From Sea Level Rise to Presidential Declared Disasters: Addressing Climate Resilience and Social Justice
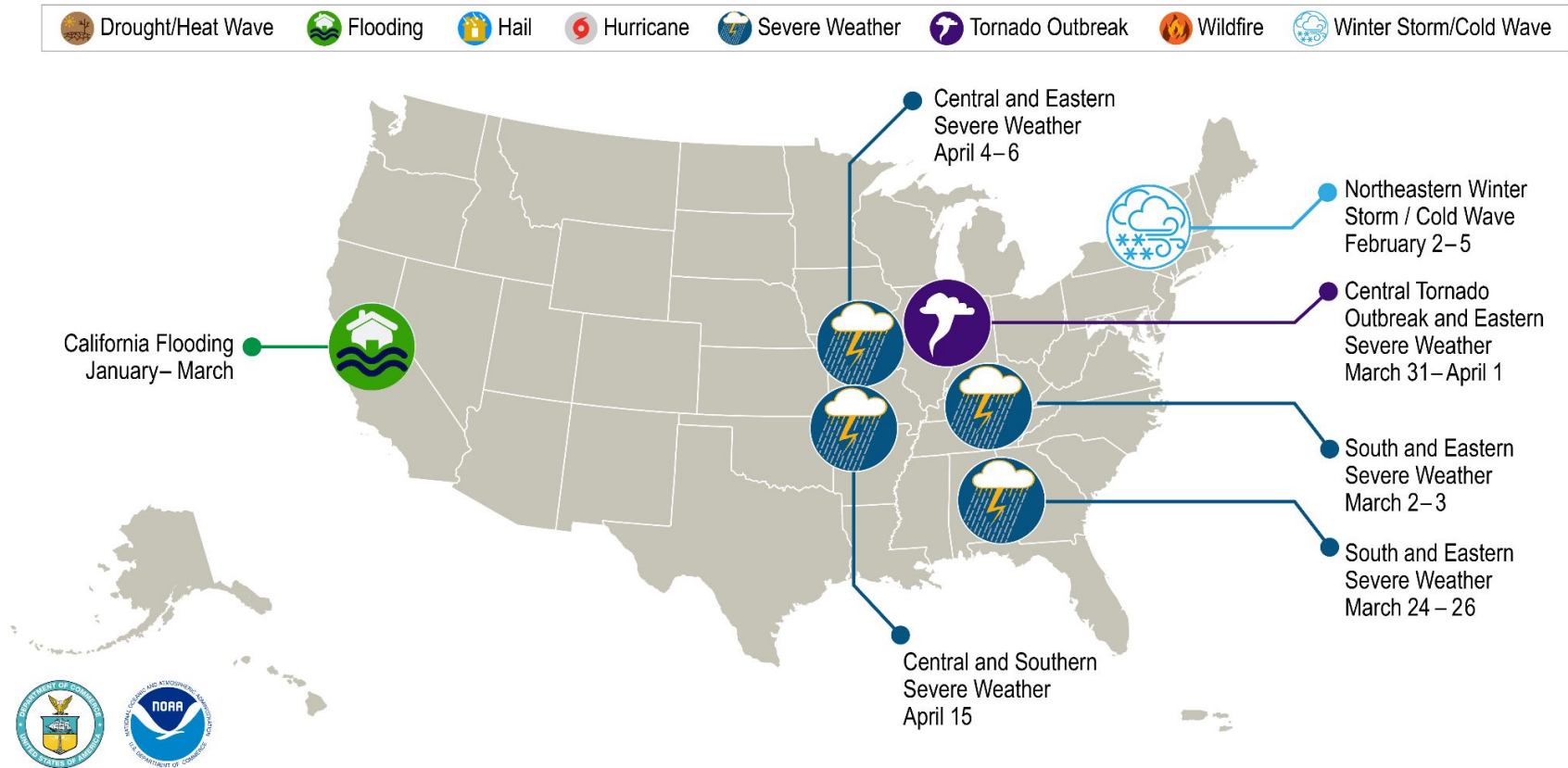
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U.S. 2023 Billion-Dollar Weather and Climate Disasters

Drought/Heat Wave　　Flooding　　Hail　　Hurricane　　Severe Weather　　Tornado Outbreak　　Wildfire　　Winter Storm/Cold Wave

Central and Eastern Severe Weather April 4–6

Northeastern Winter Storm / Cold Wave February 2–5

California Flooding January– March

Central Tornado Outbreak and Eastern Severe Weather March 31–April 1

South and Eastern Severe Weather March 2–3

South and Eastern Severe Weather March 24 – 26

Central and Southern Severe Weather April 15

*This map denotes the approximate location for each of the **7 separate billion-dollar weather and climate disasters that impacted the United States through April 2023.***

Global climate change is altering the **frequency and intensity** of many natural hazards (Felbermayr & Gröschl, 2014; Frijters et al., 2023; Hauer, 2017; Shepherd & Dissart, 2022)

The Intersection of Social Justice and Climate Resilience

Compounded Vulnerability

- Community and Infrastructure are planned and built based on human decisions

- Environmental Racism in Planning History

- Climate factors could exacerbate **existing inequality** through infrastructure

- The socially vulnerable populations (including BIPOC communities, etc.) are likely to experience **more severe** impacts of climate change with **less** resources to adapt

