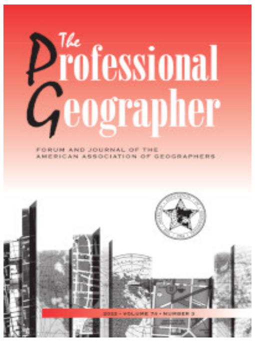

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Locating Neighborhood Displacement Risks to Climate Gentrification Pressures in Three Coastal Counties in Florida

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Residential displacement as a result of climate change impacts will manifest on varied temporal and spatial scales affecting both coastal and inland communities. As coastal residents contend with more frequent shocks and stress from sea-level rise, many will eventually need to abandon their homes and property. Inland communities consisting of socioeconomically vulnerable populations with less exposure to climate change impacts will presumably be at risk for residential displacement. This study uses three counties in Florida—Duval, Pinellas, and Miami-Dade—as cases, and employs publicly available data. The well-known principal components analysis generated representative components of housing, socioeconomic, and demographic characteristics known to predispose neighborhoods to the risk of secondary residential displacement. An additive model fit to the individual principal components analysis retained six components for Duval and Miami-Dade counties and seven for Pinellas county. The subsequent displacement risk categorization captures interrelationships between neighborhood socioeconomic and biophysical risk and allows for the identification of areas with higher secondary displacement risks. High potential second-order displacement was found in 30 percent, 25 percent, and 20 percent of the block groups in Duval, Miami-Dade, and Pinellas counties, respectively. This article serves as a framework to operationalize factors that predispose a neighborhood to climate gentrification driven by sea-level rise. **Key Words: climate gentrification, displacement, gentrification, principal components analysis, sea-level rise.**

Geographers' inquiry into environmental gentrification created by green infrastructure projects and amenities, redevelopment and new buildings, and home appreciation in areas with relatively lower climate risks is growing (Davidson and Lees 2010; Rérat, Söderström, and Piguet 2010; Pearsall and Anguelovski 2016; Heckert and Rosan 2018; Anguelovski, Connolly, et al. 2019). As municipalities in at-risk areas undertake projects that focus on adaptation to climate change impacts, there is potential to reduce risks associated with climate-influenced hazards as well as create other amenities. Resulting displacement is often justified through city or municipality urban greening agendas and projects (Anguelovski, Connolly, et al. 2019). These two dynamics converge under the idea of climate gentrification (CG), which has two primary displacement drivers: (1) gentrification from market factors associated with increased property values in areas targeted for adaptation projects that protect at-risk areas and add amenities, and (2) gentrification from neighborhood changes that result from households and businesses relocating from higher risk areas (e.g., coastal zones) to lower risk areas (e.g., inland higher ground) as hazard risks increase in at-risk areas due to climate change impacts (i.e., tropical cyclone intensification and sea-level rise [SLR]; Keenan, Hill, and Gumber 2018; Anguelovski, Connolly, et al. 2019; Anguelovski, Triguero-Mas, et al. 2019; Fu and Nijman 2021). In all of these cases, the results are similar: Lower income households and businesses involuntarily move, due to economic changes (increased rents) driven by climate change factors over which they have minimal control and little protection.

SLR is one of the climate change impacts that will very likely lead to widespread displacement pressure in the coming decades. Sea levels around the globe rose around 3.7 mm per year between 2006 and 2018 and by 2100 the global mean SLR is expected to reach between 0.44 and 0.76 m under the intermediate greenhouse gas emissions scenario (Fox-Kemper et al. 2021). Those living in low-lying coastal areas will face short- and long-term risks such as greater exposure to coastal hazards, inundation of homes and property, and finally, managed retreat away from inundated coastal areas. SLR is distinct from other coastal hazards in that it leads to permanent (or long-term) inundation rather than temporary flooding from a precipitation or storm surge event—in the case of SLR, the waters do not recede.

Over the next few decades, residents in vulnerable communities may be subject to second-order

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displacement, via in-movers pricing longtime residents out of their homes and neighborhoods (Elliott-Cooper, Hubbard, and Lees 2020). Inland neighborhoods in many of Florida's coastal communities are likely to be subjected to the cascading effects of potential coastal displacement due to inundation from SLR. Nearby, inland receiving communities will likely face secondary displacement pressures via higher income residents leaving the more vulnerable coast for higher ground (Martinich et al. 2013). Secondary displacement emanates from in-movers escaping climate hazards and in turn, displacing individuals residing in lower income, historical communities of color. Our goal is to define this complex and multifaceted process by quantifying displacement risk pressures emanating from inland communities.

Key factors from the displacement and gentrification literature describe dimensions of second-order residential displacement (Keenan and Bradt 2020). To operationalize factors that predispose neighborhoods to displacement risks, several studies use displacement risk in the context of gentrification (Bates 2013; Ding, Hwang, and Divringi 2016; Way, Mueller, and Wegmann 2018; Preis et al. 2021; Williams et al. 2021). Studies show demographic variables such as race or ethnicity and single-parent households are more likely to experience gentrification pressures emanating from increases in housing costs and rent prices and unstable housing tenure (Bates 2013). Socioeconomic variables such as median income, educational attainment, poverty, job proximity, and school proximity, and housing variables such as cost-burdened households, renter status and tenure, evictions, and median home values have been shown to be associated with neighborhoods at risk of or undergoing gentrification (Bates 2013; Ding, Hwang, and Divringi 2016; Way, Mueller, and Wegmann 2018).

Researchers commonly use multivariate techniques to simplify and group variables into a few meaningful components (Hwang and Sampson 2014). This study uses the well-known principal components analysis (PCA) to create synthetic displacement factors to construct an index to categorize neighborhoods as being at potentially high, medium, or low risk for second-order displacement. Our goal is to provide policymakers with a framework to identify neighborhoods at risk of displacement driven by CG, via inland migration from coastal residents who experience unbearable SLR, to protect nearby communities sensitive to gentrification pressures and implement policies and programs that protect affordable housing, stabilize neighborhoods, and proactively plan for CG.

Methods

Study Area

Three coastal counties in Florida were identified through an existing survey and comprehensive plan assessment as areas experiencing impacts related to flooding and changing sea levels and were selected as study areas due to their large population sizes and concentrations of coastal development, and spatially varying racial and ethnic population compositions. Each study area includes Community Redevelopment Areas (CRA), Opportunity Zones (OZ), or both designations; both identify distressed communities or public areas targeted for urban revitalization. These projects often exclude local developers and have been shown to worsen existing economic disparities in some communities (see Figure 1; Butler et al. 2019; Kim 2022). Each county participates in regional resiliency collaboratives that explore opportunities to address climate-related impacts in their communities including the installation of green infrastructure (Southeast Florida Climate Compact; Tampa Bay Regional Resiliency Coalition; North East Florida Regional).

