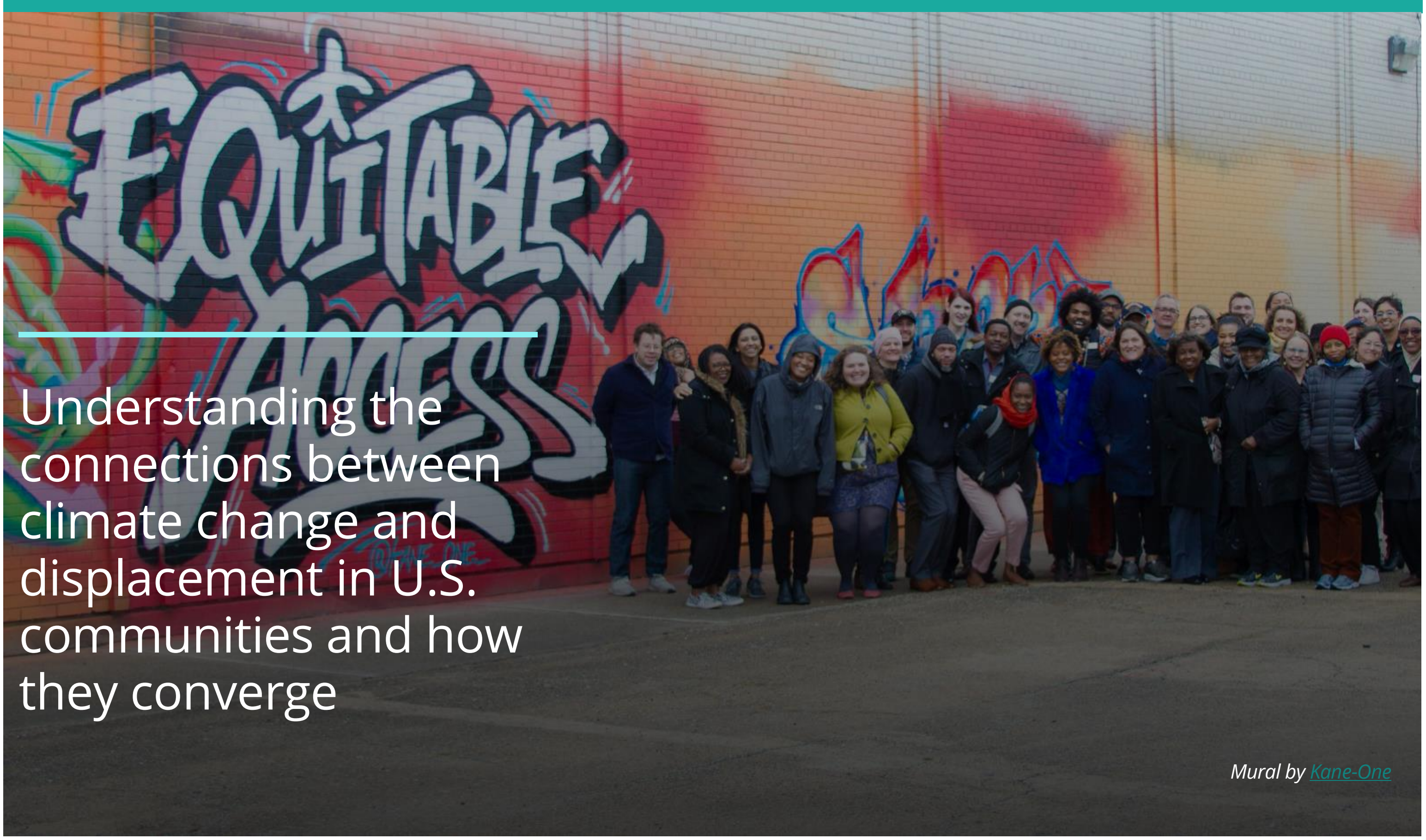
APRIL 2020

SPARCC

Climate Change and Displacement in the U.S. – A Review of the Literature



Understanding the connections between climate change and displacement in U.S. communities and how they converge

Mural by Kane-One

UC BERKELEY CENTER FOR COMMUNITY INNOVATION

SPARCC

URBAN DISPLACEMENT PROJECT
UNIVERSITY OF CALIFORNIA BERKELEY

Acknowledgments

Authors
Anna Cash
Karen Chapple
Nicholas Depsky
Renee Roy Elias
Melisa Krnjaic
Shazia Manji
Honora Montano

More Acknowledgements
The Urban Displacement Project team would like to thank:

- Miriam Zuk, Non-Resident Senior Fellow and Co-Founder of the Urban Displacement Project, for conceptualizing this project and reviewing early drafts,
- Naomi Cytron of the Federal Reserve Bank of San Francisco, Marissa Ramirez of the Natural Resources Defense Council, and Lara Hansen and Rachel Gregg of EcoAdapt for their guidance and feedback on this paper,
- Danna Walker of Natural Resources Defense Council for your copy-editing,

This report was funded by the Strong, Prosperous, and Resilient Communities Challenge (SPARCC); the views contained herein are those of the authors and do not necessarily reflect those of SPARCC.

TABLE OF CONTENTS

Climate Change and Displacement: A Review of the Literature

Centuries of burning fossil fuels and emitting greenhouse gases into the Earth's atmosphere have indelibly altered the course of our planet's global climate system. There is broad scientific consensus that our shared future is one of higher average temperatures, rising sea levels, and more frequent and severe climatic shocks. One widespread consequence of worsening climate conditions is the displacement of people from their homes and communities. The mechanisms by which climate change is creating or increasing displacement pressures are multiple and complex, and tend to fall disproportionately on socially, economically, and politically vulnerable communities. These pressures can include direct displacement due to property damage related to hurricanes or wildfires, the rising costs of utility bills and insurance premiums, and the risk that mitigation and adaptation investments may increase property values and further trends of gentrification and displacement in neighborhoods.

This literature review seeks to elucidate the relationship between climate change and displacement in the context of the United States. We synthesize findings from 380 studies, reports, and articles published from the 1970s onward to better understand the various ways in which climate change and displacement are linked, and to be a resource for researchers, policymakers, and practitioners working on these intersecting issues. This report is oriented around three guiding questions:

1. How are climate shocks and stressors related to displacement?
2. What are the unintended consequences of climate mitigation and adaptation (M/A) strategies, such as generating rising housing costs and associated displacement pressures?
3. How can current anti-displacement strategies better consider and protect vulnerable communities against climate hazards?

Key findings on the relationship between climate change and displacement, organized by guiding question, are summarized below.

QUESTION 1: HOW ARE CLIMATE SHOCKS AND STRESSORS RELATED TO DISPLACEMENT?

Across the many climate hazards that we explored, evidence from the literature shows that there are significant inequities between different socioeconomic and racial groups in vulnerability to the impacts of climate shocks and stressors. Low-income groups and communities of color, particularly African American and Hispanic communities, are often more likely to experience financial hardships related to climate hazards and physical displacement in the wake of extreme weather events. These inequities play out in varying degrees across every stage of a climate event, including in exposure to physical hazards – such as proximity to the floodplains or high fire risk areas, quality and resilience of housing and physical infrastructure, and the economic and political resources available to rebuild and influence recovery processes in the wake of climate-driven disasters.

Even in cases where the literature does not provide evidence of actual displacement, it is important to note that these same communities are still more likely to experience increased burdens, financial and otherwise, as a result of increased exposure to climate hazards and/or limited economic resources. These burdens can include, for example, adverse health impacts due to higher temperatures and air pollutant levels for low-income communities of color living in urban areas, and economic distress related to droughts and crop-yields for farmworker communities. We summarize key findings by climate hazard below.

STORMS AND SEVERE WEATHER

- Most types of storms and severe weather in the U.S. are projected to increase in both intensity and frequency.
- Vulnerability to these events is pronounced among renters and in low-income communities of color, where people are more likely to live in substandard housing and in close proximity to floodplains, and are more likely to face housing challenges when storms reduce the number of housing units available.
- Both immediate and long-term displacement from such events is disproportionately common for low-income communities of color in many regions of the U.S.

- Recovery from major storms is a challenge for low-income residents, with federal assistance difficult to access and often focused on restoring assets for wealthier residents.

WILDFIRES

- The frequency and severity of major wildfires in the U.S. (primarily in the western states) is projected to worsen. With increasing residential development in high fire risk areas, it is likely we will see increases in displacement from wildfire-related property damage.
- In some regions, communities with higher levels of social vulnerability are disproportionately exposed to fire risk and more likely to experience fire-related displacement.
- There are stark inequities in the post-fire recovery process, with renters and low-income individuals facing the biggest barriers for rebuilding and returning home, which may lead to residential displacement.
- Immediate and permanent displacement from these hazards occurs as a result of both direct drivers (e.g. danger to or destruction of property) and indirect drivers (e.g. increased insurance premiums or reduced housing availability).

SEA-LEVEL RISE AND NUISANCE FLOODING

- Sea-level rise (SLR) could result in an increase of more than 4 feet in global average sea-level by 2100; many coastal communities will be forced to relocate as SLR encroaches on their existing neighborhoods.
- Existing federal flood maps are outdated and do not adequately account for SLR projections, which means that many communities are living in areas at risk of flooding, without flood insurance protections.
- Tidal flooding caused by SLR has increased in frequency and extent across many coastal U.S. cities, causing repeat floods and costly property damage, which may force residents to relocate.
- In many regions, low-income communities of color are disproportionately vulnerable to SLR, and will likely be disproportionately displaced as a result.
- Like wildfires, SLR-induced displacement can occur as a result of both direct and indirect drivers.

EXTREME HEAT

- Extreme heat waves are becoming hotter, longer, and more frequent globally. This trend exacerbates the health and cost pressures associated with living in urban heat islands in many regions.
- Urban heat islands also tend to be worse in low-income communities of color due to disparities in landscaping and urban design.
- Displacement resulting from extreme heat is primarily due to indirect forces such as adverse health impacts or increased utility bills.
- Low-income residents and communities of color are among the most vulnerable to heat waves due to relative lack of access to air conditioning or inability to pay increased utility bills associated with its use.

DROUGHT

- Droughts can have significant impacts on farmworker livelihoods, and lead to farmworkers' displacement by reducing economic opportunity.
- Droughts can have long-term effects on farmer communities, though droughts do not necessarily lead to farmer displacement in the U.S.
- Increased displacement of residents in neighboring countries due to drought events and their impacts on subsistence agricultural communities abroad may occur in the future.

QUESTION 2: WHAT ARE THE UNINTENDED CONSEQUENCES OF CLIMATE MITIGATION AND ADAPTATION (M/A) STRATEGIES, SUCH AS GENERATING RISING HOUSING COSTS AND ASSOCIATED DISPLACEMENT PRESSURES?

Our exploration of the unintended consequences of climate mitigation and adaptation strategies shows that several commonly used policy strategies aimed at reducing greenhouse gas emissions and increasing resilience at the local level can potentially accelerate processes of gentrification and displacement of low-income residents in certain neighborhoods, under certain conditions. This is due to the fact that many of these investments – such as transit-oriented development and increased park and green space – can result in higher property values in surrounding communities. Much of the literature reviewed for this section focuses on the impact of climate change M/A policies on property and housing values, without explicitly naming or measuring displacement or gentrification. Therefore, the discussion presented in this section is at times predicated on the assumption that higher housing prices commonly contribute to the displacement of economically vulnerable residents. Additionally, it is important to note that much of the literature reviewed focuses on fast-growing real estate markets. It is imperative that policymakers and government agencies consider displacement risks and anti-displacement strategies in climate preparedness, mitigation, and adaptation efforts, and make sure that measures are designed and implemented in ways that address and do not exacerbate these inequities. Key findings organized by climate investment type are summarized below.

URBAN GREENING

- Urban greening strategies – like parks, green space, trees and community agriculture – tend to increase surrounding property values and may contribute to gentrification and displacement if not implemented equitably.
- Recent research shows that urban greenway-type parks and park proximity to downtown areas are strong predictors of gentrification.
- While the presence of street trees tends to increase property values, trees may be valued differently depending on their type, size, and location on private vs public property.

TRANSPORTATION

- Rail station areas are more likely to experience gentrification and displacement than areas without a transit stop, though context matters. Transit-oriented development and new rail stations increase surrounding property values and may drive gentrification and displacement, though properties immediately adjacent to new stations may decrease in value. Findings are mixed, and more research is needed specifically on the effects of new rail stations.
- Evidence on the impact of new bus-rapid transit on surrounding property values is limited and mixed.
- Investment in pedestrian infrastructure, bike infrastructure, and complete streets have mixed impacts on surrounding property values, with increases observed in some cases. More studies exploring the causal effects of such projects on property values are needed.

ENERGY

- Improved energy efficiency raises property values but eases utility costs, which can have countervailing effects on displacement.

- Nearby wind farms have little to no effect on surrounding property values in the U.S.
- Rooftop solar increases property values at the building level though more studies are needed, particularly to assess impacts on surrounding properties.

QUESTION 3: HOW CAN CURRENT ANTI-DISPLACEMENT STRATEGIES BETTER CONSIDER AND PROTECT VULNERABLE COMMUNITIES AGAINST CLIMATE HAZARDS?

Key findings on the climate vulnerability of anti-displacement policy strategies include:

- Subsidized housing developments are often constructed with non-resilient materials and often located in high-risk areas like floodplains or fire zones. Many policies have been proposed to reduce the climate vulnerability of affordable housing projects, including prohibiting the building of new developments in high-risk zones and involving community stakeholders in the planning and pre-construction phases.
- By preserving community ownership of land and providing affordable housing within high-risk areas, community land trusts (CLT) can serve as a useful tool in combating both affordable housing shortages and climate vulnerability. However, communities in the U.S. have not succeeded in scaling the CLT model.

Background

Centuries of burning fossil fuels and emitting greenhouse gases into the Earth's atmosphere have indelibly altered the course of our planet's global climate system. There is broad scientific consensus that our shared future is one of higher average temperatures, rising sea levels and more frequent and severe climatic shocks. Many of these trends have already begun to emerge across the globe, forcing people either to adapt in place or to leave their homes in search of stability elsewhere. These impacts can be acute or insidious and, in some cases, afflict socioeconomically disadvantaged communities disproportionately. Therefore, understanding the complex interplay between the changing climate and our social, political, and economic institutions is imperative to develop the robust, adaptive policies needed to make our societies more resilient in the face of this change.

One widespread consequence of worsening climate conditions is the displacement of people from their homes and communities. Displacement of this kind can occur as the direct result of a climate shock – such as a major storm, fire, or flood – that physically destroys or damages property and infrastructure, or more gradually as a response to worsening climate stressors. These can include, for example, nuisance flooding and extreme heat, which can introduce or exacerbate economic hardships among people living in areas vulnerable to climate hazards. The rising costs of utility bills, insurance premiums, or housing prices – resulting from housing stock shortages, changing preferences due to climate change, or increased property risks – may also lead to displacement. Furthermore, efforts to reduce greenhouse gas (GHG) emissions and prepare for climate change's worsening impacts, such as improvements in public and active transportation, urban greening, and energy efficiency measures, can have unintended consequences for the communities in which they are implemented. These essential climate mitigation and adaptation strategies may also be increasing the amenity values of these neighborhoods, namely by raising property values and housing costs, and therein contributing to the indirect displacement of residents vulnerable to rising costs.

This literature review explores the role of climate change as a driver of displacement, bringing together several bodies of literature to elucidate the various mechanisms by which climate change is creating or increasing displacement pressures. We partnered with the Strong, Prosperous, and Resilient Communities Challenge to conduct this review, which is part of a broader project in collaboration with EcoAdapt. The influence of climate on displacement varies greatly across countries, regions, and communities; this review focuses primarily on the relationship between climate change and displacement in the United States. It is meant to serve as a resource for both researchers and practitioners seeking to better understand climate and displacement, and as such we also highlight throughout the report equitable policy strategies that achieve climate goals while safeguarding vulnerable populations.

Guiding Questions

Specifically, this review is guided by the following three questions:

1. How are climate shocks and stressors related to displacement?
2. What are the unintended consequences of climate mitigation and adaptation (M/A) strategies, such as generating rising housing costs and associated displacement pressures?
3. How can current anti-displacement strategies better consider and protect vulnerable communities against climate hazards?

Results of our review related to Question 1 reveal that climate-driven shocks – which we define as major storms and wildfires – primarily drive direct displacement of people due to their immediate and physically hazardous nature. In contrast, climate stressors – which we define as extreme heat, droughts, nuisance flooding, and sea-level rise – act primarily as agents of displacement via more indirect pressures, such as adverse health effects and increases in cost of living. Living costs increase either via heightened utility and/or insurance costs in places experiencing these stressors, or because of rising housing costs in places with lower climate risks as they become relatively more attractive. However, we recognize that our definitions of climate shocks and stressors are somewhat fluid, and that many shocks and stressors exacerbate and occur simultaneously. There are many instances in which "shocks" serve as indirect drivers of displacement, such as is the case with the displacement of socioeconomically disadvantaged residents due to neighborhood change that occurs in the wake of a major storm. Similarly, there are instances in which "stressors" may serve to directly displace residents, as has been the case due to damages from sea-level rise and nuisance flooding. There are also significant inequities in exposure and vulnerability to these shocks and stressors, and in the ability to recover from them, with low-income, non-white communities and renters being disproportionately impacted.

Our exploration of the unintended consequences of climate mitigation and adaptation strategies (Question 2) shows that several commonly used policy strategies aimed at reducing GHG emissions and increasing resilience at the local level can potentially accelerate processes of gentrification and displacement of low-income residents in certain neighborhoods, under certain conditions. This is due to the fact that many of these investments – such as transit-oriented development, increased park and green space, infill development, and brownfield development – can result in higher property values in surrounding communities. Much of the literature reviewed for this section focuses on the impact of climate M/A policies on property and housing values, without explicitly naming or measuring displacement or gentrification. Therefore, the discussion presented in this section is at times predicated on the assumption that higher housing prices commonly contribute to the displacement of economically vulnerable residents.

The field of literature that considers how anti-displacement strategies can better protect vulnerable communities against the impacts of climate change (Question 3) was the sparsest among our three guiding questions; still, we highlight some valuable insights from this small body of literature. Namely, a large portion of the nation's affordable housing stock has been constructed in high-risk areas like floodplains, fire-prone areas, and zones of storm surge. Additional construction of such housing continues in these areas due to cheap land prices, with many of the planning procedures not paying proper consideration to worsening natural risks from climate change. Poor construction quality of such housing also contributes to their vulnerability to climate hazards. While affordable housing as well as other anti-displacement policies have the potential to mitigate the threats of climate change, they must be implemented in a community-engaged and research-informed manner.

Methods

This review includes literature published from the 1970s onward; the vast majority of papers and articles reviewed were written after the year 2000 as studies and reporting on climate change began to accelerate. The geographic scope of this review is primarily limited to the United States, with some international literature provided for additional context when necessary. We focus on the U.S. context for two reasons: 1) our intended audience includes researchers, policymakers, and practitioners who are addressing issues of climate and displacement primarily in the U.S., and we know that many parts of the world experience climate change and displacement in ways that may not be generalizable to the U.S., and 2) there is a sufficient wealth of U.S.-focused literature focused on climate and displacement to address our three guiding questions.

Literature reviewed for this study consisted of peer-reviewed academic papers, gray literature – such as reports, white papers, and working papers published outside of academic journals – and relevant, reputable journalistic sources. Peer-reviewed publications were generally given preference for inclusion so as to rely on the most rigorous research where possible; however, we found it vital to also include gray literature and other media reports because they offer timely and valuable insight into contemporary issues and provide information and commentary discussed by non-academic community members. For some of the issues explored – such as newer climate mitigation and adaptation strategies (Question 2) and the vulnerabilities of anti-displacement strategies to climate change (Question 3) – the academic body of literature is nascent, therefore warranting a broader utilization of gray literature and media.

For Question 1, we paired search terms relevant to climate shocks and stressors – such as “sea level rise,” “hurricanes,” “wildfires,” “drought,” and “nuisance flooding” – with displacement-relevant terms – such as “displacement,” “property values,” “housing affordability,” and “gentrification” – in order to identify literature that discussed the intersection of these two topics. We define gentrification as a process of neighborhood change that includes economic change in a historically disinvested neighborhood – by means of real estate investment and new higher-income residents moving in – as well as demographic change in terms of income levels, educational attainment, and the racial make-up of residents (Chapple and Zuk, 2015). Additionally, we reviewed recent academic studies that describe the growing scientific consensus on climate shocks and stressors, both in terms of historical patterns and future projections. This was done to contextualize the magnitude and scope of these hazards before discussing their influence on displacement. Overall, we identified and reviewed 233 relevant sources, the majority of which are academic papers.

For Question 2, we identified literature by pairing a range of land use, transportation, and energy-related search terms – such as “parks,” “transit-oriented development,” “rooftop solar,” and “bike infrastructure” – with the same displacement-related search terms used in Question 1. Where necessary and/or relevant, we then filtered research by the most recent date, study area (with preference given to U.S.-based studies), and perceived relevance. By this method, we reviewed 133 sources, with some M/A strategies covered more thoroughly than others.

Question 3, which explores the vulnerabilities of anti-displacement strategies to climate change, had the sparsest available literature of our three guiding questions, as few have studied the nexus of these topics in depth. However, there is a small and growing literature documenting the vulnerability of affordable housing to climate impacts, such as storms and flooding. For this question, we identified literature by pairing anti-displacement search terms – such as “affordable housing,” “inclusionary zoning,” and “rent control” – with climate hazard terms such as “flooding,” “fires,” and “storms” – to identify relevant sources. Our search yielded comparatively fewer results than Questions 1 or 2, and the majority of publications reviewed were gray or journalistic sources. A total of 18 sources were reviewed for this question. A full breakdown of search terms used can be found in Appendix A, and a breakdown of source types by guiding question can be found in Appendix B.

QUESTION 1

Climate Shocks, Stressors, and Displacement

Climate hazards often serve as direct or indirect drivers of displacement, though the ways in which they do so can be complex. This analysis was therefore segmented into a study of climate “shocks” and climate “stressors.” Shocks are defined as climate-related events that present immediate, acute physical danger and can cause large-scale displacement of people in a matter of minutes or hours. In contrast, stressors are defined as pressures whose physical impacts are borne incrementally and over an extended period of time (months, years). For our consideration of climate “shocks,” we identified two classes of shocks: i) major storms, and, ii) wildfires. For climate “stressors,” we consider: i) sea-level rise (SLR) and associated tidal flooding, ii) extreme heat, and, iii) drought.

