Western Engineering


ICLR Friday Forum
November 17, 2017

# Hurricane Irma Damage Assessment:

## Investigating the performance of Florida's homes during Hurricane Irma

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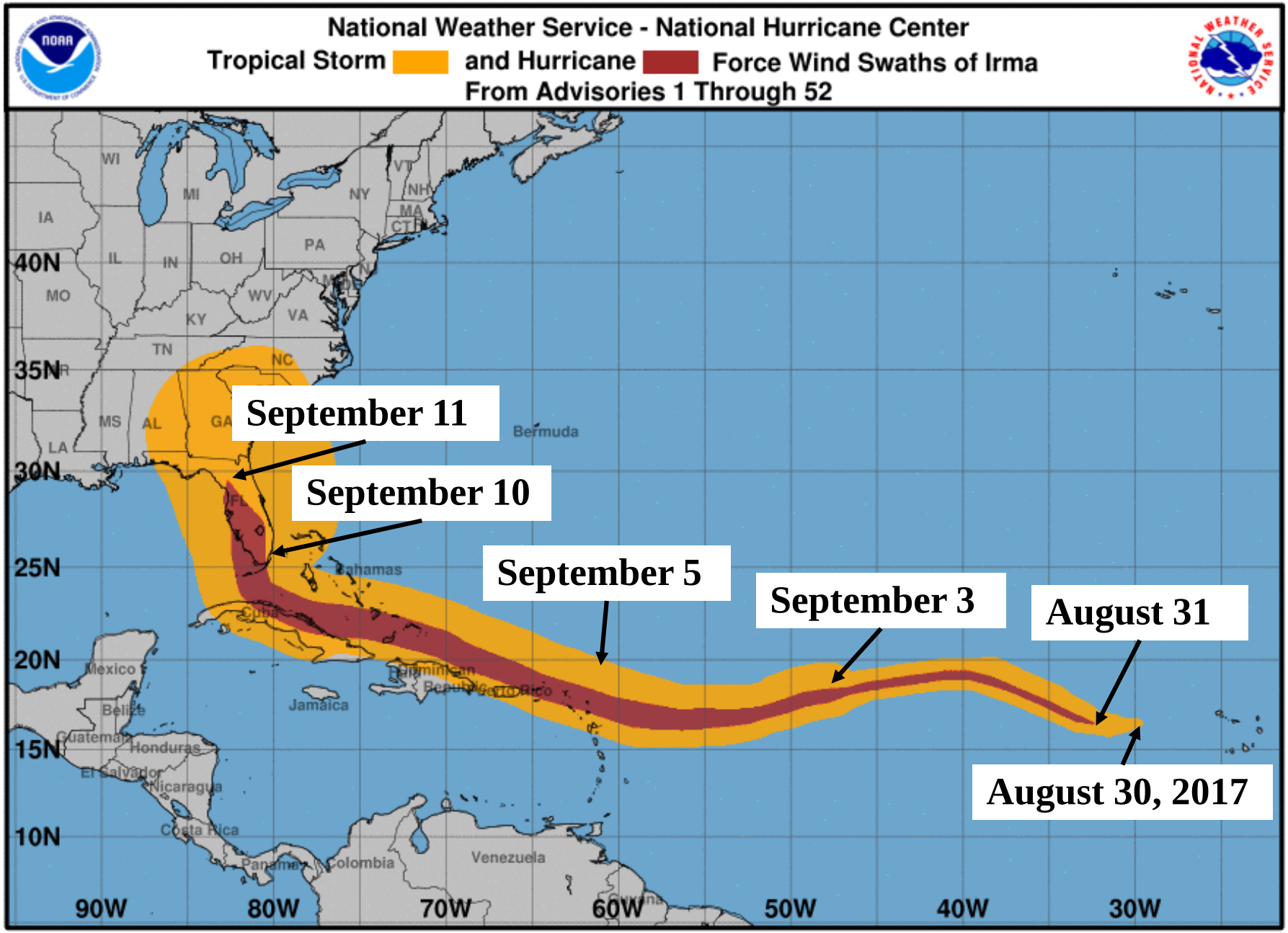
# Overview

- Hurricane Irma
  - Path and Wind Speed History
  - Impact
- Florida Damage Survey
  - Survey Methodology
  - Fulcrum App
  - Survey Regions
- Observed Damage to Residential Structures
  - Tornado Damage in Crescent Beach, FL
  - Storm Surge and Wind Damage in SW Florida
- Summary and Lessons Learned


