

# Avoiding Catastrophe

How IBHS science is turning risk into resilience

Sarah Dillingham  
Sr. Director for Product Design  
Senior Meteorologist



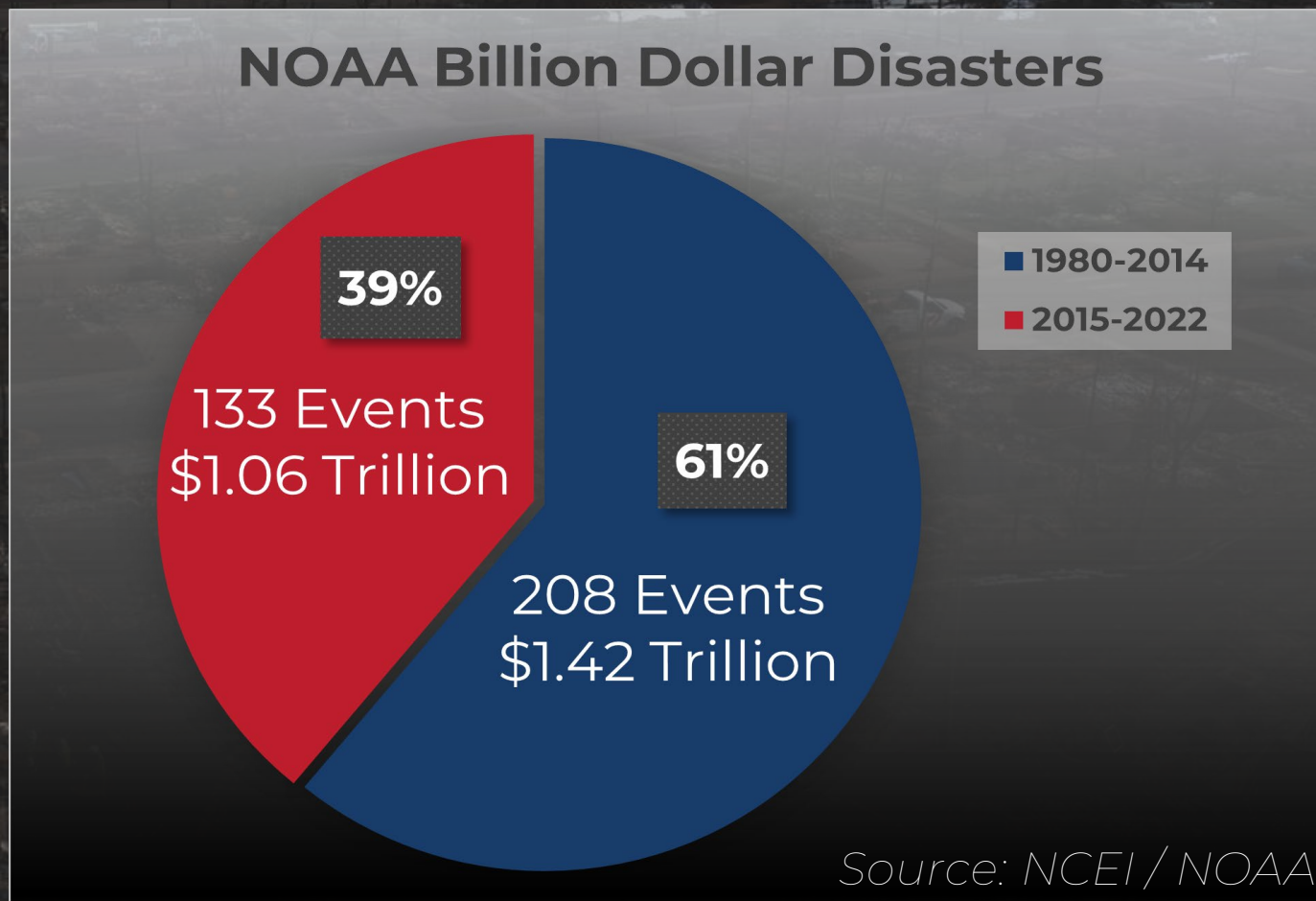
Insurance Institute for  
Business & Home Safety



Insurance Institute for Business & Home Safety

# The Growing Cost of Disasters

1980-2022  
**341**  
BILLION DOLLAR  
DISASTERS



Hurricane Laura (2020)

