of households and communities' adaptive capacity (Schlosberg et al., 2017). Procedural justice deals with who is involved in the decision-making process and the fairness of institutions; whereas distributive justice focuses on who gets benefits and burdens of goods or services – more specifically how ecosystem services are equally distributed among citizens (Walker, 2011; Thaler, 2017); and recognitional justice addresses the extent to which a government in power recognizes historical inequality and acknowledges communities' claims for equity (Young, 2011). Any violation of the aforementioned equity would trigger injustice that limits individuals' and groups' capacity to adapt to changing climate (Hayward, 2006; Robert & Parks, 2009).

Heat is a dominant weather-related impact affecting human mortality and morbidity in the United States (Berko et al., 2014; Guo et al., 2018). Urban dwellers in cities most prone to drastic weather changes, such as Southwest, are increasingly vulnerable to the

extreme summer temperatures with climate change (Chow et al., 2012; Hondula et al., 2018). Studies find that observing change in local weather is the strongest predictor of risk perceptions in many cities (Li et al., 2011; Zaval et al., 2014); on the other hand the literature is not consistent whether personal exposure to climate-related weather impacts or being socio-economically and environmentally vulnerable to local weather changes might strengthen belief in climate change (Akerlof et al., 2013; Brody et al., 2008).

Through a climate justice lens that connects adaptive capacity, exposure, and political ideology, I explore factors that affect climate beliefs in three models. Model 1 includes individuals' gender; age; race; education; employment status; and whether they had children under the age of six – which are highlighted under *Adaptive Capacity Model*. In Model 2 *Exposure Model*, I introduce people's experiences with the heat-related illnesses; and Model 3 *Ideology Model* their political beliefs.

1.1. Adaptive Capacity Model

The adaptive capacity model includes gender; age; race; education; employment status; and parenthood. Here, I generate Hypothesis (H) for each of the aforementioned variable.

Gender

Gender is frequently an important factor in adaptive capacity as well as climate change concern, and women are found more likely believe in climate change (Akerlof et al., 2015; McCright & Dunlap, 2011; Malka et al., 2009; Broady et al., 2008; Hamilton & Keim, 2009).

H1: Women are expected to hold stronger beliefs that climate change and global warming are occurring than male individuals.

Age

Age is another important factor in perceiving climate change (McCright & Dunlap 2011; Kahan et al., 2007; Marshall, 2004), and it is found that older adults (55 or older) are less likely to believe in the assessment of global warming in the US, compare to younger people (under 30) (Bohr, 2017).

H2: Individuals younger than 30 years of age are expected to hold stronger beliefs that climate change and global warming are occurring than individuals 55 and older.

Race

Researchers show a racial and ethnic gap in concerns about climate change; people of color in the United States are more likely to express higher levels of concern about global warming than are their non-Hispanic White (referred to as Anglo in the southwestern USA) counterparts (McCright & Dunlop, 2011; McCright, 2010; Malka et al., 2009; Kahan et al., 2007; Satterfield et al., 2004). Compared to Anglo individuals, Blacks and Latinos express greater support for international and national climate policies (Pearson et al., 2017).

H3: Individuals other than non-Hispanic Whites are expected to hold stronger beliefs that climate change and global warming are occurring than individuals who identify themselves as White-Anglo.

Education

Hamilton (2011) argues that the level of education could be both positively or negatively related to climate change concern depending on political ideology, with communication and information technologies (e.g. Internet, cable news) allowing educated people to select information that aligns to their ideological views. Egan & Mullin (2012) find that individuals who experienced heat changes in their local environment and have lower education levels and weaker political party affiliations were more likely to believe in climate change.

H4: Individuals with the highest levels of education (completed college) are expected to hold stronger beliefs that climate change and global warming are occurring than individuals who are less educated.

Employment

People with full-time employment are found to have more concerns about the environment (Blocker & Eckberg, 1989; Albright & Crow, 2019), whereas McCright (2010) showed that employment status has no direct effect on climate change concerns.

H5: Individuals with full-time employment are expected to hold stronger beliefs that climate change and global warming are occurring than individuals with other than full-time work.

Parenthood

People with children are found more likely to believe in climate change (Flynn et al., 1994; Krannich & Albrecht, 1995; Poortinga & Pidgeon, 2003; Marshall, 2004), Their

greater concern about climate change is associated with concern about how a changing climate will threaten their way of life (Davidson & Haan, 2012).

H6: Individuals with children under 6 years old expected to hold stronger beliefs that climate change and global warming are occurring than individuals who have kids older than 6 years or not parents.

1.2. Exposure Model

Heat exposure is recognized as one of the severe impacts to human health and wellbeing (Sheridan & Allen, 2018; Petitti et al., 2016; Harlan et al., 2013). Dramatic events such as the 1995 Chicago heat waves show that extreme weather events in urban areas disproportionately harm socio-economically disadvantaged groups with greater mortality and morbidity due to heat (Semenza et al., 1996; Klinenberg et al., 1999). Direct exposure to climate change-related events influences beliefs more than information about climate change in distant locations (Rudman et al., 2013; Whitmarsh, 2009). The relationship between exposure to climate related extreme weather events and climate change beliefs erodes overtime (Howe & Leiserowitz, 2013; Egan & Mullin, 2012). The magnitude of the event also matters; individuals experiencing climate change-related weather events with less damage are less likely to believe that climate change is occurring and also discount the seriousness of climate change (Saad 2015). Building on this research, here I focus on the relationship between the severity of the extreme heat experience and the respondents' personal experience (the respondent versus an individual in the household) and respondents' beliefs in climate change.

H7: Individuals will report higher levels of agreement with the statement that global warming and climate change are occurring if*;* a) they have experienced heat-related illness, b) they called 911 or visited the hospital for heat-related illness, c) they have someone else in their household had symptoms related to heat or high temperatures.

1.3. Ideology Model

A relationship between climate change beliefs and political ideology in the US is well established (Zonacco, 2018; Bohr, 2017; Ogunbode et al., 2017; Palm et al., 2017; Hamilton et al., 2015a; Marquart-Pyatt, 2014; McCright & Dunlap, 2011; Dunlap & McCright, 2008). Researchers find that informing public through scientific articles or reports does not alter their opinion about climate change (Hamilton et al., 2015b; Brulle et al., 2012; Kahan, 2015) as they selectively identify or dismiss scientific information through their social and political identities (Weber & Stern, 2011).

H8: Individuals who describe themselves as very liberal are expected to hold stronger beliefs that climate change and global warming are occurring than individuals who identify themselves as very conservative to somewhat liberal.

2. The Data and Methods

2.1.Study Area

Urban development is transforming the Phoenician landscape, yet these transformations are largely perpetuating inequities (York & Boone, 2018). The city has a long history of environmental injustices, where race-based segregated urban planning

embodied through redlining and industrial zoning of neighbourhoods settled by the minority groups, has led to increased exposure to toxic environments for people of color for decades (York et al., 2014). Even though there are more progressive local governments, such as the city of Phoenix and the city of Tempe, that recognize climate change as a threat to the city's future and have adopted climate change agendas to tackle the heat issue specifically, it is well-documented by the science community (Jenerette, 2011; Chow et al., 2012; Harlan et al., 2013; York et al., 2014; Hondula et al., 2018) that socio-economic segregation and lack of political power in the Phoenix metropolitan area amplifies injustice as vulnerable peoples' voices are less likely to be heard by local governments (Bolin et al., 2005; Bolin et al., 2013; York & Boone, 2018).

Analyses show that the Phoenix Metropolitan Area could witness 42.2 extreme heat days per summer in the periods of 2041 to 2070 compared to 10.6 days for the periods of 1971 to 2000 (Grossman-Clarke et al., 2014). For a growing city of more than 4,8 million people (ACS, 2018) there are grave concerns about future wellbeing of the most vulnerable residents. According to the Maricopa County-Department of Public Health (MCDPH), in 2016, 130 people aged 50 years or older lost their lives due to heat exposure. Increasing impacts of the changing climate exacerbate historic environmental injustices increasing people's vulnerability in the Phoenix Metropolitan Area (Bolin et al., 2013). My aim is to explore how perception of these changes is influenced by adaptive capacity, exposure, and ideology.

2.2. Data

To explore the hypotheses, I use the 2011 Phoenix Area Social Survey (PASS-2011) dataset, published by the Institute for Social Science Research at the Arizona State University (Harlan et al., 2017). The PASS-2011 dataset contains records from a total of 806 respondents, drawn from the population of residents in 40 neighbourhoods in the Phoenix area using a random-probability sampling design. Five neighbourhoods from each group (for a total of 40 neighbourhoods) were selected with the objectives of creating a balanced sample of neighbourhoods that represent variation in ethnic/racial composition, homeowners and renters, and municipalities across the Phoenix Metro Area. The codebook of the PASS is also available through the CAP LTER data portal to get details about full survey design (Harlan et al., 2017). A total of fourteen different cities within the Phoenix area were reported as places of residence across PASS-2011 respondents. The survey was administered online, via telephone interviews, and via face-to-face interviews, achieving a 43.36% response rate at minimum in each neighbourhood.

Dependent variable

PASS-2011 respondents were provided with the introductory statement: *"Global warming and climate change refer to the idea that the earth's average temperature has been increasing over the past 150 years, may be increasing more in the future, and that the earth's climate may change as a result".* They were then asked to express their extent of agreement or disagreement to the statement "*the effects of global warming and climate change are already occurring*" using a four-point scale containing the ordinal categories strongly agree; somewhat agree; somewhat disagree; and strongly disagree.

Responses to the above question were re-coded into a dichotomous variable, distinguishing between respondents who strongly agreed to the statement (coded as 1) and respondents who somewhat agreed, somewhat disagreed or strongly disagreed to the statement (coded as 0). Specified in this binary form, the dependent variable focuses on respondent attitudes at the extreme end of agreement to the statement versus attitudes ranging from moderate agreement to strong disagreement to the statement.

Mode-effect control variable

The study uses a PASS-2011 variable that records the mode in which each respondent completed the survey (i.e. online, telephone, or face-to-face mode). The variable is used to account for the possibility of differential response patterns being observed for PASS-2011 respondents who completed the survey in different modes. PASS-2011 respondents who completed the survey in face-to-face mode were treated as the reference category against which respondents in other modes were compared with regard to the dependent variable of the study.

Socio-demographic control variables

The study uses a range of PASS-2011 variables that record self-reported socio-demographic information about respondents at the time of the survey:

Respondent *gender* distinguishes between respondents who identify as male versus female at the time of the survey. PASS-2011 respondents who identified as female were treated as the reference category against which respondents who identified as male were compared with regard to the dependent variable of the study.

Respondent *age* at the time of the survey was originally recorded in the PASS-2011 dataset as continuous integers ranging from 18 to 92 years of age. These were banded into

three categories or roughly similar frequencies; i.e. 18 to 40 years of age, 41 to 56 years of age, and 57 years of age or older. PASS-2011 respondents in the youngest age group (i.e. 18 to 40 years of age) were treated as the reference category against which respondents in other age groups were compared with regard to the dependent variable of the study.

Respondent *racial and ethnic background* in the PASS-2011 dataset was originally recorded across seven categories (i.e. White; Black; Asian; American Indian; Hispanic; Multiracial; or any other racial background). For this study, the original categories were further grouped into two overarching categories distinguishing between respondents who had identified as non-Hispanic White versus respondents who had identified as other than non-Hispanic White (with the latter category containing respondents who had identified as Black, Asian, American Indian, Hispanic, Multiracial, or any other racial background not specifically stated). PASS-2011 respondents in the other-than-White group were treated as the reference category against which respondents in the non-Hispanic White group were compared with regard to the dependent variable of the study.

Respondent *highest level of education* completed at the time of the survey was originally recorded in the PASS-2011 dataset across seven categories (i.e. grades 1 to 8; grades 9 to 11; high school; community college; vocational or technical school; college; and graduate or professional school). For our study, the original categories were grouped into two broader categories distinguishing between respondents who had reported having completed any of grades 1 to 8, grades 9 to 11, high school, community college, and vocational or technical school versus respondents who had reported having completed college or graduate and professional schools. The former category was treated as the

reference category against which respondents in the latter category were compared with regard to the dependent variable of the study.

The PASS-2011 dataset recorded respondent *employment status* at the time of the survey across seven categories (i.e. working full time; working part time; full-time student; homemaker; retired; unemployed; and any other employment status not specifically stated). Our study grouped these original categories into two overarching categories distinguishing between respondents who at the time of the survey reported being in full-time work versus respondents who at the time of the survey reported any employment status other than full-time work. The latter category was treated as the reference category against which respondents in former were compared with regard to the dependent variable of the study.

Finally, the PASS-2011 dataset recorded whether respondents had *children under the age of six* at the time of the survey. Respondents who had reported not having children under the age of 6 were treated as the reference category against which their counterparts were compared with regard to the dependent variable of the study.

Heat Exposure

To allow us to explore the relationship between the dependent variable and PASS-2011 respondents' experiences of heat-related symptoms or illness, our study employs three PASS-2011 variables which use yes-or-no answers to record whether PASS-2011 respondents "*had experienced symptoms related to heat or high temperatures*"; "*lived in households where others had experienced symptoms related to heat or high temperatures*"; or "*had dialled 911 or had visited a hospital due to heat-related illness*" during the summer of 2010. For each of the tree variables, respondents who had answered "no" were treated

as the reference category against which their counterparts were compared with regard to the dependent variable of the study.

Political Beliefs

Respondent political ideology, as self-reported at the time of the survey, was recorded in the PASS-2011 dataset across five categories (i.e. very conservative; somewhat conservative; moderate; somewhat liberal; and very liberal). The original categories were grouped into two overarching categories distinguishing between respondents who had self-reported being very liberal as opposed to respondents who had self-reported being somewhat liberal, moderate, somewhat conservative, or very conservative. The latter category was treated as the reference category against which respondents in the former category were compared with regard to the dependent variable of the study. By grouping respondents in this fashion, the variable focuses on respondent attitudes at the extreme end of self-reported liberal political affiliation versus other political attitudes. Table 1 presents the distribution properties of the variables used in the study.

Table 3.1

Distribution PASS-2011 variables considered by this study

Variable	**Distribution Description**	**Count of respondents**	**Proportion of respondents against complete sample size (806 respondents)**
Respondent's extent of agreement with the statement "the effects of	Strongly agree	362	45%
	Somewhat agree, somewhat	408	51%

global warming and climate change are already occurring"	disagree, strongly disagree		
Survey completion mode	Online response mode	629	78%
	Telephone response mode	95	12%
	Face-to-face response mode	82	10%
Respondent gender	Female	453	56%
	Male	345	43%
Respondent age	18-40 years of age	269	33%
	41-56 years of age	265	33%
	57 years of age or older	252	31%
Respondent racial background	Non-Hispanic White	530	66%
	Other than non-Hispanic White (Black, Asian, American Indian, Hispanic, Multiracial, or any other non-White racial background not specifically stated)	260	32%
Respondent highest level of school completed	College, bachelor's degree, graduate, professional school	371	46%
	Grades 1-11, high school, community, vocational, technical	424	53%
Respondent employment status	In full-time work	371	46%
	Other than full-time work (part-time work, full-time student, homemaker, retired,	421	52%

	unemployed, or any other employment status not specifically stated)		
Respondent has children under 6 years of age	Yes	115	14%
	No	691	86%
Respondent had symptoms related to heat or high temperatures	Yes	203	25%
	No	535	66%
Someone else in respondent's household had symptoms related to heat or high temperatures	Yes	158	20%
	No	566	70%
Respondent called 911 or visited the hospital for heat-related illness	Yes	32	4%
	No	765	95%
Respondent political ideology	Very liberal	60	7%
	Other than very liberal (somewhat liberal, moderate, somewhat conservative, or very conservative)	648	80%

2.3.Approach to the analysis

A series of models were fitted using selected variables from the PASS-2011 dataset. Broadly speaking, the models investigated the relationship between a binary dependent variable (which distinguishes between respondents who strongly agree with the statement that the effects of global warming and climate change are already occurring versus respondents who do not) and a series of independent and control variables.

To quantify the strength of association between independent and control variables, and explore multicollinearity concerns, the Cramer's V metric was used (Wang, 1986). Cramer's V values do not highlight strong associations between the independent and control variables that the models use (see Annex B).

Given the geographically nested structure of the PASS-2011 data, the study first explored whether two-level logistic regression models with a random intercept at city level may be a more appropriate modelling scheme compared to simpler, single-level models (without city-level random effects). Two-level logistic regression models with a random intercept at city level were deemed as the preferred modelling option, as the analysis failed to reject the hypothesis that between-city variability in relation to the dependent variable is zero (Likelihood-ratio statistic = 14.888; df = 1; p-value <0.001).

In total, three models were fitted to explore dependencies between the dependent variable and the selected independent and control variables. Goodness-of-fit for the reported models was evaluated using the Akaike Information Criterion (AIC) metric. Reported models were also tested for singularity, to ensure that all elements of their corresponding variance-covariances matrices can be assumed to be non-zero. Only non-singular models are reported in this paper (singularity tolerance = 0.00001).

Given the modest sample size available to this study, the risk of singularity limits the number of variables that any single model can account for without demonstrating signs of overfitting, as indicated by testing positive for singularity. The authors of this study considered a large number of PASS-2011 (control and independent) variables, but ultimately adopted the theoretically driven set of control and independent variables presented here while managing and mitigating the risk that observations made by this study

become highly specific or *overfitted* to the PASS-2011 responding sample. The analysis for this study was conducted within the R environment for visual and statistical analysis (R Core Team, 2013).

3. Results

Table 2 presents three two-level logistic regression models with a random intercept at the city level; the models explore the relationship between respondents' degree of agreement with the statement "*the effects of global warming and climate change are already occurring*" (for simplicity, *the target statement*), mode-effect and socio-demographic controls, their self-reported experiences of heat-related symptoms or illness, and their political beliefs.

Table 3.2

Two-level logistic regression models with random intercept at city level predicting strong agreement with the statement "the effects of global warming and climate change are already occurring" [vs. moderate agreement, moderate disagreement, or strong disagreement]

		Coefficient (standard error)		
Variable	**Category [vs. reference category, if predictor is categorical]**	**Model 1**	**Model 2**	**Model 3**
Intercept	-	1.651*** (0.388)	1.450*** (0.419)	1.4711*** (0.431)
Survey completion mode	Online **[vs. face-to-face]**	-1.010*** (0.304)	-1.041*** (0.330)	-1.172*** (0.363)
	Telephone **[vs. face-to-face]**	-0.427 (0.357)	-0.562 (0.383)	-0.717* (0.415)

Respondent gender	Male **[vs. female]**	-0.178 (0.161)	-0.186 (0.172)	-0.083 (0.186)
Respondent age	41 to 56 years of age **[vs. 18 to 40]**	0.054 (0.206)	0.062 (0.221)	0.083 (0.244)
	57 years of age or older **[vs. 18 to 40]**	-0.127 (0.225)	-0.008 (0.245)	-0.018 (0.264)
Respondent racial background	Non-Hispanic White **[vs. other than non-Hispanic White]**	-0.879*** (0.189)	-0.830*** (0.203)	-0.874*** (0.220)
Respondent highest level of school completed	College, graduate / professional school **[vs. grades 1 to 11, high school, community college, vocational / technical school]**	0.397** (0.170)	0.342* (0.182)	0.345* (0.194)
Respondent employment status	In full-time employment **[vs. any other employment status]**	-0.109 (0.175)	-0.122 (0.188)	-0.271 (0.204)
Respondent has children under 6 years of age	Yes **[vs. no]**	-0.277 (0.249)	-0.145 (0.275)	-0.035 (0.301)
Respondent had symptoms related to heat or high temperatures	Yes **[vs. no]**		0.526** (0.240)	0.510** (0.256)
Someone else in respondent's household had symptoms related to heat or high temperatures	Yes **[vs. no]**		0.162 (0.258)	0.275 (0.274)
Respondent called 911 or visited the hospital for heat-related illness	Yes **[vs. no]**		0.992** (0.497)	1.069* (0.547)
Respondent political ideology	Very liberal **[vs. moderately liberal,**			1..729*** (0.372)

	moderately conservative, very conservative]			
Model metrics				
Sample size		730	646	583
Akaike Information Criterion		966.9	848.3	809.9

Statistical significance identifiers: {<=0.001: '***'}; {0.05: '**'}; {0.10: '*'}

Table 3.3

Overview of statistically significant effects: Effects annotation: {statistically significant positive effect: '+'}; {statistically significant negative effect: '-'}

		Coefficient (standard error)		
Variable	**Category [vs. reference category, if predictor is categorical]**	**Model 1**	**Model 2**	**Model 3**
Survey completion mode	Online **[vs. face-to-face]**	-	-	-
	Telephone **[vs. face-to-face]**			-
Respondent racial background	Non-Hispanic White **[vs. other than non-Hispanic White]**	-	-	-
Respondent highest level of school completed	College, graduate / professional school **[vs. grades 1 to 11, high school, community college, vocational / technical school]**	+	+	+

Respondent had symptoms related to heat or high temperatures	Yes **[vs. no]**	+	+
Respondent called 911 or visited the hospital for heat-related illness	Yes **[vs. no]**	+	+
Respondent political ideology	Very liberal **[vs. moderately liberal, moderately conservative, very conservative]**		+

Models 1, 2, and 3 suggest that PASS-2011 respondents who completed the survey online have a statistically significant lower propensity to strongly agree with the target statement compared to their counterparts who completed the survey face-to-face. Some of the models fitted for this study suggest that PASS-2011 respondents who completed the survey over a telephone interview may have a lower propensity to strongly agree with the target statement compared to respondents who completed the survey face-to-face (Model 3). However, this observation appears to be unstable across the model variations explored in this study.

3.1.Adaptive Capacity Model

Statistically significant relationships were identified between climate change beliefs and *race and ethnicity* and *education.* I did not observe statistically significant effects for the remainder of respondent socio-demographic characteristics that our study

considered (i.e. respondents' gender; age; employment status; or whether they had children under the age of six).

Models 1, 2 and 3 suggest that PASS-2011 respondents' *race and ethnicity* is linked to their propensity of strongly agreeing with the target statement in a statistically significant fashion. Specifically, respondents from non-Hispanic White backgrounds appear less likely to strongly agree with the target statement compared to their counterparts from non-Hispanic White backgrounds. These patterns are observed when survey mode and other socio-demographic features are controlled for (Model 1); and when the survey mode, other socio-demographic features, respondents' self-reported experiences of heat related symptoms or illness are controlled for (Model 2); and when survey mode, other socio-demographic features, respondents' self-reported experiences of heat related symptoms or illness, and their political beliefs are controlled for (Model 3). These observations support *H3* hypothesis.

Respondents' *highest level of educati*on is linked to their propensity of strongly agreeing with the target statement in a statistically significant fashion, as suggested by Models 1, 2 and 3. More specifically, respondents with college or professional qualifications appear more likely to strongly agree with the target statement compared to their counterparts with highest education qualifications at lower levels. These patterns are also observed when the aforementioned variables are controlled for in Models 1, 2 and 3. These observations support *H4* hypothesis.