The Baltimore **"Redlining" map** from 1930s,Source:Mapping Inequity   4
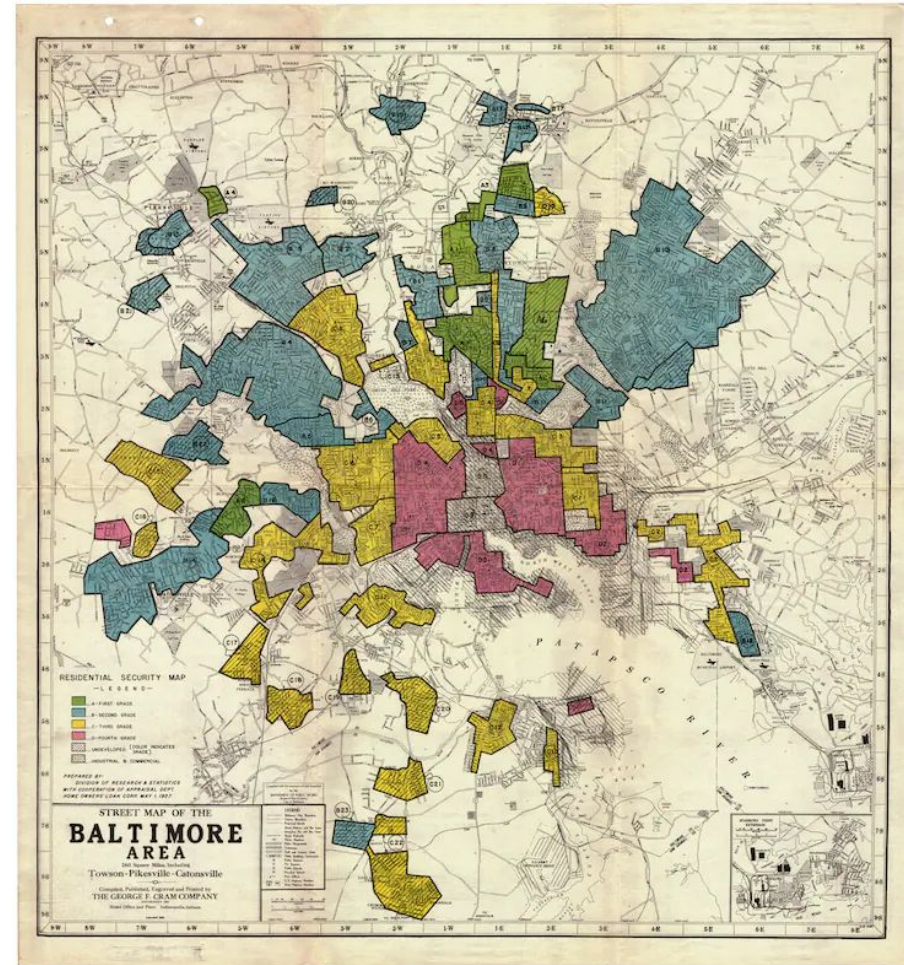
Houston during Hurricane Harvey, 2017(Source: the New Yorker)

Motivation

- Consequences of climate-related disasters can have cascading effects on social well-being and equity, including by **exacerbating vulnerabilities in the built environment** (O'Brien et al., 2006; Van Aalst, 2006)

- **Socially disadvantaged populations** are prone to experience the most severe impacts of climate change and natural hazards and have the fewest available resources to adapt and respond to these effects (Cutter, 2016; Flanagan et al., 2011; O'Brien & Leichenko, 2000)

- Natural hazards may disrupt wellbeing, especially for socially disadvantaged groups is through disruptions to **housing security** (Brennan et al., 2022; Lee & Van Zandt, 2019; Peacock et al., 2014; Rumbach et al., 2016)

Sea-Level Rise

Sea-level rise leads to flooding, which often disproportionately affects low-income and under- resourced communities.

Hurricane Devastation

Hurricanes frequently impact disadvantaged communities the hardest, whose housing and infrastructure are often the least resilient.
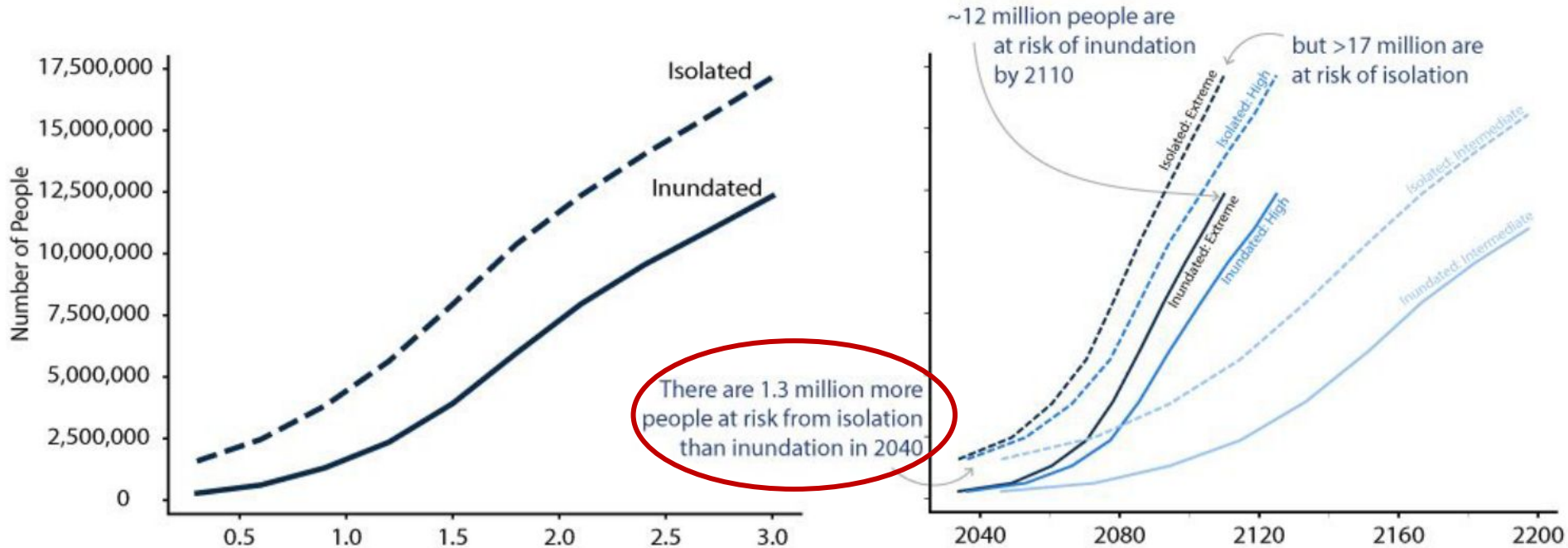
Photo credit: Scientific American

Social and Economic Disparity in **Isolation Risk** due to Sea Level Rise in the United States

