

Wind, Water, and Public Safety:

Socioeconomic Disparities in Housing Unit Hurricane Safety in South-Central Florida

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Florida Gulf Coast University, Summer 2021



Motivation

The Great Miami Hurricane of 1926 and Okeechobee Hurricane of 1928 caused thousands of fatalities, many in sub-standard or informally-constructed homes near Lake Okeechobee. Building codes developed through the late 20th century are among the institutions that have greatly reduced fatalities since, but codes continue to be different for manufactured homes – a key resource for low-income families – than for site-built housing.

Objectives

- Characterize disparities in hurricane-safety risks affecting lower-income communities of south-central Florida.
- Investigate the role of disasters in driving policy change.

Methods

- Target areas:
 - Lower-income, flood-susceptible communities
 - Hendry, Glades Counties; portions of Lee, Palm Beach Counties
- Analyze policies, current and as developed over time: conceptual basis, regionally-specified differences, building codes; Federal, state, local
- Quantify residential units exposed to greater risk
 - Census data, GIS methods (detailed, publicly-accessible data), FEMA overlays, FEMA static maps, aerial imagery

Building codes are less protective for manufactured homes than site-built homes

Manufactured Units	Authority	Site-Built Units
Federal HUD construction specs <ul style="list-style-type: none"> Medallion documenting conformance to HUD Florida DCA installation specs <ul style="list-style-type: none"> Fastened to foundation 	Authority	Florida Building Codes apply to hurricane safety since 1992; revised every three years, latest 2020
Withstand wind to CATEGORY 2 <ul style="list-style-type: none"> Glades and Hendry: 100 mph Lee and Palm Beach: 110 mph 	Wind Resistance	Withstand wind to CATEGORY 4-5 <ul style="list-style-type: none"> Glades and Hendry: 150 mph Lee and Palm Beach (target zone): 160 mph
Lowest floor elevation at or above FEMA site-specific Base Flood Elevation (BFE) Foundation resists flotation, collapse, lateral movement (CFR 2021; FL Building Code 2021)	Flood Resistance	Lowest floor elevation: 1-2 feet above BFE; <i>or</i> Local community design elevation <ul style="list-style-type: none"> Palm Beach: No modifications Glades: 1 foot above BFE or 36" above grade Hendry and Lee: Local approvals

	Unemployment, %	Per capita income, \$
Glades	12.0	21,900
Hendry	7.4	19,200
Lee (total)	4.5	33,500
Lee (target zones)	5.0	30,000
Palm Beach (total)	5.2	40,000
Palm Beach (target)	19.0	11,700
U.S. average	n/a	34,100

(U.S. Census Bureau, 2020a)

At-risk regions: less well off financially
 Counties targeted for this research, found to have higher proportions of manufactured homes, also on average have lower income, higher unemployment.

Conclusions

- Florida state and U.S. federal policies' modifications over time are designed to make homes more hurricane-resistant, sometimes directly responding to disastrous events.
- Building codes in Florida are less protective for wind velocity and flood inundation for manufactured homes than for site-built homes.
- Lower-income, lower-resourced counties and blocks studied here have high proportions of manufactured homes, including many in FEMA-designated flood zones.
- Many people in lower-income areas who choose manufactured homes as affordable housing experience greater safety threats than residents in site-built homes.

Many homes in target regions are manufactured, many of those in flood plains

	Glades County (Total)			Hendry County (Total)		
	Site-Built	Manufactured	Not determined	Site-Built	Manufactured	Not determined
Total Units	3,489	3,567	0	8,866	5,938	0
In Floodplain ³	Undeterminable	80 <i>minimum</i>	Not quantified	Undeterminable	360 <i>minimum</i>	Not quantified
Special Zone X ⁴	Undeterminable	899 <i>minimum</i>	625	Undeterminable	342 <i>minimum</i>	548