3.2.Exposure Model

Models 2 results in statistically significant positive relationships between PASS-2011 respondents' propensity to report that they strongly agree with the target statement

and whether they self-report "*having experienced symptoms related to heat or high temperatures*" as well as whether they self-report "*having called 911 or having visited the hospital due to heat-related illness*" during the summer of 2010. These observations confirm our *H7* hypothesis with an exception. The analysis does not suggest a statistically significant relationship between respondents' propensity to strongly agree with the target statement and whether they self-report that "*someone else in their household has experienced symptoms related to heat or high temperatures*" [*H7* b]. Hence, *H7* a and c hypotheses are confirmed.

3.3.Ideology Model

Controlling for PASS-2011respondents' socio-demographics, self-reported experiences of heat related symptoms or illness as well as for survey mode, the study observes that respondents who describe themselves as very liberal have a greater propensity to strongly agree with the target statement than their counterparts who position themselves differently across a spectrum of political ideologies ranging from very conservative to somewhat liberal (Model 3). Hence, our *H8* hypothesis is confirmed.

4. Discussion

In this study, I worked with the individual-level data engaged with environmental behaviour and climate perception models in order to examine how residents (N = 806) in the Phoenix Metro Area perceive the climate change and global warming and how their beliefs are affected by their socio-demographic indicators, heat exposure, and political beliefs.

4.1. Adaptive Capacity Model

Interestingly, unlike the existing literature that finds the positive relations between climate change beliefs and *socio-demographic indicators* such as age (Bohr, 2017), gender (Akerlof et al., 2015; McCright & Dunlap 2011; Malka et al., 2009; Broady et al., 2008; Hamilton & Keim, 2009), employment (Blocker&Eckberg 1989; Albright&Crow, 2019), and parenthood (Flynn et al., 1994; Krannich & Albrecht, 1995; Poortinga & Pidgeon, 2003; Marshall, 2004); I did not find any positive association between belief in climate change and global warming, and the aforementioned socio-demographic variables.

Education, specifically, respondents with college or professional qualifications appear more likely to strongly agree that climate change and global warming is occurring, confirming similar findings (Hamilton & Keim, 2009; Marshall et al., 2006). Our results raise important questions in terms of knowledge generation and awareness for climate change through formal, and informal, education, and whether education is able to shift the terms of climate change debate from zero-sum understanding.

Importantly, *race and ethnicity* are significant (McCright&Dunlop, 2011; McCright, 2010; Malka et al., 2009; Kahan et al., 2007; Satterfield et al., 2004), and similarly I observe that non-Hispanic white individuals are less likely believe that climate change and global warming is occurring. Critically this illuminates the need to consider justice in the context of climate change beliefs, especially as urban planning and infrastructure in the Phoenix Metro Area are inadequate to address the needs of the vulnerable. Higher-income and predominantly non-Hispanic white neighbourhoods are less exposed and more "comfortable places" (according to a thermal comfort index) than lower-income Hispanic neighbourhoods in the Phoenix Metro Area (Harlan et al., 2006).

People of color have been historically exposed to a concentration of industrial hazards, redlining in urban planning, and their properties are expropriated due to the construction of infrastructures (Bolin, 2013). The current increase in heat coupled with changing climate consequently disproportionately affects the adaptive capacity of people of color who are systematically excluded through socio-spatial and political economic processes.

4.2. Exposure Model

The findings from this study related to *heat exposure* suggest that personally experiencing symptoms related to heat or high temperatures is a stronger predictor of belief in climate change and global warming; this personal experience is more influential than living in a household where others may have had experienced symptoms similar symptoms. This supports findings that show beliefs in climate change and global warming are highly positively dependent on personal experience with heat-related illnesses (Zanocco, 2018; Konisky, 2015; Rudman et al., 2013; Whitmarsh, 2009).

4.3. Ideology Model

Political ideology and worldviews dominant acceptance or rejection of climate science compared to any other factors (Kahan, 2015). Showing the poll results from 1997, 2007 and 2016, Dunlap et al. (2016) report that climate change beliefs widened between people affiliated with the Democratic and Republican parties. Democrats consistently increased their agreement to the given statement "the effects of global warming have already begun" (52% in 1997; 70% in 2007; 75% in 2016), whereas Republicans grew increasingly sceptical (48% in 1996; 45% in 2007; 41% in 2016). Our analyses confirm the literature and show that people who identify themselves as very liberal (Zonacco, 2018; Bohr, 2017; Ogunbode et al., 2017; Palm et al., 2017; Hamilton et al., 2015a; Marquart-

Pyatt, 2014 ;McCright&Dunlap, 2011; Dunlap&McCright, 2008)) are more likely believe that climate change is happening.

4.4. Integrated Justice Model

Engaging environmental behaviour and justice approaches with climate belief models, I find that climate change and global warming are positively associated with race, ethnicity, and high levels of education. I have also found that beliefs in climate change in urban populations are highly influenced by heat exposure and political ideology. These results suggest that there are important justice dimensions influencing beliefs, as well as impacts of climate change. Race and ethnicity, education, heat exposure, and political beliefs are the indication of institutionally constructed vulnerabilities that are embedded in individuals' climate change beliefs.

Performing research to better characterize the institutional and organizational settings that exacerbate climate change vulnerabilities among urban population is critical to disseminate awareness about climate change and to take tangible actions to mitigate its impact. Politically, Arizona has been dominated by politicians who publicly reject human impact on climate change and resist to take actions, although the state is moving toward more liberal positions, as the demographics of the population change (younger, more college education, and more non-Hispanic white voters) (Fink, 2019), more research is needed to assess how climate adaptation policy (and other related policy) decisions at the local, state, and federal level exacerbate vulnerability for those who reside on less resilient neighbourhoods.

5. Conclusion

There are pervasive inequities in the distribution of climate change impacts in urban areas and climate justice must be contextualized from a vulnerability and adaptation perspectives. Further climate belief models must engage with environmental justice studies in order to recognize issues of justice in urban climate adaptation. The empirical research from various urban areas find that exposure to climate change impacts are distributed unevenly. Further, local attempts to adapt to climate change are often limited by local government's capacity; in contrast, major development projects occur through government collaboration with large businesses, which attract affluent residents, and may further displace the most vulnerable.

Analysing beliefs in climate change among urban population is one way to unveil the characteristics of their vulnerabilities and lack of adaptive capacity that are embedded in their perceptions. Local climate belief analyses must engage with adaptive capacity and justice perspectives as a matter to better capture the drivers of climate change perceptions. That said, this study investigated predictors of global warming and climate change beliefs by looking at heat-related illness, socio-demographic, and attitudinal dynamics in the Phoenix Metropolitan Area. Based on the results, I found that personal experience with heat-related illnesses is a stronger predictor of belief in climate change and global warming than living in a household where others may have had experienced symptoms similar symptoms. Race and ethnicity, higher education level, and strong liberal beliefs are also found positively related to beliefs in climate change and global warming, while other sociodemographic variables associated with climate change beliefs including gender, age, employment status, and parenthood were not significant.

Climate change beliefs are complex and mediated by many factors, but there is evidence in our study that personal experiences with heat-related illness may influence climate change beliefs. Empowering people, recognising social and political processes that cause maladaptation, and creating governance systems that are inclusive, redistribute benefits and making access to resources more equal is vital for increasing adaptive capacities.

Considering the increasing temperatures and asymmetries in social, economic and political power, further studies must consider focusing on the existing institutional and organizational barriers that exacerbate unjust adaptation measures and implementations for the urban population in the Phoenix Metro Area. The results of this study could also be an important consideration in the design of effective climate change strategies among key urban agents from the different levels of governments and civil societies in the Phoenix Metropolitan Area.

5. References

ACS (American Community Survey). (2018). Accessed from: https://www.census.gov/newsroom/press-releases/2019/estimates-county-metro.html

Adger, W. N. (2006). Vulnerability. *Global environmental change*, *16*(3), 268-281.

Akerlof, K., Maibach, E. W., Fitzgerald, D., Cedeno, A. Y., & Neuman, A. (2013). Do people "personally experience" global warming, and if so how, and does it matter? *Global Environmental Change*, *23*(1), 81-91.

Akerlof, K., Delamater, P., Boules, C., Upperman, C., & Mitchell, C. (2015). Vulnerable populations perceive their health as at risk from climate change. International journal of environmental research and public health, 12(12), 15419-15433.

Albright, E. A., & Crow, D. (2019). Beliefs about climate change in the aftermath of extreme flooding. Climatic Change, 1-17.

Balbus, J. M., & Malina, C. (2009). Identifying vulnerable subpopulations for climate change health effects in the United States. Journal of occupational and environmental medicine, 51(1), 33-37.

Barnett, J., & O'Neill, S. (2010). Maladaptation. *Global environmental change*, *2*(20), 211-213.

Berko, J., Ingram, D.D., Saha, S., Parker, J.D., (2014). Deaths Attributed to Heat, Cold, and Other Weather Events in the United States, 2006–2010. Natl. Health Stat. Report., pp. 1–15.

Black, T. (2016). Race, gender, and climate injustice Dimensions of social and environmental inequality. *Systemic Crises of Global Climate Change: Intersections of race, class and gender*, 26.

Blocker, T. J., & Eckberg, D. L. (1989). Environmental issues as women's issues: General concerns and local hazards. *Social Science Quarterly*, *70*(3), 586.

Bohr, J. (2017). Is it hot in here or is it just me? Temperature anomalies and political polarization over global warming in the American public. Climatic Change 142:271–285

Bolin, B., Grineski, S., & Collins, T. (2005). The geography of despair: Environmental racism and the making of South Phoenix, Arizona, USA. *Human Ecology Review*, 156-168.

Bolin, B., Barreto, J. D., Hegmon, M., Meierotto, L., & York, A. (2013). Double exposure in the Sunbelt: the sociospatial distribution of vulnerability in Phoenix, Arizona.In *Urbanization and sustainability* (pp. 159-178). Springer, Dordrecht

Brody SD, Zahran S, Vedlitz A, Grover H (2008). Examining the relationship between physical vulnerability and public perceptions of global climate change in the United States. Environment & Behaviour 40(1):72–95

Brulle, R. J., Carmichael, J., & Jenkins, J. C. (2012). Shifting public opinion on climate change: an empirical assessment of factors influencing concern over climate change in the US, 2002–2010. *Climatic change*, *114*(2), 169-188.

Brulle, Robert J., Pellow, David N., (2006). Environmental justice: human health and environmental inequalities. Annu. Rev. Publ. Health 102.

Castells, M. (2010). Globalisation, networking, urbanisation: Reflections on the spatial dynamics of the information age. Urban Studies, 47(13), 2737-2745.

Chow, W. T., Chuang, W. C., & Gober, P. (2012). Vulnerability to extreme heat in metropolitan Phoenix: spatial, temporal, and demographic dimensions. The Professional Geographer, 64(2), 286-302.

Chuang, W.-C.; Gober, P.; Chow, W.T.L.; Golden, J. (2013). Sensitivity to heat: A comparative study of Phoenix, Arizona and Chicago, Illinois. Urban Climate. 5, 1–18.

Clayton, S., Devine-Wright, P., Stern, P. C., Whitmarsh, L., Carrico, A., Steg, L., ... & Bonnes, M. (2015). Psychological research and global climate change. Nature Climate Change, 5(7), 640-646.

Cole, L. W., & Foster, S. R. (2001). *From the ground up: Environmental racism and the rise of the environmental justice movement* (Vol. 34). NYU Press.

Costello A, Abbas M, Allen A, Ball S, Bell S, Bellamy R, Friel S, Groce N, Johnson A, Kett M, Lee M, Levy C, Maslin M, McCoy D, McGuire B, Montgomery H, Napier D, Pagel C, Patel J, Puppim de Oliveira J, Redclift N, Rees H, Rogger D, Scott J, Stephenson J, Twigg J, Wolff J, Patterson C et al. (2009). Managing the health effects of climate change. The Lancet 373:1693–1733.

Correia, F., Fordhamm, M., da Graca, Saraiva, M., Bernardo F. (1998). Flood hazard assessment and management: interface with the public. Water Resource Management 12(3):209–227.

Cottrell, S. P. (2003). Influence of sociodemographics and environmental attitudes on general responsible environmental behavior among recreational boaters. *Environment and Behavior*, *35*(3), 347-375.

Curriero, F.C., Heiner, K.S., Samet, J.M., Zeger, S.L., Strug, L. and Patz, J.A. (2002). Temperature and mortality in 11 cities of the eastern United States. *American journal of epidemiology*, *155*(1), pp.80-87.

Cutter, S. L. (1995). Race, class and environmental justice. *Progress in human geography*, *19*(1), 111-122.

Cutter, S. L., & Finch, C. (2008). Temporal and spatial changes in social vulnerability to natural hazards. *Proceedings of the National Academy of Sciences*, *105*(7), 2301-2306.

Davidson, D. J., & Haan, M. (2012). Gender, political ideology, and climate change beliefs in an extractive industry community. Population and Environment, 34(2), 217-234.

Dunlap, R. E., and A. M. McCright. (2008). A widening gap: Republican and Democratic views on climate change. Environment: Science and Policy for Sustainable Development 50 (5): 26–35.

Dunlap, R. E., McCright, A. M., & Yarosh, J. H. (2016). The political divide on climate change: Partisan polarization widens in the US. *Environment: Science and Policy for Sustainable Development*, *58*(5), 4-23.

Egan PJ, Mullin M (2012). Turning personal experience into political attitudes: the effect of local weather on Americans' perceptions about global warming. J Polit 74(3):796–809.

Escobar, A. (1998). Whose knowledge, whose nature? Biodiversity, conservation, and the political ecology of social movements. *Journal of political ecology*, *5*(1), 53-82.

Fink, J. H. (2019). Contrasting governance learning processes of climate-leading and-lagging cities: Portland, Oregon, and Phoenix, Arizona, USA. *Journal of environmental policy & planning*, *21*(1), 16-29.

Flynn, James, Paul Slovic, and C.K. Mertz. (1994). "Gender, Race, and Perception of Environmental Health Risks." *Risk Analysis* 14: 1101-1108.

Friel, S., Hancock, T., Kjellstrom, T. (2011). Urban health inequities and the added pressure of climate change: an action-oriented research agenda. J Urban Health 88(5):886–895.

Gasparrini, Antonio, Yuming Guo, Francesco Sera, Ana Maria Vicedo-Cabrera, Veronika Huber, Shilu Tong, Micheline de Sousa Zanotti Stagliorio Coelho, et al. (2017). "Projections of Temperature-Related Excess Mortality under Climate Change Scenarios." *The Lancet Planetary Health* 1 (9): e360–67.

Grossman-Clarke, S., Schubert, S., Clarke, T. A., & Harlan, S. L. (2014). Extreme summer heat in Phoenix, Arizona (USA) under global climate change (2041-2070). DIE ERDE–Journal of the Geographical Society of Berlin, 145(1-2), 49-61.

Guo, Y., et al. (2018). Quantifying excess deaths related to heatwaves under climate change scenarios: A multicountry time series modelling study. PLoS Med., 15, e1002629, https://doi.org/10.1371/journal.pmed.1002629.

Hamilton LC, Keim BD. (2009). Regional variation in perceptions about climate change. International Journal of Climatology. 29(15):2348–2352.

Hamilton, L.C. (2011). Education, politics and opinions about climate change evidence for interaction effects. Climatic Change, 104 (2): 231-242.

Hamilton, LC., Hartter, J., Lemcke-Stampone, M. (2015a). Tracking public beliefs about anthropogenic climate change. PLoS One 10:e0138208.

Hamilton, L. C., Hartter, J., & Saito, K. (2015b). Trust in scientists on climate change and vaccines. *Sage Open*, *5*(3), 2158244015602752.

Harlan, S.L., Brazel, A.J., Prashad, L., Stefanov, W.L. and Larsen, L. (2006). Neighborhood microclimates and vulnerability to heat stress. *Social science & medicine*, *63*(11), pp.2847-2863.

Harlan, S. L., Declet-Barreto, J. H., Stefanov, W. L., & Petitti, D. B. (2013). Neighborhood effects on heat deaths: social and environmental predictors of vulnerability in Maricopa County, Arizona. *Environmental health perspectives*, *121*(2), 197-204.

Harlan, S. L., Chowell, G., Yang, S., Petitti, D. B., Morales Butler, E. J., Ruddell, B. L., & Ruddell, D. M. (2014). Heat-related deaths in hot cities: estimates of human tolerance to high temperature thresholds. International journal of environmental research and public health, 11(3), 3304-3326.

Harlan, S.L., R. Aggarwal, D. Childers, J.Declet-Barreto, S. Earl, K. Larson, M.Nation, et al. (2017). Phoenix Area Social Survey (PASS): 2011.

Hartz, D. A., Brazel, A. J., & Golden, J. S. (2013). A comparative climate analysis of heat-related emergency 911 dispatches: Chicago, Illinois and Phoenix, Arizona USA 2003 to 2006. International journal of biometeorology, 57(5), 669-678.

Hayden, M.H., Brenkert-Smith, H., Wilhelmi, O.V. (2011). Differential adaptive capacity to extreme heat: a Phoenix, Arizona, case study.Weather Clim. Soc. 3 (4), 269–280.

Hayward, T. (2006). Human rights vs emissions rights: climate justice and the equitable distribution of ecological space. *Available at SSRN 929675*.

Heynen, N., Perkins, H. A., & Roy, P. (2006). The political ecology of uneven urban green space: The impact of political economy on race and ethnicity in producing environmental inequality in Milwaukee. *Urban Affairs Review*, *42*(1), 3-25.

Hondula, D. M., Kuras, E. R., Longo, J., & Johnston, E. W. (2018). Toward precision governance: infusing data into public management of environmental hazards. Public Management Review, 20(5), 746-765.

Howe, P. D., & Leiserowitz, A. (2013). Who remembers a hot summer or a cold winter? The asymmetric effect of beliefs about global warming on perceptions of local climate conditions in the US. Global environmental change, 23(6), 1488-1500.

Hughes, S. (2013). Justice in urban climate change adaptation: criteria and application to Delhi. *Ecology and Society*, *18*(4).

Jenerette, G. D., Harlan, S. L., Stefanov, W. L., & Martin, C. A. (2011). Ecosystem services and urban heat riskscape moderation: water, green spaces, and social inequality in Phoenix, USA. Ecological applications, 21(7), 2637-2651.

Kahan, D. M. (2015). Climate-science communication and the measurement problem. *Political Psychology*, *36*, 1-43.

Kahan, D. M., Braman, D., Gastil, J., Slovic, P., & Mertz, C. K. (2007). Culture and identity-protective cognition: Explaining the White-male effect in risk perception. *Journal of Empirical Legal Studies*, **4**, 465– 505.

Kates, R. W., Travis, W. R., & Wilbanks, T. J. (2012). Transformational adaptation when incremental adaptations to climate change are insufficient. *Proceedings of the National Academy of Sciences*, *109*(19), 7156-7161.

Klinenberg, E. (1999). Denaturalizing disaster: A social autopsy of the 1995 Chicago heat wave. Theory and Society, 28(2), 239-295.

Kollmuss, A., & Agyeman, J. (2002). Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior?. *Environmental education research*, *8*(3), 239-260.

Konisky, D. M., Hughes, L., & Kaylor, C. H. (2016). Extreme weather events and climate change concern. *Climatic change*, *134*(4), 533-547.

Krannich, R. S., & Albrecht, S. L. (1995). Opportunity/Threat Responses to Nuclear Waste Disposal Facilities 1. *Rural Sociology*, *60*(3), 435-453.

Krellenberg, K., Welz, J., Link, F., & Barth, K. (2017). Urban vulnerability and the contribution of socio-environmental fragmentation: Theoretical and methodological pathways. *Progress in Human Geography*, *41*(4), 408-431.

Kuokkanen, A., Yazar, M. (2018). Cities in sustainability transitions: comparing Helsinki and Istanbul. *Sustainability*, *10*(5), 1421.

Leiserowitz, A. (2005). American risk perceptions: Is climate change dangerous? Risk Analysis, 25, 1433–1442.

Li, Y., Johnson, E. J. & Zaval, L. (2011). Local warming: Daily temperature change influences belief in global warming. Psychol. Sci. 22, 454-459.

Madrigano, J., Lane, K., Petrovic, N., Ahmed, M., Blum, M., & Matte, T. (2018). Awareness, risk perception, and protective behaviors for extreme heat and climate change in New York City. International journal of environmental research and public health, 15(7), 1433.

Malka, A., Krosnick, J. A., & Langer, G. (2009). The association of knowledge with concern about global warming: Trusted information sources shape public thinking. *Risk Analysis: An International Journal*, *29*(5), 633-647.

Maricopa County Department of Public Health (MCDPH). (2019). Heat-Associated Deaths in Maricopa County, AZ Final Report for 2017. Pheonix, AZ: Maricopa County Department of Public Health.

Marquart-Pyatt, S. T., McCright, A. M., Dietz, T., & Dunlap, R. E. (2014). Politics eclipses climate extremes for climate change perceptions. *Global environmental change*, *29*, 246-257.

Marshall, M. L. (2004). Examining school climate: Defining factors and educational influences.

Marshall, B. K., Picou, J. S., Formichella, C., & Nicholls, K. (2006). Environmental risk perceptions and the white male effect: Pollution concerns among deep-South coastal residents. *Journal of Applied Sociology*, (2), 31-49.

McCarthy, M. P., Best, M. J., & Betts, R. A. (2010). Climate change in cities due to global warming and urban effects. *Geophysical research letters*, *37*(9).

McCright, A. M. (2010). The effects of gender on climate change knowledge and concern in the American public. Population and Environment, 32(1), 66-87.

McCright, AM., Dunlap, RE., Marquart-Pyatt, ST. (2016). Political ideology and views about climate change in the European Union. Environ Polit 25:338–358.

McCright, AM., Dunlap, RE. (2011). Cool dudes: the denial of climate change among conservative white males in the United States. Glob Environ Chang 21:1163–1172.

Moser, S. C., & Ekstrom, J. A. (2010). A framework to diagnose barriers to climate change adaptation. *Proceedings of the national academy of sciences*, *107*(51), 22026-22031.

O'BRIEN, K. A. R. E. N., Eriksen, S., Nygaard, L. P., & Schjolden, A. N. E. (2007). Why different interpretations of vulnerability matter in climate change discourses. *Climate policy*, *7*(1), 73-88.

Ogunbode, C. A., Liu, Y., & Tausch, N. (2017). The moderating role of political affiliation in the link between flooding experience and preparedness to reduce energy use. *Climatic Change*, *145*(3-4), 445-458.

Osberghaus, D., Dannenberg, A., Mennel, T., Sturm, B. (2010). The role of the government in adaptation to climate change. Environ Plan C Gov Policy 28:834–850.

Paavola, J. (2008). Science and social justice in the governance of adaptation to climate change. Environ Polit 17(4):644–659.

Palm, R., Lewis, G. B., & Feng, B. (2017). What causes people to change their opinion about climate change?. *Annals of the American Association of Geographers*, *107*(4), 883-896.

Paavola, J., N, Adger. (2006). Fair adaptation to climate change. Ecol. Econ. 56 (4), 594–609

Pearson, A. R., Ballew, M. T., Naiman, S., & Schuldt, J. P. (2017). Race, class, gender and climate change communication. In *Oxford research encyclopedia of climate science*.

