The Impact of Hurricanes Harvey and Irma on the U.S. Mainland

Eric Uhlhorn, Ph.D.
Karthik Ramanathan, Ph.D.

Verisk Analytics
SERVE | ADD VALUE | INNOVATE

AIR WORLDWIDE®

Meet the Speakers

Dr. Eric Uhlhorn
Principal Scientist

Dr. Karthik Ramanathan
Senior Manager

Agenda

- Mid-season summary
- A meteorological perspective
- Is this a sign of global climate change?
- Damage survey findings
- Impacts and implications
- AIR's view of industry loss estimates

Anticipating the Hyperactive 2017 Season

Climatological Average

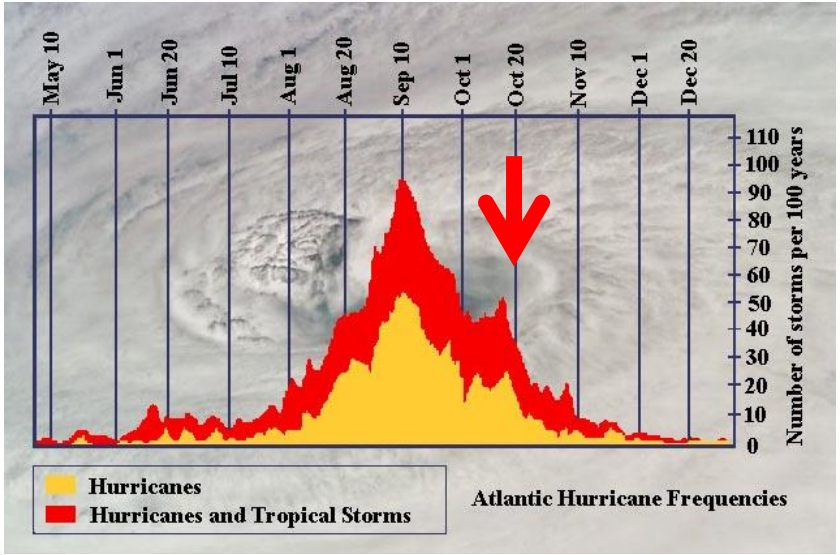
Named Storms	Hurricanes	Major Hurricanes
12.1	6.4	2.7

Pre-season Forecasts August Update

Source	Named Storms	Hurricanes	Major Hurricanes
Colorado State University	11 **16**	4 **8**	2 **3**
NOAA	11-17 **14-19**	5-9 **5-9**	2-4 **2-5**

This year so far…

Named Storms	Hurricanes	Major Hurricanes
15 (+0.9σ)	**10** (+1.1σ)	**6** (+1.5σ)



Courtesy: Weather Underground

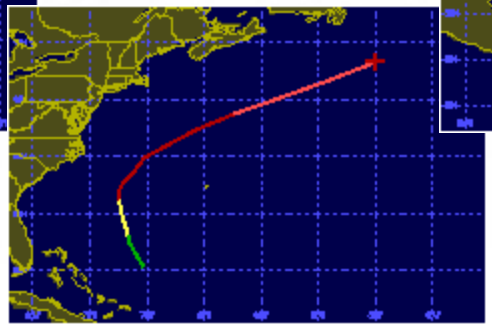
- Why so active?

- Anomalously warm sea surface temperatures in the Tropical Atlantic
- AMO index remains positive
- El Niño's "failure to launch"
- Strong subtropical ridge (Bermuda high) steering storms west

August Spawned Four Hurricanes…

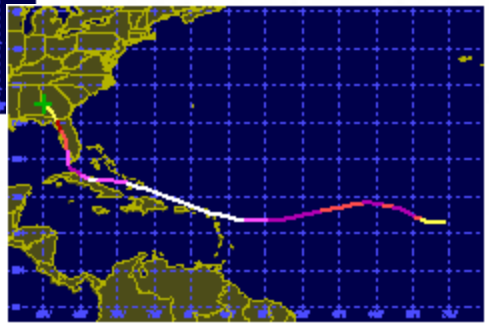
- 2004 and 2005 each only had three
- Max lifetime intensity increased steadily with each one
- First time two Cat-4 storms struck the U.S. in same season

Franklin – Cat 1
07 AUG-10 AUG



Gert – Cat 2
13 AUG-17 AUG

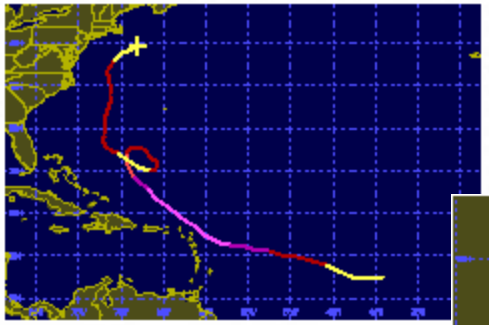
Harvey – Cat 4
17 AUG-01 SEP



Irma – Cat 5
30 AUG-12 SEP

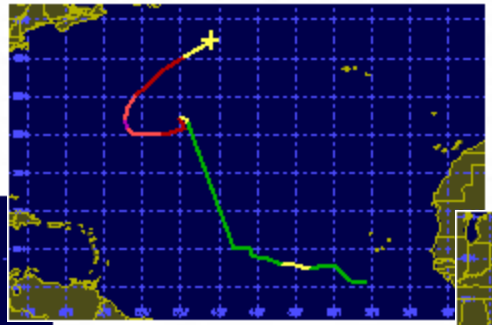
…September Spawned Four More…

- Eight consecutive hurricanes
- Maria was second Cat-5 storm in as many months
- First time since 2007 with 2 Cat-5 landfalls in Atlantic basin

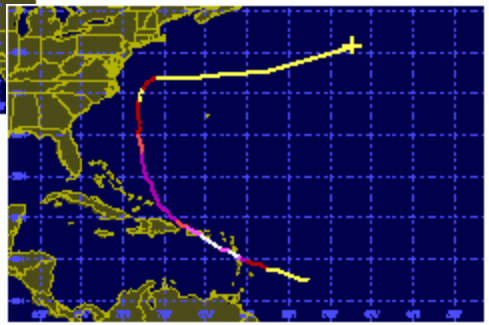


Jose – Cat 4
05 SEP-21 SEP

Katia – Cat 2
05 SEP-09 SEP



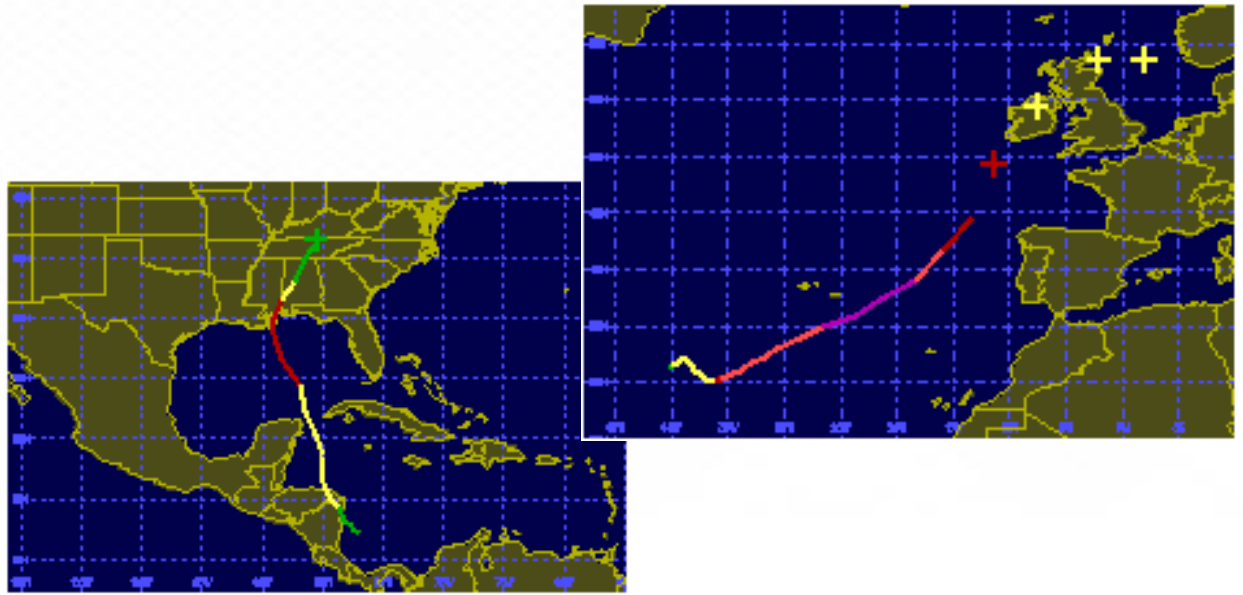
Lee – Cat 3
15 SEP-29 SEP



Maria – Cat 5
16 SEP-30 SEP

…And Then October Got in on the Act

- Two more hurricanes makes 10 consecutive (unprecedented)
- Nate 3rd mainland U.S. landfall
- Ophelia furthest east major hurricane



Ophelia – Cat 3
09-15 OCT

Nate – Cat 1
04-09 OCT


Hurricane Harvey

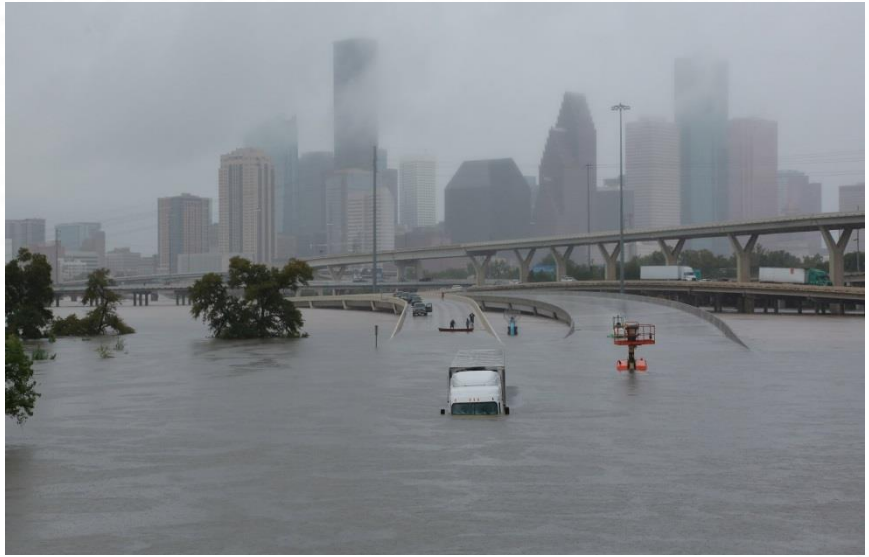
Harvey Really Broke the Drought

- First major hurricane to make U.S. landfall since Wilma in 2005

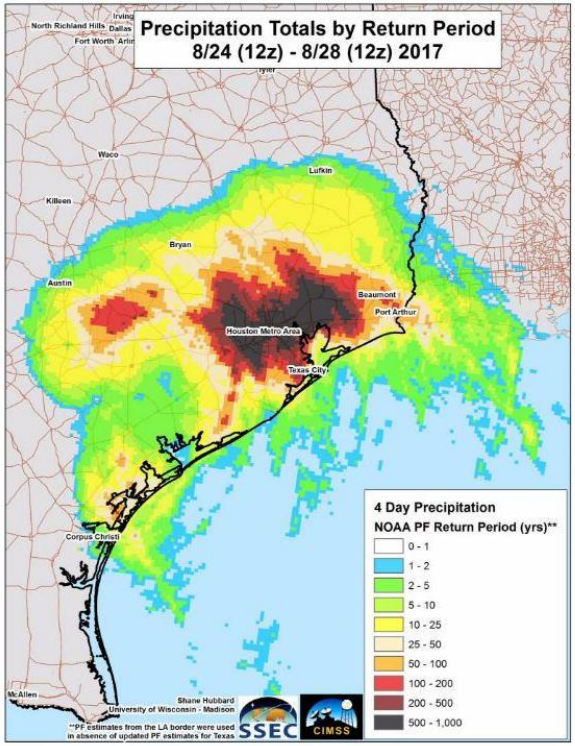
- Ended longest “drought” between major hurricane landfalls U.S. has ever experienced (3,937 days).