The literature regarding these hazards and their impacts is summarized below. However, we acknowledge that many of these climate hazards often occur in tandem, exacerbating one another, so we therefore highlight these intersections when relevant. Each hazard also results in distinct displacement pressures, so we discuss each separately. These pressures are characterized along a continuum of direct versus indirect drivers of displacement. Examples of direct displacement drivers caused by a given climate hazard may be the damage or destruction of one’s home or property, or a threat to an individual’s safety. Indirect drivers of displacement may be increased costs of living, perhaps associated with rising insurance premiums, utility bills, housing prices ushered in by neighborhood change after a climate shock, or housing cost increases in neighborhoods where stressors and shocks are less of a risk.

CLIMATE SHOCK: STORMS & SEVERE WEATHER

Climate Context

In many regions of the world, the patterns of storms and extreme weather are influenced by anthropogenic (human-caused) climate change and may worsen in the coming years. The climatic shocks discussed in this section include tropical cyclones (hurricanes and typhoons), floods, tornadoes and thunderstorms, and atmospheric rivers. Though recent occurrences and trends in severe weather are partly due to random, natural variability in the atmospheric system irrespective of a shifting climate, a number of historical trends and future projections can be confidently linked to human-influenced climate change and are listed below.

- **HURRICANES**: Average intensity (i.e. maximum wind speeds, precipitation rates, storm surge levels) of hurricanes will very likely increase globally throughout the 21st century (*Knutson et al. 2015, Walsh et al. 2015)*. Frequency of very intense hurricanes (e.g. category 4–5 hurricanes) will also likely increase globally, though global changes in frequency of all hurricane classes remains unclear (*Christensen et al. 2013*). Rates of intensification and duration of hurricanes may also increase under continued, increased ocean-warming (*Kossin et al. 2017*). These trends primarily threaten U.S. residents living in Caribbean areas such as Puerto Rico and along the Gulf and East coasts.

- **TORNADOES & THUNDERSTORMS**: The season for tornadoes and severe thunderstorms in the U.S. appears to be lengthening, though the average total number of storm days each year has decreased in recent years (*Kossin et al. 2017)*. However, the number of distinct tornadoes on days in which they do occur appears to be increasing sharply (*Elsner et al. 2015*). Model projections predict that the frequency and intensity of severe thunderstorm environments across the U.S. will likely increase in coming decades, namely in the Midwest and southern Great Plains regions during spring months (*Diffenbaugh et al. 2013, Kossin et al. 2017*).

- **ATMOSPHERIC RIVERS**: These streams of tropical, atmospheric moisture that transport huge amounts of rainfall to (primarily) the West Coast of the U.S. are projected to increase in both frequency and intensity in the future as part of the changing global climate (*Gao et al. 2015,*

SUMMARY: STORMS & SEVERE WEATHER

- Most types of storms and severe weather in the U.S. are projected to increase in both intensity and frequency.
- Vulnerability to these events is pronounced in low-income communities of color and among renters, where people are more likely to live in substandard housing and in close proximity to floodplains, and to face housing challenges when storms reduce the number of units available.
- Both immediate and long-term displacement from such events are disproportionately common for low-income communities of color in many regions of the U.S.
- Recovery from major storms is a challenge for low-income residents, with federal assistance difficult to access and often focused on restoring assets for wealthier residents.

Warner et al. 2015). However, the increase in these severe events does not necessarily translate to an increase in mean annual precipitation totals projected for western states (*Kossin et al. 2017*).

» **FLOODS***:* The fact that both high-intensity hurricanes and atmospheric rivers are projected to increase in frequency and magnitude means that flooding that accompanies these events will likely worsen in regions of impact. Similarly, the fairly confident conclusion that heavy rainfall events will increase across the country means that flooding risk will likely increase in many regions, a trend corroborated by observed increases in flood frequency and annual peak streamflows throughout the central U.S. and Mississippi River Valley in recent decades *(Mallakpour & Villarini 2015, McCabe et al. 2014, Wehner et al. 2017)*.

Inequities in Vulnerability

A large body of literature focuses on how various types of social vulnerability intersect with storms and displacement. In many regions, low-income or otherwise socially vulnerable communities are more likely to live in areas of higher risk to natural hazards than other residents, due to a legacy of segregation, siting of subsidized housing, and lower housing costs in higher risk areas. These disparities are often most pronounced in rapidly growing urban areas, such as Houston, Texas, or the greater Sacramento, California, area, where sprawl into high-risk areas, such as floodplains, has occurred due to the shortage of available land and housing closer to the city center (*Burby et al. 2001, Godschalk 1999, Paterson 1998*). One study of Austin, Texas, revealed that the proportion of low-income residents living in floodplains increased dramatically between 1990 and 2000 due to low property prices in those areas (*Lee & Jung 2014)*. Non-white, low-income, less educated residents in Houston also made up the bulk of the population in areas most impacted by flooding during Hurricane Harvey in 2017, partly due to a legacy of discriminatory housing policies precluding such residents from obtaining housing in more desirable and resilient neighborhoods, as well as under-investment in flood mitigation in these neighborhoods (*Deaton 2017, Greater Houston Flood Mitigation Consortium 2019, Krause & Reeves 2017*). During Hurricane Katrina in 2005, low-income, black residents were the most likely to experience flooding, with renters and unemployed populations also disproportionately impacted (*Frey & Singer 2006, Graif 2006*).

These disparities are enabled and reinforced by the siting of public housing projects in high-risk floodplains. Roughly 8–9% of all subsidized or public housing projects are located in 100-year or 500-year floodplains, often due to the availability of cheap land and in conjunction with the Department of Housing and Urban Development's lack of a comprehensive flood risk policy (*Mervosh 2019, Peri et al. 2017, Rosoff & Yager 2017*). While flood risk has not historically been a part of Fair Housing conversations, these location decisions broadly fit a pattern of public housing being sited in areas of relatively less opportunity (*Rabe Thomas 2019, Rothstein 2017*). Moreover, flood maps maintained by FEMA, which inform the agency's National Flood Insurance Program, have been shown to be outdated or inaccurate in many instances and do not account for future trends resultant from a changing climate, such as sea-level rise, fueling a cycle of over-development, and under-insurance of communities located within floodplains *(Bruggers 2018, Rosoff & Yager 2017, Scata 2019, Wing 2018)*. One study estimates that after accounting for updated flood frequencies and housing development in high risk areas, the population exposed to severe flooding in the U.S. is roughly triple that of previous, official estimates (*Wing et al. 2018*).

There is also differential vulnerability to climate hazards depending on the quality of housing stock. Low-income, non-white renters have been shown to be most likely to occupy older, substandard housing built to lower building codes with less maintenance, increasing the risk of structural collapse, damage, or bodily harm in the event of a disaster (*Burby et al. 2003, Fussell 2015, Krause and Reeves 2017, Rosenbaum 1996)*. Hurricane Maria in 2017 in Puerto Rico, for example, inflicted significantly more damage on low-income, often informally built housing structures as compared to those in more affluent areas built with stronger materials and under stricter building codes (*Viglucci 2018*). One study found that living in low-quality housing, especially mobile home units, was one of the strongest predictors of tornado-related fatalities (2,587 deaths from 1980 to 2019) in the U.S (*Lim et al. 2017, NOAA - NWS 2019*).

Many socially vulnerable communities also tend to be located closer to facilities containing hazardous materials, which may escape containment in times of storms and floods, potentially exposing nearby residents to dangerous contaminants (*Bullard et al. 2008, Burby et al. 2003, Crowder and Downey 2010, Krause and Reeves 2017*). Nearly 75% of the 82 Superfund sites (federally managed pollution remediation sites) that were located in counties impacted by Hurricane Harvey are in low-income and/or communities of color, a number of which experienced containment breaches during the storm, leading to concerns about toxic waste spreading into homes and neighborhoods *(Baptiste 2017)*. Additionally, disparities in evacuation rates and abilities have been observed across different communities in past storms. Specifically, renter, single-parent, low-income, and non-white households have exhibited slower, and lower overall rates of evacuation during major hurricanes, partly because they are closer to congested city centers and their residents have less access to personal vehicles (*Cutter & Emrich 2006, Van Zandt et al. 2012*).

Driving Displacement and Inequities in Recovery

Major storm and flooding events often directly displace hundreds of thousands of people from their homes every year in the United States. For example, the 10 hurricanes of the Atlantic hurricane season of 2017 resulted in more than 3,300 deaths, nearly $300 billion in damage (the costliest season on record), and several million evacuees, damaging or destroying over a million homes, primarily in Puerto Rico during Hurricane Maria, and southeast Texas during Hurricane Harvey (*NOAA 2018*). Early that same year, a number of consecutive atmospheric river storms struck California, resulting in the flooding of numerous communities, over $2 billion in damage and contributing to the partial failure of the Oroville Dam's main spillway, causing the evacuation of nearly 200,000 people. While many evacuees were able to return home relatively quickly, there were many who could not due to the loss of their homes or property and were thus permanently displaced.

The inequities in vulnerability discussed in the previous section put certain communities at higher risk of being displaced following disasters. Following Hurricane Katrina, which triggered the evacuation of some 1.7 million people, it has been shown that black residents were slower to return to New Orleans than white residents and were more likely to remain permanently displaced *(Frey et* *al. 2007, Fussell et al. 2010, Graif 2016)*. This was partly due to the fact that black residents were more likely to have been living in older homes located in high-risk flood zones, incurring greater property damage as a result. Additionally, limited social infrastructure for vulnerable residents to return in the context of privatized recovery efforts also played a role (*Adams et al 2009, Klein 2007)*. A year after the hurricane, many residents were still unable to return home, though the differences between different races were stark; the white population at this time was at 64% of pre-storm levels, while the black population of the city was at a mere 43% of pre-storm levels, failing to fully recover in subsequent years (*Frey et al. 2007, Groen & Povlika 2010*). Similarly, the share of low-income and less-educated residents declined following the storm, with residents who had been living in subsidized rental units 70% less likely to be in their homes following Katrina than those living in market-rate units (*Fussell & Harris 2014*).

Rental units also tend to be reconstructed more slowly or not at all compared to owner-occupied homes and high-value units (*Fussell 2015, Peacock et al. 2014, Zhang & Peacock 2009*). As seen in New Orleans following Hurricane Katrina, the damage-induced shortage in housing stock following disasters often causes a sharp increase in prices and can play a role in long-term neighborhood change or gentrification (*Fussell et al. 2010, Peacock et al. 2014*). Market-rate housing prices in New Orleans spiked by more than 40% in the months following the disaster and continued to rise in many neighborhoods (*Levine et al. 2007, Opdyke 2005*). Following Hurricane Harvey, Houston has experienced similarly high rental prices due to increased demand from displaced tenants and reduced supply, as well as substantial losses for lower-income homeowners that could not afford to repair their homes, repay mortgage loans, or pay for short-term housing (*Dickerson 2017*).

Additionally, choices made about redevelopment can accelerate neighborhood change. In New Orleans, for example, four large public housing developments that had sustained damages were redeveloped by the city into mixed-income units, contributing to a decline in the number of residents of public housing from roughly 5,000 pre-Katrina to just 1,900 following the storm (*Fussell 2015, Mitchell et al. 2011, Mueller et al. 2011*). Not only were many residents not able to return, but some public housing demolition was viewed by residents as paving the way for accelerated gentrification, for example in the Treme neighborhood (*Crutcher 2010*). Indeed, subsidized housing demolition can play a role in indirect displacement, gentrification, and demographic change *(Goetz 2011)*; when neighborhoods do gentrify around subsidized housing projects, the preservation of these projects can help ensure more diversity and access to opportunity in gentrifying neighborhoods *(Dastrup & Ellen 2016)*.

The structure and administration of federal recovery assistance programs, such as the Federal Emergency Management Agency (FEMA), have also been shown to exacerbate inequalities following some disasters. FEMA is the main source of reconstruction funding for households, but there is significant variation in coverage across geographies and socioeconomic status (*Peacock et al. 2014*). Government emergency assistance programs are primarily designed to restore wealth, and therefore primarily benefit homeowners, particularly those with more valuable properties (*Comerio 1997, Fussell & Harris 2014, Hersher & Benincasa 2019, Kamel 2012, Mueller et al. 2011, Vigdor 2008, Zhang & Peacock 2009*). Following Hurricane Katrina, low-income households and households of color were more likely to report insurance payments that were inadequate to meet repair and recovery needs, in part because of inadequate federal insurance coverage in low-income communities, especially communities of color (*Peacock et al. 2014*). Following Hurricane Harvey, white and upper-income residents were more likely to receive assistance from FEMA than black residents, even though the latter reported greater property damage (*Hamel et al. 2017*). The receipt of federal funds is also often slow and delayed, leaving at-risk and displaced households discouraged and waiting for crucially needed funds (*Blakely 2008, Bubenik 2018, Dickerson 2017, Morris 2018, Olshansky et al. 2008*). One report from 2019 examined the financial impacts faced by homeowners following recent natural disasters and found racial inequities in credit score declines for homeowners hit by disasters, with communities of color experiencing a much larger decline on average than majority-white communities (*Ratcliffe et al. 2019*). Additionally, increases in mortgage delinquency and foreclosures for homeowners who have experienced natural disasters are more common than for those who have not, which can make sources of credit more difficult or expensive to obtain in the future.

Policy Highlights

Addressing the combined threats of storms and displacement is a complex undertaking for local, state, and federal agencies. The proposals to address storm and flood risk in the first place include updating federal flood maps, limiting development in high-risk areas, and strengthening protective infrastructure *(Wing et al. 2018)*. Using social vulnerability maps to inform emergency mapping and recovery planning can help improve community resilience because socially vulnerable communities tend to be among the most impacted by disasters (*Van Zandt et al. 2012*).

In the aftermath of storms, then, Zhang and Peacock (*2009*) suggest that state and local governments impose moratoria on foreclosures and insurance cancellations during times of emergency, provide incentives to encourage the rebuilding of low-income and rental properties, reuse abandoned properties, and work with land bank programs to stabilize housing prices following disasters. In Houston, there are some examples of such efforts, including dedication of public land to affordable housing and strengthening community land trusts. Additionally, equitable recovery efforts in Houston aim to address unclear or "tangled title" issues complicating recovery funding access for low-income homeowners, as well as to provide increased access to recovery dollars for renters, and to improve housing quality for older apartments (*Miller & Goodman 2019*). Calls for equitable recovery post-Hurricane Irma in Florida in 2017 include direct assistance to displaced tenants, replacement of mobile homes with high-quality, safe homes, and analysis of racial disparities in funding *(Community Justice Project 2018).* Also, a rapid rehousing model out of Houston called Rapido – in which builders use pre-assembled temporary housing cores that can quickly expand to house more families – is getting attention. The backbone of this temporary-to-permanent model is the pre-planning efforts that cities and counties must undertake in advance of disasters to make permitting, funding, and implementation of effective disaster housing relief possible. (*Binkovitz 2016*).

Local disaster recovery relief distribution programs should not only be analyzed, but also reformed to ensure an equitable apportionment of federal aid to victims after storms. This would help prevent instances like the lopsided assistance seen following Hurricane Harvey, in which wealthy, white, politically vocal residents received dramatically more aid than more heavily impacted disadvantaged communities of color (*Capps 2018*).

CLIMATE SHOCK: WILDFIRES

Climate Context

Decreasing summer precipitation, rising temperatures, increased lightning strikes, drier land and earlier spring snowmelt are all contributing to a lengthening and intensification of the fire season in the western U.S. (*Holden et al. 2018, Romps et al. 2014, Westerling et al. 2006*). Though this region has historically been prone to large-scale wildfires, especially during the summer and fall months, there has been a significant increase since the mid-1980s in the frequency and size of blazes from the Rocky Mountains westward (*Higuera et al. 2015*, *Running 2006, Westerling et al. 2016*). In California, 15 of the state's 20 largest and most destructive fires have occurred since the year 2000 (*CAL-FIRE 2019*). Population growth throughout the region has contributed to an increase in human-induced wildfires over this time period (*Byrant & Westerling 2014*). However, the principal increase in wildfires observed in recent decades has been due to an uptick of natural, lightning-induced fires. Decades of forest management that focused on fire suppression rather than allowing periodic burns resulted in an overabundance of brush and vegetation, which has created conditions conducive to particularly destructive fires (*Moore et al. 1999, Stephens et al. 2013, Westerling 2016*). These fuel-rich conditions, combined with higher temperatures that desiccate the landscape and increase the frequency of lightning strikes, have resulted in the significant surge in fires observed in recent years. (*Wehner et al. 2017*, *Romps et al. 2014*). One study showed that human-caused changes to the climate were likely responsible for much of the increased aridity in forests since the early 1970s and a doubling of burned forest area since the mid-1980s (*Abatzoglou & Williams 2016*). Therefore, wildfires from both human and natural causes are fueled by changing physical and climate conditions and are projected to worsen in the coming decades, especially for western states, including Alaska (*Flannigan et al. 2009, Westerling et al. 2011, Westerling et al. 2016, Young et al. 2016*).

SUMMARY: WILDFIRES

- The frequency and severity of major wildfires in the U.S. (primarily in the western states) is projected to worsen in the future. With increasing residential development in high fire risk areas, it is likely that we will see increases in displacement from wildfire-related property damage.
- In some regions, communities with higher levels of social vulnerability are disproportionately exposed to fire risk and more likely to experience fire-related displacement.
- There are stark inequities in the post-fire recovery process, with renters and low-income individuals facing the biggest barriers to rebuilding and returning home, which may lead to residential displacement.
- Both immediate and permanent displacement from these hazards occur as a result of both direct drivers (e.g. danger to or destruction of property) and indirect drivers (e.g. increased insurance premiums or reduced housing availability).

Inequities in Vulnerability

Given current trajectories of climate conditions and human development in the western U.S., it is estimated that residential wildfire risk will increase by a factor of three to four by the middle of this century, even under scenarios of global reduction of GHG emissions (*Bryant & Westerling 2008)*. Residential areas most at risk are those in the "wildland-urban interface" (WUI), populated zones among or adjacent to wildland vegetation (*Berger & Susskind 2018*). The extent of the WUI in the U.S. has increased dramatically in recent years, due to the construction of some 12 million new homes between 1990 and 2010 in these areas, and WUI housing is estimated to be the most rapidly growing type of land-use in the conterminous U.S. (*Radeloff et al. 2018*). In California, it is estimated that some 11 million people, roughly a quarter of the state's population, live in areas of high-wildfire risk (*California Wildfire Strike Force 2019, NAIC 2019*). There are numerous reasons for this rapid expansion of development in WUI areas, but a major driving factor cited by California's governor, Gavin Newsom, is the housing affordability crisis throughout the state and many major cities in the broader region (*California Wildfire Strike Force 2019)*. The lack of affordable housing supply in the state's urban centers has driven many people to more affordable housing zones, many of which are located on the fringe of towns and urban centers, often in high-risk, WUI areas (*California Wildfire Strike Force 2019, Kasler 2019, NAIC 2019, Peterman et al. 2019, Thompson 2019*).

Exposure to wildfires is not limited to a single demographic or community type, though there have been a number of studies highlighting disparate patterns of fire risk across income and other factors of social vulnerability in certain regions. One 2003 study estimated that a third of residents in WUI areas across the western U.S. struggled to cover the costs of basic needs, let alone additional costs of investing in fire mitigation projects and home renovations (*Lynn 2003*). In the case of the devastating 2018 Camp Fire in Butte County, California, which claimed the lives of 85 people and forced over 50,000 people to evacuate, 14% of the affected residents were living below the poverty line and a quarter of them were reliant on Medicare or Medicaid for health insurance (*Squires 2018*). Two analyses of the southeastern U.S. found that in six states there were numerous areas where high wildfire risk was correlated with high social vulnerability, as defined by poverty rates, race, level of education, and housing tenure, and that these communities lacked access to fire mitigation programs (*Gaither et al. 2011, Poudyal et al. 2012*). A similar study of the Pacific Northwest found that poor households disproportionately occupied high-risk zones and had less fire response capabilities compared to more affluent regions (*Lynn & Gerlitz 2006*). In California's Tuolumne County, where some 80% of housing units are in high or extreme-risk areas, 40% of the population is older than 60, meaning there is a disproportionate exposure of elderly residents to wildfire throughout the county, a pattern shared by a number of neighboring foothill counties (*Shuman 2019*). While patterns of disproportionate vulnerability across income levels, age or other demographic characteristics are not universal across the country, due to the diversity of income classes and community types occupying WUI zones such patterns are important to consider at the community-scale in order to identify potentially vulnerable sub-groups.

Driving Displacement and Inequities in Recovery

Catastrophic wildfires have resulted in the direct displacement of hundreds of thousands of people, many of them permanently. In the latter half of 2018, alone, there were an estimated 350,000 people displaced in California due to evacuation orders and destruction of their homes. These fire refugees found themselves in overcrowded shelters ill-equipped to house and supply the influx of people

(*Sellers 2018*). Multiple disease outbreaks were documented in such shelters and many people resorted to sleeping in their cars or outside, despite poor air quality and subsequent rainstorms (*Squires 2018, Wootson 2018*). Due to the extent of destruction and the prohibitive costs of rebuilding, many have been unable to return home, instead left to search for housing in a state with a chronic housing shortage and affordability crisis. As a result, many families have been left marginally housed, meaning, for example, they stay in a series of motels, paying up to ten times what they had paid in monthly rent before the fire, and ultimately looking to neighboring counties or states for available housing; many evacuees remain homeless, and several can be found in homeless encampments in the Bay Area's major cities, such as Oakland (*Fuller & Haner 2019, Sellers 2018*).

Many individuals who lost their homes to wildfires in previous years have remained homeless due not only to the lack of affordable housing but also to inadequate recovery assistance (*Fuller & Haner 2019, Mockrin et al. 2015*). Relying on federal assistance to rebuild and recover has proven to be a slow and complex process for many, and the mechanisms for paying liabilities for utility-caused fires, such as the Tubbs and Camp Fires in California, have been shown to be insufficient and unsustainable for both recipients, ratepayers, and shareholders (*Mockrin et al. 2015, Peterman et al. 2019*). Newly constructed homes are often also subject to more stringent regulations requiring them to be made of fire-resistant materials, which can add to the cost of reconstruction and discourage some displaced homeowners from rebuilding altogether (*Passy 2018*). Recovery for renters following fires is particularly difficult. The majority of renters nationwide lack renter's insurance, preventing them from receiving compensation for belongings lost in fires. Even those with insurance are left without support to find a new home due to the fact that most renter insurance plans do not provide relocation support in the event of a natural disaster (*Marcus & Verma 2017*).

