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Managed retreat: a nationwide study of the local, racially segmented resettlement of homeowners from rising flood risks

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Abstract

The government-funded retreat of homeowners from flood-prone housing is a globally ascendant policy of climate adaptation. Yet, we still know relatively little about some fairly basic questions involving its participants: e.g. How much risk do homeowners tolerate before retreating? Where do they move? Does that move reduce their future flood risk? And, to what extent do answers to these questions vary by the type of racial and ethnic communities in which they live? To answer these questions, we combine novel address-to-address residential history data with future flood risk estimates and indices of local context to better understand how retreat is unfolding across the United States. Results indicate that, when voluntarily undertaken, retreat is a highly local process that yields notable reductions in household flood risk. These movements, however, are racially segmented, with homeowners in majority-White communities being more likely to stay in the face of higher risk and less likely to relocate to nearby areas that are not also majority-White.

1. Introduction

Of all climate hazards, flooding exerts the greatest economic impact on the US population, much of it through damage to people's homes [1], and that impact is increasing not just nationwide but around the world [2–4]. To meet this rising challenge, governments large and small are funding the complex but important task of paying people to demolish their at-risk housing and relocate elsewhere [5, 6]. Yet, despite its national [7–11] and international [12–19] ascendance, this policy of 'managed retreat' remains an understudied mode of climate adaptation. In the US, 'only a handful of buyout programs have been the focus of empirical studies or formal evaluations,'[20] and those programs are 'typically analyzed on a case-by-case basis, leaving their broader patterns and implications unclear'[21]. Consequently and despite implementation in hundreds of locales throughout the country, we continue to know relatively little about some fairly basic questions: e.g. How much risk do homeowners tolerate before retreating? Where do they move? Does that move reduce their future flood risk? And, to what extent do answers to these questions vary by the type of racial and ethnic communities in which they live?

Answering these questions can illuminate the extent to which climate change is influencing not only decisions about when to move but also where to resettle. This, in turn, can illuminate the extent to which adaptation-by-relocation conforms to classic theories of migration [22–24], which emphasize the predominantly local character of residential moves in general. If this is the case, it would support calls to shift 'attention from "climate migration" to "climate mobilities"… [to] capture the multiple forms, directions and multiplicities of [local] human movement in the context of climate change.' [25] Examining how these climate mobilities vary (or not) across different racial and ethnic communities can additionally illuminate how the implementation of managed retreat policy intersects with another powerful force that has long shaped housing opportunities in the US: racial and ethnic segregation [26–28].

To advance these efforts, we assemble and analyze new address-to-address residential data for thousands

of US homeowners who voluntarily sold their housing and moved through the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program (HMGP) between 1990 and 2017. The HMGP pays homeowners a (pre-disaster) 'fair market' price to acquire and demolish their flood-prone homes [29]. The aim is to promote climate adaptation by returning the purchased parcels to their prior undeveloped state, never to be built-on again except possibly for flood mitigation infrastructure. To date, officials have implemented the program in more than 500 cities and towns in every state but Hawaii. Records for participating property owners were recently released through a petition filed under the Freedom of Information Act [30]. Below, we leverage and extend those data to answer the questions posed above. To assess the generalizability of our findings, we examine their variation across different types of local geographic and demographic context.

2. Data

2.1. Address-to-address residential relocation data

Of the 41 004 HMGP records publicly released by FEMA in 2019, 22 015 contain the name of the property owner. Of those owners, 14 254 (65%) are identifiable as (noncommercial) occupants of the properties they sold. We focus on these owner occupants, or resident homeowners, because we are interested in residential retreat, not the sale and demolition of rental or vacant properties. Figure 1 maps the location and numeric distribution of these retreating homeowners across the US.

To locate where these 14 254 owner-occupants moved, we first worked with the consumer data company Infutor, whose residential history data have been validated in prior peer-reviewed research [31, 32]. Their proprietary algorithm was able to match destination addresses to 4838 cases.

For the unmatched cases, research assistants performed several steps. First, they selected a random sample of 50 cases that Infutor was able to match and cross-validated the destination addresses for those cases using two online data sources. The first was FastPeopleSearch.com, and the second was Anywho.com. For all cases matched by Infutor, validation was achieved in one or both databases, giving us confidence in both Infutor's results and the two supplemental online sources. Research assistants then used the two supplemental sources to search for destination addresses for cases unmatched by Infutor. This effort produced destination addresses for 4713 additional cases. The final, combined dataset contains origin and destination addresses for 9551 retreating homeowners who participated in FEMA's HMGP between 1990 and 2017. Figure 2 provides a flowchart illustrating our data collection process.

To assess selectivity bias between the 9551 retreating homeowners for whom we found destination addresses and the 4703 for whom we did not, we compared the two subsamples across a number of observed characteristics. Results appear in appendix table A1 and indicate a high degree of similarity across found and unfound cases (e.g. with respect to the year of buyout, proportion of single-family structures, number of buyouts in the surrounding county, region, and place size). To the extent there is divergence, it is largely with respect to the mean price paid for the bought-out property, which tends to be higher in our analytic sample. Thus, we consider our results to be widely generalizable but less so to the lowest priced buyouts (e.g. under $20 000). Even so, our analytic sample contains more such properties than not (e.g. under $20 000: $n = 687$ found v. $n = 536$ unfound).