Petitti, D. B., Hondula, D. M., Yang, S., Harlan, S. L., & Chowell, G. (2016). Multiple trigger points for quantifying heat-health impacts: new evidence from a hot climate. *Environmental health perspectives*, *124*(2), 176-183.

Poortinga, W., & Pidgeon, N. (2003). Public perceptions of risk, science and governance. *Centre for Environmental Risk, University of East Anglia, Norwich, UK*.

R Core Team. (2013). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, AU.

Reinhart, R. J. (2018). Global warming age gap: younger Americans most worried. Politics, 11.

Romero Lankao, P. (2010). Water in Mexico City: what will climate change bring to its history of water-related hazards and vulnerabilities? Environment and Urbanization 22 (1):157-178.

Rudman, L. A., McLean, M. C., & Bunzl, M. (2013). When truth is personally inconvenient, attitudes change: the impact of extreme weather on implicit support for green politicians and explicit climate-change beliefs. Psychological science, 24(11), 2290-2296.

Saad, L. (2015). US views on climate change stable after extreme winter. *POLITICS*.

Sassen, S. (1996). Rebuilding the global city: economy, ethnicity and space. In Re-presenting the city (pp. 23-42). Palgrave, London.

Satterfield, T. A., Mertz, C. K., & Slovic, P. (2004). Discrimination, vulnerability, and justice in the face of risk. *Risk analysis: An international journal*, *24*(1), 115-129.

Scannell, L., & Gifford, R. (2010). The relations between natural and civic place attachment and pro-environmental behavior. *Journal of environmental psychology*, *30*(3), 289-297.

Schlosberg, D,, Collins, LB., Niemeyer, S., (2017). Adaptation policy and community discourse: risk, vulnerability, and just transformation. Environ. Polit. 26 (3), 413–437

Sheridan, S. C., & Allen, M. J. (2018). Temporal trends in human vulnerability to excessive heat. *Environmental research letters*, *13*(4), 043001.

Shi, L., Chu, E., Anguelovski, I., Aylett, A., Debats, J., Goh, K., ... & Roberts, J. T. (2016). Roadmap towards justice in urban climate adaptation research. *Nature Climate Change*, *6*(2), 131-137.

Semenza, J. C., Rubin, C. H., Falter, K. H., Selanikio, J. D., Flanders, W. D., Howe, H. L., & Wilhelm, J. L. (1996). Heat-related deaths during the July 1995 heat wave in Chicago. New England journal of medicine, 335(2), 84-90.

Spence, A., Poortinga, W., Butler, C., & Pidgeon, N. F. (2011). Perceptions of climate change and willingness to save energy related to flood experience. Nature climate change, 1(1), 46.

Stocker, TF., Qin, D., Plattner, G-K. IPCC. (2012). Climate Change 2013: the Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate. Cambridge University Press, Cambridge.

Thaler, T., Zischg, A., Keiler, M., & Fuchs, S. (2018). Allocation of risk and benefits—distributional justices in mountain hazard management. *Regional environmental change*, *18*(2), 353-365.

United Nations Framework Convention on Climate Change (2015). INDC submission. Retrieved from http://unfccc.int/focus/indc_portal/items/8766.php

UN. (2014). The United Nations world water development report. Water and energy vol. 1. New York: United Nations Development Programme.

Verbeke, P., Fonager, J., Clark, BFC., Rattan, SIS. (2001). Heat shock response and ageing: mechanisms and applications. Cell Biol Int 25(9):845–857.

Walker, G., & Burningham, K. (2011). Flood risk, vulnerability and environmental justice: evidence and evaluation of inequality in a UK context. *Critical social policy*, *31*(2), 216-240.

Wang, G. R. (1986). A Cramer rule for minimum-norm (T) least-squares (S) solution of inconsistent linear equations. *Linear algebra and its applications*, *74*, 213-218.

Weber, E. U., & Stern, P. C. (2011). Public understanding of climate change in the United States. American Psychologist, 66, 315–328.

Whitmarsh, L. (2009). What's in a name? Commonalities and differences in public understanding of “climate change” and “global warming”. Public understanding of science, 18(4), 401-420.

Yazar, M., Hestad, D., Mangalagiu, D., Saysel, A. K., Ma, Y., & Thornton, T. F. (2020a). From urban sustainability transformations to green gentrification: urban renewal in Gaziosmanpaşa, Istanbul. *Climatic Change*, 160: 637-653.

Yazar, M., Hestad, D., Mangalagiu, D., Ma, Y., Thornton, T. F., Saysel, A. K., Zhu, D. (2020b). Enabling environments for regime destabilization towards sustainable urban transitions in megacities: comparing Shanghai and Istanbul. *Climatic Change*, 160: 727-752.

Young, I. M. (2011). *Justice and the Politics of Difference*. Princeton University Press.

York, A., Tuccillo, J., Boone, C., Bolin, B., Gentile, L., Schoon, B., & Kane, K. (2014). Zoning and land use: A tale of incompatibility and environmental injustice in early Phoenix. *Journal of Urban Affairs*, *36*(5), 833-853.

York, Abigail M. and Boone, Christopher G. (2018). Inventing Phoenix: Land use, politics, and environmental justice. Pp. 161-180 in *The American Environment Revisited*. Eds. Geoffrey L. Buckley and Yolanda Youngs. Lanham: Rowman and Littlefield.

Zanocco, C., Boudet, H., Nilson, R., Satein, H., Whitley, H., & Flora, J. (2018). Place, proximity, and perceived harm: extreme weather events and views about climate change. *Climatic Change*, *149*(3-4), 349-365.

Zaval, L., Keenan, E. A., Johnson, E. J., & Weber, E. U. (2014). How warm days increase belief in global warming. Nature Climate Change, 4(2), 143-147.

Zografos, C., Anguelovski, I. and Grigorova, M. (2016). When exposure to climate change is not enough: Exploring heatwave adaptive capacity of a multi-ethnic, low-income urban community in Australia. *Urban Climate*, *17*, pp.248-26.

CHAPTER 4

ADAPTATION, EXPOSURE, AND POLITICS: LOCAL EXTREME HEAT AND GLOBAL CLIMATE CHANGE RISK PERCEPTIONS IN THE PHOENIX METRO AREA

Introduction

Today, 4.2 billion people live in urban areas (Ritchie & Roser, 2018), and halting the risks carried by the impact of climate change is especially urgent for socio-economically vulnerable people living in cities (Pelling, 2003; Wilhelmi & Hayden, 2010; Wolf et al., 2010). Many institutions all over the world, including development assistance and urban policies and plans, aim to address complex socio-ecological and technical challenges exacerbated by climate change that directly affect the vulnerable urban populations' greenspace (Anguelovski et al., 2014; Shi et al., 2016).

Vulnerability is multidimensional, including biophysical and social vulnerabilities; vulnerability to physical events (e.g., exposure to natural hazards, changing climate) and social vulnerability focuses on exposure to hazards, the sensitivity of systems or populations to absorb impact, and people's adaptive capacity to recover from the exposure (Turner et al., 2003; Adger 2006; O'Brien et al., 2007). Adaptive capacity is a part of a nested hierarchy of vulnerability representing multi-level (including individual, social groups, cities) and multi-scale (parcel to the planet); this nested hierarchy is also reflected in local versus broad exposure to risk (Smith & Wandel 2006). Adaptive capacity is the ability to take anticipatory and precautionary actions that aim to handle the impacts of changing climate (Adger & Vincent, 2005; Smit & Wandel, 2006; Gallopin, 2006). Thus,

adaptive capacity depends on factors such as political and economic systems (e.g., public opinion, political will, financial capacity) and is shaped by various physical and social aspects in a given urban context (e.g. the conditions of the infrastructure, urban planning) (Pelling & High, 2005; Nelson et al., 2010; Krellenberg et al., 2014; Yazar et al., 2020b).

Cities in the USA have increasingly become hotspots for extreme weather events, such as hurricanes, floods and heatwaves, exacerbated by climate change (Curriero et al., 2002; Hayden et al., 2011; Madrigano et al., 2018). Local extreme weather results in exposure that individuals are more or less able to withstand based on their adaptive capacity (Brody et al., 2008; McCarthy et al., 2010; Harlan et al., 2014; Yazar et al., 2021). Individuals' perceptions of climate change or natural hazards risks are associated with their adaptive capacity (Chow et al., 2012; Saad, 2015; Sheridan et al., 2018). Despite the growing literature on vulnerability and risk assessments of urban communities to changing climate, the literature on the perceptions of risks posed by local weather conditions and climate change often is not framed through an adaptive capacity lens; nor are the multi-level and scalar aspects of vulnerability explored.

I unveil the factors influencing the perspectives of the risks posed by local extreme weather and global climate change. I explore how various aspects of individual and neighbourhood level adaptive capacity (socio-demographics, green infrastructure, social capital), personal exposure to extreme heat, place attachment and political ideology affect locals' perception of risks: 1) extreme heat, and 2) global warming and climate change in the Phoenix Metropolitan Area. The Phoenix Metropolitan Area is the fifth-largest metropolitan area in the US and heavily vulnerable to extreme heat coupled with global climate change.

I use the 2017 Phoenix Social Survey (N= 496), which is established as part of the Central Arizona Phoenix Long-term Ecological Research (CAP LTER) (Larson et al., 2019). I find that several aspects of adaptive capacity including greenspace, measured as satisfaction with the amount of trees in and around the neighbourhood, and social capital, the sense of close-knit relationships within neighbourhoods, have negative associations with perception of risks posed by local extreme heat and by global warming and climate change.

Meanwhile, identification with one's local neighborhood is positively associated with perception of extreme heat risk, but not associated with global warming and climate change. Latinx identity is associated with perceptions of local extreme heat as a threat, whereas income is associated with perceiving global warming and climate change as a threat. Personal experience of extreme heat and liberal political beliefs also have positive associations with acknowledging both these risks. I explore connections between adaptive capacity and exposure with a hierarchal vulnerability framing to perception of local versus global climate risks; this work advances scholarship needed for governance reconfigurations ensuring just climate actions.

1. Theoretical Context

Adaptive capacity is influenced by hard and soft infrastructure (e.g. transportation systems, economic and governance); social structure (e.g. social class, gender, race); and agency which is contextualized as the ability to mobilize the aforementioned resources within the structure (Lemos et al., 2016). The importance of both individual and collective adaptive capacity to recover from drastic hazards through learning, skills development and

willingness to take adaptive actions are also recognized (Marshall et al., 2012; Berkes & Ross, 2013; Eakin et al., 2014). Adaptive capacity scholarship often focuses on resources, socio-economic measures, and socio-psychological conditions (Li et al., 2011; Chow et al., 2012; Zaval et al., 2014).

Research of informal urban settlements, where dwellers' adaptive capacity is analyzed through physical and social environmental factors specifically social capital, place attachments, and physical urban form provides a new direction demonstrating the role of mutually constituted relationships between people, land, landscapes, and objects (Waters & Adger 2017)., Therefore, people's adaptive capacity, which depends on physical and social environmental factors, could also determine individuals' risk perceptions of both local weather conditions and global climate change.

People's adaptive capacity is, thus, interwoven with both constant and external risks, such as local weather conditions (e.g. extreme heat, floods) and global climate change, as well as domestic politics and global commitments. The literature is not consistent whether personal experience or being vulnerable to local weather changes might heighten extreme weather and global climate change risk perceptions (Akerlof et al., 2013; Brody et al., 2008). The scalar dimensions of beliefs about the aforementioned risks can bring into particularly sharp focus the ways in which inequalities are created and maintained by the existing urban planning, social and political processes. Here, I will be specifically focus on green space, place attachment, and social capital together with socio-demographics, heat exposure, and political beliefs.

1.1. Adaptive Capacity: Social Structure, Green Space, Social Capital

Social structure is a critical aspect of adaptive capacity; prior work has demonstrated that sociodemographic characteristics are associated with climate change beliefs, including age (Bohr, 2017; McCright & Dunlap, 2011; Kahan et al., 2007; Marshall, 2004), race (Yazar et al., 2021; McCright & Dunlop, 2011; Kahan et al., 2007; Satterfield et al., 2004), gender (Davidson & Haan, 2012; McCright & Dunlap, 2011; Malka et al., 2009; Brody et al., 2008), income (Bohr, 2014; McCright & Dunlap, 2011; Kahan et al., 2007; Marshall, 2004), and employment (McCright & Dunlap, 2011; Albright & Crow, 2019). Here, I hypothesise that:

H1: Sociodemographic characteristics affect perception of local extreme heat and global warming and climate change.

Scholars find that greenspace, such as urban trees and parks, do not only increase the resilience of urban infrastructure during the extreme weather events such as floods (Gill et al., 2007; Guneralp et al., 2015), but they have strong influence to increase people's adaptive capacity to cope with changing climate and extreme local weather conditions (Walters & Adger, 2017 ;Derkzen et al., 2017; Byrne et al., 2015). Jenerette et al. (2007), for instance, find that high-income neighbourhoods in the Phoenix metro area are located closer to the desert with lower population density, and consequently, dwellers of these neighbourhoods are less likely affected by the extreme heat due to more green areas providing shade, and minimal night-time temperatures that cool surface quicker than neighbourhoods in the urban core (Connors et al., 2013).

Studies also show how urban green is distributed unevenly in cities, and lower-income neighbourhoods' lack access to such green amenities (Dai, 2011; Yazar et al., 2020a). The unequal distribution of and limited access to green spaces in socio-economically deprived neighbourhoods consequently increase vulnerability and affect locals' adaptive capacity during and after extreme weather events. Yet, there is still a gap in the literature assessing the extent to which tree canopy affects people's risk perceptions about their local weather and global warming or climate change. Building on existing literature that highlights a positive correlation between access to the urban green amenities and higher adaptive capacity to cope with extreme weather events, I hypothesise that:

H2: Individuals who are strongly satisfied with the amount of trees in and around their neighbourhood will less likely acknowledge that the risks posed by both extreme heat and by global warming and climate change are extremely or very serious for their households and ways of life.

Researchers contextualize social capital as the strength of networks of trusts, reciprocity, and norms between individuals who share social identity (Pelling & High, 2005; Dressel et al., 2020). Higher social capital is found to determine a higher adaptive capacity of individuals after an extreme weather event (Aldrich, 2012; Alrich & Meyer, 2014), as well as more likely to show support for climate policy (Hao et al., 2020). Studies also find that there is an imbalance in the availability of social capital among low-income residents of a community (McCarthy, 2014). For instance, in relation to the effects of a Chicago heatwave, social-capital weakness and associated barriers to accessing assistance were a pervasive reason for mortality among socio-economically disadvantaged groups (Semenza et al.,1996; Klinenberg et al.,1999). From this standpoint I hypothesise that;

*H3***:** Individuals who live in close-knit neighbourhoods will less likely acknowledge that both the risks posed by extreme heat and by global warming and climate change are extremely or very serious for their households and ways of life.

1.2. Exposure

Personal exposure to climate change-related events influences beliefs more than information about climate change in distant locations (Rudman et al., 2013; Whitmarsh, 2009; Ruiz et al., 2020), but also the relationship between exposure to climate-related extreme weather events and climate change beliefs erodes overtime (Howe & Leiserowitz, 2013; Egan & Mullin, 2012). The magnitude of the event also matters; individuals experiencing climate change-related weather events with less damage are less likely to believe that climate change is occurring and also discount the seriousness of climate change (Yazar et al., 2021; Saad, 2015).

H4: Personal experience with extreme heat symptoms is associated with the perception of local extreme heat and global warming and climate change risk.

1.3. The Effects of Place Attachment

People's connectedness to their places (either neighbourhood or city) is found to be an important indicator for their environmental behaviours and their engagement to conservation-related actions (Scannel & Gifford, 2010; Gosling & Williams, 2010). Devine-Wright et al. (2015) find that individuals with high levels of global attachment are more concerned about climate change comparing to individuals with stronger national attachment. Experience of extreme weather events triggered by changing climate - such as

floods - make people less certain about their future, but also flood risks trigger people to leave their properties to prevent further damages regardless the levels of their place attachment, but people with higher sense of place, especially those who have strong social bonding with their locals, prefer to move back (Chamlee-Wright & Virgil, 2009). The ambiguous relationships between place attachment (global, national, local) and the perception of threats posed by climate change can suggest that the constant experience with the extreme local weather events - coupled with strong sense of belonging and social bonding - might increase beliefs that they cause serious risks to people's wellbeing. Here, I hypothesise that:

H5: Individuals who are very attached to their neighbourhood will more likely acknowledge that the risks posed by extreme heat, whereas less likely to acknowledge the risks posed by global warming and climate change are extremely or very serious for their households and ways of life.

1.4. Political Beliefs

A relationship between climate change beliefs and political ideology in the US is well established (Bohr, 2017; Hamilton et al., 2015; Marquart-Pyatt, 2014; McCright & Dunlap, 2011). Researchers find that informing the public through scientific articles or reports does not alter their opinion about climate change (Hamilton et al., 2015; Brulle et al., 2012; Kahan, 2015) as they selectively identify or dismiss scientific information through their social and political identities (Weber & Stern, 2011). Studies find that individuals who identify themselves as liberals are more likely to believe that climate change is happening (Bohr, 2017; Hamilton et al., 2015; Marquart-Pyatt, 2014; McCright

& Dunlap, 2011). Similarly, political ideology is found one of the strongest predictors in perceiving health risks associated with extreme heat (Cutler et al., 2018).

H6: Liberal political ideology is associated with perception of local extreme heat and global warming and climate change risk.

2. The Data and Methods

2.1.Study Area

The Phoenix Metro Area has one of the most extreme climates in the USA and the world with heat with temperatures in excess of 35.9°C (NOAA, 2020), affecting an urban population of 4.8 million (ACS ,2018). Phoenix's historic and current socio-spatial inequalities associated with extreme heat and climate change are due in part to historical legacy of race-based segregation and redlining in urban planning (Bolin et al., 2013; York & Boone, 2018). Low-income communities are more likely to be exposed to higher air and surface temperatures due to fewer material and social resources that may help adapt to the impacts of extreme heat, such as centralized air conditioning (Harlan et al., 2006; Jenerrette et al., 2011), while there is also uneven distribution of vegetation throughout the metropolitan area generating and recreating spatial patterns of heat vulnerability that amplify individual vulnerabilities of low-income of communities of color (Harlan et al., 2006; Larson et al., 2017).

2.2. Data

I use the 2017 Phoenix Area Social Survey (PASS-2017) dataset (Larson et al., 2019) in order to test our six hypotheses. Selected variables from this dataset were analysed using individual-level logistic regression models. The PASS-2017 dataset contains records from a total of 496 respondents, drawn from the population of residents in the Phoenix area using a random-probability sampling design. The survey was conducted in a total of 12 different neighbourhoods within the Phoenix Metro and selecting localities with diverse income levels, ethnic profiles and time of development. The survey was delivered by mail only from June to early August 2017, achieving a response rate of 39.4%. Questions were selected for analysis related to vulnerability, adaptation, and exposure, as well as controls based upon the existing literature (see Table 1 for distribution properties of PASS-2017 variables considered by this study).

Dependent variables

PASS-2017 respondents were asked to share their thoughts about how serious the risks posed by *"extreme heat"* and *"global warming and climate change"* are for their households and ways of life using a five-point scale containing ordinal categories; not at all serious, not too serious, somewhat serious, very serious and extremely serious. To compare their risk perceptions to the two given risks, I identified two dependent variables, namely "*the risks posed by extreme heat are extremely or very serious for my household and way of life"*, and *"the risks posed by global warming and climate change are extremely and very serious for my household and way of life."*

Both responses to the two dependent variables are coded into a dichotomous variable, distinguishing between respondents who extremely or very seriously agreed that extreme heat and global warming and climate change risk their households and ways of life (coded as 1) and respondents who find the two risks somewhat serious, not too serious, and not at all serious (coded as 0). Specified in this binary form, the two dependent variables focus on the respondents' attitudes at the extreme end of agreements to the risks versus attitudes ranging from moderate to strong disagreements.

Adaptative Capacity: Social Structure

The study uses a range of PASS-2017 variables that record self-reported socio-demographic information about respondents at the time of the survey. Respondent *gender* distinguishes between respondents who identify as male versus female, and female is treated as the reference category. Respondent *age* at the time of the survey was originally recorded in the PASS-2017 dataset as continuous integers ranging from 18 to 96 years of age. These were banded into three categories or roughly similar frequencies; i.e. 40 or younger, 41 to 56 years of age, and 57 or older. The youngest age group (i.e. 40 or younger) were treated as the reference category against which respondents in other age groups were compared with regard to the dependent variable of the study.

Respondents' level of *income* in the dataset is originally recorded across eleven categories ($20k and under, 20,001 to $40k, $40,001 to $60k, $60,001 to $80k, $80,001 to $100k, $100,001 to $120k, $120,001 to $140k, $140,001 to $160k, $160,001 to $180k, $180,001 to $200k, more than $200k). I grouped income levels into three categories, namely $40k or under, $40,001 to $80k, and $80,0001 or more. $80,001 or more is treated

as the reference category against the remaining two categories to capture differences between lower income levels.

Respondents' *racial and ethnic background* in the PASS-2017 dataset is originally recorded across six categories (i.e. Mexican, Mexican-American, Chicano, Hispanic, Latino, or of Spanish background; White or Anglo; African-American, Asian or Asian-American; American Indian or Native American; or any other racial background). For our study, the original categories are further grouped into three overarching categories, namely Latinx, White-Anglo, Others (including African-American, Asian or Asian-American; American Indian or Native American; or any other racial background). White-Anglo is treated as the reference category against which respondents in Latinx and Others racial groups are compared with regard to the dependent variables of the study.

Respondent's *highest level of education* (i.e. grades 1 to 8; grades 9 to 11; high school; community college; vocational or technical school; college; and graduate or professional school). For our study, the original categories were grouped into two broader categories distinguishing between respondents who had reported having completed any of grades 1 to 8, grades 9 to 11, high school, community college, and vocational or technical school versus respondents who reported having completed college or graduate and professional schools. The former category is treated as the reference category against which respondents in the latter category are compared with regard to the dependent variable of the study.

The PASS-2017 dataset recorded respondent *employment status* at the time of the survey across seven categories (i.e. working full time; working part-time; full-time student; homemaker; retired; unemployed; and any other employment status not specifically stated).

Our study grouped these original categories into two overarching categories distinguishing between respondents who at the time of the survey reported being in full-time work versus respondents who reported any employment status other than full-time work. The latter category is treated as the reference category against which respondents in the former are compared with regard to the dependent variable of the study.

Adaptative Capacity: Green Space

Respondents' satisfaction with the amount of trees in and around their neighbourhood is recorded in the dataset across five categories; strongly dissatisfied, somewhat dissatisfied, neither dissatisfied nor satisfied, somewhat satisfied, strongly satisfied. The categories are grouped into two overarching categories distinguishing between respondents who are strongly satisfied as opposed to other than strongly satisfied including somewhat dissatisfied, neither dissatisfied nor satisfied, somewhat satisfied, strongly satisfied. The first category is treated as the reference category with regard to the dependent variables of this study. This categorization allows us to focus on the respondents at the extreme end of satisfaction with the trees in and around their neighbourhood.