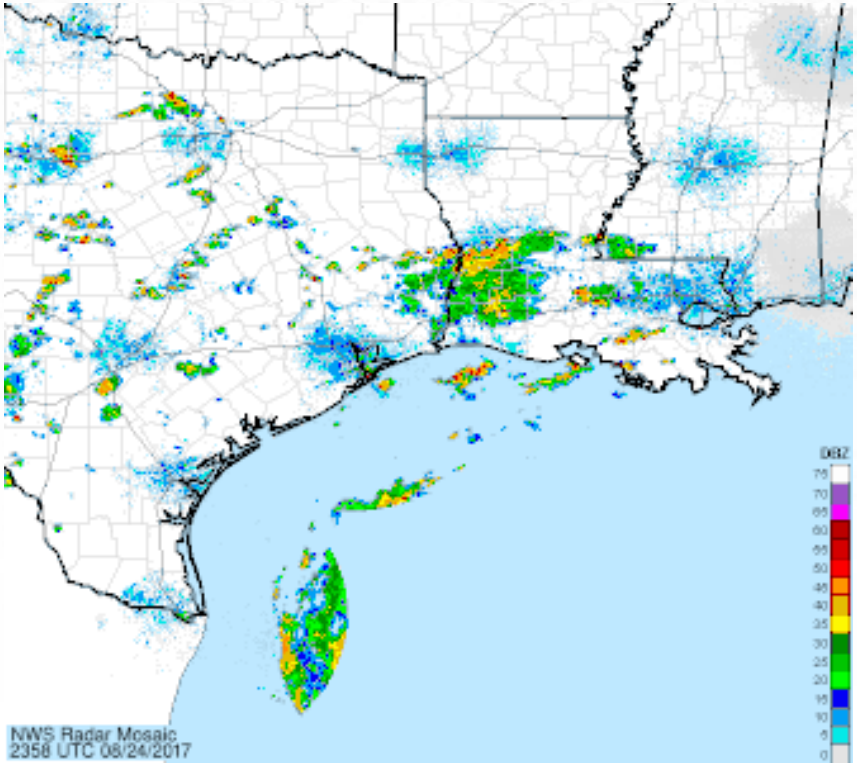
- Late Friday evening on August 25 2017, Hurricane Harvey’s Category 4 winds crossed the U.S. coastline at Rockport, Texas

- *Wind and surge impacts are not what will be remembered….*



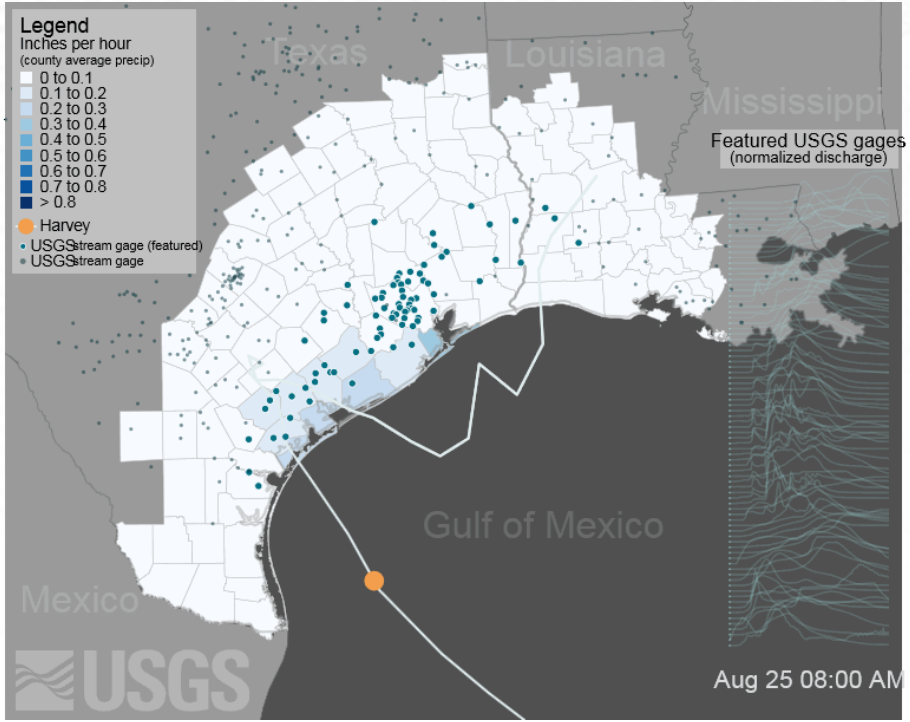
Harvey's Precipitation Footprint Was Enormous

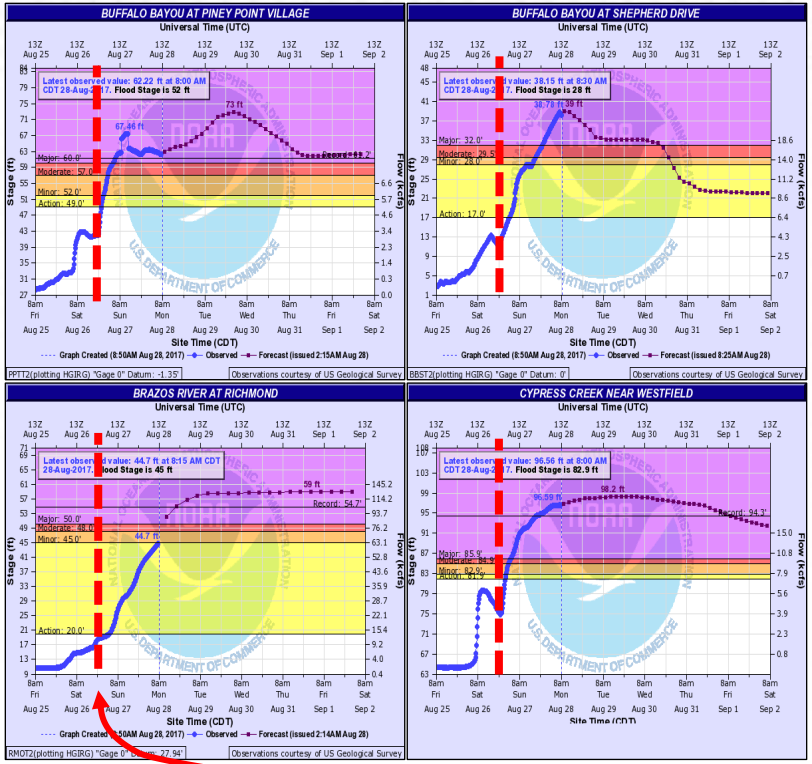




Radar loop courtesy Brian McNoldy (U. Miami)

Water Levels Rising in Houston Before Landfall

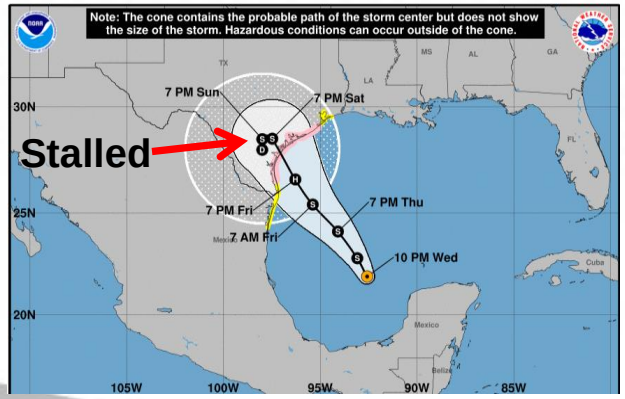




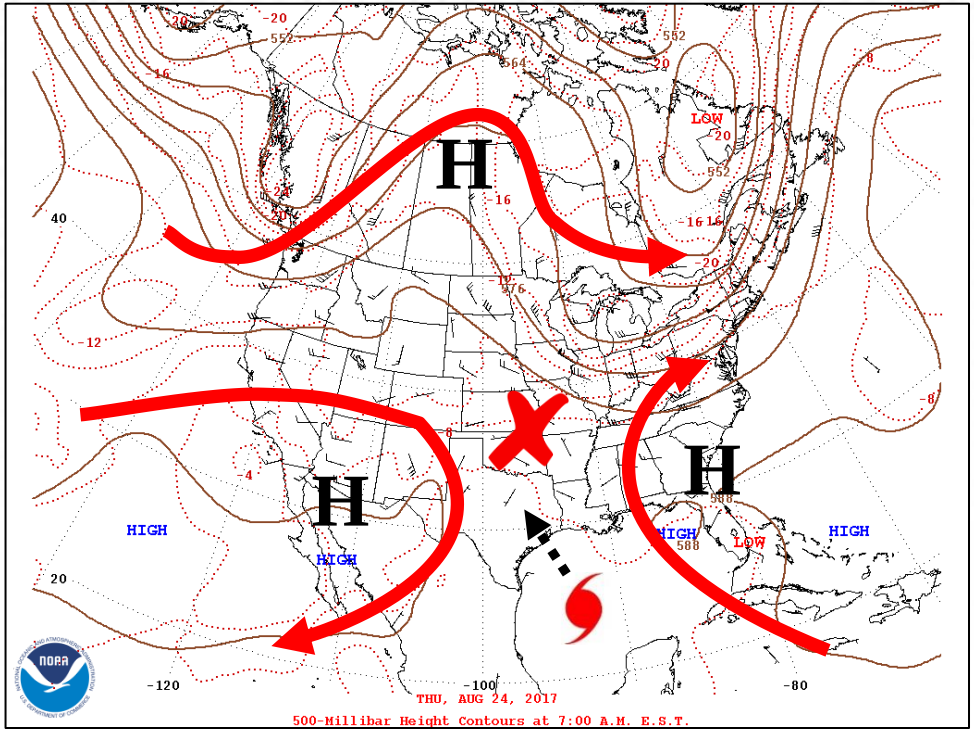
Landfall ~200 mi away

Harvey Moved Slower than People Walk

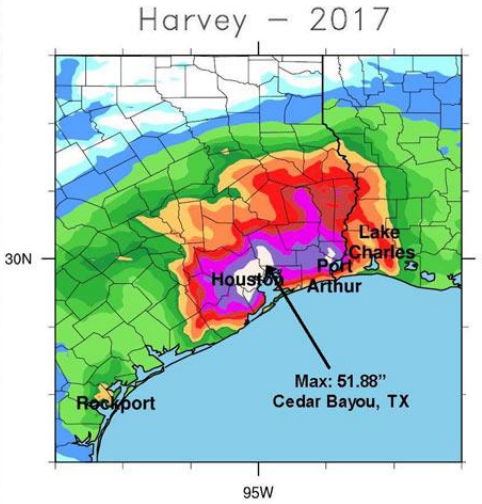
- The potential for historical rainfall amounts was evident for several days
- Forecast models were in agreement that Harvey would stall along the Texas coast after landfall
- With no trough nearby in any direction, Harvey was essentially stranded in East TX…for days