Hurricane Delta (2020)

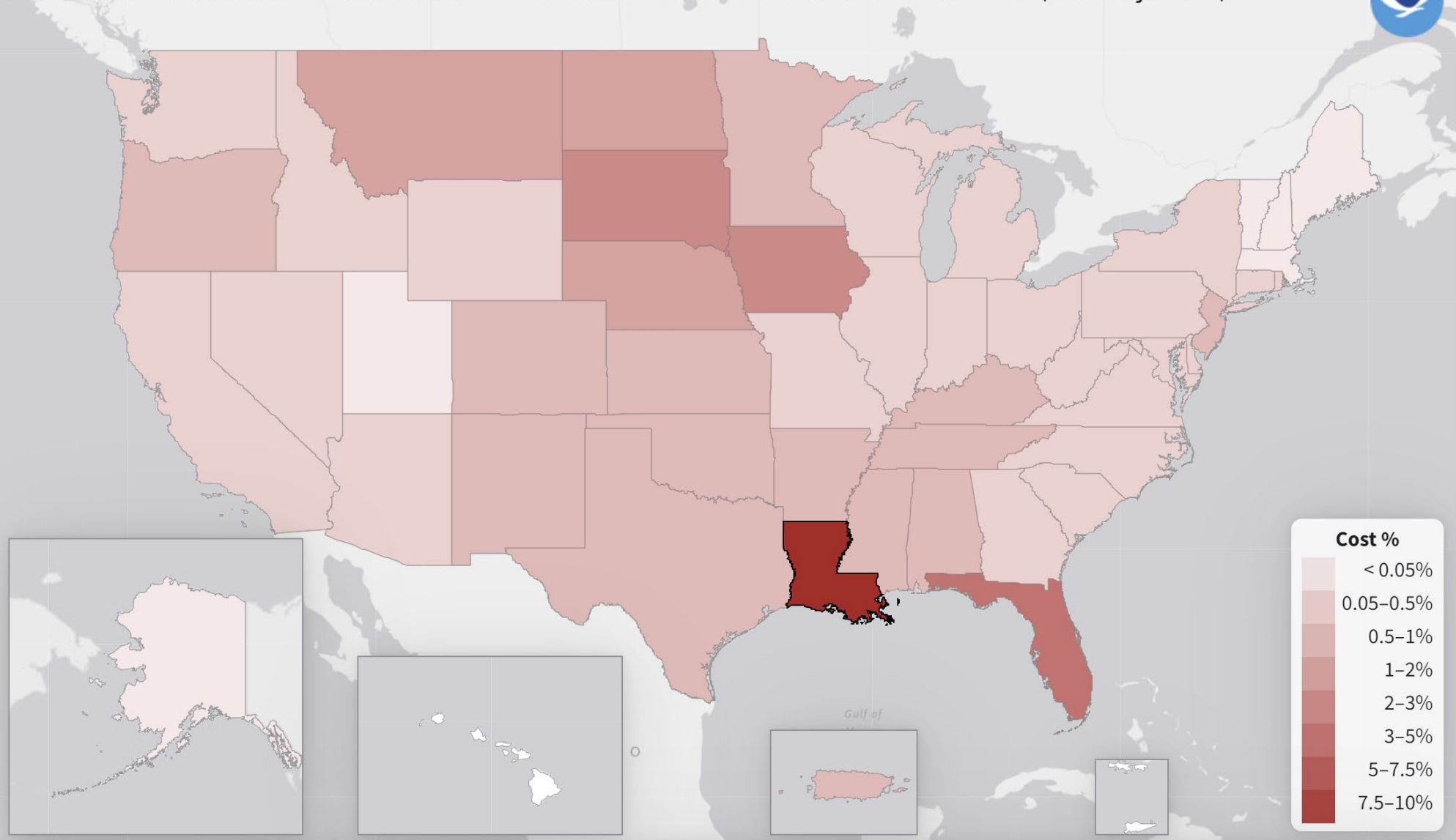
Hurricane Ida (2021)

Hurricane Zeta (2020)

08-29-2021 02:27:24 UTC



# 2020-2022 Billion-Dollar Weather and Climate Disaster Cost as % of State GDP (CPI-Adjusted)



## Louisiana

Drought:	< 0.05%	Flooding:	0.05–0.5%	Freeze:	0%	Severe Storm:	0.05–0.5%
Tropical Cyclone:	7.5–10%	Wildfire:	0%	Winter Storm:	0.05–0.5%	All Disasters:	10–12.5%

The images of loss and displacement are all too familiar...