2.2. Address-level future flood risk

Address-specific estimates of future flood risk at origin and destination come from the First Street Foundation (FSF), which uses a combination of 21 global climate models under the middle Intergovernmental Panel on Climate Change (IPCC) RCP 4.5 emissions scenario while considering a range of high (75th percentile) and low (25th percentile) scenarios. They also incorporate a baseline climate period of 1980–2010 as well as data on historical flood events. Using this methodology, FSF calculates a Flood Factor (FF) for each addressed parcel in the US [33, 34]. The FF is an integer ranging between 1 and 10 that captures the likelihood and severity of flooding by 2050, with 1 representing minimal risk and 10 representing extreme risk. For example, a property at 'moderate risk' (FF = 3) has a 6%–12% chance of flooding by 2050, and a good chance of that flooding reaching a depth of 6–9 inches.

FSF's flood modeling methodology has been independently reviewed and used by the US Environmental Protection Agency in their 2021 report on social vulnerability and climate change [35]. For addresses where the FF is missing, we use the value of the next closest parcel. We assume that even if a participating resident was unaware of their home's exact FF, its value nonetheless provides a valid and reliable estimate of the future flood risk they weighed in deciding if and where to retreat. That estimate refers to their parcel flooding not necessarily their home, which depends on other factors unobserved in the FF's calculation (e.g. the home's elevation from ground level).

2.3. Racial and ethnic tract composition & median housing value

Because reliable individual-level data on participants' demographic characteristics are unavailable and because we are interested in community-level racial

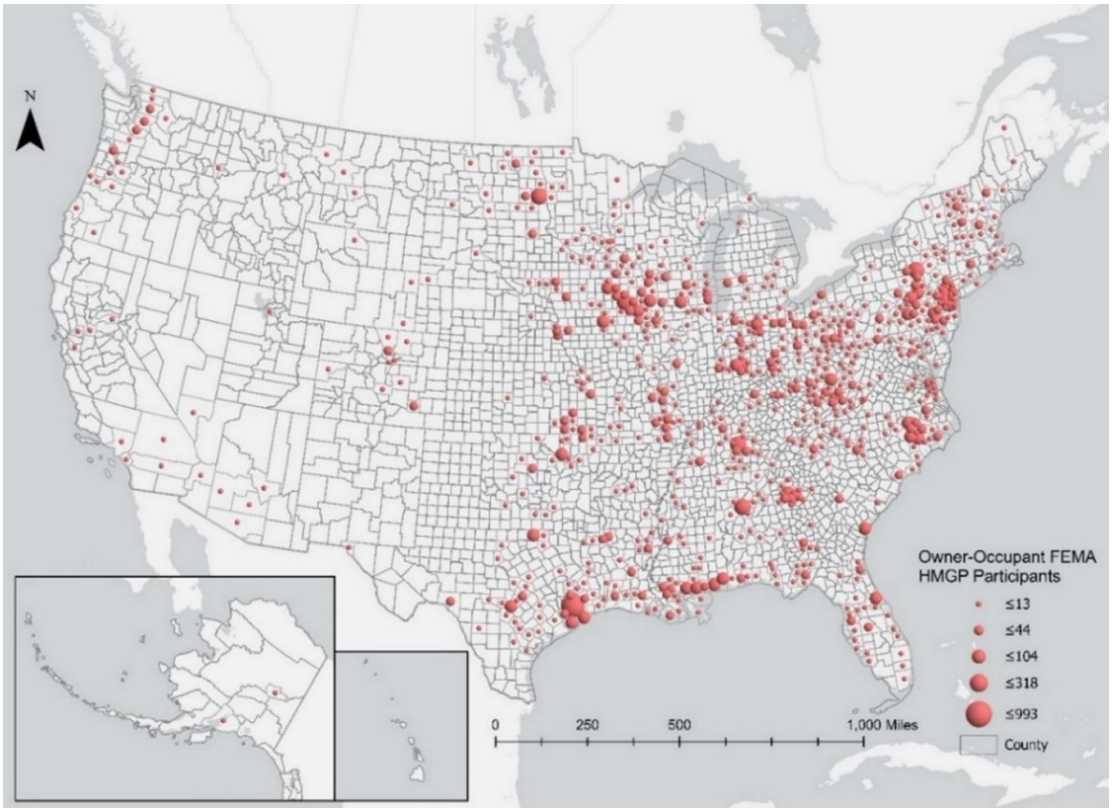

Figure 1. Distribution of owner–occupant FEMA HMGP participants, 1990–2017.

