

Renters are Predicted to be More Mobile than Homeowners Following Flooding: The Role of Housing Tenure in Environmental Migration Research

Kathryn Foster

kef72@cornell.edu

Cornell University

Research Article

Keywords: renters, homeowners, flooding, mobility, vulnerability

Posted Date: September 30th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10657545/v1>

License:   This work is licensed under a Creative Commons Attribution 4.0 International License. [Read Full License](#)

Additional Declarations: No competing interests reported.

Abstract

As flooding becomes the leading driver of weather-related displacement in the United States, research is racing to identify predictors of post-flood environmental migration to better inform climate adaptation policies and planning. Many studies find that social vulnerabilities such as race, income, and age may be predictors of post-flood mobility. However, despite well-documented differences in mobility across homeowners and renters, environmental migration researchers have given relatively little attention to housing tenure. In this study, I explore the role of housing tenure in predicting the likelihood of post-flood migration. This research uses longitudinal data from the Panel Study of Income Dynamics, combined with storm event data from the National Oceanic and Atmospheric Administration and the Federal Emergency Management Agency, and demographic data from the American Community Survey, spanning from 2009 to 2023, to examine the role of tenure in post-flood im/mobility. Employing a series of linear probability models, I find that renters are more likely to move out of their ZCTA after flooding in comparison to homeowners. In contrast, homeowners are more likely to stay after flooding. Furthermore, poverty increases the likelihood of homeowner immobility following flooding. These results highlight the importance of home tenure as a predictor of environmental migration in shaping equitable climate adaptation and recovery policies.

INTRODUCTION

Flooding has become a leading driver of weather-related displacement over the past decade and is projected to affect approximately 2.5 million United States residents by 2050 (Climate Central, 2025; Rumbach and McTarnaghan, 2023). A growing body of scholarship positions migration as a potential form of climate adaptation (Black et al., 2011). However, disasters are experienced unevenly across lines of class, race, and economic status, thus potentially affecting both the aspirations and capabilities of post-disaster migration (Boas et al., 2022; Fussell et al., 2010; Wiegel et al., 2019). Consequently, it is theorized that post-disaster migration patterns tend to reproduce rather than mitigate preexisting social and spatial inequalities (Peacock et al., 2014). Paralleling rising flood damages, the United States is confronting an intensifying housing crisis marked by escalating housing costs, shrinking affordable housing, and a 70% increase in the wealth gap between renters and homeowners over the past three decades (Choi & Zin, 2024). As flooding increases alongside these housing discrepancies, home tenure may be more influential in post-flood relocation than previously thought. As a result of these current worries, academics and policymakers alike face key questions concerning post-flood migration. First, in a moment of increasing housing insecurity, what is the relationship between home tenure and relocation after experiencing a flood event? Second, given the widening disparities in wealth and housing security, does the association of home tenure with the probability of moving after a flood depend on household income and race?

While many scholars have shown that social vulnerabilities contribute to both immobility and mobility after flooding, home tenure, specifically whether one owns or rents their housing, is often not considered as a vulnerability within these studies, despite arguments that housing captures the intersection of both social and physical vulnerabilities (Lee & Van Zandt, 2019). Peacock and colleagues argue that disaster research should consider the broader picture for both renters and homeowners, as they experience disasters differently based on their housing status (2014). Building on calls from scholars that future disaster research should focus more on housing tenure for both renters and homeowners, this research highlights housing tenure as a social vulnerability, specifically surrounding flooding within the United States (Best et al., 2023; Lee & Van Zandt, 2019; Peacock et al., 2014; Potter & Godshall, 2024).

The economic landscape of flooding in the United States is of particular interest, as the national government mandates owners carry flood insurance for federally backed mortgages in high-risk areas, to which homeowners can receive payouts for flood damage through the National Flood Insurance Program (NFIP), often leaving renters uninsured and unprotected (Knowles & Kunreuther, 2014; Michael-Kerjan, 2010). Although flooding affects homeowners and renters alike by destroying or damaging infrastructure and homes, policy responses through Federal Emergency Management Agency (FEMA) and the NFIP tend to protect physical property, thereby protecting property owners, while leaving renters more exposed to post-disaster risks (Potter & Godshall, 2024). A recent report found that roughly one fourth of the 43.7 million renter households in the United States live in ZIP codes that have suffered over \$1 million in home damages due to natural disasters between 2008 and 2018. Furthermore, 8.1 million renter households report financial strain as a determining factor of their mobility during disaster, specifically restraining their ability to move following disaster (Joint Center for Housing Studies of Harvard University, 2020). While tenure captures the intersection of social and physical aspects of vulnerability, it is not a primary focus in previous disaster-related research, which instead emphasizes social vulnerabilities such as income and race (Lee & Van Zandt, 2019). While renters may appear more vulnerable to floods than their counterparts, homeowners, some findings suggest that low-income renters, in comparison to low-income homeowners are more resilient to disaster (Madajewicz, 2020). Yet, flood-related research still largely centers homeowner experience in part because datasets surrounding climate losses are often derived from federal climate policies and responses, which tend to focus on property owners and their losses, making it difficult to identify renter losses (Potter & Godshall, 2024). As a result, the relationship between home tenure status, specifically renters', and post-flood mobility remains understudied in the literature. I aim to address this need in the research by directly comparing homeowner and renter mobility following flooding, while accounting for race and income.

BACKGROUND

In socioenvironmental research, extreme weather events or hazards are often regarded as natural, whereas disasters occur when natural hazards intersect with socioecological systems (Mileti, 1999). Recent research in disaster management defines vulnerability as a community's susceptibility of harm from disasters, influenced by socioeconomic factors such as income, age, race, and access to resources (Fatemi et al., 2017; Singh et al., 2012). Many scholars argue that natural disasters are socially constructed through our perceptions of disaster, development patterns, physical exposure, and social vulnerability (Fothergill et al., 2002; Wisner et al., 2004). As such research finds that these disasters magnify and aggravate pre-existing social vulnerabilities in communities (Bates & Swan, 2008; Peacock et al., 2014). Thus, pre-existing conditions are essential predictors of post-storm outcomes.

Demographic studies find that disasters can amplify, attenuate, or redirect population processes such as migration, fertility, mortality, and aging (Donner & Rodríguez, 2008; Hauer, 2017; Ahmed et al., 2024; Hauer et al., 2024). For example, Lynch and colleagues found associations between cause-specific

mortality and large-scale flooding in the United States (2025). Furthermore, research finds that as climate migration continues due to sea-level rise, it will then accelerate aging processes in origin counties in the United States (Hauer et al., 2024). As disasters affect population processes, they may also exacerbate inequities within these processes. Environmental migration research seeks to delineate the social, environmental, and economic mechanisms that drive these population processes. Yet the drivers of environmental migration are highly contested within the research (Castelli, 2018). Contemporary migration theory suggests that mobility is primarily guided by an individual's aspiration to migrate, and their capabilities to do so (Carling, 2014; Carling & Schewel, 2020; De Haas 2021). Yet when considering how the environment then shapes these mobilities, scholars find it difficult to conceptualize the mechanisms that drive migration in the wake of disaster (Boas et al., 2022).

Just as there are drivers of mobility, migration studies within recent years have introduced a mobilities perspective to understand the importance of the drivers of immobility as well (Schewel, 2020). The mobilities perspective advances the aspiration-capability framework (Carling & Collins 2018; De Haas 2021) by arguing that understanding why someone migrates equally important as to understanding why someone stays. Environmental migration studies first began exploring immobility with the concept of 'trapped populations', or vulnerable populations who may be displaced but unable to migrate away from environmental hazards (Adams, 2016; Black et al., 2013); however, recent migration studies pushes back against this notion that equates immobility to being 'trapped', suggesting that environmental immobility occurs for more reasons than this (Zickgraf, 2021). The mobilities perspective maintains that mobility is interrelated across households, communities, and political scales, intersecting with the environment to prompt either im/mobility (Weigel et al., 2019). Understanding who and why someone might stay through environmental hazards may demonstrate who has the ability and desire to be im/mobile. In the context of flooding, much is still to be understood about im/mobility. Immobility may be driven by pre-flood mobility desires (Rhodes & Besbris, 2022) place attachment (Adams, 2016; Blondin, 2021) and or sociodemographic vulnerabilities (Correll et al., 2021; Seebauer & Winkler, 2020). To advance knowledge surrounding im/mobilities I discuss both mobility and immobility at the intersection of flooding, home tenure, race, and income.

Much of the environmental migration literature, specifically regarding floods in the United States, emerged from event-centered approaches that sought to isolate the mechanisms influencing mobility in the wake of specific disasters (Curtis et al., 2015; Fussell et al., 2010; Gutman & Field, 2010). These studies helped identify predictors of migration following flooding disasters, laying the foundation for subsequent studies that model predicted environmental migration (Hauer et al., 2020; Hauer et al., 2024; Schewel et al., 2024). These event-centered approaches highlight the importance of social vulnerability in population processes after a disaster; however, a population-centered approach focuses on individuals over time rather than on a single event (Elliot & Howell, 2017). Following previous studies, I adopt a population-centered approach, using a nationally representative sample over time to enable a more generalizable understanding of how individuals respond to flooding (Elliot & Howell, 2017; Elliot & Howell, 2019; Spring, 2025). Additionally, many quantitative environmental migration studies focus on county-to-county migration because disaster data are often not recorded at smaller geographic scales. Although, many moves may occur within smaller geographies after flooding than across county lines; this research seeks to capture such moves by focusing on ZIP Code Tabulation Areas (ZCTAs).