Miami-Dade County, located at the southeasternmost tip of Florida, is the most populated county (2,699,428 residents) in Florida (U.S. Census Bureau 2019). Coastal areas, especially the east coast and southern islands, are most vulnerable to SLR (Ann Conyers, Grant, and Roy 2019). Once SLR increases to around 1.5 to 2 m, predictions suggest close to 2 million residents will retreat from inundation pressures (McLeman 2018). Pinellas County is the sixth most populated county in the state, with a population of 964,666 (U.S. Census Bureau 2019). Tampa-St. Petersburg is one of the U.S. port cities at greatest risk to SLR (Melillo et al. 2014). SLR exposure risk is currently affecting the residential real estate markets in Pinellas County (Melillo et al. 2014). Along with Miami-Dade, trends in the residential real estate market in Pinellas indicate exposed properties sell at a reduced price compared to homes in less exposed areas (Fu and Nijman 2021). Duval County is the seventh most populated county in Florida, with a population of 957,755. It is located in northeastern Florida along the Atlantic coast (U.S. Census Bureau 2019). Its SLR profile is more complex given the tidally influenced St. John's River, which runs through the heart of Jacksonville, driving displacement pressures well beyond the coastal areas.

Data

A wide range of housing, socioeconomic, and demographic characteristics are known to predispose a neighborhood to the risk of residential displacement. Socioeconomic, demographic, and housing data came from the U.S. Census Bureau's (2018) American Community Survey (ACS), eviction rates were obtained from Princeton University's Eviction Lab (Desmond et al. 2018), and job proximity and school proficiency indexes from are from the U.S. Department of Housing and Urban Development

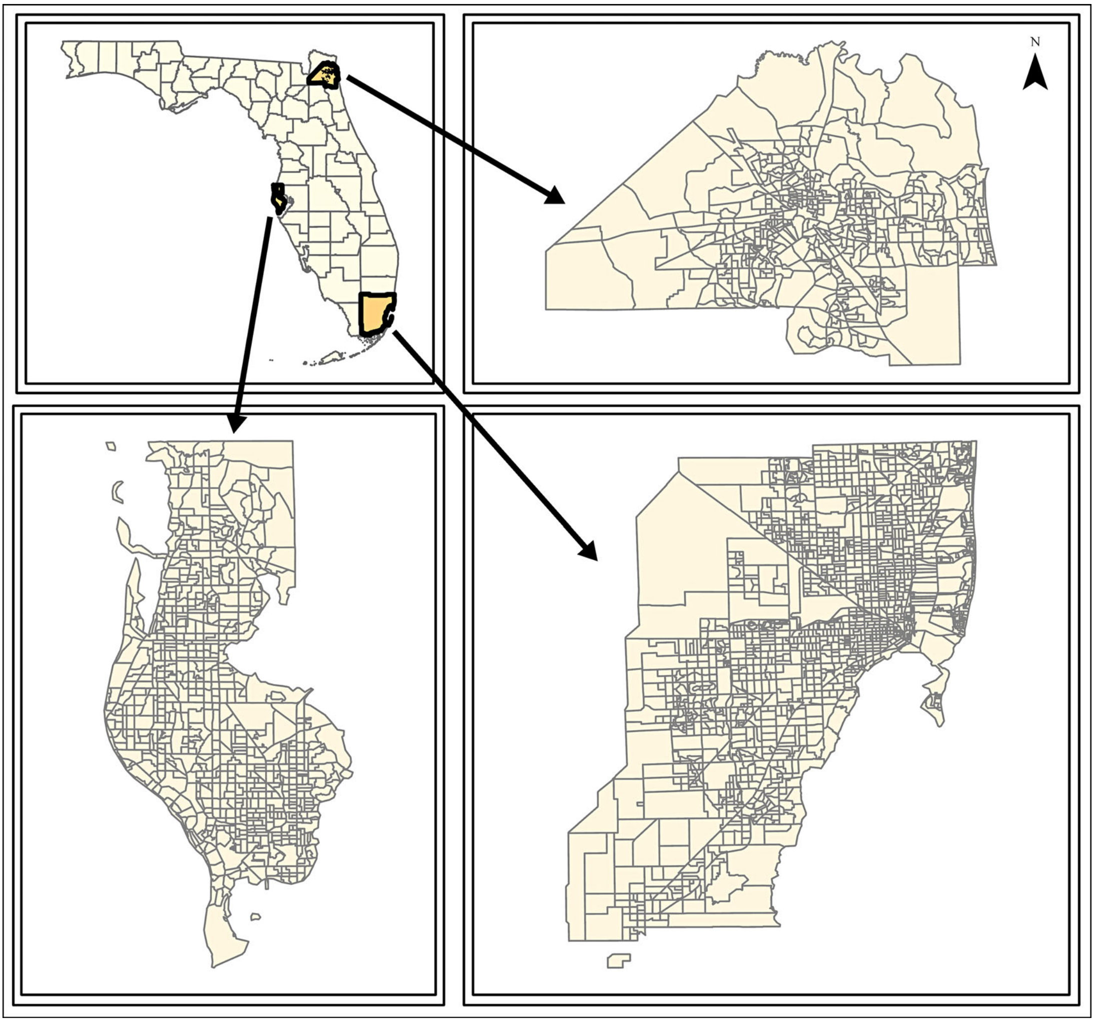

Figure 1 *Study area with community redevelopment areas and opportunity zones.*

(HUD 2017). Five-year socioeconomic, demographic, and housing estimates (2014–2018) were gathered at the block group level. We drew from existing studies on displacement risks to identify factors representative of demographic, socioeconomic, and housing conditions (Bates 2013; Way, Mueller, and Wegmann 2018; Institute for Housing Studies at DePaul 2020; Largent and Quimby 2020; Williams et al. 2021). Numerous studies reported that displacement differentially affects African American and Hispanic residents, citing spatial patterns of racial segregation and rising costs of living (Atkinson 2002; Kirkland 2008; Largent and Quimby 2020). Climate justice advocates note lower resourced and historically marginalized communities will likely be receiving communities (Shi et al. 2016). Socioeconomic conditions include percentage of persons living below the poverty level, percentage of persons over twenty-five years old with less than a bachelor's degree, the job proximity index, and the school proficiency index. The school proficiency index measures elementary school performance to determine which neighborhoods are near high- or low-performing schools, and the jobs proximity index is a measure of census block groups' or neighborhoods' accessibility to all job locations within a core-based statistical area (CBSA; HUD 2017). Largent and Quimby (2020) identified neighborhoods composed of individuals living near or below poverty and having less education as being susceptible to displacement as a consequence of an influx of wealthier, more educated individuals having greater autonomy over where they decide to live. Housing and family characteristics consist of the percentage of renter-occupied households, percentage of single-parent households, and eviction rates. These factors have been shown to lessen an individual's or household's financial capacity to resist residential displacement and are areas that "first" gentrifiers target for investment (Bates 2013). Hot-spot analysis reveals the spatial patterns associated with each of the secondary

Table 1 *Description of the 10 indicators*

Indicator	Data source
% African American	American Community Survey (2014–2018)
% Hispanic or Latino	American Community Survey (2014–2018)
% population 25 years or older with no high school diploma	American Community Survey (2014–2018)
% civilian noninstutionalized population living below the poverty level	American Community Survey (2014–2018)
% single-parent households	American Community Survey (2014–2018)
% renter-occupied households	American Community Survey (2014–2018)
Eviction rate	Princeton Eviction Lab (2016)
Job proximity index	U.S. Department of Housing and Urban Development (2017)
School proficiency index	U.S. Department of Housing and Urban Development (2017)
% inundated under 2040 sea-level rise scenario	University of Florida GeoPlan Center

displacement indicators in each study area, respectively. A link to the ArcGIS online map is included in the Appendix.