Even if they don't lose their homes and are not permanently displaced, those who live in a high-risk area may still face indirect displacement, due either to increased home insurance premiums or to the decrease in available housing stock in areas recently impacted by fire. Insurance payouts from the 2017 and 2018 California wildfire seasons amounted to some $26 billion, causing many insurance companies to eliminate high-risk properties from their portfolios and/or increase premiums on those they retain (*Makaula 2019, The Allstate Corp. 2018*). Many residents in high-risk zones of western states have reported having their policies abruptly canceled, while others report facing instant rate increases of 200–500%, resulting in monthly premiums as high as $5,000–$7,000 (*Makaula 2019, Quinton 2019, Smith 2016, Shuman 2019*). For states like Montana and Idaho, where more than a quarter of all available housing stock is located in high-risk fire zones, the resulting high cost of home insurance alone has precluded many from being able to afford a home and has pressured others to relocate (*Kasler 2019*). According to California's Department of Insurance, average rates in WUI zones are 50% higher than in the remainder of the state (*Peterman et al. 2019*). Not only are insurance rates in high-risk zones becoming dramatically more expensive, but in many cases, insurance is virtually impossible to obtain, as more companies decline to insure properties deemed too risky (*Shuman 2019, Thompson 2019*). This results in many residents resorting to unregulated "surplus" insurance plans or plans offered through state agencies, such as California's Fair Access to Insurance Requirements Plan, which tend to provide minimal coverage at very high cost (*Peterman et al. 2019, Smith 2016*). Major utility-caused wildfires – such as the Tubbs and Camp Fires – have resulted in lawsuits, sinking utility stock prices, and mandatory fire mitigation investments. The costs of capital improvements to utility infrastructure then gets passed on to customers in the form of increased utility rates, which can be an additional, indirect cause of displacement for residents already facing high housing and insurance costs *(Peterman et al. 2019)*.

In summary, growing fire risk due to climate change and increasing insurance and utility rates have converged with pre-existing shortages in affordable housing to create a unique landscape of direct and indirect displacement pressures, especially in western states, in a trend that is projected to worsen in decades to come.

Policy Highlights

A number of local, state and federal-level policy solutions have been proposed in recent years in an attempt to mitigate fire risk, improve post-fire recovery processes, and stabilize insurance rate hikes for homeowners. In December 2019, California imposed a one-year moratorium prohibiting insurance companies from dropping customers in fire-affected areas in order to prevent further financial burdens for victims, though critics cite the need for a longer-term, comprehensive solution (*Serna 2019*). Many such policies are outlined in a report by the California Governor's Strike Force on Wildfires and Climate Change. These include recommendations to deprioritize new development in extreme fire risk areas and prioritize the development of infill lots and overall housing production across the state, especially in low-risk urban areas. The report also proposes increasingly stringent wildland building codes and promises to provide a list of low-cost retrofits that homeowners can implement in order to improve the safety of their homes against fires. It also suggests improvements to local policies, such as fire risk assessments and evacuation plans. Additionally, the report recommends that the state's Department of Insurance begin to analyze trends in rate hikes in fire-prone areas to assess the increased burden being placed on residents – important information needed to curb displacement (*CA Wildfire Strike Force 2019*). Other suggestions of climate-smart fire policies include implementing state-level policies requiring increased defensible space surrounding homes and encouraging more local Volunteer Organizations Active in Disasters (VOADs) in order to help rural communities access aid for post-fire recovery (*Bryant and Westerling 2014, Edgeley 2017*). Finally, in California, the Governor's declaration of a State of Emergency following wildfires in fall 2019 required landlords to justify any rent increase above 10 percent *(California Office of the Attorney General)*. Since then, state legislation has passed capping rents for many rental units across the state. Following wildfires, this kind of renter protection may make the difference in whether people in low-income households are able to return.

CLIMATE STRESSOR: SEA-LEVEL RISE & NUISANCE FLOODING

Climate Context

Globally, it has been estimated that average sea-levels rose by roughly 7–8 inches from 1900 to present, with an additional rise of 12–98 inches (1.0–8.2 ft) in store by 2100 (*Sweet et al. 2017*). The exact amount of SLR is dependent on both global greenhouse gas (GHG) emissions and rates of ice-melt from places like Greenland and Antarctica, a process shown to be accelerating faster than previously thought (*Dangendorf et al. 2017, Kopp et al. 2017, Kulp & Strauss 2019*). Rising sea levels and increased tidal flooding impact coastal communities throughout the U.S. and can act both as a direct and indirect driver of displacement. SLR is classified here as a climate stressor because, while it does exacerbate coastal surges of seawater during major storms, the underlying processes driving it are gradual and continuous and its (non-storm) effects are generally not life-threatening. Its physical impacts include the damage and destruction of homes and property, damage to important infrastructure such as roads and freeways, and the disruption of emergency operations.

One consequence of SLR in the U.S. is the increased frequency and extent of tidal flooding, also referred to as “nuisance,” or “sunny day,” flooding in coastal areas, which will only continue to worsen in coming decades. These events result from cyclical tidal patterns throughout the year and, depending on the geography and infrastructure of a given coastal community, can inundate and damage roads, beaches and walkways, homes and property. Between 1960 and 2010, the average number of tidal flooding days occurring each year in cities like Charleston, Annapolis and Baltimore has increased dramatically – up to 9 times the historical average in some places – costing tens of millions of dollars in damages and impacted economic activity (*Sweet et al. 2014*). Additionally, there is new research suggesting that the spatial extent of future SLR and its impact on coastal communities may be far greater than previously anticipated, estimating that globally, the number of people living in areas today that will be within high-tide zones by 2100 is about 190 million, roughly tripling previous estimates *(Kulp & Strauss 2019)*. SLR not only impacts coastal cities via tidal flooding but also leads to the intrusion of saltwater into freshwater supplies that currently serve critical drinking water and ecological needs in some regions, such as South Florida and California *(Curtis & Schneider 2011, Lund et al. 2010, Noss et al. 2011, SFRCCC 2015).*

SUMMARY: SEA-LEVEL RISE & NUISANCE FLOODING

- Sea-level rise (SLR) could result in an increase of more than 4 feet in global average sea level by 2100; many coastal communities will be forced to relocate as SLR encroaches on their existing neighborhoods.
- Existing federal flood maps are outdated and do not adequately account for SLR projections, which means that many communities are living in areas at risk of flooding, without flood insurance protections.
- Tidal flooding caused by SLR has increased in frequency and extent across many coastal U.S. cities, causing repeat floods and costly property damage, which may force residents to relocate.
- In many regions, low-income communities of color are disproportionately vulnerable to SLR, and will likely be disproportionately displaced as a result.
- Like wildfires, SLR-induced displacement can occur as a result of both direct and indirect drivers.

Inequities in Vulnerability

In the U.S., coastal counties make up roughly 40% of the country’s population and in many of these counties tidal flooding and SLR have disproportionately impacted low-income and communities of color (*Kusnetz 2018, Morris 2018, NOAA - OCM 2019*). In Atlantic City, New Jersey, working class communities in low-lying coastal areas have been some of the most impacted from nuisance flooding in recent years. However, the bulk of local municipal and federal protection efforts has been on constructing barriers along the downtown corridor and in front of wealthy, oceanfront neighborhoods (*Upton 2017*). Many critics argue that such adaptation is guided by a desire to mitigate economic damages, but does not adequately address issues of social vulnerability and equity (*Heberger et al. 2009, Martinich et al. 2013, Upton 2017*). One study found that in ten California counties throughout the San Francisco Bay Area and North Coast, populations vulnerable to SLR were disproportionately made up of people of color (*Heberger et al. 2009*). A similar analysis of the U.S. found that in many areas, socially vulnerable communities, as defined primarily by wealth and race, are disparately exposed to flooding by rising sea levels and less likely to be protected, a trend that is especially pronounced in the Gulf Coast region (*Martinich et al. 2013*).

Generally speaking, the resources needed to combat the effects of SLR are less available to lower-income communities and socially vulnerable groups. The amount of financial resources needed to build or upgrade seawalls and barriers, retrofit homes and buildings, make repairs following flooding, and ultimately to relocate, can be out of reach for many less-wealthy residents and communities (*Curtis & Schneider 2011*). Political buy-in required to organize attention around these efforts and garner external funding and support can also be difficult to attain in vulnerable communities already lacking political voice (*Hardy et al. 2017*). In general, recovering from flooding events and SLR-related damage is much harder for lower-income residents, given the fact that many assistance and recovery programs are designed to restore wealth, which tends to favor residents with higher-value assets to begin with (*Elliott & Howell 2017, Howell & Elliott 2018, Pais & Elliott 2008*). One study found that low-income homeowners whose wealth rests largely within their home values are unlikely to recover from the economic losses incurred if their homes are destroyed by flooding (*Sarmiento & Miller 2006*).

Driving Displacement

The influence that sea-level rise has on the displacement of people in the United States is complex and will likely have related impacts that ripple throughout the country. SLR displaces people both directly, by inundating their homes and communities, as well as indirectly, by decreasing viable housing supply, increasing home insurance rates, diminishing regional economic opportunities and, in some cases, impacting local groundwater supplies. In Florida, where tidal flooding has already become commonplace in many cities, Curtis & Schneider *(2011)* estimate that upwards of 9.9 million people will be at risk of direct displacement by 2030. An additional 10 million people are likely to face flooding and potential direct displacement from SLR-related impacts in California, South Carolina, and New Jersey combined *(Curtis & Schneider 2011)*. However, despite these increasing risks, housing growth rates in many high-risk flood zones in coastal states are accelerating. In New Jersey, there were nearly 3.5 times as many homes built in high-risk flood zones as in low-risk areas in the state from 2010 to 2016 (*Climate Central & Zillow 2018*). While coastal communities will bear the direct impacts of these hazards, the resultant redistribution of population from these communities has the potential to impact states across the country as they are tasked with receiving and integrating those fleeing the threat of inundation (*Hauer 2017, Keenan 2018*).

As with many climate stressors (as opposed to shocks), some displacement pressures that burden residents from SLR can be diffuse and indirect. For example, SLR and nuisance flooding can increase insurance rates. In New Jersey, many residents received letters from the Federal Emergency Management Agency (FEMA) that their flood insurance rates would be increased by 5–18% annually due to risks from SLR; this itself can create significant displacement pressure for residents *(Upton 2017)*. Moftakhari et al. (2017) find that the cumulative cost of frequent nuisance flooding in Miami may exceed the cost of extreme but infrequent storm events. In another study on flooding in Miami, McAlpine & Porter *(2018)* estimate that, between 2005 and 2016, properties projected to be flooded by 2032 had already collectively lost over $465 million in market value. Overall, the housing market saw a decrease in almost $16 billion of home values along the eastern and Gulf coasts of the U.S. from 2005 to 2017 and industry leaders are explicitly expressing concern regarding displacement from SLR (*Freddie Mac 2016, McAlpine & Porter 2019*). While lower property values can translate to lower housing prices and therefore potentially offset economic displacement pressures faced from increased insurance prices, they can also result in "trapped populations" – those who cannot afford to sell their devalued homes for a loss, even if they are being compelled to do so by climate hazards *(Freddie Mac 2016, Upton 2017)*. Lower prices in high-risk zones will also exacerbate disparate exposure of low-income residents to climate impacts, as they may be pushed to these areas due to affordability pressures.

In some areas, neighborhood change ushered in by the occurrence and perceived fear of future SLR has resulted in the displacement of long-time residents. Many long-time residents, whose families were originally excluded from desirable, beachfront neighborhoods due to racist, redlining policies, are now finding themselves evicted or priced out of their homes with few affordable housing options nearby (*Campo-Flores & Kusisto 2019*, *Green 2019*). One recent study showed that in Miami-Dade County, Florida, a region highly vulnerable to SLR, higher elevation properties have been appreciating in price faster than those at lower elevations, fueling regional "climate gentrification" in some neighborhoods (*Keenan et al. 2018*). Little Haiti is one such Miami neighborhood. Historically home to low-income and minority communities, it is becoming increasingly sought after by wealthy home buyers and developers due to its higher elevation (*Green 2019*). This trend has resulted in housing price increases in Little Haiti that are double that of the city average as well as waves of evictions that have displaced residents and local businesses *(Campo-Flores & Kusisto 2019, Green 2018, Green 2019)*. This is one of many examples of communities that are experiencing climate-influenced gentrification across the country, a trend that is likely to increase as climate hazards intensify. In Seattle's Duwamish Valley, the Duwamish River Cleanup Coalition sees a cycle of SLR inundating the industrial area and then leading to infrastructure and public health investments that raise property values and represent displacement pressures on long-term residents; as is described in the following section, this leads the Coalition to simultaneously focus on protecting the environment, empowering community, and promoting place-keeping (*Lopez 2019*).

Policy Highlights

Given the complex nature of sea-level rise and its effects on the direct and indirect displacement of people in coastal communities, identifying and implementing effective policies can be a challenge. First and foremost, local, state, and federal agencies must acknowledge and assess the intersections of SLR, displacement and the shortage of affordable housing, and then craft responses accordingly. The city of Miami is attempting to do this, adopting a resolution last year to explicitly research climate change-driven gentrification in areas such as Little Haiti and to investigate methods to prevent displacement (City of Miami 2018). This is in addition to $100 million allocated to affordable housing as part of the city's climate resilience-oriented Miami Forever Bond and adoption of inclusionary zoning policies to encourage denser development with more affordable units (*City of Miami 2019, Flechas & Harris 2018*). However, local advocacy groups such as the Family Action Network Movement, Catalyst Miami and the Community Justice Project are urging for more comprehensive solutions to the climate-driven displacement crisis in the city, such as community-driven development and climate resiliency planning, public land banking, revolving loan funds, improving the climate resilience of affordable housing, investing in green jobs and nurturing local, 'circular' economies (*Adrien & Page 2019, Bastien 2019, Boyd 2019, Duffrin 2019*). One example of collaborative, community-driven planning to improve coastal climate resilience while preventing displacement is Seattle's recent Duwamish Valley Action Plan, which details plans for improving green infrastructure, public health, increasing affordable housing and counteracting displacement. This includes economic development, such as hiring locally on city projects and providing funding for a coalition of residents to become affordable housing developers, particularly in the South Park neighborhood, which is "ground zero" for SLR in Seattle (*City of Seattle 2018*, *Duffrin 2019, Lopez 2019*).

CLIMATE STRESSOR: EXTREME HEAT

Climate Context

As average annual temperatures increase globally from year to year, extreme heat becomes more commonplace in many regions of the world and can drive displacement by increasing utility costs, necessitating building upgrades that spur evictions, and creating adverse health impacts for vulnerable community members. Heat waves and daily extreme temperatures are becoming more intense and more frequent in many communities and the effect of urban heat islands more pronounced (*Vose et al. 2017*). By the middle of this century, scholars estimate that mean temperatures of extreme heat waves (those that occur on average once per decade and last 5 days or longer) in the U.S. will increase by nearly 11°F, with the potential for even higher increases in the country's northern regions (*Sun et al. 2015*). However, in terms of total number of extreme heat days per year, the Southeast and Southwest will be the hottest in the country (*Sun et al. 2015*). By late century, high temperatures that currently only occur every 20 years, on average, will likely occur every year. Similarly, 1-in-20-year minimum temperatures will likely cease to occur (*Wuebbles et al. 2014*). In the same timeframe, the average number of days exceeding 100°F nationwide will likely double, and those above 105°F will quadruple (*Dahl et al. 2019*). Even assuming no future

> **SUMMARY: EXTREME HEAT**
>
> - Extreme heat waves are becoming hotter, longer, and more frequent globally. This trend exacerbates the health and cost pressures associated with living in urban heat islands in many regions.
> - Urban heat islands also tend to be worse in low-income communities of color due to disparities in landscaping and urban design in these neighborhoods.
> - Displacement resulting from extreme heat is primarily due to indirect forces such as adverse health impacts or increased utility bills.
> - Low-income residents and communities of color are among the most vulnerable to heat waves due to relative lack of access to air conditioning or inability to pay increased utility bills associated with their use.

population growth, the number of people in the United States who will be exposed to 30 or more days each year with a heat index of 105°F or higher will likely increase from below one million people currently to over 90 million by the year 2050, and to 180 million by 2100 (*Dahl et al. 2019*).

Inequities in Vulnerability & Driving Displacement

Across the United States, high temperatures have been shown to have unevenly distributed impacts, with sick, elderly, low-income, non-white, homeless and other historically marginalized people most affected *(Harlan et al. 2006, Reid et al. 2009)*. Heat waves and chronically high temperatures can present deadly health risks by increasing rates of heart attacks, heat strokes, and other cardiovascular and respiratory mortality *(Curriero et al. 2002, Medina-Ramón et al. 2006)*. In 1995, more than 700 people were killed during a heat wave in Chicago, many of whom were isolated, elderly, African-American residents living in apartments without air conditioning *(Klinenberg 1999)*. In 2006, a severe heat wave in California's Central Valley killed at least 146 people, the majority of whom were members of Latinx farm laborer communities facing high levels of heat exposure while working outdoors *(Knowlton et al. 2009, Mera et al. 2015)*. One study estimates that an increase of 5°F in average annual temperatures, which corresponds to a low-to-moderate GHG emissions scenario by the end of this century, could result in nearly 2,000 additional heat-related deaths nationwide each summer *(Bobb et al. 2014)*.

Staying cool during heat waves and increasingly long and hot summers is vitally important, but can be difficult, expensive, or impossible for many, especially in disadvantaged communities. One study in New York City revealed that some 30% of residents in the city's most impoverished neighborhoods did not have air conditioning in their homes, compared to only 1% of those in the wealthiest neighborhoods *(Ito et al. 2018)*. Another study of New York City found that poverty and access to air conditioning were strong predictors of heat-related mortality among seniors *(Rosenthal et al. 2014)*. Racial inequities in access to air conditioning and resultant disproportionality of heat-related deaths have also been well-documented across the U.S. *(Fletcher et al. 2012, Harlan 2006, Jesdale 2013, Mitchell 2014, O'Neill et al. 2005, Rosenthal et al. 2014)*. For example, an analysis of Chicago, Detroit, Minneapolis and Pittsburgh found that air conditioning prevalence in black households was less than half of what it was in white households, and that deaths among black residents were more strongly associated with heat waves as compared to white residents *(O'Neill et al. 2005)*.

While households without pre-existing AC units experience increased pressure to purchase cooling units, numerous household surveys cite cost pressures as a common reason for going without. Increased cooling needs during heat waves and summer months result in higher expenditures on electricity for powering AC, fans and other methods of cooling. The increased financial burden of additional cooling-related expenditures can be substantial for many households, especially for renters and low-income residents *(Cook et al. 2008, Hernandez & Bird 2010)*. Tenants already struggling to pay rent and other bills are often forced to decide between buying food or paying for electricity *(Bhattacharaya et al 2003, Evens 2017, Harrison & Popke, 2011, Hernandez & Bird, 2010)*. An energy spending analysis for all U.S. households from 2001 to 2012 found that while households with annual incomes of $50,000 or greater spend on average 3% of their income on electricity, households making less than $10,000 annually spend about 33% of their incomes just to keep the lights on *(ACCCE 2013)*. This disproportionate burden is due not only to differences in incomes but also in housing quality and cooling efficiency, with houses and rental units in low-income and non-white areas tending to be older, poorly insulated and subject to neglect from landlords *(Bednar 2016, Boardman 2013, Evans 2004)*.

For many of these households, missed or delayed utility payments can exacerbate existing cycles of debt via late fees, power shut-offs, and additional charges for reconnection *(Evens 2017, Halpern-Meekin et al. 2015, Hernandez & Bird 2010)*. In a number of recent instances, power shut-offs have even resulted in the deaths of a number of elderly residents who had their electricity cut in months when extreme heat waves afflicted their communities *(Dahl et al. 2019)*. Currently, only 9 states have high temperature-based power cutoff restrictions *(Dahl et al. 2019)*. Limited evidence also suggests that increased energy burdens may drive displacement by increasing the likelihood of evictions for renters. One recent study found that, with all other factors held constant, there was a strong causal relationship between an increased monthly electric utility bill and the probability of receiving an eviction notice *(Finnigan & Meagher 2016)*. Building upgrades and retrofits, while needed to lessen the energy burden on renters, may create additional vulnerabilities for low-income renters if the cost of capital improvements is passed on to tenants in the form of increased rent *(Hernandez & Phillips 2015)*.

Many low-income communities and communities of color are also subject to urban heat island effects – the phenomena by which urban areas experience higher temperatures than surrounding rural areas. In some cases, temperature differences between urban centers and surrounding areas can exceed 5°F during the hottest part of the day and by up to 20°F in the early evening *(Akbari 2005, Richards & Bradshaw 2017)*. Neighborhoods within cities that generally experience the worst heat island effects are commonly low-income, non-white renter communities that have experienced decades of disinvestment and are densely developed and paved, while being devoid of shade and vegetation *(Gronlund 2014, Harlan 2006, Jenerette 2007, Jesdale 2013, Mitchell 2014, White-Newsome 2009)*. A study of over 100 cities around the country found that neighborhoods that were formerly "redlined" by the Home Owners' Loan Corporation – meaning that they were designated as hazardous areas for real estate investment based primarily on their racial makeup – have on average higher land surface temperatures than non-redlined areas, in some areas by as much as 7 degrees Celsius. *(Hoffman et al 2020; Rothstein 2017)*.

Though evidence has not shown extreme heat to directly displace communities in the same way that acute climate shocks do, extreme heat may drive indirect forms of displacement, principally by increasing energy-related costs – and in some cases the likelihood of evictions – for low-income households. Higher temperatures and increasingly severe and frequent heat waves may also shift market preferences for people overall. Numerous studies have shown that Americans will opt to pay more to avoid excess heat than excess cold, though not all residents can afford to be selective about where they live *(Albouy et al. 2016, Fan et al. 2012, Fan et al. 2016)*. Given that many of the nation's hottest regions (e.g. Southern California) are also areas of major population growth, it is difficult to say if heat-related environmental preferences are, or will be, reflected in the housing market *(Albouy et al. 2016)*. Those who would like to move because of the dangers or discomforts of high heat but cannot afford to do so may constitute "trapped populations" similar to those discussed in the case of sea-level rise.