National Weather Service - National Hurricane Center
Tropical Storm and Hurricane Force Wind Swaths of Irma
From Advisories 1 Through 52
September 11
September 10
September 5
September 3
August 31
August 30, 2017
40N
35N
30N
25N
20N
15N
10N
90W
80W
70W
60W
50W
40W
30W
Bermuda
Bahamas
Cuba
Jamaica
Mexico
Belize
Guatemala
Honduras
El Salvador
Nicaragua
Costa Rica
Panama
Colombia
Venezuela


Source: National Weather Service (NWS)

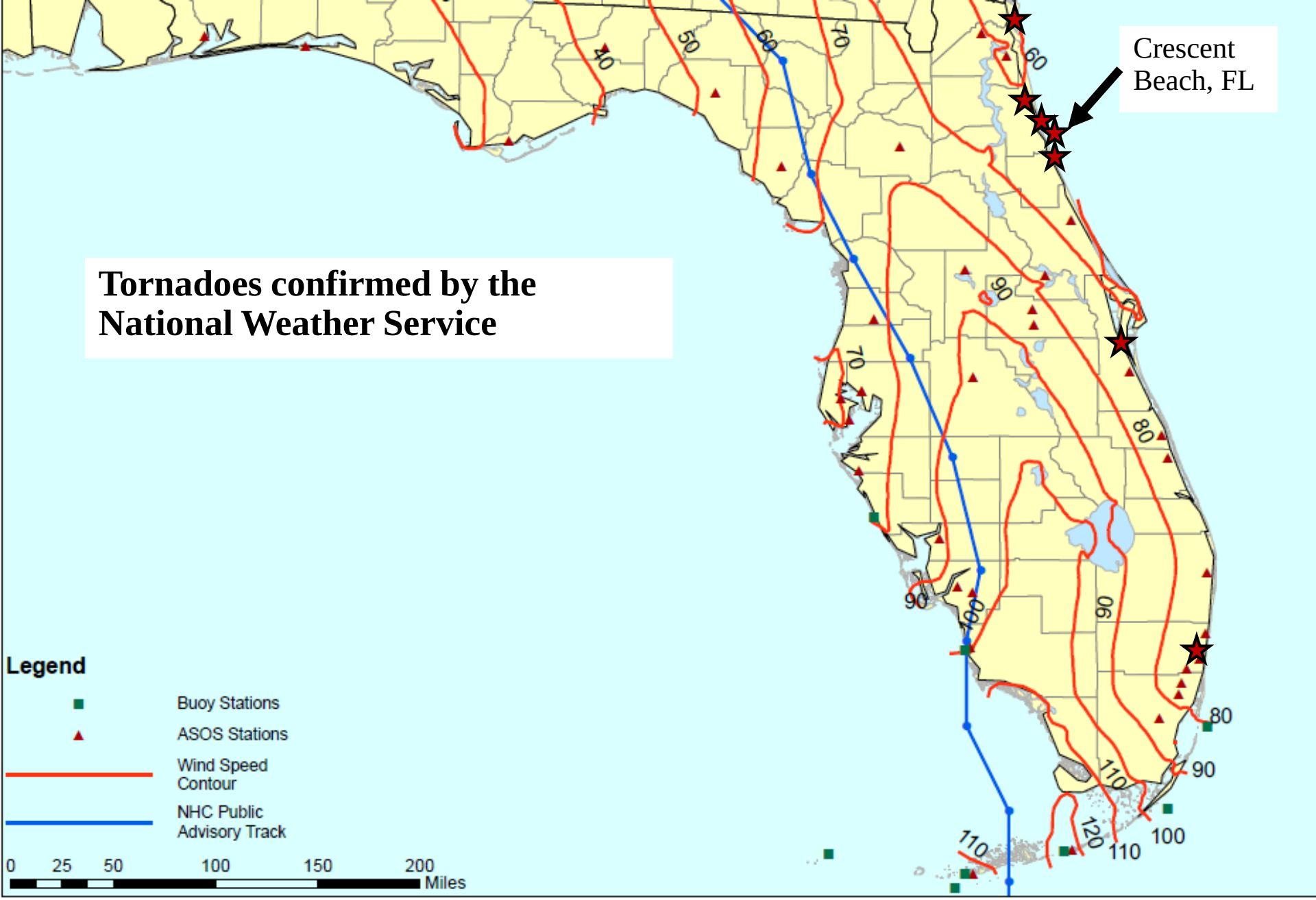
# Irma's Impact in Florida

- 75 total fatalities
  - Florida: 11 fatalities (including 8 elderly persons due to a nursing home air conditioning malfunction)
- 116,000 people evacuated into 530 shelters
- Power loss affected up to 3 million customers
- Damage due to several tornadoes reported on the East Coast
- Severe damage due to storm surge reported along the Southern Coasts and the Keys


Hurricane Irma (2017): Preliminary Peak Wind Gust(mph)

Estimated 3-second gust wind speeds (mph) at 10 m above ground over open terrain from ARA model fit to surface level observations using NHC storm track and central pressure data through Forecast/Advisory 52 at 0300UTC on 9/12/2017.