We included the SLR 2040 scenario from the University of Florida GeoPlan Center as a primary climate risk factor that captures long-term inundation risks related to SLR. The study selected 2040 SLR that influences contemporary displacement and migration that is a precursor to the larger inundation areas projected for 2050. Inundation scenarios were generated at the University of Florida GeoPlan Center from U.S. Army Corps of Engineers (USACE) sea-level change data, and National Oceanic and Atmospheric Administration (NOAA) SLR projections (University of Florida 2020). This inundation layer represents areas that are not already submerged. For the block groups, the total coverage in square miles for each block group under this SLR scenario was considered in the secondary displacement risk index. Thus, the index highlights secondary displacement risks and incorporates flood risks related to SLR.

Principal Components Analysis

PCA is a multivariate dimension reduction technique used to summarize interrelationships between correlated variables (James et al. 2013). The PCA creates new synthetic variables that are linear combinations of the original displacement risk indicators where in order each combination, or feature, explains more variation than the next (James et al. 2013). The PCA allowed us to understand how groups of variables can predict varying degrees of displacement pressures by block group across each county. PCAs were run individually for each study area using the individual displacement risk indicators listed in Table 1. Components were examined with loadings greater than 0.30 and less than −0.30 considered (Wang et al. 2017). Component scores represent the sum of all components in each study area and were standardized, equally weighted, and added into a unitless displacement risk score. The crude displacement risk score was subsequently categorized into moderate displacement (within one-half standard deviation of the mean), whereas values above and below one-half standard deviation of the mean were subsequently categorized as high and low displacement risk, respectively. One-half standard deviation from the mean resulted in the block groups being distributed into a roughly equal number of observations in each category of secondary displacement risk.

Results

Individual PCAs yielded six components for Duval and Miami-Dade and seven components for Pinellas County. Respectively, these components explained around 85 percent, 87 percent, and 86 percent of the variation in the original data set (Figures 5-7). Table 2 presents the results of the PCA for each study area. In Duval County, these components were interpreted as (1) low socioeconomic position, (2) Hispanic renters in neighborhoods near jobs, (3) Hispanic homeowners in areas away from block groups likely to be inundated in the 2040 scenario, (4) Hispanics living in neighborhoods that are likely to be inundated under the SLR 2040 scenario, (5) neighborhoods near jobs with high eviction rates that are likely to be inundated under the SLR 2040 scenario, and (6) neighborhoods with high eviction rates and low-proficiency schools. Components 1 through 3 and 6 imply increasing second-order displacement risk. In Miami-Dade County, components were interpreted as (1) low socioeconomic position, (2) Hispanic renters, (3) renters living near employment centers, (4) block groups that are likely to be inundated under the SLR 2040 scenario, (5) Hispanics in high eviction rate neighborhoods and (6) single parents and low-proficiency schools. Components 1, 5, and 6 imply increasing second-order displacement risk. Finally, in Pinellas County, components were interpreted as (1) low socioeconomic position, (2) Hispanic renters, (3) block groups that are likely to be inundated under the SLR 2040 scenario, (4) single-parent Hispanic neighborhoods near high-proficiency schools, (5) neighborhoods likely to be inundated composed of persons with less than a bachelor's degree living with high eviction rates and near high-proficiency schools, (6) neighborhoods with low job proximity scores and low proficiency schools, and (7)

Table 2 *Principal components analysis results*

Loadings	Component 1	Component 2	Component 3	Component 4	Component 5	Component 6	Component 7
Duval County							
School proficiency index	0.367	–0.198	0.259	0.205	—	–0.502	—
Job proximity index	—	–0.634	0.218	–0.271	0.504	0.267	—
Eviction rate	–0.318	0.226	–0.274	—	0.589	–0.601	—
% poverty	–0.407	–0.159	0.22	—	—	0.156	—
% less than bachelor's	–0.398	0.176	–0.215	0.183	—	0.320	—
% Hispanic	—	–0.373	–0.674	0.495	—	—	—
% renters	–0.311	–0.419	0.161	0.263	—	–0.286	—
% single-parent households	–0.373	—	0.193	0.197	–0.461	–0.244	—
% African American	–0.43	0.206	0.181	–0.114	—	—	—
% inundated under 2040 sea-level rise scenario	0.121	0.296	0.406	0.687	0.418	0.205	—
Miami-Dade County							
School proficiency index	0.411	—	—	—	–0.118	–0.609	—
Job proximity index	0.146	–0.199	0.723	–0.143	—	0.255	—
Eviction rate	–0.217	0.318	—	–0.156	0.863	–0.263	—
% poverty	–0.414	–0.271	0.116	—	—	—	—
% less than bachelor's	–0.394	–0.206	–0.425	—	—	0.261	—
% Hispanic	0.148	–0.613	–0.329	—	0.329	—	—
% renters	–0.301	–0.414	0.396	—	—	—	—
% single-parent households	–0.387	–0.173	—	—	–0.178	–0.639	—
% African American	–0.418	0.398	—	—	–0.258	—	—
% inundated under 2040 sea-level rise scenario	—	—	—	0.972	0.158	—	—
Pinellas County							
School proficiency index	0.28	–0.275	—	0.543	0.352	–0.585	–0.230
Job proximity index	–0.121	0.615	—	–0.365	0.164	–0.532	—
Eviction rate	–0.358	–0.207	—	–0.326	0.515	—	–0.522
% poverty	–0.417	—	—	—	—	–0.287	0.284
% less than bachelor's	–0.37	–0.116	–0.279	0.140	0.527	—	0.488
% Hispanic	–0.215	0.501	–0.160	0.451	0.127	0.380	–0.363
% renters	–0.386	0.209	0.169	0.265	–0.307	–0.26	–0.232
% single-parent households	–0.378	—	0.165	0.380	–0.170	—	0.258
% African American	–0.348	–0.409	0.201	–0.157	–0.270	—	–0.286
% inundated under 2040 sea-level rise scenario	—	0.117	0.884	—	0.301	0.263	0.139