Home Tenure

Home tenure, which indicates whether a household owns or rents its residence, is a key factor in assessing social vulnerability to disasters (Peacock et al., 2014; Lee et al., 2019). The social-vulnerability index considers the type of housing structure; however, it does not delineate between owners and renters, which can be essential in understanding vulnerabilities, especially after a disaster (Cutter et al., 2012; Lee et al., 2019). Previous studies have found that spatial inequality is clearly reflected in the distribution of housing within a community, exacerbating inequities during and after a disaster (Kammerbauer & Wamsler, 2017; Lee & Van Zandt, 2019). While many studies link income, race, and age to inequities in household disaster recovery, few argue that tenure is perhaps one of the most overlooked elements of social vulnerability in disaster recovery research (Lee & Van Zandt, 2019; Peacock et al., 2014). Even fewer studies explore how tenure may affect post-disaster population processes, such as migration, and instead mainly focus on home ownership as a determinant of return migration (Kim & Soo, 2014; Mayer et al., 2020; Paul et al., 2024). Furthermore, sociodemographic environmental research primarily focuses on homeowners, even though renters are arguably the most at risk of permanent displacement, as data is often more readily available on homeowners after disaster (Mongold et al., 2024; Peacock et al., 2014).

Home tenure represents both a physical and social vulnerability, though it can differ from homeowner to renters. Physical vulnerability in home tenure refers to the housing unit, for example, renters lack the legal right to influence rebuilding or redevelopment of their previous housing structures after a disaster, which puts them at heightened risk of displacement after flooding (Potter & Godshall, 2024). Homeowners may have a say in the rebuilding process after flooding but may remain physically vulnerable as owners may have to spend more of their income to recover and may experience a loss of housing during the rebuilding process (Lee & Zandt, 2019; Madajewicz, 2020). Social vulnerability in relation to home tenure refers to the household statuses, such as age, number of members in the housing unit, race, income status, and or rent and mortgage payments. For example, low-income renters of color are often pushed in houses that have greater risks of flooding, and low-income homeowners have a greater likelihood of staying in areas with greater flood risk (Coes et al., 2020; Thomas, forthcoming). Disasters magnify these vulnerabilities which may affect mobility further after flooding. Furthermore, while federal assistance is available for renters and homeowners, research finds that federal assistance loans are disproportionately focused on homeowners, with renters receiving a significantly smaller share of these loans, although housing types more common to renters are more likely to experience greater levels of damage during a disaster (Alverio & Leblang, 2023; Ma & Smith, 2020; Miao et al., 2026; Peacock et al., 2014).

Homeowners and renters may differ largely in their mobility aspirations and capabilities following flooding. Houses tend to be one of the largest assets for homeowners, and are more difficult to sell after flooding, making it difficult for a homeowner to relocate (Thompson et al., 2026; Rhodes & Besbris, 2022). Furthermore, homeowners are generally older and wealthier than renters, and may have stronger place attachments and networks for recovery after disaster than renters, who may not have been in the community as long, allowing them to stay in place after disaster (Lee & Van Zandt, 2019). In contrast, affordable housing is often disproportionately affected by flooding, and renter evictions increase after disaster, contributing to a renter's need to relocate (Brennan et al.,

2020; Raymond et al., 2021). While there are differences between renters' and homeowners' recovery following a flood, migration research often fails to make this distinction in exploring environmental mobility. Building on previous research surrounding the importance of understanding social vulnerability in disaster recovery, this study incorporates models comparing home tenure and then models stratifying by renters and homeowners to explore post-disaster mobility. I test the following hypothesis:

H₁

Renters are more likely to move out of their ZCTA following flooding, whereas homeowners have a greater likelihood of staying after flooding.

Race

Prior research shows that race is a social determinant of both mobility and immobility after flooding disasters (Bea et al., 2025; Bolin & Kurtz, 2017; Li et al., 2024). Previous studies suggest that non-White households are more mobile after disaster, though these studies largely focus on singular extreme disasters such as Hurricane Katrina (Fussell et al., 2010). However, Alverio and Leblang (2023) found that White residents are 8% more likely to migrate in comparison to Black residents who are 26% less mobile after a FEMA-declared emergency. Furthermore, research shows Black homeowners are more likely to stay living in a tract with flood risk than that of Black homeowners who do not have flood risk (Thomas, forthcoming). Community influence may also shape migration patterns and that Black and Latino households are more likely to live near relatives and less likely to move away during disasters due to those kin connections (Ackert et al., 2019; Molloy & Smith, 2019; Spring, 2025).

The intersection of home tenure and race may be another determinant of vulnerability in disaster recovery and subsequently post-disaster migration. Historically, the United States' housing landscape has driven low-income, non-White residents into rental households. Furthermore, research in Houston found that occupied subsidized housing units were almost twice as likely to be in neighborhoods with higher flood risk (Chakraborty et al., 2021). Residential discrimination theory follows place stratification perspective by suggesting that discriminatory actions by the real estate market and local government create barriers to residential attainment for minority home seekers, thus reducing the ability of minority families to move out of, or avoid moving into, environmentally hazardous neighborhoods, therefore maintaining environmental racial inequality (Bullard 1993; Crowder & Downey 2010; Godsil 1991; Mohai & Bryant 1992). Moving out of an environmentally hazardous neighborhood, may be largely affected by the resources communities have to leave; furthermore, aid provided by FEMA may contribute to procedural vulnerabilities, which may allow for more aid to be given to white homeowners, in comparison to other sociodemographic population, thus increasing inequity and inhibiting movement (Howell & Elliot 2019; Dundon & Camp, 2021; Rivera et al., 2021). By combining the social vulnerability of being a renter with residential discrimination theory, this research aims to test how the intersection of race and renter status post-flooding may affect mobility patterns. I test the hypothesis:

H₂

Non-Hispanic Black and Hispanic renters will stay at greater rates following flooding than renters who do not experience flooding.

Additionally, housing recovery is uneven across different demographic populations, potentially changing mobility outcomes for non-White homeowners after flooding (Peacock et al., 2014; Spring, 2025). The residential discrimination thesis suggests that leaving neighborhoods may be more difficult for homeowners of color due to discriminatory market practices. These difficulties may make it more difficult for non-White households to leave potentially environmental hazardous areas, thus perpetuating environmental racism (Crowder & Downey, 2010). Thus, I test the hypothesis:

H₃

Non-White homeowners will have a greater likelihood of staying after flooding than non-white homeowners who do not experience flooding.

Income

As many scholars theorize that aspirations and capabilities guide mobility decisions, income may serve as a capability, or barrier, in determining the likelihood of moving after flooding (De Haas 2021; Rhodes & Besbris, 2022; Wilson et al., 2021; Zickgraff 2021). In considering home tenure alongside income Madajewicz (2020) finds that in comparison to low-income renters, middle- and low-income homeowners are less financially resilient spending a larger share of their income on recovery costs. Alongside Madajewicz's (2020) finding, Coes and colleagues (2020) find housing costs for low-income residents take a greater share of household income than other residents, which potentially ties residents to mortgages making moving more difficult.

Income may also interact with other sociodemographic variables to influence migration after flooding. For example, there are significant racial inequalities across home equity nationally, with non-White homeowners being more likely than White homeowners to owe more in mortgage debt (Edelberg et al. 2021), which may make repairs and recovery after flooding more difficult, leaving these homeowners in vulnerable situations. In line with the residential discrimination thesis, lower-cost housing is often located in high-risk flood areas where structures are cheaper, more vulnerable to flooding, and less likely to have infrastructure to protect buildings from flooding, which may make recovering more costly and difficult for low-income nonwhite residents (Coes et al., 2020; Fothergill & Peek, 2004; Roth Tran & Sheldon, 2017). Crowder and Downey find that income matters for non-White mobility, however, non-Hispanic White residents move away at all levels of income. The income-inequality perspective explains this by positing that racial differences in the likelihood of moving into and out of environmentally hazardous neighborhoods arise primarily from differences in groups' resources (Crowder & Downey, 2010). However, this theory hypothesizes that racial differences will be attenuated through controlling for income. Place stratification theory argues that in comparison to White residents, even with increased income, non-White residents will still reside in environmentally hazardous neighborhoods (Malega, 2019; Pais et al.,

2012) Combined, both place stratification theory and the residential discrimination thesis argue that, in comparison to White households, members of non-white households will be less likely to leave environmentally hazardous areas (Crowder & Downey, 2010).

Though these theories explore the intersection of race, income, mobility, and housing in terms of environmental hazards, they fail to delineate the importance of home tenure in shaping these vulnerabilities during mobility. This study examines the intersection of tenure, race, and income in shaping the likelihood of mobility after flooding, recognizing that these variables are determinants of social vulnerability during disasters. I test the hypothesis:

H₄

Income will have a greater effect on mobility for non-White individuals than White individuals; with Black and Hispanic low-income homeowners being less likely to migrate after flooding than other groups.

METHODOLOGY

Data

This study links household and individual-level data from the Panel Study of Income Dynamics (PSID) with Zip Code level data from the Federal Emergency Management Agency (FEMA), the American Community Survey (ACS), and county-level data from the National Oceanic and Atmospheric Administration (NOAA). PSID and FEMA data are recoded at the United Postal Service Zip Code level, whereas the ACS and the transformed NOAA flooding data are reported at the Census Zip Code Tabulation Area (ZCTA) level. The National Historical Geographic Information System crosswalk data enables merging between the United States Postal Service Zip Code and the Census ZCTA. The analytical period of this study spans from 2009 to 2023.

The PSID is an ongoing nationally representative longitudinal study that began with 18,000 individuals and has since collected data from over 84,000 people in the United States. Beginning in 1999, data were collected biannually, and panel refreshes have been conducted to include more Hispanic and Latino families, reflecting shifts in the U.S. population's demographic composition. Due to the longitudinal nature of the data collection, the PSID can be used to track a household's mobility over many years. The information collected in this survey is from a *household reference person*, defined as an individual in the household who is at least 18 years of age and has the greatest financial responsibility within the household. The address where the reference person resides during the year of the interview is then geocoded to the Zip Code for each survey wave. I use the PSID data for a set of sociodemographic characteristics as controls. PSID data are recorded biannually, whereas the other variables are recorded annually. To account for this difference annually collected data are combined to create biannual values corresponding with the PSID years.