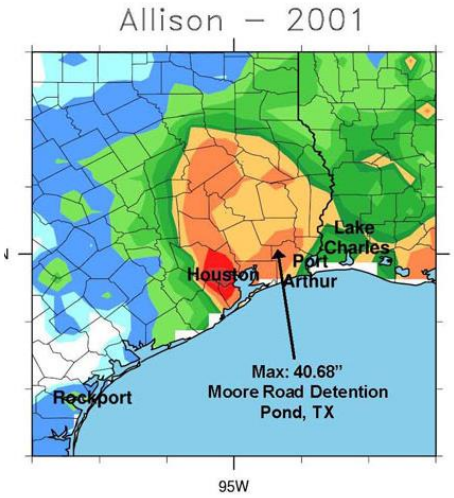


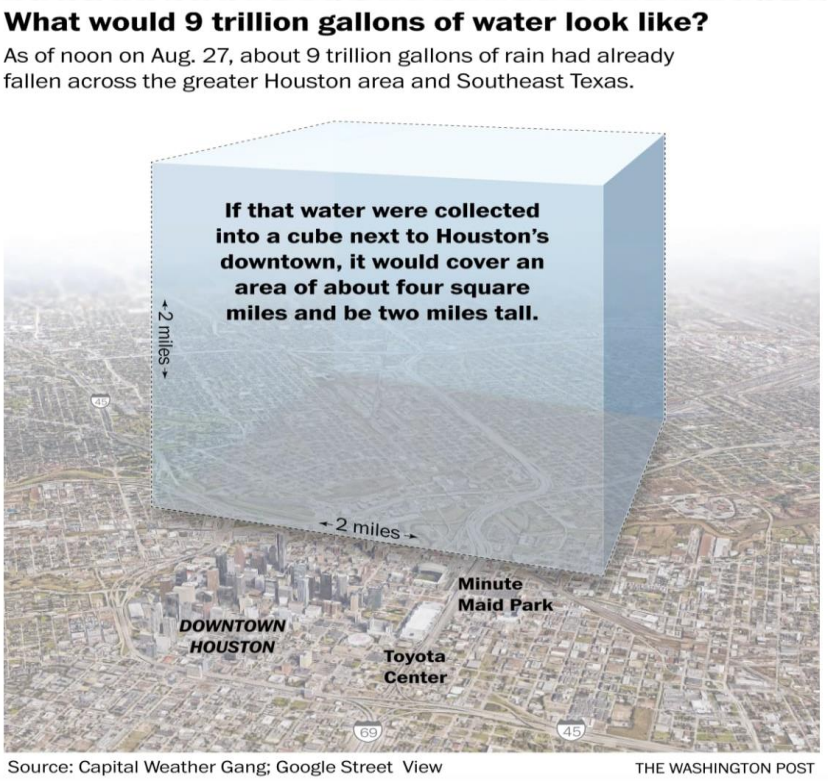
Steering Flow that Blocked Harvey



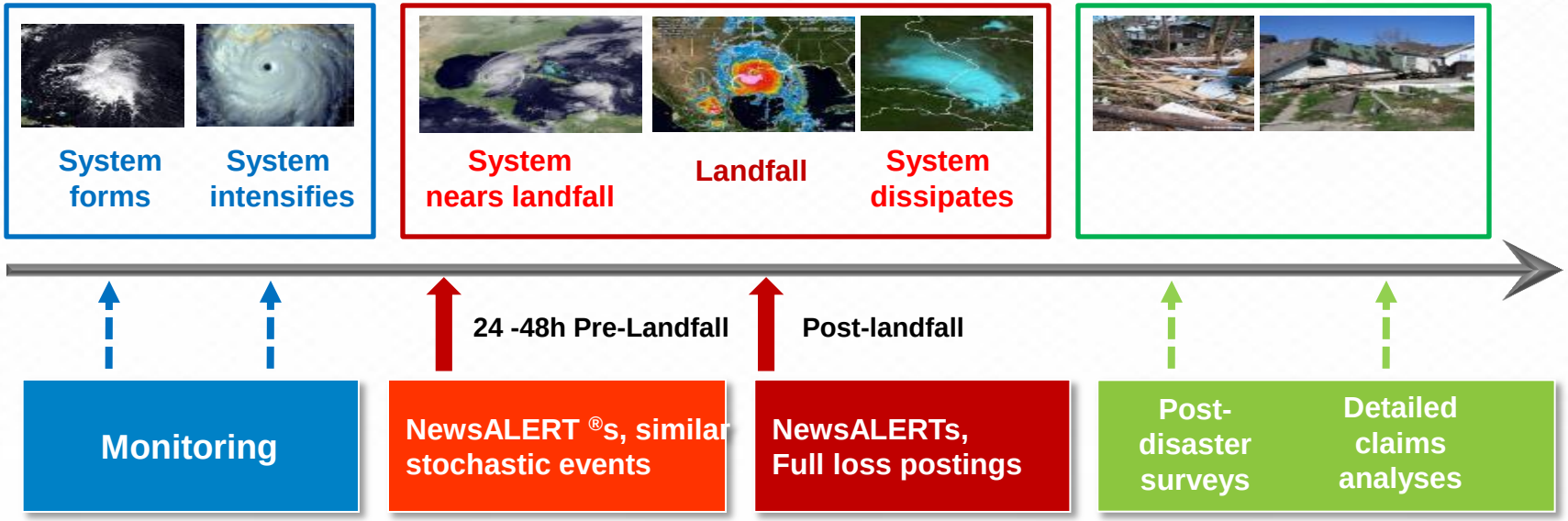
Harvey's Precipitation in Perspective



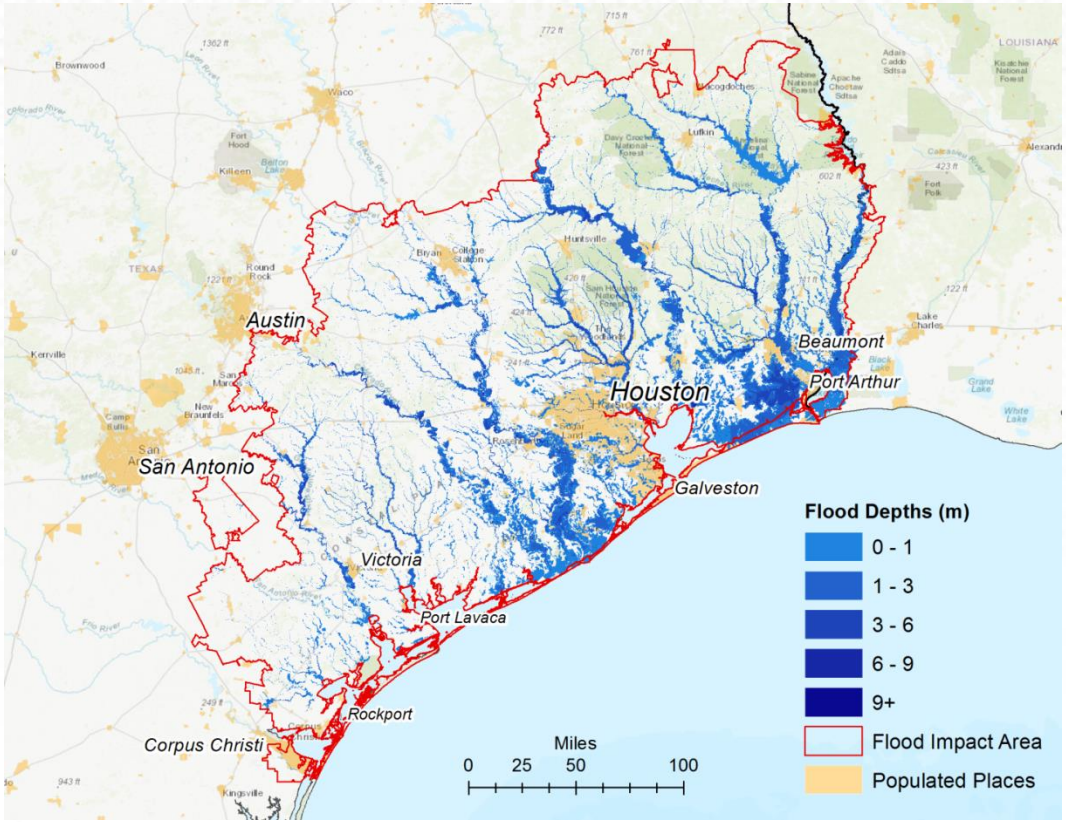


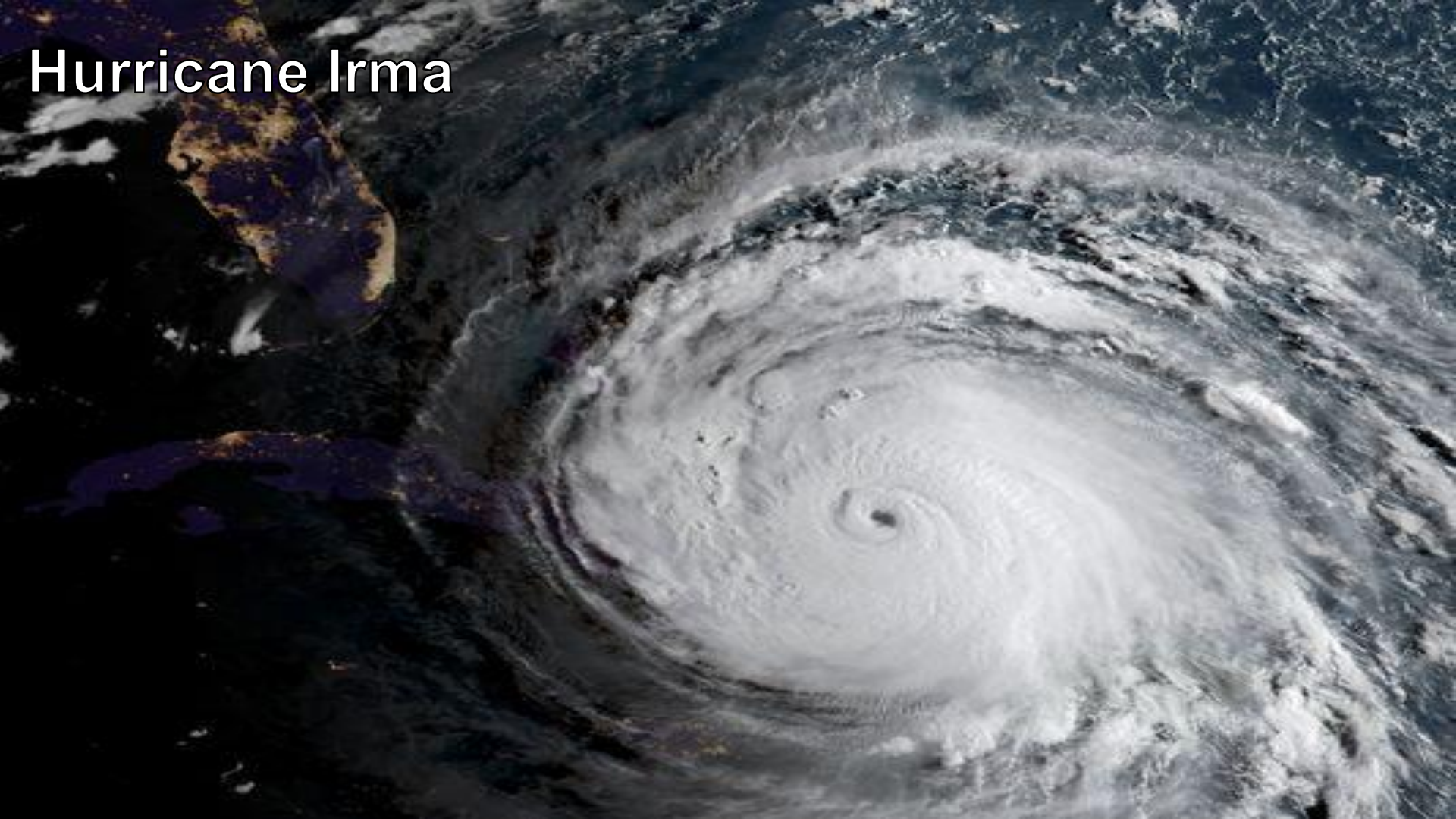


Overview of the **A**IR **L**oss **E**stimation in **R**eal-**T**ime (ALERT) Process for U.S. Hurricanes