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SEVERE  
WEATHER  
DRIVES LOSS

DAMAGE

DISRUPTION

DISPLACEMENT

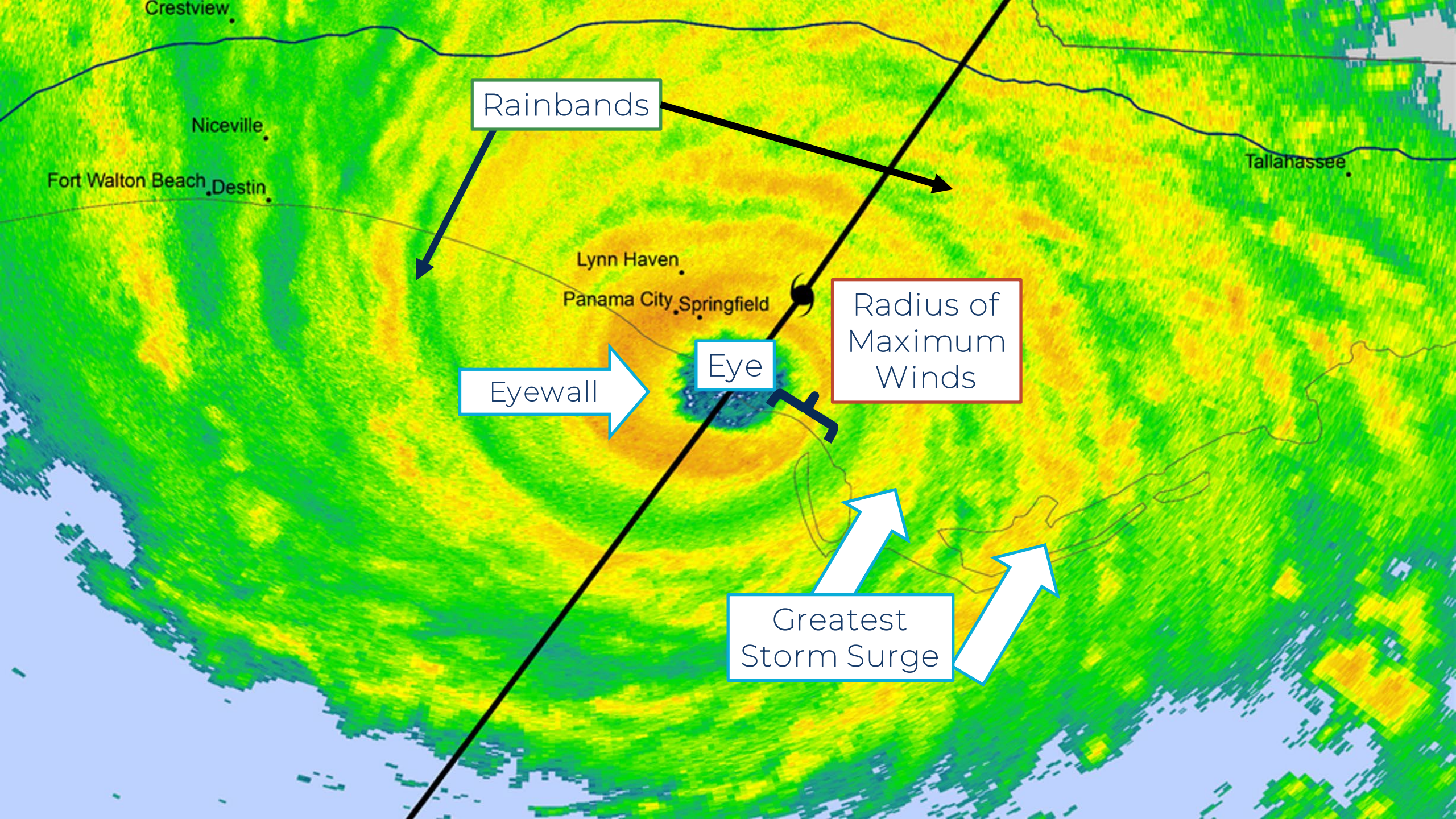
REBUILD



How do  
we break  
the chain ?