FEMA's National Flood Insurance Program (NFIP) policy dataset provides details on insurance coverage within a ZCTA. Alongside this flood data, NOAA storm event location information is used to identify the number of storms and the damage a ZCTA experienced biannually. Census TIGER/Line shapefiles were used to identify which ZCTAs were along any given flood or storm track.

5-year ACS estimates provide ZCTA characteristics on population and housing. Estimates are used for 2007–2011, 2011–2015, 2015–2019, and 2019–2023 and are used in the corresponding years for analysis.

Measurement

Moving out of the ZCTA is defined as the PSID household reference person moving out of the ZCTA of residence between PSID survey waves. It is a dichotomous variable indicating whether the household reference person moved out of the ZCTA of origin between the survey waves from time t to $t + 1$. This is recorded as a dichotomous variable, 1 for those who moved to a different ZCTA between waves, and 0 for those who remained in the same ZCTA. For example, if the reference person moved between 2015 and 2017, they would be given a 1 in 2017, indicating that they had moved between survey waves. The mean average for moving out of a ZCTA is higher for renters than it is for homeowners during the analysis period (see Table 1).

Table 1
Summary Statistics by Renters and Homeowners

Variables	Renters				Homeowners		
	Definition	Mean	SD	Obs	Mean	SD	Obs
Moved Out of ZCTA	Whether <i>R</i> changed ZCTAs from time <i>t</i> to <i>t</i> + 1 (1 = yes)	0.287	0.452	23,891	0.026	0.158	29,160
<i>Flooding Variables (annually, by ZCTA)</i>							
Flood in ZCTA	Flood in ZCTA at time <i>t</i> .	0.385	0.487	29,468	0.379	0.485	36,071
Policy Count	The total amount of active flood insurance policies in a ZCTA at time <i>t</i> .	664.280	2057.029	29,135	671.280	2,163.34	35,313
Flood Damage	The amount of damage proportional to flood amount in a ZCTA as estimated by NOAA damage costs over the total household income in the ZCTA from the ACS at time <i>t</i> .	26.392	937.468	29,433	50.211	2182.337	36,008
Flood Days	Total number of flood days in a ZCTA.	1.102	4.949	29,468	1.283	6.095	38,071
<i>Sociodemographic Characteristics (head of household)</i>							
Non-Hispanic White	Whether <i>R</i> is non-Hispanic White (1 = yes).	0.345	0.476	29,468	0.652	0.476	36,071
Non-Hispanic Black	Whether <i>R</i> is non-Hispanic Black (1 = yes).	0.533	0.499	29,468	0.264	0.441	36,071
Hispanic	Whether <i>R</i> is Hispanic (1 = yes).	0.126	0.332	29,468	0.085	0.278	36,071
Age 18–34	Whether <i>R</i> is between the ages of 18–35 (1 = yes).	0.467	0.499	29,468	0.152	0.359	36,071
Age 65+	Whether <i>R</i> is 65 and older (1 = yes).	0.074	0.261	29,468	0.223	0.416	36,071
Living Density	The total population in a ZCTA to the occupied housing units in that ZCTA.	1.029	0.158	29,433	1.023	0.064	36,008
College	Whether <i>R</i> is college educated (1 = yes).	0.210	0.407	29,468	0.368	0.482	36,071
Family Members in Household	Number of family members in <i>R</i> 's household at time <i>t</i> .	2.185	1.429	29,468	2.438	1.288	36,071
Relative Poverty	<i>R</i> 's total household income is below 60% of ZCTA's median income (1 = yes).	0.619	0.485	29,445	0.316	0.464	36,048
Total Household Income	<i>R</i> 's total household income at time <i>t</i> .	46,699.43	54,710.62	29,468	102,113.50	129,796.90	36,071

Note: *R* refers to the Reference Person (Householder) in PSID data set.

Table 2. Linear Probability Models Predicting Mobility Out of ZCTA, Comparing Home Tenure: PSID Householders, 2009–2023

1 (Tenure Comparison)			2 (Flood & Sociodemographic Characteristics)		3 (Race Interactions)		4 (Income Interactions)	
Independent Variables	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>
<i>Home Tenure (t-1)</i>								
Homeowner, Flooded ZCTA	0.003	0.002	0.001	0.006	-0.001	0.006	0.001	0.006
Renter, No Flooding	0.166***	0.006	0.127***	0.007	0.124***	0.009	0.126***	0.007
Renter, Flooded ZCTA	0.160***	0.007	0.119***	0.009	0.112***	0.0121	0.119***	0.009
<i>Home Tenure (t-1) * Race</i>								

Variables	Renters			Homeowners			
	Definition	Mean	SD	Obs	Mean	SD	Obs
Homeowner, Flooded ZCTA * Non-Hispanic Black				0.013†	0.007		
Renter, No Flooding * Non-Hispanic Black				0.029*	0.013		
Renter, in a Flooded ZCTA* Non-Hispanic Black				0.031*	0.015		
Homeowner, Flooded ZCTA * Hispanic				-0.005	0.011		
Renter, No Flooding * Hispanic				-0.074***	0.018		
Renter, Flooded ZCTA * Hispanic				-0.050*	0.021		
<i>Home Tenure (t-1) * Income (t-1)</i>							
Homeowner in a Flooded ZCTA*Centered Total Household Income (ln)					0.001		0.002
Renter, No Flooding *Centered Total Household Income (ln)					-0.004		0.003
Renter, in a Flooded ZCTA*Centered Total Household Income (ln)					-0.002		0.004
<i>Flooding(t-1)</i>							
Flood in ZCTA		0.002	0.002	0.002	0.002	0.002	0.002
Policy Count (arcsinh)		-0.003	0.003	-0.003	0.003	-0.003	0.003
Flood Damage (arcsinh)		0.002	0.001	0.002	0.001	0.002	0.001
Total Flood Days (arcsinh)		-0.002	0.005	-0.003	0.006	-0.003	0.005
<i>Sociodemographic</i>							
Non-Hispanic Black		0.031***	0.011	0.009	0.011	0.031**	0.011
Hispanic		-0.030***	0.014	0.009	0.014	-0.030**	0.014
Age 18–34 (t-1)		0.098***	0.006	0.098***	0.006	0.098***	0.006
Age 65+ (t-1)		-0.025***	0.005	-0.024***	0.004	-0.025***	0.005
Living Density (t-1)		0.169**	0.063	0.167**	0.064	0.170**	0.064
College (t-1)		0.003	0.007	0.003	0.006	0.002	0.005
Family Members in Household		-0.006**	0.002	-0.006**	0.002	-0.006**	0.002
Centered Total Household Income (ln) (t-1)		-0.006**	0.002	-0.006**	0.002	-0.004*	0.002
Constant	0.026***	-0.134*		-0.129†	-0.135*		
R-square	0.294	0.309		0.310	0.309		
N	36,880	35,982		35,982	35,982		
*p<.05; **p<.01; ***p<.001; † p > 0.05 & < 0.10							

Renter in a flooded ZCTA describes whether the reference person was a renter in a ZCTA that experienced flooding at the time of the survey (1 = yes, 0 = no). The homeowner in a flooded ZCTA variable indicates whether the reference person was a homeowner in a ZCTA that experienced flooding. In models that are not stratified by home tenure, a factor variable is used to directly compare homeowners and renters (0 = homeowner did not experience flooding, 1 = homeowner experienced flooding, 2 = renter did not experience flooding, 3, renter did experience flooding).

A flood in ZCTA variable is created using the NOAA Storm Event location dataset. This data provides start and end locations for each weather event in the dataset. I then overlay storm event data with the Census TIGER/Line shapefile for 2020 ZCTAs. Using the start and end point provided in the NOAA data, I create a track for each flooding events between 2009–2023. Each ZCTA boundary intersecting with the flood track was marked as affected by the specific flooding event. I include coastal, rain, hurricane, and flash floods within the analysis. Aligning the data with PSID survey waves, the flood in ZCTA variable receives a 1 if the ZCTA had a flood during the years between survey waves, and a 0 if the ZCTA had no flooding.

A proportion of damage costs was created using the flood track used to identify whether a flood crossed in ZCTA boundaries. A proportional variable was created to show how much of the flood track occurred in the ZCTA; the total cost of the flood event was then multiplied by the proportion of flood within the ZCTA. This is not a perfect measure of damage, as it assumes where the ZCTA where a majority of the flood occurred is where most of the damage cost accrued; the flood damage variable will be further discussed in the limitation section. Following Raker (2025), I construct a flood damage variable using the ZCTA damage costs created above, indexed to total ZCTA household income, from corresponding year of ACS estimates, to mitigate bias of treating high property damage in ZCTA with high socioeconomic status.

Using the start and end data of each flooding event, the number of days per each event is recorded if the flood track crossed into the ZCTA boundary. The total flood days variable is the sum of all days that a ZCTA had flooding within the year.

As having an active flood insurance policy aids residential recovery of damaged homes, leading to a greater ability to stay in place (Han & Ye, 2022), count of flood insurance policies variable controls for any bias in flood insurance coverage within a ZCTA. Homeowners in the data tended to live in areas with slightly more flood insurance policies than renters. I use the inverse hyperbolic sine of the count of flood insurance policies, total flood days, and flood damage to handle skewed data while retaining zeros

Two types of income variable are explored within the analysis. First, is the centered log transformation of the householder' total household income. I begin by log transforming the total household income with a base of two, then center the variable. I use this variable as an interaction effect in subsequent analysis. The income variable is centered as suggested by previous work to make the interaction effect more interpretable (Williams, 2021). In further exploring income in relation to moving after flooding, a relative income poverty measure is used to identify a household's poverty in relation to the median income of their ZCTA. There are many debates surrounding the use of absolute poverty measures (such as the U.S Census, comparing pre-tax cash income against a fixed national income) and relative poverty measures. I use a relative poverty measure for this analysis to capture the income necessary to achieve what is considered minimal living in the householders ZCTA (Decerf, 2022).