Map is subject to change. Created on: 9/18/2017.

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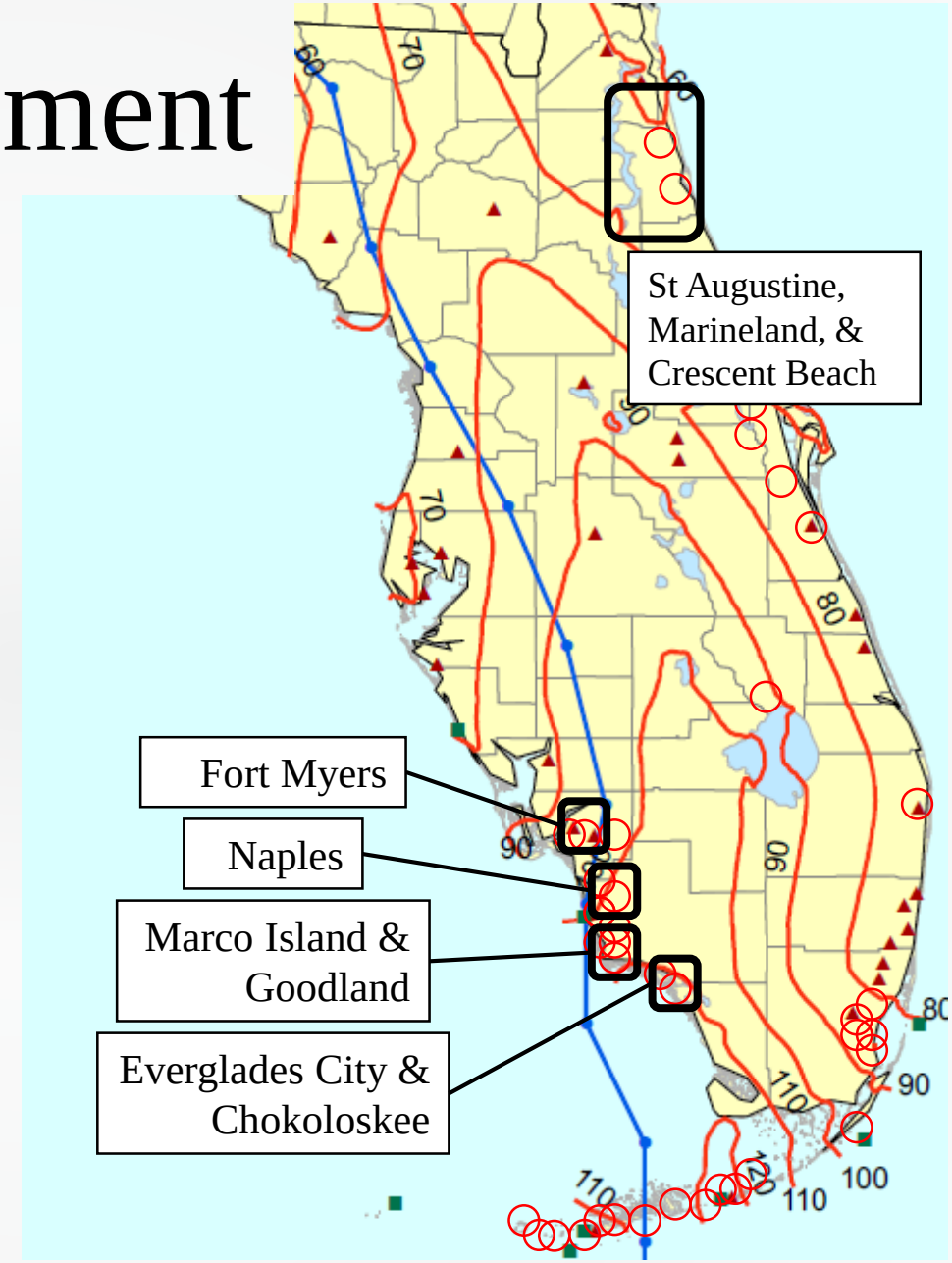
# Damage Assessment