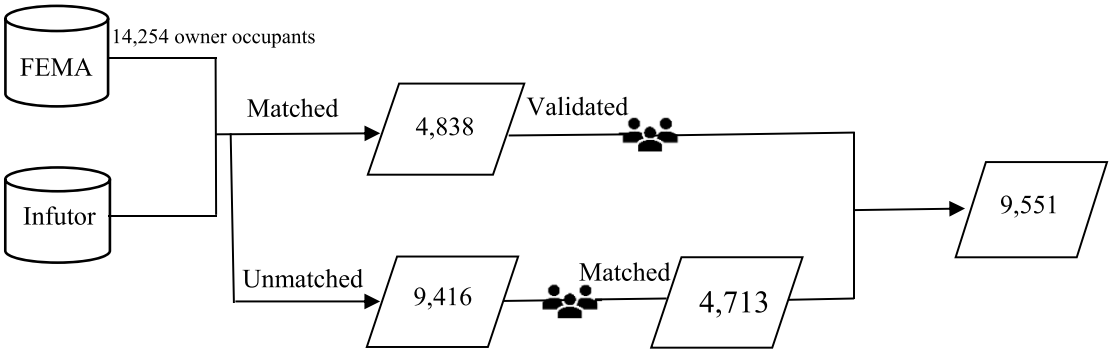

Figure 2. Residential history data collection process.

and ethnic composition, we measure the latter at the level of census tracts, a common proxy for neighborhood communities. For each case, we estimate the tract's composition at origin and destination for the year of HMGP participation by applying linear interpolation to decennial population data standardized to 2010 tract boundaries in the longitudinal tract database (LTDB) [36]. Using those estimates, we characterize origin and destination tracts by their racial and ethnic majority at time of buyout, defined as 50.1% or more of the resident population. We use this approach because we are interested in the numerically dominant group in the community, not the group's representation relative to the population in the surrounding area. For our calculations, we identify four mutually exclusive types of majority: non-Hispanic Black, Hispanic, non-Hispanic White, and other or no majority. Henceforth, we refer to tracts as majority-Black, majority-Hispanic, majority-White, and no/other-majority, respectively. In supplemental analyses (in section 3.5), we also use tract-level median housing values similarly interpolated from the LTDB.

2.4. Local county context

To assess the generalizability of our findings across different local contexts we append two types of county-level indicators to each buyout address. One

type is geographic and follows the National Oceanic and Atmospheric Agency's (NOAA's) observation that 'coastal counties' are now a common framework for describing and assessing human dimensions of the coast [37]. Broadly, NOAA defines coastal *watershed* counties as those in which water flows into the ocean or Great Lakes. To qualify, at least 15% of the county's land area must be located within a coastal watershed, or its land area must account for 15% of a coastal USGS eight-digit hydrologic cataloging unit. Because coastal watersheds can extend inland, NOAA defines *shoreline* counties as the subset of watershed counties located directly adjacent to the open ocean, major estuaries and the Great Lakes. This is where the US population is most directly affected by the coast. We treat the two types of coastal counties—shoreline and watershed—as mutually exclusive categories. To characterize remaining non-coastal counties, we subdivide them into whether their state abuts the Atlantic, Gulf or Pacific coasts. If so, we classify the county as *inland*, meaning it is located in a coastal state but not itself coastal; otherwise, we classify it as *interior*, meaning it is located within a landlocked state. In both non-coastal types, flood risks derive mainly from rainfall; in shoreline and watershed counties, they also derive from tropical storms and sea level rise.

Our second county-level indicator of local context is demographic. It uses the US Department of Agriculture's (2013) rural–urban continuum codes [38], which we collapse into four categories: *nonmetropolitan; small metropolitan* (<250 000 residents); *mid metropolitan* (250 000–1M residents); and, *big metropolitan* (>1M residents). The presumption is that more populated counties have more nearby housing to which to move as well as more racially and ethnically diverse neighborhoods across which to actualize that move.

3. Methods and results

3.1. The different contexts of retreat for different racial and ethnic communities

We begin by subdividing all retreating homeowners by the racial and ethnic majority of residents in their buyout tract. Figure 3 then shows where those tracts are located geographically and demographically. In this way, we can see how local contexts of retreat vary for different racial and ethnic communities nationwide, adding further insight to prior research that focused on all HMGP properties in general rather than focusing specifically on retreating homeowners, as we do here [39, 40].

Overall, results indicate that 80% of homeowners who have retreated through FEMA's buyout program lived in majority-White tracts (n = 11 411/14 254). Respective pie charts further indicate that most of these majority-White tracts are located in interior, or landlocked, states and, compared with other racial and ethnic communities, tend to be located in nonmetropolitan areas. Retreat from within majority-Black tracts, by contrast, has occurred more commonly in big metropolitan areas, where retreat from within majority-Hispanic tracts has also concentrated at even higher levels, especially in shoreline counties. The implication is that while managed retreat may be taking place nationwide, it is doing so across different contexts for different racial and ethnic communities, with overlap occurring mainly in coastal metropolitan counties.

3.2. Higher risk tolerance in majority-White communities

Next, we assess the risk level at which resident homeowners give up their housing for demolition through the HMGP. Nationwide, calculations show that the average FF at origin for retreating homeowners is 5.6, which corresponds to an 86% chance of the parcel flooding by 2050.