Following how the Organization for Economic Cooperation and Development (OECD) accounts for relative poverty, I first create the relative poverty measure by creating an income equivalence scale by dividing the total family income by the square-root of the number of family members in the household (Folbre et al., 2018; Forster et al., 2002). To make the real poverty indicator, householders are recorded as 1 if their equivalence income is below 60% (as suggested by previous research) of their ZCTA's median income and recorded as a 0 if their equivalence income is greater than 60% of their ZCTA's median income (Bradshaw & Mayhew, 2010; Notten & De Neubourg, 2011). 62% of renters in the PSID dataset have been or are in relative poverty for their ZCTA, whereas only 32% of homeowners met this relative poverty measure.

Control Variables use characteristics from the PSID to include dichotomous variables for the reference person's race and ethnicity (non-Hispanic White, non-Hispanic Black, and Hispanic; non-Hispanic Asian did not have a large enough sample to be included within the analysis); sex (female); two dichotomous age-group variables (18–35 and 65+); whether the householder is college-educated, number of members in the household. Age group variables were decided based on previous demographic research that found younger adults are more likely to be more mobile, whereas older adults and adults in retirement are more likely to remain in place (Plane, 1991; Plane, 1992; Cherry et al., 2009). Alongside these demographic variables, 5-year ACS estimates are included to account for the living density of a ZCTA, calculated as the total population divided by the total occupied housing units within a ZCTA. These control variables are drawn from previous research that identifies them as predictors of internal migration in the United States (Molloy & Smith, 2019).

Insert Table 1 here

Analytical Strategy

This study uses a series of Linear Probability Models (LPMs) predicting the likelihood of moving out of a ZCTA. LPMs are chosen for these models because they allow comparison of coefficients across models, which is not possible with logistic regression due to rescaling issues (Huang, 2022). Year and ZCTA fixed effects are used for the models, with robust standard errors clustered at the householder-level. Following a population-centered approach, I use population-averaged linear probability for later models stratified by race and relative poverty to understand the average response of the population, rather than individual-specific deviations. I include fixed-effects for year and robust standard error in the stratified models. The variables across all models are lagged, so that movement at time t is conditioned on the variables from the prior survey wave. For example, whether a reference person moved by time t is regressed on a householder who experienced flooding in their ZCTA in the previous survey wave ($t-1$).

To directly compare homeowners and renters a factor variable is used in models 1–4 with the baseline comparison group being homeowners who did not have flooding in their ZCTA (0 = Homeowners, no flooding 1 = Homeowners with flooding in ZCTA, 2 = Renters, no flooding, 3 = Renters with flooding in ZCTA). Interactions between race and income are included for models 3–4 (see Eq. 2.).

$$\text{Eq1: } \Pr(\text{ZCTAMove}) = \beta_0 + \beta_1 D_{ik} (\text{TenureFloodingFactor})_{t-1} + \beta_{2,3,4,5,6} (\text{FloodingCovariates})_{t-1} + \beta_{7,8,9,10,11,12,13} (\text{SociodemographicCovariates})_{t-1} + \text{Year} + \epsilon_{it}$$

$$\text{Eq 2: } \Pr(\text{ZCTAMove}) = \beta_0 + \beta_1 D_{ik} (\text{TenureFloodingFactorVariables} * \text{InteractionEffect}(\text{either Race or TotalHouseholdIncome}_{in, centered}))_{t-1} + \beta_{2,3,4,5,6} (\text{FloodingCovariates})_{t-1} + \beta_{7,8,9,10,11,12,13} (\text{SociodemographicCovariates})_{t-1} + \text{Year} + \epsilon_{it}$$

After comparing renters to homeowners, subsamples are used to compare renters to renters and homeowners to homeowners. Models for both homeowners and renters follow a similar format to Eq. 1. Instead of a factor variable, the models include dichotomous variables; renters that did not experience flooding are the comparison group for renter models, and homeowners that did not experience flooding are comparison group for the homeowner models. A final round of models follows the same equations as the models above; except they are stratified by race, home tenure, and relative poverty using population-averaged estimators.

As it may take time for a person to move after flooding, subsequent models were tested to explore variation in the timing of whether the reference person stays or moves after a flood. All variables were lagged by two survey waves. Findings remained relatively the same and are not included in this paper.

RESULTS

I conduct a series of multivariate models predicts the likelihood of out-migration to understand the relationship between home tenure, flooding, and mobility. In table 2, models 1 and 4 examine the associations between home tenure, flooding, and relocation from the ZCTA of origin. Across all models that include the tenure factor variable, I find that both renters who lived in a ZCTA with flooding and a ZCTA without flooding have a greater likelihood of moving out of their ZCTA. However, renters in a ZCTA with flooding across all these models are roughly 1 percentage point less likely than renters in ZCTAs without flooding to move out of their ZCTA, net of demographic controls. In comparison to the other tenure variables, being a homeowner living in a ZCTA with flooding had no significant relationship with the likelihood of moving out of their ZCTA.

In model 3., Black renters in a ZCTA with flooding were 3.1 percentage points likelier to move out of their ZCTA than white homeowners in a ZCTA with no flooding. Whereas Hispanic renters in a ZCTA with flooding were 5 percentage points less likely that white homeowners in a ZCTA with no flooding to move out of their ZCTA. While total household income is significant across all models, the interaction between home tenure and total household income is not significantly related to the probability of moving.

Across the models 1–4, being 18–34 increases the likelihood of moving and being 65 and older decreases the likelihood of moving. An increased in living density increases the likelihood of moving out of the ZCTA. The number of family members within the household decreases the probability of moving out of a ZCTA, but only by less than 1 percentage point. The flooding covariates are not significantly related to moving out of a ZCTA.

Insert Table 2 here

In the population-averaged linear probability models stratified by race and tenure (see Table 3), both non-Hispanic White (4.7 percentage points) and Hispanic renters (9.3 percentage points) in the ZCTA with flooding have a greater probability of staying in their ZCTA than renters that live in a ZCTA without flooding. The relationship between mobility and non-Hispanic Black renters in a ZCTA with flooding was not significant. Age groups followed similar patterns to the previous models with 18–34-year-olds having positive significant relationship with moving out of the ZCTA and householders 65 and older having a negative significant relationship with moving out of the ZCTA. Living density was only positively related out-migration for non-Hispanic Black renters. Being college educated increased the likelihood of moving for non-Hispanic White and Hispanic renters. Being a homeowner in a ZCTA with flood increased the likelihood of staying in the ZCTA in comparison to homeowner in ZCTAs without flooding across all stratified race models. In the models for homeowners, demographic variables followed similar patterns to that of previous models.

Table 3
Population-Averaged Linear Probability Model Predicting Mobility Out of ZCTA, Stratified by Home Tenure and Race: PSID Householder, 2009–2023

	Renter						Homeowner					
	Non-Hispanic Black		Non-Hispanic White		Hispanic		Non-Hispanic Black		Non-Hispanic White		Hispanic	
Independent Variables	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>
<i>Home Tenure (t-1)</i>												
Renter, Flooded ZCTA	0.006	0.016	-0.047***	0.019	-0.093**	0.036						
Homeowner, Flooded ZCTA							-0.036***	0.008	-0.027***	0.005	-0.031*	0.015
<i>Flooding(t-1)</i>												
Flood in ZCTA	-0.010	0.006	0.006	0.008	-0.022	0.028	0.003	0.003	-0.003*	0.002	-0.002	0.004
Policy Count (arcsinh)	0.011***	0.003	0.009*	0.003	0.005	0.004	-0.001	0.001	0.001	0.001	-0.001	0.002
Flood Damage (arcsinh)	0.005	0.005	0.014*	0.006	-0.014	0.011	-0.001	0.001	-0.002†	0.001	0.001	0.003
Total Flood Days (arcsinh)	-0.001	0.015	0.006	0.007	0.129*	0.051	0.011	0.007	0.018***	0.004	0.011	0.016
<i>Sociodemographic</i>												
Age 18–34 (t-1)	0.139***	0.012	0.138***	0.016	0.099***	0.021	0.046***	0.009	0.042***	0.005	0.055***	0.014
Age 65+ (t-1)	-0.080***	0.018	-0.101***	0.021	-0.042	0.035	-0.015***	0.008	-0.015***	0.002	-0.011	0.008
Living Density (t-1)	0.049***	0.009	0.026	0.106	-0.101	0.094	0.072	0.068	0.052†	0.03	0.077	0.161
College (t-1)	0.019	0.018	0.051**	0.018	0.067*	0.035	-0.000	0.005	0.004	0.003	0.008	0.010
Family Members in Household	-0.006	0.004	-0.010†	0.006	-0.026***	0.006	-0.000	0.002	-0.004**	0.001	-0.005	0.003
Centered Total Household Income (ln) (t-1)	0.004	0.003	0.001	0.005	-0.001	0.008	-0.001	0.002	-0.003**	0.001	-0.008	0.005
Constant	0.141***		0.193†		0.292**		-0.045		-0.029		-0.042	
<i>N</i>	8,510		5,105		1,830		5,905		14,406		1,739	
* <i>p</i> < .05; ** <i>p</i> < .01; *** <i>p</i> < .001; † <i>p</i> > 0.05 & < 0.10												

While the flooding covariates were insignificant in the previous linear probability models, when stratifying the models by race and tenure, some of the variables had a significant relationship with mobility. For non-Hispanic Black and non-Hispanic White renters, the increased amount of flood insurance policies within a ZCTA increases the likelihood of moving by roughly 1 percentage point. While this finding may be confounding as renters often do not carry flooding insurance policies, this result may show renters moving away from flood risk, as more flood insurance policies within an area may illustrate that the ZCTA is a higher flood risk area; however, further research is needed to better understand this finding. Flood damage increases the likelihood of moving for non-Hispanic White renters by 1.4 percentage points. The total amount of flood days within a ZCTA increase the likelihood of moving for Hispanic renters by 12.9 percentage points, and for non-Hispanic White homeowners by 1.8 percentage points.