Adaptative Capacity: Social Capital

Social capital is measured as a dichotomous variable; respondents indicating that "strongly agree" that "I live in a close-knit neighbourhood" versus other responses with "strongly agree" as the reference category.

Exposure

To explore the relationship between the two dependent variables and PASS-2017 respondents' experience of heat-related illness, I used the following question: *"During last summer, did you or anyone else in your household have symptoms related to heat or high*

temperatures such as leg cramps, dry mouth, dizziness, fatigue, fainting, rapid heartbeat or hallucinations?". The question accepts yes or no answers. Respondents who answered "yes" are treated as the reference category against which their counterparts were compared with regard to the dependent variables of the study.

Place attachment

Place attachment is also measured as dichotomous variable; respondents indicating "strongly agree" that "I am very attached to my neighbourhood" versus other responses with "strongly agree" as the reference category.

Political Ideology

Respondent political ideology, as self-reported at the time of the survey, was recorded in the PASS-2017 dataset across seven categories (i.e. very conservative; conservative, slightly conservative; moderate; slightly liberal; liberal; and very liberal). The original categories were grouped into two overarching categories distinguishing between respondents who had self-reported being very liberal, liberal and slightly liberal as opposed to respondents who had self-reported being very conservative, conservative, slightly conservative, and moderate. The first category is treated as the reference category against which respondents in the latter category are compared with regard to the dependent variables of the study.

Table 4.1

Distribution properties of PASS-2017 variables considered by this study

Variable	**Distribution description**	**Count of respondents**	**Proportion of respondents against complete sample size (496 respondents)**
TARGET VARIABLES (LOCAL VS. GLOBAL PHENOMENA)			
Respondent's extent of acknowledgment with the *risks posed by extreme heat for their households and ways of lives*	Extremely and very serious	279	56%
	Other than extremely and very serious (not at all serious, not too serious, somewhat serious)	212	43%
Respondent's extent of acknowledgment with the *risks posed by global warming and climate change for their households and ways of lives*	Extremely and very serious	235	47%
	Other than extremely and very serious (not at all serious, not too serious, somewhat serious)	255	51%
ADAPTIVE CAPACITY: SOCIAL STRUCTURE			
Respondent gender	Female	293	59%
	Male	195	39%
Respondent age	40 years of age or younger	157	32%
	41-56 years of age	131	26%
	57 years of age or older	200	40%
Respondent ethnic/racial background	White-Anglo	314	63%
	Latino-Hispanic	104	21%

	Others (including African-American, Asian or Asian-American)	79	16%
Respondent income	$40,000 or under	101	20%
	$40,001 to $80,000	131	26%
	$80,001 or more	225	45%
Respondent highest level of school completed	College, bachelor's degree, graduate, professional school	276	57%
	Grades 1-11, high school, community, vocational, technical	208	42%
Respondent employment status	In full-time work	249	50%
	Other than full-time work (part-time work, full-time student, homemaker, retired, unemployed, or any other employment status not specifically stated)	244	49%
ADAPTIVE CAPACITY: GREEN SPACE			
Respondent satisfied with the amount of trees in and around their neighbourhood	Strongly satisfied	116	23%
	Other than strongly satisfied (somewhat satisfied, neither dissatisfied nor satisfied, somewhat dissatisfied)	379	76%
ADAPTIVE CAPACITY: SOCIAL CAPITAL			
Respondent lives in a close-knit neighbourhood	Strongly agree	62	13%
	Other than strongly agree (somewhat agree, neither disagree nor agree, somewhat disagree)	432	87%
EXPOSURE			
Respondent symptoms related to heat or high temperatures	Yes	118	24%
	No	369	74%

PLACE ATTACHMENT			
Respondent is very attached to their neighbourhood	Strongly agree	140	28%
	Other than strongly agree (somewhat agree, neither disagree nor agree, somewhat disagree)	352	71%
POLITICAL IDEOLOGY			
Respondent political ideology	Liberal	165	33%
	Moderate or conservative	315	64%

2.1.Approach to the analysis

A total of 4 models are fitted using the aforementioned variables from the PASS-2017 dataset. More specifically 2 models are created for each of the two dependent variables namely, "*the risks posed by extreme heat are extremely and very serious for my household and way of life"*, and *"the risks posed by global warming and climate change are extremely and very serious for my household and way of life."* The models investigated the relationship between two binary dependent variables and a series of independent and control variables. I used Cramer's metric in order to show the strength of association in the models (see Annex C).

At the first stages of the analysis, I explored whether two-level logistic regression models with a random intercept at city-level would be more appropriate for this study compared to individual-level logistic regressions without city-level random effects. Given the small sample size available to this study, significant city-level effects were not detected, and therefore, the individual-level logistic regression was deemed as the preferred modelling option.

The authors of this study have considered a large number of PASS-2017 (control and independent) variables before concluding to the mix of variables accounted for in the models presented here; a mix of variables that has been selected to enable a discussion around the hypotheses of this study, while optimising the goodness-of-fit of the models proposed. Goodness-of-fit for the reported models was evaluated using the Akaike Information Criterion (AIC) metric. All analyses were carried out using R version 3.6.2 (Team R.C., 2013).

3. Results

Table 2 presents two individual-level logistic regression models that explore the relationship between responses to the statement "*the risks posed by extreme heat are extremely and very serious for my household and way of life"* (for simplicity, *the* local phenomena (A)), their satisfaction about the trees in and around their neighbourhood, their place attachments and social ties, their experience of heat-related illness, and their political beliefs. The table also presents two individual-level logistic regression models with the aforementioned independent and socio-demographic variables against responses to the statement "*the risks posed by global warming and climate change are extremely and very serious for my household and way of life"* (for simplicity, global phenomena (B)).

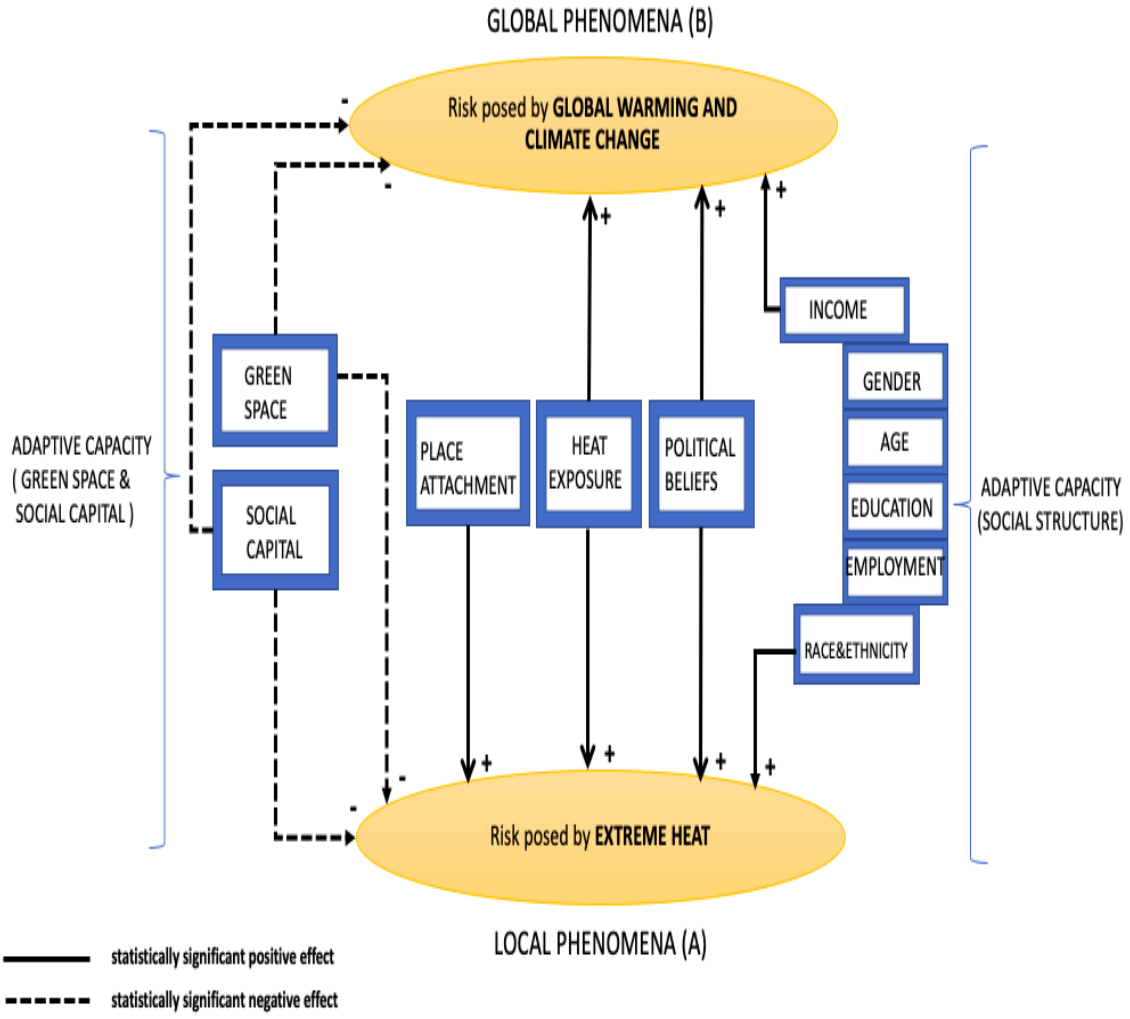
Table 4.2

*Individual-level logistic regression models acknowledging "the risk posed by **extreme heat is extremely or very serious** for my household and my way of life (A) " [vs. somewhat serious, not too serious, or not at all serious], and "the risk posed by **global warming and climate change is extremely or very serious** for my household and my way of life (B)" [vs. somewhat serious, not too serious, or not at all serious]*

		LOCAL PHENOMENA (A)		GLOBAL PHENOMENA (B)	
Variable	**Category [vs. reference category, if predictor is categorical]**	**Model 1A**	**Model 2A**	**Model 1B**	**Model 2B**
Intercept	-	-0.343 (0.404)	-0.282 (0.415)	-1.161*** (0.413)	-1.082*** (0.422)
Respondent gender	Female **[vs. male]**	0.104 (0.219)	0.158 (0.226)	0.071 (0.223)	0.102 (0.228)
Respondent age	41 to 56 years of age **[vs. 40 or younger]**	0.217 (0.284)	0.153 (0.289)	0.466 (0.288)	0.477 (0.293)
	57 or older **[vs. 40 or younger]**	-0.278 (0.277)	-0.331 (0.291)	0.331 (0.283)	0.413 (0.294)
Respondent income	$40,000 or under **[vs. $80,001 or more]**	0.169 (0.307)	0.211 (0.314)	0.547* (0.312)	0.531* (0.316)
	$40,001 to $80,000 **[vs.$80,001 or more]**	0.143 (0.254)	0.125 (0.259)	0.174 (0.257)	0.149 (0.263)
Respondent racial background	Latino or Hispanic **[vs. White-Anglo]**	0.581* (0.302)	0.592* (0.309)	0.356 (0.296)	0.408 (0.301)
	Others (including African-American, Asian or Asian-American) **[vs. White-Anglo]**	0.050 (0.311)	0.073 (0.321)	-0.272 (0.325)	-0.311 (0.329)
Respondent highest level of school completed	College, graduate / professional school **[vs. grades 1 to 11, high school, community college, vocational / technical school]**	-0.284 (0.236)	-0.289 (0.243)	-0.176 (0.240)	-0.149 (0.244)
Respondent employment status	In full-time employment **[vs. any other employment status]**	-0.023 (0.233)	-0.058 (0.238)	-0.076 (0.235)	-0.084 (0.239)
Respondent symptoms related to heat or high temperatures	Yes **[vs. no]**	0.788*** (0.259)	0.749*** (0.264)	0.744*** (0.256)	0.723*** (0.259)
Respondent political ideology	Liberal **[vs. moderate or conservative]**	1.239*** (0.233)	1.245*** (0.239)	1.703*** (0.238)	1.713*** (0.243)
Respondent satisfied with the amount of trees in the neighbourhood	Strongly satisfied **[vs. somewhat satisfied, neither dissatisfied nor satisfied, somewhat dissatisfied]**		-0.663** (0.264)		-0.577** (0.273)
Respondent is very attached to their neighbourhood	Strongly agree **[vs. somewhat agree, neither dissagree nor agree, somewhat dissagree]**		0.563*** (0.288)		0.383 (0.282)
Respondent lives in a close-knit neighbourhood	Strongly agree **[vs. somewhat agree, neither dissagree nor agree, somewhat dissagree]**		-0.796** (0.362)		-0.806** (0.368)
Model metrics					
Sample size		433	430	432	429
Akaike Information Criterion		563.3	550.7	551.4	544.5

Statistical significance identifiers: {<=0.001: '***'}; {0.05: '**'}; {0.10: '*'}

Figure 4.1 *Factors drive perceptions of local and global climate phenomena*



3.1. Adaptive Capacity: Social Structure, Green Space, Social Capital

Social Structure: Statistically significant relationships are identified between perceived risks posed by extreme heat and *race,* whereas *income* appears to be significantly associated with perceived risks posed by global warming and climate change. Other than the two aforementioned variables, I did not observe statistically significant effects for the remainder of respondent socio-demographic characteristics that our study considered. More specifically, Models 1A and 2A suggest that PASS-2017 respondents from Latino or Hispanic racial backgrounds appear more likely to report that the risks described by local phenomena are extremely or very serious compared to their counterparts from White-Anglo racial backgrounds. On the other hand, Models 1B and 2B, suggest that PASS-2017 respondents with lower-income ($40k or under) are more likely to report that the risks described by global phenomena are extremely or very serious compared to their counterparts with higher-income levels. Our *H1* is confirmed the roles of race and income in acknowledging local and global phenomena respectively.

Greenspace: Models 2A and 2B systematically suggest that PASS-2017 respondents who are strongly satisfied with the amount of trees in and around their neighbourhood have a statistically significant lower propensity to report that the risks described by local and global phenomena are extremely or very serious compared to their counterparts who are other than strongly satisfied. In other words, individuals who are strongly satisfied with the amount of trees in and around their neighbourhood are less likely to acknowledge that the risks posed by extreme heat and by global warming and climate

change are extremely and very serious for their households and ways of life. Hence, our *H2* is confirmed.

Social Capital: Models 2A and 2B systematically suggest that PASS-2017 respondents who strongly agree that they live in close-knit neighbourhoods have a statistically significant lower propensity to report that the risks described by local and global phenomena are extremely or very serious compared to their counterparts who are other than strongly agree. Effectively, individuals who strongly agree that they live in a close-knit neighbourhood are less likely to believe that the risks posed both by extreme heat and by global warming and climate change are extremely and very serious for their households and ways of life. *H3* is confirmed for the two risks explored in this study.

3.2.Exposure

The study finds respondents self-reporting personal experience of heat-related symptoms or illness have a greater propensity to report that the risks described by both local phenomena and global phenomena are extremely or very serious (Models 1A and 1B). Thus, *H4* is confirmed.

3.3.Effects of Place Attachment

Model 2A suggests that individuals who strongly agree that they are attached to their neighbourhood have a statistically significant higher propensity to report that the risks from extreme heat are extremely or very serious compared to their counterparts who are other than strongly agree. I did not observe a similar association between place attachment and the global phenomena with regard to global warming and climate change in Model 2B. Thus, *H5* is confirmed.

3.4.Socio-Political Ideology

The study also observes that respondents who describe themselves as liberal have a greater propensity to report that the risks described by both local and global phenomena are extremely or very serious than their counterparts who position themselves as conservative to moderate (Models 1A and 1B). Hence, *H6* is confirmed.

4. Discussion

This study explored how socio-spatial, attitudinal and socio-demographic indicators affect locals' (N=496) in the Phoenix Metro Area in acknowledging the severity of the risk posed by 1) extreme heat, and 2) global warming and climate change for their households and ways of life. Increasingly people throughout the world perceive climate change as a serious threat (Lee et al., 2015), but there is limited research exploring local versus global risks. I find the factors influencing perception of local versus global climate risks are not the same.

Adaptive Capacity: Social Structure, Green Space, Social Capital

Social structure affects risk perception; *race* is strongly associated with acknowledging the risks posed by extreme heat, whereas *income* is strongly associated with acknowledging the risks posed by global warming and climate change. More specifically, individuals with Latino or Hispanic racial background are more likely threatened by the risks caused by extreme heat compared to White-Anglo and other racial backgrounds. Respondents with lowest-income levels ($40k or under), are more likely threatened by the risks posed by global warming and climate change compared to their counterparts with

higher-income. These findings are highly in line with the literature that links racial or ethnic status and income level to the adaptive capacity to respond to hazards (Harlan et al., 2006; Chow et al., 2012).

Social structure is connected to local environment in many cities and specifically for the Phoenix Metro Area, high-income neighbourhoods are located closer to the desert with lower population density and more green areas providing shade (Jenerette et al., 2007), with lower night-time temperatures that cool surface quicker than neighbourhoods in the urban core (Connors et al., 2013). Neighbourhoods with a predominantly Latinx population are more likely to experience extreme heat conditions in Phoenix (Harlan et al., 2006). Our results further amplify these results illustrating that that social structure affects perception of local and global climate risks.

In terms of *green space*, our analysis finds that individuals, who are strongly satisfied with the amount of trees in and around their neighbourhood, are less likely acknowledge that the risks posed by extreme heat and global warming and climate change are extremely or very serious for their households and ways of life. Studies find that less affluent citizens in the Phoenix Metro Area live in less green spaces and have socio-spatial disadvantages in accessing urban green facilities (Harlan et al., 2006; Jenerette et al., 2007; Jenerette et al., 2011). Many cities are adopting urban resiliency planning and greening strategies (Fainstein, 2018; Haase et al., 2017), yet focusing on social justice in resilient urban planning is controversial as case studies from many major cities show that urban greening becomes a tool for attracting affluent locals for new residential projects, especially those which take place in gentrified neighbourhoods (Yazar et al., 2020a; Pearsall, 2010; Dooling, 2009). More research is needed to better understand the extent to

which investing in green spaces without considering social justice can heighten climate injustices, and how the uneven distribution of green spaces in cities worsens locals' adaptive capacity to extreme weather changes. Satisfaction with green space moderates perceptions of local and global climate risks.

Leiserowitz (2005) finds that most Americans believe that the future threat of climate change will impact people and places that are temporally and geographically distant. From a *social capital* perspective, I find that respondents, who identify a sense that they live in close-knit neighbourhoods, are less likely to acknowledge the risks posed by both extreme heat and by global warming and climate change as extremely or very serious for their households and ways of life. This result supports literature suggesting that higher social capital increases adaptive capacity (Aldrich, 2012; Alrich & Meyer, 2014). More research is, however, needed to better understand the underlying cultural and cognitive reasons based on which people acknowledge risks from weather changes but do not show similar concern about global-level climate change, and how this potential proximity-based bias affects action-taking for increasing individuals' adapting capacity to a changing climate.

Exposure

Regarding *heat exposure*, I find that personal experience of heat-related symptoms or illness is associated to a greater propensity of acknowledging the severity of risks related to extreme heat and global warming and climate change. The literature shows that the degree of seriousness in personal damage and time duration after the damage affect people's perceptions about the seriousness of climate change (Saad, 2015; Egan & Mullin, 2012).

Place Attachment

The role of *place attachment* suggests different patterns in acknowledging the severity of risks posed by extreme heat or global warming and climate change. More specifically, individuals who strongly agree that they are very attached to their neighbourhood see the risk posed by extreme heat as extremely or very serious for their households and ways of life. Yet, place attachment is not significantly associated with perceived risks from global warming and climate change. These results show that neighbourhood (local) attachment is more concerned with the observable local weather changes but does not necessarily link them to the global warming and climate change. This complement research findings suggesting that individuals with high levels of global attachment are more concerned about climate change compared to individuals with stronger national attachment (Devine-Wright et al., 2015).

Political Beliefs

From a *political beliefs* perspective, I find that individuals who describe themselves as liberal have a greater propensity to acknowledge the risks posed by extreme heat and by global warming and climate change as extremely or very serious for their households and ways of life. This supports existing findings suggesting that people with liberal political beliefs are more likely to recognize the risks posed by climate change and support policies to tackle extreme weather changes compared to people who are moderate and conservative (Bohr, 2017; Hamilton et al., 2015; Marquart-Pyatt, 2014; McCright & Dunlap, 2011). Moreover, Bromley-Trujillo & Poe (2020) find even though Democrat controlled states tended to be climate policy adopters; without a high degree of salient climate conditions,

their climate adoption rate decreases. Also, researches find that power dynamics on the local and state levels moderately influence local climate action (Gurney et al., 2021). As this result suggests that conservatives may not feel as threatened as liberals, the Republican-dominated state administration in Arizona could use state-level policy-making mechanisms to advance the policy beliefs associated with climate and heat of more conservative Phoenicians, while more liberal residents may feel more threatened because of the inaction to support their beliefs and concerns, such as increasing adaptive-capacity of the vulnerable urban population in the Phoenix Metro Area. More research is needed to identify how the public issue salience plays important role in influencing the institutional and organizational capacities of the cities of Phoenix Metro Area and whether they are constrained by the state-level decisions for further climate adaptation measures and actions.

Adaptive capacity has social and biophysical aspects, such as reducing exposure to heat through the increased tree canopy. Social structure (race and ethnicity and income), greenspace, and social capital influence perceptions of climate risk. Satisfaction with tree canopy and high levels of social capital reduce the perception of risk, while Latinx identity and low-income status increases likelihood of perception of risk.

Exposure and liberalness increase the perception of risk. Latinx identity and strong place attachment are associated with perceived local risks, low-income with global risk, while exposure, political ideology, greenspace and social capital are associated with both local and global. The differences in significant factors for local versus global illustrates important scalar differences; only one adaptive capacity social structure, income, is associated with perception of a risk of global warming and climate change, while Latinx identity is associated with the perception of local risk. Interestingly high levels of social

capital and satisfaction with tree canopy reduce the perception of both local and global risks, perhaps illustrating a buffering effect of adaptive capacity at the neighborhood level. Exposure and political ideology are strong and significant predictors of both local and global risk illustrating critical links in perception, which may, in turn, affect support for policy changes, an area for future research.

5. Conclusion

As socio-spatial and socio-demographic inequalities vary in each city, these inequalities must be taken into account when deploying climate adaptation actions. Importantly, our results indicate that the historical legacy of race-based segregation and redlining in urban planning is coupled with the existing dominant political constellation and discourse in climate change beliefs, which directly exacerbates the adaptative capacities of citizens, especially through increased exposure and limited green space. In this sense, it is important to unveil in which ways either local or state governments are claiming to act on behalf of citizens to accelerate or inhibit climate actions; and whether their actions lead in increasing or decreasing the levels of people's adaptive capacity.

The scalar dimensions of beliefs about the aforementioned risks, therefore, can bring into particularly sharp focus the ways in which inequalities are created and maintained by the existing urban planning, social and political processes. In thinking through what response could local or state governments generate in the midst of changing climate, it is also necessary to understand whether there are civil society and grassroot organizations that increase public issue salience in the form of climate issue attention. Although in some cases local, state, and federal governments might share common

thoughts about climate change, the key question is how such institutional and organizational alliance is challenged by public salience supported by grassroots to generate climate actions for vulnerable people's priorities. Consequently, adaptive capacities of urban populations cannot be understood without the scales of institutions and organizations embedded within the existing socio-political, economic and infrastructure contexts. Further studies must pay attention to city-wide socio-political priorities, infrastructural challenges, and alternative governance reconfigurations suggested by bottom-up that aim to address the existing climate injustices.