Next, we investigate how this risk level varies across different types of places. To do so, we use ordinary least squares (OLS) regression to predict the FF of each buyout address by its geographic, demographic, and ethnoracial context simultaneously. This method allows us to statistically control for the uneven distributions observed in figure 2, thus yielding more comparable results across respective factors. Predicted values appear in figure 4.

At the top, we see that homeowners in shoreline counties exhibit higher risk tolerance prior to retreating than other homeowners, especially those living in interior, or landlocked, states. This pattern is consistent with the relative attractiveness of coastal living as well as a higher probability that some of the housing there is elevated. Next, we see similar variation between metropolitan and nonmetropolitan counties, with the latter showing lower risk tolerance, perhaps because relocation is less costly and investments in flood mitigation less likely. Third and notably, both of these axes of variation pale in comparison to the gap between majority-White and majority-Black tracts. Risk tolerance, in other words, seems to be more a function of the racial composition of the buyout tract in which it occurs than the wider geographic or demographic context in which it is embedded.

3.3. The local nature of retreat

Next, we use the address-to-address database described above (section 2.1) to assess where people resettle once they decide to retreat. Overall, results indicate that while long-distance moves do occur, they are rare. Nationwide, the median driving distance from buyout origin to destination is just

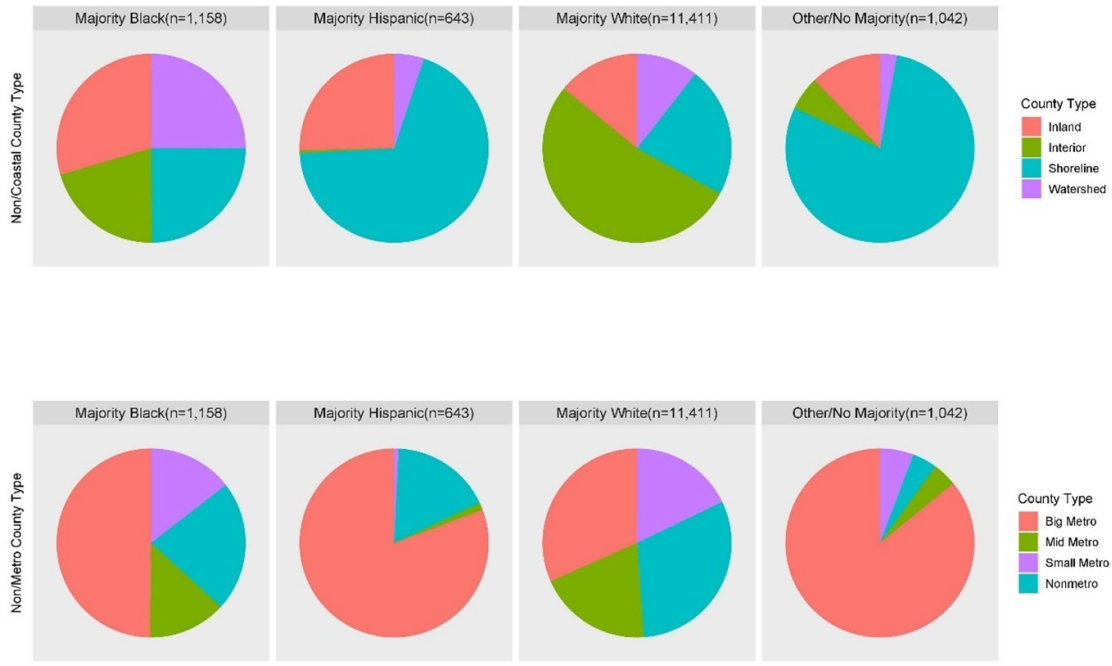

Figure 3. Distribution of owner–occupant HMGP participants by the racial/ethnic majority of their census tract at time of retreat, by local contexts.

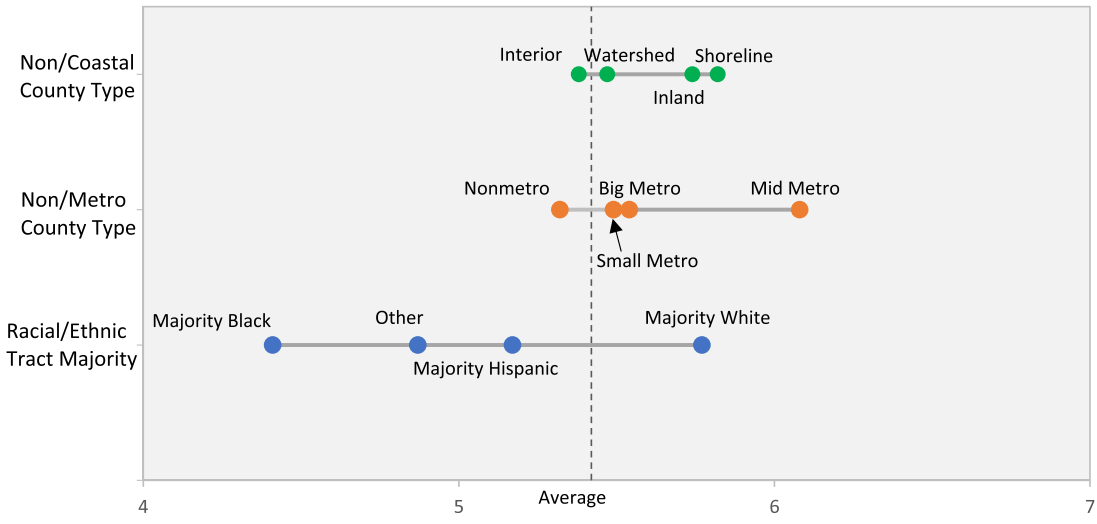

Figure 4. Flood Factor of HMGP owner-occupied buyout properties, by local contexts.