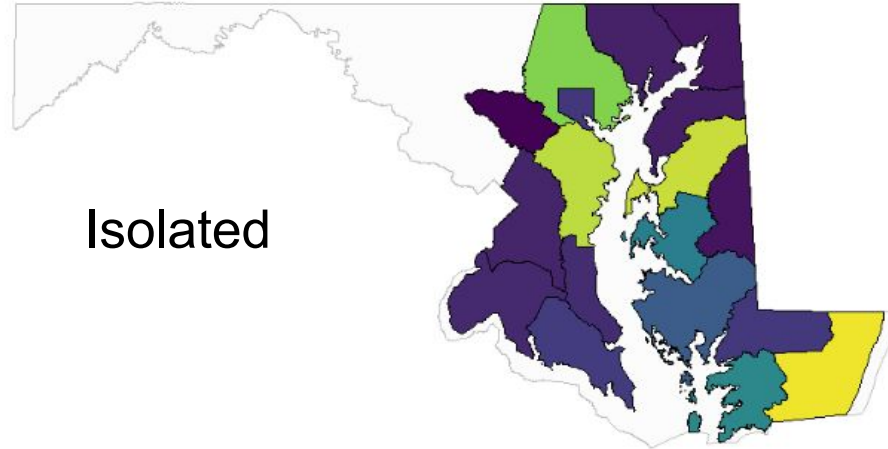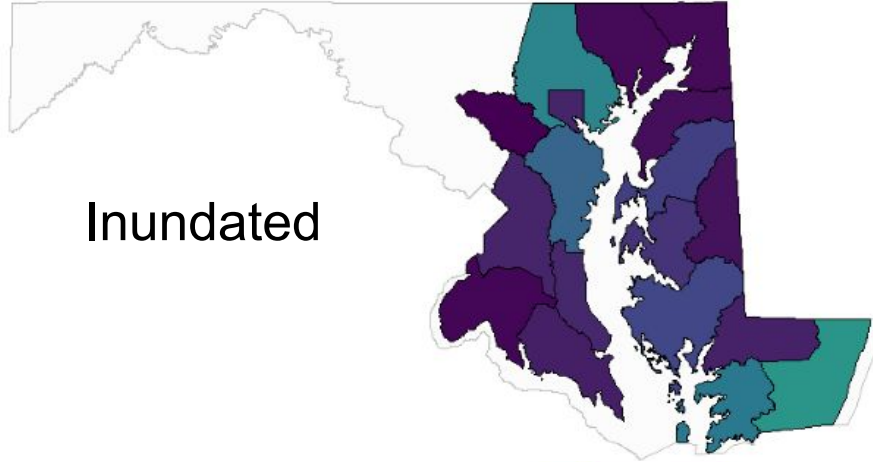Kelsea Best, Qian He, Allison Reilly, Deb Niemeier, Shuyu Jin, Mitchell Anderson, Tom Logan

Under review at *Nature Communications*

# Inundation **underestimates** the population in burden due to SLR

~12 million people are at risk of inundation by 2110

but >17 million are at risk of isolation

There are 1.3 million more people at risk from isolation than inundation in 2040

(Logan et al., 2023)

Inundation v. Isolation in Maryland

Inundated

Isolated

Population (County) impacted by Isolation (SLR = 5)

20000
15000
10000
5000
0
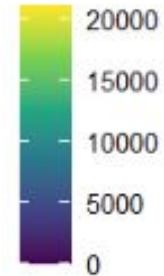
Gap: Who will be impacted by isolation due to SLR?

1. How do **isolation risk** vary between race and ethnic groups in the coastal areas of the United States?

2. What are the **characteristics of communities** most susceptible to isolation under the different SLR scenarios?

Data & Methodology

- Isolation method developed by Logan et al. (2023)

- OpenStreetMap (OSM) road network

- NOAA's mean higher high water (MHHW) for global sea-level rise scenarios (1-10ft)

- American Community Survey (5Y-2019)
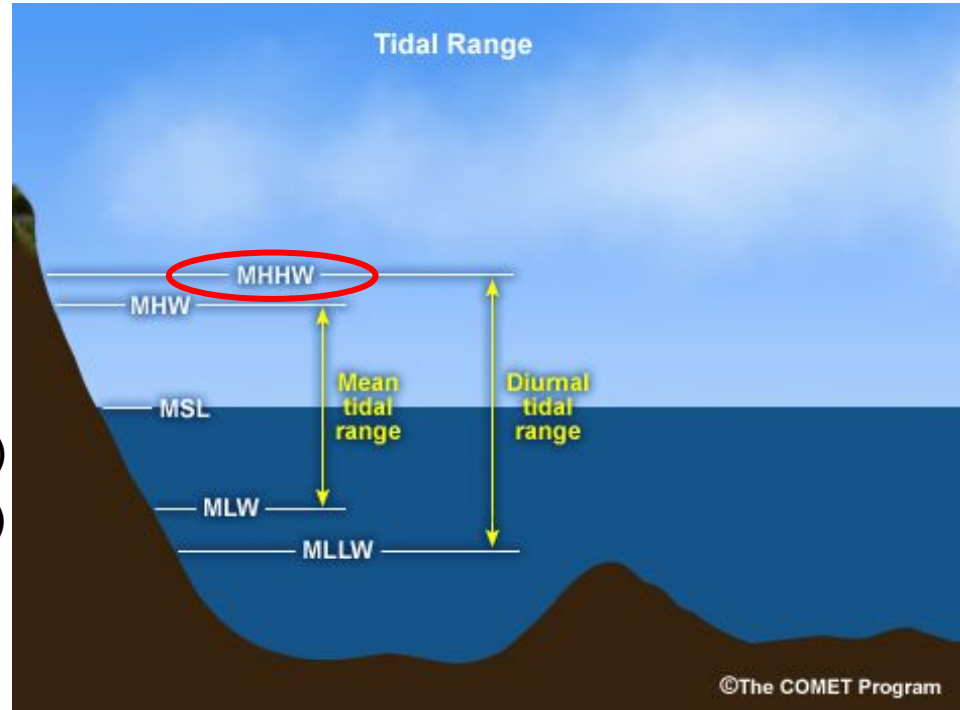
A census block is considered **isolated** if it lacks an unflooded route between the block centroid and any *fire stations* or *primary schools*.