This study has demonstrated that the ever-increasing vulnerability of cities to local and global climate change are perceived differently depending on their adaptive capacity based on race, income, their proximity to urban green space, their place attachment and social capital, personal experiences of heat-related symptoms or illnesses, and political beliefs. The existing weak resiliency in urban infrastructure and planning, as well as political institutions that fail to act to mediate climate change shape locals' perceptions of risks posed by both extreme weather conditions and global climate change. More importantly, the aforementioned factors have a direct impact on determining people's adaptive capacity.

Risk perceptions are politicized through socio-demographic polarization, individual political beliefs, and urban planning (e.g. access to urban green space). The contest between political and social priorities – more of a power – agency dynamics - clearly exacerbate vulnerabilities and raise concerns around equity and justice in climate adaptation through neighborhood improvements. The political ecology of social exclusion

through the access of public lands and socio-spatial inequality in urban climate adaption planning must be given sufficient attention in further studies.

6. References

Abrahamson, V., Wolf, J., Lorenzoni, I., Fenn, B., Kovats, S., Wilkinson, P., ... & Raine, R. (2009). Perceptions of heatwave risks to health: interview-based study of older people in London and Norwich, UK. *Journal of public health*, *31*(1), 119-126.

ACS (American Community Survey). (2018). Accessed from: https://www.census.gov/newsroom/press-releases/2019/estimates-county-metro.html

Adger, W. N., & Vincent, K. (2005). Uncertainty in adaptive capacity. Comptes Rendus Geoscience, 337(4), 399-410.

Adger, W. N. (2006). Vulnerability. Global environmental change, 16(3), 268-281.

Akerlof, K., Maibach, E. W., Fitzgerald, D., Cedeno, A. Y., & Neuman, A. (2013). Do people "personally experience" global warming, and if so how, and does it matter?. *Global Environmental Change*, *23*(1), 81-91.

Albright, E. A., & Crow, D. (2019). Beliefs about climate change in the aftermath of extreme flooding. Climatic Change, 1-17.

Aldrich DP (2012) Building resilience: social capital in post-disaster recovery. University of Chicago Press, Chicago.

Aldrich DP, Meyer MA. (2014) Social capital and community resilience. Am Behav Sci 59:254-269.

Anguelovski, I., Chu, E., & Carmin, J. (2014). Variations in approaches to urban climate adaptation: Experiences and experimentation from the global South. Global Environmental Change, 27, 156-167

Berkes, F., Ross, H., 2013. Community resilience: toward an integrated approach. Soc. Nat. Resour. 26, 5–20.

Brody SD, Zahran S, Vedlitz A, Grover H (2008). Examining the relationship between physical vulnerability and public perceptions of global climate change in the United States. Environment & Behaviour 40(1):72–95.

Bohr j (2014) Public views on the dangers and importance of climate change: predicting climate change beliefs in the United Stayes through income moderated by party identification. Clim Change 126: 217-227.

Bohr, J. (2017). Is it hot in here or is it just me? Temperature anomalies and political polarization over global warming in the American public. Climatic Change 142:271–285

Bolin, B., Barreto, J. D., Hegmon, M., Meierotto, L., & York, A. (2013). Double exposure in the Sunbelt: the sociospatial distribution of vulnerability in Phoenix, Arizona. In Urbanization and sustainability (pp. 159-178). Springer, Dordrecht.

Bromley-Trujillo, R., & Poe, J. (2020). The importance of salience: public opinion and state policy action on climate change. Journal of Public Policy, 40(2), 280-304.

Brulle, R. J., Carmichael, J., & Jenkins, J. C. (2012). Shifting public opinion on climate change: an empirical assessment of factors influencing concern over climate change in the US, 2002–2010. Climatic change, 114(2), 169-188.

Byrne, J. A., Lo, A. Y., & Jianjun, Y. (2015). Residents' understanding of the role of green infrastructure for climate change adaptation in Hangzhou, China. Landscape and Urban Planning, 138, 132-143.

Change, I. C. (2014). Synthesis Report. Contribution of working groups I. II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, 151(10.1017).

Chamlee-Wright, E., & Storr, V. H. (2009). "There's no place like New Orleans": sense of place and community recovery in the Ninth Ward after Hurricane Katrina. *Journal of Urban Affairs*, *31*(5), 615-634.

Chow, W.T.L., Chuang, W.-C., Gober, P., 2012. Vulnerability to extreme heat in metropolitan phoenix: spatial, temporal, and demographic dimensions. Prof. Geogr. 64 (2), 286e302.

Connors, J. P., C. S. Galletti, and W. T. Chow. 2013 . Landscape configuration and urban heat island effects: Assessing the relationship between landscape characteristics and land surface temperature in Phoenix, Arizona. Landscape Ecology 28 (2):271–83.

Crutzen, P. J. (2006). The "anthropocene". In Earth system science in the anthropocene (pp. 13-18). Springer, Berlin, Heidelberg.

Curriero, F.C., Heiner, K.S., Samet, J.M., Zeger, S.L., Strug, L. and Patz, J.A., 2002. Temperature and mortality in 11 cities of the eastern United States. American journal of epidemiology, 155(1), pp.80-87.

Cutler, M. J., Marlon, J. R., Howe, P. D., & Leiserowitz, A. (2018). The influence of political ideology and socioeconomic vulnerability on perceived health risks of heat

waves in the context of climate change. *Weather, climate, and society*, *10*(4), 731-746.

Dai, D. (2011). Racial/ethnic and socioeconomic disparities in urban green space accessibility: Where to intervene?. Landscape and Urban Planning, 102(4), 234-244.

Davidson, D. J., & Haan, M. (2012). Gender, political ideology, and climate change beliefs in an extractive industry community. Population and Environment, 34(2), 217-234.

Derkzen, M. L., van Teeffelen, A. J., & Verburg, P. H. (2017). Green infrastructure for urban climate adaptation: How do residents' views on climate impacts and green infrastructure shape adaptation preferences?. Landscape and urban planning, 157, 106-130.

Devine-Wright, P., Price, J., & Leviston, Z. (2015). My country or my planet? Exploring the influence of multiple place attachments and ideological beliefs upon climate change attitudes and opinions. Global Environmental Change, 30, 68-79.

Dressel, S., Johansson, M., Ericsson, G., & Sandström, C. (2020). Perceived adaptive capacity within a multi-level governance setting: The role of bonding, bridging, and linking social capital. *Environmental Science & Policy*, *104*, 88-97.

Dooling, S. (2009). Ecological gentrification: A research agenda exploring justice in the city. International Journal of Urban and Regional Research, 33(3), 621-639.

Eakin, H., Lemos, M.C., Nelson, D.R., 2014. Differentiating capacities as a means to sustainable climate change adaptation. Global Environ. Change 27, 1–8.

Egan PJ, Mullin M (2012). Turning personal experience into political attitudes: the effect of local weather on Americans' perceptions about global warming. J Polit 74(3):796–809

Fainstein, S. S. (2018). Resilience and justice: planning for New York City. Urban Geography, 39(8), 1268-1275.

Gallopín, G. C. (2006). Linkages between vulnerability, resilience, and adaptive capacity. Global environmental change, 16(3), 293-303.

Gill, S. E., Handley, J. F., Ennos, A. R., & Pauleit, S. (2007). Adapting cities for climate change: the role of the green infrastructure. *Built environment*, *33*(1), 115-133.

Gosling, E., & Williams, K. J. (2010). Connectedness to nature, place attachment and conservation behaviour: Testing connectedness theory among farmers. Journal of environmental psychology, 30(3), 298-304.

Gurney, R. M., Hamlet, A. F., & Regan, P. M. The influences of power, politics, and climate risk on US subnational climate action. *Environmental Science & Policy*, *116*, 96-113.

Güneralp, B., Güneralp, İ., & Liu, Y. (2015). Changing global patterns of urban exposure to flood and drought hazards. *Global environmental change*, *31*, 217-225.

Haase, D., Kabisch, S., Haase, A., Andersson, E., Banzhaf, E., Baró, F., ... & Krellenberg, K. (2017). Greening cities–To be socially inclusive? About the alleged paradox of society and ecology in cities. Habitat International, 64, 41-48.

Hamilton LC, Hartter J, Lemcke-Stampone M et al (2015) Tracking public beliefs about anthropogenic climate change. PLoS One 10:e0138208.

Hao, F., Liu, X., & Michaels, J. L. (2020). Social Capital, carbon dependency, and public response to climate change in 22 European countries. *Environmental Science & Policy*, *114*, 64-72.

Harlan, S.L., Brazel, A.J., Prashad, L., Stefanov, W.L. and Larsen, L., 2006. Neighborhood microclimates and vulnerability to heat stress. Social science & medicine, 63(11), pp.2847-2863.

Harlan, S. L., Chowell, G., Yang, S., Petitti, D. B., Morales Butler, E. J., Ruddell, B. L., & Ruddell, D. M. (2014). Heat-related deaths in hot cities: estimates of human tolerance to high temperature thresholds. International journal of environmental research and public health, 11(3), 3304-3326.

Hayden, M.H., Brenkert-Smith, H., Wilhelmi, O.V., 2011. Differential adaptive capacity to extreme heat: a Phoenix, Arizona, case study.Weather Clim. Soc. 3 (4), 269–280.

Howe, P. D., & Leiserowitz, A. (2013). Who remembers a hot summer or a cold winter? The asymmetric effect of beliefs about global warming on perceptions of local climate conditions in the US. Global environmental change, 23(6), 1488-1500.

Jenerette, G. D., Harlan, S. L., Brazel, A., Jones, N., Larsen, L., & Stefanov, W. L. (2007). Regional relationships between surface temperature, vegetation, and human settlement in a rapidly urbanizing ecosystem. Landscape ecology, 22(3), 353-365.

Jenerette, G. D., S. L. Harlan, W. L. Stefanov, and C. A. Martin. (2011). Ecosystem services and urban heat riskscape moderation: Water, green spaces, and social inequality in Phoenix, USA. Ecological Applications 21 (7):2637– 51.

Kahan, D. M. (2015). Climate-science communication and the measurement problem. Political Psychology, 36, 1-43.

Kahan, D. M., Braman, D., Gastil, J., Slovic, P., & Mertz, C. K. (2007). Culture and identity-protective cognition: Explaining the White-male effect in risk perception. Journal of Empirical Legal Studies, **4**, 465– 505.

Klinenberg, E. (1999). Denaturalizing disaster: A social autopsy of the 1995 Chicago heat wave. Theory and Society, 28(2), 239-295.

Krellenberg, K., Link, F., Welz, J., Harris, J., Barth, K., & Irarrazaval, F. (2014). Supporting local adaptation: The contribution of socio-environmental fragmentation to urban vulnerability. Applied Geography, 55, 61-70.

Larson, K. L., Hoffman, J., & Ripplinger, J. (2017). Legacy effects and landscape choices in a desert city. Landscape and Urban Planning, 165, 22-29.

Larson, K., York, A., Andrade, R., & Wittlinger, S. (2019). Phoenix Area Social Survey (PASS): 2017.

Lee, T. M., Markowitz, E. M., Howe, P. D., Ko, C. Y., & Leiserowitz, A. A. (2015). Predictors of public climate change awareness and risk perception around the world. Nature climate change, 5(11), 1014-1020.

Leiserowitz, A. A. (2005). American risk perceptions: Is climate change dangerous?. Risk Analysis: An International Journal, 25(6), 1433-1442.

Lemos, M.C., Lo, Y.-J., Nelson, D.R., Eakin, H., Bedran-Martins, A.M., 2016. Linking development to climate adaptation: leveraging generic and specific capacities to reduce vulnerability to drought in NE Brazil. Global Environ. Change 39, 170–179.

Li, Y., Johnson, E. J. & Zaval, L. (2011). Local warming: Daily temperature change influences belief in global warming. Psychol. Sci. 22, 454-459.

Madrigano, J., Lane, K., Petrovic, N., Ahmed, M., Blum, M., & Matte, T. (2018). Awareness, risk perception, and protective behaviors for extreme heat and climate change in New York City. International journal of environmental research and public health, 15(7), 1433.

Malka, A., Krosnick, J. A., & Langer, G. (2009). The association of knowledge with concern about global warming: Trusted information sources shape public thinking. Risk Analysis: An International Journal, 29(5), 633-647.

Marquart-Pyatt, S. T., McCright, A. M., Dietz, T., & Dunlap, R. E. (2014). Politics eclipses climate extremes for climate change perceptions. Global environmental change, 29, 246-257.

Marshall, N.A., Park, S.E., Adger, W.N., Brown, K., Howden, S.M., 2012. Transformational capacity and the influence of place and identity. Environ. Res. Lett. 7, 034022.

McCarthy, JF. (2014). Using community led development approaches to address vulnerability after disaster caught in a sad romance. Glob Environ Change, 27: 144-155.

McCright, AM., Dunlap, RE. (2011). Cool dudes: the denial of climate change among conservative white males in the United States. Glob Environ Chang 21:1163–1172.

Moser, S. C., & Ekstrom, J. A. (2010). A framework to diagnose barriers to climate change adaptation. *Proceedings of the national academy of sciences*, *107*(51), 22026-22031.

Nelson, R., Kokic, P., Crimp, S., Martin, P., Meinke, H., Howden, S. M., ... & Nidumolu, U. (2010). The vulnerability of Australian rural communities to climate variability and change: Part II—Integrating impacts with adaptive capacity. Environmental Science & Policy, 13(1), 18-27.

NOAA National Centers for Environmental information, Climate at a Glance: City Time Series, published March 2020, retrieved on March 21, 2020 from https://www.ncdc.noaa.gov/cag/

O'BRIEN, K. A. R. E. N., Eriksen, S., Nygaard, L. P., & Schjolden, A. N. E. (2007). Why different interpretations of vulnerability matter in climate change discourses. Climate policy, 7(1), 73-88.

Pearsall, H. (2010). From brown to green? Assessing social vulnerability to environmental gentrification in New York City. Environment and Planning C: Government and Policy, 28(5), 872-886.

Pelling, M. (2003). The vulnerability of cities: natural disasters and social resilience. Earthscan.

Pelling, M., & High, C. (2005). Understanding adaptation: what can social capital offer assessments of adaptive capacity?. Global environmental change, 15(4), 308-319.

Petitti, D. B., Hondula, D. M., Yang, S., Harlan, S. L., & Chowell, G. (2016). Multiple trigger points for quantifying heat-health impacts: new evidence from a hot climate. Environmental health perspectives, 124(2), 176-183.

Ritchie, H., & Roser, M. (2018). Urbanization. Our world in data.

Rudman, L. A., McLean, M. C., & Bunzl, M. (2013). When truth is personally inconvenient, attitudes change: the impact of extreme weather on implicit support for green politicians and explicit climate-change beliefs. Psychological science, 24(11), 2290-2296.

Ruiz, I., Faria, S. H., & Neumann, M. B. (2020). Climate change perception: Driving forces and their interactions. *Environmental Science & Policy*, *108*, 112-120.

Saad, L. (2015). US views on climate change stable after extreme winter. POLITICS.

Satterfield, T. A., Mertz, C. K., & Slovic, P. (2004). Discrimination, vulnerability, and justice in the face of risk. Risk analysis: An international journal, 24(1), 115-129.

Scannell, L., & Gifford, R. (2010). Defining place attachment: A tripartite organizing framework. Journal of environmental psychology, 30(1), 1-10.

Semenza, J. C., Rubin, C. H., Falter, K. H., Selanikio, J. D., Flanders, W. D., Howe, H. L., & Wilhelm, J. L. (1996). Heat-related deaths during the July 1995 heat wave in Chicago. New England journal of medicine, 335(2), 84-90.

Sheridan, S. C., & Allen, M. J. (2018). Temporal trends in human vulnerability to excessive heat. Environmental research letters, 13(4), 043001.

Shi, L., Chu, E., Anguelovski, I., Aylett, A., Debats, J., Goh, K., ... & Roberts, J. T. (2016). Roadmap towards justice in urban climate adaptation research. Nature Climate Change, 6(2), 131-137.

Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. Global environmental change, 16(3), 282-292.

Team, R. C. (2013). R: A language and environment for statistical computing.

Turner, B. L., Kasperson, R. E., Matson, P. A., McCarthy, J. J., Corell, R. W., Christensen, L., ... & Polsky, C. (2003). A framework for vulnerability analysis in sustainability science. Proceedings of the national academy of sciences, 100(14), 8074-8079.

Waters, J., & Adger, W. N. (2017). Spatial, network and temporal dimensions of the determinants of adaptive capacity in poor urban areas. *Global Environmental Change*, *46*, 42-49.

Weber, E. U., & Stern, P. C. (2011). Public understanding of climate change in the United States. American Psychologist, 66, 315–328.

Wilhelmi, O. V., & Hayden, M. H. (2010). Connecting people and place: a new framework for reducing urban vulnerability to extreme heat. Environmental Research Letters, 5(1), 014021.

Whitmarsh, L. (2009). What's in a name? Commonalities and differences in public understanding of "climate change" and "global warming". Public understanding of science, 18(4), 401-420.

Wolf, J., Adger, W. N., Lorenzoni, I., Abrahamson, V., & Raine, R. (2010). Social capital, individual responses to heat waves and climate change adaptation: An empirical study of two UK cities. Global Environmental Change, 20(1), 44-52.

Yazar, M., York, A., & Kyriakopoulos, G. (2021). Heat exposure and the climate change beliefs in a Desert City: The case of Phoenix metropolitan area. *Urban Climate*, *36*, 100769.

Yazar, M., Hestad, D., Mangalagiu, D., Saysel, A. K., Ma, Y., & Thornton, T. F. (2020a). From urban sustainability transformations to green gentrification: urban renewal in Gaziosmanpaşa, Istanbul. Climatic Change, 1-17.

Yazar, M., Hestad, D., Mangalagiu, D., Ma, Y., Thornton, T. F., Saysel, A. K., & Zhu, D. (2020b). Enabling environments for regime destabilization towards sustainable urban transitions in megacities: comparing Shanghai and Istanbul. *Climatic Change*.

York, Abigail M. and Boone, Christopher G. (2018). Inventing Phoenix: Land use, politics, and environmental justice. Pp. 161-180 in The American Environment Revisited. Eds. Geoffrey L. Buckley and Yolanda Youngs. Lanham: Rowman and Littlefield.

Zaval, L., Keenan, E. A., Johnson, E. J., & Weber, E. U. (2014). How warm days increase belief in global warming. Nature Climate Change, 4(2), 143-147.

CHAPTER 5

RESEARCH FINDINGS SYNTHESIS

Climate change research increasingly calls for broad analyses with diverse perspectives and knowledges. This dissertation sought to analyze three issues of concern related to climate change in urban contexts; governance, beliefs systems about climate change, and the risk perceptions of global climate and local weather changes.

Cities that are unable or unwilling to advance climate governance structures to implement adaptation and mitigation strategies inevitably exacerbate power asymmetries and perpetuate climate injustice for vulnerable populations (Hughes, 2013; Holland, 2017). Climate justice literature increasingly engages with three pillars of justice frame, 1) concerns fair distributions, 2) political and social recognition, and 3) procedural inclusion, which are seen as necessary capabilities to address the basic needs, rights and political processes to adapt to global environmental challenges (Schlosberg, 2012). I argue that analyzing urban climate governance requires closer attention to the three pillars of climate justice focusing on the outcomes of urban climate governance (e.g. policy outcomes, regulations, and climate adaptation and mitigation implementation strategies) that have the power to leverage or inhibit the political and social recognition of changing climate, fair distributions of climate mitigation and adaptation strategies, and who is included, or excluded, in the decision-making process. My research on urban climate governance shows how the contest between political and social priorities and agency dynamics jeopardize governance reconfigurations suggested by the bottom-up that aim to address the existing climate injustices.

Participation in decision-making processes requires power (e.g. political, economic, social) and power is not fairly distributed among the most vulnerable socio-economic groups; nevertheless, the unfair power structures might be dismantled by bottom-up local actions spurred through grassroots and civil society organizations. Embracing deliberative engagement in urban climate governance through inclusive, bottom-up processes, may help support transitions to fair distributions and recognition over time.

This dissertation has some limitations, as with most research, that are essential to mention here. This research's case studies are focused on two different urban environments, namely the Istanbul and Phoenix Metro Areas. Therefore, the results highlighted from the two selected cities cannot be directly generalizable for cities outside Turkey and the United States. On the other hand, the urban governance framework developed in Chapter 2 drew on fieldwork and evidence from Istanbul to better understand climate decision-making and generate effective climate strategy tools to other cities that are part of a unitary system of government.

Climate change adaptation research requires multi-stakeholder engagement (including community members, civil society, organizations and institutions interplay in different administrative scales) for micro-spatial scale context (Corfee-Morlot, 2011; Waters & Adger, 2017); qualitative data supplemented with in-situ conclusions generate policy-relevant insights for local contexts. Challenges associated with the current covid19 pandemic, such as travel restrictions and border closures, prohibited further fieldwork planned in the Phoenix Metro Area and in Istanbul. An innovative mixed-method approach allowed integrated econometric analyses focused on climate justice and adaptive capacity

in the Phoenix Metro Area, explained in detail in Chapters 3 and 4, are examined using the existing Phoenix Area Social Survey (PASS) data which is part of the CAP-LTER collected in 2011 (Harlan et al., 2017) and 2017 (Larson et al., 2019).

In Chapter 2, my research highlights the general structure of urban climate change governance; it also provides insights on how climate change is governed in a megacity, outside of the Western context, under a unitary system of government in Turkey. Urban climate governance is highly connected to national policies and regulations as well as to the regional and global networks. The commitment to reflect complex and fragmented policy issues through collaboration between national government actors beyond nation states (e.g. supranational and intergovernmental organizations, as well as global networks) is produced through global or regional climate agendas, such as the Paris Agreement, and the European Green Deal. The transnational climate networks also represent an affirmation of partnerships as a central strategy to contribute agenda settings and diffusing best local climate adaptation and mitigation solutions through collaborating across geographical and administrative borders.

Research in Istanbul shows that the climate change agenda for Istanbul is introduced by the transnational municipal networks and adopted by the IMM. The collaboration between the local government and the transnational network did not inform the national government on potential policy change or adaptation to climate change. The external bodies of urban governance are not included in the climate agenda-setting processes. I find that swings in political leadership, the divergence between the existing laws and newly adopted urban climate agenda, and conflicting priorities between policy entrepreneurs generate barriers to long-run and tangible climate change actions in Istanbul.

On the other hand, I argue there is an opportunity space for local governments to co-create new governance mechanisms, as the national government does not have the capacity to lead climate change action, nor is there political will and focus at the highest levels of government to engage deeply in this policy space.