7.4 miles, with 58% of retreating homeowners staying within a 10 mile drive of their bought-out home, and 74% staying within a 20 mile drive. Notably, these short-distance moves often go missing in commonly used government data sources such as the US Population Census, American Community Survey, and Internal Revenue Service Area-to-Area Migration Files, which publicly report residential mobility data only at the county level or higher.

To investigate these local moves further, we restrict analysis to homeowners who retreated within a 20 mile drive of their bought-out property ($n = 7032$). An example appears in figure 5, which displays the moves of 84 homeowners who retreated with the help of FEMA's HMGP from a single (majority-White) census tract in Middlesex, NJ following Superstorm Sandy in 2012. Here, we see that the vast majority of retreating homeowners remained within a 5 mile drive (as indicated by the inner-most dashed circle). Note, too, that many moved towards the shoreline, not away from it.

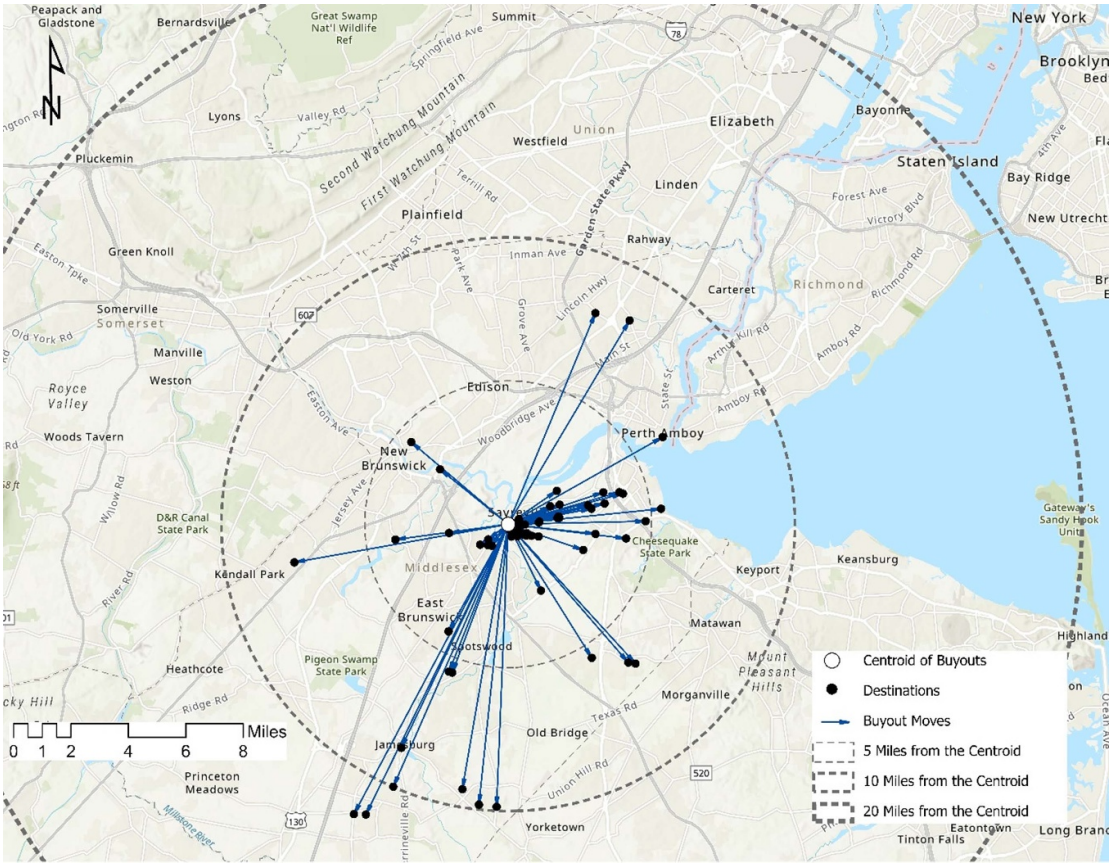

Figure 5. Local moves of HMGP participants from a census tract in middlesex, NJ after Superstorm Sandy (2012).

Using our national sample of local movers (⩽20 driving miles), we deployed OLS regression to estimate distance moved by the participant's FF at origin, net of its respective non/coastal, non/metropolitan, and ethnoracial context. Results (not shown) indicate no relationship between one's flood risk at origin and distance moved. Higher risk, in other words, does not lead to longer retreats. Instead, distance moved is primarily a function of place size, with big metropolitan areas exhibiting slightly longer local retreats (with a mean of 6.6 driving miles compared with 4.8 driving miles in nonmetropolitan areas). Once these place differences are statistically controlled, census tracts with different racial and ethnic majorities exhibit roughly similar distances moved: 6.5 driving miles. Managed retreat, in other words, is a highly local process for most resident homeowners, regardless of the geographic, demographic, and community context in which they live.