Insert Table 3 here

In exploring how income levels may affect post-flood mobility, the following models are stratified by home tenure, race, and who are in relative poverty. When stratified by relative poverty, all renter models lose significance between the relationship between a renter in a flooded ZCTA and moving away from the ZCTA. Whereas the homeowner models when stratified by relative poverty retain significance for these relationships. For non-Hispanic Black homeowners in a ZCTA with flooding decreases the likelihood of moving by 4 percentage points in comparison to other non-Hispanic Black homeowners in relative poverty without flooding in their ZCTA. For non-Hispanic White homeowners in relative poverty with flooding in ZCTA it decreases their likelihood of leaving by 2.7 percentage points and for Hispanic homeowners in relative poverty with flooding decreases their likelihood by 7.4 percentage points. Flood and sociodemographic covariates maintain similar levels of significance in comparison to other models.

Insert Table 4 here

Table 4
Population-Averaged Linear Probability Model Predicting Mobility Out of ZCTA, Stratified by Home Tenure, Race, and Relative Poverty: PSID Householder, 2009–2023

Independent Variables	Renter						Homeowner					
	Non-Hispanic Black		Non-Hispanic White		Hispanic		Non-Hispanic Black		Non-Hispanic White		Hispanic	
	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>
<i>Home Tenure (t-1)</i>												
Renter, Flooded ZCTA	0.027	0.019	-0.037	0.027	-0.078	0.049						
Homeowner, Flooded ZCTA							-0.040**	0.014	-0.027**	0.010	-0.074*	0.030
<i>Flooding(t-1)</i>												
Flood in ZCTA	-0.005	0.007	0.003	0.011	-0.004	0.033	0.012	0.008	-0.003	0.003	-0.004	0.012
Policy Count (arcsinh)	0.011**	0.003	0.016**	0.005	0.004	0.006	-0.003†	0.002	0.001	0.001	-0.001	0.003
Flood Damage (arcsinh)	0.007	0.006	0.021*	0.009	-0.014	0.015	-0.002	0.002	-0.003†	0.001	-0.007	0.005
Total Flood Days (arcsinh)	-0.021	0.017	-0.011	0.027	0.097	0.064	0.001	0.123	0.016*	0.008	0.042	0.027
<i>Sociodemographic</i>												
Age 18–34 (t-1)	0.132***	0.014	0.148***	0.021	0.101***	0.025	0.056***	0.014	0.040***	0.009	0.084***	0.023
Age 65+ (t-1)	-0.067**	0.023	-0.127**	0.026	-0.012	0.045	-0.013**	0.014	-0.018***	0.004	-0.005	0.016
Living Density (t-1)	0.024	0.108	0.182	0.153	0.349	0.442	-0.010	0.064	-0.051*	0.025	0.201	0.272
College (t-1)	0.009	0.024	0.072**	0.024	0.102*	0.040	-0.001	0.010	0.001	0.005	0.002	0.002
Family Members in Household	-0.002	0.005	-0.012†	0.006	-0.023**	0.008	0.003	0.003	-0.003	0.003	-0.003	0.006
Centered Total Household Income (ln) (t-1)	0.001	0.005	-0.003	0.007	-0.001	0.012	-0.001	0.003	-0.005*	0.002	-0.022*	0.011
Constant	0.167		-0.007		-0.399		0.045		0.073*		-0.188	
<i>N</i>	5,363		2,856		1,246		2,038		3,634		702	
* <i>p</i> < .05; ** <i>p</i> < .01; *** <i>p</i> < .001; † <i>p</i> > 0.05 & < 0.10												

DISCUSSION

My findings indicate that home tenure status is vital in understanding the likelihood of mobility after flooding. While renter status emerges as a strong predictor of mobility following flooding, renters in a ZCTA with flooding were slightly less likely to move than renters who lived in a ZCTA without flooding in the models containing a factor variable. I then use a Wald test for linear parameters to compare this difference between renters in a flooded ZCTA versus renters without flooding in their ZCTA, there was no statistical difference. Homeowners living in a ZCTA with flooding in the models comparing renters and homeowners did not have a significant relationship. However, the Wald test for linear parameters shows a statistical difference in comparing homeowners with flooding to renters with flooding in their ZCTA. When comparing to homeowners without flooding in the stratified models, homeowners in flooded ZCTAs had a greater likelihood of staying. My findings confirm my first hypothesis that renters are more likely to move out of their ZCTA following flooding in comparison to homeowners; and that homeowner with flooding in their ZCTA are more likely to stay than renters with flooding in their ZCTA (seen in the post-estimation Wald test for linear parameters). While not explicitly explored in environmental migration research, these results align with other sociological findings suggesting that renters are more mobile and homeowners are more rooted (Helderman et al., 2006; Lee, 2014). Additionally, as renters are more mobile, they may have less information regarding the environmental disasters within the area, and they may have fewer social attachments or experiences with environmental hazards in their neighborhoods compared to homeowners, leaving homeowners to be more likely to stay after flooding and renters more likely to leave (Lee & Van Zandt, 2019). Previous studies find that rental housing often recovers more slowly than owner-occupied housing (Best et al., 2025; Peacock et al., 2014), which may prompt renters to relocate quicker than homeowners.

I find that non-Hispanic Black renters with flooding have a greater likelihood by 3.1 percentage points than non-Hispanic White homeowners without flooding to leave their ZCTA following flooding. Meanwhile, Hispanic renters with flooding have a greater likelihood by 5 percentage points to stay after flooding in comparison to non-Hispanic White homeowners without flooding. This finding may be confounding, as tenants are at greater risk of eviction during the post-disaster period, which may also account for the increased mobility of Black renters relative to homeowners (Brennan et al., 2022; Raymond et al., 2022), specifically when coupled with DeLuca and colleagues' (2019) theory of reactive mobility, which suggests that Black renter households are often under constrained conditions, such as evictions, to move. However, while Hispanic renters with flooding have a greater likelihood of staying, in comparison to Hispanic renters without flooding they are less likely to stay by 2 percentage points. When stratified by race, non-Hispanic White and Hispanic renters in

flooded ZCTAs are more likely to stay, which is consistent with Thomas's finding (forthcoming) of renters being more likely to stay and reside in tracts with greater flood risk. Only part of hypothesis 2 can be accepted, as Hispanic renters will stay at greater rates following flooding.

Homeowners across all races have a greater probability of staying after flooding than homeowners who live in a ZCTA without flooding, confirming my third hypothesis. As flooding increases the probability of staying, this may be in part due to the time it takes to recover, lack of resources to move once a house is damaged, or the inability to move due to surmounting home repair costs (Rhodes & Besbris, 2022; Woodhall-Melnik & Weissman, 2020). Similarly, relative to renters, homeowners may be more inclined to stay and recover, because houses are often the largest asset a resident has. For non-Hispanic Black and Hispanic homeowners, research finds that homes tend to disproportionately represent a larger portion of household expenses than White householders, causing a larger negative impact after disaster than White households because they have less resources to recover (Dundon & Camp, 2021), which may affect a household's ability to move. When stratified by relative poverty, immobility increases across all races in comparison to homeowners in relative poverty who did not have flooding in their ZCTA. This shows that income matters for homeowners' mobility, increasing the likelihood of immobility after flooding.

Income was not significant in the interaction models. In the models stratified by relative poverty, there was no relationship between relatively impoverished renters in a flooded ZCTA and mobility; however, relatively impoverished homeowners were less likely to migrate following flooding. Income may matter more for homeowners than renters during disaster recovery thus influencing im/mobility. This finding is consistent with Madajewicz' (2020) work, which shows that middle- and low-income homeowners are less financially resilient than low-income renters. Homeowners, especially relatively impoverished homeowners, may have larger portions of their wealth tied to their house than that of renters, thus affecting post-flood im/mobility more. My finding show that income may be more relevant for homeowner im/mobility following flooding than for renters im/mobility.

Home tenure is a critical yet overlooked variable in the understanding of disasters that affect both population processes and the reproduction of inequities. As disasters exacerbate existing housing problems and reduce the stock of affordable housing, understanding how different groups respond to disasters through mobility is critical to avoiding the reproduction of various systems of inequality and environmental racism. Policymakers should consider the importance of home tenure as a social vulnerability in informing future adaptation policies, as it may affect post-flooding im/mobility. They should ask: how might we consider renters in our climate policies? Are renters mobile, voluntarily or involuntarily, after flooding? How can we protect their homes? How can recovery be equitable for relatively impoverished homeowners? This study contributes to both environmental migration literature and current housing debates by emphasizing home tenure as a predictor of post-flood mobility. This relevance will only increase as climate change worsens the frequency and severity of floods in residential areas.

However, some limitations of this study deserve consideration for future research. First, many mechanisms that shape differences in mobility outcomes could not be assessed with the data; mechanisms such as the desire to stay or migrate (Boas et al., 2025; Rhodes & Besbris, 2022), place attachment (Boas et al., 2022; Bukvic et al., 2022), and kin networks (Spring, 2025). These factors may help explain the variation observed across the studies' models; however, it is difficult to assess with the currently available migration data. While there has been a call for longitudinal panel data, such as the PSID, to include more questions around why residents decide to migrate, these questions remain largely absent from quantitative analyses (Leibbrand & Crowder, 2018). Future surveys should include more questions about reasons to migrate or stay and further research should continue to explore these mechanisms of migration, both qualitatively and quantitatively, with greater consideration of home tenure as a social vulnerability in the mobility process.

Second, many limitations exist surrounding the current state of disaster data. Many post-disaster moves occur at smaller scales than across county lines and beyond (Bukvic & Barnett, 2023; Graif, 2017). While this study attempts to account for smaller moves by considering flood damage at a smaller scale through identifying where the flood path occurred across ZCTA lines, this is an imperfect measure. The challenge being that start to end point data often does not attend to the spatial structuring of data and may occur at larger or smaller scales than what is accounted for in the data. Similarly, while a ZCTA may have experienced flooding, that does not mean that the resident experienced flooding within their home, which makes it hard to know precisely why a resident was staying or moving. Future research should continue to explore different ways to account for flooding at scales smaller than the county for more precise interpretation of the interaction between flood events and damage to im/mobility.