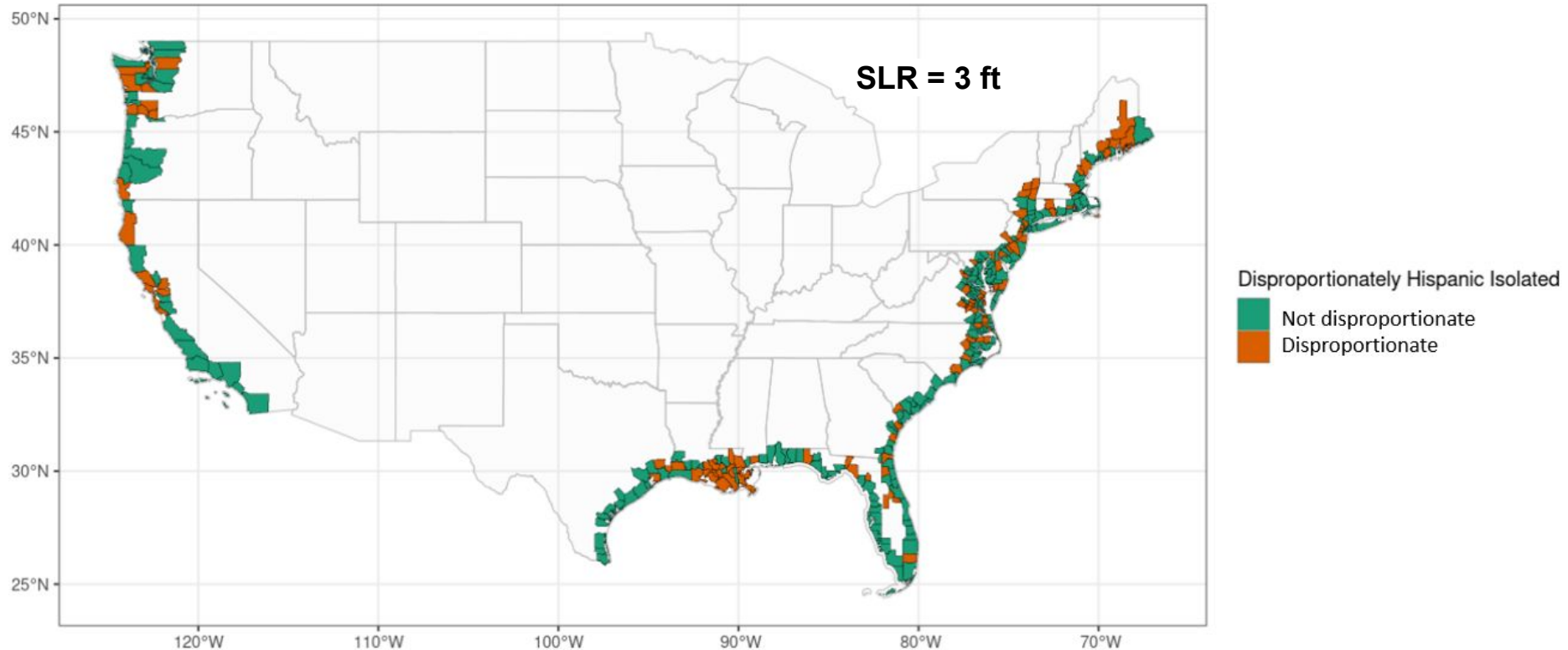# **Question 1:** Disproportionate effects on racial groups
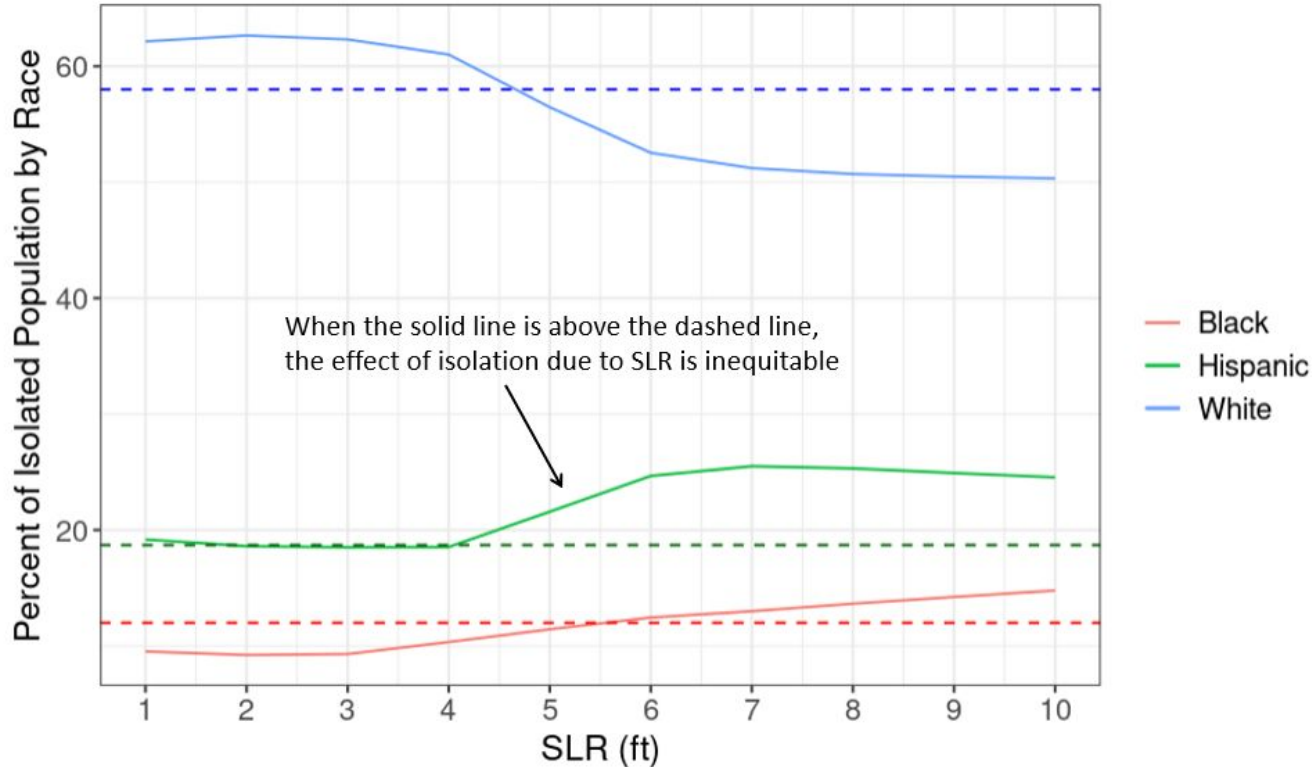
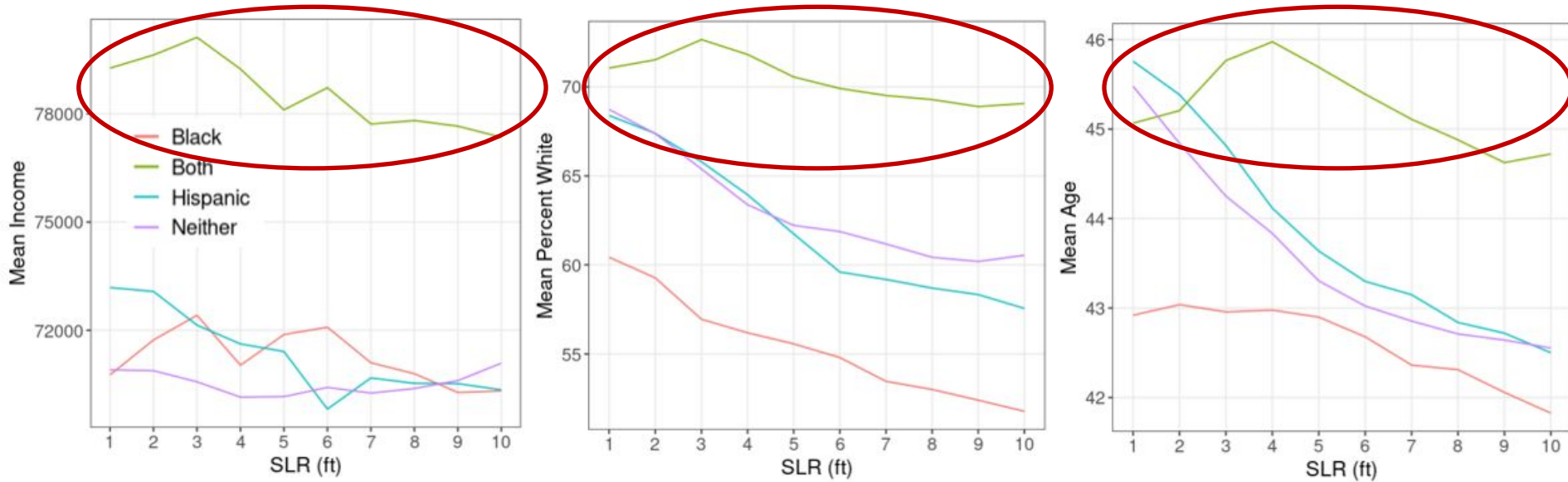# **Question 1:** Disproportionate effects on racial groups