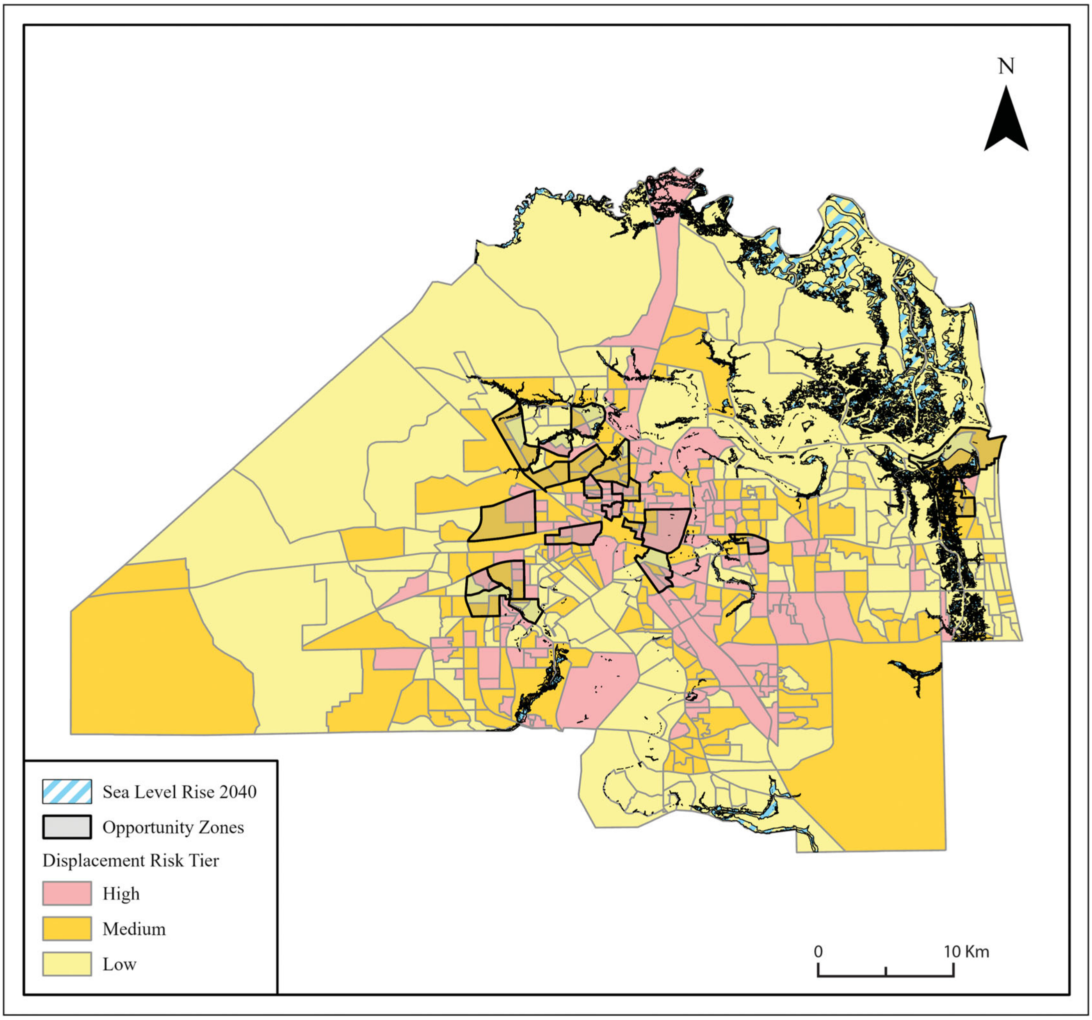

Figure 2 *Duval County displacement risk.*

Hispanics living in neighborhoods with high eviction rates. Components 1, 2, 4, 6, and 7 imply increasing second-order displacement risk.

Discussion and Conclusion

This study is predicated on a growing concern and hypothesis that CG is likely to increase in pace and scale in this century (Weir 2019). With tropical cyclone intensification, expansive and extended droughts, ruthless heat wave events, increasing rates of SLR, rampant wildfire seasons, and predictions of worse to come (Fox-Kemper et al. 2021; NOAA National Centers for Environmental Information 2021), the potential for climate-related displacement is likely to increase over time. Where people will go is unclear at this point, but people are likely to move away from high-risk areas over time leading to potential displacement of populations in areas less vulnerable to climate risks but highly vulnerable to gentrification (Hauer, Evans, and Mishra 2016). Thus, nearby inland areas, away from the coast and outside the range of projected SLR, nuisance flooding, or both, will be recipient areas for coastal migrants, or in-movers (Keenan, Hill, and Gumber 2018; Zuk et al. 2018; Elliott-Cooper, Hubbard, and Lees 2020; Keenan and Bradt 2020). Whether the CG hypothesis plays out as predicted is less important than how these predictions can help reduce the risks of involuntary and unwanted displacement that has highly disruptive effects on economic and social systems, mental and physical well-being, and household and community resilience (Fullilove 2020; Largent and Quimby 2020; Cole et al. 2021).

Separately, green infrastructure projects and urban green agendas are often adopted as a means to protect against climate change impacts (Derickson, Klein, and Keeler 2021). These adaptation strategies can likewise lead to processes