Policy Highlights

While there have been many policy prescriptions aimed at reducing energy burdens and safeguarding against utility shut offs in the past, many of them have fallen short. The Low Income Home Energy Assistance Program (LIHEAP), for example, which provides utility bill assistance, is only utilized by a small percentage of households that qualify, largely due to uncoordinated outreach and implementation (*Colton 2014, Hernandez & Bird 2010*). Advocates have asserted that a more coordinated, regional approach focusing on energy conservation, energy literacy, and utility rate affordability would be the most effective (*Hernandez & Bird 2010*). Increasing the availability of free or subsidized weatherization programs to improve housing efficiency, especially of low-income and rental units, is important, albeit with safeguards to ensure existing tenants are not evicted in the process (*Hernandez & Bird 2010*). Tax credits, rebates and low-interest loans can also be employed to help lessen upfront costs for homeowners who would like to improve their homes' cooling efficiency (*Bednar 2016*).

Outreach programs explaining the dangers of heat-related illnesses and how to stay cool during heat waves, along with heat-based utility shutoff restrictions should be implemented nationwide (*Dahl et al. 2019, O'Neill et al. 2005*). California took an important step in this direction in 2017 when Gov. Jerry Brown signed SB 598 into law, which placed additional restrictions on utility shut-offs aimed at protecting vulnerable residents (*TURN 2017*). Urban greening projects, such as Los Angeles' goal of planting 90,000 new trees by 2021 as part of its L.A. Green New Deal plan, can have substantial benefits in terms of reducing urban heat island effects and are widely supported among residents (*Byrne et al. 2016, The City of Los Angeles 2019*).

CLIMATE STRESSOR: DROUGHT

Climate Context

Many regions of the world – particularly rural agricultural areas – depend upon regular patterns of rainfall, soil moisture and streamflows in order to grow crops, nourish livestock, and maintain the livelihoods of farming communities. Disruptions to these cycles, such as the occurrence of an extended drought, can induce shortages of food and potable water, fuel regional conflicts, and drive displacement among afflicted communities (*Antwi-Agyei et al. 2012, Gleick 2014, Hannah et al. 2017, Henry et al. 2004, Kelley et al. 2015, Tucker et al. 2010*).

SUMMARY: DROUGHT

- Droughts can have significant impacts on farmworker livelihoods and lead to their displacement by reducing economic opportunity.
- Droughts can have long-term effects on farmer communities, though droughts do not necessarily lead to farmer displacement in the U.S.
- Increased displacement of residents in neighboring countries due to drought events and their impacts on subsistence agricultural communities abroad may occur in the future.

Generally speaking, the scientific prognosis regarding trends in rainfall and drought patterns for a given region is less certain than it is regarding temperature. There is, however, fairly high certainty that many dry, subtropical regions (e.g. southern Mexico, Central America, portions of Sub-Saharan Africa, India etc.) will likely experience a higher frequency of droughts by the end of the 21st century due to human-induced climate change and reduced precipitation (*IPCC 2014*).This includes regions in the U.S. such as Hawaii, Puerto Rico, the U.S. Virgin Islands, and the U.S.-affiliated Pacific islands, where droughts are projected to increase in both frequency and severity in the coming decades (*Gould et al. 2018, Keener et al. 2018*). For the contiguous U.S., definitive trends in precipitation are less clear, though changing climate conditions are expected to influence and exacerbate drought conditions in some regions (*Wehner et al. 2017*). Warmer temperatures will dry the soils of farmlands and decrease the amount of rainfall falling as snow, which is of critical importance to water systems, particularly in western states dependent on mountain snowpack in winter for water supply throughout the year (*Knowles et al. 2006, Mao et al. 2015, Seager et al. 2015, Stewart et al. 2005*).

Even if annual precipitation totals do not decline, the earlier melting of snow and reduced snowpack may contribute to hydrologic drought (lack of adequate streamflow) during summer and fall months. (*Hidalgo et al. 2009, Pierce et al. 2008*). Some studies suggest that the southwestern and south-central regions of the U.S. will likely experience significant rainfall deficits in the spring and summer months, respectively, due to human-induced climate change (*Easterling et al. 2017, Ryu & Hayhoe 2017*). Additionally, there have been a number of studies that suggest that major droughts, such as the one in California from 2011 to 2015, are at least partially attributable to human influence on the climate and may be more likely to occur in the future (*Angélil et al. 2017, Diffenbaugh et al. 2015, Knutson et al. 2014, Swain et al. 2014*).

Inequities in Vulnerability & Driving Displacement

Rainfed agricultural communities in developing nations are particularly vulnerable, and residents often must seek employment in nearby urban centers or neighboring countries during times of drought (*Adger et al. 2015, Iglesias et al. 2009, Nawrotzki et al. 2015, Richards & Bradshaw 2017, Warner 2009*). Globally, millions of people have been documented in recent decades as migrating out of high-risk drought zones, primarily in Africa and South-Central Asia (*Richards & Bradshaw 2017*). Within the U.S, however, large-scale irrigation systems, federal subsidies and food imports decrease the vulnerability of agricultural communities and consumers to droughts, as compared to more climate-sensitive, rainfed-farming communities abroad. Therefore, fewer farming communities in the U.S. are forced to abandon their communities due directly to shortages of available food or potable water during a given drought. However, drought can act as a driver of indirect displacement in the U.S, especially for farm laborers seeking consistent employment or for farmers experiencing chronic loss of income during multi-year drought events (*Howitt et al. 2015, Lang 2015*). The distinction between “direct” and “indirect” displacement becomes slightly blurred in some of these cases, since droughts themselves do not bring acute, life-threatening climatic hazards. However, those fleeing droughts are often doing so as a direct result of lost employment and ensuing food insecurity, exemplifying how “direct” and “indirect” displacement exist along a continuum (as opposed to a binary classification).

Periods of drought in the U.S. do commonly have disproportionate impacts on certain communities, particularly farm laborer populations, often composed of predominantly low-income, Latinx immigrants. Employment opportunities and income can fluctuate dramatically for these workers depending on the level of productivity for a given agricultural season. At the height of the 2011–2015

California drought, curtailed farm-water deliveries, fallowed croplands and diminished agricultural production meant poverty rates among the farm laborer community throughout California's Central Valley soared (*Lang 2015*). Many California farm laborers were forced into marginal living situations or were driven from their communities in search of work. The small city of Mendota, CA, which has a majority farm-laborer population, saw many of its residents living in shanty towns and makeshift structures. The result was an exodus of many of these residents from the city in search of work elsewhere, such as the neighboring states of Oregon and Washington (*Lang 2015*). While many perceive farm labor to be an inherently mobile and temporary occupation, this has been less true in recent years. The USDA estimated in its 2017 Census of Agriculture that over 80% of farmworkers were not migrants, but rather settled and working at locations within 75 miles of their homes (*USDA-ERS 2020*). Therefore, drought-induced migration for these workers is often a costly, major disruption.

Impacts of drought on farmers themselves can also be drastic during times of drought. In 2015 alone, direct agricultural economic losses in California were estimated at about $1.8 billion, with a total economic impact statewide of over $2.7 billion (*Howitt et al. 2015*). There are few studies that specifically link the stresses of drought with the displacement of farmers within the U.S., but such events undoubtedly increase the debt burden and economic hardships of those affected and likely have diffuse effects in the decision-making process of smaller landholders and younger generations on whether to continue farming. One study does predict a net out-migration of nearly 4% of the adults living in rural counties throughout the country's Corn Belt by 2050 due to drought and other climate-related impacts on the region's crop yields, with even higher predicted values of out-migration by 2100 (*Feng et al. 2012*).

Drought also has the potential to continue to fuel displacement of people from other countries *into* the United States. While it remains difficult to confidently identify causal links between specific drought events and subsequent influxes of migrants into the U.S., there is a growing consensus that dry spells and droughts play an important role in the economic decision-making processes of members of vulnerable communities abroad, including the decision whether to emigrate. A recent study by the Inter-American Development Bank and the United Nations World Food Programme concluded that a major drought brought on by El Niño conditions in 2014 throughout Central America's Northern Triangle region (Guatemala, El Salvador, Honduras) caused a "significant increase in irregular migration to the United States" from 2014 to 2016 (*IDB et al. 2017*). A number of other studies and articles have also cited drought as being a major influencing factor for emigration from Central America to the United States in recent years, a trend that could potentially worsen if drought conditions grow more intense and more frequent, as predicted (*Arévalo et al. 2015, IOM et al. 2016, IPCC 2014, Steffans 2018*).

Policy Spotlight

An effective way to prevent drought-driven displacement among vulnerable communities, such as farm laborers, is to invest in alternative employment opportunities and skills-building programs that allow these workers to supplement their income locally during years of low agricultural production, or allow them to switch sectors altogether. One example is the program offered by the non-profit Proteus Inc. in Fresno, CA – a city in the heart of California's agricultural region – that provides training courses in solar panel design and installation, as well as truck driving (*Hecht 2015*). Many current, former and displaced farmworkers have taken advantage of these programs, which are funded in part by the U.S. Department of Labor and the California Employment Development Program, to find new supplemental and full-time careers in more stable industries, including those oriented toward a green energy transition (*Hecht 2015*). Programs like these can serve as a blueprint for other agricultural regions throughout the country facing instability due to droughts and climate change.

QUESTION 2

Unintended Consequences of Mitigation and Adaptation Strategies

Responding to the changing climate requires reducing greenhouse gas emissions (mitigation) as well as planning and preparing for its worsening impacts (adaptation), such as rising sea-levels, heat waves, droughts, fires, storms, and floods. Local and state actors have proposed or implemented a wide variety of climate change mitigation and adaptation (M/A) strategies, including land use, transportation and clean energy policies. These essential actions can, however, have unintended consequences for the communities in which they are applied, namely by raising property and housing values, and thereby contributing to the indirect displacement of vulnerable residents. This section presents findings from the literature on climate M/A measures, including urban greening, transit-oriented development, renewable energy and emissions trading policies, and their potential impacts on housing affordability, displacement, inequality and neighborhood change. Understanding negative impacts that may arise from such strategies can help policymakers weave necessary safeguards into these policies and even potentially leverage "green" investments to address not just climate goals, but those of housing affordability and displacement as well.

It is important to note that many of the policy strategies discussed, such as urban greening initiatives and transit-oriented development, are existing planning concepts that are not inherently climate-related. However, the climate change M/A benefits of such projects have made them common components of local and state climate plans. Unfortunately, there are many gaps in existing research. Much of the literature pertaining to the impacts of climate change M/A policies focuses on the impact of such measures on property and housing values, without directly discussing displacement or gentrification. While increasing property and housing prices may be precursors to displacement in certain cases, few studies explicitly make this connection explicit. Therefore, the discussion here of the ways in which climate M/A policies can act as a driver for indirect displacement and neighborhood change is largely based on this potential connection between higher housing prices and the displacement of economically vulnerable residents, rather than actual evidence of displacement.

In this section we focus primarily on urban greening, transportation, and energy-related adaptation and mitigation measures. Land use densification strategies – such as infill development, upzoning, and urban growth boundaries – may also help reduce greenhouse gas emissions by reducing vehicle miles traveled, and create climate change adaptation benefits through denser development *(Cohen 2018)*. Our initial review suggests that evidence is mixed on the extent to which these strategies contribute to displacement *(Angotti & Morse 2017, Been et al 2018, Freemark 2019, Haninger et al 2017, Lang & Cavanagh 2018, Mast 2019, Nelson et al 2002, Pough 2018, Zuk & Chapple 2016)*, suggesting a need for further research. There is a stronger body of evidence on urban greening initiatives to support climate mitigation and adaptation efforts, and their role in "green gentrification" if not implemented equitably. As a result, our review focuses primarily on urban greening, rather than densification, as a land use strategy for climate resilience.

URBAN GREENING

Strategies broadly categorized as urban greening consist of investments such as constructing parks and green space, planting trees and encouraging the use of community gardens and urban agriculture. From a mitigation and adaptation perspective, these initiatives help remove atmospheric carbon, cool urban heat islands, provide locally sourced food, and help manage stormwater runoff. However, we highlight research below that shows that urban greening often increases nearby property and housing prices, which can drive indirect displacement of low-income residents. Therefore, these strategies and investments, important as they are, should be implemented with concern to potential inequitable spillover effects that they may have on surrounding communities.

SUMMARY: URBAN GREENING

- Urban greening strategies – like parks, green space, trees and community agriculture – all tend to increase surrounding property values and may contribute to gentrification and displacement if not implemented equitably.
- Recent research shows that urban greenway type parks and park proximity to downtown areas are strong predictors of gentrification.
- While the presence of street trees tends to increase property values, trees may be valued differently depending on their type, size, and location on private vs public property.

Parks and Green Space

Parks, open space, and green space refer to land that is undeveloped and reserved for the purposes of formal and informal sport and recreation, preservation of natural environments, provision of green space, and/or urban stormwater management. Parks and open space are generally found to increase property values of surrounding homes, with proximity to parks and park type playing some role in the degree of influence on price. Many of the studies showing this relationship also reveal that proximity to parks has the greatest impact on prices and that there is an observable distance-decay function between parks and homes, meaning that the impact of park proximity on home prices diminishes as the distance between them increases (*Bolitzer & Netusil 2000, Cho et al. 2011a, Conway et al. 2010, Lutzenhiser & Netusil 2001, Miller 2001, Nicholls 2002*). In general, evidence shows that passive-use parks (i.e. walking paths, trees, open fields etc.) result in higher premiums in home values than parks serving active recreation users (i.e. basketball, softball, tennis courts) (*Crompton 2005, Crompton 2001, Hendon et al. 1967, More et al. 1988, Sainsbury 1964*). Findings are mixed regarding the role of park size on surrounding property values, with some studies showing that larger parks are associated with higher values (*Lutzenhiser & Netusil 2001, Miller 2001*), while others find smaller parks reflected in higher home values (*Treg 2010*, *Miller 2001*). Other factors, such as the relative abundance of park space, nearby home lot-sizes, and surrounding home types may influence the impact that parks have on surrounding property values (*Cho et al. 2011b, Dehring & Dunse 2006, Jim & Chen 2010, Miller 2001, Nicholls 2002*).

A smaller body of literature examines the role of parks in facilitating "green gentrification" specifically. A recent paper by Rigolon and Nemeth (*2019*) tests whether proximity to downtown cores, size, and function of new parks predict future gentrification of surrounding census tracts in 10 major U.S. cities. Their findings show that park type, particularly new greenway parks with walking/biking paths, and park proximity to downtown cores are strong predictors of gentrification, while park size is not. Their results support the findings of other studies focused on gentrification impacts of greenways in the U.S., which found that housing units near new greenway parks, such as the "BeltLine" in Atlanta, the "606" in Chicago, and the "High Line" in New York City, experienced higher price appreciation than those further away, a trend that is particularly pronounced for single family homes in low-income neighborhoods (*Immergluck 2009, Immergluck & Balan 2018*, *Loughran 2014*, *Rigolon & Nemeth 2018, Smith et al. 2016*).This contributes to declining affordability and potentially untenable property tax increases for low-income homeowners living in close proximity to new greenway projects, and may indirectly drive displacement for such residents.

It is worth noting that urban greening projects not only have the potential to usher in indirect displacement, but in some cases can lead to direct displacement. For example, in Atlanta, a water drainage tunnel built for the 1996 Olympics terminated in the neighborhood of Peoplestown south of downtown, and caused flooding that worsened following heavy rains in 2006 and 2012.The city is using eminent domain on several houses in the neighborhood to construct a park and pond as mitigation measures and residents have pushed back against these measures and the redevelopment as a vehicle for gentrification (*Albright, 2017*).

Street Trees

Street trees are planted in cities on public or private rights-of-way, forming part of urban tree canopies and urban forests. Trees remove carbon dioxide from the atmosphere (mitigation) and provide shade and cooling that lessens the intensity of urban heat island effects (adaptation) (*LA's Green New Deal 2019)*. In general, the presence of street trees is found to increase property values (*Anderson & Cordell 1988, Dombrow et al. 2000, Donavan & Butry 2010, Donavan & Butry 2011, Heckert & Mennis 2012, Morales 1980, Orland et al. 1992, Pandit et al. 2013, Theriault et al. 2002, Wachter & Wong 2008*). However, impacts on home values may vary depending on tree type, size, and location on public or private property, as well as household composition and stated preference for wooded areas (*Donavan & Butry 2011, Orland et al. 1992, Pandit et al. 2013, Theriault et al. 2002*).

Urban Agriculture and Community Farms and Gardens

Community farms and gardens are defined as any piece of land farmed or gardened by a group of people utilizing either shared or individual plots on public or private land, often at schools, institutions, or the grounds of residential developments. They provide climate change mitigation benefits primarily by providing a local, alternative food source, which does not have the embedded greenhouse gas emissions associated with the transportation of store-bought food *(Dubbeling & de Zeeuw 2011, McClintock 2010)*. While there is a limited amount of literature on the topic, existing studies and media coverage consistently show that community farms and gardens increase property values (*Fisher 1992, Guitart et al. 2012, Raver 1993, Voicu & Been 2008*). Research also highlights how urban farms and gardens can be vital community spaces that materially support low-income residents as a form of community development, and serve as sites of political and community engagement *(Aptekar 2015, Marche 2015, Martinez 2010, McClintock 2014, Ruelas et al 2011)*.

TRANSPORTATION

Cities and states utilize numerous transportation strategies in attempts to reduce dependence upon car travel and associated greenhouse gas emissions by expanding and improving modes of public transportation and infrastructure that promote walking, cycling, or rolling from one place to another. We reviewed literature on transit-oriented development, heavy and light passenger rail, bus rapid transit, pedestrian and bicycle infrastructure, and complete streets strategies (transportation policies and designs that enable streets to be safe and efficient for all people, regardless of transportation mode).

Transit-Oriented Development

Transit-oriented development (TOD) integrates a mix of residential, office, and commercial development into a walkable neighborhood that is within half a mile of access to public transportation, such as a light-rail station or bus stop. This form of development is often proposed in conjunction with upzoning in these areas to allow for higher housing density as part of efforts to reduce vehicle miles traveled as well as increase housing supply. Studies of TOD find that areas adjacent to transit stops often experience enhanced commercial activity with the introduction of shops, restaurants, and other businesses that attract commuters and non-commuters alike, and that proximity to public transit and faster commute times often leads to higher home values and rents, resulting in gentrification and sometimes displacement as well

SUMMARY: TRANSPORTATION

- » Rail station areas are more likely to experience gentrification and displacement than areas without a transit stop, though context matters. Transit-oriented development and new rail stations increase surrounding property values and may drive gentrification and displacement, though properties immediately adjacent to new stations may decrease in value. Findings are mixed, and more research is needed specifically on the effects of new rail stations.
- » Evidence on the impact of new bus-rapid transit on surrounding property values is limited and mixed.
- » Investment in pedestrian infrastructure, bike infrastructure, and complete streets have mixed impacts on surrounding property values, with increases observed in some cases. More studies exploring the causal effects of such projects on property values are needed.

(*Bluestone et al. 2008, Chapple & Loukaitou-Sideris 2019, Wardrip 2011, Duncan 2008, Hess & Almeida 2007, Diaz 1999*). However, being immediately adjacent to transit hubs has been shown to cause decreases in property values due to heightened noise, congestion, pollution, and traffic (*Cervero 2006, Kilpatrick et al. 2007*).

Passenger Rail

Passenger railways constitute public transit that operates on fixed rail lines and includes both heavy rail (elevated and or/separated from streets and traffic) and light rail (streetcars and other rail systems that may share roads, streetlights, and traffic with cars) systems. Findings are mixed as to whether rail station areas are more likely to experience gentrification and displacement than areas without a transit stop. Some studies find that new rail and transit developments often result in higher prices for nearby homes and with them the prospect of "transit-induced gentrification" (*Chapple et al 2017, Dawkins 2016*). One such study in Los Angeles found that both new heavy and light rail stations contributed to an uptick in nearby housing prices and gentrification, though the effects of new heavy rail stations were slightly higher than that of new light rail stations (*Brown 2015*). In contrast, Boarnet et al. (2017) examined new rail station-induced displacement in Los Angeles and found mixed results. Move-out rates surrounding Gold Line stations increased for all income groups, with the greatest effect observed among higher-income households; however, surrounding Red and Purple Line stations, an increase in out-migration was only observed among the lowest-income households *(Boarnet et al. 2017)*.

Equitable transit-oriented development (ETOD) has become an important pillar of anti-displacement strategies overall. One study of the Washington, D.C., Metro rail system and surrounding housing impacts suggests that implementing housing subsidies via supply-side mechanisms like Low-Income Housing Tax Credit housing, Section 8 Project-Based Rental Assistance, or Community Development Block Grants specifically in transit zones can serve as effective ways of creating low-income housing near transit (*Dawkins and Moeckel 2016*). Acting to acquire land for affordable housing production before a transit investment is announced and land values go up is another strategy to promote neighborhood affordability. For example, TriMet, a transit agency in Portland, acquired and banked land adjacent to a light rail expansion, and then dedicated it to subsidized housing development, leveraging transit money and federal funds (*Zuk and Carlton 2015*). The $24 million Denver Regional Transit-Oriented Development Fund makes similar kinds of strategic acquisitions. Other strategies include transit-based affordable housing production incentives, such as the Los Angeles Gold and Blue Line TOD Ordinance, which allows a density bonus of up to 50 percent in certain transit neighborhoods along the Gold and Blue lines if at least one-third of the new units are for low-income households or half of the units are reserved for qualifying senior citizens.

Bus Rapid Transit

Bus Rapid Transit (BRT) is defined as a bus transit service that operates on surface streets but in its own dedicated lanes. Adoption of BRT systems in the U.S. is still relatively nascent, though given the construction speed and cost advantages it holds over rail systems, it is beginning to become more widespread nationally. However, much of the literature to date focuses on other countries and generally offers mixed evidence regarding BRT's impact on surrounding land and property values. A number of studies find that BRT has little or no impact on property values (*Cervero & Duncan 2002,* *Knight & Trygg 1977, Rodŕiguez & Targa 2004*), while others find that it leads to significant increases in property values and rents of surrounding residential areas (*Brown 2014, Bocarejo et al 2013, Muñoz-Raskin 2010, Perk & Catalá 2009*).