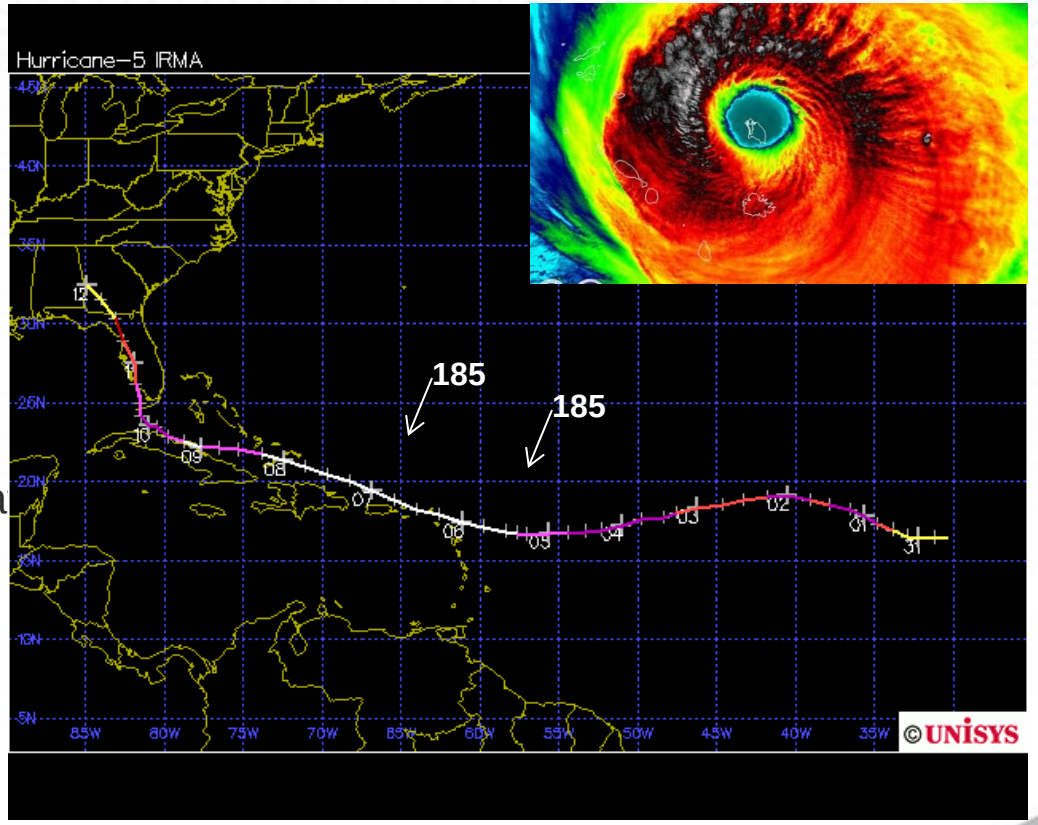
AIR's Harvey Flood Footprint




Hurricane Irma

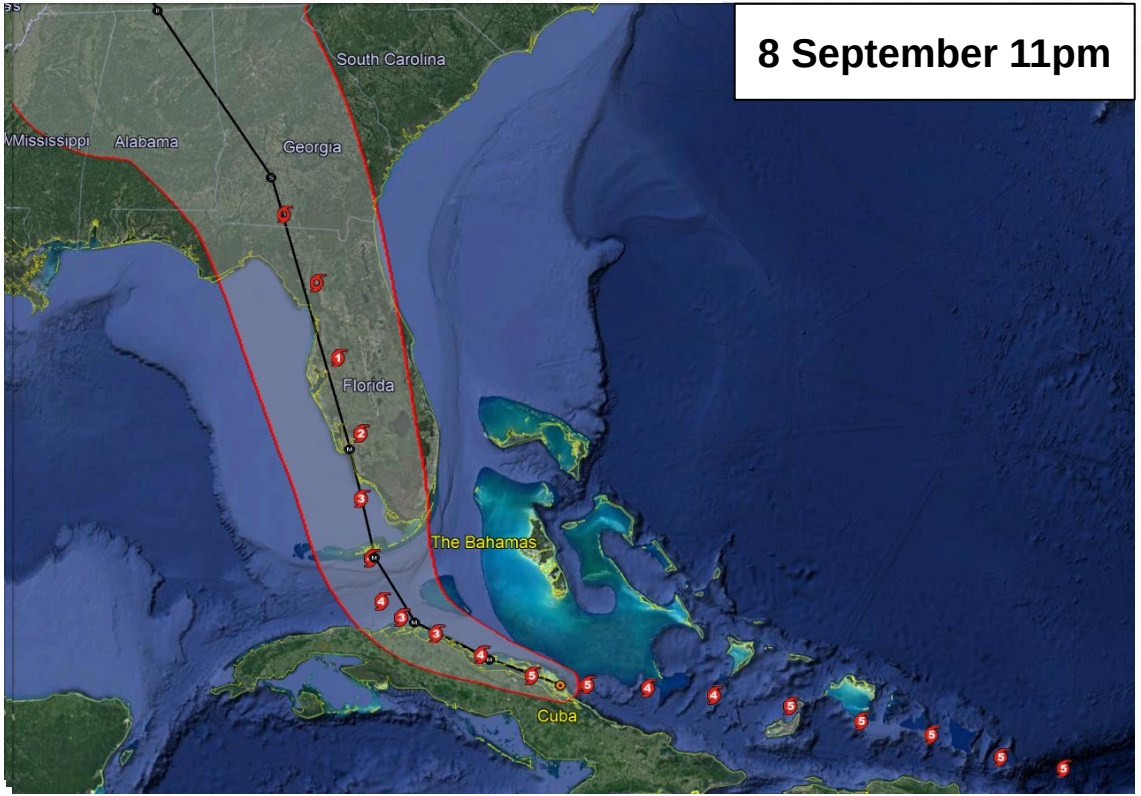
Irma Was Noteworthy Because of Its Intensity

- Second-most intense (max. sustained wind) TC ever in the Atlantic (Allen 1980
- Second-highest ACE - 67.5 ever for an Atlantic storm (Ivan 2004)
- 185 mph winds for 37 straight hours also set world record for longest at that intensity
- First time US hit by two Cat 4's in ~2 week period



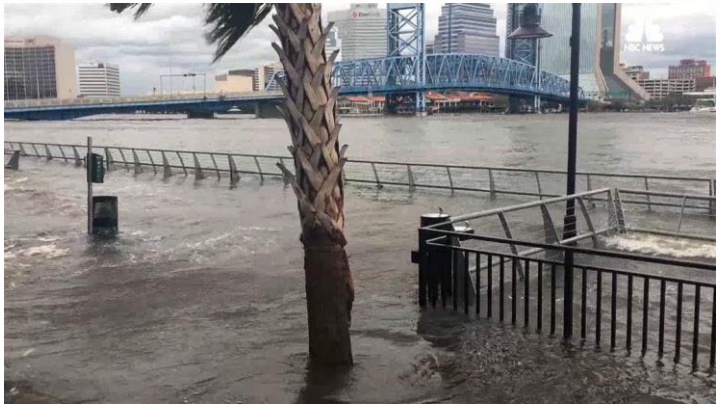
Irma Forecasts Were Quite Good

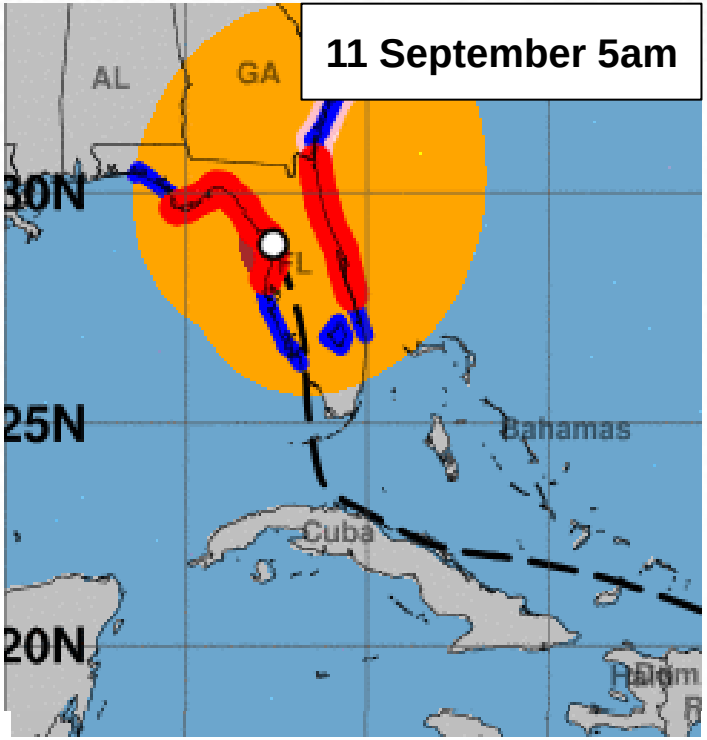
- Initially a worst-case scenario for South Florida
- Forecast tracks shifted landfall from Florida Atlantic to Gulf coasts
- Track fell within cone of uncertainty
- Three days before landfall, cone is twice a wide as Florida
- As wide as Florida one day prior