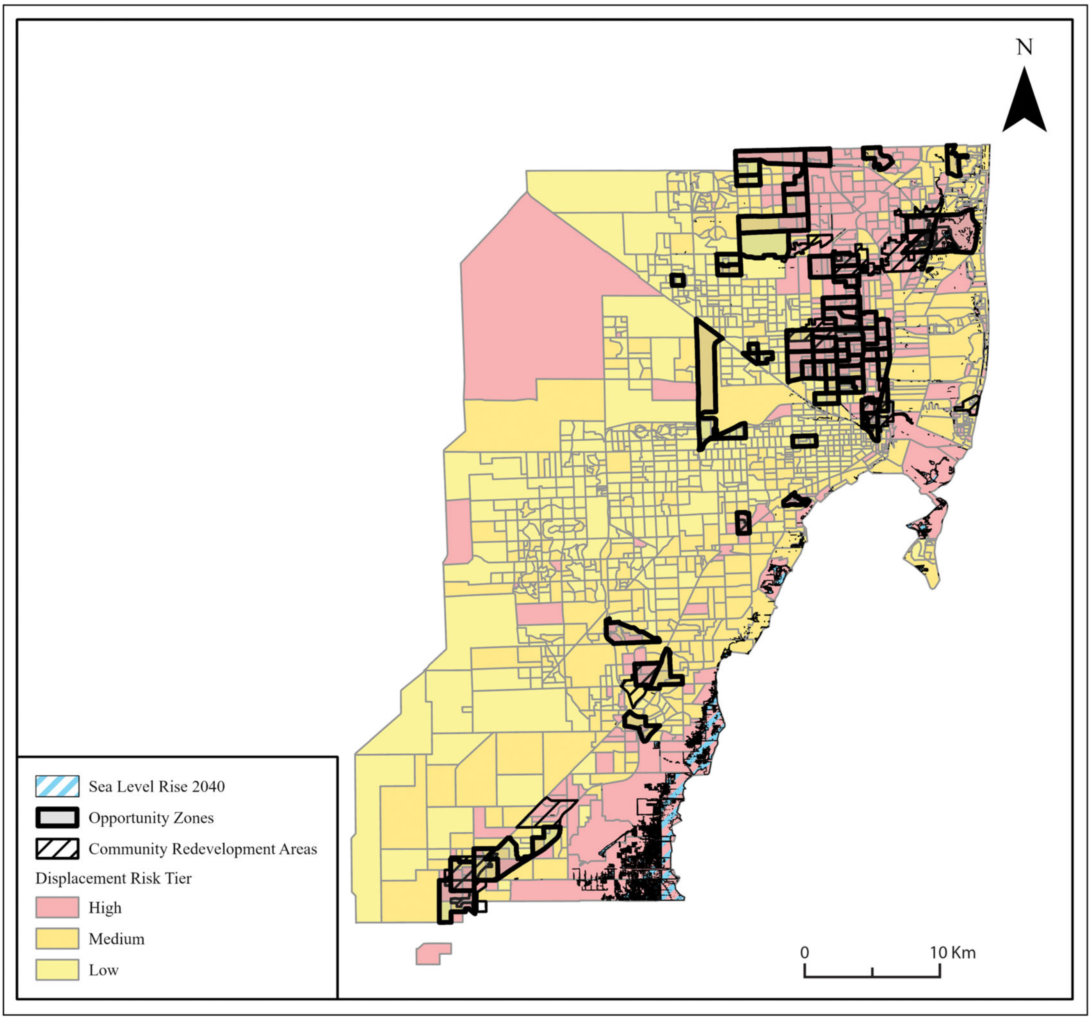

Figure 3 *Miami-Dade County displacement risk.*

associated with gentrification through increases in property values and rents (Anguelovski, Connolly, et al. 2019). Those neighborhoods that have historically been affected by uneven investment and development are most at risk of not benefiting or worse, being harmed by green infrastructure projects aimed at mitigating climate change impacts (Gould and Lewis 2017; Largent and Quimby 2020). It is therefore imperative for policymakers to consider how green and climate-resilient investments are likely to affect housing demand and affordability for longtime residents. Recently, Derickson, Klein, and Keeler (2021) composed a toolkit detailing antidisplacement strategies and tools to encourage collaboration among stakeholders in the housing and environmental sectors.

The PCA allows local planners and policymakers to get ahead of the problem, at least to a degree. Incorporating projected SLR inundation data into the PCA balances identifying geographic areas at risk of displacement from SLR inundation and more important, census block groups that have a greater or lesser likelihood of displacement risk from CG pressures. This approach offers a new methodology that incorporates flood risks related to SLR and displacement pressures as a result of potential future gentrification.

Figures 2 through 4 show two important dynamics. First, the PCA maps demonstrate that those areas that are most at risk from SLR inundation were identified as mostly low-risk areas for secondary displacement. In other words, these households have relatively stable contexts and more than likely have access to adaptive assets to cope with disruptions including insurance, secondary homes, and money for adaptive retrofits. Although greenhouse mitigation is the most cost-effective long-term solution to slowing the rate of sea level change, SLR adaptations are the most viable options to protect infrastructure and reduce risk to changes that are

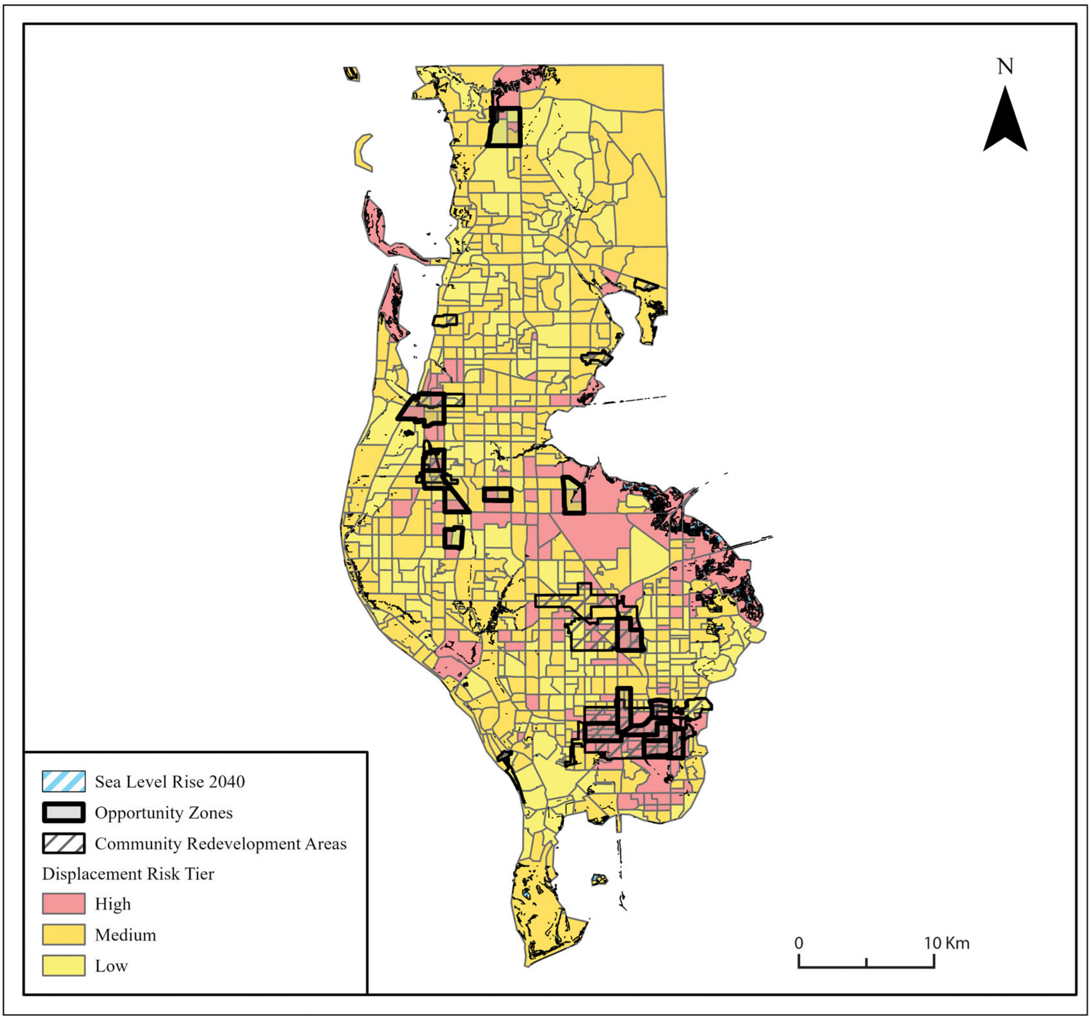

Figure 4 *Pinellas County displacement risk.*

already happening (Butler, Deyle, and Mutnansky 2016). Protective measures could be quite costly and mostly buy some time, but time might be an important factor in ensuring that inland communities have time to plan for receiving climate migrants (Butler, Holmes, and Lange 2021).