Pedestrian Infrastructure and Walkability

Expanding and improving pedestrian infrastructure entails constructing a network of paths and sidewalks that make walkable commutes viable. Studies consistently and universally find that residential properties located in walkable areas are associated with higher property values (*Bliesner et al 2010, Cortright 2009, Leinberger 2013, Leinberger & Alfonzo 2012, Pivo & Fisher 2009, Sohn et al. 2012, Washington 2013*). However, these findings are correlative and do not represent robust evidence of a causal link between walkability and increased values.

Bike Infrastructure

Expanding and improving bicycle infrastructure means ensuring that a network of pathways and lanes is in place to enable cycling and similar forms of mobility. The majority of studies examining bike infrastructure find that proximity to bike infrastructure tends to be associated with higher property values and serves as a specific selling point for sellers and a desired amenity for buyers (*Asabere & Huffman 2009, City of Vancouver 1999, Greer 2000, Lagerway & Punochar 1987, Li & Joh 2017, Lindsey 2004, Macy & Macdonald 1995, Miller 1992, Moore 1992, Racca & Dhanju 2006, Welch et al. 2016*). Given disparate investment in bicycle facilities in relatively privileged areas, bike infrastructure has frequently been a flashpoint in gentrification disputes (*Chavis et al 2018, Flanagan et al. 2016, Hoffman 2013*). Despite many studies finding positive or neutral impact from the presence of cycling infrastructure, a number of additional studies have found bike facilities to be negatively associated with property values (*Lindsey 2004, Netusil 2005, Woolley 2018*). Given the wide variety of bicycle infrastructure types studied, from greenway trails to bike lane improvements, it is difficult to draw firm conclusions as to the likely effects of bike infrastructure investments on surrounding property values.

Complete Streets

Complete streets are a transportation, policy, and design approach that requires streets to be planned, designed, operated, and maintained to enable safe and efficient mobility access for all users, regardless of transportation mode. There is a relative lack of research specifically addressing the effect of complete streets on housing prices and/or displacement. However, one San Francisco study found that the city's complete streets yielded increased property values (*Yu et al. 2018*), while an analysis of complete streets in cities throughout New York and New Jersey found no statistically significant relationship between complete streets and property values (*Vandegrift & Zanoni 2018*). More research is needed to fully understand the impact of complete streets on surrounding communities, though many of its individual components, such as bike and transit-oriented infrastructure, do have relatively more, albeit oftentimes mixed, evidence.

ENERGY

We reviewed literature on both energy efficiency measures and renewable energy technology in order to assess how such investments can influence housing prices and potentially contribute to gentrification and displacement. Buildings are major energy consumers, so improving their energy efficiency significantly helps reduce overall greenhouse gas emissions and other pollutants and can also be effective in lowering household energy costs. Investing in renewable energy sources such as solar and wind at the individual building or neighborhood scale is also an important step toward reducing emissions. Renewable energy can also have adaptation benefits. Given the more distributed and modular nature of renewables, they are less prone to large-scale failure during storms and other disasters.

SUMMARY: ENERGY

- Improved energy efficiency raises property values but eases utility costs, which can have countervailing effects on displacement.
- Nearby wind farms have little to no effect on surrounding property values in the U.S.
- Rooftop solar increases property values at the building-level though more studies are needed, particularly to assess impacts on surrounding properties.

Energy Efficiency

Residential energy efficiency can include a wide variety of energy-saving measures that reduce energy use from lighting, heating and cooling, water use, and appliances. Research done to date overwhelmingly supports the finding that, regardless of geography or climate, the value of a property increases with the addition of energy efficiency measures (*Alberini 2013, Brounen & Kok 2011, Dinan & Miranowski 1989, Hyland et al. 2013, Jafari et al. 2017, Nevin & Watson 1998, Pride et al. 2018, Schweitzer & Tonn 2002, Ugarte 2016*). One national study found that energy efficient homes increased value by roughly 4–10%, though in cold states, such as Alaska, this was as high as 16% (*Nevin & Watson 1998*). The impact of these increased housing values on the displacement of low-income residents is complex. This is due to the fact that while improved energy efficiency can make housing less affordable, it also serves to lower utility bills and burdens for renters and homeowners, thereby reducing the risk of utility shut-offs or eviction (*Schweitzer & Tonn 2002*).

Wind Energy

Wind energy refers to the process of harnessing energy from passing currents of air and converting it to electricity. Research on the impact of wind turbines on property values yields mixed results, with the majority of U.S. studies finding that neither the announcement of planned wind farms nor their installation had appreciable impact on nearby property values (*Atkinson-Palombo & Hoen 2014, Carter 2011, Hoen et al. 2011, Laposa & Mueller 2010, Rakitan 2017, Sims et al. 2008, Sterzinger et al. 2003*). However, a number of non-U.S. studies found that wind turbines negatively impact property values (*Dröes & Koster 2016, Gibbons 2015, Heintzelman & Tuttle 2012, Jensen, Panduro, & Lundhede 2014, Sunak & Madlener 2012, Sunak & Madlener 2016, Sunak & Madlener 2017*).

Solar Energy

Solar photovoltaic systems absorb and convert energy from the sun into electricity. Various types of solar generation exist, from small-scale rooftop solar panels and medium-sized community solar gardens, up to large, utility-scale solar plants. Research examining the intersection of solar panels and property values is fairly new, though three different studies and literature reviews suggest a positive relationship between property values and associated rooftop solar installations (*Brinkley & Leach 2018, Dastrup, et al. 2012, Mandell & Wilhelmsson 2011*). These studies found that rooftop solar increased property values for homes on which they were installed, that new homes were more likely than older ones to increase in price with solar installations and that price impacts were related to neighborhood composition and the relative abundance of solar on surrounding homes.

EMISSIONS TRADING SCHEMES (CAP & TRADE)

Some recent research has focused on the social and environmental equity impacts of large-scale climate mitigation efforts, such as regional cap and trade programs for the market-based trading of greenhouse gas emissions credits. Examples include California's cap and trade system (known as AB-32) implemented in 2006. Though there is no research suggesting that these programs have direct impacts on displacement, they may have inequitable health consequences for some disadvantaged communities by concentrating emissions and air pollutants in certain areas (*Cushing et al. 2018, Shonkoff et al. 2009*). Though these findings have been the subject of debate (*Farber 2012, Walch 2018*), California has pledged to reinvest a portion of its revenues from this program into disadvantaged communities statewide in an effort to address environmental injustices more broadly. Large-scale climate change mitigation policies like these are desperately needed at the national and global levels, but should nevertheless be implemented equitably. For example, Transformative Climate Communities (TCC), one of the programs that leverages cap-and-trade dollars toward improving wellbeing in disadvantaged communities, requires that investments be paired with place-based Displacement Avoidance Plans.

QUESTION 3

Vulnerability of Anti-Displacement Strategies to Climate Change

Anti-displacement strategies are broadly defined as public policies and investments aimed at preventing the displacement of vulnerable residents in a given community. In the context of the U.S., these strategies most commonly consist of regulations that are geared toward providing support to low-income residents facing increasing housing and other living costs so that they may be able to remain in their home communities. Examples of such anti-displacement strategies include the provision of publicly owned or subsidized affordable housing, inclusionary zoning and other affordability-oriented densification approaches, community land trusts, local employment programs, rent stabilization ordinances and eviction protections, utility payment assistance programs, and nutritional assistance programs, to name a few (see *Cash and Zuk 2019* for inventory of anti-displacement strategies). However, anti-displacement strategies also include disaster relief and recovery assistance programs that are specifically aimed at alleviating post-disaster burdens and thus decreasing the risk of permanent displacement of impacted residents. While not all of these anti-displacement strategies are directly vulnerable to a changing climate, they are all challenged by the economic and displacement impacts of climate change, pointing to a need for a thoughtful climate lens on their implementation.

SUMMARY: ANTI-DISPLACEMENT STRATEGIES

- Subsidized housing developments are often constructed with non-resilient materials and often located in high-risk areas like floodplains or fire zones. Many policies have been proposed to reduce the climate vulnerability of affordable housing projects, including prohibiting the building of new developments in high-risk zones and involving community stakeholders in the planning and pre-construction phases.
- By preserving community ownership of land and providing affordable housing within high-risk areas, community land trusts (CLT) can serve as a useful tool in combating both affordable housing shortages and climate vulnerability. However, communities in the U.S. have not succeeded in scaling the CLT model.

Some strategies, however, are explicitly vulnerable to physical climate hazards, such as subsidized housing developments, which are often constructed with non-resilient materials and often located in high-risk areas, like floodplains or fire zones. Only a small number of states are attempting to build publicly subsidized housing with climate-resilient materials due to higher costs, though these extra costs have been steadily decreasing in recent years (*Duffrin 2019*). Investing the extra dollars for climate-resilient materials is likely to pay for itself, especially in highly climate-vulnerable regions, such as along the coast or in tornado-prone areas (housing construction quality has been shown to be one of the biggest predictors of tornado-caused deaths) (*Duffrin 2019, Lim et al. 2017*). Poor construction of government-owned or subsidized housing is one of the reasons that low-income communities are disproportionately affected by climate impacts. Investment in more climate-resilient construction can reduce vulnerability to floods and storms (*Martin et al. 2013, Ross 2013*).

Nearly a half million government-subsidized homes – roughly 9% of the nation's total – are located in floodplains, with many more located in areas at high risk of storm-related damage (*Hammett & Worzala 2018, Rosoff & Yager 2017*). However, these floodplains delineated by FEMA are largely out of date and do not account for worsening climate risks such as rising sea levels, more frequent extreme storms, and heavy rainfall, likely causing underestimates in the calculations of flood-vulnerable housing (*Mervosh 2019, Rosoff & Yager 2017*). One study of Florida housing funded by federal Low Income Housing Tax Credits (LIHTC) – the country's largest source of funding for affordable, multifamily housing – found that roughly 70% of these developments were located in coastal counties, and roughly a third of this housing stock statewide would likely be damaged or destroyed by a Category 5 hurricane. Some Florida counties stood to lose almost 100% of their LIHTC housing stock in such an event, including in areas where overall damage to other structures was relatively low (*Hammett & Worzala 2018, Uhlmann 2018*). Though many existing affordable housing projects were constructed before concerns regarding climate change were as prevalent as they are today, the new construction of affordable housing across the country has continued in high-risk areas in recent years, largely due to the low prices of climate-vulnerable lands (*Hammett & Worzala 2018, Mervosh 2019*, *Uhlmann 2018*). In Florida, over two-thirds of new LIHTC housing stock was constructed in zones vulnerable to storm surges from 2004 to 2010 (*Worzala & Hammett 2017*). Environmental justice advocates point out racial and socioeconomic inequities caused by high-risk, affordable housing developments, citing the legacy racist redlining practices as likely having contributed to the placement of earlier low-income housing projects in flood zones (*Mervosh 2019*).

Some argue that the affordable housing crisis warrants the rapid construction of cheaply constructed housing units, even if they are located in high-risk zones, because abandoning existing developments in these zones without replacing them will worsen housing shortages and affordability (*Duffrin 2019*, *Mervosh 2019*). However, construction of new projects without proper regard for climate threats can end up exacerbating the displacement of low-income residents if these developments are destroyed by a storm, flood, or fire. Many residents displaced from government-subsidized housing are provided with interim housing vouchers to be used in the private housing market, but research shows that voucher holders are often discriminated against by landlords *(Cunningham et al. 2018).* After government-subsidized housing projects are damaged or destroyed, reconstruction efforts can be slow or incomplete, and homes are often simply rebuilt in the same high-risk zones as before (*Cusick 2018, Mervosh 2019, Mock 2019*). This is partly due to the unique regulatory structure surrounding public housing projects. For example, FEMA relief for damaged LIHTC housing projects is limited to Small Business Administration grants, which makes rehabilitation efforts more debt-laden in comparison to restoration efforts of non-subsidized housing (*Hammett & Worzala 2018*). Additionally, the tight operating budgets and restrictions against rent increases in LIHTC and other publicly subsidized housing projects makes weatherizing and improving climate-resiliency financially difficult, resulting in the neglect of badly needed upgrades (*Yager 2015*). However, for developments located in extreme-risk areas, investing in such upgrades may never be cost-effective due to the likelihood of destruction. The priority for such communities should be on relocation and reconstruction in safer areas (*Duffrin 2019*).

Many policies have been proposed to improve the climate vulnerability of affordable housing projects. These include obvious measures like prohibiting the building of new developments in high-risk zones, as well as involving community stakeholders in the planning and pre-construction phases of new affordable housing projects (*Giambrone 2019, Worzala & Hammett 2017*). It is critical to assess geographic climate risks using up-to-date scientific information and analysis; such assessments should guide all housing development decisions, including affordable/public housing (*Hammett & Worzala 2018*). Expanding the overall share and availability of affordable housing (perhaps by expanding LIHTC or disaster recovery community development block grants) may help address the affordable housing shortage following disasters (*Ross 2013*). Protective infrastructure, such as dams, levees, barriers, grading, and landscaping should be maintained and constructed when necessary to protect existing affordable housing developments in high-risk zones (*Ross 2013, Uhlmann 2019*). Protective upgrades of housing units, via weatherization or replacement of poor construction materials, should be implemented without raising prices on tenants (*Ross 2013*). One innovative example of developing green affordable housing is PUSH Buffalo's "Green Development Zones," where $60 million has been invested in green affordable housing, green infrastructure, and stormwater management in zones specifically designated for green development and green jobs creation (*Ghirmatzion 2019*). Climate-vulnerable residents living in extreme risk zones could potentially qualify for housing vouchers, allowing them to relocate to safer areas while local governments move or reconstruct high-risk housing projects (*Mervosh 2019*).

Another anti-displacement strategy, community land trusts (CLTs), is rapidly gaining momentum as a way to safeguard affordable housing in neighborhoods experiencing rapid increases in housing prices. By preserving community ownership of land and providing affordable housing within these areas, CLTs can serve as a useful tool in combating both affordable housing shortages and climate vulnerability. Though CLTs located in high-risk zones, such as flood plains, will accordingly be vulnerable to the effects of climate change, they more likely can serve to improve community resilience to climate change by allowing communities to return and rebuild without facing the climate-driven gentrification that may follow major storms or other shocks. The Caño Martín Peña CLT in Puerto Rico has allowed residents to return and recover from climate disasters, such as Hurricane Maria, more quickly and reliably than surrounding areas (*Leon 2019*). Additionally, many CLTs incorporate a mission of sustainable land stewardship, which can have both climate mitigation and adaptation benefits (*Land Trust Alliance 2020*).

Conclusion

Climate shocks and stressors exacerbate patterns of displacement. Some climate M/A strategies result, albeit unintentionally, in higher property values. Some existing anti-displacement strategies are themselves vulnerable to climate stresses, while others have unrealized potential to mitigate climate hazards.

There are vast inequities in vulnerability to climate shocks and stressors between different socioeconomic and racial groups, especially related to exposure to these hazards and the ability to recover from them. These shocks and stressors also drive displacement, with shocks like storms, floods and fires responsible for both directly and indirectly displacing residents, while stressors like sea level rise, extreme heat and drought more strongly drive indirect displacement. Without proactive policy measures to improve climate resilience and address inequities in vulnerability, climate-driven displacement is likely to worsen as climate hazards become more frequent and intense.

Several commonly used policy strategies aimed at reducing greenhouse gas emissions and improving climate resilience at a local level can potentially have the unintended effects of accelerating gentrification and displacement of low-income residents in certain neighborhoods. This is due to the fact that many of these investments, such as transit-oriented development, parks and greenways, and rooftop solar can result in higher property values in surrounding communities. While many of these M/A strategies are essential parts of the fight to address climate change, they should be implemented with proper attention paid to the potential for the unintended, inequitable impacts they might have.

Finally, a large portion of the nation's affordable housing stock has been constructed in high-risk areas like floodplains, fire-prone areas and zones of storm surge. Additional construction of such housing continues in these areas due to cheap land prices, with little planning for the natural risks from climate change. Poor construction quality of such housing also contributes to their vulnerability to climate hazards. Still, affordable housing as well as other anti-displacement policies may help to mitigate the threats of climate change, suggesting a potential path forward.

APPENDIX A

Literature Review Search Terms

<table>
<tr><th>DISPLACEMENT</th><th>CLIMATE HAZARD</th><th>MITIGATION & ADAPTATION</th></tr>
<tr><td>Neighborhood change
Housing affordability
Housing price
Housing mobility
Property values
Property appreciation
Displacement
Gentrification
Dislocation
Relocation
Right to return
Utility costs
Evictions</td><td>Climate gentrification
Climate displacement
Climate migration
Disaster recovery, reconstruction
Rising sea level
Nuisance flooding, tidal floods
Extreme heat
Heat wave
Urban heat island
Drought
Storms, storm surge
Extreme weather
Hurricanes
Typhoons
Tropical storm
Wildfire, forest fire
Fire insurance
Insurance redlining</td><td rowspan="3">Energy efficiency
Renewable energy (solar, wind)
Green building certification
Urban growth controls
Infill development
Upzoning, densification
Brownfield redevelopment
Parks & open space
Street trees
Urban agriculture and gardens
Stormwater management
Transit-Oriented Development
Bus Rapid Transit
Fixed rail (heavy & light)
Walking, walkability
Pedestrian infrastructure
Biking, bike infrastructure
Complete streets
EV charging infrastructure
Zero-emission vehicles</td></tr>
<tr><th>ANTI-DISPLACEMENT</th><th>VULNERABILITY</th></tr>
<tr><td>Affordable housing
Inclusionary zoning
Rent control
Rent regulations
Code enforcement
Building codes
Preservation, acquisition</td><td>Renter, owner
Public housing
Affordable housing
Housing quality
Segregation
Income, low-income, poverty
Race, racism, racial equity
Environmental justice
Toxics, toxic exposure
Citizenship, immigration</td></tr>
</table>

APPENDIX B

References Matrix

	QUESTION 1	QUESTION 2	QUESTION 3	TOTAL*
ACADEMIC	145	104	3	**251**
GRAY	48	26	6	**79**
MEDIA	40	3	9	**50**
TOTAL	**233**	**133**	**18**	

* Totals do not add up because a small number of sources were referenced in multiple sections.

References

Abatzoglou, J.T. and Williams, A.P., 2016. Impact of anthropogenic climate change on wildfire across western US forests. *Proceedings of the National Academy of Sciences*, 113(42), pp.11770-11775.

Adams, V., Van Hattum, T. and English, D., 2009. Chronic disaster syndrome: Displacement, disaster capitalism, and the eviction of the poor from New Orleans. *American ethnologist*, 36(4), pp.615-636.

Adger, W.N., Arnell, N.W., Black, R., Dercon, S., Geddes, A. and Thomas, D.S., 2015. Focus on environmental risks and migration: causes and consequences. *Environmental Research Letters*, 10(6), p.060201.

Adrien, J., Page, R., 2019. 'Climate Gentrification in Little Haiti: Fighting climate-induced displacement through legal advocacy and economics' [PowerPoint presentation]. *Community Justice Project and Earth Economics*.

Akbari, H., 2005. Energy saving potentials and air quality benefits of urban heat island mitigation (No. LBNL-58285). Ernest Orlando *Lawrence Berkeley National Laboratory, Berkeley*, CA (US).

Alberini, A., Banfi, S. and Ramseier, C., 2013. Energy efficiency investments in the home: Swiss homeowners and expectations about future energy prices. *The Energy Journal*, 34(1).

Albouy, D., Graf, W., Kellogg, R. and Wolff, H., 2016. Climate amenities, climate change, and American quality of life. *Journal of the Association of Environmental and Resource Economists*, 3(1), pp.205-246.

Albright, C., 2017. Gentrification is sweeping through America. Here are the people fighting back. *The Guardian*.

American Coalition for Clean Coal Electricity (ACCCE), 2015. Energy Cost Impacts on American Families. *American Coalition for Clean Coal Electricity* (Report).

Anderson, L.M. and Cordell, H.K., 1988. Influence of trees on residential property values in Athens, Georgia (USA): A survey based on actual sales prices. *Landscape and Urban Planning*, 15(1-2), pp.153-164.

Angélil, O., Stone, D., Wehner, M., Paciorek, C.J., Krishnan, H. and Collins, W., 2017. An independent assessment of anthropogenic attribution statements for recent extreme temperature and rainfall events. *Journal of Climate*, 30(1), pp.5-16.

Angotti, T. and Morse, S. eds., 2017. *Zoned Out!: Race, Displacement, and City Planning in New York City*. Urban Research (UR).

Antwi-Agyei, P., Fraser, E.D., Dougill, A.J., Stringer, L.C. and Simelton, E., 2012. Mapping the vulnerability of crop production to drought in Ghana using rainfall, yield and socioeconomic data. *Applied Geography*, 32(2), pp.324-334.

Aptekar, S., 2015, March. Visions of public space: Reproducing and resisting social hierarchies in a community garden. *Sociological Forum*, 30(1), pp. 209-227.

Arévalo, M., Mazariegos, F., Portal, I., Salinas, R., Caravantes, L., Herrarte, G., Barrientos, C., 2015. Como un Factor de Migrácion Interna y Externa dentro de un Contexto de Violencia y Crimen en los Países del Triángulo Norte: Guatemala, Honduras y El Salvador. *International Organization for Migration, United Nations World Food Programme*.

Asabere, P.K. and Huffman, F.E., 2009. The relative impacts of trails and greenbelts on home price. *The Journal of Real Estate Finance and Economics*, 38(4), pp.408-419.

Atkinson-Palombo, C. and Hoen, B., 2014. Relationship between wind turbines and residential property values in Massachusetts. University of Connecticut.

Baptiste, N., 2017. When Texas' Most Toxic Sites Flooded These Are the Communities that Suffered Most. *Mother Jones*.

Bastien, M. 2019. Little Haiti is Fighting Climate Change. *UC Berkeley - The Othering & Belonging Institute*.

Bednar, D., 2016. The Intersection of Energy and Justice: Exploring the Spatial, Racial, and Socioeconomic Patterns of Residential Heating Affordability, Consumption and Efficiency in Wayne County, Michigan (Doctoral dissertation). University of Michigan.

Been, V., Ellen, I.G. and O'Regan, K., 2019. Supply skepticism: Housing supply and affordability. *Housing Policy Debate*, 29(1), pp.25-40.

Berger, A., Susskind, J., 2018. Cataloguing the Interface: Wildfire and Urban Development in California. *MIT - Leventhal Center for Advanced Urbanism*.

Bhattacharya, J., DeLeire, T., Haider, S. and Currie, J., 2003. Heat or eat? Cold-weather shocks and nutrition in poor American families. *American Journal of Public Health*, 93(7), pp.1149-1154.