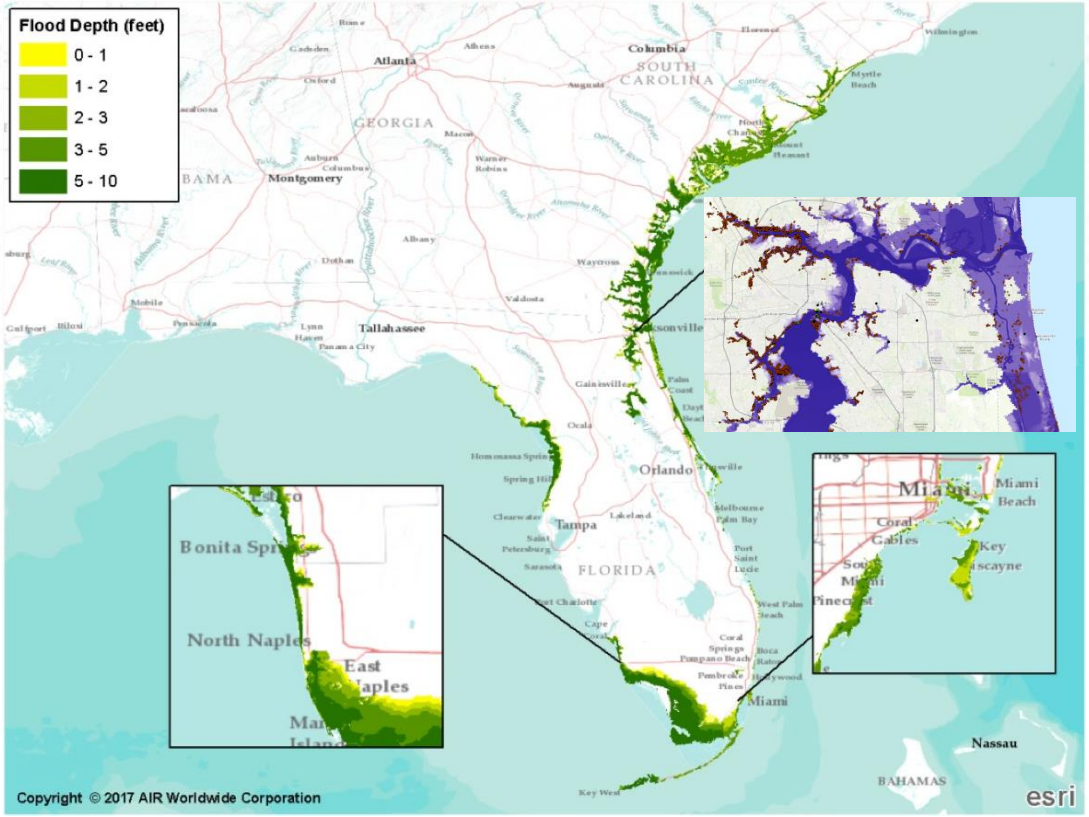
Irma's Wind Field Grew Large

- As Irma made landfall in southwest Florida, its wind field expanded
- Storm surge impacted Atlantic coast
- Flooding in Jacksonville, FL

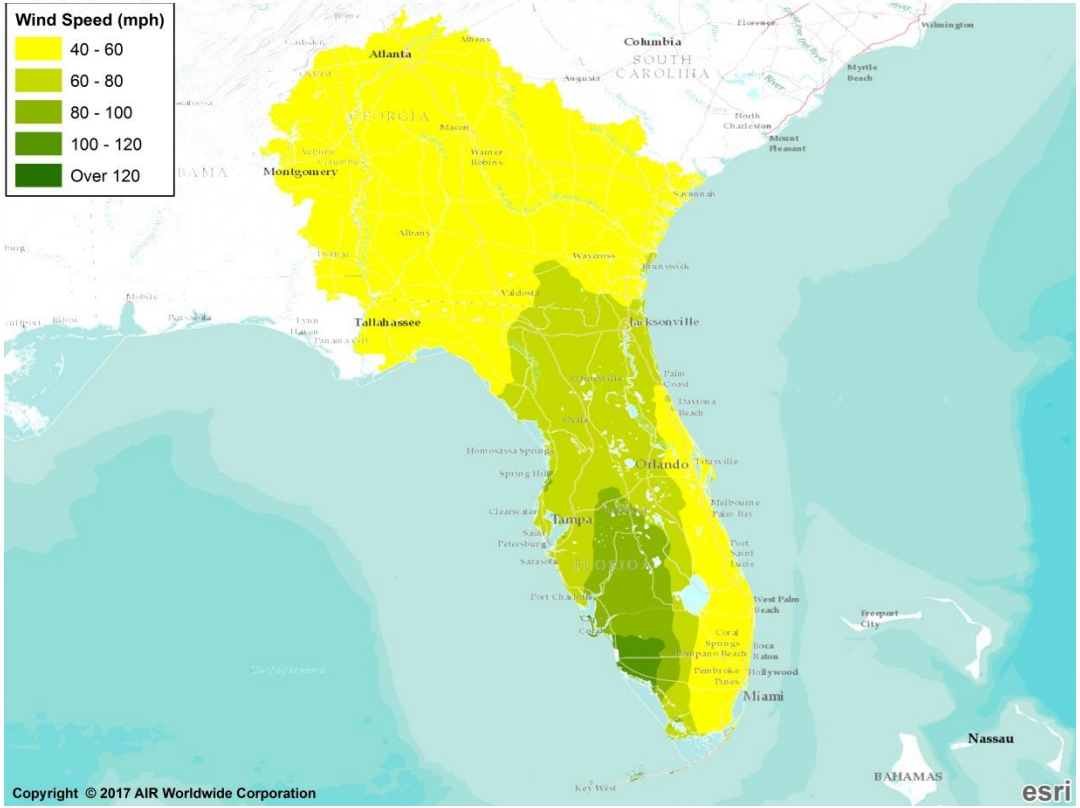




AIR's Irma Surge Footprint



AIR's Irma Wind Field Footprint



Is this a Sign of Global Climate Change?

- Physical arguments
  - Higher sea surface temperature
  - Warmer atmosphere holding more moisture
  - More very intense hurricanes

- Practical counter arguments
  - “One season (or 5) does not a climate change argument make”
  - Recent lull in activity (the “drought”)
  - Global TC activity below average in 2017

Damage Assessment and Modeled Losses

Oceanfront home in Big Pine Key, Florida, with significant wind damage from 2017 Hurricane Irma

AIR

Collateral wind damage to properties in Marathon, Florida

AGENDA

I. Learnings from Damage Surveys for Hurricanes Harvey and Irma

II. General Impacts from the Hurricanes

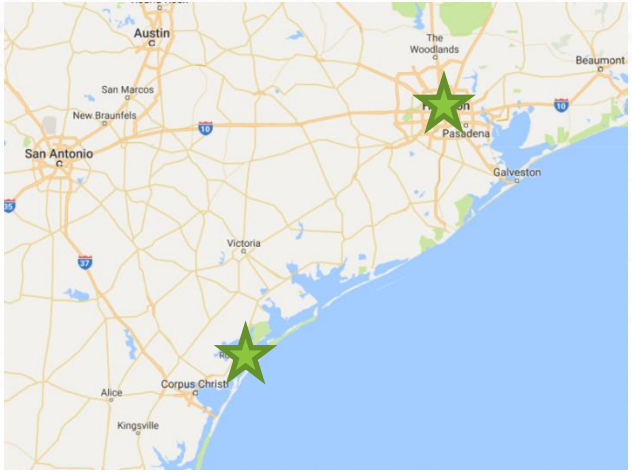
III. AIR's View of Industry Loss Estimates from Hurricanes Harvey and Irma

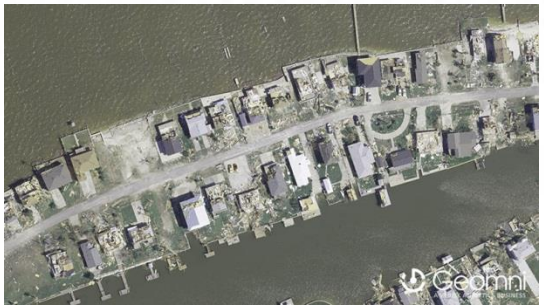
Learnings from Damage Surveys

Wind Damage
Flood (and Storm Surge) Damage

Near total destruction of a single-family home from Hurricane Harvey in Key Allegro, Rockport, Texas

Surveyed Areas





Naples, FL

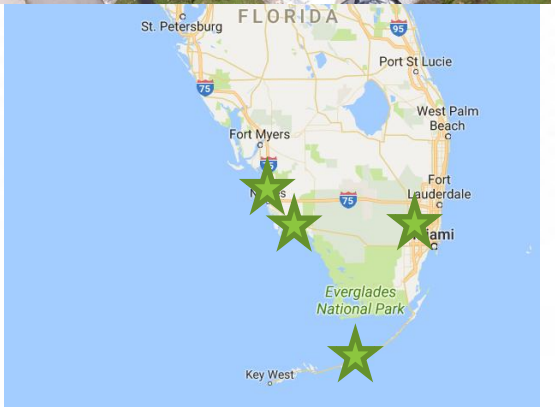
Everglades City, FL

Miami, FL

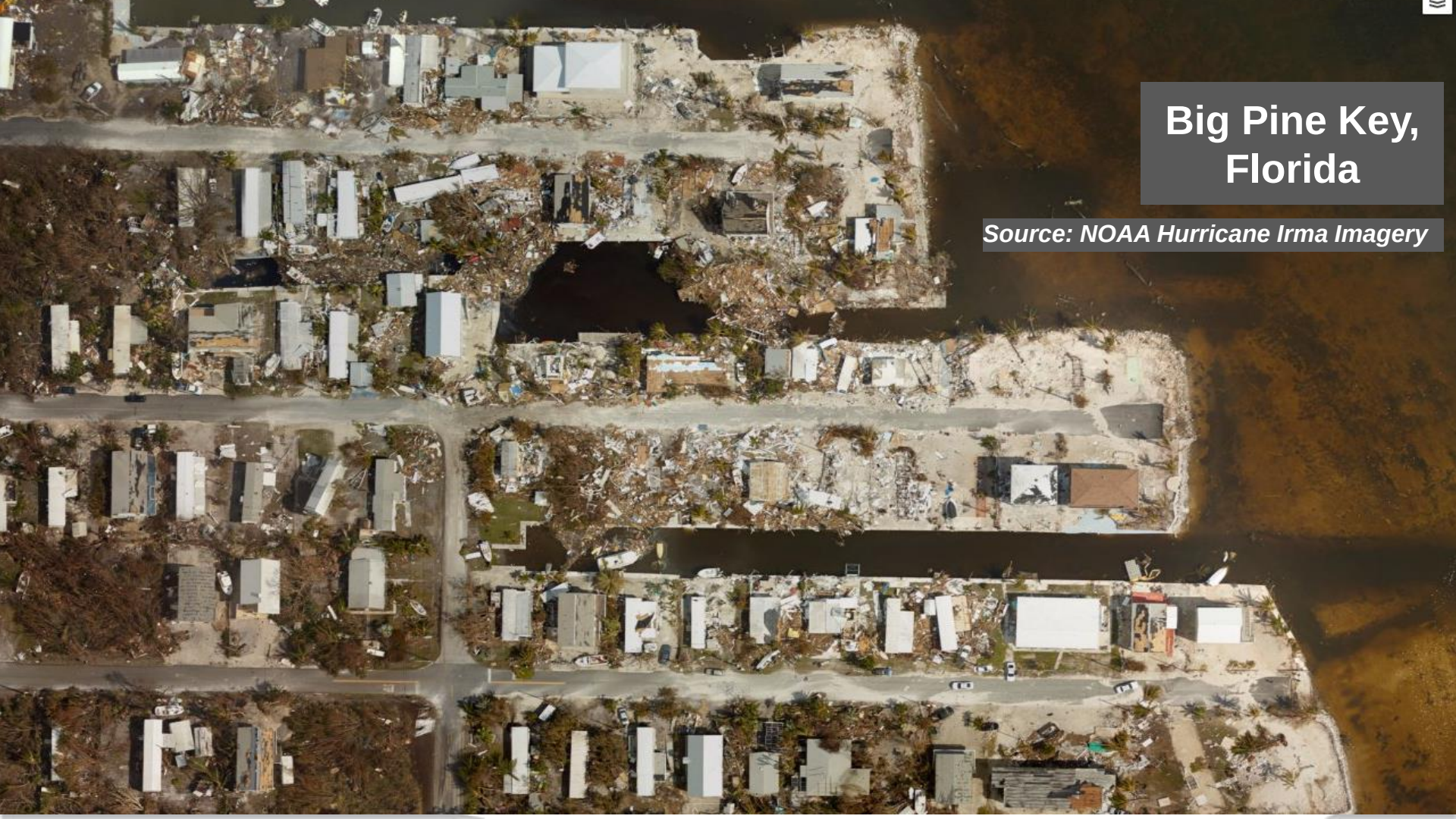
Florida Keys

Rockport, TX

Houston, TX



Courtesy: Geomni


Big Pine Key, Florida
Source: NOAA Hurricane Irma Imagery

There Is Nothing Homogeneous About Single- and Multi-Family Homes

Fundamental damage mechanisms that lead to significant damage in residential structures:

Cudjoe Key, FL

Internal pressurization due to envelope breach

Key Allegro, Rockport, TX

Lack of continuous load path

Little Torch Key, FL

Structural failure of roof structures – connection and gable ends

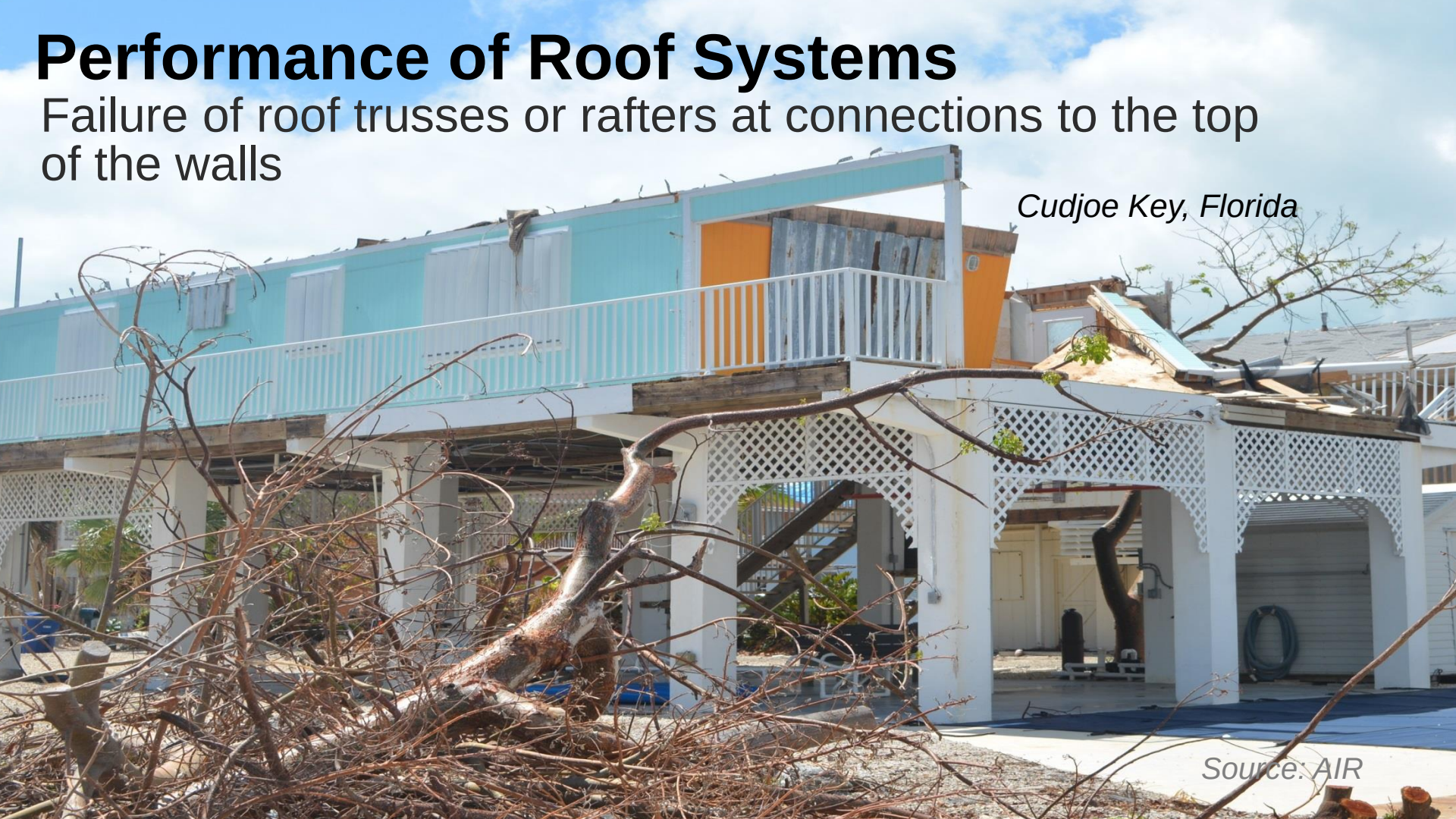
Performance of Roof Systems

Roof sheathing failure due to inadequate connections to the underlying framing

Source: AIR

Performance of Roof Systems

Failure of roof trusses or rafters at connections to the top of the walls



Cudjoe Key, Florida

Source: AIR

Performance of Roof Systems

Collapse of gable end walls

Rockport, Texas

Source: AIR

Performance of Roof Cover Types

- Metal panel roofs performed better than asphalt shingles or tiled roofs
- Significant damage was seen to roofs with shingles and clay/concrete tiles
- Mortar- and adhesive-set, mechanically attached clay tile roofs all suffered similar levels of damage

Marco Island, Florida

Big Coppitt Key, Florida

Source: AIR

Performance of Roof Cover Types

Clay tile roof cover damage

Rockport, Texas

Big Coppitt Key, Florida

Plantation Key, Florida

Source: AIR

Source: AIR

Metal Panel Roofs

- Success or failure of the metal roof coverings depends upon the fastener spacing and type, and the panel gauge
- Screws provided greater pull-out resistance than ring-shank nails

Marathon, Florida

Damage to soffits was most common in metal panel roofs

Summerland Key, Florida

Lower Sugarloaf Key, Florida

Source: AIR

Marco Island, Florida

Source: AIR

Poor performance of attached structures such as pool enclosures also caused damage to the main building

Marco Island, Florida

Source: AIR

Poor performance of attached structures such as pool enclosures also caused damage to the main building

Garage Door Failures

Cudjoe Key, Florida

Summerland Key Cove Airport, Florida

Source: AIR

Significant Wind Damage to Condominiums

Source: AIR

Building Code Implications from Florida

- Newer buildings adhering to the Florida Building Code performed better than older buildings
- Variability in the level of opening protection in Monroe County; almost 100% opening protection in Miami-Dade County
- Continued presence of unreinforced masonry

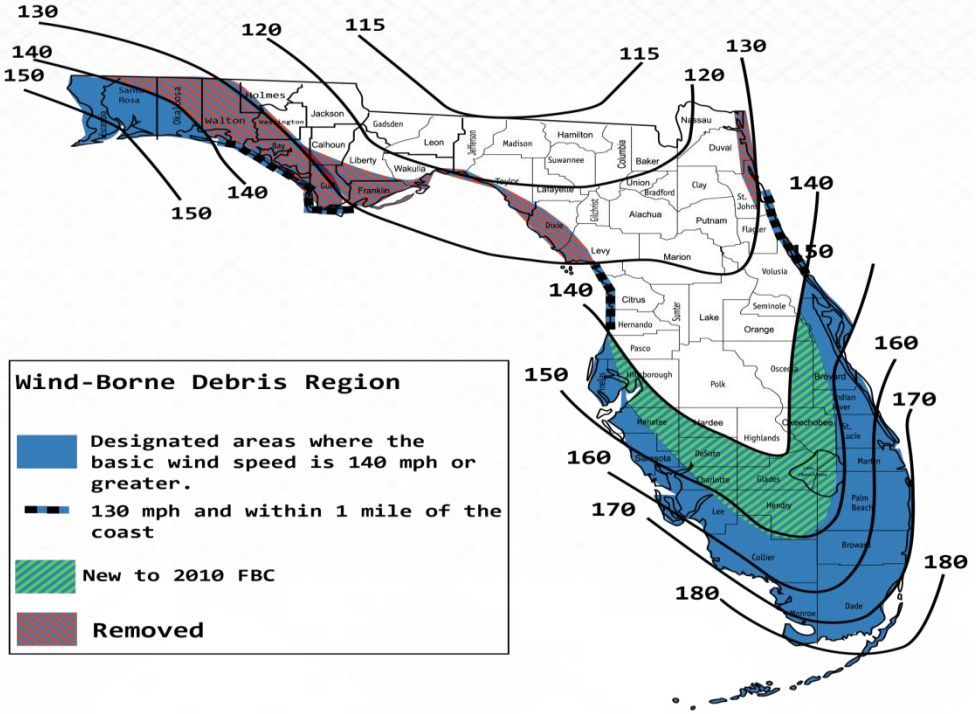


Figure 1609A Wind-Borne Debris Region, Category II and III Buildings and Structures except health care facilities

Source: AIR

Complete Destruction of Manufactured Homes in Several Parks

Cudjoe Key, Florida

Surge Performance of Residential Single- and Multi-Family Homes

Islamorada, Florida

Source: AIR

Slab foundations were poor performers

Building Codes Can Minimize Surge Damage

Big Pine Key, Florida

- First floor elevated sufficiently above ground
- Elevation of service equipment

Upper Sugarloaf Key, Florida

Source: AIR

AIR

Significant Wind Damage to a Wide Variety of Commercial and Industrial Buildings

Glazing damage to a high rise commercial building on Brickell Avenue, Miami, Florida

Damage to a metal panel roof of an office building in Rockport, Texas

Source: AIR

Damage to Hotels

Key West, Florida

Source: AIR

Damage to Churches

Key West, Florida

Source: AIR

Damage to roof, architectural features, and openings—including expensive stained glass windows

Gas Stations Are Some of the Most Vulnerable Structures

Source: AIR

Wind Damage to Industrial Buildings

- Damage to roof, metal panel wall sidings, openings, machinery
- Significant damage to contents and associated business interruption