- Objective: To investigate the performance of residential structures in regions experiencing hurricane-force wind speeds
  - The main focus was on single family homes, including some mobile homes and multi-family vacation rentals
- Survey Team:
  - Faculty from the University of Florida (UF) and Auburn University
  - Graduate students from UF (5) and Western (2)
  - UAV (drone) pilot

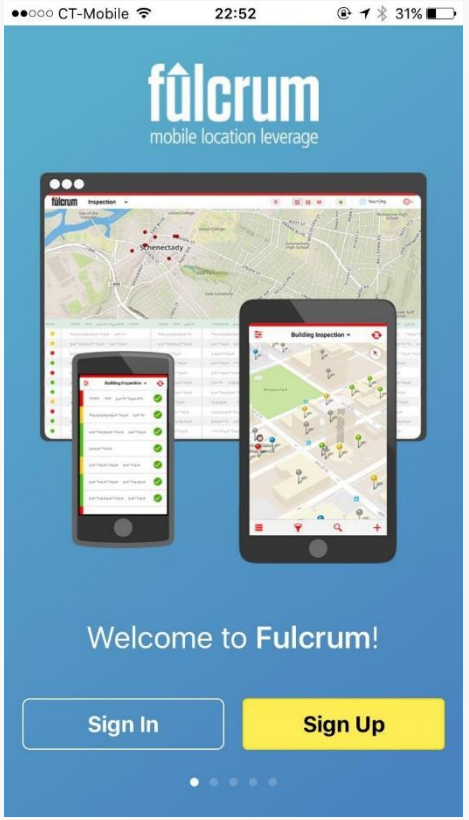
# Damage Assessment

- Approach:
  - Walking surveys of select neighborhoods
  - Every structure in each study area was inspected – even those with no visible damage
  - Fulcrum smartphone app was used to document surveys of individual structures



# Damage Assessment

- Fulcrum App (www.fulcrum.com)
  - App survey form developed based on ATC-20
    - The purpose of the form is to provide consistent, detailed evaluation procedures for engineers and building inspectors
  - Data was stored locally, then synced to the Hurricane Irma database
  - GPS coordinates link the damage information to the location