Second, the PCA maps demonstrate that areas that have the highest risk of gentrification-driven displacement based on demographic, socioeconomic, and housing factors tend to be inland in Florida. These areas are therefore even more likely to be targeted for redevelopment as higher ground becomes sought after by those leaving flooded coastal areas. Another factor that targets these areas for redevelopment is that many of the neighborhoods identified as at risk by our PCA are also areas that have been designated as OZs or have CRAs assigned to them. Using CRAs and OZs, we are better able to determine where neighborhoods have already been identified as targets of redevelopment and reinvestment schemes (Figures 2–4). Although these institutions are not inherently pushing a pro-gentrification agenda, redevelopment projects undertaken without simultaneous protections for affordable housing and neighborhood stabilization run the risk of exacerbating displacement pressures rather than improving quality of life for existing residents (Gelfond and Looney 2018; Kim 2022).

CG and climate equity bring together longstanding concerns about access to housing, involuntary displacement, and racial and gender inequality with concerns about how climate change impacts will shape urban futures. The neighborhood displacement risk allows planners and policymakers to proactively plan for these trends and implement antidisplacement strategies such as community land trusts, rent controls, inclusionary housing, right of first refusal, and community benefit agreements among other tools (Bates 2013; Way et al. 2018). Strategies such as inclusionary zoning can protect

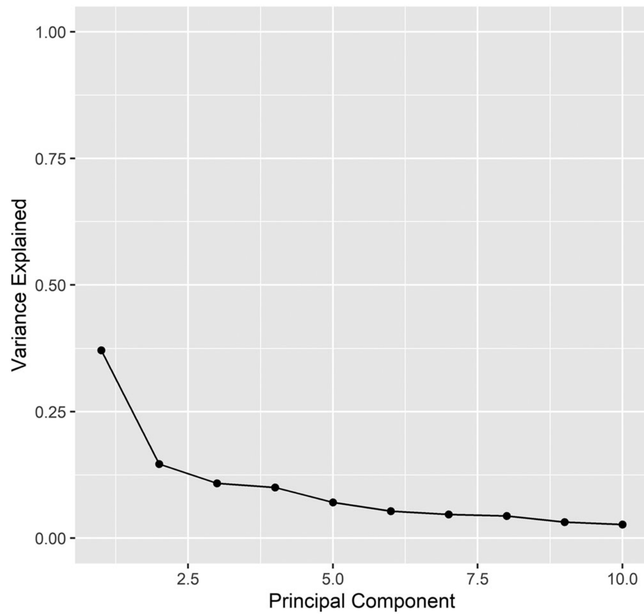

Figure 5 *Scree plot principal components analysis results for Duval County. Source: R Core Team 2021.*

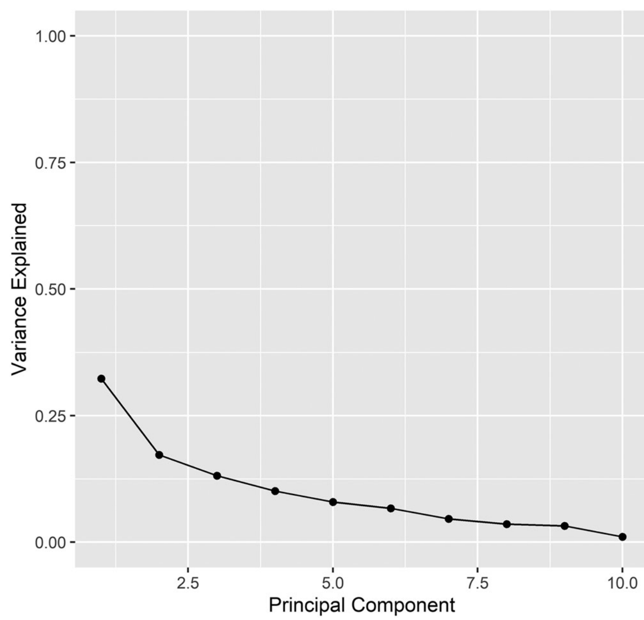

Figure 6 *Scree plot principal components analysis results for Miami-Dade County. Source: R Core Team 2021.*

and ensure affordable housing in areas under potential threat of CG pressures. Moreover, community land trusts can establish community members as the sole decision makers over the direction of future development in their communities (Oscilowicz et al. 2021). Further research is required to understand the potential barriers to integration and identification of opportunities to bridge the gaps between these separate but interdependent spheres.

There are several limitations inherent in this study. First, the index has not been validated against actual displacement. Recent studies examining county-level residential mobility as a result of gentrification pressures validated their methods using longitudinal data sources from the Federal Reserve Bank of New York Consumer Credit Panel/Equifax data and county-to-county migration data from the Internal Revenue Service (Ding, Hwang, and

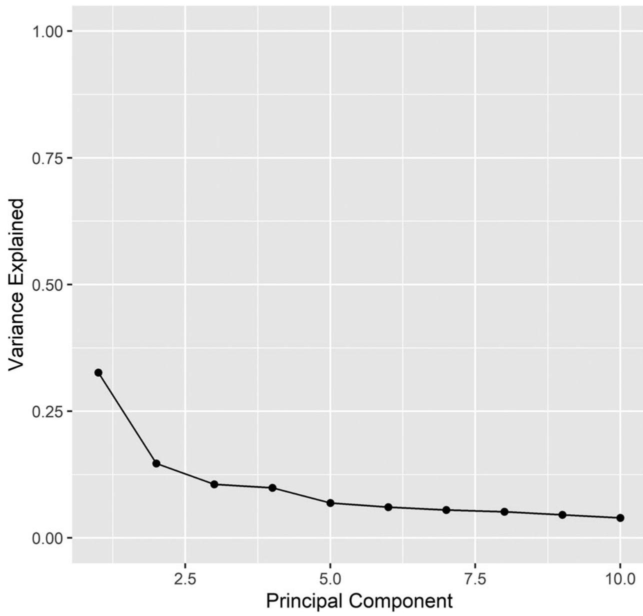

Figure 7 *Scree plot principal components analysis results for Pinellas County. Source: R Core Team 2021.*

Divringi 2016; Hauer and Byars 2019). At the time of this study, there were no publicly available neighborhood-level housing mobility data sets. Future research can benefit from incorporating indicators from the storm surge building vulnerability model such as SLOSH data and tax parcel building attributes to construct a more fine-grained assessment of first- and second-order neighborhood displacement risks to storm surge and SLR exposure to better assess gentrification displacement risks (Chao, Ghansah, and Grant 2021). Similarly, further work developing a displacement risk index will allow for a more in-depth analysis of CG. Incorporating a number of socioeconomic and demographic risk factors, housing market changes, and flood risks (e.g., exposure to SLR, high tide flooding, storm surge, etc.) can provide a robust assessment and identification of vulnerable receiving communities (Keenan and Bradt 2020).