Isolation risk may be as high as **10x greater** than representation in the general population for Black residents and more than **20x greater** for Hispanic residents
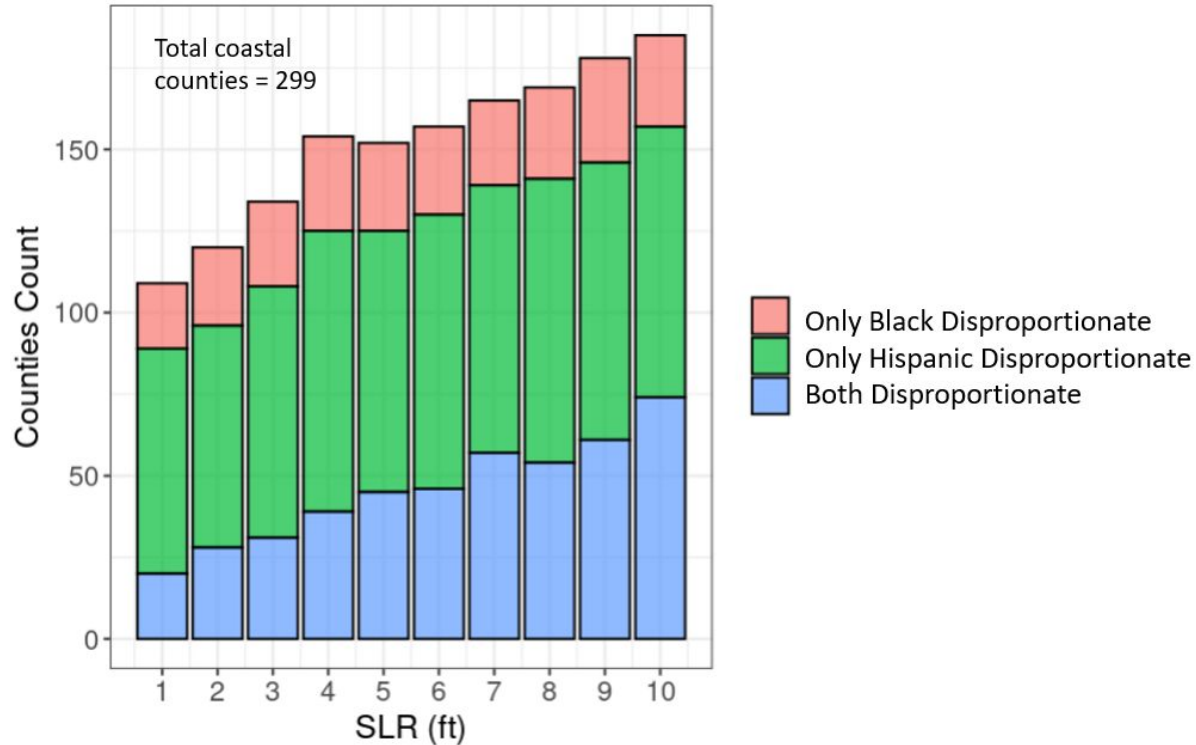
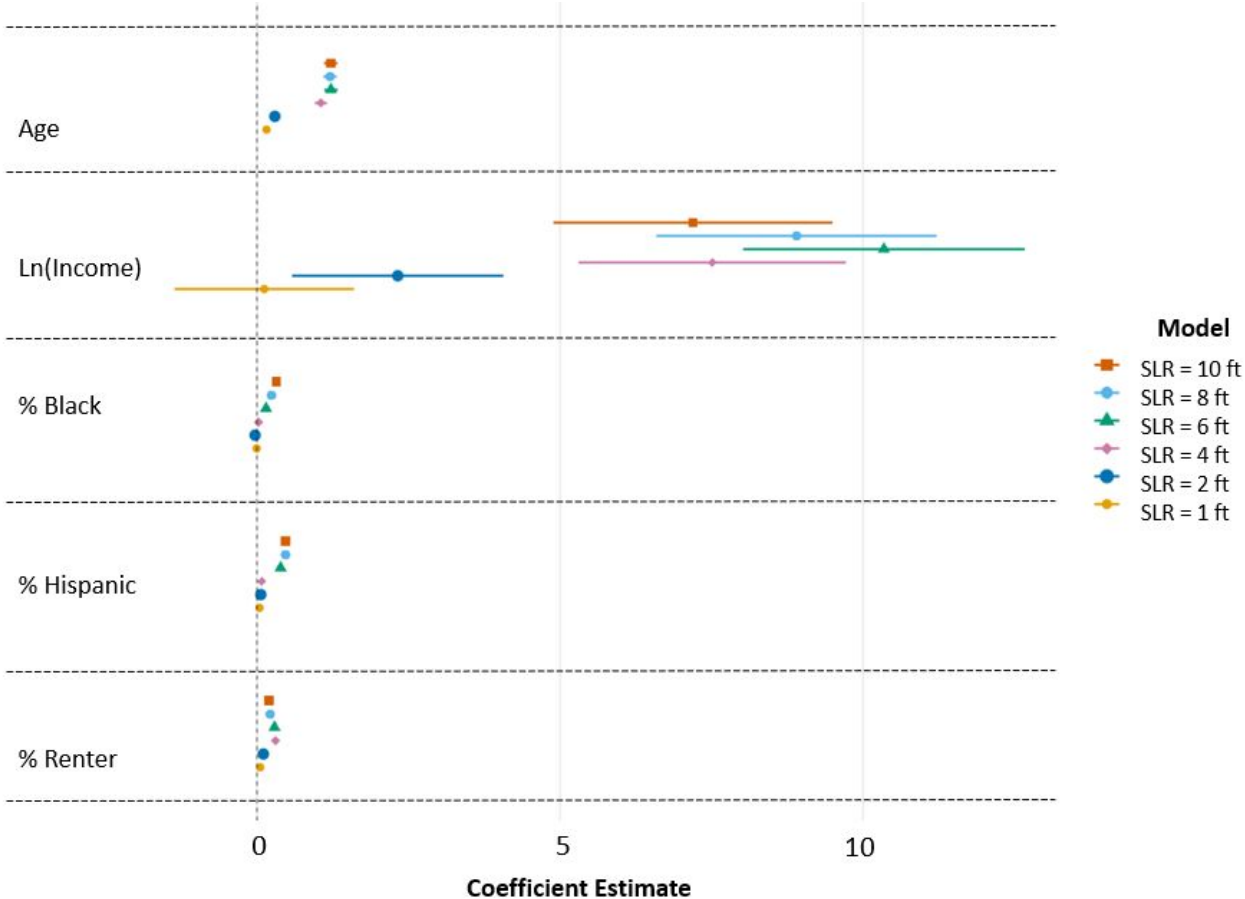# **Question 1:** Disproportionate effects on racial groups