# Damage Assessment

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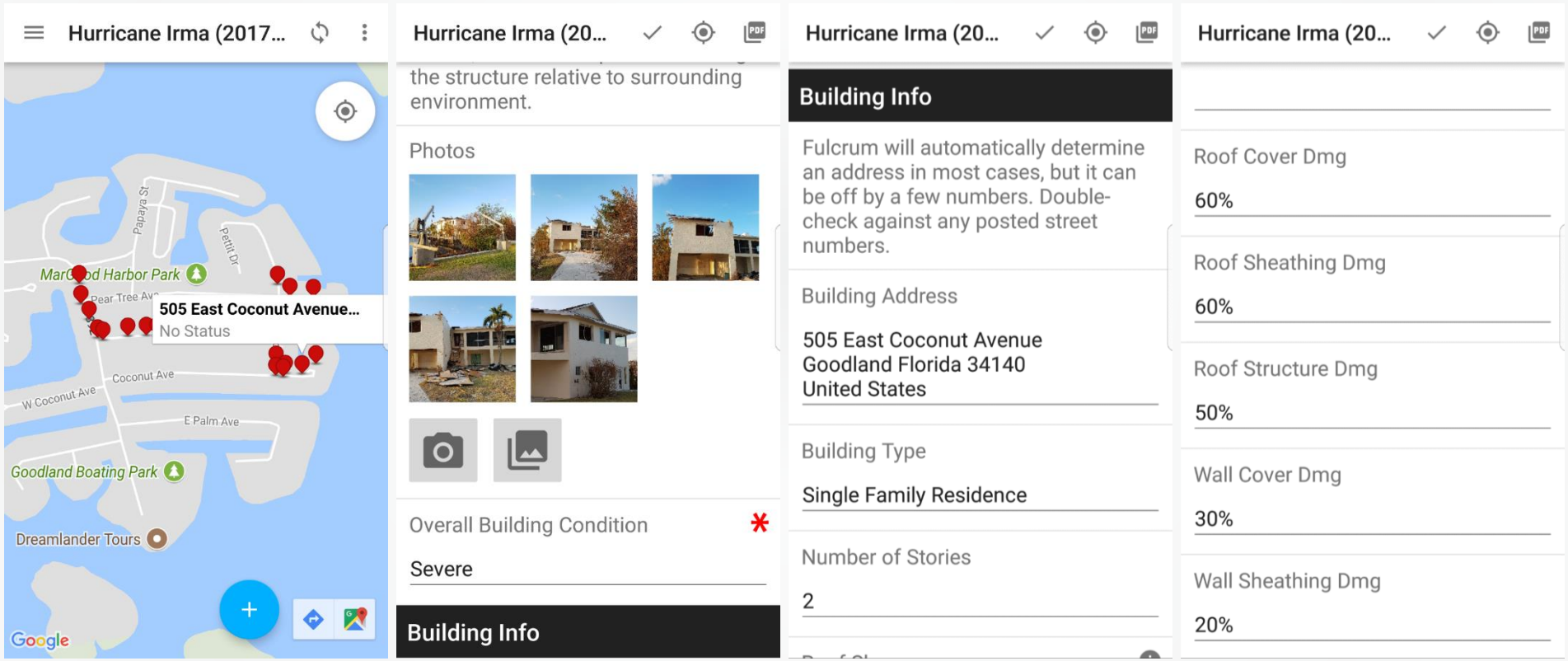
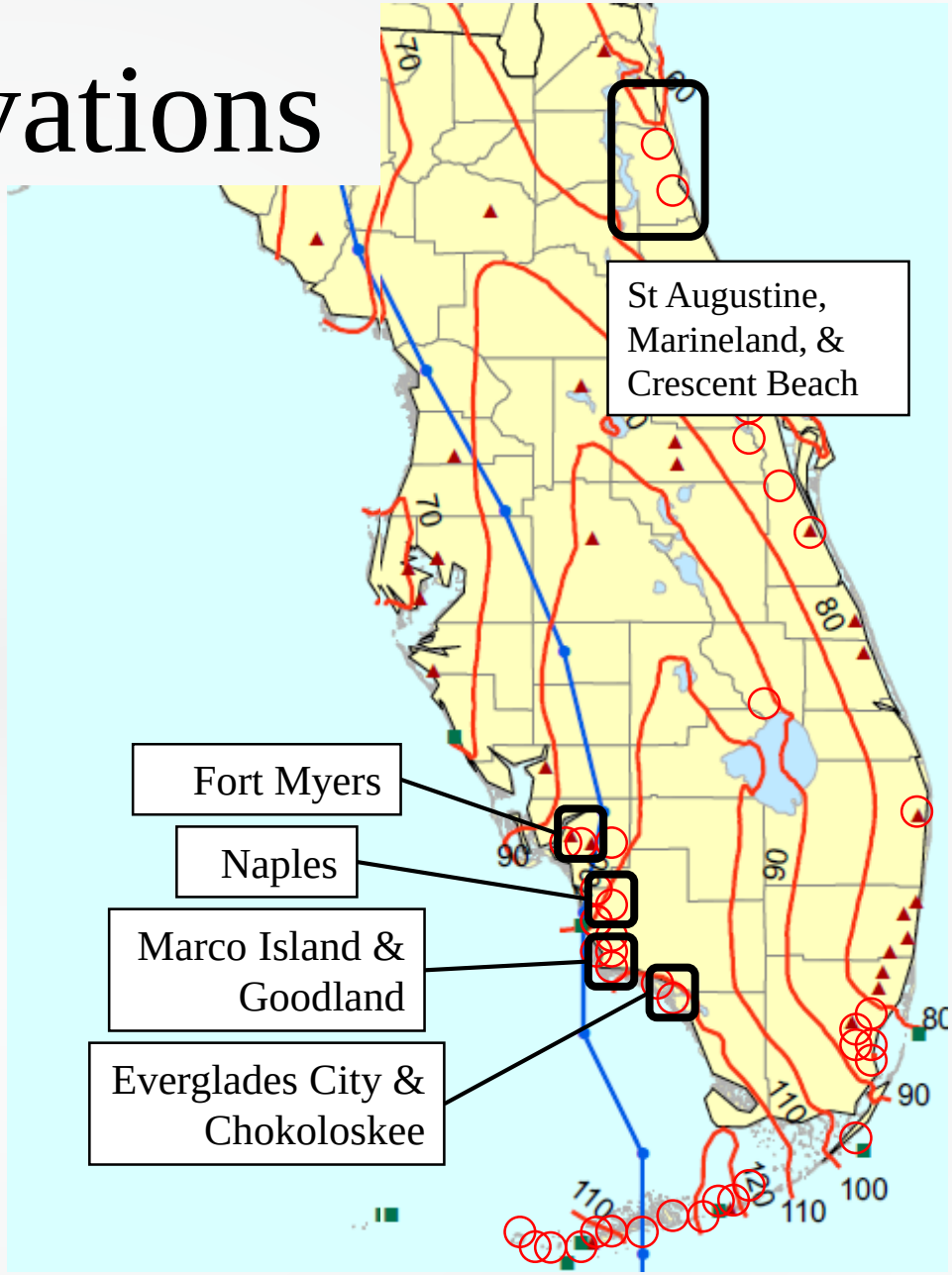