# Storm surge Freshwater flooding Wind





Rainbands

Eyewall

Eye

Radius of  
Maximum  
Winds

Greatest  
Storm Surge

Crestview


Niceville

Fort Walton Beach  
Destin

Lynn Haven

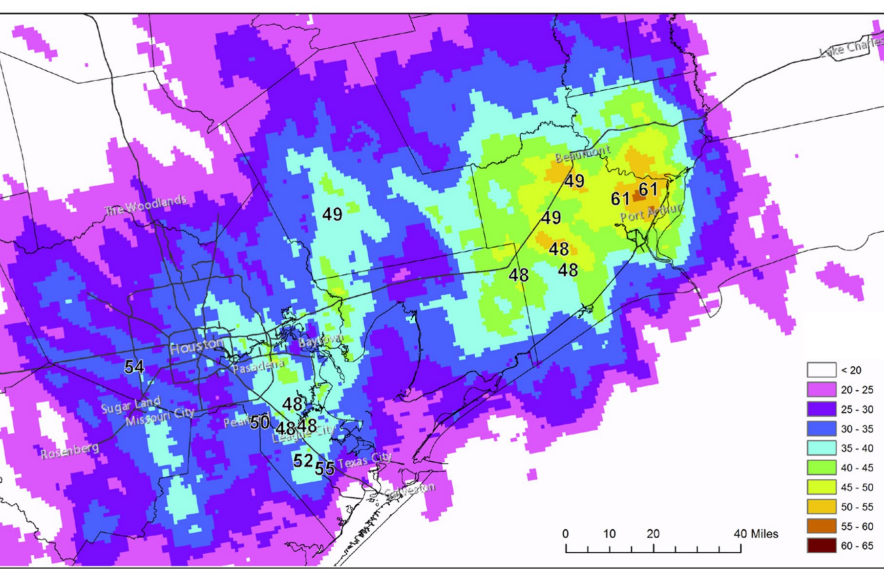
Panama City  
Springfield

Tallahassee

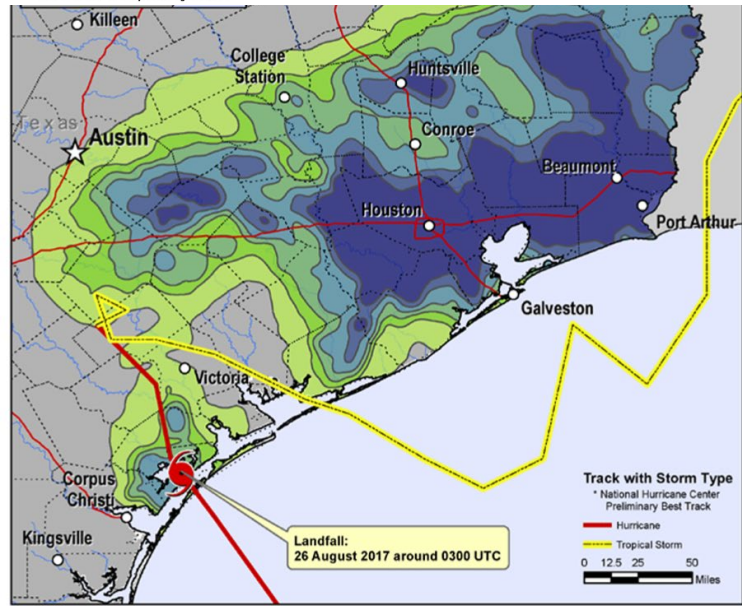
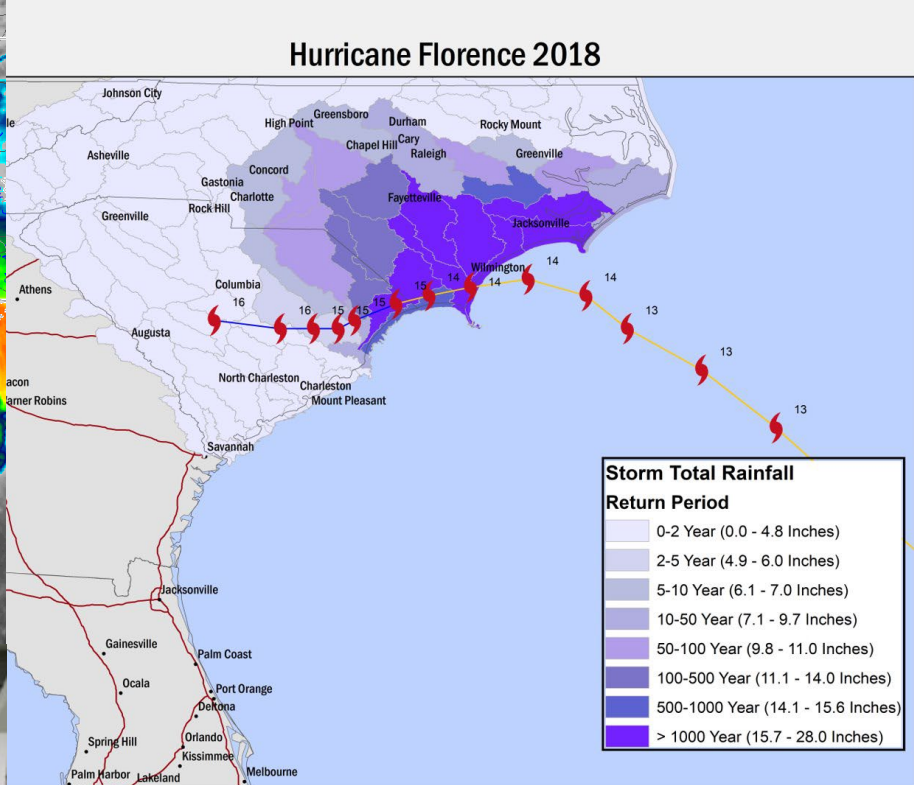
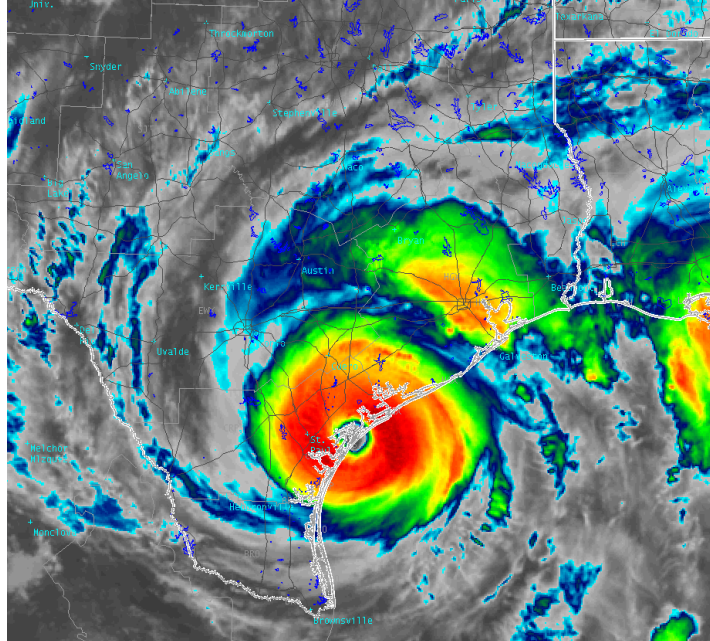
An aerial photograph showing the aftermath of a storm surge. The left side of the image is dominated by a large, dark, sandy area where buildings have been completely destroyed or buried under sand. A road runs diagonally from the top center towards the bottom right, separating the destroyed area from a more intact residential area on the right. The residential area shows many houses with damaged roofs and some debris scattered around. In the background, there are more buildings, some of which appear to be multi-story apartment complexes. The overall scene is one of significant destruction and flooding.

# Storm surge

Storm Size  
Intensity & duration  
Coastal bathymetry



NOAA gauge-corrected, multi-radar multi-sensor quantitative precipitation estimates for Harvey (inches), 25 August-1 September 2017. The black numbers are actual rain gauge values, all of which exceed the previous U.S. continental rainfall record for a tropical cyclone.