Source: AIR

Damage Was Not Restricted to Residential and Commercial Buildings

Electric substation in Big Pine Key, FL suffered major damage

Damage to a concrete plant in Big Pine Key, FL

Source: AIR

Flood Damage to Commercial Buildings

Source: AIR

Chase Bank Branch in Downtown Houston

Flood Damage to Commercial Buildings

Flooded restaurant in Downtown Houston

Retail store damaged due to storm surge in Key West

Source: AIR

Damage to Automobiles

Summerland Key, Florida

Sugarloaf Key, Florida

Houston, Texas

Source: AIR

Damage to Pleasure Boats and Aircrafts

Damage to aircrafts at the Marathon Airport, Marathon, FL

Source: AIR

A Look at General Impacts and Losses from Hurricane Harvey

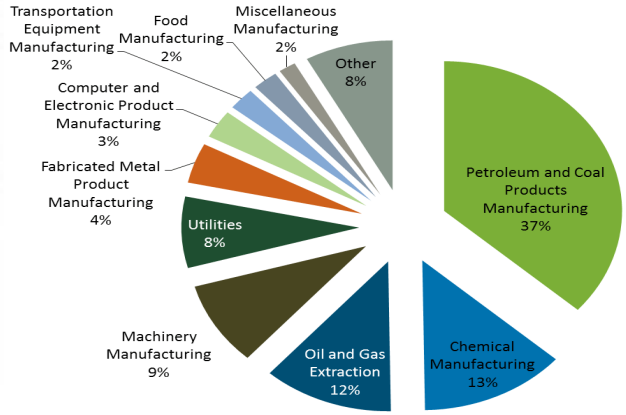
AIR

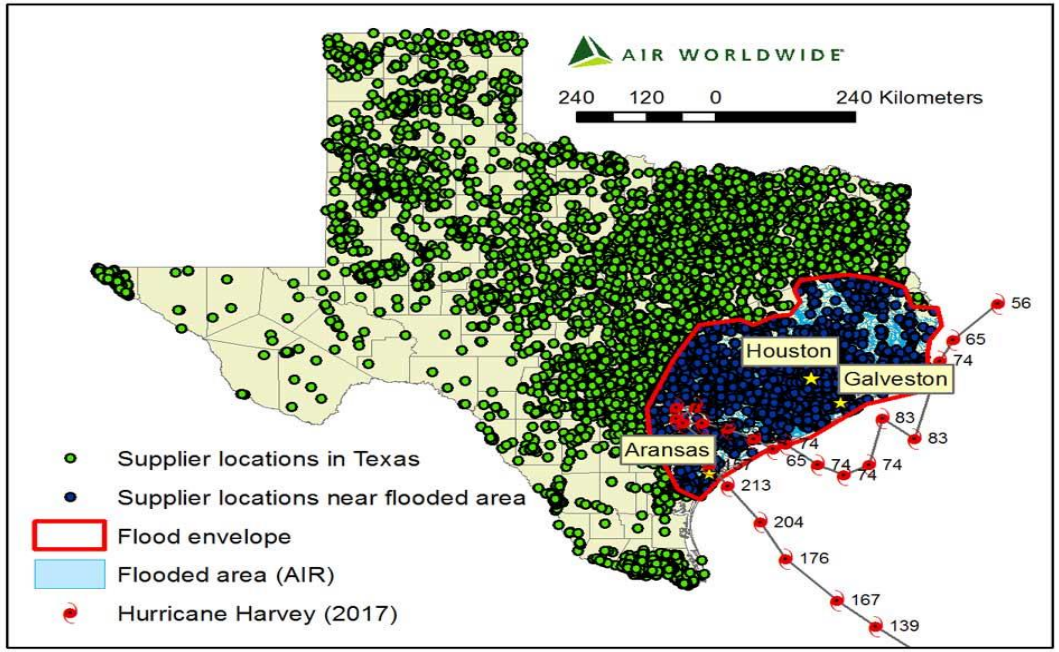
Damage from Hurricane Harvey exacerbated by rapid urbanization in the Houston area

Courtesy: David J. Phillip, AP

Potential Supply Chain Disruptions from Hurricane Harvey

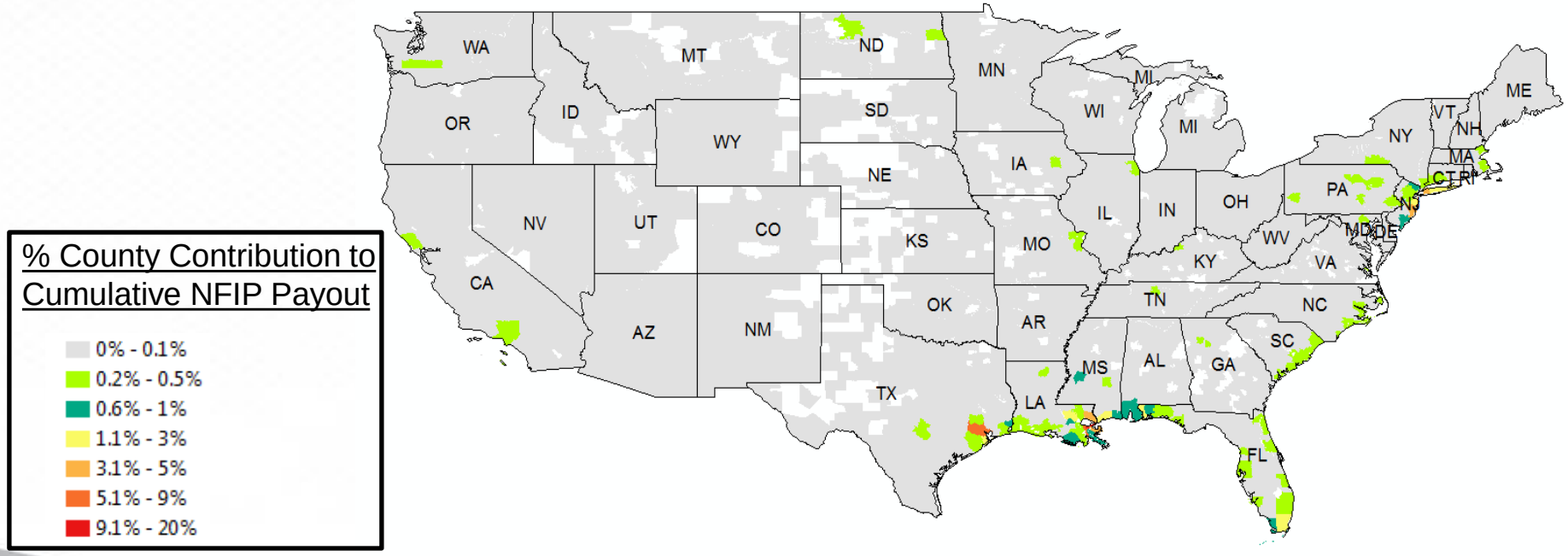
Global and local contingent BI from Harvey remain to be seen





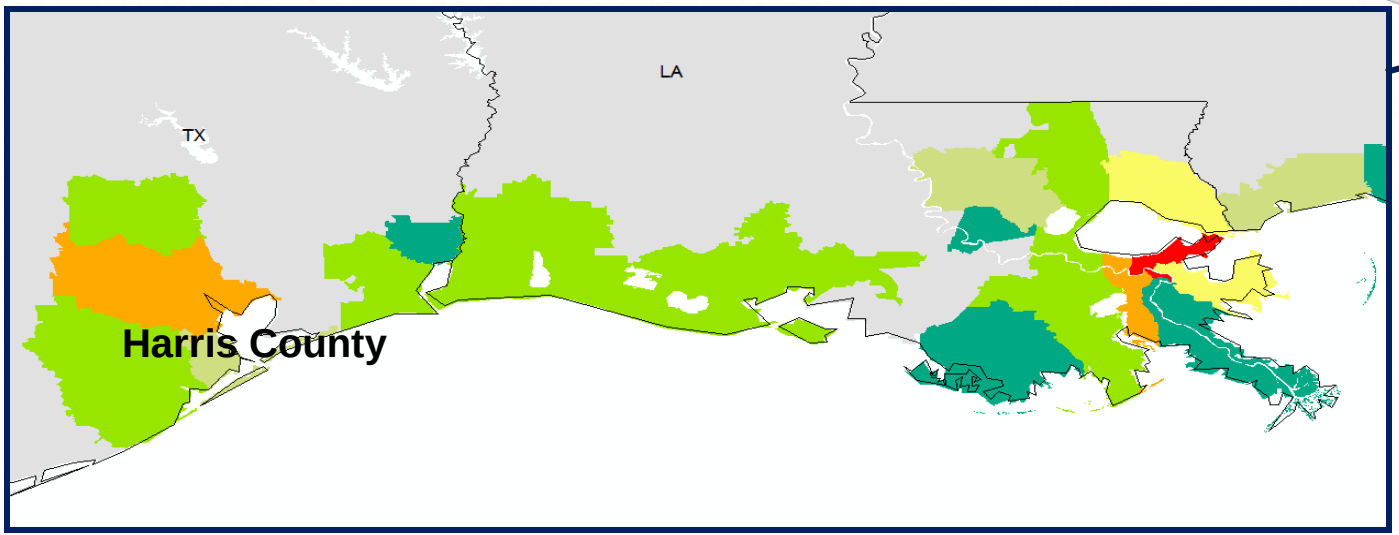
Harris County, Texas, Is Among the Highest Flood Risk Counties in the United States

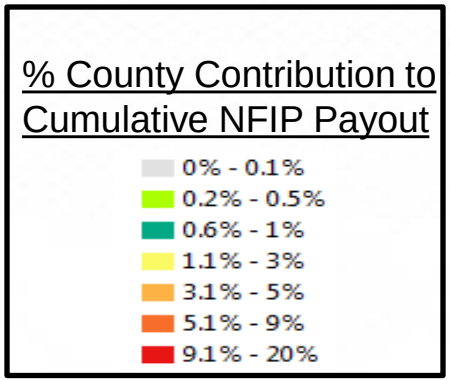
Cumulative NFIP payout from 1978 through July 31, 2017



Harris County, Texas, Is Among the Highest Flood Risk Counties in the United States

Harris County ranks #3 in terms of highest NFIP payout





AIR's View of Industry Insurable Flood Loss Estimates

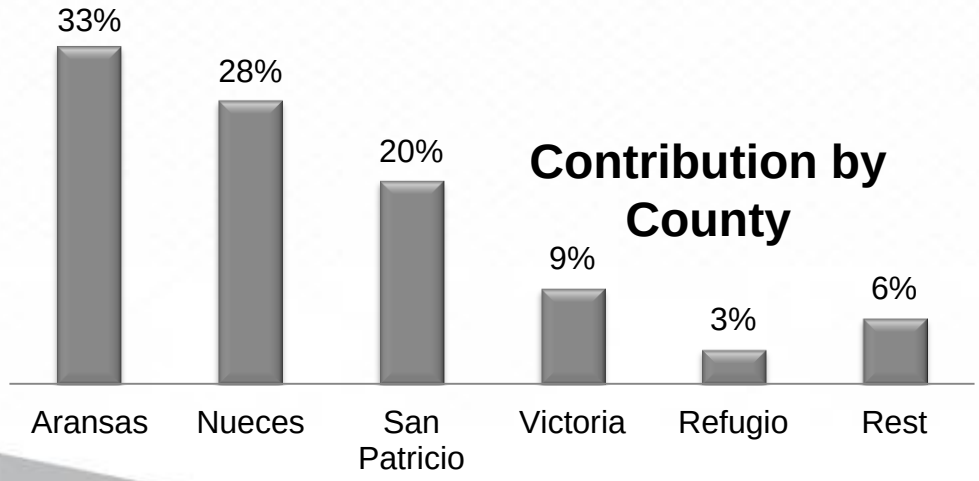
- AIR estimates that property losses from the flooding in Texas caused by Hurricane Harvey's record-breaking rainfall will be between USD 65 billion and USD 75 billion
- These figures include damage to all properties eligible for coverage regardless of whether they are actually insured and without any application of deductibles or limits

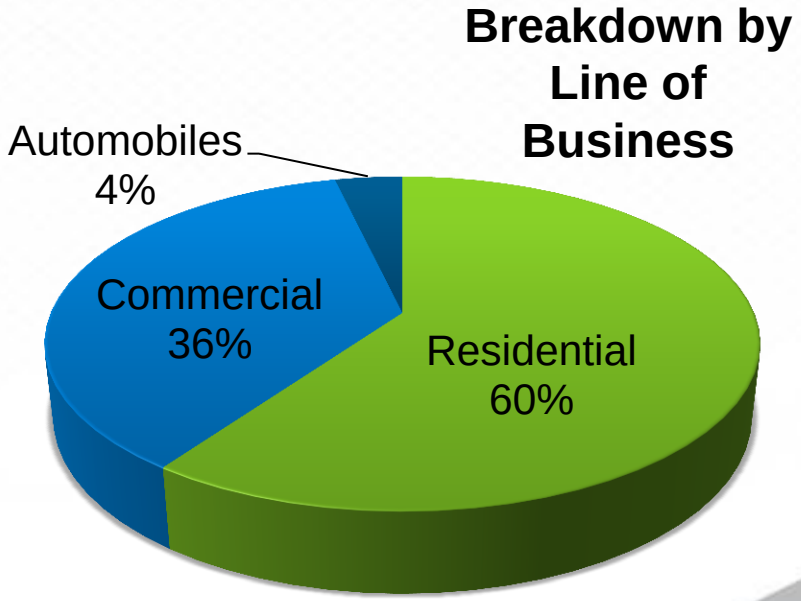
AIR's View of Industry Insured Loss Estimates from Hurricane Harvey