3.4. The risk reduction of retreat

To determine if retreating homeowners actually lower their future flood risk, we compared the FFs of HMGP participants at origin and destination. Nationwide, we find 70% reduced their score, while only 8% increased it. Overall, the average reduction is 63%, from a mean of 5.6 at origin to 2.1 at destination. This reduction is roughly similar for local movers (⩽20 driving miles) and for all movers. Further investigation reveals that, understandably, those exhibiting higher risk prior to retreat reduce it the most by moving. Because that flood risk at origin tends to be higher in majority-White tracts (see section 3.2), participants from those areas generally experience greater risk reduction as they retreat.

At destination, however, risk scores are roughly similar, regardless of the racial and ethnic majority of the respective tract, spanning from an average of 1.9 for moves ending in a majority-Black tract to an average of 2.2 for those ending in a majority-White tract. What matters more for destination flood risk is the geographic context in which retreat occurs. In shoreline counties, destination risk scores remain uniformly higher, averaging 2.4 compared to 1.9 elsewhere. If that area is also nonmetropolitan, the average risk score at destination jumps to 4.9. Destination risk, in other words, is more a function of the intersecting types of geographic and demographic context in which (local) retreats occur, not the racial and ethnic community in which they originate or end.

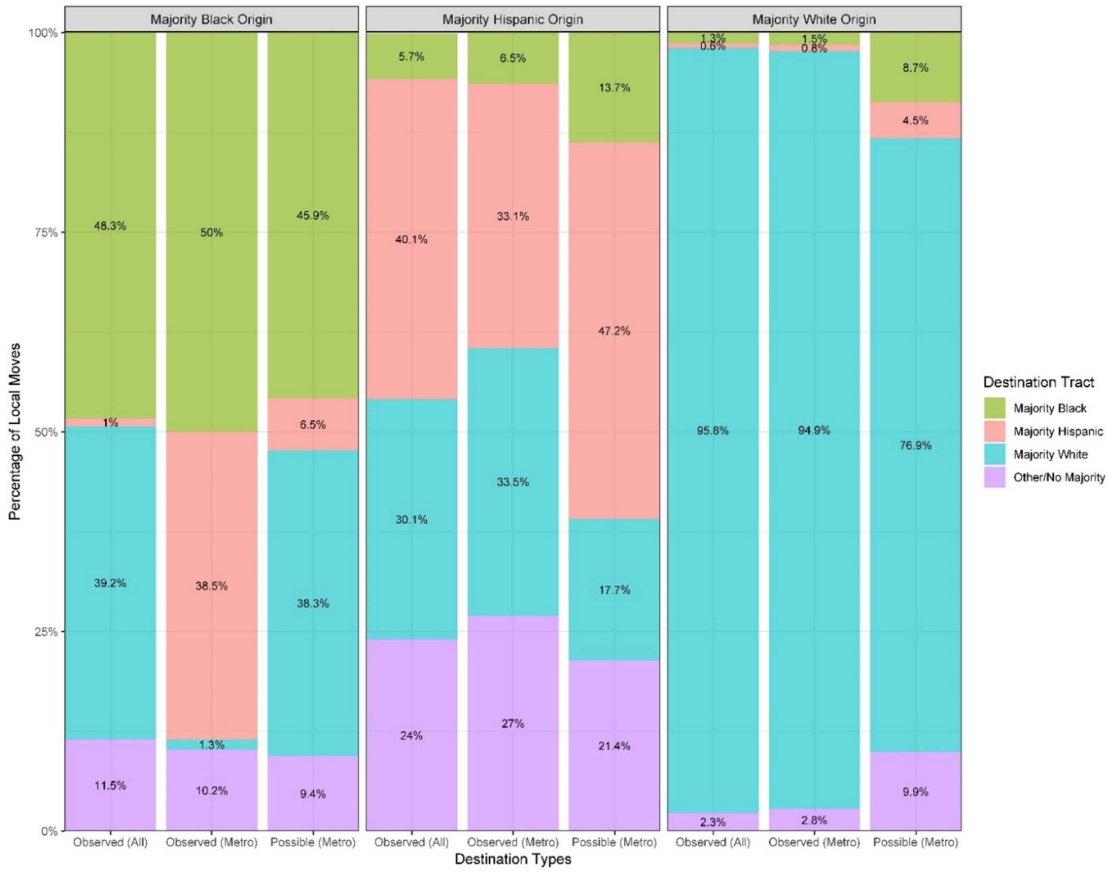

Figure 6. Proportions of local retreats (⩽20 driving miles) ending in different types of racial- and ethnic-majority tracts, by the racial- and ethnic-majority of origin tract.