# Damage Observations

- Tornado Damage
- Wind Damage
- Storm Surge



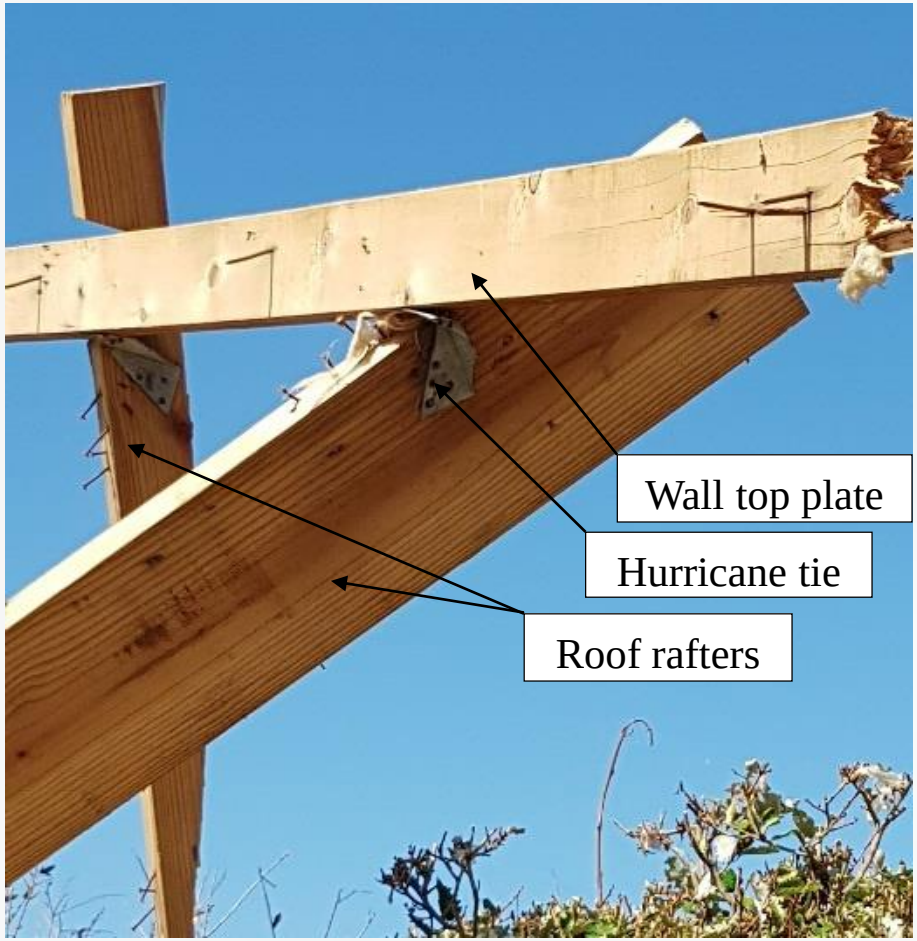
# Tornado Damage

- Crescent Beach, FL
- Vacation townhome rentals, oldest buildings constructed in 1982 – some had been rebuilt in the 2000's following a previous tornado

# Tornado Damage

- Estimated wind speed: 130 mph
- Design wind speed: 132 mph
  - Previous design wind speed (2005): 121 mph