Second, the indicators chosen do not reflect all known characteristics associated with gentrification and residential displacement. The data used, however, are all publicly available and capture important neighborhood and individual-level characteristics associated with residential instability. The reality is that predicting and modeling displacement is notoriously difficult and has many layers and facets that both drive household decisions to move and policy effectiveness in reducing involuntary displacement (Preis et al. 2021). Despite these limitations, the contribution of this work is to provide a starting point for policymakers and planners to put climate gentrification risks on the map and begin the fine-grained work of identifying neighborhoods that need greater protections to minimize negative impacts of displacement on those communities. ■

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Literature Cited

Anguelovski, I., J. J. Connolly, M. Garcia-Lamarca, H. Cole, and H. Pearsall. 2019a. New scholarly pathways on green gentrification: What does the urban "green turn" mean and where is it going? *Progress in Human Geography* 43 (6):1064–86. doi: 10.1177/0309132518803799.

Anguelovski, I., M. Triguero-Mas, J. T. Connolly, P. Kotsila, G. Shokry, C. Pérez Del Pulgar, M. Garcia-Lamarca, L. Argüelles, J. Mangione, K. Dietz, et al. 2019. Gentrification and health in two global cities: A call to identify impacts for socially vulnerable residents. *Cities Health* 4 (1):1–10.

Ann Conyers, Z., R. Grant, and S. S. Roy. 2019. Sea level rise in Miami Beach: Vulnerability and real estate exposure. *The Professional Geographer* 71 (2):278–91. doi: 10.1080/00330124.2018.1531037.

Atkinson, R. 2002. Does gentrification help or harm urban neighbourhoods? An assessment of the evidence-base in the context of the new urban agenda. Paper 5. Glasgow: ESRC Center for Neighborhood Research.

Bates, L. K. 2013. Gentrification and displacement study: Implementing an equitable inclusive development strategy in the context of gentrification. https://www.portlandoregon.gov/bps/62635.

Butler, W., R. Deyle, and C. Mutnansky. 2016. Low-regrets incrementalism: Land use planning adaptation to accelerating sea level rise in Florida's coastal communities. *Journal of Planning Education and Research* 36 (3): 319–32. doi: 10.1177/0739456X16647161.

Butler, W., T. Holmes, and Z. Lange. 2021. Mandated planning for climate change. *Journal of the American Planning Association* 87 (3):370–82. doi: 10.1080/01944363.2020.1865188.

Butler, W., T. Holmes, A. Milordis, Z. Lange, J. Hunt, B. Naselius, and B. Gordon. 2019. Assessing sea level rise adaptation planning in Florida's coastal communities: Part 1, Comprehensive plan review analysis report. Florida Department of Environmental Protection, Tallahassee, FL.

Chao, S. R., B. Ghansah, and R. J. Grant. 2021. An exploratory model to characterize the vulnerability of coastal buildings to storm surge flooding in Miami-Dade County, Florida. *Applied Geography* 128:102413. doi: 10.1016/j.apgeog.2021.102413.

Cole, H. V. S., R. Mehdipanah, P. Gullón, and M. Triguero-Mas. 2021. Breaking down and building up: Gentrification, its drivers, and urban health inequality. *Current Environmental Health Reports* 8 (2):157–66. doi: 10.1007/s40572-021-00309-5.

Davidson, M., and L. Lees. 2010. New-build gentrification: Its histories, trajectories, and critical geographies. *Population, Space and Place* 16 (5):395–411. doi: 10.1002/psp.584.

Derickson, K., M. Klein, and B. L. Keeler. 2021. Reflections on crafting a policy toolkit for equitable green infrastructure. *NPJ Urban Sustainability* 1 (1):1–4. doi: 10.1038/s42949-021-00014-0.

Desmond, M., A. Gromis, L. Edmonds, J. Hendrickson, K. Krywokulski, L. Leung, and A. Porton. 2018. *Eviction lab national database: Version 1.0*. Princeton, NJ: Princeton University.

Ding, L., J. Hwang, and E. Divringi. 2016. Gentrification and residential mobility in Philadelphia. *Regional Science and Urban Economics* 61:38–51. doi: 10.1016/j.regsciurbeco.2016.09.004.

Elliott-Cooper, A., P. Hubbard, and L. Lees. 2020. Moving beyond Marcuse: Gentrification, displacement and the violence of un-homing. *Progress in Human Geography* 44 (3):492–509. doi: 10.1177/0309132519830511.

Eyer, J., R. Dinterman, N. Miller, and A. Rose. 2018. The effect of disasters on migration destinations: Evidence from Hurricane Katrina. *Economics of Disasters and Climate Change* 2 (1):91–106. doi: 10.1007/s41885-017-0020-3.

Fox-Kemper, B., H. T. Hewitt, C. Xiao, G. Aðalgeirsdóttir, S. S. Drijfhout, T. L. Edwards, N. R. Golledge, M. Hemer, R. E. Kopp, G. Krinner, A. Mix, D. Notz, S. Nowicki, I. S. Nurhati, L. Ruiz, J.-B. Sallée, A. B. A. Slangen, and Y. Yu. 2021. Ocean, cryosphere and sea level change. In *Climate change 2021: The physical science basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, ed. V. Masson-Delmotte, P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J. B. R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou, 1211–1362. Cambridge, UK, and New York: Cambridge University Press, Cambridge. doi: 10.1017/9781009157896.011.

Fu, X., and J. Nijman. 2021. Sea level rise, homeownership, and residential real estate markets in South Florida. *The Professional Geographer* 73 (1):62–71. doi: 10.1080/00330124.2020.1818586.

Fullilove, M. T. 2020. From "root shock" to "Main Street": For a biopsychosocial urban psychology. *Journal of Urban Regeneration and Renewal* 13 (3):251–56.

Gelfond, H., and A. Looney. 2018. *Learning from opportunity zones: How to improve place-based policies*. Washington, DC: Brookings Institution.

Gould, K. A., and T. L. Lewis. 2017. *Green gentrification: Urban sustainability and the struggle for environmental justice*. London and New York: Routledge.

Hauer, M., and J. Byars. 2019. IRS county-to-county migration data, 1990–2010. *Demographic Research* 40: 1153–66. doi: 10.4054/DemRes.2019.40.40.