Question 2: Demographics and isolation risk

Higher income, whiter, and older communities are estimated to disproportionately isolate both Black and Hispanic populations

Question 2: Demographics and isolation risk

Older

Higher percent minority

More renters

Conclusions

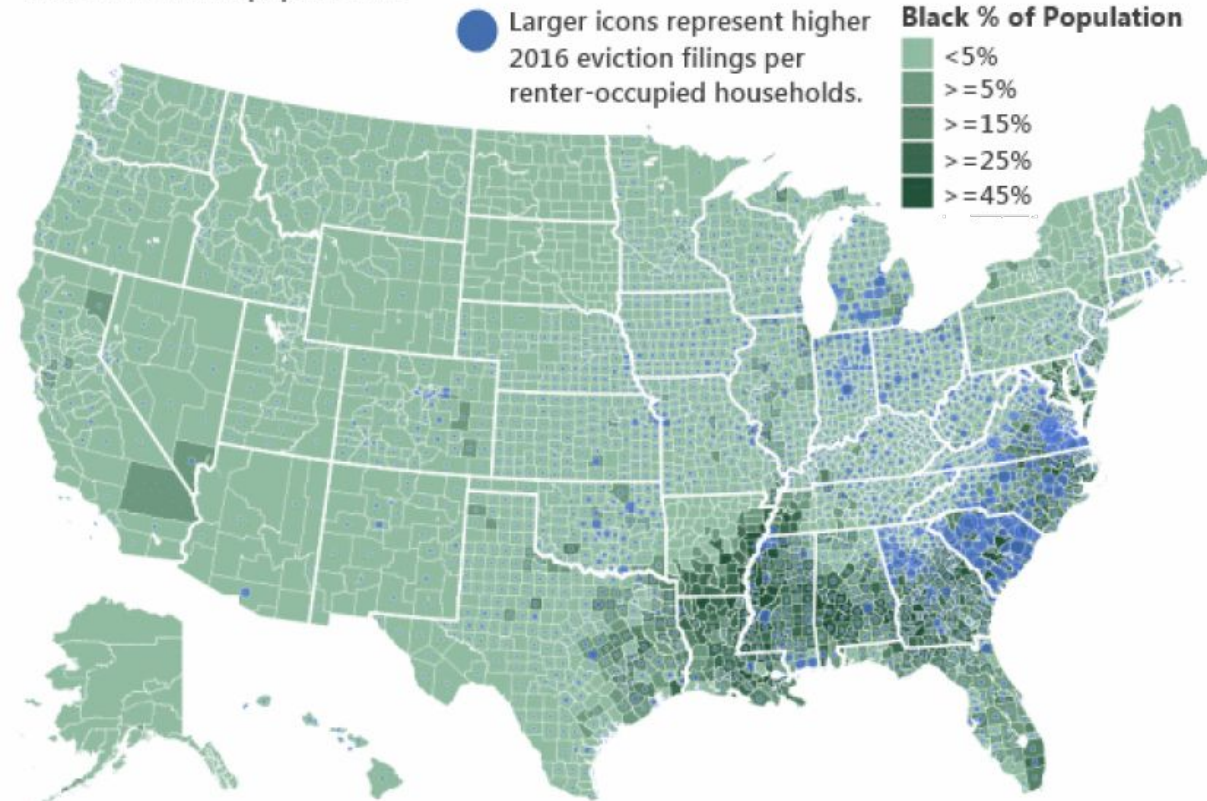- The impact of isolation due to SLR, is **not equitably distributed** and this could **exacerbate** the existing social inequity in the U.S