CONCLUSION

Through my study, I advocate for including tenure as a key element of social vulnerability in environmental disaster research. The analysis shows that renters are generally more likely to move following disasters than homeowners; however, are less likely to move than renters that lived in a ZCTA with no flooding. Since the U.S. housing landscape has historically pushed low-income, non-white residents into rental housing, excluding different types of home tenure from analyses further neglects these communities in both academic climate-migration studies and climate adaptation planning, perhaps perpetuating environmental injustices for vulnerable communities. Ignoring tenure perpetuates inequities and overlooks how social vulnerability interacts with and influences population movements after a disaster.

Many previous studies have documented how renters and renters' experiences are often left out of recovery aid and policy conversations (Dundon & Camp, 2021; Potter & Godshall, 2024). With millions of rental units at risk from environmental hazards and renters often being more vulnerable to climate impacts with fewer federal resources available, the ability to remain in neighborhoods after a disaster may depend more on tenure status than previously recognized (Potter & Godshall, 2024; Solá, 2024). Climate justice and transformative adaptation approaches advocate for vulnerable communities, such as low-income and non-white renters, to be included in conversations about climate adaptation (Dundon & Camp 2021; Shi & Moser 2021). This study advocates for renters to be included in these conversations by highlighting their experiences after flooding and how mobility might vary by race and income.

Furthermore, this study highlights the importance of income in a homeowner's immobility after flooding, with relatively impoverished homeowners in flooded ZCTAs having a greater likelihood of staying than other relatively impoverished homeowners. This raises questions both about the equity of recovery and

how equitable recovery affects mobility. Transformative climate adaptation and recovery would allow for even impoverished households to recover without the financial burden and mobility constraints.

Lastly, this study contributes to ongoing debates on climate adaptation and climate equity by examining mobility responses across multiple demographic and socioeconomic dimensions. While migration is often viewed as an adaptive response to climate threats, mobility and immobility after a disaster may be more about inequalities than about choice; future research should further explore the aspirations and capabilities related to mobility by home tenure. Additionally, to avoid the reproduction and intensification of inequities after flooding, climate policies need to consider the importance of the differing home tenure populations and the implications for climate justice by working to protect them and their homes amid increasing environmental hazards (Minkara & Monahan, 2024; Samara, 2024).

Declarations

Author Contribution

I designed, analyzed, and drafted the manuscript.

Acknowledgement

I would like to thank John A. Zinda, Ph.D., for providing the time to read my drafts and provide thoughtful feedback as the project developed. I would also like to express gratitude to those who provided feedback at the Population Association of America 2025 meeting, which allowed me to explore the ideas of this work further.

Data Availability

The data that supported this study are available under Panel Study of Income Dynamics (restricted use data), National Oceanic and Atmospheric Administration storm event data, Federal Emergency Management Agency NFIP Redacted Policies data, American Community Survey, and National Historical Geographic Information Systems crosswalks.

References

1. Ackert, E., Spring, A., Crowder, K., & South, S. J. (2019). Kin location and racial disparities in exiting and entering poor neighborhoods. *Social Science Research*, 84, 102346. <https://doi.org/10.1016/j.ssresearch.2019.102346>
2. Adams, H. (2016). Why populations persist: mobility, place attachment and climate change. *Population and Environment*, 37(4), 429–448. <https://doi.org/10.1007/s11111-015-0246-3>
3. Ahmed, K. J., Tan, Y., & Rudd, D. (2024). Exploring the relationship between changes in fertility and disasters: a review of the literature. *Journal of Population Research*, 41(1), 1. <https://doi.org/10.1007/s12546-023-09324-9>
4. Alverio, G. N., & Leblang, D. (2023). *Racial disparities in U.S. climate migration*. <https://doi.org/10.21203/rs.3.rs-3464783/v1>
5. Anon. (2025). Coastal Flood Risks across the U.S. *Climate Central*. Retrieved August 5, 2026 (https://assets.ctfassets.net/cxgxp8r5d/1MbLA4rrFhhrlE8WLUG6JG/2e41d8695ee76f6a2a600adb312a1e86/FINAL__Exposure_Analysis_Report.doc)
6. Bates, A., & Swan, R. S. (2008). *Through the eye of Katrina: social justice in the United States*. Carolina Academic.
7. Bea, M. D., Bley, K., Faber, J. W., & Haile, S. (2024). Who Pays for Flooding? Local Flood Disasters and Racial Inequality in the Mortgage Market. *Human Ecology*, 52(6), 1341–1360. <https://doi.org/10.1007/s10745-025-00566-0>
8. Bea, M. D., Bley, K., Faber, J. W., et al. (2024). Who Pays for Flooding? Local Flood Disasters and Racial Inequality in the Mortgage Market. *Hum Ecol*, 52, 1341–1360. <https://doi.org/10.1007/s10745-025-00566-0>
9. Bell, A., & Jones, K. (2015). Explaining fixed effects: Random effects modeling of time-series cross-sectional and panel data. *Political science research and methods*, 3(1), 133–153. <https://doi.org/10.1017/psrm.2014.7>
10. Best, K. B., He, Q., Reilly, A., Tran, N., & Niemeier, D. (2025). Rent affordability after hurricanes: Longitudinal evidence from US coastal states. *Risk Analysis*, 45(11), 3439–3451. <https://doi-org/10.1111/risa.14224>
11. Black, R., Bennett, S. R., Thomas, S. M., & Beddington, J. R. (2011). Migration as adaptation: Climate change. *Nature*, 478(7370), 447–449. <https://doi.org/10.1038/478477a>
12. Black, R., Arnell, N. W., Adger, W. N., Thomas, D., & Geddes, A. (2013). Migration, immobility and displacement outcomes following extreme events. *Environmental Science & Policy*, 27, S32–S43. <https://doi.org/10.1016/j.envsci.2012.09.001>
13. Blondin, S. (2021). Staying despite disaster risks: Place attachment, voluntary immobility and adaptation in Tajikistan's Pamir Mountains. *Geoforum*, 126, 290–301. <https://doi.org/10.1016/j.geoforum.2021.08.009>
14. Boas, I., Wiegel, H., Farbotko, C., Warner, J., & Sheller, M. (2022). Climate mobilities: Migration, im/mobilities and mobility regimes in a changing climate. *Journal of Ethnic and Migration Studies*, 48(14), 3365–3379. <https://doi-org/10.1080/1369183X.2022.2066264>
15. Boas, I., Sterly, H., Farbotko, C., Hulme, M., Benveniste, H., Schewel, K. D., & Zickgraf, C. (2025). Climate-induced redistribution of people is not inevitable. *Environmental Research Letters*, 20(10), 101001. <https://doi.org/10.1088/1748-9326/adfdff>