Industry insured wind and storm surge gross loss range with demand surge

USD 1.2 – 2.3 Billion

Surge Contribution
<0.5%



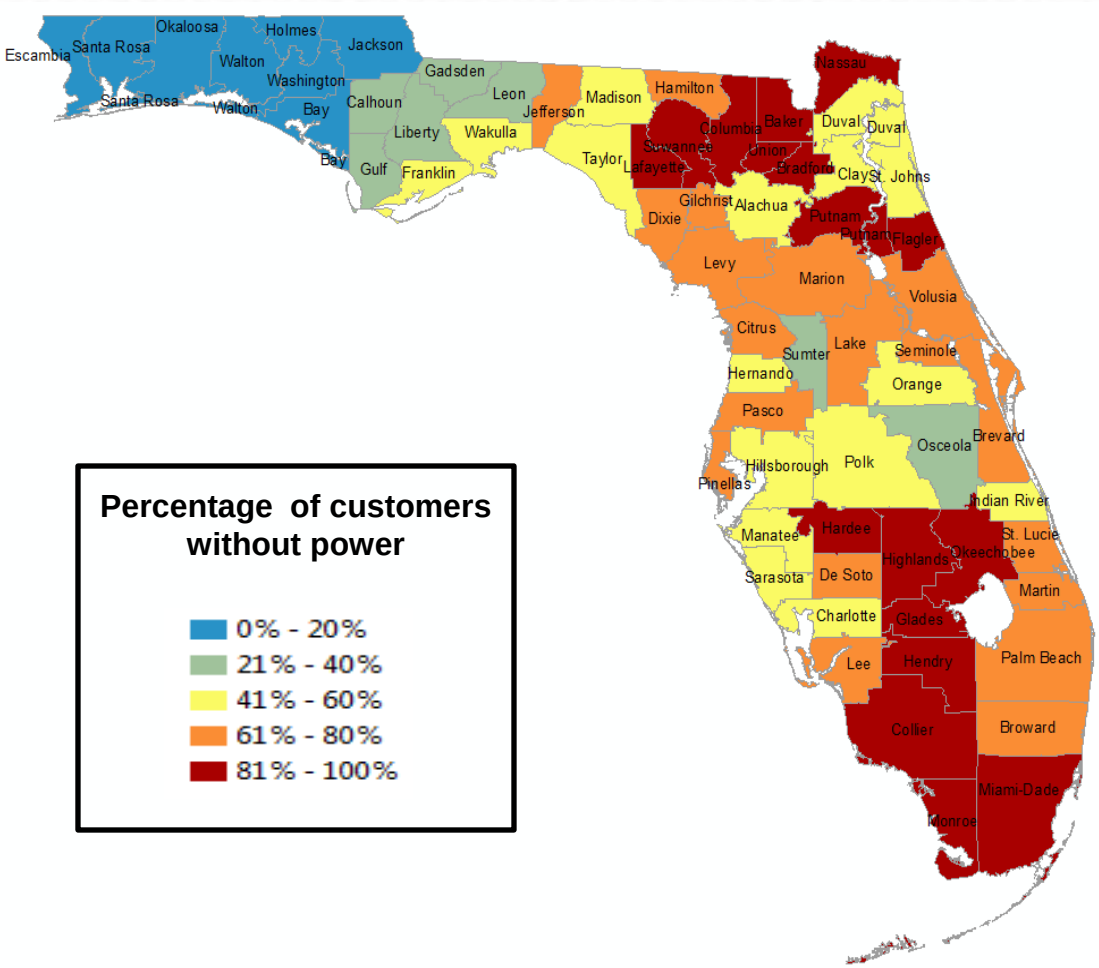


A Look at General Impacts and Losses from Hurricane Irma

AIR

Florida Power Outages At the Height of Irma

Approximately 6.7 million customers were without power on Monday, September 11

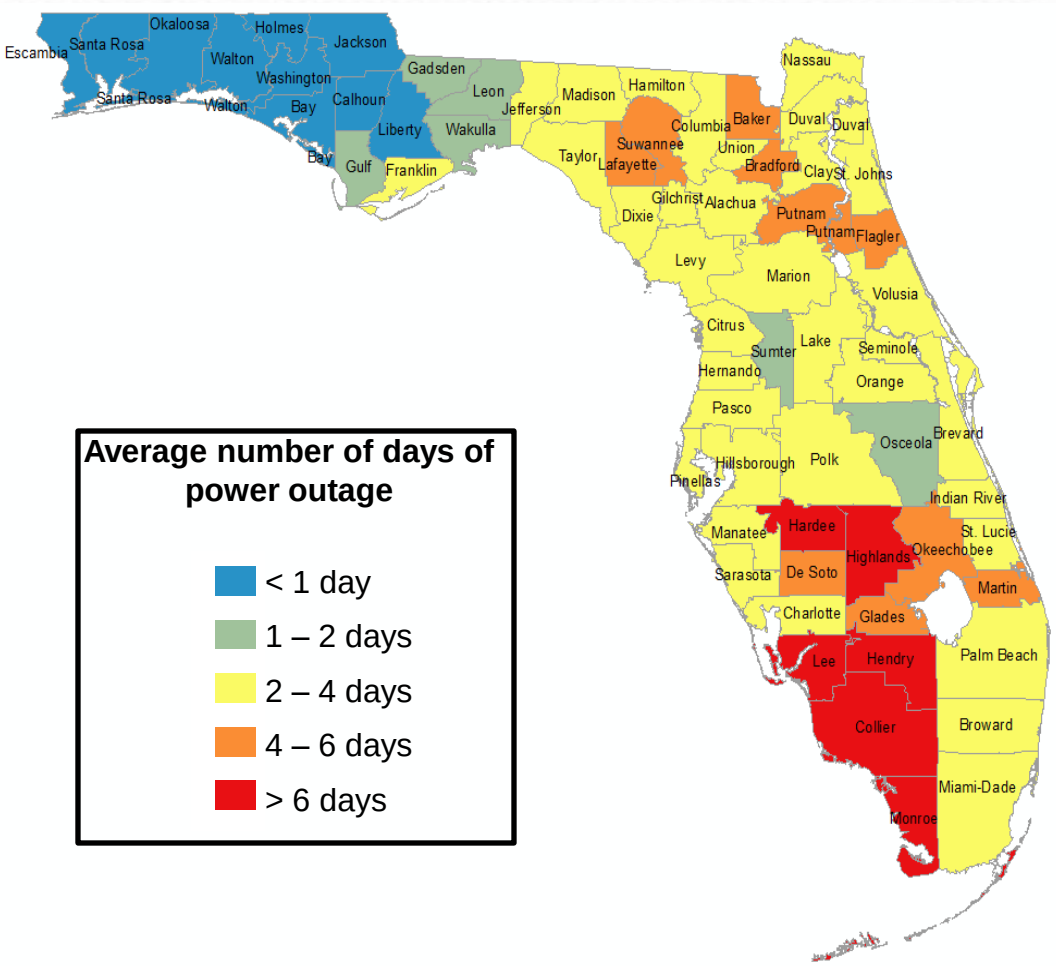


Source: www.floridadisaster.org

Florida Power Outages at the Height of Irma

Six out of 67 Florida counties experienced a power outage of greater than six days

- Monroe
- Highlands
- Collier
- Hendry
- Lee
- Hardee

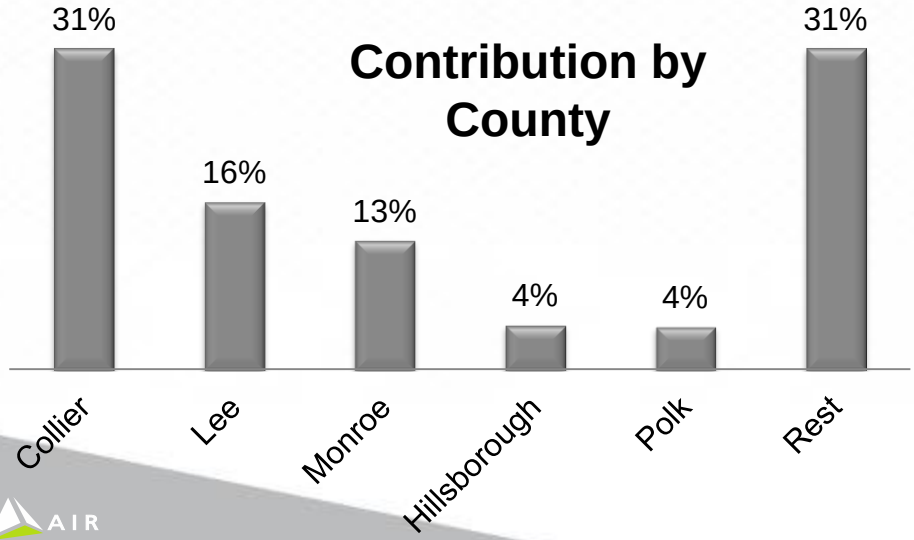


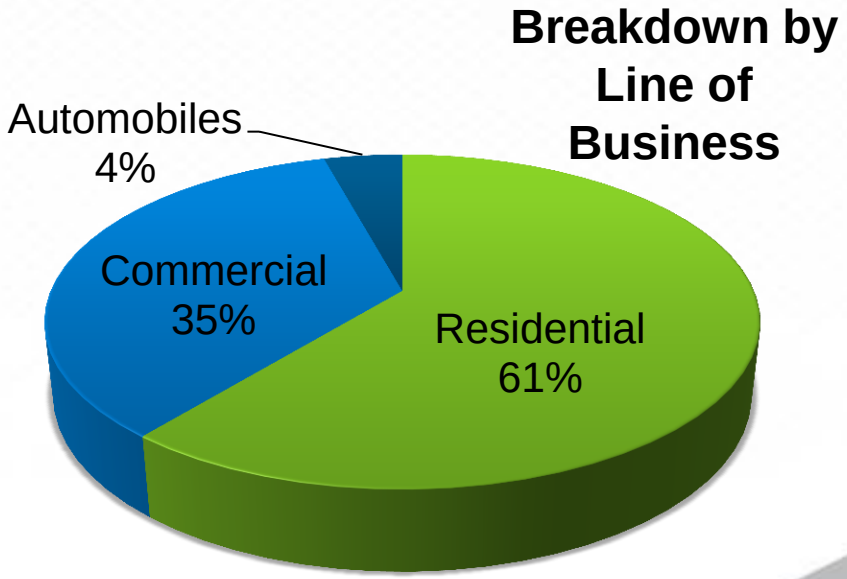
AIR's View of Industry Insured Loss Estimates from Hurricane Irma in U.S. Mainland

Industry insured wind and storm surge gross loss range with demand surge

USD 24.5 – 35.6 Billion

Surge Contribution
6.5%





What's Next?

Link to recording will be emailed to all webinar attendees

Learn about the impact of hurricanes Irma and Maria on the Caribbean, and the overall 2017 hurricane season, during our second installment in early December

Stay tuned for more details!