- **Black and Hispanic** communities are likely to face disproportionately greater risk of isolation

- Communities with **older residents** and greater percentages of **renter** status are more vulnerable to isolation risk

- Analysis **elucidates "missing" populations** left out of inundation measures namely younger, whiter, higher income, and higher proportion renters

Photo credit: Miami New Times

How do Hurricanes and Federal Aid Affect **Eviction Risk**? Decade-long Evidence from the United States

Qian He, Kelsea Best, Allison Reilly, Deb Niemeier

Evictions are common throughout many parts of the country, particularly those with large African-American populations.

Larger icons represent higher 2016 eviction filings per renter-occupied households.

Black % of Population
- <5%
- >=5%
- >=15%
- >=25%
- >=45%

Source: Eviction Lab, U.S. Census Bureau American Community Survey

More than 2 million eviction filings and nearly 900,000 evictions occur every year, disproportionately affecting BIPOC households (EvictionLab, 2023).

Data & Method

- Hurricanes in the Presidential Disaster Declarations (PDDs): OpenFEMA
  - Hurricane frequency, maximum sustained wind speed
- American Community Survey (5-Year Estimates)
  - Socioeconomic: gross median rents, percent white, median income
  - Housing variables: percent renters, percent vacant property, percent crowding, housing units per capita
- Eviction data: EvictionLab (Princeton University)
- Public Aid: FEMA Individual Assistance (IA), PA (Public Assistance), HMA (Hazard Mitigation Assistance); HUD Community Development Block Grant Disaster Recovery
- Panel dataset for all counties in U.S. East and Gulf Coast States from 2009 to 2018

Hurricane variables   Public Aid

Stage 1

Median Rent

Stage 2

Eviction Risk
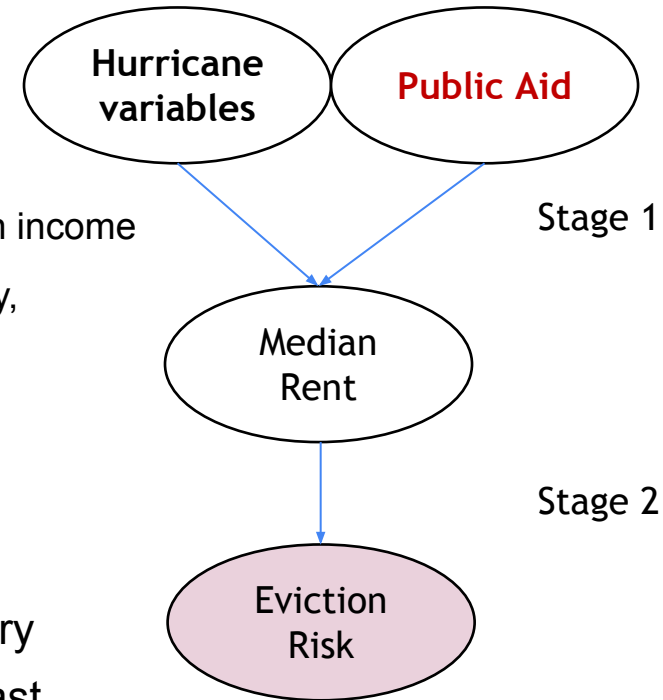
Evictions 2009-2018
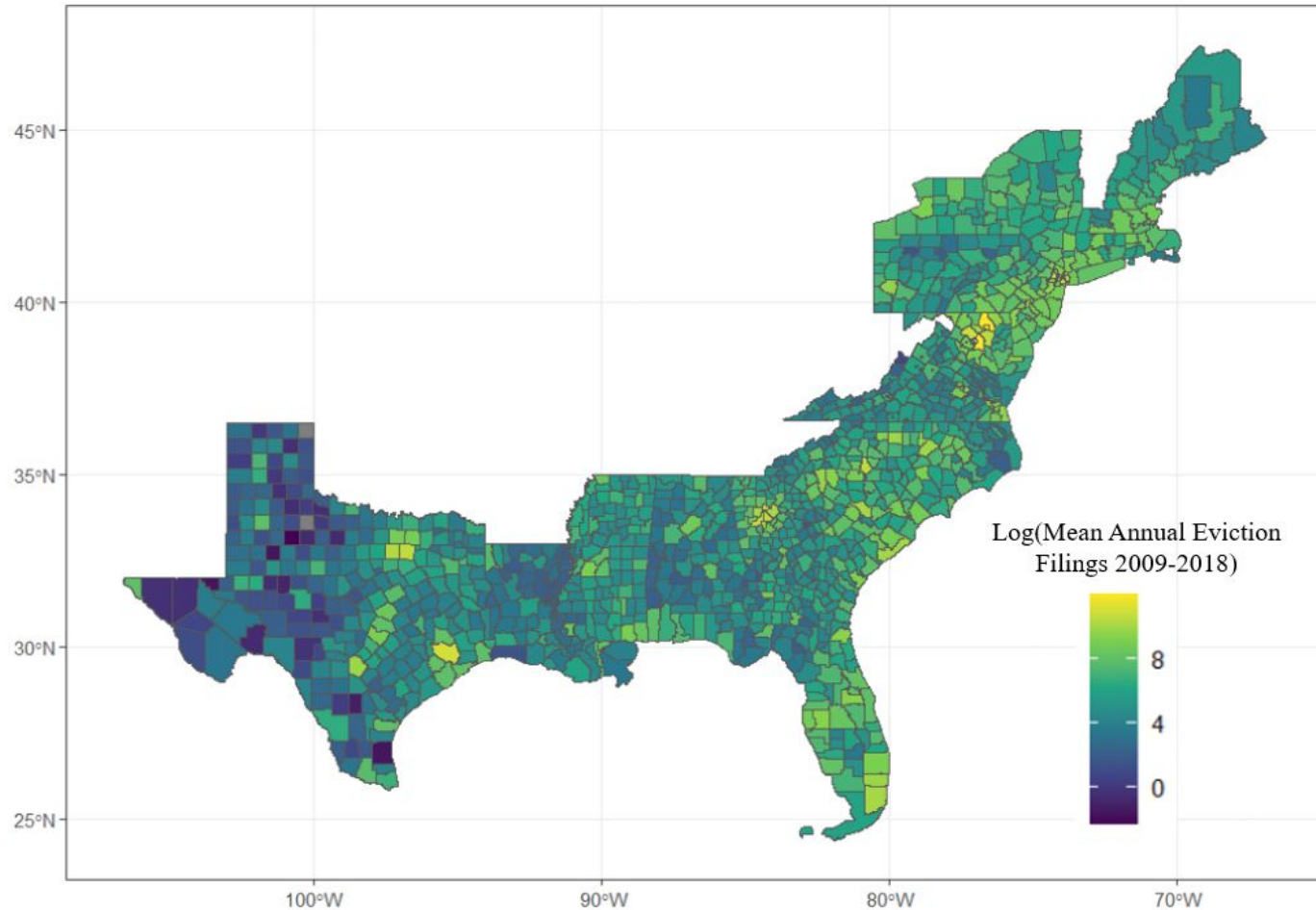
Two-stage Random Effect Modeling