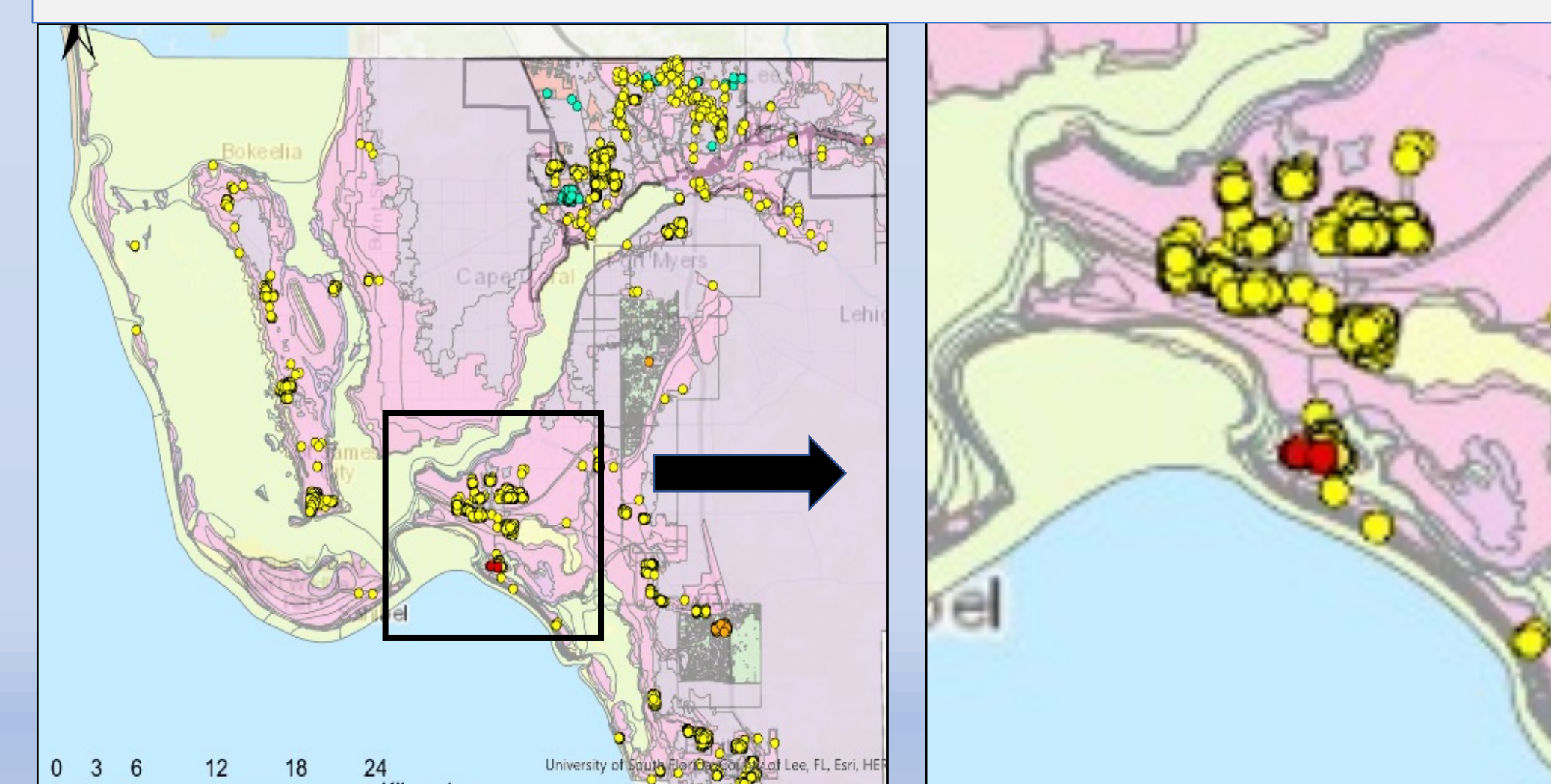
	Lee County (Total)			Lee County (Target Region ¹)		
	Site-Built	Manufactured	Not determined	Site-Built	Manufactured	Not determined
Total Units	356,587	37,460	0	41,733	10,334	0
In Floodplain ³	90,083	10,008	0	8,569	3,017	0

	Palm Beach County (Total)			Palm Beach County (Target Region ²)		
	Site-Built	Manufactured	Not determined	Site-Built	Manufactured	Not determined
Total Units	667,379	18,831	0	11,184	1,412 <i>min</i>	9,772
In Floodplain ³	Undeterminable	5,508 <i>min</i>	Not quantified	Undeterminable	937 <i>min</i>	Not quantified

1. Ft. Myers Shores and North Ft. Myers CCDs 2. Belle Glade-Pahokee and Glades CCDs 3. FEMA zones A, AE, AH, AO 4. "Shadow of Hoover Dike"

Regions have unequal information

Methods are much less precise in less-well-resourced counties, which have more low-income residents and more at-risk homes



- Lee County [left]: Manufactured homes zoned into clusters, well documented in GIS data, with digitized FEMA floodplains, readily verified with aerial imagery
- Hendry County [above]: Few clusters; most manufactured homes are scattered, not distinguishable using aerial images; FEMA floodplain available only as static overlay