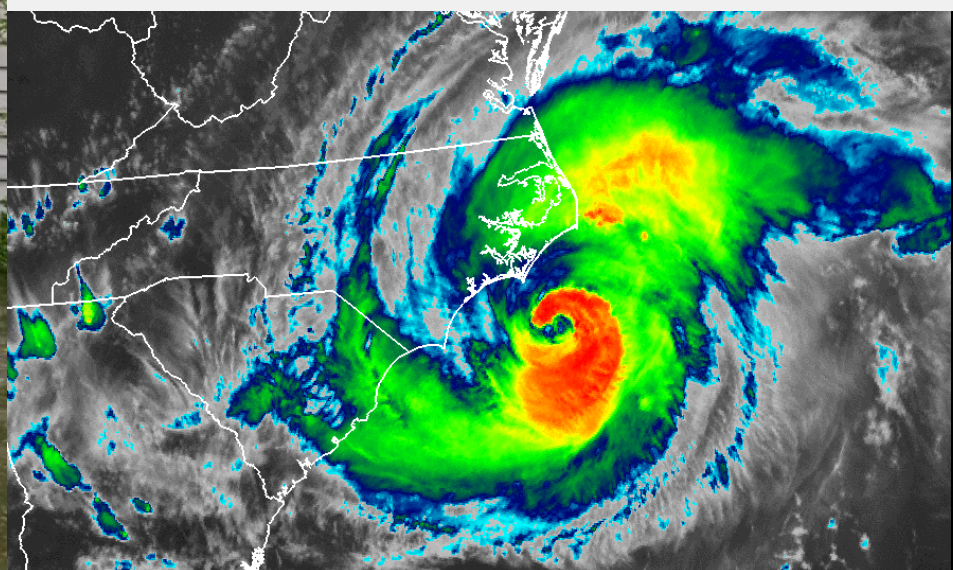


### Hurricane Harvey, 25 - 31 August 2017 Annual Exceedance Probabilities (AEPs) for the Worst Case 4-day Rainfall

Hydrometeorological Design Studies Center  
Office of Water Prediction, National Weather Service  
National Oceanic and Atmospheric Administration  
<http://www.nws.noaa.gov/ohd/hdsc/>

Created: 16 November 2017  
Rainfall frequency estimates are from preliminary NOAA Atlas 14, Volume 11, Version 1.  
Rainfall values come from 6-hour Stage IV data.

- > 1/10
- 1/50 - 1/10
- 1/100 - 1/50
- 1/200 - 1/100
- 1/500 - 1/200
- 1/1000 - 1/500
- < 1/1000