# Tornado Damage




# Coastal Failures

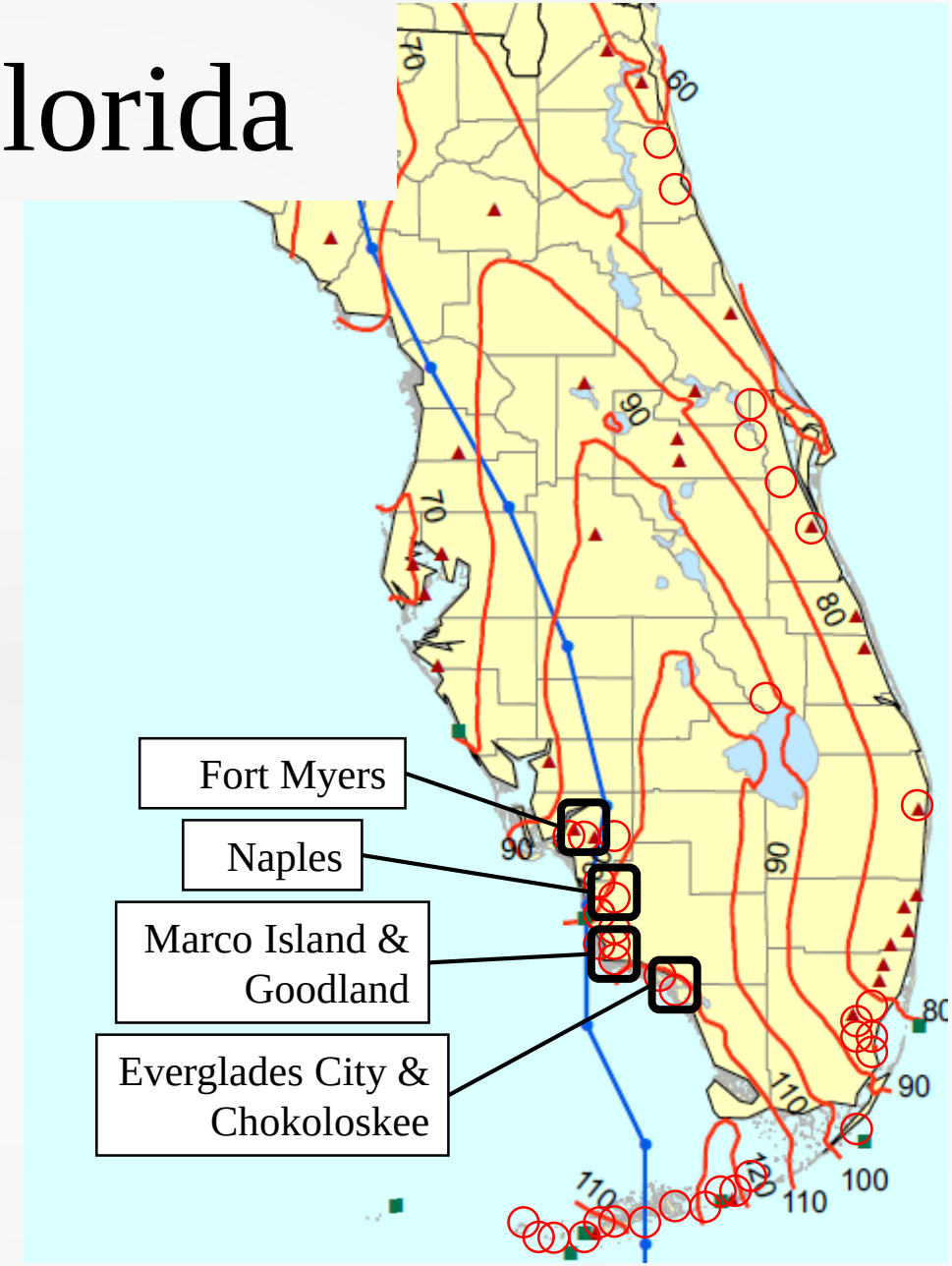
- Vilano Beach, FL
- Storm surge height up to 6 feet measured nearby (USGS data)

# Coastal Failures

- Vilano Beach, FL

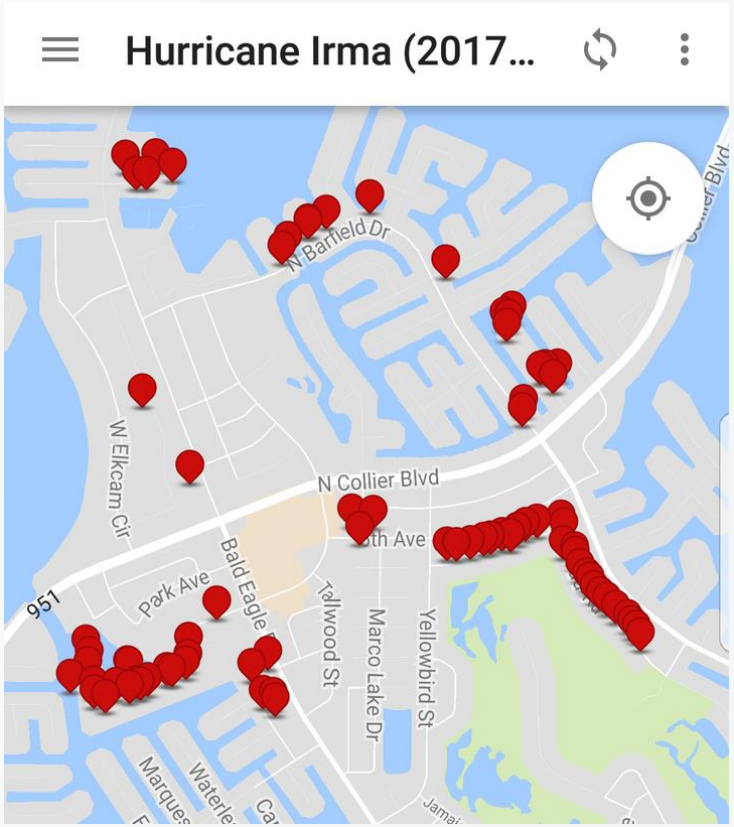
# Southwestern Florida

- Marco Island
- Goodland
- Chokoloskee
- Everglades City
- Port Charlotte
- Fort Myers
- East Naples