Binkovitz, L., 2016. As slow disaster recoveries plague residents, some argue key to relief is 'precovery'. *Kinder Institute for Urban Research Urban Edge Blog*.

Blakely, E.J., 2008. The Elliot Richardson Lecture 2008: Ethics in Times of Crisis. *Public Integrity*, 10(4), pp.355-364.

Bliesner, J., Bouton, S. and Schultz, B., 2010. Walkable Neighborhoods: An Economic Development Strategy. *AARP Livable Communities*.

Bluestone, B., Stevenson, M.H. and Williams, R., 2008. *The Urban Experience: Economics, Society, and Public Policy*. Oxford University Press.

Boardman, B., 2013. *Fixing Fuel Poverty: Challenges and Solutions*. Routledge.

Boarnet, M.G., Bostic, R.W., Rodnyansky, S., Santiago-Bartolomei, R., Williams, D. and Prohofsky, A., 2017. Sustainability and Displacement: Assessing the Spatial Pattern of Residential Moves Near Rail Transit. *UC Davis: National Center for Sustainable Transportation*.

Bobb, J.F., Peng, R.D., Bell, M.L. and Dominici, F., 2014. Heat-related mortality and adaptation to heat in the United States. *Environmental health perspectives*, 122(8), pp.811-816.

Bocarejo, J.P., Portilla, I. and Pérez, M.A., 2013. Impact of Transmilenio on Density, Land Use, and Land Value in Bogotá. *Research in Transportation Economics*, 40(1), pp.78-86.

Bolitzer, B. and Netusil, N.R., 2000. The impact of open spaces on property values in Portland, Oregon. *Journal of Environmental Management*, 59(3), pp.185-193.

Boyd, R., 2019. Has Climate Gentrification Hit Miami? The City Plans to Find Out. *The Natural Resources Defense Council - Southeast Dispatch* (Article).

Brinkley, C. and Leach, A., 2019. Energy next door: A meta-analysis of energy infrastructure impact on housing value. *Energy Research & Social Science*, 50, pp.51-65.

Brounen, D. and Kok, N., 2011. On the economics of energy labels in the housing market. *Journal of Environmental Economics and Management*, 62(2), pp.166-179.

Brown, A., 2014. Neighborhood Change Along the Orange Line (Doctoral dissertation, University of California, Los Angeles).

Brown, A.E., 2015. Uneven Effects: The Mixed Story of Transit-Oriented Gentrification in Los Angeles. *Critical Planning*, 22(1).

Bruggers, J., 2018. FEMA Flood Maps Ignore Climate Change, and Homeowners Are Paying the Price. *Inside Climate News*.

Bryant, B. and Westerling, A., 2008. Potential effects of climate change on residential wildfire risk in California. California Energy Commission, *PIER Energy Related Environmental Research Program* CEC-500-2009-048-D.

Bryant, B.P. and Westerling, A.L., 2014. Scenarios for future wildfire risk in California: links between changing demography, land use, climate, and wildfire. *Environmetrics*, 25(6), pp.454-471.

Bubenik, T., 2018. As Post-Harvey Buyout Money Rolls In, Some Have Already Given Up On The Program. *Houston Public Media*.

Bullard, R.D., Mohai, P., Saha, R. and Wright, B., 2008. Toxic wastes and race at twenty: Why race still matters after all of these years. *Environmental Law*, 38, p.371.

Burby, R.J., Steinberg, L.J. and Basolo, V., 2003. The tenure trap: The vulnerability of renters to joint natural and technological disasters. *Urban Affairs Review*, 39(1), pp.32-58.

Byrne, J., Ambrey, C., Portanger, C., Lo, A., Matthews, T., Baker, D. and Davison, A., 2016. Could urban greening mitigate suburban thermal inequity? the role of residents' dispositions and household practices. *Environmental Research Letters*, 11(9), p.095014.

California Department of Forestry and Fire Protection, 2019. Top 20 Most Destructive California Wildfires. *CAL-FIRE Media*.

California Office of the Attorney General. FAQs on Price Gouging. *State of California Department of Justice*. Available at: https://oag.ca.gov/consumers/pricegougingduringdisasters

California Wildfire Strike Force, 2019. Wildfires and Climate Change: California's Energy Future. Governor Newsom's Strike Force (Report).

Campo-Flores, A., Kusisto, L., 2019. On Higher Ground, Miami's Little Haiti Is the New Darling of Developers. *The Wall Street Journal*.

Capps, K., 2018. Why Are These Tiny Towns Getting So Much Hurricane Harvey Aid? *CityLab*.

Carter, J., 2011. The effect of wind farms on residential property values in Lee County, Illinois, Preliminary Draft. Illinois State University.

Cash, A., Zuk, M., 2019. Investment Without Displacement: From Slogan to Strategy. *Shelterforce*.

Cervero, R. and Duncan, M., 2002. Transit's Added Value. At what point does locating near transit raise real estate values? *Urban Land*, 61(2), pp.77-87.

Cervero, R., 2006. Effects of light and commuter rail transit on land prices: Experiences in San Diego County. *Journal of the Transportation Research Forum*.

Chapple, K. and Loukaitou-Sideris, A., 2019. *Transit-Oriented Displacement Or Community Dividends? Understanding the Effects of Smarter Growth on Communities*. MIT Press.

Chapple, K., Waddell, P., Chatman, D., Zuk, M., Loukaitou-Sideris, A., Ong, P., Gorska, K., Pech, C. and Gonzalez, S.R., 2017. Developing a new methodology for analyzing potential displacement. University of California, Berkeley and University of California, Los Angeles.

Chapple, K., Zuk, M., 2015. Gentrification Explained. *Urban Displacement Project*. Available at: https://www.urbandisplacement.org/gentrification-explained.

Chavis, C., Barnes, P.J., Grasso, S., Bhuyan, I.A., Nickkar, A., 2018. Bicycle Justice or Just Bicycles? Analyzing Equity in Baltimore's Bike Share Program. *Department of Transportation and Urban Infrastructure at Morgan State University*.

Cho, S.H., Kim, S.G. and Roberts, R.K., 2011b. Values of environmental landscape amenities during the 2000–2006 real estate boom and subsequent 2008 recession*. Journal of Environmental Planning and Management*, 54(1), pp.71-91.

Cho, S.H., Lambert, D.M., Kim, S.G., Roberts, R.K. and Park, W.M., 2011a. Relationship between value of open space and distance from housing locations within a community. *Journal of Geographical Systems*, 13(4), pp.393-414.

Christensen, J.H., Kanikicharla, K.K., Aldrian, E., An, S.I., Cavalcanti, I.F.A., De Castro, M., Dong, W., Goswami, P., Hall, A., Kanyanga, J.K. and Kitoh, A., 2013. Climate phenomena and their relevance for future regional climate change. In Climate Change 2013 the Physical Science Basis: Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (pp. 1217-1308). Cambridge University Press.

City of Vancouver, 1999. 1999 Bicycle Plan: Reviewing the Past, Planning the Future. City of Vancouver Engineering Services and Bike Vancouver.

Climate Central and Zillow, 2018. Ocean at the Door: New Homes and the Rising Sea. *Climate Central and Zillow* (Research Report).

Cohen, D.A., 2018. Climate Justice and the Right to the City. Penn: Current Research on Sustainable Urban Development. Philadelphia: University of Pennsylvania.

Colton, R., 2014. May Illinois 2013 Home Energy Affordability Gap. Available from. http://www.homeenergyaffordabilitygap.com.

Comerio, M.C., 1997. Housing issues after disasters. *Journal of Contingencies and Crisis Management*, 5(3), pp.166-178.

Community Justice Project, 2018. Demand an Equitable Recovery. *Community Justice Project*. Available at: http://communityjusticeproject.com/cdbg.

Conway, D., Li, C.Q., Wolch, J., Kahle, C. and Jerrett, M., 2010. A spatial autocorrelation approach for examining the effects of urban greenspace on residential property values. *The Journal of Real Estate Finance and Economics*, 41(2), pp.150-169.

Cook, J.T., Frank, D.A., Casey, P.H., Rose-Jacobs, R., Black, M.M., Chilton, M., Decuba, S.E., Appugliese, D., Coleman, S., Heeren, T. and Berkowitz, C., 2008. A brief indicator of household energy security: associations with food security, child health, and child development in US infants and toddlers. *Pediatrics*, 122(4), pp.e867-e875.

Cortright, J., 2009. Walking the walk: How walkability raises home values in US cities. *CEOs for Cities*.

Crompton, J.L., 2001. The impact of parks on property values: A review of the empirical evidence. *Journal of Leisure Research*, 33(1), pp.1-31.

Crompton, J.L., 2005. The impact of parks on property values: empirical evidence from the past two decades in the United States. *Managing Leisure*, 10(4), pp.203-218.

Crowder, K. and Downey, L., 2010. Inter-neighborhood migration, race, and environmental hazards: Modeling microlevel processes of environmental inequality. *American Journal of Sociology*, 115(4), pp.1110-1149.

Crutcher Jr, M.E., 2010. *Tremé: Race and Place in a New Orleans Neighborhood (Vol. 5)*. University of Georgia Press.

Cunningham, M., Galvez, M., Aranda, C.L., Santos, R., Wissoker, D.A., Oneto, A.D., Pitingolo, R. and Crawford, J., 2018. A Pilot Study of Landlord Acceptance of Housing Choice Vouchers. *US Department of Housing and Urban Development, Office of Policy Development and Research*.

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.

Curtis, K.J. and Schneider, A., 2011. Understanding the demographic implications of climate change: estimates of localized population predictions under future scenarios of sea-level rise. *Population and Environment*, 33(1), pp.28-54.

Cushing, L., Blaustein-Rejto, D., Wander, M., Pastor, M., Sadd, J., Zhu, A. and Morello-Frosch, R., 2018. Carbon trading, co-pollutants, and environmental equity: Evidence from California's cap-and-trade program (2011–2015). *PLoS Medicine*, 15(7).

Cusick, D., 2018. We want the opportunity to rebuild out of the floodplain. *ClimateWire*.

Cutter, S.L. and Emrich, C.T., 2006. Moral hazard, social catastrophe: The changing face of vulnerability along the hurricane coasts. *The Annals of the American Academy of Political and Social Science*, 604(1), pp.102-112.

Dahl, K., Spanger-Siegfried, E., Licker, R., Caldas, A., Abatzoglou, J., Mailloux, N., Cleetus, R., Udvardy, S., Declet-Barreto, J., Worth, P., 2019. Killer Heat in the United States. *The Union of Concerned Scientists* (Report).

Dangendorf, S., Marcos, M., Wöppelmann, G., Conrad, C.P., Frederikse, T. and Riva, R., 2017. Reassessment of 20th century global mean sea level rise. *Proceedings of the National Academy of Sciences*, 114(23), pp.5946-5951.

Dastrup, S. and Ellen, I.G., 2016. Linking residents to opportunity: gentrification and public housing. *Cityscape*, 18(3), pp.87-108.

Dastrup, S.R., Zivin, J.G., Costa, D.L. and Kahn, M.E., 2012. Understanding the Solar Home price premium: Electricity generation and "Green" social status. *European Economic Review*, 56(5), pp.961-973.

Dawkins, C. and Moeckel, R., 2016. Transit-induced gentrification: Who will stay, and who will go? *Housing Policy Debate*, 26(4-5), pp.801-818.

Deaton, J., 2017. Hurricane Harvey Hit Low-Income communities hardest. *Nexus Media News*.

Dehring, C. and Dunse, N., 2006. Housing density and the effect of proximity to public open space in Aberdeen, Scotland. *Real Estate Economics*, 34(4), pp.553-566.

Diaz, R.B., 1999. Impacts of Rail Transit on Property Values. McLean, VA: *Booz Allen & Hamilton Inc*, (pp. 1-8).

Dickerson, A.M., 2017. Hurricane Harvey and the Houston Housing Market. *Texas Law Review Online*, 96, pp.102.

Diffenbaugh, N.S., Scherer, M. and Trapp, R.J., 2013. Robust increases in severe thunderstorm environments in response to greenhouse forcing. *Proceedings of the National Academy of Sciences*, 110(41), pp.16361-16366.

Diffenbaugh, N.S., Swain, D.L. and Touma, D., 2015. Anthropogenic warming has increased drought risk in California. *Proceedings of the National Academy of Sciences*, 112(13), pp.3931-3936.

Dinan, T.M. and Miranowski, J.A., 1989. Estimating the implicit price of energy efficiency improvements in the residential housing market: A hedonic approach. *Journal of Urban Economics*, 25(1), pp.52-67.

Dombrow, J., Rodriguez, M. and Sirmans, C.F., 2000. The market value of mature trees in single-family housing markets. *Appraisal Journal*, 68(1), pp.39-43.

Donovan, G.H. and Butry, D.T., 2010. Trees in the city: Valuing street trees in Portland, Oregon. *Landscape and Urban Planning*, 94(2), pp.77-83.

Donovan, G.H. and Butry, D.T., 2011. The effect of urban trees on the rental price of single-family homes in Portland, Oregon. *Urban Forestry & Urban Greening*, 10(3), pp.163-168.

Dröes, M.I. and Koster, H.R., 2016. Renewable energy and negative externalities: The effect of wind turbines on house prices. *Journal of Urban Economics*, 96, pp.121-141.

Dubbeling, M. and De Zeeuw, H., 2011. Urban Agriculture and Climate Change Adaptation: Ensuring Food Security Through Adaptation. In *Resilient Cities* (pp. 441-449). Springer, Dordrecht.

Duffrin, L., 2019. Three Approaches to Preventing Climate Displacement. *Crosswalk Magazine*.

Duncan, M., 2008. Comparing rail transit capitalization benefits for single-family and condominium units in San Diego, California. *Transportation Research Record*, 2067(1), pp.120-130.

Easterling, D.R., K.E. Kunkel, J.R. Arnold, T. Knutson, A.N. LeGrande, L.R. Leung, R.S. Vose, D.E. Waliser, and M.F. Wehner, 2017: Precipitation change in the United States. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. *U.S. Global Change Research Program*, Washington, DC, USA, pp. 207-230, doi: 10.7930/J0H993CC.

Edgeley, C.M. and Paveglio, T.B., 2017. Community recovery and assistance following large wildfires: The case of the Carlton Complex Fire. *International Journal of Disaster Risk Reduction*, 25, pp.137-146.

Elliott, J.R. and Howell, J., 2017. Beyond disasters: a longitudinal analysis of natural hazards' unequal impacts on residential instability. *Social Forces*, 95(3), pp.1181-1207.

Elsner, J.B., Elsner, S.C. and Jagger, T.H., 2015. The increasing efficiency of tornado days in the United States. *Climate Dynamics*, 45(3-4), pp.651-659.

Evans, G.W., 2004. The environment of childhood poverty. *American Psychologist*, 59(2), p.77.

Evens, A., Garascia, M. and Isaacson, M., 2017. Utilities and health: Energy efficiency as a common link. *The Electricity Journal*, 30(5), pp.10-14.

Fan, Q., Klaiber, H.A. and Fisher-Vanden, K., 2012. Climate change impacts on us migration and household location choice (No. 323-2016-11437). *AgEcon Search*.

Fan, Q., Klaiber, H.A. and Fisher-Vanden, K., 2016. Does extreme weather drive interregional brain drain in the US? Evidence from a sorting model. *Land Economics*, 92(2), pp.363-388.

Farber, D.A., 2012. Pollution markets and social equity: Analyzing the fairness of cap and trade. *Ecology Law Quarterly*.

Federal Home Loan Mortgage Corporation (Freddie Mac), 2016. Life's a Beach. *Freddie Mac - Insight* (Article).

Feng, S., Oppenheimer, M. and Schlenker, W., 2012. Climate change, crop yields, and internal migration in the United States (No. w17734). *National Bureau of Economic Research*.

Finnigan, R. and Meagher, K., 2016, March. Energy Costs and Housing-Related Deprivation in the United States. *In 2016 Annual Meeting. PAA*.

Finnigan, R. and Meagher, K.D., 2019. Past Due: Combinations of Utility and Housing Hardship in the United States. *Sociological Perspectives*, 62(1), pp.96-119.

Fisher, I., 1992. A blessing for gardens where green is so rare. *New York Times*.

Flanagan, E., Lachapelle, U. and El-Geneidy, A., 2016. Riding tandem: Does cycling infrastructure investment mirror gentrification and privilege in Portland, OR and Chicago, IL? *Research in Transportation Economics*, 60, pp.14-24.

Flannigan, M., Stocks, B., Turetsky, M. and Wotton, M., 2009. Impacts of climate change on fire activity and fire management in the circumboreal forest. *Global Change Biology*, 15(3), pp.549-560.

Flechas, J., Harris, A., 2018. What would Miami build with $58 million the city wants to borrow? Here's the list. *The Miami Herald*.

Fletcher, B.A., Lin, S., Fitzgerald, E.F. and Hwang, S.A., 2012. Association of summer temperatures with hospital admissions for renal diseases in New York State: a case-crossover study. *American Journal of Epidemiology*, 175(9), pp.907-916.

Freemark, Y., 2019. Upzoning Chicago: Impacts of a zoning reform on property values and housing construction. *Urban Affairs Review*, pp.1-32.

Frey, W.H. and Singer, A., 2006. Katrina and Rita impacts on gulf coast populations: First census findings. Washington: Brookings Institution, *Metropolitan Policy Program*.

Frey, W.H., Singer, A. and Park, D., 2007. Resettling New Orleans: The first full picture from the Census. *Brookings Institution Metropolitan Policy Program*.

Fuller, T., Haner, J., 2019. Among the World's Most Dire Places: This California Homeless Camp. *The New York Times*.

Fussell, E. and Harris, E., 2014. Homeownership and housing displacement after Hurricane Katrina among low-income African-American mothers in New Orleans. *Social Science Quarterly*, 95(4), pp.1086-1100.

Fussell, E., 2015. The long-term recovery of New Orleans' population after Hurricane Katrina. *American Behavioral Scientist*, 59(10), pp.1231-1245.

Fussell, E., Sastry, N. and VanLandingham, M., 2010. Race, socioeconomic status, and return migration to New Orleans after Hurricane Katrina. *Population and Environment*, 31(1-3), pp.20-42.

Gaither, C.J., Poudyal, N.C., Goodrick, S., Bowker, J.M., Malone, S. and Gan, J., 2011. Wildland fire risk and social vulnerability in the Southeastern United States: An exploratory spatial data analysis approach. *Forest Policy and Economics*, 13(1), pp.24-36.

Gao, Y., Lu, J., Leung, L.R., Yang, Q., Hagos, S. and Qian, Y., 2015. Dynamical and thermodynamical modulations on future changes of landfalling atmospheric rivers over western North America. *Geophysical Research Letters*, 42(17), pp.7179-7186.

Ghirmatzion, 2019. 'People United for Sustainable Housing: A Just Transition Story' [PowerPoint presentation]. *People United for Sustainable Housing Buffalo*.

Giambrone, A., 2019. Three-quarters of D.C. metro residents say they support laws to stop building in high-risk areas. *Curbed - Washington D.C.* (Article).

Gibbons, S., 2015. Gone with the wind: Valuing the visual impacts of wind turbines through house prices. *Journal of Environmental Economics and Management*, 72, pp.177-196.

Gleick, P.H., 2014. Water, drought, climate change, and conflict in Syria. *Weather, Climate, and Society*, 6(3), pp.331-340.

Godschalk, D., Beatley, T., Berke, P., Brower, D. and Kaiser, E.J., 1998. *Natural Hazard Mitigation: Recasting Disaster Policy and Planning*. Island Press.

Goetz, E., 2011. Gentrification in black and white: The racial impact of public housing demolition in American cities. *Urban Studies*, 48(8), pp.1581-1604.

Gould, W.A., E.L. Díaz, (co-leads), N.L. Álvarez-Berríos, F. Aponte-González, W. Archibald, J.H. Bowden, L. Carrubba, W. Crespo, S.J. Fain, G. González, A. Goulbourne, E. Harmsen, E. Holupchinski, A.H. Khalyani, J. Kossin, A.J. Leinberger, V.I. Marrero-Santiago, O. Martínez-Sánchez, K. McGinley, P. Méndez-Lázaro, J. Morell, M.M. Oyola, I.K. Parés-Ramos, R. Pulwarty, W.V. Sweet, A. Terando, and S. Torres-González, 2018: U.S. Caribbean. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. *U.S. Global Change Research Program*, Washington, DC, USA, pp. 809–871. doi: 10.7930/NCA4.2018.CH20

Graif, C., 2016. (Un) natural disaster: vulnerability, long-distance displacement, and the extended geography of neighborhood distress and attainment after Katrina. *Population and Environment*, 37(3), pp.288-318.

Greater Houston Flood Mitigation Consortium, 2019. Affordable Multi-Family Housing: Risks and Opportunities. *Greater Houston Flood Mitigation Consortium, Houston*.

Green, N., 2018. In Miami's Little Haiti, one of the largest waves of evictions is currently underway. *Public Radio International (PRI)*.

Green, N., 2019. As Seas Rise, Miami's Black Communities Fear Displacement From The High Ground. *WLRN - Miami*.

Greer, D.L., 2000. Omaha recreational trails: their effect on property values and public safety. *Recreation and Leisure Studies Program, University of Nebraska at Omaha*.

Groen, J.A. and Polivka, A.E., 2010. Going home after Hurricane Katrina: Determinants of return migration and changes in affected areas. *Demography*, 47(4), pp.821-844.

Gronlund, C.J., 2014. Racial and socioeconomic disparities in heat-related health effects and their mechanisms: a review. *Current Epidemiology Reports*, 1(3), pp.165-173.

Guitart, D., Pickering, C. and Byrne, J., 2012. Past results and future directions in urban community gardens research. *Urban Forestry & Urban Greening*, 11(4), pp.364-373.

Halpern-Meekin, S., Edin, K., Tach, L. and Sykes, J., 2015. *It's not like I'm poor: How working families make ends meet in a post-welfare world*. Univ of California Press.

Hamel, L., Wu, B., Brodie, M., Sim, S.C. and Marks, E., 2017. An Early Assessment of Hurricane Harvey's Impact on Vulnerable Texans in the Gulf Coast Region: Their Voices and Priorities to Inform Rebuilding Efforts. *Henry J. Kaiser Family Foundation*.

Hammett, L., Worzala, E., 2018. The Devastating Impact of Storm Surge on Coastal Communities A Case Study on Florida's Low-Income Housing Tax Credit Projects. *Real Estate Issues*, Volume 42, Number 12.