3.5. The (White) racial segmentation of retreat

Finally, to assess the extent to which retreat diverges for homeowners in different racial and ethnic communities, we continue to strict analysis to local moves occurring within 20 driving miles. We do so because, as established above (in section 3.3), retreat is a highly local process. We also do so because a neighborhood's racial and ethnic composition has long operated to distinguish local housing choices [26]. To start, figure 6 presents data on homeowner retreat from tracts of different racial and ethnic majorities. The far-right panel, for example, shows retreat from housing in majority-White tracts. The first stacked bar is for all such moves and shows that nationwide, 96% of retreats starting in a majority-White tract end in a majority-White tract. This rate of racial correspondence is nearly twice that observed for moves originating in majority-Black or majority-Hispanic tracts, which are just 48% and 33% respectively.

The second stacked bar in each panel then limits analysis just to metropolitan areas, where there is presumably a wider range of racial and ethnic neighborhoods in which to resettle locally, relative to nonmetropolitan areas. Still, we see almost no decline in the matching rate of majority-White origin to destination tracts (95% v 96% for all observed local moves). This consistency suggests that the high matching rate observed nationwide is not simply due to a lack of nearby alternatives.

To probe further, we identified the actual set of tracts to which each metropolitan participant who retreated locally could have resettled. To construct that choice set, we extended a radial buffer of 20 driving miles from each participant's origin (buyout) address. We then identified all tracts that fell within or intersected that radial buffer. We then appended census data to each of those tracts for the observed buyout year and classified them by the racial and ethnic majority of their residents.

Results appear in the third and final stacked-bar of each panel in figure 6.

Here, we see for example that the average metropolitan resident who retreated locally from a majority-White tract had only a 77% chance of ending up in a majority-White destination tract (including their own). This rate is 18 percentage points lower than the observed destination rate in the stacked-bar just to the left. The implication is that in metropolitan areas, the high rate of local retreat between majority-White tracts is not random.

Is this uniquely high rate explained by lower flood risks in nearby majority-White tracts? No. On average, the observed FF is actually higher for local moves ending in majority-White tracts. Is it explained by those retreating from majority-White tracts wanting to avoid tracts with lower median housing values? No. The median housing value of one's buyout tract predicts the odds of ending up in a majority-White tract at a p-value of only 0.49, indicating random association. Finally, is it because all retreating homeowners, regardless of community type, prefer destinations racially and ethnically similar to the ones from which they retreat? No. As figure 6 shows, retreat from majority-White tracts is unique in its high level of racial and ethnic correspondence at destination.

4. Discussion

One reason we know so little about when, where and how US homeowners are retreating from rising flood risk is that the federal government's primary program promoting such climate adaptation-by-relocation focuses on where it can save the most money on future disaster costs, not on where participants actually move. Another reason is that, to date, limited efforts to fill resulting gaps have relied on case studies of unknown generalizability. The present study sought to address these shortcomings in route to providing a broader view of how homeowners nationwide are relocating through managed retreat policy. Several findings stand out.

First, for retreating homeowners in the US, the biggest predictor of risk tolerance prior to giving up one's home for demolition and relocating is not whether one lives in a coastal or inland area, or whether one lives in a big metropolis or a small town. It is the racial composition of one's immediate neighborhood. More specifically, the higher the percentage of White residents in one's census tract, the more flood risk one is willing to tolerate before selling to the government and relocating. Supplemental analyses affirm that this is true even after accounting for total and per capita property damages from recent local disasters.

Prior research hints at several reasons why this is likely to be the case. One is the heightened social valuation of White residential spaces in general, which encourages ongoing public and private investments even after major disasters [41–43]. These investments make it physically and financially safer to stay at higher risk levels or to sell through the market than to engage in government-funded retreat. Another likely reason involves who is retreating from flood-prone communities of color. In Houston, for example, research finds that one of the strongest predictors of retreat is not the current racial and ethnic composition of one's neighbors but the extent of white flight over recent decades [44]. Here, it seems White homeowners are the ones retreating from newly transitioned communities of color, leaving a checkerboard of vacant lots in their wake. Meanwhile, ethnographic research indicates that homeowners of color in historically non-White communities often resist retreating due to strong community attachments and distrust in government renewal efforts more generally [45]. In these intersecting and complex ways, race and ethnicity appear to be segmenting who retreats where and at what risk levels.

Our second major finding is that, regardless of this complexity, if homeowners do retreat, they typically stay close. For most Americans, in other words, the decision to retreat is predicated on finding somewhere proximate to resettle and thus preserving a sense of place [46, 47]. In this way, managed retreat behavior conforms to classic migration theories that emphasize the local nature of resettlement in general and the associated power of community attachment [48]. This is universally true nationwide: Regardless of where retreat occurs, those engaging in it are much more likely to move among nearby neighborhoods than to migrate long distances to safer towns, states or regions. This is good news for local tax bases. It is also good news for local flood control efforts, because our third major finding is that, on average, these moves, despite being local, do reduce homeowners' future flood risks quite substantially. Thus, it seems that for retreating homeowners, climate signals are influencing decisions about not only if to move but also where to relocate. This finding suggests community attachment and risk reduction can occur together. Yet, for policymakers, the converse may offer an even more important lesson: Unless homeowners can stay close *and* reduce risk (*and* if they live in a majority-White neighborhood end up in a majority-White neighborhood), they will not voluntarily retreat.