The role of top-down agenda-setting in Istanbul climate governance raises important questions about the inequity in climate change impacts and the important role that beliefs play in policymaking in democratic societies. In democratic societies, efforts to scale local mitigation to meet global goals and to implement adaptation plans to address community needs are influenced in part by local beliefs in climate change (Moser & Ekstrom, 2010). Researchers show that the right-wing politicians and their populist agendas have negative impacts on domestic and international climate policy ambitions. Right-wing populist politicians – with the support from the media - infuse climate skepticism to support fossil fuel-based industries and economy in certain regions (Zuk & Szulecki, 2020; Batel & Devine-Wright, 2018), which consequently leads to the polarisation of society and increases social tensions for climate change mitigation and adaptation strategies (e.g. support for Green New Deal in the US or The European Green Deal). Therefore, the mitigation of and adaptation to climate change are not only about technological advancements or financial issues; they are highly related to cultural, cognitive, and political-ideology imaginaries.

In Chapter 3, I focus on factors, such as gender, age, race, education, employment, parenthood as well as heat exposure and political beliefs influencing climate change beliefs in the USA's fifth-largest metropolitan area, the Phoenix Metropolitan Area, which is

extremely vulnerable to climate change due to its geographical location in the Southwestern US with average summer temperatures in excess of 106.2 °F (41.2°C) (NOAA 2020; Putnam et al., 2018; Hondula et al., 2018). Cities of the Southwest of the USA are testbeds for urban resilience because of the drastic weather changes (e.g. extreme heat), which enable experimentation through city-science partnerships in terms of adaptation (Hondula et al., 2019). On the other hand, exploring beliefs in climate change among urban dwellers with different exposures and socio-demographic vulnerabilities is necessary to understand and address the obstacles that decrease people's adaptive capacity in the changing climate.

I find that belief in climate change and global warming among urban populations in the Phoenix Metro Area is positively associated with race, high levels of education, personal experience with heat-related illnesses, and liberal beliefs. Widespread agreement about climate change is found within the scientific community, but general populations, especially in the USA, lag in accepting climate change. Critically there are important justice dimensions absent in the existing literature relevant to understanding beliefs and impacts of climate change. Unpacking these factors could help inform policymakers and civil society organizations in their efforts to design more "*just adaptation*" strategies. As conventional urban planning approaches are inadequate for dealing with climate vulnerabilities, more analyses must also include climate justice in order to address the underlying governance structures and institutional systems and whether injustice is likely to occur as a result of urban decision making.

Chapter 4 focuses on the drivers affecting people's perceptions of global and local climate risks; it is essential to understand people's existing vulnerabilities and adaptive capacities in the midst of a changing climate. I investigated the Phoenix Metro Area urban

population's perceptions of two risks, extreme heat and global warming and climate change examining how satisfaction with the number of trees in and around their neighborhood, their attachment to their neighborhood, and their sense of close-knit relations in their neighborhoods affects their perceptions. The aforementioned variables were examined with a range of adaptive capacity social structure factors: gender, age, income levels, race, education, and employment status; and their personal experience with heat-related symptoms or illnesses, and their political beliefs. Results show that the threats of extreme weather and global climate change are perceived differently by individuals depending on their vulnerabilities and capacities to adapt.

I find that greenspace and social capital, aspects of adaptive capacity, reduce the perception of risk at both the local and global scale. Individuals' place attachment increases the perception of local but not global risk. Latinx identity is associated with local but not global risk perception. Liberalness and experience of heat-related symptoms are significant predictors of risk perception at both the local and global scales. The results demonstrate that greenspace and tight-knit communities, aspects of adaptive capacity, serve as protective elements reducing climate risk perception. It is critical to examine individual aspects of adaptive capacity (such as income and education) and community-based determinants. Factors such as ethnic identity and connection to place are more closely associated with local versus global risks. In contrast, political ideology and personal experiences moderate the perception of both local and global risks.

Research in the Phoenix Metro Area underlines the importance of integrating analyses of justice and addressing power imbalances among urban populations in climate beliefs models. The Phoenix Metro Area is a unique case, as the city has been dramatically

experiencing the direct impacts of the changing climate due to its geographic location. More importantly, the dominant political constellation and discourse against human-driven climate change consequently hinders vulnerable groups' maneuvering space to demand climate actions at the state-level; inaction at the state-level limits local action. The results from Chapter 3 and Chapter 4 clearly show that the city-wide infrastructural challenges (unevenly distributed environmental amenities and uneven development of neighbourhoods) create obstacles for vulnerable groups' capacity to adapt to the extreme weather events; future work will explore how these same processes and the resulting spatial injustice may inhibit collective action from the bottom-up.

The two regression-models should be tested by researchers in other cities to generate comparative results about the role of climate change impact exposure, adaptive capacity, and political ideology on climate change beliefs. Collectively this research agenda provides a foundation for understanding local political support for urban climate change policy. Integrating this effort with multi-level governance perspectives, such as explored in chapter 2, reveals the dynamics of urban climate governance, such as the intersection of local or individual perceptions (and collective action) with national political agendas. Exploring these ideas with cases from different contexts will result in a greater understanding of multi-level governance processes that generate urban climate change policy adoption (or inaction).

REFERENCES

Abrahamson, V., Wolf, J., Lorenzoni, I., Fenn, B., Kovats, S., Wilkinson, P., ... & Raine, R. (2009). Perceptions of heatwave risks to health: interview-based study of older people in London and Norwich, UK. *Journal of public health*, *31*(1), 119-126.

Acuto, M., & Rayner, S. (2016). City networks: breaking gridlocks or forging (new) lock-ins?. *International Affairs*, *92*(5), 1147-1166.

ACS (American Community Survey). (2018). Accessed from: https://www.census.gov/newsroom/press-releases/2019/estimates-county-metro.html

Adaman, F., Akbulut, B., & Arsel, M. (Eds.). (2017). *Neoliberal Turkey and its discontents: Economic policy and the environment under Erdogan*. Bloomsbury Publishing.

Adger, W. N. (1996). Approaches to Vulnerability to Climate Change. Global Environmental Change Working Paper 96-05, Center for Social and Economic Research on the Global Environment, University of East Anglia and University College London.

Adger, W. N. (2000). Institutional adaptation to environmental risk under the transition in Vietnam. *Annals of the Association of American Geographers*, *90*(4), 738-758.

Adger, W. N., & Vincent, K. (2005). Uncertainty in adaptive capacity. Comptes Rendus Geoscience, 337(4), 399-410.

Adger, W. N. (2006). Vulnerability. Global environmental change, 16(3), 268-281.

Akilli, Hüsniye, & Akilli, H. Serkan. (2014). Decentralization and recentralization of local governments in Turkey. *Procedia Social and Behavioral Sciences*, 140, 682–686

Akerlof, K., Maibach, E. W., Fitzgerald, D., Cedeno, A. Y., & Neuman, A. (2013). Do people "personally experience" global warming, and if so how, and does it matter? *Global Environmental Change*, *23*(1), 81-91.

Akerlof, K., Delamater, P., Boules, C., Upperman, C., & Mitchell, C. (2015). Vulnerable populations perceive their health as at risk from climate change. International journal of environmental research and public health, 12(12), 15419-15433.

Albright, E. A., & Crow, D. (2019). Beliefs about climate change in the aftermath of extreme flooding. Climatic Change, 1-17.

Aldrich, D., & Crook, K. (2008). Strong civil society as a double-edged sword: Siting trailers in Post-Katrina New Orleans. Political Research Quarterly, 61, 379–389.

Aldrich DP (2012) Building resilience: social capital in post-disaster recovery. University of Chicago Press, Chicago.

Aldrich DP, Meyer MA. (2014) Social capital and community resilience. Am Behav Sci 59:254-269.

Anguelovski, I., Chu, E., & Carmin, J. (2014). Variations in approaches to urban climate adaptation: Experiences and experimentation from the global South. *Global Environmental Change*, *27*, 156-167.

Anguelovski, I., Shi, L., Chu, E., Gallagher, D., Goh, K., Lamb, Z., ... & Teicher, H. (2016). Equity impacts of urban land use planning for climate adaptation: Critical perspectives from the global north and south. *Journal of Planning Education and Research*, *36*(3), 333-348.

Arnold, G. Does Entrepreneurship Work? Understanding What Policy Entrepreneurs Do and Whether It Matters. *Policy Studies Journal*.

Ascione, F., De Masi, R. F., de Rossi, F., Fistola, R., Sasso, M., & Vanoli, G. P. (2013). Analysis and diagnosis of the energy performance of buildings and districts: Methodology, validation and development of Urban Energy Maps. *Cities*, *35*, 270-283.

Aylett, A. (2013). The socio-institutional dynamics of urban climate governance: A comparative analysis of innovation and change in Durban (KZN, South Africa) and Portland (OR, USA). *Urban Studies*, *50*(7), 1386-1402.

Bache, I., & Flinders, M. (2004). Themes and issues in multi-level governance. In I. Bache & M. Flinders (Eds.), Multi-level Governance (pp. 1–11). Oxford: Oxford University Press.

Bache, I., Bartle, I., Flinders, M., & Marsden, G. (2015). Blame games and climate change: Accountability, multi-level governance and carbon management. *The British Journal of Politics and International Relations*, *17*(1), 64-88.

Baklanov, A., Lawrence, M., Pandis, S., Mahura, A., Finardi, S., Moussiopoulos, N., ... & Borbon, A. (2010). MEGAPOLI: concept of multi-scale modelling of megacity impact on air quality and climate. *Advances in Science and Research*, *4*, 115-120.

Balbus, J. M., & Malina, C. (2009). Identifying vulnerable subpopulations for climate change health effects in the United States. Journal of occupational and environmental medicine, 51(1), 33-37.

Barnett, J., & O'Neill, S. (2010). Maladaptation. *Global environmental change*, *2*(20), 211-213.

Batel, S., & Devine-Wright, P. (2018). Populism, identities and responses to energy infrastructures at different scales in the United Kingdom: A post-Brexit reflection. *Energy Research & Social Science*, *43*, 41-47.

Bednar, D., Henstra, D., & McBean, G. (2019). The governance of climate change adaptation: are networks to blame for the implementation deficit? *Journal of Environmental Policy & Planning*, 1-16.

Berkes, F., Ross, H., 2013. Community resilience: toward an integrated approach. Soc. Nat. Resour. 26, 5–20.

Berko, J., Ingram, D.D., Saha, S., Parker, J.D., (2014). Deaths Attributed to Heat, Cold, and Other Weather Events in the United States, 2006–2010. Natl. Health Stat. Report., pp. 1–15.

Bernard, H. R., A. Wutich, and G. W. Ryan. 2016. *Analyzing qualitative data: systematic approaches*. SAGE, Thousand Oaks, California, USA.

Betsill, M. M. (2001). Mitigating climate change in US cities: opportunities and obstacles. *Local environment*, *6*(4), 393-406.

Birkland, T. A. (2006). Lessons of disaster: Policy change after catastrophic events. Washington, DC: Georgetown University Press.

Black, T. (2016). Race, gender, and climate injustice Dimensions of social and environmental inequality. *Systemic Crises of Global Climate Change: Intersections of race, class and gender*, 26.

Blaikie, P.; Cannon, T.; Davis, I.; and Wisner, B. (1994). At Risk: Natural Hazards, People's Vulnerability and Disasters. London: Routledge.

Blocker, T. J., & Eckberg, D. L. (1989). Environmental issues as women's issues: General concerns and local hazards. *Social Science Quarterly*, *70*(3), 586.

Boasson, E. L., & Huitema, D. (2017). Climate governance entrepreneurship: Emerging findings and a new research agenda. *Environment and Planning C: Politics and Space*, *35*(8), 1343-1361.

Bohr, J. (2014) Public views on the dangers and importance of climate change: predicting climate change beliefs in the United States through income moderated by party identification. Clim Change 126: 217-227.

Bohr, J. (2017). Is it hot in here or is it just me? Temperature anomalies and political polarization over global warming in the American public. Climatic Change 142:271–285

Bolin, B., Grineski, S., & Collins, T. (2005). The geography of despair: Environmental racism and the making of South Phoenix, Arizona, USA. *Human Ecology Review*, 156-168.

Bolin, B., Barreto, J. D., Hegmon, M., Meierotto, L., & York, A. (2013). Double exposure in the Sunbelt: the sociospatial distribution of vulnerability in Phoenix, Arizona.In *Urbanization and sustainability* (pp. 159-178). Springer, Dordrecht

Brody SD, Zahran S, Vedlitz A, Grover H (2008). Examining the relationship between physical vulnerability and public perceptions of global climate change in the United States. Environment & Behaviour 40(1):72–95.

Bromley-Trujillo, R., & Poe, J. (2020). The importance of salience: public opinion and state policy action on climate change. Journal of Public Policy, 40(2), 280-304.

Brulle, R. J., Carmichael, J., & Jenkins, J. C. (2012). Shifting public opinion on climate change: an empirical assessment of factors influencing concern over climate change in the US, 2002–2010. *Climatic change*, *114*(2), 169-188.

Brulle, Robert J., Pellow, David N., (2006). Environmental justice: human health and environmental inequalities. Annu. Rev. Publ. Health 102.

Bulkeley, H. (2013). Cities and climate change. Oxon/New York: Routledge, Abingdon.

Betsill, M., & Bulkeley, H. (2003). *Cities and climate change*(Vol. 4). Routledge.

Bromley-Trujillo, R., & Poe, J. (2020). The importance of salience: public opinion and state policy action on climate change. Journal of Public Policy, 40(2), 280-304.

Bulkeley, H., & Castán Broto, V. (2013). Government by experiment? Global cities and the governing of climate change. *Transactions of the institute of British geographers*, *38*(3), 361-375.

Burström, F., & Korhonen, J. (2001). Municipalities and industrial ecology: reconsidering municipal environmental management. *Sustainable Development*, *9*(1), 36-46.

Byrne, J. A., Lo, A. Y., & Jianjun, Y. (2015). Residents' understanding of the role of green infrastructure for climate change adaptation in Hangzhou, China. Landscape and Urban Planning, 138, 132-143.

Castells, M. (2010). Globalisation, networking, urbanisation: Reflections on the spatial dynamics of the information age. Urban Studies, 47(13), 2737-2745.

Cardona, O.D., M.K. van Aalst, J. Birkmann, M. Fordham, G. McGregor, R. Perez, R.S. Pulwarty, E.L.F. Schipper, and B.T. Sinh. (2012). Determinants of risk: exposure and vulnerability. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 65-108.

Chamlee-Wright, E., & Storr, V. H. (2009). "There's no place like New Orleans": sense of place and community recovery in the Ninth Ward after Hurricane Katrina. *Journal of Urban Affairs*, *31*(5), 615-634.

Change, I. C. (2014). Synthesis Report. Contribution of working groups I. II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, 151(10.1017).

Cheon, A. (2020). Advocacy, social movements, and climate change. In *Handbook of US Environmental Policy*. Edward Elgar Publishing.

Chow, W. T., Chuang, W. C., & Gober, P. (2012). Vulnerability to extreme heat in metropolitan Phoenix: spatial, temporal, and demographic dimensions. The Professional Geographer, 64(2), 286-302.

Chuang, W.-C.; Gober, P.; Chow, W.T.L.; Golden, J. (2013). Sensitivity to heat: A comparative study of Phoenix, Arizona and Chicago, Illinois. Urban Climate. 5, 1–18.

Clayton, S., Devine-Wright, P., Stern, P. C., Whitmarsh, L., Carrico, A., Steg, L., ... & Bonnes, M. (2015). Psychological research and global climate change. Nature Climate Change, 5(7), 640-646.

Cole, L. W., & Foster, S. R. (2001). *From the ground up: Environmental racism and the rise of the environmental justice movement* (Vol. 34). NYU Press.

C40. *Climate Action in Megacities 3.0* (2015). available at http://cam3.c40.org/#/main/home

Connelly, R. I., & Bal, P. G. (2016). Local networks of resilience and climate adaptation: the case of Istanbul. In *Climate Change Adaptation, Resilience and Hazards* (pp. 109-123). Springer, Cham.

Connors, J. P., C. S. Galletti, and W. T. Chow. (2013). Landscape configuration and urban heat island effects: Assessing the relationship between landscape characteristics and land surface temperature in Phoenix, Arizona. Landscape Ecology 28 (2):271–83.

Corfee-Morlot, J., Cochran, I., Hallegatte, S., & Teasdale, P. J. (2011). Multilevel risk governance and urban adaptation policy. *Climatic change*, *104*(1), 169-197.

Correia, F., Fordhamm, M., da Graca, Saraiva, M., Bernardo F. (1998). Flood hazard assessment and management: interface with the public. Water Resource Management 12(3):209–227.

Costello A, Abbas M, Allen A, Ball S, Bell S, Bellamy R, Friel S, Groce N, Johnson A, Kett M, Lee M, Levy C, Maslin M, McCoy D, McGuire B, Montgomery H, Napier D, Pagel C, Patel J, Puppim de Oliveira J, Redclift N, Rees H, Rogger D, Scott J, Stephenson J, Twigg J, Wolff J, Patterson C et al. (2009). Managing the health effects of climate change. The Lancet 373:1693–1733.

Cottrell, S. P. (2003). Influence of sociodemographics and environmental attitudes on general responsible environmental behavior among recreational boaters. *Environment and Behavior*, *35*(3), 347-375.

Crutzen, P. J. (2006). The "anthropocene". In Earth system science in the anthropocene (pp. 13-18). Springer, Berlin, Heidelberg.

Curriero, F.C., Heiner, K.S., Samet, J.M., Zeger, S.L., Strug, L. and Patz, J.A. (2002). Temperature and mortality in 11 cities of the eastern United States. *American journal of epidemiology*, *155*(1), pp.80-87.

Cutler, M. J., Marlon, J. R., Howe, P. D., & Leiserowitz, A. (2018). The influence of political ideology and socioeconomic vulnerability on perceived health risks of heat waves in the context of climate change. *Weather, climate, and society*, *10*(4), 731-746.

Cutter, S. L. (1995). Race, class and environmental justice. *Progress in human geography*, *19*(1), 111-122.

Cutter, S. L., & Finch, C. (2008). Temporal and spatial changes in social vulnerability to natural hazards. *Proceedings of the National Academy of Sciences*, *105*(7), 2301-2306.

Dai, D. (2011). Racial/ethnic and socioeconomic disparities in urban green space accessibility: Where to intervene?. Landscape and Urban Planning, 102(4), 234-244.

Davidson, D. J., & Haan, M. (2012). Gender, political ideology, and climate change beliefs in an extractive industry community. Population and Environment, 34(2), 217-234.

Derkzen, M. L., van Teeffelen, A. J., & Verburg, P. H. (2017). Green infrastructure for urban climate adaptation: How do residents' views on climate impacts and green infrastructure shape adaptation preferences?. Landscape and urban planning, 157, 106-130.

Devine-Wright, P., Price, J., & Leviston, Z. (2015). My country or my planet? Exploring the influence of multiple place attachments and ideological beliefs upon climate change attitudes and opinions. Global Environmental Change, 30, 68-79.

Dressel, S., Johansson, M., Ericsson, G., & Sandström, C. (2020). Perceived adaptive capacity within a multi-level governance setting: The role of bonding, bridging, and linking social capital. *Environmental Science & Policy*, *104*, 88-97.

Dooling, S. (2009). Ecological gentrification: A research agenda exploring justice in the city. International Journal of Urban and Regional Research, 33(3), 621-639.

Dunlap, R. E., and A. M. McCright. (2008). A widening gap: Republican and Democratic views on climate change. Environment: Science and Policy for Sustainable Development 50 (5): 26–35.

Dunlap, R. E., McCright, A. M., & Yarosh, J. H. (2016). The political divide on climate change: Partisan polarization widens in the US. *Environment: Science and Policy for Sustainable Development*, *58*(5), 4-23.

Dupuis, J., & Knoepfel, P. (2013). The adaptation policy paradox: the implementation deficit of policies framed as climate change adaptation. *Ecology and Society*, *18*(4).

Eakin, H., Lemos, M.C., Nelson, D.R., 2014. Differentiating capacities as a means to sustainable climate change adaptation. Global Environ. Change 27, 1–8.

Egan PJ, Mullin M (2012). Turning personal experience into political attitudes: the effect of local weather on Americans' perceptions about global warming. J Polit 74(3):796–809.
Egan PJ, Mullin M (2012). Turning personal experience into political attitudes: the effect of local weather on Americans' perceptions about global warming. J Polit 74(3):796–809

Escobar, A. (1998). Whose knowledge, whose nature? Biodiversity, conservation, and the political ecology of social movements. *Journal of political ecology*, *5*(1), 53-82.

Eriksen, S. H., & O'brien, K. (2007). Vulnerability, poverty and the need for sustainable adaptation measures. *Climate policy*, *7*(4), 337-352.

Fainstein, S. S. (2018). Resilience and justice: planning for New York City. Urban Geography, 39(8), 1268-1275.

Figueres, C., Schellnhuber, H. J., Whiteman, G., Rockström, J., Hobley, A., & Rahmstorf, S. (2017). Three years to safeguard our climate. *Nature News*, *546*(7660), 593.

Fink, J. H. (2019). Contrasting governance learning processes of climate-leading and-lagging cities: Portland, Oregon, and Phoenix, Arizona, USA. *Journal of environmental policy & planning*, *21*(1), 16-29.

Fiorino, D. J. (2010). Sustainability as a conceptual focus for public administration. *Public Administration Review*, *70*, 78-88.

Flynn, James, Paul Slovic, and C.K. Mertz. (1994). "Gender, Race, and Perception of Environmental Health Risks." *Risk Analysis* 14: 1101-1108.

Folberth, G. A., Butler, T. M., Collins, W. J., & Rumbold, S. T. (2015). Megacities and climate change–A brief overview. *Environmental Pollution*, *203*, 235-242.

Forrest, S., Trell, E. M., & Woltjer, J. (2017). Flood groups in England: Governance arrangements and contribution to flood resilience. In *Governing for resilience in vulnerable places* (pp. 92-115). Routledge.

Friel, S., Hancock, T., Kjellstrom, T. (2011). Urban health inequities and the added pressure of climate change: an action-oriented research agenda. J Urban Health 88(5):886–895.

Fünfgeld, H. (2015). Facilitating local climate change adaptation through transnational municipal networks. *Current Opinion in Environmental Sustainability*, *12*, 67-73.

Gallopín, G. C. (2006). Linkages between vulnerability, resilience, and adaptive capacity. Global environmental change, 16(3), 293-303.

Gasparrini, Antonio, Yuming Guo, Francesco Sera, Ana Maria Vicedo-Cabrera, Veronika Huber, Shilu Tong, Micheline de Sousa Zanotti Stagliorio Coelho, et al. (2017). "Projections of Temperature-Related Excess Mortality under Climate Change Scenarios." *The Lancet Planetary Health* 1 (9): e360–67.

Gill, S. E., Handley, J. F., Ennos, A. R., & Pauleit, S. (2007). Adapting cities for climate change: the role of the green infrastructure. *Built environment*, *33*(1), 115-133.

Glaeser, E. L. (2012). The challenge of urban policy. Journal of Policy Analysis and Management, 31(1), 111-122.

Gordon, D. J., & Johnson, C. A. (2017). The orchestration of global urban climate governance: conducting power in the post-Paris climate regime. *Environmental Politics*, *26*(4), 694-714.

Gordon, D. (2016). The politics of accountability in networked urban climate governance. Global Environmental Politics, 16 (2), 82–100.