Table 1: First-stage EC2SLS Regression Output for Eviction Filings and Eviction Threats

(Ln_Rent Price)	Eviction Filing Model			Eviction Threat Model		
	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z
Number of Hurricane_d	**-0.0309941**	**0.0089462**	***	**-0.0309941**	**0.0089376**	***
Number of Hurricane_1year_d	**0.0220371**	**0.008733**	**	**0.0220371**	**0.0087247**	**
Number of Hurricane_2years_d	-0.0135176	0.0164034	0.41	-0.0135176	0.0163877	0.409
Maximum Wind speed_d	**-0.0014464**	**0.0002664**	***	**-0.0014464**	**0.0002661**	***
Maximum Wind Speed_1year_d	-0.0001723	0.000484	0.722	-0.0001723	0.0004836	0.722
Maximum Wind Speed_2years_d	**0.0019491**	**0.0008271**	**	**0.0019491**	**0.0008263**	**
Log Federal Aid_d	-0.0016098	0.0010162	0.113	-0.0016098	0.0010152	0.113
Coastal Binary_d	**0.9169158**	**0.3394586**	***	**0.9199227**	**0.3391329**	***
Number of Hurricane_m	-0.0015741	0.0058622	0.788	-0.0015479	0.0058566	0.792
Number of Hurricane_1year_m	-0.000383	0.0089777	0.966	-0.0003759	0.0089691	0.967
Number of Hurricane_2year_m	0.0006516	0.01594	0.967	0.0006395	0.0159247	0.968
Maximum Wind speed_m	-0.0001181	0.0002261	0.601	-0.0001161	0.0002259	0.607
Maximum Wind Speed_1yeard_m	0.0001335	0.0005051	0.791	0.0001312	0.0005046	0.795
Maximum Wind Speed_2year_m	-0.0003513	0.0009557	0.713	-0.0003452	0.0009548	0.718
Log Federal Aid_m	**0.0014669**	**0.000631**	**	**0.0014421**	**0.0006304**	**
Coastal Binary_m	**0.0063387**	**0.0029283**	***	**0.0062314**	**0.0029255**	*
County Income_d	9.77E-06	8.18E-07	***	9.77E-06	8.17E-07	***
Percentage of White Population_d	-1.129488	1.29E-01	***	-1.129488	0.1284173	***
Percentage of Vacant Units_d	-0.0183874	0.1071158	0.864	-0.0183874	0.1070131	0.864
Crowding Fraction_d	-0.0515997	0.1185626	0.663	-0.0515997	0.118449	0.663
County Income_m	1.06E-06	9.54E-08	***	1.04E-06	9.53E-08	***
Percentage of White Population_m	-0.0143484	0.0071375	*	-0.0141065	0.0071307	*
Percentage of Vacant Units_m	-0.0022291	0.012337	0.857	-0.0021923	0.0123251	0.859
Crowding Fraction_m	-0.0261882	0.0420171	0.533	-0.025748	0.0419768	0.54
_cons	6.628293	0.0987122	***	6.628302	0.1002913	***

Table 2: Stage Two output from EC2SLS random-effects IV regression for Eviction Filings and Eviction Threats

Dependent Variable: Ln_Eviction Record Instrument: Ln_Rent Price	Eviction Filing Model			Eviction Threat Model		
	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z
Ln_Rent Price	**8.61E-01**	**2.64E-01**	***	**0.8479184**	**0.2785354**	***
County Income	4.10E-06	4.26E-06	0.336	4.45E-06	4.50E-06	0.323
Percentage of White Population	-0.4661237	0.2892213	0.107	-0.5655708	0.3022979	0.061
Percentage of Vacant Units	**-2.171815**	**0.3436087**	***	**-2.470198**	**0.3619338**	***
Crowding Fraction	-0.3442968	0.452983	0.447	-0.383186	0.4792165	0.424
_cons	0.602071	1.688687	0.721	0.9503159	1.779573	0.593

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Findings

- Increases in **rental prices** are associated with increases in both **eviction filings and eviction threats**

- **Hurricanes** (same with sustained wind speed) have a **lagged effect on increasing rental prices**, which leads to **more eviction filings and threats**, despite an initial calming effect in the immediate aftermath of a disaster

- **Coastal counties** have higher rent prices, leading to further risk of higher eviction filing and eviction threats

- **Public Aid amount received by a county** were associated with higher rent, and hence higher eviction risk

Brief Takeaways

- Climate adaptation plans and infrastructure projects need to center on **people**

- Undoing historical injustice requires **contextual understanding** of neighborhood vulnerabilities (through race, ethnicity, socioeconomic characteristics, tenure status, and lived-experience) facing climate challenge

- Urban planning decisions (comprehensive plans, zoning, etc.) and community development policies (e.g., public aids) need to consider both **short** and **long term climate hazards** in climate adaptation and community resilience

- **Coordinated public policies** and **targeted aid programs**, specifically after disaster events, are necessary to ensure that **at-risk communities** have access to sufficient financial resources and legal support

Acknowledgements

Thank you!

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Photo credit: ASCE