The latter finding reminds us again that rising climate risks are not solo performers. Rather, they play in concert with ongoing community attachments, which in the US remain segmented by race and ethnicity in complex and historically unequal ways. This fact is strongly evidenced by the reluctance of those retreating from majority-White neighborhoods to consider resettling in anything but those types of neighborhoods. This tendency does not diminish concern about climate gentrification [49], but it does help to put it into broader context.

5. Conclusion

As climate change encourages governments across the US and around the world to buy and demolish

flood-prone housing to save on future disaster costs, resident homeowners must decide when and where they will relocate. To uncover emergent features of this new and growing 'great displacement,' [50] we combined novel residential history data with future flood risk estimates and local contextual indicators. Using summary statistics, regression analyses, and simulated choice sets, we find that managed retreat, when voluntarily undertaken, exhibits several identifiable patterns nationwide. First and regardless of context, most people only give up their homes for demolition if they can retreat to somewhere nearby. Second, these local moves yield notable reductions in household flood risk, indicating that climate signals are entering residential decision-making at destination as well as at origin and doing so at highly granular scales—that is, distinguishing among nearby homes and neighborhoods rather than pushing participants to entirely new towns or regions or even away from the coast. Third, these local climate mobilities appear to be racially segmented, with homeowners in majority-White communities tolerating higher flood risks before they retreat and then doing so only if they can resettle in majority-White communities. Retreat, in other words, is shaped not just by rising flood risks and government policy but also by community ties that remain highly localized and racially segmented in complex and unequal ways.

Data availability statement

The data that support the findings of this study are openly available at the following URL/DOI: https://osf.io/dnjvg/files/osfstorage. Data will be available from 31 December 2024.

Acknowledgments

We thank the First Street Foundation for generous access to their data and the Kinder Institute for Urban Research for their geographic expertise and computing resources. We thank the following students for their research assistance: Phylicia Brown, Basma Bedawi, Aubrey Calaway, Adrian Frias, Cole Holladay, Alex Priest, Lindsey Schirn, and Allison Yelvington. We also thank members of the Spatial Processes And City Environments (SPACE) working group at Rice University as well as ERL's anonymous reviewers for their constructive feedback on earlier drafts. Grant support came from the National Science Foundation, Award#2116488.

Appendix

Table A1. Descriptive statistics for owner–occupant FEMA HMGP participants by whether their destination address was found (or not).

	Destination Found ($n = 9551$)	Destination Not Found ($n = 4703$)
Buyout household (at origin)		
Buyout year (mean)	2006	2005
Average price paid for buyout property (mean)[a]	82 968	67 649
Structure type (%)		
Single family	93.8	90.7
Multiple families	2.0	2.3
Manufactured home	4.1	6.8
Buyout county (at origin)		
(% of all $N = 819$ buyout counties covered) {% of all owner–occupants for whom a destination was found for at least one HMGP participant in their county}[b]	(92.1%) {99.8%}	(66.5%)
Number of buyouts in county (mean)	236	257
Geographic county context (%)[c]		
Interior (land-locked state)	43.5	46.2
Inland (non-coastal county in coastal state)	15.9	15.4
Coastal watershed	11.2	10.6
Coastal shoreline	29.4	27.8
Shoreline region (shoreline only, %)		
Gulf of Mexico	56.1	57.6
Atlantic Ocean	23.8	23.0
Interior (Great Lake)	16.2	15.3
Pacific Ocean	3.9	4.1
Demographic County Context (%)[d]		
Nonmetropolitan	25.3	32.6
Small metropolitan (<250 K population)	16.5	14.7
Mid metropolitan (250 K–1 M population)	18.2	14.9
Big metropolitan (>1 M population)	40.0	37.8
Racial/ethnic majority of origin buyout tract (%)[e]		
Majority non-Hispanic White	81.3	77.5
Majority non-Hispanic Black	7.9	8.5
Majority Hispanic	4.1	5.3
No/other Majority	6.7	8.7

[a] Only 64% of cases have valid data for price paid: $n = 5{,}963$, destination found; $n = 3{,}035$, destination missing. Reported mean values control for year of buyout to adjust for inflation.

[b] There are only $n = 32$ cases located in 21 buyout counties where no destination was found for any participant.

[c] See NOAA'S coastal county definitions, which include counties along the Great Lakes as shoreline: https://coast.noaa.gov/data/digitalcoast/pdf/defining-coastal-counties.pdf.

[d] See 2013 USDA urban–rural continuum codes: www.ers.usda.gov/data-products/rural-urban-continuum-codes.aspx.

[e] The racial/ethnic majority of buyout tracts is assigned according to whichever mutually exclusive racial/ethnic group accounted for 50.1% or more of residents living in the tract during the year the participant's buyout occurred. Data historically standardized to 2010 tract boundaries come from the longitudinal tract database: https://s4.ad.brown.edu/projects/diversity/researcher/LTDB.htm. We use linear interpolation to compute annual estimates for buyout years occurring between censuses.

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