Haninger, K., Ma, L. and Timmins, C., 2017. The value of brownfield remediation. *Journal of the Association of Environmental and Resource Economists*, 4(1), pp.197-241.

Hannah, L., Donatti, C.I., Harvey, C.A., Alfaro, E., Rodriguez, D.A., Bouroncle, C., Castellanos, E., Diaz, F., Fung, E., Hidalgo, H.G. and Imbach, P., 2017. Regional modeling of climate change impacts on smallholder agriculture and ecosystems in Central America. *Climatic Change*, 141(1), pp.29-45.

Hardy, R.D., Milligan, R.A. and Heynen, N., 2017. Racial coastal formation: The environmental injustice of colorblind adaptation planning for sea-level rise. *Geoforum*, 87, pp.62-72.

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.

Harrison, C. and Popke, J., 2011. "Because you got to have heat": the networked assemblage of energy poverty in eastern North Carolina. *Annals of the Association of American Geographers*, 101(4), pp.949-961.

Hauer, M.E., 2017. Migration induced by sea-level rise could reshape the US population landscape. *Nature Climate Change*, 7(5), p.321.

Heberger, M., Cooley, H., Herrera, P., Gleick, P.H., Moore, E., 2009. The Impacts of Sea-Level Rise on the California Coast. *The Pacific Institute*.

Hecht, P., 2015. Vanishing water, fewer jobs, but still hope in the Central Valley. *The Sacramento Bee*.

Heckert, M. and Mennis, J., 2012. The economic impact of greening urban vacant land: a spatial difference-in-differences analysis. *Environment and Planning A*, 44(12), pp.3010-3027.

Heintzelman, M.D. and Tuttle, C.M., 2012. Values in the wind: a hedonic analysis of wind power facilities. *Land Economics*, 88(3), pp.571-588.

Hendon, W.S., Kitchen, J.W. and Pringle, B., 1967. The sociological and economic impact of urban parks in Dallas, Texas. Lubbock, TX, *Tech University Press*

Henry, S., Schoumaker, B. and Beauchemin, C., 2004. The impact of rainfall on the first out-migration: A multi-level event-history analysis in Burkina Faso. *Population and Environment*, 25(5), pp.423-460.

Hernández, D. and Bird, S., 2010. Energy burden and the need for integrated low-income housing and energy policy. *Poverty & Public Policy*, 2(4), pp.5-25.

Hernández, D. and Phillips, D., 2015. Benefit or burden? Perceptions of energy efficiency efforts among low-income housing residents in New York City. *Energy Research & Social Science*, 8, pp.52-59.

Hersher, R., Benincasa, R., 2019. How Federal Disaster Money Favors The Rich. *National Public Radio*.

Hess, D.B. and Almeida, T.M., 2007. Impact of proximity to light rail rapid transit on station-area property values in Buffalo, New York. *Urban Studies*, 44(5-6), pp.1041-1068.

Hidalgo, H.G., Das, T., Dettinger, M.D., Cayan, D.R., Pierce, D.W., Barnett, T.P., Bala, G., Mirin, A., Wood, A.W., Bonfils, C. and Santer, B.D., 2009. Detection and attribution of streamflow timing changes to climate change in the western United States. *Journal of Climate*, 22(13), pp.3838-3855.

Higuera, P.E., Abatzoglou, J.T., Littell, J.S. and Morgan, P., 2015. The changing strength and nature of fire-climate relationships in the northern Rocky Mountains, USA, 1902-2008. *PloS One*, 10(6), p.e0127563.

Hoen, B., Wiser, R., Cappers, P., Thayer, M. and Sethi, G., 2011. Wind energy facilities and residential properties: the effect of proximity and view on sales prices. *Journal of Real Estate Research*, 33(3), pp.279-316.

Hoffman, J.S., Shandas, V. and Pendleton, N., 2020. The Effects of Historical Housing Policies on Resident Exposure to Intra-Urban Heat: A Study of 108 US Urban Areas. *Climate*, 8(1), p.12.

Hoffmann, M.L., 2013. Our bikes in the middle of the street: community-building, racism and gentrification in urban bicycle advocacy (doctoral dissertation). University of Minnesota.

Holden, Z.A., Swanson, A., Luce, C.H., Jolly, W.M., Maneta, M., Oyler, J.W., Warren, D.A., Parsons, R. and Affleck, D., 2018. Decreasing fire season precipitation increased recent western US forest wildfire activity. *Proceedings of the National Academy of Sciences*, 115(36), pp. E8349-E8357.

Howell, J. and Elliott, J.R., 2018. As Disaster Costs Rise, So Does Inequality. *Socius: Sociological Research for a Dynamic World*, 4(1), pp.1-3.

Howitt, R., MacEwan, D., Medellín-Azuara, J., Lund, J. and Sumner, D., 2017. Economic analysis of the 2015 drought for California agriculture. *UC Davis Center for Watershed Sciences*.

Hyland, M., Lyons, R.C. and Lyons, S., 2013. The value of domestic building energy efficiency—evidence from Ireland. *Energy Economics*, 40, pp.943-952.

Iglesias, A., Moneo, M. and Quiroga, S., 2009. Methods for evaluating social vulnerability to drought. In Coping with drought risk in agriculture and water supply systems (pp. 153-159). *Springer*, Dordrecht.

Immergluck, D. and Balan, T., 2018. Sustainable for whom? Green urban development, environmental gentrification, and the Atlanta Beltline. *Urban Geography*, 39(4), pp.546-562.

Immergluck, D., 2009. Large redevelopment initiatives, housing values and gentrification: the case of the Atlanta Beltline. *Urban Studies*, 46(8), pp.1723-1745.

Inter-American Development Bank (IDB), International Fund for Agricultural Development, International Organization for Migration and Organization of American States, United Nations World Food Programme, 2017. Food Security and Emigration: Why people flee and the impact on family members left behind in El Salvador, Guatemala, and Honduras. *Inter-American Development Bank, International Fund for Agricultural Development, International Organization for Migration and Organization of American States, United Nations World Food Programme*.

Internal Displacement Monitoring Centre (IDMC), 2019. Global Report on Internal Displacement 2019. *Internal Displacement Monitoring Centre* (Report).

International Organization for Migration (IOM), London School of Economics and Political Science, Organization of American States, United Nations World Food Programme, 2016. Hunger Without Borders, The hidden links between Food Insecurity, Violence and Migration in the Northern Triangle of Central America. *International Organization for Migration (IOM), London School of Economics and Political Science, Organization of American States, United Nations World Food Programme.*

IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. *IPCC, Geneva, Switzerland*, 151 pp.

Ito, K., Lane, K. and Olson, C., 2018. Equitable Access to Air Conditioning: A City Health Department's Perspective on Preventing Heat-related Deaths. *Epidemiology*, 29(6), pp.749-752.

Jafari, A., Valentin, V. and Berrens, R.P., 2017. Estimating the economic value of energy improvements in US residential housing. *Journal of Construction Engineering and Management*, 143(8), p.04017048.

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

Jensen, C.U., Panduro, T.E. and Lundhede, T.H., 2014. The vindication of Don Quixote: The impact of noise and visual pollution from wind turbines. *Land Economics*, 90(4), pp.668-682.

Jesdale, B.M., Morello-Frosch, R. and Cushing, L., 2013. The racial/ethnic distribution of heat risk–related land cover in relation to residential segregation. *Environmental Health Perspectives*, 121(7), pp.811-817.

Jim, C.Y. and Chen, W.Y., 2010. External effects of neighbourhood parks and landscape elements on high-rise residential value. *Land Use Policy*, 27(2), pp.662-670.

Kamel, N., 2012. Social marginalisation, federal assistance and repopulation patterns in the New Orleans metropolitan area following Hurricane Katrina. *Urban Studies*, 49(14), pp.3211-3231.

Kasler, D., Sabalow, R., Reese, P., 2019. 'Sticker shock' for California wildfire areas: Insurance rates doubled, policies dropped. *The Sacramento Bee*.

Keenan, J.M., Hill, T. and Gumber, A., 2018. Climate gentrification: from theory to empiricism in Miami-Dade County, Florida. *Environmental Research Letters*, 13(5), p.054001.

Keener, V., D. Helweg, S. Asam, S. Balwani, M. Burkett, C. Fletcher, T. Giambelluca, Z. Grecni, M. Nobrega-Olivera, J. Polovina, and G. Tribble, 2018: Hawai'i and U.S.-Affiliated Pacific Islands. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. *U.S. Global Change Research Program*, Washington, DC, USA, pp. 1242–1308. doi: 10.7930/NCA4.2018.CH27

Kelley, C.P., Mohtadi, S., Cane, M.A., Seager, R. and Kushnir, Y., 2015. Climate change in the Fertile Crescent and implications of the recent Syrian drought. *Proceedings of the National Academy of Sciences*, 112(11), pp.3241-3246.

Kilpatrick, J., Throupe, R., Carruthers, J. and Krause, A., 2007. The Impact of Transit Corridors on Residential Property Values. *Journal of Real Estate Research*, 29(3), pp.303-320.

Klein, N., 2007. *The Shock Doctrine: The Rise of Disaster Capitalism*. Macmillan.

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

Knight, R.L. and Trygg, L.L., 1977. Land use impacts of rapid transit: implications of recent experience. Final report (No. DOT-TPI-10-77-29). *De Leuw, Cather and Co., San Francisco, CA (USA).*

Knowles, N., Dettinger, M.D. and Cayan, D.R., 2006. Trends in snowfall versus rainfall in the western United States. *Journal of Climate*, 19(18), pp.4545-4559.

Knowlton, K., Rotkin-Ellman, M., King, G., Margolis, H.G., Smith, D., Solomon, G., Trent, R. and English, P., 2008. The 2006 California heat wave: impacts on hospitalizations and emergency department visits. *Environmental Health Perspectives*, 117(1), pp.61-67.

Knutson, T.R., Sirutis, J.J., Zhao, M., Tuleya, R.E., Bender, M., Vecchi, G.A., Villarini, G. and Chavas, D., 2015. Global projections of intense tropical cyclone activity for the late twenty-first century from dynamical downscaling of CMIP5/RCP4. 5 scenarios. *Journal of Climate*, 28(18), pp.7203-7224.

Knutson, T.R., Zeng, F. and Wittenberg, A.T., 2014. Seasonal and annual mean precipitation extremes occurring during 2013: A US focused analysis. *Bulletin of the American Meteorological Society*, 95(9), pp. S19-S23.

Kopp, R.E., DeConto, R.M., Bader, D.A., Hay, C.C., Horton, R.M., Kulp, S., Oppenheimer, M., Pollard, D. and Strauss, B.H., 2017. Evolving understanding of Antarctic ice-sheet physics and ambiguity in probabilistic sea-level projections. *Earth's Future*, 5(12), pp.1217-1233.

Kossin, J.P., T. Hall, T. Knutson, K.E. Kunkel, R.J. Trapp, D.E. Waliser, and M.F. Wehner, 2017: Extreme storms. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. *U.S. Global Change Research Program*, Washington, DC, USA, pp. 257-276, doi: 10.7930/J07S7KXX.

Krause, E. and Reeves, R.V., 2017. Hurricanes hit the poor the hardest. *Social Mobility Memos* (blog).

Kulp, S.A. and Strauss, B.H., 2019. New elevation data triple estimates of global vulnerability to sea-level rise and coastal flooding. *Nature Communications*, 10(1), pp.1-12.

Kusnetz, N., 2018. Norfolk Wants to Remake Itself as Sea Level Rises, but Who Will Be Left Behind? *Inside Climate News*.

L.A.'s Green New Deal: Sustainable City Plan, 2019. *Office of Los Angeles Mayor Eric Garcetti*. Available at https://plan.lamayor.org/sites/default/files/pLAn_2019_final.pdf.

Lagerway, P. and Punochar, B., 1988. Evaluation of the Burke-Gilman Trail's effect on property values and crime. *Transportation Research Record*, 1168, pp.57-59.

Land Trust Alliance, 2020. Jefferson Land Trust's Conservation Plan and Forward-Facing Forestry. Land Trust Alliance - Case Studies.

Lang, C. and Cavanagh, P., 2018. Incomplete Information and Adverse Impacts of Environmental Cleanup. *Land Economics*, 94(3), pp.386-404.

Lang, M., 2015. Without water, work or homes: Farm laborers displaced by drought. *San Francisco Chronicle*.

Laposa, S. and Mueller, A., 2010. Wind farm announcements and rural home prices: Maxwell ranch and rural Northern Colorado. *Journal of Sustainable Real Estate*, 2(1), pp.383-402.

Lee, D. and Jung, J., 2014. The growth of low-income population in floodplains: A case study of Austin, TX. *KSCE Journal of Civil Engineering*, 18(2), pp.683-693.

Leinberger, C.B. and Alfonzo, M., 2012. Walk this way: The economic promise of walkable places in metropolitan Washington, DC (p. 22). Washington, DC: *Brookings Institution*.

Leinberger, C.B. and Austin, M., 2013. The WalkUP Wake-Up Call: Atlanta. Atlanta, GA: *The George Washington University School of Business*.

Leon, H., 2019. Community Land Trusts in the Age of Climate Change. *Shelterforce*.

Levine, J.N., Esnard, A.M. and Sapat, A., 2007. Population displacement and housing dilemmas due to catastrophic disasters. *Journal of Planning Literature*, 22(1), pp.3-15.

Li, W. and Joh, K., 2017. Exploring the synergistic economic benefit of enhancing neighbourhood bikeability and public transit accessibility based on real estate sale transactions. *Urban Studies*, 54(15), pp.3480-3499.

Lim, J., Loveridge, S., Shupp, R. and Skidmore, M., 2017. Double danger in the double wide: Dimensions of poverty, housing quality and tornado impacts. *Regional Science and Urban Economics*, 65, pp.1-15.

Lindsey, G., Man, J., Payton, S. and Dickson, K., 2004. Property Values, Recreation Values, and Urban Greenways. *Journal of Park & Recreation Administration*, 22(3).

Lopez, L., 2019. 'Our Duwamish Valley: We are still here' [PowerPoint presentation]. Duwamish *River Cleanup Coalition*.

Loughran, K., 2014. Parks for profit: The high line, growth machines, and the uneven development of urban public spaces. *City & Community*, 13(1), pp.49-68.

Lund, J., Hanak, E., Fleenor, W., Bennett, W. and Howitt, R., 2010. Comparing futures for the Sacramento-San Joaquin delta (Vol. 3). Univ of California Press.

Lutzenhiser, M. and Netusil, N.R., 2001. The effect of open spaces on a home's sale price. *Contemporary Economic Policy*, 19(3), pp.291-298.

Lynn, K. and Gerlitz, W., 2006. Mapping the relationship between wildfire and poverty. USDA Forest Service Proceedings RMRS-P-41.

Lynn, K., 2003. Wildfire and rural poverty: disastrous connections. *Natural Hazards Observer*.

Macy, S., Alexander, L., Macdonald, S.H. and Ford, C., 1995. The effect of greenways on property values and public safety. *The Conservation Fund and Colorado State Parks State Trails Program, Colorado State Parks, State Trails Program*

Makaula, W., 2019. Homeowner's insurance rates in wildfire-prone areas on rise. *KCRA News*.

Mallakpour, I. and Villarini, G., 2015. The changing nature of flooding across the central United States. *Nature Climate Change*, 5(3), p.250.

Mandell, S. and Wilhelmsson, M., 2011. Willingness to pay for sustainable housing. *Journal of Housing Research*, 20(1), pp.35-51.

Mao, Y., Nijssen, B. and Lettenmaier, D.P., 2015. Is climate change implicated in the 2013–2014 California drought? A hydrologic perspective. *Geophysical Research Letters*, 42(8), pp.2805-2813.

Marche, G., 2015. What can urban gardening really do about gentrification? A case-study of three San Francisco community gardens. *European Journal of American Studies*, 10(3).

Marcus, J., Verma, P., 2017. Disaster and displacement in the Bay Area. *UC Berkeley Economics* (Blog).

Martin, C., Campillo, G., Meirovich, H., Navarrete, J., 2013. Climate Change Mitigation & Adaptation through Publicly-Assisted Housing Theoretical Framework for the IDB's Regional Policy Dialogue on Climate Change. *Inter-American Development Bank*.

Martinez, M.J., 2010. *Power at the Roots: Gentrification, Community Gardens, and the Puerto Ricans of the Lower East Side*. Lexington Books.

Martinich, J., Neumann, J., Ludwig, L. and Jantarasami, L., 2013. Risks of sea level rise to disadvantaged communities in the United States. *Mitigation and Adaptation Strategies for Global Change*, 18(2), pp.169-185.

Mast, E., 2019. The effect of new market-rate housing construction on the low-income housing market. Upjohn Institute Working Paper 19-307, *W.E. Upjohn Institute for Employment Research*.

McAlpine, S.A. and Porter, J.R., 2018. Estimating Recent Local Impacts of Sea-Level Rise on Current Real-Estate Losses: A Housing Market Case Study in Miami-Dade, Florida. *Population Research and Policy Review*, 37(6), pp.871-895.

McAlpine, S.A. and Porter, J.R., 2019. Rising Seas Erode $15.8 Billion in Home Value from Maine to Mississippi. *First Street Foundation* (Report).

McCabe, G.J. and Wolock, D.M., 2014. Spatial and temporal patterns in conterminous United States streamflow characteristics. *Geophysical Research Letters*, 41(19), pp.6889-6897.

McClintock, N., 2010. Why Farm the City? Theorizing Urban Agriculture Through a Lens of Metabolic Rift. *Cambridge Journal of Regions, Economy and Society*, 3(2), pp.191-207.

McClintock, N., 2014. Radical, reformist, and garden-variety neoliberal: coming to terms with urban agriculture's contradictions. *Local Environment*, 19(2), pp.147-171.

Medina-Ramón, M., Zanobetti, A., Cavanagh, D.P. and Schwartz, J., 2006. Extreme temperatures and mortality: assessing effect modification by personal characteristics and specific cause of death in a multi-city case-only analysis. *Environmental Health Perspectives*, 114(9), pp.1331-1336.

Mera, R., Massey, N., Rupp, D.E., Mote, P., Allen, M. and Frumhoff, P.C., 2015. Climate change, climate justice and the application of probabilistic event attribution to summer heat extremes in the California Central Valley. *Climatic Change*, 133(3), pp.427-438.

Mervosh, S., 2019. Unsafe to Stay, Unable to Go: Half a Million Face Flooding Risk in Government Homes. *The New York Times*.

Miller, A., Goodman, J., 2019. Striving for Equity in Post-Disaster Housing. *Planning Magazine*.

Miller, A.R., 2001. Valuing open space: Land economics and neighborhood parks (Doctoral dissertation, Massachusetts Institute of Technology).

Miller, M., 1992. The Impact of the Brush Creek Trail on Property Values and Crime. Environmental Studies and Planning Senior Project, Sonoma State University, Santa Rosa, CA.

Mitchell, B.C. and Chakraborty, J., 2014. Urban heat and climate justice: a landscape of thermal inequity in Pinellas County, Florida. *Geographical Review*, 104(4), pp.459-480.

Mitchell, C.M., Esnard, A.M. and Sapat, A., 2011. Hurricane events, population displacement, and sheltering provision in the United States. *Natural Hazards Review*, 13(2), pp.150-161.

Mock, B., 2019. Why Flood Victims Blame Their City, Not the Climate. *CityLab*.

Mockrin, M.H., Stewart, S.I., Radeloff, V.C., Hammer, R.B. and Alexandre, P.M., 2015. Adapting to wildfire: rebuilding after home loss. *Society & Natural Resources*, 28(8), pp.839-856.

Moftakhari, H.R., AghaKouchak, A., Sanders, B.F. and Matthew, R.A., 2017. Cumulative hazard: The case of nuisance flooding. *Earth's Future*, 5(2), pp.214-223.

Moore, M.M., Wallace Covington, W. and Fulé, P.Z., 1999. Reference conditions and ecological restoration: a southwestern ponderosa pine perspective. *Ecological Applications*, 9(4), pp.1266-1277.

Moore, R.L., 1992. The impacts of rail-trails: A study of the users and property owners from three trails. Rivers, Trails and Conservation Assistance Program, National Park Service, Washington, D.C.

Morales, D.J., 1980. The contribution of trees to residential property value. *Journal of Arboriculture*, 6(11), pp.305-308.

More, T.A., Stevens, T. and Allen, P.G., 1988. Valuation of urban parks. *Landscape and Urban Planning*, 15(1-2), pp.139-152.

Morris, M., 2018. Oft-flooded neighborhood slowly disappears, buyout by reluctant buyout. *Houston Chronicle*.

Mueller, E.J., Bell, H., Chang, B.B. and Henneberger, J., 2011. Looking for home after Katrina: postdisaster housing policy and low-income survivors. *Journal of Planning Education and Research*, 31(3), pp.291-307.

Munoz-Raskin, R., 2010. Walking accessibility to bus rapid transit: Does it affect property values? The case of Bogotá, Colombia. *Transport Policy*, 17(2), pp.72-84.

National Association of Insurance Commissioners (NAIC), 2019. Wildfires. *The Center for Insurance Policy and Research*.

National Oceanic and Atmospheric Administration - National Weather Service (NOAA - NWS), 2019. Annual U.S. Killer Tornado Statistics. *Storm Prediction Center*.

National Oceanic and Atmospheric Administration - Office for Coastal Management (NOAA - OCM), 2019. Fast Facts - Economics and Demographics.

National Oceanic and Atmospheric Administration (NOAA), 2018. Costliest U.S. tropical cyclones tables updated. *National Hurricane Center*.

Nawrotzki, R.J., Hunter, L.M., Runfola, D.M. and Riosmena, F., 2015. Climate change as a migration driver from rural and urban Mexico. *Environmental Research Letters*, 10(11), p.114023.

Nelson, A.C., Pendall, R., Dawkins, C.J. and Knaap, G.J., 2002. The Link Between Growth Management and Housing Affordability: The Academic Evidence. *Growth Management and Affordable Housing: Do They Conflict?* 117, p.158.

Netusil, N.R., 2005. The effect of environmental zoning and amenities on property values: Portland, Oregon. *Land Economics*, 81(2), pp.227-246.

Nevin, R. and Watson, G., 1998. Evidence of rational market valuations for home energy efficiency. *The Appraisal Journal*, 4(66), pp.401-409

Nicholls, S., 2002. Does open space pay? Measuring the impacts of green spaces on property values and the property tax base. College Station, TX, Texas A&M University (Doctoral dissertation).