Gosling, E., & Williams, K. J. (2010). Connectedness to nature, place attachment and conservation behaviour: Testing connectedness theory among farmers. Journal of environmental psychology, 30(3), 298-304.

Gouldson, A., Colenbrander, S., Sudmant, A., McAnulla, F., Kerr, N., Sakai, P., ... & Kuylenstierna, J. (2015). Exploring the economic case for climate action in cities. *Global Environmental Change*, *35*, 93-105.

Green, J. F. (2017). Policy entrepreneurship in climate governance: Toward a comparative approach. *Environment and Planning C: Politics and Space*, *35*(8), 1471-1482.

Greenwood, S. (2008). Bad for business? Entrepreneurs and democracy in the Arab world. *Comparative Political Studies*, *41*(6), 837-860.

Grimm, N. B., Faeth, S. H., Golubiewski, N. E., Redman, C. L., Wu, J., Bai, X., & Briggs, J. M. (2008). Global change and the ecology of cities. *science*, *319*(5864), 756-760.

Grossman-Clarke, S., Schubert, S., Clarke, T. A., & Harlan, S. L. (2014). Extreme summer heat in Phoenix, Arizona (USA) under global climate change (2041-2070). DIE ERDE–Journal of the Geographical Society of Berlin, 145(1-2), 49-61.

Guo, Y., et al. (2018). Quantifying excess deaths related to heatwaves under climate change scenarios: A multicountry time series modelling study. PLoS Med., 15, e1002629, https://doi.org/10.1371/journal.pmed.1002629.

Gurney, R. M., Hamlet, A. F., & Regan, P. M. The influences of power, politics, and climate risk on US subnational climate action. *Environmental Science & Policy*, *116*, 96-113.

Güneralp, B., Güneralp, İ., & Liu, Y. (2015). Changing global patterns of urban exposure to flood and drought hazards. *Global environmental change*, *31*, 217-225.

Güney, Aylin, & Çelenk, Ayşe Aslıhan. (2010). Europeanization and the dilemma of decentralization: Center-local relations in Turkey. *Journal of Balkan and near Eastern Studies*, 12(3), 241–257.

Haase, D., Kabisch, S., Haase, A., Andersson, E., Banzhaf, E., Baró, F., ... & Krellenberg, K. (2017). Greening cities–To be socially inclusive? About the alleged paradox of society and ecology in cities. Habitat International, 64, 41-48.

Hamilton LC, Keim BD. (2009). Regional variation in perceptions about climate change. International Journal of Climatology. 29(15):2348–2352.

Hamilton, L.C. (2011). Education, politics and opinions about climate change evidence for interaction effects. Climatic Change, 104 (2): 231-242.

Hamilton, LC., Hartter, J., Lemcke-Stampone, M. (2015a). Tracking public beliefs about anthropogenic climate change. PLoS One 10:e0138208.

Hamilton, L. C., Hartter, J., & Saito, K. (2015b). Trust in scientists on climate change and vaccines. *Sage Open*, *5*(3), 2158244015602752.

Hanssen, G. S., Mydske, P. K., & Dahle, E. (2013). Multi-level coordination of climate change adaptation: By national hierarchical steering or by regional network governance? Local Environment, 18(8), 869–887.

Hao, F., Liu, X., & Michaels, J. L. (2020). Social Capital, carbon dependency, and public response to climate change in 22 European countries. *Environmental Science & Policy*, *114*, 64-72.

Harlan, S.L., R. Aggarwal, D. Childers, J.Declet-Barreto, S. Earl, K. Larson, M.Nation, et al. (2017). Phoenix Area Social Survey (PASS): 2011.

Harlan, S.L., Brazel, A.J., Prashad, L., Stefanov, W.L. and Larsen, L. (2006). Neighborhood microclimates and vulnerability to heat stress. *Social science & medicine*, *63*(11), pp.2847-2863.

Harlan, S. L., Declet-Barreto, J. H., Stefanov, W. L., & Petitti, D. B. (2013). Neighborhood effects on heat deaths: social and environmental predictors of vulnerability in Maricopa County, Arizona. *Environmental health perspectives*, *121*(2), 197-204.

Harlan, S. L., Chowell, G., Yang, S., Petitti, D. B., Morales Butler, E. J., Ruddell, B. L., & Ruddell, D. M. (2014). Heat-related deaths in hot cities: estimates of human tolerance to high temperature thresholds. International journal of environmental research and public health, 11(3), 3304-3326.

Hartz, D. A., Brazel, A. J., & Golden, J. S. (2013). A comparative climate analysis of heat-related emergency 911 dispatches: Chicago, Illinois and Phoenix, Arizona USA 2003 to 2006. International journal of biometeorology, 57(5), 669-678.

Hayden, M.H., Brenkert-Smith, H., Wilhelmi, O.V. (2011). Differential adaptive capacity to extreme heat: a Phoenix, Arizona, case study.Weather Clim. Soc. 3 (4), 269–280.

Hayward, T. (2006). Human rights vs emissions rights: climate justice and the equitable distribution of ecological space. *Available at SSRN 929675*.

Herweg, N., Nikolaos, Z.,& Reimut, Zohlnhöfer. (2017). The Multiple Streams Framework: Foundations, Refinements, and Empirical Applications. In Theories of the Policy Process, 4th ed., ed. Christopher Weible, and Paul Sabatier. Boulder, CO: Westview Press, 17– 53.

Hesse J and Sharpe L (1991) Local government in international perspective: Some comparative observations. In: Hesse J (ed.) Local Government and Urban Affairs in International Perspective: Analysis of Twenty Western Industrialized Countries. Baden-Baden: Nomos, pp. 603–621.

Heynen, N., Perkins, H. A., & Roy, P. (2006). The political ecology of uneven urban green space: The impact of political economy on race and ethnicity in producing environmental inequality in Milwaukee. *Urban Affairs Review*, *42*(1), 3-25.

Holland, B. (2017). Procedural justice in local climate adaptation: political capabilities and transformational change. *Environmental Politics*, *26*(3), 391-412.

Hondula, D. M., Sabo, J. L., Quay, R., Chester, M., Georgescu, M., Grimm, N. B., ... & Rittmann, B. (2019). Cities of the Southwest are testbeds for urban resilience. *Frontiers in Ecology and the Environment*, *17*(2).

Hondula, D. M., Kuras, E. R., Longo, J., & Johnston, E. W. (2018). Toward precision governance: infusing data into public management of environmental hazards. Public Management Review, 20(5), 746-765.

Howe, P. D., & Leiserowitz, A. (2013). Who remembers a hot summer or a cold winter? The asymmetric effect of beliefs about global warming on perceptions of local climate conditions in the US. Global environmental change, 23(6), 1488-1500.

Hughes, S. (2013). Justice in urban climate change adaptation: criteria and application to Delhi. *Ecology and Society*, *18*(4).

Hughes, S., Chu, E. K., & Mason, S. G. (Eds.). (2018). Climate change in cities, the urban book series. Cham: Springer International Publishing. International Council for Local Environmental Initiatives. 2010. *ICLEI's five milestones for climate mitigation* Retrieved July 11, 2019, from http://www.icleiusa.org/action-center/getting-started/iclei2019s-five-milestones-for-climate-protection/

ICCAP (2018). Istanbul Climate Change Action Plan 2016-2018. https://www.iklim.istanbul Accessed 21 July 2018

Intergovernmental Panel on Climate Change. (2018). *Global Warming of 1.5° C: An IPCC Special Report on the Impacts of Global Warming of 1.5° C Above Pre-industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*. Intergovernmental Panel on Climate Change.

Jalali, R. (2002). Civil Society and the State: Turkey after the Earthquake. Disasters, 26, 120–139.

Jenerette, G. D., Harlan, S. L., Brazel, A., Jones, N., Larsen, L., & Stefanov, W. L. (2007). Regional relationships between surface temperature, vegetation, and human settlement in a rapidly urbanizing ecosystem. Landscape ecology, 22(3), 353-365.

Jenerette, G. D., Harlan, S. L., Stefanov, W. L., & Martin, C. A. (2011). Ecosystem services and urban heat riskscape moderation: water, green spaces, and social inequality in Phoenix, USA. Ecological applications, 21(7), 2637-2651.

Jones, B., & Baumgartner, F. (2005). The Politics of Attention. How Government Prioritizes Problems. Chicago: Chicago University Press.

Johnson, C., Toly, N., & Schroeder, H. (Eds.). (2015). The urban climate challenge: Rethinking the role of cities in the global climate regime, cities and global governance. Oxon/New York: Routledge, Abingdon.

Kadıkoy Belediyesi. (2016). *Citizens' Participation in the 2015-2019 Strategic Plan of Kadikoy Municipality: All in People's Power, All Discussed and Decided by the People*. Available at: http://www.kadikoy.bel.tr/Documents/file/GeneralContent/Stratejikplan-f54d06ff-ed36-482c-8e9f-b137af23c336.pdf (Accessed 11 March 2019).

Kahan, D. M. (2015). Climate-science communication and the measurement problem. *Political Psychology*, *36*, 1-43.

Kahan, D. M., Braman, D., Gastil, J., Slovic, P., & Mertz, C. K. (2007). Culture and identity-protective cognition: Explaining the White-male effect in risk perception. *Journal of Empirical Legal Studies*, **4**, 465– 505.

Kaldjian P. (2004). İstanbul's bostans: A Millennium of market gardens. *Geographical Review*. 94 (3). 284-304.

Karaman, O. (2013). Urban Renewal in Istanbul: Reconfigured Spaces, Robotic Lives. International Journal of Urban and Regional Research 37:715-33.

Kasperson, R. E. (1992). The Social Amplification of Risk: Progress in Developing an Integrative Framework. In Social Theories of Risk, ed. S. Krimsky and D. Golding, pp. 153–78. Westport, CT: Praeger.

Kates, R. W., Travis, W. R., & Wilbanks, T. J. (2012). Transformational adaptation when incremental adaptations to climate change are insufficient. *Proceedings of the National Academy of Sciences*, *109*(19), 7156-7161.

Kennedy, H., E., Krahn, H., & Krogman, N. T. (2015). Are we counting what counts? A closer look at environmental concern, pro-environmental behaviour, and carbon footprint. *Local Environment*, *20*(2), 220-236.

Kettl, D. F. (2002). Managing indirect government. *The tools of government: A guide to the new governance*, 490-510. In (eds) Elliott, O. V., & Salamon, L. M. *The tools of government: A guide to the new governance*. Oxford University Press.

Khan, J. (2013). What role for network governance in urban low carbon transitions?. *Journal of Cleaner Production*, *50*, 133-139.

Kingdon, J., W. (2011). Agendas, Alternatives, and Public Policy. New York: Longman.

Klinenberg, E. (1999). Denaturalizing disaster: A social autopsy of the 1995 Chicago heat wave. Theory and Society, 28(2), 239-295.

Kollmuss, A., & Agyeman, J. (2002). Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior?. *Environmental education research*, *8*(3), 239-260.

Konisky, D. M., Hughes, L., & Kaylor, C. H. (2016). Extreme weather events and climate change concern. *Climatic change*, *134*(4), 533-547.

Krannich, R. S., & Albrecht, S. L. (1995). Opportunity/Threat Responses to Nuclear Waste Disposal Facilities 1. *Rural Sociology*, *60*(3), 435-453.

Krellenberg, K., Turhan, E. (2017). 'How to respond to climate change at the local level: A guideline for Turkish cities', UFZ Report no.03/2017, Helmholtz Centre for Environmental Research.

Krellenberg, K., Welz, J., Link, F., & Barth, K. (2017). Urban vulnerability and the contribution of socio-environmental fragmentation: Theoretical and methodological pathways. *Progress in Human Geography*, *41*(4), 408-431.

Krellenberg, K., Link, F., Welz, J., Harris, J., Barth, K., & Irarrazaval, F. (2014). Supporting local adaptation: The contribution of socio-environmental fragmentation to urban vulnerability. Applied Geography, 55, 61-70.

Kuokkanen, A., Yazar, M. (2018). Cities in sustainability transition: comparing Helsinki and Istanbul. Sustainability 5:1421

Kuyucu, T., Ünsal, O. (2010). 'Urban transformation' as state -led property transfer: an analysis of two cases of urban renewal in Istanbul. Urban Studies 47:1479– 9.

Larsen, H. N., & Hertwich, E. G. (2009). The case for consumption-based accounting of greenhouse gas emissions to promote local climate action. *Environmental Science & Policy*, *12*(7), 791-798.

Larson, K. L., Hoffman, J., & Ripplinger, J. (2017). Legacy effects and landscape choices in a desert city. Landscape and Urban Planning, 165, 22-29.

Larson, K., York, A., Andrade, R., & Wittlinger, S. (2019). Phoenix Area Social Survey (PASS): 2017.

Lee, T., & Hughes, S. (2017). Perceptions of urban climate hazards and their effects on adaptation agendas. *Mitigation and Adaptation Strategies for Global Change*, *22*(5), 761-776.

Lee, T., & Koski, C. (2015). Multilevel governance and urban climate change mitigation. *Environment and Planning C: Government and Policy*, *33*(6), 1501-1517.

Lee, T. M., Markowitz, E. M., Howe, P. D., Ko, C. Y., & Leiserowitz, A. A. (2015). Predictors of public climate change awareness and risk perception around the world. Nature climate change, 5(11), 1014-1020.

Leiserowitz, A. A. (2005). American risk perceptions: Is climate change dangerous?. *Risk Analysis: An International Journal*, *25*(6), 1433-1442.

Lemos, M.C., Lo, Y.-J., Nelson, D.R., Eakin, H., Bedran-Martins, A.M., 2016. Linking development to climate adaptation: leveraging generic and specific capacities to reduce vulnerability to drought in NE Brazil. Global Environ. Change 39, 170–179.

Li, Y., Johnson, E. J. & Zaval, L. (2011). Local warming: Daily temperature change influences belief in global warming. Psychol. Sci. 22, 454-459.

Long, J., & Rice, J. L. (2020). Climate urbanism: crisis, capitalism, and intervention. *Urban Geography*, 1-7.

Lovell, H. (2009). The role of individuals in policy change: The case of UK low-energy housing. Environment and Planning C: Government and Policy. 27: 491–511.

Madrigano, J., Lane, K., Petrovic, N., Ahmed, M., Blum, M., & Matte, T. (2018). Awareness, risk perception, and protective behaviors for extreme heat and climate change in New York City. International journal of environmental research and public health, 15(7), 1433.

Malka, A., Krosnick, J. A., & Langer, G. (2009). The association of knowledge with concern about global warming: Trusted information sources shape public thinking. *Risk Analysis: An International Journal*, *29*(5), 633-647.

Maricopa County Department of Public Health (MCDPH). (2019). Heat-Associated Deaths in Maricopa County, AZ Final Report for 2017. Pheonix, AZ: Maricopa County Department of Public Health.

Marquart-Pyatt, S. T., McCright, A. M., Dietz, T., & Dunlap, R. E. (2014). Politics eclipses climate extremes for climate change perceptions. *Global environmental change*, *29*, 246-257.

Marshall, N.A., Park, S.E., Adger, W.N., Brown, K., Howden, S.M. (2012). Transformational capacity and the influence of place and identity. Environ. Res. Lett. 7, 034022.

Marshall, M. L. (2004). Examining school climate: Defining factors and educational influences.

Marshall, B. K., Picou, J. S., Formichella, C., & Nicholls, K. (2006). Environmental risk perceptions and the white male effect: Pollution concerns among deep-South coastal residents. *Journal of Applied Sociology*, (2), 31-49.

McCarthy, JF. (2014). Using community led development approaches to address vulnerability after disaster caught in a sad romance. Glob Environ Change, 27: 144-155.

McCarthy, M. P., Best, M. J., & Betts, R. A. (2010). Climate change in cities due to global warming and urban effects. *Geophysical research letters*, *37*(9).

McCright, A. M. (2010). The effects of gender on climate change knowledge and concern in the American public. Population and Environment, 32(1), 66-87.

McCright, AM., Dunlap, RE., Marquart-Pyatt, ST. (2016). Political ideology and views about climate change in the European Union. Environ Polit 25:338–358.

McCright, AM., Dunlap, RE. (2011). Cool dudes: the denial of climate change among conservative white males in the United States. Glob Environ Chang 21:1163–1172.

McFarlane, C. (2011). Assemblage and critical urbanism. *City*, *15*(2), 204-224.

McIlwaine, C. (2009). Civil society. In R. Kitchin, & N. Thrift (Eds.), International encyclopedia of human geography (pp. 136–141). Amsterdam, The Netherlands: Elsevier.

Markus, M., & Savini, F. (2016). The implementation deficits of adaptation and mitigation: Green buildings and water security in Amsterdam and Boston. Planning Theory & Practice, 17(4), 497–515.

Mintrom, M., & Norman, P. (2009). Policy entrepreneurship and policy change. *Policy Studies Journal*, *37*(4), 649-667.

Mintrom, M. & Luetjens, J. (2017). Policy entrepreneurs and problem framing: The case of climate change. Environment and Planning C: Politics and Space 35(8): 1362–1377.

Moloney, S., & Fünfgeld, H. (2015). Emergent processes of adaptive capacity building: Local government climate change alliances and networks in Melbourne. *Urban Climate*, *14*, 30-40.

Moser, S. C., & Ekstrom, J. A. (2010). A framework to diagnose barriers to climate change adaptation. *Proceedings of the national academy of sciences*, *107*(51), 22026-22031.

Nakamura, K., & Hayashi, Y. (2013). Strategies and instruments for low-carbon urban transport: An international review on trends and effects. *Transport Policy*, *29*, 264-274.

Neebe, M., & Reusswig, F. (2012). Chapter 4 Climate Protection and Civil Society: Does Effective Local Climate Policy Need the Participation and Engagement of Citizens? A Comparison Between the Cities of Potsdam and Muenster. In *Urban Areas and Global Climate Change* (pp. 75-104). Emerald Group Publishing Limited.

Nelson, R., Kokic, P., Crimp, S., Martin, P., Meinke, H., Howden, S. M., ... & Nidumolu, U. (2010). The vulnerability of Australian rural communities to climate variability and change: Part II—Integrating impacts with adaptive capacity. Environmental Science & Policy, 13(1), 18-27.

Niemeier, D., Grattet, R., & Beamish, T. (2015). "Blueprinting" and climate change: Regional governance and civic participation in land use and transportation

planning. *Environment and Planning C: Government and Policy*, *33*(6), 1600-1617.

NOAA National Centers for Environmental information, Climate at a Glance: City Time Series, published March 2020, retrieved on March 21, 2020 from https://www.ncdc.noaa.gov/cag/

North DC (1990) Institutions, institutional change and economic performance. Cambridge University Press, Cambridge.

O'BRIEN, K. A. R. E. N., Eriksen, S., Nygaard, L. P., & Schjolden, A. N. E. (2007). Why different interpretations of vulnerability matter in climate change discourses. Climate policy, 7(1), 73-88.

OECD. (2018). *Gross domestic product (GDP) (indicator).* Available at:. https://data.oecd.org/gdp/gross-domestic-product-gdp.htm. (Accessed 28 January 2019).

Ogunbode, C. A., Liu, Y., & Tausch, N. (2017). The moderating role of political affiliation in the link between flooding experience and preparedness to reduce energy use. *Climatic Change*, *145*(3-4), 445-458.

Osberghaus, D., Dannenberg, A., Mennel, T., Sturm, B. (2010). The role of the government in adaptation to climate change. Environ Plan C Gov Policy 28:834–850.

Ostrom, E. (2014). A polycentric approach for coping with climate change. *Annals of Economics and Finance* 15(1): 97–134.

Ostrom, E. (2010). Polycentric systems for coping with collective action and global environmental change. *Global environmental change*, *20*(4), 550-557.

Özkaynak, B., Aydın, C. İ., Ertör-Akyazı, P., & Ertör, I. (2015). The Gezi Park resistance from an environmental justice and social metabolism perspective. *Capitalism Nature Socialism*, *26*(1), 99-114.

Paavola, J. (2008). Science and social justice in the governance of adaptation to climate change. Environ Polit 17(4):644–659.

Palm, R., Lewis, G. B., & Feng, B. (2017). What causes people to change their opinion about climate change?. *Annals of the American Association of Geographers*, *107*(4), 883-896.

Paavola, J., N, Adger. (2006). Fair adaptation to climate change. Ecol. Econ. 56 (4), 594–609

Pearsall, H. (2010). From brown to green? Assessing social vulnerability to environmental gentrification in New York City. Environment and Planning C: Government and Policy, 28(5), 872-886.

Pearson, A. R., Ballew, M. T., Naiman, S., & Schuldt, J. P. (2017). Race, class, gender and climate change communication. In *Oxford research encyclopedia of climate science*.

Pelling, M. (2003). The vulnerability of cities: natural disasters and social resilience. Earthscan.

Pelling, M., & High, C. (2005). Understanding adaptation: what can social capital offer assessments of adaptive capacity?. Global environmental change, 15(4), 308-319.

Petitti, D. B., Hondula, D. M., Yang, S., Harlan, S. L., & Chowell, G. (2016). Multiple trigger points for quantifying heat-health impacts: new evidence from a hot climate. *Environmental health perspectives*, *124*(2), 176-183.

Poortinga, W., & Pidgeon, N. (2003). Public perceptions of risk, science and governance. *Centre for Environmental Risk, University of East Anglia, Norwich, UK*.

Pressman, J. L., & Wildavsky, A. (1984). Implementation: How great expectations in Washington are dashed in Oakland; Or, why it's amazing that federal programs work at all, this being a saga of the Economic Development Administration as told by two sympathetic observers who seek to build morals on a foundation. Univ of California Press.

Putnam, H., Hondula, D. M., Urban, A., Berisha, V., Iñiguez, P., & Roach, M. (2018). It's not the heat, it's the vulnerability: attribution of the 2016 spike in heat-associated deaths in Maricopa County, Arizona. *Environmental research letters*, *13*(9), 094022.

R Core Team. (2013). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, AU.

Rabe, B. (2004). State House and Greenhouse: The Emerging Politics of American Climate Change Policy. Washington, DC: Brookings Press.

Reinhart, R. J. (2018). Global warming age gap: younger Americans most worried. Politics, 11.

Revill, C., & Harris, V. (2017). *2020: The Climate Turning Point*.

Rhodes, R. A. W. (1996). The new governance: governing without government. *Political studies*, *44*(4), 652-667.

Rice, J.L., Cohen, D.A., Long, J., Jurjevich, J.R., 2019. Contradictions of the Climate-Friendly City: New Perspectives on Eco-Gentrification and Housing Justice. Int. J. Urban Reg. Res.

Ritchie, H., & Roser, M. (2018). Urbanization. Our world in data.

Romero Lankao, P. (2010). Water in Mexico City: what will climate change bring to its history of water-related hazards and vulnerabilities? Environment and Urbanization 22 (1):157-178.

Rosenzweig, C. Solecki, W. Hammer, AS. Mehrotra, S. (2010). Cities lead the way in climate–change action, Nature. 7318, pp. 909-11.

Rudman, L. A., McLean, M. C., & Bunzl, M. (2013). When truth is personally inconvenient, attitudes change: the impact of extreme weather on implicit support for green politicians and explicit climate-change beliefs. Psychological science, 24(11), 2290-2296.