Hauer, M. E., J. M. Evans, and D. R. Mishra. 2016. Millions projected to be at risk from sea-level rise in the continental United States. *Nature Climate Change* 6 (7): 691–95. doi: 10.1038/nclimate2961.

Heckert, M., and C. D. Rosan. 2018. Creating GIS-based planning tools to promote equity through green infrastructure. *Frontiers in Built Environment* 4:27. doi: 10.3389/fbuil.2018.00027.

Hwang, J., and R. J. Sampson. 2014. Divergent pathways of gentrification: Racial inequality and the social order of renewal in Chicago neighborhoods. *American Sociological Review* 79 (4):726–51. doi: 10.1177/0003122414535774.

Institute for Housing Studies at DePaul University. 2020. Mapping displacement pressure in Chicago, 2020. https://www.housingstudies.org/releases/mapping-displacement-pressure-chic-2020/

James, G., D. Witten, T. Hastie, and R. Tibshirani. 2013. *An introduction to statistical learning*. New York: Springer.

Keenan, J. M., and J. T. Bradt. 2020. Underwaterwriting: From theory to empiricism in regional mortgage markets in the U.S. *Climatic Change* 162 (4):2043–67. doi: 10.1007/s10584-020-02734-1.

Keenan, J. M., T. Hill, and A. Gumber. 2018. Climate gentrification: From theory to empiricism in Miami-Dade County, Florida. *Environmental Research Letters* 13 (5):054001. doi: 10.1088/1748-9326/aabb32.

Kim, M. 2022. How do tax-based revitalisation policies affect urban property development? Evidence from

Bronzeville, Chicago. *Urban Studies* 59 (5):1031–47. doi: 10.1177/0042098021995148.

Kirkland, E. 2008. What's race got to do with it? Looking for the racial dimensions of gentrification. *Western Journal of Black Studies* 32:18–30.

Largent, A., and M. Quimby. 2020. Gentrification, displacement, and perception of community among long-time residents of Austin, Texas: Implications from six case studies. 10:34.

Mapping Displacement Pressure in Chicago. 2018. https://www.housingstudies.org/releases/mapping-displacement-pressure-chicago-project-2018/.

Martinich, J., J. Neumann, L. Ludwig, and L. Jantarasami. 2013. Risks of sea level rise to disadvantaged communities in the United States. *Mitigation and Adaptation Strategies for Global Change* 18 (2):169–85. doi: 10.1007/s11027-011-9356-0.

McLeman, R. 2018. Migration and displacement risks due to mean sea-level rise. *Bulletin of the Atomic Scientists* 74 (3):148–54. doi: 10.1080/00963402.2018.1461951.

Melillo, J., M. Terese, T. C. Richmond, and G. W. Yohe. 2014. Climate change impacts in the United States: The third national climate assessment. U.S. Global Change Research Program. doi: 10.7930/J0Z31WJ2.

National Oceanic Atmospheric Administration, National Centers for Environmental Information. 2021. State of the climate: Global climate report for annual 2020. Accessed March 15, 2021. https://www.ncdc.noaa.gov/sotc/global/202013.

Oscilowicz, E., E. Lewartowska, A. Levitch, J. Luger, S. Hajtmarova, E. O'Neill, A. P. Carbonell, H. Cole, C. R. Blanco, and E. Monroe. 2021. Policy and planning tools for urban green justice: Fighting displacement and gentrification and improving accessibility and inclusiveness to green amenities. Barcelona Laboratory for Urban Environmental Justice & Sustainability, Barcelona, Spain.

Pearsall, H., and I. Anguelovski. 2016. Contesting and resisting environmental gentrification: Responses to new paradoxes and challenges for urban environmental justice. *Sociological Research Online* 21 (3):121–27. doi: 10.5153/sro.3979.

Preis, B., A. Janakiraman, A. Bob, and J. Steil. 2021. Mapping gentrification and displacement pressure: An exploration of four distinct methodologies. *Urban Studies* 58 (2):405–20. doi: 10.1177/0042098020903011.

R Core Team. 2021. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/.

Rérat, P., O. Söderström, and E. Piguet. 2010. New forms of gentrification: Issues and debates. *Population, Space and Place* 16 (5):335–43. doi: 10.1002/psp.585.

Shi, L., E. Chu, I. Anguelovski, A. Aylett, J. Debats, K. Goh, T. Schenk, K. C. Seto, D. Dodman, D. Roberts, et al. 2016. Roadmap towards justice in urban climate adaptation research. *Nature Climate Change* 6 (2):131–37. doi: 10.1038/nclimate2841.

University of Florida. 2020. GeoPlan center: Florida sea level scenario sketch planning tool. https://sls-geoplan-ufl-edu.proxy.lib.fsu.edu/viewer/

U.S. Census Bureau, American Community Survey. 2018. American Community Survey 5-year estimates, Table. U.S. Census Bureau, Washington, DC.

U.S. Census Bureau. 2019. 2015–2019 American Community Survey 5-year Public Use Microdata Samples [Excel Data file].

U.S. Department of Housing and Urban Development (HUD). 2017. School proficiency index & job proximity index. School Proficiency Index | HUD Open Data Site (arcgis.com) | Jobs Proximity Index | HUD Open Data Site (arcgis.com).

Wang, R., R. J. Walter, A. A. Arafat, X. Ding, and A. A. Naji. 2017. Examining neighborhood opportunity and locational outcomes for housing choice voucher recipients: A comparative study between Duval County, Florida, and Bexar County, Texas. *City & Community* 16 (4):421–46. doi: 10.1111/cico.12254.

Way, H., E. Mueller, and J. Wegmann. 2018. Uprooted: Residential displacement in Austin's gentrifying neighborhoods and what can be done about it. University of Texas at Austin Center for Sustainable Development, Austin, TX. Accessed March 2021. https://sites.utexas.edu/gentrificationproject/files/2019/09/UTGentrificationFullReport.pdf.

Weir, B. 2019. Miami's Little Haiti wasn't a target for developers, until the seas started to rise. *CNN US* July 12. https://www.cnn.com/2019/07/11/us/miami-little-haiti-climate-gentrification-weir-wxc/index.html

Williams, P. C., R. Krafty, T. Alexander, Z. Davis, A.-V. Gregory, R. Proby, W. Troxel, and C. Coutts. 2021. Greenspace redevelopment, pressure of displacement, and sleep quality among Black adults in southwest Atlanta. *Journal of Exposure Science & Environmental Epidemiology* 31 (3):412–26. doi: 10.1038/s41370-021-00313-9.

Zuk, M., A. H. Bierbaum, K. Chapple, K. Gorska, and A. Loukaitou-Sideris. 2018. Gentrification, displacement, and the role of public investment. *Journal of Planning Literature* 33 (1):31–44. doi: 10.1177/0885412217716439.

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Appendix

See link for hot-spot analysis on secondary residential displacement risk indicators (hosted via ArcGIS online map viewer): https://arcg.is/f89zv.