16. Bolin, B., & Kurtz, L. C. (2017). Race, class, ethnicity, and disaster vulnerability. *Handbook of disaster research*, 181–203. https://doi.org/10.1007/978-3-319-63254-4_10
17. Bradshaw, J., & Mayhew, E. (2010). Understanding extreme poverty in the European Union. *European Journal of Homelessness*, 4, 171–186. ISSN: 2030–2762.
18. Brennan, M., Srini, T., Steil, J., Mazereeuw, M., & Ovalles, L. (2022). A perfect storm? Disasters and evictions. *Housing Policy Debate*, 32(1), 52–83. <https://doi-org/10.1080/10511482.2021.1942131>
19. Bukvic, A., Whittemore, A., Gonzales, J., & Wilhelmi, O. (2022). Understanding relocation in flood-prone coastal communities through the lens of place attachment. *Applied Geography*, 146, 102758. <https://doi.org/10.1016/j.apgeog.2022.102758>
20. Bullard, R. D. (1993). The threat of environmental racism. *Natural Resources & Environment*, 7(3), 23–56.
21. Carling, J. (2014). The role of aspirations in migration. *Determinants of International Migration International Migration Institute University of Oxford Oxford*, 2325.
22. Carling, J., & Collins, F. (2018). Aspiration, desire and drivers of migration. *Journal of ethnic and migration studies*, 44(6), 909–926. <https://doi-org>
23. Carling, J., & Schewel, K. (2020). Revisiting aspiration and ability in international migration. *Aspiration, desire and the drivers of migration* (pp. 37–55). Routledge.
24. Castelli, F. (2018). Drivers of migration: why do people move? *Journal of travel medicine*, 25(1).
25. Chakraborty, J., McAfee, A. A., Collins, T. W., & Grineski, S. E. (2021). Exposure to Hurricane Harvey flooding for subsidized housing residents of Harris County. *Texas Natural Hazards*, 106(3), 2185–2205. <https://doi.org/10.1007/s11069-021-04536-9>
26. Cherry, K. E., Allen, P. D., Galea, S., & Dass-Brailsford, P. (2009). Older adults and natural disasters. *Crisis and disaster counseling: Lessons learned from Hurricane Katrina and other disasters*, 115 – 30.
27. Choi, J. H., & Zinn, A. (2024). The wealth gap between homeowners and renters has reached a historic high. Urban Institute. <https://www.urban.org/urban-wire/wealth-gap-between-homeowners-and-renters-has-reached-historic-high>
28. Coes, C., & Loh, T. H. (2020). and Tola Myczkowska. The Great Real Estate Reset. Brookings series. Risky (Housing) Business: Distorted and Destabilized Housing Markets Are Pushing Households into Climate-Risky, Low-Opportunity Communities. The Brookings Institution, Washington, DC. <https://www.brookings.edu/essay/distorted-and-destabilized-housing-markets-arepushing-households-into-climate-risky-low-opportunitycommunities/>
29. Correll, R. M., Lam, N. S., Mihunov, V. V., Zou, L., & Cai, H. (2021). Economics over risk: Flooding is not the only driving factor of migration considerations on a vulnerable coast. *Annals of the American Association of Geographers*, 111(1), 300–315. <https://doi.org/10.1080/24694452.2020.1766409>
30. Collins, S. (2025). COME HOME OR HIGH WATER: HOW NATIONAL FLOOD INSURANCE REQUIREMENTS ARE CREATING REDLINING 2.0. *Vermont Journal of Environmental Law*, 26(2).
31. Crowder, K., & Downey, L. (2010). Interneighborhood migration, race, and environmental hazards: Modeling microlevel processes of environmental inequality. *American journal of sociology*, 115(4), 1110–1149.
32. Curtis, K. J., Fussell, E., & DeWaard, J. (2015). Recovery migration after Hurricanes Katrina and Rita: Spatial concentration and intensification in the migration system. *Demography*, 52(4), 1269–1293. <http://doi.org/10.1007/s13524-015-0400-7>.
33. Cutter, S. L., Johnson, L. A., Finch, C., & Berry, M. (2007). The US hurricane coasts: increasingly vulnerable? *Environment: Science and Policy for Sustainable Development*, 49(7), 8–21. <https://doi.org/10.3200/ENVT.49.7.8-21>
34. Cutter, S. L., Boruff, B. J., & Shirley, W. L. (2012). Social vulnerability to environmental hazards. *Hazards vulnerability and environmental justice* (pp. 115–132). Routledge.
35. Decerf, B. (2022). *Absolute and Relative Poverty Measurement: A Survey*. World Bank. <https://doi.org/10.1596/1813-9450-10008>. Washington, DC.
36. De Haas, H. (2021). A theory of migration: the aspirations-capabilities framework. *Comparative migration studies*, 9(1), 8. <https://doi.org/10.1186/s40878-020-00210-4>
37. De Haas, H. (2025). Towards a global migration paradigm: And the imperative of ridding ourselves of the ‘push-pull’ model. *Comparative Migration Studies*, 13(1), 76. <https://doi.org/10.1186/s40878-025-00481-9>
38. DeLuca, S., Wood, H., & Rosenblatt, P. (2019). Why poor families move (and where they go): Reactive mobility and residential decisions. *City & Community*, 18(2), 556–593. <https://doi.org/10.1111/cico.12386>Digital Object Identifier (DOI).
39. Donner, W., & Rodríguez, H. (2008). Population composition, migration and inequality: The influence of demographic changes on disaster risk and vulnerability. *Social forces*, 87(2), 1089–1114. <https://doi.org/10.1353/sof.0.0141>
40. Dundon, L. A., & Camp, J. S. (2021). Climate justice and home-buyout programs: renters as a forgotten population in managed retreat actions. *Journal of Environmental Studies and Sciences*, 11(3), 420–433. <https://doi.org/10.1007/s13412-021-00691-4>
41. Edelberg, W., Estep, S., Lu, S., & Moss, E. (2021). A comparison of renters and homeowners in recent decades. *The Hamilton Project, Brookings Institution, Washington, DC*.
42. Elliott, J. R., & Howell, J. (2017). Beyond disasters: A longitudinal analysis of natural hazards’ unequal impacts on residential instability. *Social Forces*, 95(3), 1181–1207. <https://doi.org/10.1093/sf/sox010>
43. Fatemi, F., Ardalan, A., Aguirre, B., Mansouri, N., & Mohammadfam, I. (2017). Social vulnerability indicators in disasters: Findings from a systematic review. *International journal of disaster risk reduction*, 22, 219–227. <https://doi.org/10.1016/j.ijdrr.2016.09.006>
44. Farber, S. (1987). The value of coastal wetlands for protection of property against hurricane wind damage. *Journal of Environmental Economics and Management*, 14(2), 143–151. [https://doi.org/10.1016/0095-0696\(87\)90012-X](https://doi.org/10.1016/0095-0696(87)90012-X)

45. Federal Emergency Management Agency (2026). FIMA NFIP Redacted Policies - v2 (retrieved on January 1, 2026). U.S. Department of Homeland Security. FIMA NFIP Redacted Policies.
46. Folbre, N., Murray-Close, M., & Suh, J. (2018). Equivalence scales for extended income in the U.S. *Review of Economics of the Household*, 16(2), 189–227. <https://doi.org/10.1007/s11150-017-9387-8>
47. Fothergill, A., Maestas, E. G., & Darlington, J. D. (2002). Race, ethnicity and disasters in the United States: A review of the literature. *Disasters*, 23(2), 156–173. <https://doi.org/10.1111/1467-7717.00111>
48. Fothergill, A., & Peek, L. A. (2004). Poverty and disasters in the United States: A review of recent sociological findings. *Natural hazards*, 32(1), 89–110. <https://doi.org/10.1023/B:NHAZ.0000026792.76181.d9>
49. Forster, M., Förster, M., & Pearson, M. (2002). Income Distribution and Poverty in the OECD Area: Trends and Driving Forces. *OECD Economic Studies*, 2002, 2–2.
50. Fussell, E., Sastry, N., & Van Landingham, M. (2010). Race, socioeconomic status, and return migration to New Orleans after Hurricane Katrina. *Population and environment*, 31(1), 20–42. <https://doi.org/10.1007/s11111-009-0092-2>
51. Galster, G. C., Galster, J., & Vachuska, K. (2024). The color of water: Racial and income differences in exposure to floods across US neighborhoods. *Real Estate Economics*, 52(3), 753–793. <https://doi.org/10.1111/1540-6229.12480>
52. Godsil, R. D. (1991). Remedying environmental racism. *Michigan Law Review*, 90(2), 394–427. <https://doi.org/10.2307/1289559>
53. 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), 288–318. <https://doi.org/10.1007/s11111-015-0243-6>
54. Gutmann, M. P., & Field, V. (2010). Katrina in historical context: environment and migration in the US. *Population and environment*, 31(1), 3–19. <https://doi.org/10.1007/s11111-009-0088-y>
55. Han, Y., & Ye, X. (2022). Examining the effects of flood damage, federal hazard mitigation assistance, and flood insurance policy on population migration in the conterminous US between 2010 and 2019. *Urban Climate*, 46, 101321. <https://doi.org/10.1016/j.uclim.2022.101321>
56. Hauer, M. E. (2017). Migration induced by sea-level rise could reshape the US population landscape. *Nature Climate Change*, 7(5), 321–325. <https://doi.org/10.1038/nclimate3271>
57. Hauer, M. E., Jacobs, S. A., & Kulp, S. A. (2024). Climate migration amplifies demographic change and population aging. *Proceedings of the National Academy of Sciences*, 121(3), e2206192119. <https://doi.org/10.1073/pnas.220619211>
58. Helderman, A. C., Van Ham, M., & Mulder, C. H. (2006). Migration and home ownership. *Tijdschrift voor Economische en Sociale Geografie*, 97(2), 111–125. <https://doi.org/10.1111/j.1467-9663.2006.00506.x>
59. Howell, J., & Elliott, J. R. (2019). Damages done: The longitudinal impacts of natural hazards on wealth inequality in the United States. *Social problems*, 66(3), 448–467. <https://doi.org/10.1093/socpro/spy016>
60. Joint Center for Housing Studies of Harvard University (2020). America's Rental Housing.
61. Kammerbauer, M., & Wamsler, C. (2017). Social inequality and marginalization in post-disaster recovery: Challenging the consensus? *International journal of disaster risk reduction*, 24, 411–418. <https://doi.org/10.1016/j.ijdrr.2017.06.019>
62. Kim, J., & Soo Oh, S. (2014). The virtuous circle in disaster recovery: Who returns and stays in town after disaster evacuation? *Journal Of Risk Research*, 17(5), 665–682. <https://doi.org/10.1080/13669877.2013.822917>
63. Knowles, S. G., & Kunreuther, H. C. (2014). Troubled waters: The national flood insurance program in historical perspective. *Journal of Policy History*, 26(3), 327–353. <https://doi.org/10.1017/S0898030614000153>
64. Leal, M., Ramos, C., & Pereira, S. (2018). Different types of flooding lead to different human and material damages: the case of the Lisbon Metropolitan Area. *Natural Hazards*, 91(2), 735–758. <https://doi.org/10.1007/s11069-017-3153-3>
65. Lee, J. Y., & Van Zandt, S. (2019). Housing tenure and social vulnerability to disasters: A review of the evidence. *Journal of planning literature*, 34(2), 156–170. <https://doi.org/10.1177/08854122188120>
66. Lee, K. O. (2014). Why do renters stay in or leave certain neighborhoods? The role of neighborhood characteristics, housing tenure transitions, and race. *Journal of Regional Science*, 54(5), 755–787. <https://doi.org/10.1111/jors.12124>
67. Leibbrand, C., & Crowder, K. (2018). Migration, mobility, and neighborhood attainment: Using the PSID to understand the processes of racial stratification. *The ANNALS of the American Academy of Political and Social Science*, 680(1), 172–192. <https://doi.org/10.1177/00027162187979>
68. Li, B., Fan, C., Chien, Y. H., Hsu, C. W., & Mostafavi, A. (2024). Mobility behaviors shift disparity in flood exposure in US population groups. *International Journal of Disaster Risk Reduction*, 108, 104545. <https://doi.org/10.1016/j.ijdrr.2024.104545>
69. Lukyanets, A. S., Ryazantsev, S. V., Maksimova, A. S., Moiseeva, E. M., & Manshin, R. V. (2019). Theoretical, methodological and statistical problems of studying environmental migration. *Amazonia Investiga*, 8(19), 227–236.
70. Lynch, V. D., Sullivan, J. A., Flores, A. B., Xie, X., Aggarwal, S., Nethery, R. C., & Parks, R. M. (2025). Large floods drive changes in cause-specific mortality in the United States. *Nature Medicine*, 31(2), 663–671. <https://doi.org/10.1038/s41591-024-03358-z>
71. Ma, C., & Smith, T. (2020). Vulnerability of renters and low-income households to storm damage: Evidence from Hurricane Maria in Puerto Rico. *American journal of public health*, 110(2), 196–202. <https://doi.org/10.2105/AJPH.2019.305438>
72. Madajewicz, M. (2020). Who is vulnerable and who is resilient to coastal flooding? Lessons from Hurricane Sandy in New York City. *Climatic Change*, 163(4), 2029–2053. <https://doi.org/10.1007/s10584-020-02896-y>
73. Malega, R. (2019). Understanding the Neighborhood Concentration of Affluent Black Households in the 1990s. *Urban Science*, 3(1), 6. <https://doi.org/10.3390/urbansci3010006>