Ruiz, I., Faria, S. H., & Neumann, M. B. (2020). Climate change perception: Driving forces and their interactions. *Environmental Science & Policy*, *108*, 112-120.

Saad, L. (2015). US views on climate change stable after extreme winter. *POLITICS*.

Sassen, S. (1996). Rebuilding the global city: economy, ethnicity and space. In Re-presenting the city (pp. 23-42). Palgrave, London.

Satterfield, T. A., Mertz, C. K., & Slovic, P. (2004). Discrimination, vulnerability, and justice in the face of risk. *Risk analysis: An international journal*, *24*(1), 115-129.

Scannell, L., & Gifford, R. (2010). The relations between natural and civic place attachment and pro-environmental behavior. *Journal of environmental psychology*, *30*(3), 289-297.

Schneider, M., & Teske, P. (1992). Toward a theory of the political entrepreneur: evidence from local government. *American Political Science Review*, *86*(3), 737-747.

Scholten, P. W. (2013). Agenda dynamics and the multi-level governance of intractable policy controversies: the case of migrant integration policies in the Netherlands. *Policy Sciences*, *46*(3), 217-236.

Schlosberg, D. (2012). Climate justice and capabilities: A framework for adaptation policy. *Ethics & International Affairs*, *26*(4), 445-461.

Schlosberg, D,, Collins, LB., Niemeyer, S., (2017). Adaptation policy and community discourse: risk, vulnerability, and just transformation. Environ. Polit. 26 (3), 413–437

Schreurs, M. A. (2008). From the bottom up: local and subnational climate change politics. *The Journal of Environment & Development*, *17*(4), 343-355.

Schroeder, H., Burch, S., & Rayner, S. (2013). Novel multisector networks and entrepreneurship in urban climate governance. *Environment and Planning C: Government and Policy*, *31*(5), 761-768.

Semenza, J. C., Rubin, C. H., Falter, K. H., Selanikio, J. D., Flanders, W. D., Howe, H. L., & Wilhelm, J. L. (1996). Heat-related deaths during the July 1995 heat wave in Chicago. New England journal of medicine, 335(2), 84-90.

Seto, K. C., Güneralp, B., & Hutyra, L. R. (2012). Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools. *Proceedings of the National Academy of Sciences*, *109*(40), 16083-16088.

Sheng, N., & Tang, U. W. (2016). The first official city ranking by air quality in China—a review and analysis. *Cities*, *51*, 139-149.

Sheridan, S. C., & Allen, M. J. (2018). Temporal trends in human vulnerability to excessive heat. Environmental research letters, 13(4), 043001.

Shi, L., Chu, E., Anguelovski, I., Aylett, A., Debats, J., Goh, K., ... & Roberts, J. T. (2016). Roadmap towards justice in urban climate adaptation research. Nature Climate Change, 6(2), 131-137.

Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. Global environmental change, 16(3), 282-292.

Spence, A., Poortinga, W., Butler, C., & Pidgeon, N. F. (2011). Perceptions of climate change and willingness to save energy related to flood experience. Nature climate change, 1(1), 46.

Stocker, TF., Qin, D., Plattner, G-K. IPCC. (2012). Climate Change 2013: the Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate. Cambridge University Press, Cambridge.

Şahin, S. Z. (2019). The urbanization policy of Turkey: an uneasy symbiosis of unimplemented policy with centralized pragmatic interventions. *Turkish Studies*, *20*(4), 599-618.

Tan, Evrim. "Quo vadis? The local government in Turkey after public management reforms." *International Review of Administrative Sciences* 86, no. 1 (2020): 115-133.

Tansel, C. B. (2019). Reproducing authoritarian neoliberalism in Turkey: Urban governance and state restructuring in the shadow of executive centralization. *Globalizations*, *16*(3), 320-335.

Taylor, M. (2014). *The political ecology of climate change adaptation: Livelihoods, agrarian change and the conflicts of development*. Routledge.

Team, R. C. (2013). R: A language and environment for statistical computing.

Termeer C, Dewulf A, van Rijswick H, et al. (2011). The regional governance of climate adaptation: A framework for developing legitimate, effective, and resilient governance arrangements. *Climate Law* 2(2): 159–179.

Thaler, T., Zischg, A., Keiler, M., & Fuchs, S. (2018). Allocation of risk and benefits—distributional justices in mountain hazard management. *Regional environmental change*, *18*(2), 353-365.

Timmermans, JS, van der Heiden, S, Born, MP. (2013). Policy entrepreneurs in sustainability transitions: Their personality and leadership profiles assessed. Environmental Innovation and Societal Transitions 13: 96–108.

Torenvlied, R., & Akkerman, A. (2004). Theory of 'Soft' Policy Implementation in Multilevel Systems with an Application to Social Partnership in the Netherlands. Acta Politica, 39, 31–58.

Toros, H., Abbasnia, M., Sagdic, M., & Tayanç, M. (2017). Long-term variations of temperature and precipitation in the megacity of Istanbul for the development of adaptation strategies to climate change. *Advances in Meteorology*, *2017*.

Turhan, E., Cerit Mazlum, S., Şahin, Ü., Şorman, A. H., & Cem Gündoğan, A. (2016). Beyond special circumstances: climate change policy in Turkey 1992–2015. *Wiley Interdisciplinary Reviews: Climate Change*, *7*(3), 448-460.

Turner, B. L., Kasperson, R. E., Matson, P. A., McCarthy, J. J., Corell, R. W., Christensen, L., ... & Polsky, C. (2003). A framework for vulnerability analysis in sustainability science. Proceedings of the national academy of sciences, 100(14), 8074-8079.

Türkün, A. (2011). Urban regeneration and hegemonic power relationships. *International planning studies*, *16*(1), 61-72.

Tsebelis, G. (1995). Decision making in political systems: Veto players in presidentialism, parliamentarism, multicameralism and multipartyism. British journal of political science, 25(3), 289-325.

Turk Stat (Turkish Statistical Institute) (2016) Address Based Population Registration System Results. http://www.turkstat.gov.tr/PreTablo.do?alt_id=1059. Accessed 18 January 2019

Ugur, M., & Yankaya, D. (2008). Policy entrepreneurship, policy opportunism, and EU conditionality: The AKP and TÜSİAD experience in Turkey. *Governance*, *21*(4), 581-601.

UNFCC, C. (2015). Paris agreement. FCCCC/CP/2015/L. 9/Rev. 1.

United Nations Framework Convention on Climate Change (2015). INDC submission. Retrieved from http://unfccc.int/focus/indc_portal/items/8766.php

UN. (2014). *The United Nations world water development report. Water and energy*Vol. 1. New York: United Nations Development Programme.

Ünal, B. (2014). Sustainable Development of Istanbul Built EnvironmeVan der Heijden, J., Luckmann, O., & Cherkasheva, A. (2020). Urban climate governance in Russia: Insights from Moscow and St. Petersburg. *Journal of Urban Affairs*, *42*(7), 1047-1062.

Verbeke, P., Fonager, J., Clark, BFC., Rattan, SIS. (2001). Heat shock response and ageing: mechanisms and applications. Cell Biol Int 25(9):845–857.

Walker, G., & Burningham, K. (2011). Flood risk, vulnerability and environmental justice: evidence and evaluation of inequality in a UK context. *Critical social policy*, *31*(2), 216-240.

Wang, G. R. (1986). A Cramer rule for minimum-norm (T) least-squares (S) solution of inconsistent linear equations. *Linear algebra and its applications*, *74*, 213-218.

Waters, J., & Adger, W. N. (2017). Spatial, network and temporal dimensions of the determinants of adaptive capacity in poor urban areas. *Global Environmental Change*, *46*, 42-49.

Weber, E. U., & Stern, P. C. (2011). Public understanding of climate change in the United States. American Psychologist, 66, 315–328.

Westman, L. K., Broto, V. C., & Huang, P. (2019). Revisiting multi-level governance theory: Politics and innovation in the urban climate transition in Rizhao, China. *Political Geography*, *70*, 14-23.

White C., Shopov A., & Casson A. (2015). Heritage under threat: saving the ancient gardens of Istanbul, Turkey. *The SAA Archaeological Record*. 15 (1), 7-9.

Whitmarsh, L. (2009). What's in a name? Commonalities and differences in public understanding of "climate change" and "global warming". Public understanding of science, 18(4), 401-420.

Wilhelmi, O. V., & Hayden, M. H. (2010). Connecting people and place: a new framework for reducing urban vulnerability to extreme heat. Environmental Research Letters, 5(1), 014021.

Wolf, J., Adger, W. N., Lorenzoni, I., Abrahamson, V., & Raine, R. (2010). Social capital, individual responses to heat waves and climate change adaptation: An empirical study of two UK cities. Global Environmental Change, 20(1), 44-52.

Yazar, M., York, A., & Kyriakopoulos, G. (2021). Heat exposure and the climate change beliefs in a Desert City: The case of Phoenix metropolitan area. *Urban Climate*, *36*, 100769.

Yazar, M., Hestad, D., Mangalagiu, D., Saysel, A. K., Ma, Y., & Thornton, T. F. (2020). From urban sustainability transformations to green gentrification: urban renewal in Gaziosmanpaşa, Istanbul. *Climatic Change*, *160*(4), 637-653.

Yazar, M., Hestad, D., Mangalagiu, D., Ma, Y., Thornton, T. F., Saysel, A. K., & Zhu, D. (2020b). Enabling environments for regime destabilization towards sustainable urban transitions in megacities: comparing Shanghai and Istanbul. *Climatic Change*, 1-26.

Young, I. M. (2011). *Justice and the Politics of Difference*. Princeton University Press.

York, A., Tuccillo, J., Boone, C., Bolin, B., Gentile, L., Schoon, B., & Kane, K. (2014). Zoning and land use: A tale of incompatibility and environmental injustice in early Phoenix. *Journal of Urban Affairs*, *36*(5), 833-853.

York, Abigail M. and Boone, Christopher G. (2018). Inventing Phoenix: Land use, politics, and environmental justice. Pp. 161-180 in *The American Environment Revisited*. Eds. Geoffrey L. Buckley and Yolanda Youngs. Lanham: Rowman and Littlefield.

Zahariadis, N. H. (2016). Handbook of Public Policy Agenda Setting. Cheltenham, UK and Northampton, MA: Edward Elgar.

Zanocco, C., Boudet, H., Nilson, R., Satein, H., Whitley, H., & Flora, J. (2018). Place, proximity, and perceived harm: extreme weather events and views about climate change. *Climatic Change*, *149*(3-4), 349-365.

Zaval, L., Keenan, E. A., Johnson, E. J., & Weber, E. U. (2014). How warm days increase belief in global warming. Nature Climate Change, 4(2), 143-147.

Zografos, C., Anguelovski, I. and Grigorova, M. (2016). When exposure to climate change is not enough: Exploring heatwave adaptive capacity of a multi-ethnic, low-income urban community in Australia. *Urban Climate*, *17*, pp.248-26.

Żuk, P., & Szulecki, K. (2020). Unpacking the right-populist threat to climate action: Poland's pro-governmental media on energy transition and climate change. *Energy Research & Social Science*, *66*, 101485.

APPENDIX A

CO-AUTHORS PERMISSION

School of Human Evolution and Social Change
Arizona State University

February 3, 2021

Graduate College

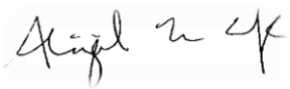
Arizona State

University

Dear Graduate College,

Regarding candidate Mahir Yazar's Chapter 3, which is a preprint version of a co-authored paper published in *Urban Climate*, Mahir Yazar is the corresponding and first author; I consent my permission as a co-author of the manuscript for Yazar's inclusion in his dissertation.

Sincerely,



Abigail York

Associate Professor of Governance and Public Policy

Director of Graduate Studies, School of Human Evolution and Social Change,

Co-Director Earth System Science for the Anthropocene, Arizona State University

Senior Research Fellow Earth System Governance

External Faculty Associate Ostrom Workshop, Indiana University

School of Human Evolution and Social Change
An academic unit of The College of Liberal Arts and Sciences
P.O. Box 872402 Tempe, AZ 85287-2402
p: 480-965-6215 **f:** 480-965-7671 **email:** shesc@asu.edu **web:** shesc.asu.edu

February 3, 2021

Graduate College
Arizona State
University

Dear Graduate College,

Regarding candidate Mahir Yazar's Chapter 3, which is a preprint version of a co-authored paper published in *Urban Climate,* Mahir Yazar is the corresponding and first author; I consent my permission as a co-author of the manuscript for Yazar's inclusion in his dissertation.

Sincerely,

Georgios S. Kyriakopoulos, PhD

APPENDIX B

DESCRIPTION OF INTERVIEWEE'S SECTORS AND POSITIONS

Identified Codes for the Interviewees	Sectors	Positions
NG1	National government	Officer, the Ministry of Energy and Natural Resources
NG2	National government	Officer, the Ministry of Energy and Natural Resources
NG3	National government	Officer, the Ministry of Environment and Urbanization
LG1	Local government	Environmental Engineer, Istanbul Metropolitan Municipality
LG2	Local government	Environmental Engineer, Istanbul Metropolitan Municipality
LG3	Local government	Environmental Engineer, Istanbul Metropolitan Municipality
LG4	Local government	Urban Planner, Istanbul Metropolitan Municipality
LG5	Local government	Urban Planner, Istanbul Metropolitan Municipality
LG6	Local government	Urban Planner, Istanbul Metropolitan Municipality
LG7	Local government	Urban Planner, Istanbul Metropolitan Municipality
U1	Unions	Urban Planner
U2	Unions	Urban Planner
C1	CSOs	Founder, urban planning community organization
C2	CSOs	Staff member
N1	NGOs	Project Manager
N2	NGOs	Founder/social entrepreneur

G1	Global networks	International Consultant
R1	Regional networks	Project Coordinator
A1	Academia	Faculty Member

APPENDIX C

CRAMMER'S V FOR PASS-2011 DATA

Variable Pair	Crammer's V
[1] "AGE_perc" "KIDSUnder6"	0.3613588
[1] "AGE_perc" "Q100RECODE (Employment)"	0.2243522
[1] "AGE_perc" "Q104(Education)"	0.05664526
[1] "AGE_perc" "Q109 (Political Ideology)"	0.008831151
[1] "AGE_perc" "RACENET2"	0.1929365
[1] "KIDSUnder6" "Q109 (Political Ideology)"	0.02859964
[1] "KIDSUnder6" "RACENET2"	0.1554441
[1] "MODE" "KIDSUnder6"	0.1091982
[1] "MODE" "Q100RECODE (Employment)"	0.1810928
[1] "MODE" "AGE_perc"	0.1200509
[1] "MODE" "RACENET2"	0.2297096
[1] "MODE" "Q104 (Education)"	0.2006067
[1] "MODE" "Q109 (Political Ideology)"	0.06302904
[1] "MODE" "Q111 (Gender)"	0.01152775
[1] "Q100RECODE (Employement)" "KIDSUnder6"	0.03537825
[1] "Q100RECODE (Employment)" "Q109 (Political Ideology)"	0.05180808
[1] "Q100RECODE (Employment)" "Q104 (Education)"	0.1374733
[1] "Q100RECODE (Employment)" "RACENET2"	0.03324067
[1] "Q104 (Education)" "KIDSUnder6"	0.05144223
[1] "Q104 (Education)" "RACENET2"	0.1854828
[1] "Q104 (Education)" "Q109 (Political Ideology)"	0.03706273
[1] "Q111 (Gender)" "KIDSUnder6"	0.08397965
[1] "Q111 (Gender)" "Q100RECODE (Employment)"	0.1157468
[1] "Q111 (Gender)" "AGE_perc"	0.02956163
[1] "Q111 (Gender)" "RACENET2"	0.02738949
[1] "Q111 (Gender)" "Q104 (Education)"	0.04352617
[1] "Q111 (Gender)" "Q109 (Political Ideology)"	0.042356
[1] "Q239 (Personal illness due to heat)" "KIDSUnder6"	0.05334975
[1] "Q239 (Personal illness due to heat)" "Q100RECODE (Employment)"	0.01917542
[1] "Q239 (Personal illness due to heat)" "AGE_perc"	0.1042329
[1] "Q239 (Personal illness due to heat)" "RACENET2"	0.1115937
[1] "Q239 (Personal illness due to heat)" "Q242 (Called 911 or visited hospital due to heat)"	0.08248906
[1] "Q239 (Personal illness due to heat)" "MODE"	0.06214737
[1] "Q239 (Personal illness due to heat)" "Q104 (Education)"	0.03230842
[1] "Q239 (Personal illness due to heat)" "Q109 (Political Ideology)"	0.0123502
[1] "Q239 (Personal illness due to heat)" "Q240 (Others have illness due to heat)"	0.3898708
[1] "Q239 (Personall illness due to heat)" "Q111 (Gender)"	0.02600456
[1] "Q240 (Others have illness due to heat)" "KIDSUnder6"	0.0410279
[1] "Q240 (Others have illness due to heat)" "Q100RECODE (Employment)"	0.03554967

[1] "Q240 (Others have illness due to heat)" "AGE_perc" 0.06463527
[1] "Q240 (Others have illness due to heat)" "RACENET2" 0.0718473
[1] "Q240 (Others have illness due to heat)" "MODE" 0.02360175
[1] "Q240 (Others have illness due to heat)" "Q104 (Education)" 0.003197032
[1] "Q240 (Others have illness due to heat)" "Q109 (Political Ideology)" 0.007988256
[1] "Q240 (Others have illness due to heat)" "Q111 (Gender)" 0.04906772
[1] "Q240 (Others have illness due to heat)" "Q242 (Called 911 or visited hospital due to heat)" 0.04496726
[1] "Q242 (Called 911 or visited hospital due to heat)" "KIDSUnder6" 0.07927083
[1] "Q242 (Called 911 or visited hospital due to heat)" "Q100RECODE" 0.02669648
[1] "Q242 (Called 911 or visited hospital due to heat)" "AGE_perc" 0.01509293
[1] "Q242 (Called 911 or visited hospital due to heat)" "RACENET2" 0.05204049
[1] "Q242 (Called 911 or visited hospital due to heat)" "MODE" 0.1007245
[1] "Q242 (Called 911 or visited hospital due to heat)" "Q104 (Education)" 0.03572735
[1] "Q242 (Called 911 or visited hospital due to heat)" "Q109 (Political Ideology)" 0.01397728
[1] "Q242 (Called 911 or visited hospital due to heat)" "Q111 (Gender)" 0.002647977
[1] "RACENET2" "Q109 (Political Ideology)" 0.01767036

APPENDIX D

CRAMMER'S V FOR PASS-2017 DATA

Variable Pair	Crammer's V
[1] "AGE_Q50" "q62" (income)	0.1067696
[1] "AGE_Q50" "q57" (employment)	0.1366696
[1] "AGE_Q50" "q63" (education)	0.03392151
[1] "AGE_Q50" "q64" (gender)	0.03607646
[1] "AGE_Q50" "ethnicity"	0.2532516
[1] "AGE_Q50" "q9a" (green space)	0.06247093
[1] "AGE_Q50" "q11d" (attachment)	0.1268784
[1] "AGE_Q50" "q12a" (social capital)	0.07155929
[1] "AGE_Q50" "q21" (heat exposure)	0.1019696
[1] "AGE_Q50" "q67" (political beliefs)	0.07693319
[1] "q62" (income) "q57" (employment)	0.1326538
[1] "q62" (income) "q63" (education)	0.2189903
[1] "q62" (income) "q64" (gender)	0.09450023
[1] "q62" (income) "ethnicity"	0.2839928
[1] "q62" (income) "q9a" (green space)	0.08305438
[1] "q62" (income) "q11d" (attachment)	0.04017212
[1] "q62" (income) "q12a" (social capital)	0.001463309
[1] "q62" (income) "q21" (heat exposure)	0.1028497
[1] "q62" (income) "q67" (political beliefs)	0.02410297
[1] "q57" (employment) "q63" (education)	0.08300463
[1] "q57" "q64" (gender)	0.1168141
[1] "q57" "ethnicity"	0.003425748
[1] "q57" "q9a" (green space)	0.049692
[1] "q57" "q11d" (attachment)	0.03593813
[1] "q57" "q12a" (social capital)	0.02549732
[1] "q57" "q21" (heat exposure)	0.08979408
[1] "q57" "q67" (political beliefs)	0.06496219
[1] "q63" (education) "q64" (gender)	0.1067797
[1] "q63" "ethnicity"	0.2204635
[1] "q63" "q9a" (green space)	0.0820594
[1] "q63" "q11d" (attachment)	0.04332899
[1] "q63" "q12a" (social capital)	0.01216824
[1] "q63" "q21" (heat exposure)	0.07382634
[1] "q63" "q67" (political beliefs)	0.08306929
[1] "q64" (gender) "ethnicity"	0.09112452
[1] "q64" "q9a" (green space)	0.02430963
[1] "q64" "q11d" (attachment)	0.01065507
[1] "q64" "q12a" (social capital)	0.03836529
[1] "q64" "q21" (heat exposure)	0.06460816
[1] "q64" "q67" (political beliefs)	0.03099853
[1] "ethnicity" "q9a" (green space)	0.09526277
[1] "ethnicity" "q11d" (attachment)	0.09509348
[1] "ethnicity" "q12a" (social capital)	0.05443628
[1] "ethnicity" "q21" (heat exposure)	0.06028975

[1] "ethnicity" "q67" (political beliefs)	0.02659677
[1] "q9a" "q11d" (attachment)	0.144353
[1] "q9a" "q12a" (social capital)	0.1088931
[1] "q9a" "q21" (exposure)	0.04181178
[1] "q9a" "q67" (political beliefs)	0.009676895
[1] "q11d" (attachment) "q12a" (social capital)	0.2749688
[1] "q11d" "q21" (heat exposure)	0.002124335
[1] "q11d" "q67" (political beliefs)	0.02915709
[1] "q12a" "q21" (heat exposure)	0.001295999
[1] "q12a" "q67" (political beliefs)	0.008222283
[1] "q21" (heat exposure) "q67" (political beliefs)	0.05667454

APPENDIX E

INSTITUTIONAL REVIEW BOARD (IRB) APPROVAL DOCUMENTS

EXEMPTION GRANTED

Abigail York
CLAS-SS: Human Evolution and Social Change, School of (SHESC)
480/727-6889
Abigail.York@asu.edu

Dear Abigail York:

On 6/5/2019 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Cities in multi-level urban governance perspectives: Comparing Istanbul and Phoenix
Investigator:	Abigail York
IRB ID:	STUDY00010043
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	• recruitment script Graduate Researcher.pdf, Category: Recruitment Materials; • Protocol, Category: IRB Protocol; • Interview Questions Translated, Category: Translations; • Recruitment Script Translated, Category: Translations; • Consent Document Social Behavioral, Category: Consent Form; • Interview Questions, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • Recruitment Script Translated PI, Category: Translations; • Consent Form Translated, Category: Translations; • recruitment script PI.pdf, Category: Recruitment Materials; • Translation Certificate, Category: Translations;

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (2) Tests, surveys, interviews, or observation on 6/5/2019.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator

cc: Mahir Yazar
Mahir Yazar
Abigail York