Noss, R.F., 2011. Between the devil and the deep blue sea: Florida's unenviable position with respect to sea level rise. *Climatic Change*, 107(1-2), pp.1-16.

O'Neill, M.S., Zanobetti, A. and Schwartz, J., 2005. Disparities by race in heat-related mortality in four US cities: the role of air conditioning prevalence. *Journal of Urban Health*, 82(2), pp.191-197.

Olshansky, R.B., Johnson, L.A., Horne, J. and Nee, B., 2008. Longer view: Planning for the rebuilding of New Orleans. *Journal of the American Planning Association*, 74(3), pp.273-287.

Opdyke, J.D. 2005. Baton Rouge real estate becomes hot property. *The Wall Street Journal Online*.

Orland, B., Vining, J. and Ebreo, A., 1992. The effect of street trees on perceived values of residential property. *Environment and Behavior*, 24(3), pp.298-325.

Pais, J.F. and Elliott, J.R., 2008. Places as recovery machines: Vulnerability and neighborhood change after major hurricanes. *Social Forces*, 86(4), pp.1415-1453.

Pandit, R., Polyakov, M., Tapsuwan, S. and Moran, T., 2013. The effect of street trees on property value in Perth, Western Australia. *Landscape and Urban Planning*, 110, pp.134-142.

Passy, J., 2018. California wildfire victims face new challenges finding housing. *MarketWatch*.

Paterson, R.G., 1998. The third sector: Evolving partnerships in hazard mitigation (pp. 203-230). Joseph Henry Press, Washington, DC Pg.

Peacock, W.G., Van Zandt, S., Zhang, Y. and Highfield, W.E., 2014. Inequities in long-term housing recovery after disasters. *Journal of the American Planning Association*, 80(4), pp.356-371.

Peri, C., Rosoff, S., Yager, J., 2017. Population in the U.S. Floodplains. *NYU Furman Center* (Data Brief).

Perk, V.A. and Catala, M., 2009. Land use impacts of bus rapid transit: effects of BRT station proximity on property values along the Pittsburgh Martin Luther King, Jr. East Busway. *National Bus Rapid Transit Institute, Federal Transit Administration, and Department of Transportation*.

Peterman, C., Jones, D., Kahn, M., Nava, P., Wara, M., 2019. Final Report of the Commission on Catastrophic Wildfire Cost and Recovery. *California Governor's Office of Planning and Research* (Report).

Pierce, D.W., Barnett, T.P., Hidalgo, H.G., Das, T., Bonfils, C., Santer, B.D., Bala, G., Dettinger, M.D., Cayan, D.R., Mirin, A. and Wood, A.W., 2008. Attribution of declining western US snowpack to human effects. *Journal of Climate*, 21(23), pp.6425-6444.

Pivo, G. and Fisher, J.D., 2011. The walkability premium in commercial real estate investments. *Real Estate Economics*, 39(2), pp.185-219.

Poudyal, N.C., Johnson-Gaither, C., Goodrick, S., Bowker, J.M. and Gan, J., 2012. Locating spatial variation in the association between wildland fire risk and social vulnerability across six southern states. *Environmental Management*, 49(3), pp.623-635.

Pough, B., 2018. Neighborhood Upzoning and Racial Displacement: A Potential Target for Disparate Impact Litigation. *University of Pennsylvania Journal of Law and Social Change*, 21, pp. 267-294.

Pride, D., Little, J. and Mueller-Stoffels, M., 2018. The value of residential energy efficiency in interior Alaska: A hedonic pricing analysis. *Energy Policy*, 123, pp.450-460.

Quinton, S., 2019. As Wildfire Risk Increases, Home Insurance Is Harder to Find. PEW - Stateline.

Rabe Thomas, J., 2019. Separated by Design: How Some of America's Richest Towns Fight Affordable Housing. *The Connecticut Mirror*.

Racca, D.P. and Dhanju, A., 2006. Project Report for Property Value/Desirability Effects of Bike Paths Adjacent to Residential Areas. *Delaware Center for Transportation. The State of Delaware Department of Transportation*. Newark.

Radeloff, V.C., Helmers, D.P., Kramer, H.A., Mockrin, M.H., Alexandre, P.M., Bar-Massada, A., Butsic, V., Hawbaker, T.J., Martinuzzi, S., Syphard, A.D. and Stewart, S.I., 2018. Rapid growth of the US wildland-urban interface raises wildfire risk. *Proceedings of the National Academy of Sciences*, 115(13), pp.3314-3319.

Rakitan, T.J., 2017. Essays in the economics of energy development and disamenities (Doctoral dissertation). Iowa State University.

Ratcliffe, C., Congdon, W.J., Stanczyk, A., Teles, D., Martín, C. and Kotapati, B., 2019. Insult to Injury: Natural Disasters and Residents' Financial Health. *Urban Institute*.

Raver, A., 1993. Is this city big enough for gardens and houses? New York Times.

Reid, C.E., O'Neill, M.S., Gronlund, C.J., Brines, S.J., Brown, D.G., Diez-Roux, A.V. and Schwartz, J., 2009. Mapping community determinants of heat vulnerability. *Environmental Health Perspectives*, 117(11), pp.1730-1736.

Richards, J.A. and Bradshaw, S., 2017. Uprooted by Climate Change: Responding to the growing risk of displacement. *Oxfam*.

Rigolon, A. and Németh, J., 2018. "We're not in the business of housing:" Environmental gentrification and the nonprofitization of green infrastructure projects. *Cities*, 81, pp.71-80.

Rigolon, A. and Németh, J., 2019. Green gentrification or 'just green enough': Do park location, size and function affect whether a place gentrifies or not? *Urban Studies*, 57(2), pp.402-420.

Rodŕiguez, D.A. and Targa, F., 2004. Value of Accessibility to Bogotá's Bus Rapid Transit System. *Transport Reviews*, 24(5), pp.587-610.

Romps, D.M., Seeley, J.T., Vollaro, D. and Molinari, J., 2014. Projected increase in lightning strikes in the United States due to global warming. *Science*, 346(6211), pp.851-854.

Rosenbaum, E., 1996. Racial/ethnic differences in home ownership and housing quality, 1991. *Social Problems*, 43(4), pp.403-426.

Rosenthal, J.K., Kinney, P.L. and Metzger, K.B., 2014. Intra-urban vulnerability to heat-related mortality in New York City, 1997–2006. *Health & Place*, 30, pp.45-60.

Rosoff, S., Yager, J., 2017. Housing in the U.S. Floodplains. *New York University Furman Center* (Data Brief).

Ross, T., 2013. A Disaster in the Making: Addressing the Vulnerability of Low-Income Communities to Extreme Weather. *Center for American Progress*.

Rothstein, R., 2017. *The Color of Law: A Forgotten History of How Our Government Segregated America*. Liveright Publishing.

Ruelas, V., Iverson, E., Kiekel, P. and Peters, A., 2012. The role of farmers' markets in two low income, urban communities. *Journal of Community Health*, 37(3), pp.554-562.

Running, S.W., 2006. Is global warming causing more, larger wildfires? *Science*, 313(5789), pp.927-928.

Ryu, J.H. and Hayhoe, K., 2017. Observed and CMIP5 modeled influence of large-scale circulation on summer precipitation and drought in the South-Central United States. *Climate Dynamics*, 49(11-12), pp.4293-4310.

Sainsbury, J.C., 1964. The impact of urban parks on surrounding residential areas: A case study. Seattle, WA. (Master's Thesis, University of Washington).

Sampson, N.R., Gronlund, C.J., Buxton, M.A., Catalano, L., White-Newsome, J.L., Conlon, K.C., O'Neill, M.S., McCormick, S. and Parker, E.A., 2013. Staying cool in a changing climate: Reaching vulnerable populations during heat events. *Global Environmental Change*, 23(2), pp.475-484.

Sarmiento, C. and Miller, T.E., 2006. Inequities in flood management protection outcomes (No. 379-2016-21673). *AgEcon Search* (Conference Paper).

Scata, J., 2019. The Uncertain Flood Zone. *Shelterforce*.

Schweitzer, M. and Tonn, B., 2002. Non-energy benefits from the weatherization assistance program: A summary of findings from the recent literature. Prepared for U.S. Department of Energy, Oak Ridge National Laboratory, Oak Ridge, TN, USA.

Seager, R., Hoerling, M., Schubert, S., Wang, H., Lyon, B., Kumar, A., Nakamura, J. and Henderson, N., 2015. Causes of the 2011–14 California drought. *Journal of Climate*, 28(18), pp.6997-7024.

Sellers, F.S., Wilson, S., Craig, T., 2018. With illness in shelters and hotels at capacity, wildfire evacuees desperately seek refuge. *The Washington Post*.

Serna, J., 2019. California bans insurers from dropping policies in fire-ravaged areas. *The Los Angeles Times*.

Sheridan, S.C., 2007. A survey of public perception and response to heat warnings across four North American cities: an evaluation of municipal effectiveness. *International Journal of Biometeorology*, 52(1), pp.3-15.

Shonkoff, S.B., Morello-Frosch, R., Pastor, M. and Sadd, J., 2009. Minding the climate gap: environmental health and equity implications of climate change mitigation policies in California. *Environmental Justice*, 2(4), pp.173-177.

Shonkoff, S.B., Morello-Frosch, R., Pastor, M. and Sadd, J., 2009. Minding the climate gap: environmental health and equity implications of climate change mitigation policies in California. *Environmental Justice*, 2(4), pp.173-177.

Shuman, M., 2019. Fire risk leaves Tuolumne County residents scrambling to find affordable insurance. *Modesto Bee*.

Sims, S., Dent, P. and Oskrochi, G.R., 2008. Modelling the impact of wind farms on house prices in the UK. *International Journal of Strategic Property Management*, 12(4), pp.251-269.

Smith, G., Duda, S., Lee, J.M. and Thompson, M., 2016. Measuring the impact of the 606: understanding how a large public investment impacted the surrounding housing market. *Institute for Housing Studies at DePaul University*, Chicago.

Smith, K., 2016. This is how a California wildfire can change your homeowner's insurance rate. Press Telegram, *San Gabriel Valley Tribune*.

Sohn, D.W., Moudon, A.V. and Lee, J., 2012. The economic value of walkable neighborhoods. *Urban Design International*, 17(2), pp.115-128.

Southeast Florida Regional Climate Change Compact (SFRCCC) - Sea Level Rise Work Group, 2015. Unified Sea Level Rise Projection - Southeast Florida. Southeast Florida Regional Climate Change Compact (Report).

Squires, L., 2018. California Wildfires: Mapping Social Vulnerability. *Direct Relief*.

Steffans, G., 2018. Changing climate forces desperate Guatemalans to migrate. *National Geographic*.

Stephens, S.L., Agee, J.K., Fule, P.Z., North, M.P., Romme, W.H., Swetnam, T.W. and Turner, M.G., 2013. Managing forests and fire in changing climates. *Science*, 342(6154), pp.41-42.

Sterzinger, G., Beck, F., and Kostiuk, D., 2003. The effect of wind development on local property values. *Renewable Energy Policy Project*.

Stewart, I.T., Cayan, D.R. and Dettinger, M.D., 2005. Changes toward earlier streamflow timing across western North America. *Journal of Climate*, 18(8), pp.1136-1155.

Sun, L., Kunkel, K.E., Stevens, L.E., Buddenberg, A., Dobson, J.G. and Easterling, D.R., 2015. Regional surface climate conditions in CMIP3 and CMIP5 for the United States: differences, similarities, and implications for the US national climate assessment. *National Oceanographic and Atmospheric Administration* - Technical Report NESDIS 144.

Sunak, Y. and Madlener, R., 2012. The impact of wind farms on property values: a geographically weighted hedonic pricing model. *Institute for Future Energy Consumer Needs and Behavior*.

Sunak, Y. and Madlener, R., 2016. The impact of wind farm visibility on property values: A spatial difference-in-differences analysis. *Energy Economics*, 55, pp.79-91.

Sunak, Y. and Madlener, R., 2017. The impact of wind farms on property values: A locally weighted hedonic pricing model. *Papers in Regional Science*, 96(2), pp.423-444.

Swain, D.L., Tsiang, M., Haugen, M., Singh, D., Charland, A., Rajaratnam, B. and Diffenbaugh, N.S., 2014. The extraordinary California drought of 2013/2014: Character, context, and the role of climate change. *Bulletin of the American Meteorological Society*, 95(9), pp. S3-S7.

Sweet, W.V., Park, J., Marra, J., Zervas, C., Gill, S., 2014. Sea level rise and nuisance flood frequency changes around the United States. *US Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Center for Operational Oceanographic Products and Services*.

Sweet, W.V., R. Horton, R.E. Kopp, A.N. LeGrande, and A. Romanou, 2017: Sea level rise. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. *U.S. Global Change Research Program*, Washington, DC, USA, pp. 333-363, doi: 10.7930/J0VM49F2.

The Allstate Corporation, 2018. Allstate Announces Impact of California Wildfires. *Allstate Newsroom*.

The City of Los Angeles - Office of the Mayor, 2019. L.A.'s Green New Deal Sustainability Plan 2019 (Report). *The City of Los Angeles*.

The City of Miami, 2018. Miami, FL Resolution R-18-0501. *The City of Miami - Sea Level Rise Committee*.

The City of Miami, 2019. Miami Forever Bond. *The City of Miami - Office of Capital Improvements*.

The City of Seattle, 2018. Duwamish Valley Action Plan. *The City of Seattle - Office of Sustainability and the Environment.*

The Utility Reform Network (TURN), 2017. Governor Signs TURN Bill to Reduce Shutoffs. *TURN* (Article).

Thériault, M., Kestens, Y. and Des Rosiers, F., 2002. The impact of mature trees on house values and on residential location choices in Quebec City, in Meeting of the IEMSs Society Lugano, Switzerland. *International Environmental Modelling and Software Society*, pp. 478–483.

Thompson, D., 2019. California Struggles with Insurance Costs and Wildfire Risks. *Wildland Firefighter*.

Treg, C., 2010. A Multilevel Property Hedonic Approach to Valuing Parks and Open Space (Doctoral Dissertation, University of Vermont).

Tucker, C.M., Eakin, H. and Castellanos, E.J., 2010. Perceptions of risk and adaptation: coffee producers, market shocks, and extreme weather in Central America and Mexico. *Global Environmental Change*, 20(1), pp.23-32.

Ugarte, S., van der Ree, B., Voogt, M., Eichhammer, W., Ordoñez, J.A., Reuter, M., Schlomann, B., Lloret Gallego, P. and Villafafila Robles, R., 2016. Energy efficiency for low-income households. Directorate-General for Internal Policies, Policy Department A: Economic and Scientific Policy.

Uhlmann, R., 2018. Florida tax-credit housing is often in flood zones, study finds. Clemson University, School of Business - *The Newsstand* (News Article).

United States Department of Agriculture - Economic Research Service (USDA - ERS), 2020. Farm Labor. *United States Department of Agriculture - Economic Research Service, Farm Economy.*

Upton, J., 2017. The Injustice of Atlantic City's Floods. *Climate Central* (Report).

US EPA, 2019. Overview of EPA's Brownfields Program, United States Environmental Protection Agency. Available at: https://www.epa.gov/brownfields/overview-epas-brownfields-program (Accessed: 8 February 2020).

Van Zandt, S., Peacock, W.G., Henry, D.W., Grover, H., Highfield, W.E. and Brody, S.D., 2012. Mapping social vulnerability to enhance housing and neighborhood resilience. *Housing Policy* Debate, 22(1), pp.29-55.

Vandegrift, D. and Zanoni, N., 2018. An economic analysis of complete streets policies. *Landscape and Urban Planning*, 171, pp.88-97.

Vigdor, J., 2008. The economic aftermath of Hurricane Katrina. *Journal of Economic Perspectives*, 22(4), pp.135-54.

Viglucci, A., 2018. Half of Puerto Rico's housing was built illegally. Then came Hurricane Maria. *Miami Herald*.

Viglucci, A., 2018. Miami will start making developers provide affordable housing in some new towers. *Miami Herald*.

Voicu, I. and Been, V., 2008. The effect of community gardens on neighboring property values. *Real Estate Economics*, 36(2), pp.241-283.

Vose, R.S., D.R. Easterling, K.E. Kunkel, A.N. LeGrande, and M.F. Wehner, 2017: Temperature changes in the United States. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. *U.S. Global Change Research Program*, Washington, DC, USA, pp. 185-206, doi: 10.7930/J0N29V45.

Wachter, S.M. and Wong, G., 2008. What is a tree worth? Green-city strategies, signaling and housing prices. *Real Estate Economics*, 36(2), pp.213-239.

Walch, R.T., 2018. The Effect of California's Carbon Cap and Trade Program on Co-Pollutants and Environmental Justice: Evidence from the Electricity Sector. *Department of Economics at University of Oregon.*

Walsh, K.J., Camargo, S.J., Vecchi, G.A., Daloz, A.S., Elsner, J., Emanuel, K., Horn, M., Lim, Y.K., Roberts, M., Patricola, C. and Scoccimarro, E., 2015. Hurricanes and climate: the US CLIVAR working group on hurricanes. *Bulletin of the American Meteorological Society*, 96(6), pp.997-1017.

Wardrip, K., 2011. Public Transit's Impact on Housing Costs: A Review of the Literature. Insights from Housing Policy Research, *Center for Housing Policy and National Housing Conference*.

Warner, K., Ehrhart, C., Sherbinin, A.D., Adamo, S. and Chai-Onn, T., 2009. In search of shelter: Mapping the effects of climate change on human migration and displacement. *The Center for International Earth Science Information Network (CIESIN) - Columbia University*.

Warner, M.D., Mass, C.F. and Salathé Jr, E.P., 2015. Changes in winter atmospheric rivers along the North American west coast in CMIP5 climate models. *Journal of Hydrometeorology*, 16(1), pp.118-128.

Washington, E., 2013. Role of walkability in driving home values. *Leadership and Management in Engineering*, 13(3), pp.123-130.

Wehner, M.F., J.R. Arnold, T. Knutson, K.E. Kunkel, and A.N. LeGrande, 2017: Droughts, floods, and wildfires. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. *U.S. Global Change Research Program*, Washington, DC, USA, pp. 231-256, doi: 10.7930/J0CJ8BNN.

Welch, T.F., Gehrke, S.R. and Wang, F., 2016. Long-term impact of network access to bike facilities and public transit stations on housing sales prices in Portland, Oregon. *Journal of Transport Geography*, 54, pp.264-272.

Westerling, A.L., 2016. Increasing western US forest wildfire activity: sensitivity to changes in the timing of spring. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 371(1696), p.20150178.

Westerling, A.L., Brown, T.J., Schoennagel, T., Swetnam, T.W., Turner, M.G. and Veblen, T.T., 2016. Climate and Wildfire in Western US Forests. *Forest Conservation in the Anthropocene: Science, Policy, and Practice*, pp.43-55.

Westerling, A.L., Bryant, B.P., Preisler, H.K., Holmes, T.P., Hidalgo, H.G., Das, T. and Shrestha, S.R., 2011. Climate change and growth scenarios for California wildfire. *Climatic Change*, 109(1), pp.445-463.

Westerling, A.L., Hidalgo, H.G., Cayan, D.R. and Swetnam, T.W., 2006. Warming and earlier spring increase western US forest wildfire activity. *Science*, 313(5789), pp.940-943.

White-Newsome, J., O'Neill, M.S., Gronlund, C., Sunbury, T.M., Brines, S.J., Parker, E., Brown, D.G., Rood, R.B. and Rivera, Z., 2009. Climate change, heat waves, and environmental justice: Advancing knowledge and action. *Environmental Justice*, 2(4), pp.197-205.

Wing, O.E., Bates, P.D., Smith, A.M., Sampson, C.C., Johnson, K.A., Fargione, J. and Morefield, P., 2018. Estimates of present and future flood risk in the conterminous United States. *Environmental Research Letters*, 13(3), p.034023.

Wing, O.E., Bates, P.D., Smith, A.M., Sampson, C.C., Johnson, K.A., Fargione, J. and Morefield, P., 2018. Estimates of present and future flood risk in the conterminous United States. *Environmental Research Letters*, 13(3), p.034023.

Woolley, B., 2018. The effect of bike lane infrastructure on urban housing markets (senior thesis). University of Richmond.

Wootson, C.R., 2018. The deadliest, most destructive wildfire in California's history has finally been contained. *The Washington Post*.

Worzala, E. and Hammett, V.L., 2017. Post-disaster recovery for real estate development: An analysis of multi-family investment from the perspective of a low-income housing tax credit (LIHTC) project. *In Routledge Companion to Real Estate Development* (pp. 260-273). Routledge.

Wuebbles, D., Meehl, G., Hayhoe, K., Karl, T.R., Kunkel, K., Santer, B., Wehner, M., Colle, B., Fischer, E.M., Fu, R. and Goodman, A., 2014. CMIP5 climate model analyses: climate extremes in the United States. *Bulletin of the American Meteorological Society*, 95(4), pp.571-583.

Yager, J., 2015. Planning for Resilience: The Challenge of Floodproofing Multifamily Housing. *New York University Furman Center* (Report).

Young, A.M., Higuera, P.E., Duffy, P.A. and Hu, F.S., 2017. Climatic thresholds shape northern high-latitude fire regimes and imply vulnerability to future climate change. *Ecography*, 40(5), pp.606-617.

Yu, C.Y., Xu, M., Towne, S.D. and Iman, S., 2018. Assessing the economic benefits and resilience of complete streets in Orlando, FL: A natural experimental design approach*. Journal of Transport & Health*, 8, pp.169-178.

Zhang, Y. and Peacock, W.G., 2009. Planning for housing recovery? Lessons learned from Hurricane Andrew. *Journal of the American Planning Association*, 76(1), pp.5-24.

Zuk, M. and Carlton, I., 2015. Equitable Transit Oriented Development: Examining the progress and continued challenges of developing affordable housing in opportunity and transit-rich neighborhoods. *Poverty & Race Research Action Council.*

Zuk, M. and Chapple, K., 2016. Housing Production, Filtering and Displacement: Untangling the Relationships. *Institute of Governmental Studies*, University of California, Berkeley.

Zuk, M., Bierbaum, A.H., Chapple, K., Gorska, K. and Loukaitou-Sideris, A., 2018. Gentrification, displacement, and the role of public investment. *Journal of Planning Literature*, 33(1), pp.31-44.