74. Mayer, J., Moradi, S., Nejat, A., Ghosh, S., Cong, Z., & Liang, D. (2020). Drivers of post-disaster relocations: The case of Moore and Hattiesburg tornados. *International Journal Of Disaster Risk Reduction : Ijdr*, 49 (Oct), 101643. <https://doi.org/10.1016/j.ijdr.2020.101643>
75. Michel-Kerjan, E. O. (2010). Catastrophe economics: the national flood insurance program. *Journal of economic perspectives*, 24(4), 165–186. <https://doi.org/10.1257/jep.24.4.165>.
76. Mileti, D. (1999). *Disasters by design: A reassessment of natural hazards in the United States*. National Academies.
77. Miao, Q., Rothenberg, S., Tomaszewski, B., & Schneider, J. (2026). Schools underwater: social disparities in flooding risk and disaster aid for US schools. *Climatic Change*, 179(5), 104. <https://doi.org/10.1007/s10584-026-04193-6>
78. Mohai, P., & Bryant, B. (1992). Environmental injustice: weighing race and class as factors in the distribution of environmental hazards. *U Colo L Rev*, 63, 921.
79. Mongold, E., Costa, R., Zsarnóczy, Á., & Baker, J. W. (2024). Modeling post-disaster recovery: Accounting for rental and multi-family housing. *Earthquake Spectra*, 40(2), 1353–1375. <https://doi.org/10.1177/875529302312227>
80. Molloy, R., & Smith, C. (2019). *US internal migration: Recent patterns and outstanding puzzles* (A House Divided: Geographic Disparities in Twenty-First Century America). Federal Reserve Bank of Boston. <https://www.bostonfed.org/-/media/Images/research-conference-2019/papers/Session-4-MolloySmith.pdf>
81. Notten, G., & De Neubourg, C. (2011). Monitoring Absolute and Relative Poverty: Not Enough Is Not the Same as Much Less. *Review of Income and Wealth*, 57(2), 247–269. <https://doi.org/10.1111/j.1475-4991.2011.00443.x>
82. National Oceanic and Atmospheric Administration (NOAA). (n.d.) Storm Events Database. U.S. Department of Commerce, NOAA National Centers for Environmental Information. Retrieved January 1 (2026). from <https://www.ncei.noaa.gov/stormevents/>
83. Pais, J., South, S. J., & Crowder, K. (2012). Metropolitan heterogeneity and minority neighborhood attainment: Spatial assimilation or place stratification? *Social problems*, 59(2), 258–281. <https://doi.org/10.1525/sp.2012.59.2.258>
84. Panel Study of Income Dynamics, restricted use data. (2025). *Produced and distributed by the Survey Research Center*. Institute for Social Research, University of Michigan.
85. Paul, N., Galasso, C., & Baker, J. (2024). Household displacement and return in disasters: A review. *Natural Hazards Review*, 25(1), 03123006. <https://doi.org/10.1061/NHREFO.NHENG-1930>
86. Plane, D. A. (1991). Age-composition change and the geographical dynamics of interregional migration in the US. *Annals of the association of American Geographers*, 82(1), 64–85. <https://doi.org/10.1111/j.1467-8306.1992.tb01898.x>
87. Plane, D. A. (1992). Demographic influences on migration. *Regional studies*, 27(4), 375–383. <https://doi.org/10.1080/00343409312331347635>
88. Peacock, W. G., & Girard, C. (2012). Ethnic and racial inequalities in hurricane damage and insurance settlements. *Hurricane Andrew* (pp. 171–190). Routledge.
89. Peacock, W. G., Van Zandt, S., Zhang, Y., & Highfield, W. E. (2014). Inequities in long-term housing recovery after disasters. *Journal of the American Planning Association*, 80(4), 356–371. <https://doi.org/10.1080/01944363.2014.980440>
90. Potter, C., & Godshall, L. (2024). Renting at the edge of the world: climate change protections failing renters. *Wash UJL & Pol'y*, 74, 117.
91. Samara, T. R. (2024). Shelter from the storm: a framework for housing and climate justice. *Agenda for Social Justice* 3 (pp. 142–150). Policy. <https://doi.org/10.51952/9781447371410.ch016>
92. Schewel, K. (2020). Understanding immobility: Moving beyond the mobility bias in migration studies. *International migration review*, 54(2), 328–355. <https://doi.org/10.1177/019791831983195>
93. Schewel, K., Dickerson, S., Madson, B., & Nagle Alverio, G. (2024). How well can we predict climate migration? A review of forecasting models. *Frontiers in Climate*, 5, 1189125. <https://doi.org/10.3389/fclim.2023.1189125>
94. Schroeder, J., Van Riper, D., Manson, S., Knowles, K., Kugler, T., Roberts, F., Ruggles, S., & IPUMS National Historical Geographic Information System. (2025). : Version 20.0 Crosswalks to 5-Digit ZIP Code Tabulation Areas. Minneapolis, MN: IPUMS. <http://doi.org/10.18128/D050.V20.0>
95. Seebauer, S., & Winkler, C. (2020). Should I stay or should I go? Factors in household decisions for or against relocation from a flood risk area. *Global Environmental Change*, 60, 102018. <https://doi.org/10.1016/j.gloenvcha.2019.102018>
96. Simpson, N. B. (2022). Demographic and economic determinants of migration. *IZA World of Labor*. <https://doi.org/10.15185/izawol.373.v2>.
97. Singh, S. R., Eghdami, M. R., & Singh, S. (2014). The concept of social vulnerability: A review from disasters perspectives. *International Journal of Interdisciplinary and Multidisciplinary Studies*, 1(6), 71–82.
98. Spring, A. (2025). Internal migration following local environmental disasters: the intersection of race, socioeconomic status, and local family ties. *Population And Environment*, 47, 43. <https://doi.org/10.1007/s11111-025-00511-9>
99. Roth Tran, B., & Sheldon, T. L. (2017). Same storm, different disasters: Consumer credit access, income inequality, and natural disaster recovery. *Different Disasters: Consumer Credit Access, Income Inequality, and Natural Disaster Recovery*. <https://dx.doi.org/10.2139/ssrn.3380649>
100. Raker, E. J. (2025). Flooding, Sociospatial Risk, and Population Health. *Demography*, 62(1), 61–85. <https://doi.org/10.1215/00703370-11792975>
101. Raymond, E. L., Green, T., & Kaminski, M. (2022). Preventing evictions after disasters: The role of landlord-tenant law. *Housing Policy Debate*, 32(1), 35–51. <https://doi.org/10.1080/10511482.2021.1931929>
102. Rivera, D. Z., Jenkins, B., & Randolph, R. (2022). Procedural vulnerability and its effects on equitable post-disaster recovery in low-income communities. *Journal of the American Planning Association*, 88(2), 220–231. <https://doi.org/10.1080/01944363.2021.1929417>
103. Rhodes, A., & Besbris, M. (2022). *Soaking the middle class: Suburban inequality and recovery from disaster*. Russell Sage Foundation.

103. Rumbach, A., & McTarnaghan, S. (2023). More Than 3 Million Americans Were Displaced by a 'Natural' Disaster in the Past Year. How Can We Prepare for Our Climate Future? | Urban Institute. [www.urban.org](https://www.urban.org/urban-wire/more-3-million-americans-were-displaced-natural-disaster-past-year-how-can-we-prepare). Available online at: <https://www.urban.org/urban-wire/more-3-million-americans-were-displaced-natural-disaster-past-year-how-can-we-prepare> (Accessed November 17, 2025).
104. Tate, E., Rahman, M. A., Emrich, C. T., & Sampson, C. C. (2021). Flood exposure and social vulnerability in the United States. *Natural Hazards*, 106(1), 435–457. <https://doi.org/10.1007/s11069-020-04470-2>
105. Thomas, K. (Ed.). (Forthcoming). Countering the Current: Flood Risk and Uneven Patterns of Immobility. *Demography*.
106. Thompson, J. J., Wilby, R. L., Hillier, J. K., Connell, R., & Gunn, N. (2026). Flood-affected homes in England lose value and are owned longer than those in unaffected areas. *Communications Earth & Environment*, 7(1), 530. <https://doi.org/10.1038/s43247-026-03586-w>
107. Wiegel, H., Boas, I., & Warner, J. (2019). A mobilities perspective on migration in the context of environmental change. *Wiley Interdisciplinary Reviews: Climate Change*, 10(6), e610. <https://doi.org/10.1002/wcc.610>
108. Williams, R. (2021). *Interpreting Interaction Effects; Interaction Effects and Centering*.
109. Wilson, B., Tate, E., & Emrich, C. T. (2021). Flood recovery outcomes and disaster assistance barriers for vulnerable populations. *Frontiers in water*, 3, 752307. <https://doi.org/10.3389/frwa.2021.752307>.
110. Wisner, B., Blaikie, P., & Cannon, T., and Ian Davis (2004). *At Risk: Natural Hazards, People's Vulnerability and Disasters* (2nd ed.). Routledge.
111. Woodhall-Melnik, J., & Weissman, E. P. (2023). Living with disaster: exploring complex decisions to stay in or leave flood prone areas. *Housing Studies*, 38(5), 747–769. <https://doi.org/10.1080/02673037.2021.1900794>
112. Zickgraf, C. (2021). Theorizing (im) mobility in the face of environmental change. *Regional Environmental Change*, 21(4), 126. <https://doi.org/10.1007/s10113-021-01839-2>