# Marco Island

- Consistent, minor damage observed over large residential areas
  - 215 Structures Surveyed
  - Minor damage to clay tile and asphalt roofing was common



# Marco Island

- Estimated wind speed: 108 mph
- Design wind speed: 170 mph
  - Previous design wind speed (2005): 137 mph

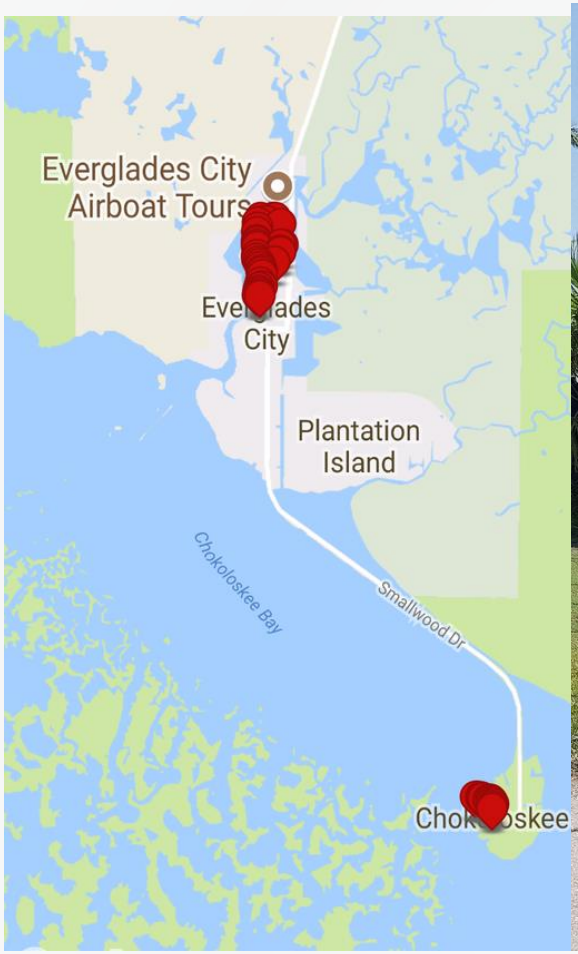
# Goodland

- Estimated wind speed: 108 mph
- Design wind speed: 170 mph
  - Previous design wind speed (2005): 137 mph


# Goodland

# Chokoloskee


# Everglades City




# Everglades City


# Everglades City

# Port Charlotte & Fort Myers

- Insurance Institute for Business and Home Safety (IBHS) FORTIFIED Homes™
  - https://disastersafety.org/fortified/fortified-home/
  - Inspected and compared to neighboring homes to assess relative performance
- Minor roof cover damage
  - Comparable levels of damage in FORTIFIED and other nearby homes

# Naples

- Estimated wind speed: 100 mph
- Design wind speed: 166 mph

# Naples

# Naples

# Naples

# Summary of Observations

- Damage was generally minor, but widespread across the state
  - Tornado, storm surge and wind damage in the Northeast
  - Storm surge and wind damage in the Southwest
- Severe damage occurred in isolated cases
- Maximum recorded gusts were below current design wind speeds
  - Difference in design speeds for older homes could have contributed to observed wind damage

# Summary of Observations

- Storm surge damage caused significant losses
  - Newer, elevated homes performed well
- Extent of interior damage was not generally assessed, unless homeowner was present

# Things We Learned

- Hurricanes bring a number of hazards in addition to wind - often act in combination
- Identification of different structure types by external inspection - attention to details
- It is important to collect a representative dataset - not just the dramatic failures
- Adaptability
- Be prepared (bottled water, power banks for phones, cameras, sunscreen, etc.) but pack as light as possible

# We wish to extend our sincere thanks to:

- Institute for Catastrophic Loss Reduction
- The University of Florida team:
  - Dr. David Prevatt
  - Dr. Kurt Gurley
  - Jack, Rodrigo, Jason, Karthik, Andreas
- Dr. David Roueche
- Kwasi Perry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# Thank you for your time!


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