Policies and regulations: Building codes have evolved 1980-2020

1980s: Multiple hurricanes throughout US (Pfof 2003; Dixon 2007)

1986-98: FL Legislature gradually imposes state authority over local codes

1992: Hurricane Andrew

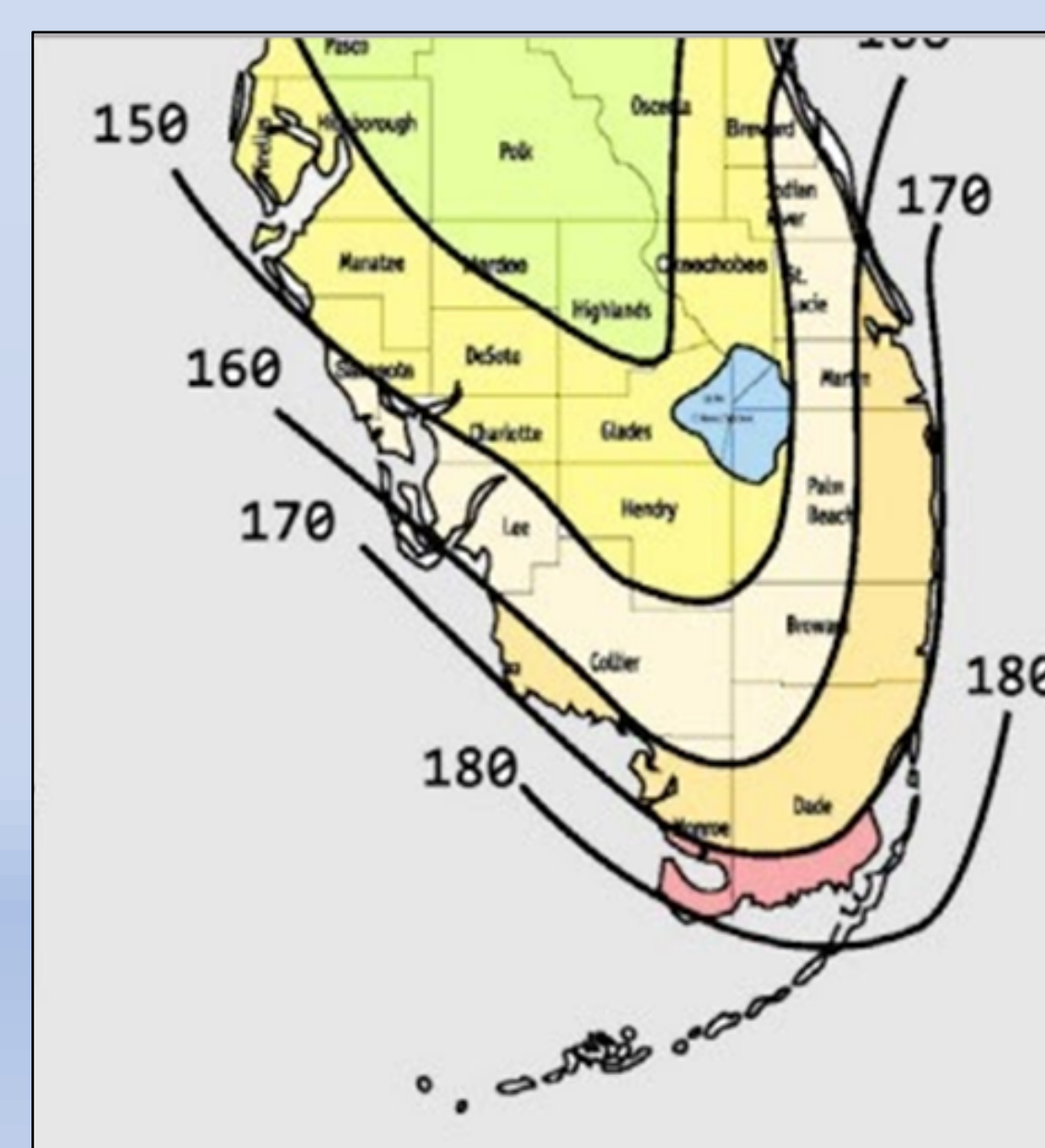
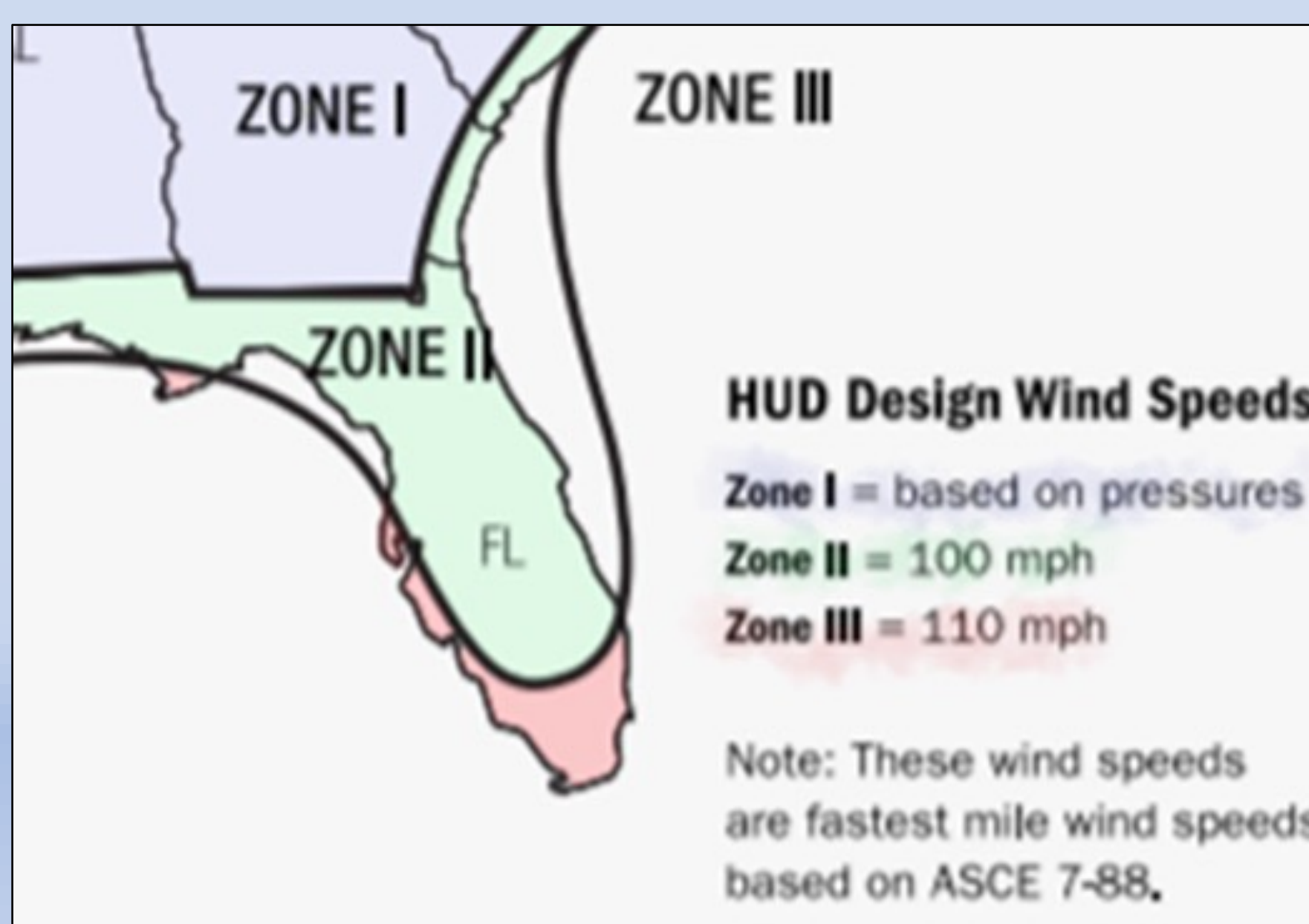
Florida state-level codes judged not successful, esp. for mobile homes

1993-96: metal connectors, wood bracing, reinforced concrete columns/beams; manufactured homes, attached foundations

2004: Hurricanes Charley (highest winds), others

Better performance, esp. manufactured homes

2004-07: cladding, windows/doors, protection from airborne debris



Wind requirements for residential units: Manufactured units [left] (FEMA, 2009); Site-built units [right] (FL Building Code, 2021)

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Acknowledgements

Funding for this research was provided by the FGCU Communities in Transition (CiT) program under the Office of Undergraduate Studies and Honors College at Florida Gulf Coast University. This research derives from the work of Kyria Wickham and Camila Rimoldi Ibanez and collaborators at South Florida State College and is conducted in collaboration with the FGCU Department of Justice Studies and the City of Sebring, Florida.