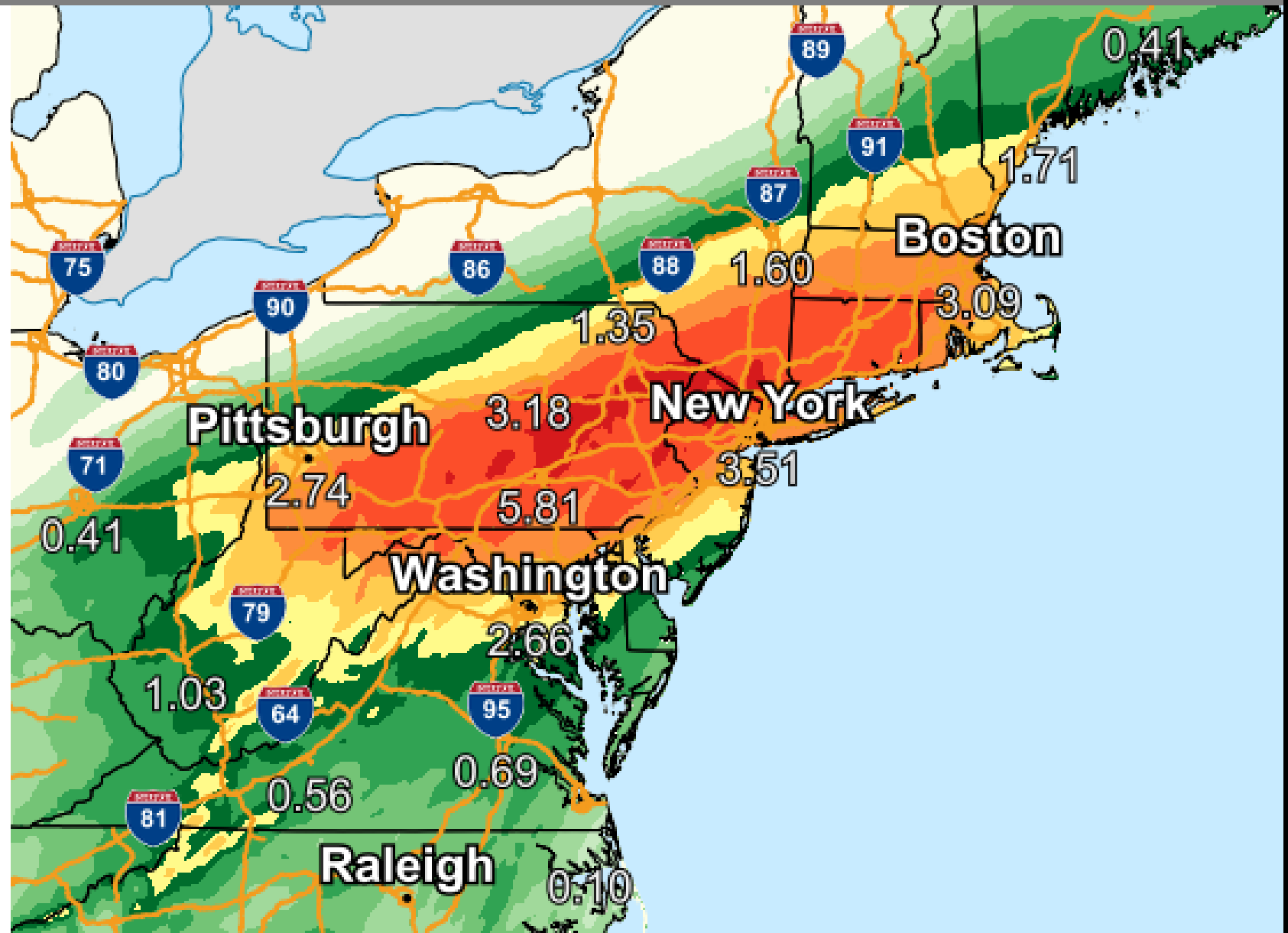




# Forecast Precipitation

Valid Ending Thursday September 2nd, 2021 at 8 AM EDT

- Up to 0.1 inch
- 0.1 to 0.25 inches
- 0.25 to 0.5 inches
- 0.5 to 1.0 inches
- 1.0 to 1.5 inches
- 1.5 to 2.0 inches
- 2.0 to 3.0 inches
- 3.0 to 4.0 inches
- 4.0 to 6.0 inches
- 6.0 to 8.0 inches
- 8.0 to 10.0 inches
- 10.0 to 15.0 inches
- 15.0 to 20.0 inches
- 20.0 to 30.0 inches
- 30.0 to 50.0 inches



Graphic Created  
September 1st, 2021  
4:57 AM EDT



# Forecast Precipitation

Valid Ending Thursday September 2nd, 2021 at 8 AM EDT

Select Northeast Rainfall Totals			
Midtown Manhattan, NY	7.49"	Hopewell Township, NJ	9.02"
Stamford, CT	8.10"	Ringoes, NJ	9.73"
Madison, CT	8.90"	Manville, NJ	10.06"
North Arlington, NJ	8.80"	Downingtown, PA	10.10"
Cranford, NJ	9.05"	Coatesville, PA	9.02"
Newark Airport, NJ	8.44"	Hatfield, PA	8.41"
Wilmington, DE	5.86"	Farmington, CT	6.27"
East Sandwich, MA	6.87"	Portsmouth, RI	8.32"
Whitman, MA	6.60"	Newport, RI	6.55"

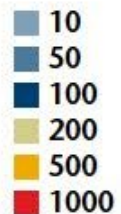
Graphic Created  
September 1st, 2021  
4:57 AM EDT



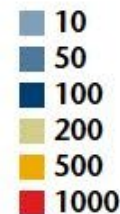
# Hurricane Ida: Rainfall Return Period (RP)

Data: NOAA  
Graphic: @SteveBowenWx; Aon

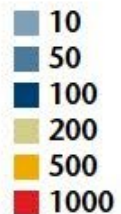
Sep 2, 2021  
3-Hour RP



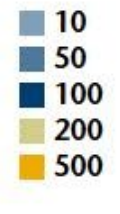
Sep 2, 2021  
6-Hour RP



Sep 2, 2021  
12-Hour RP

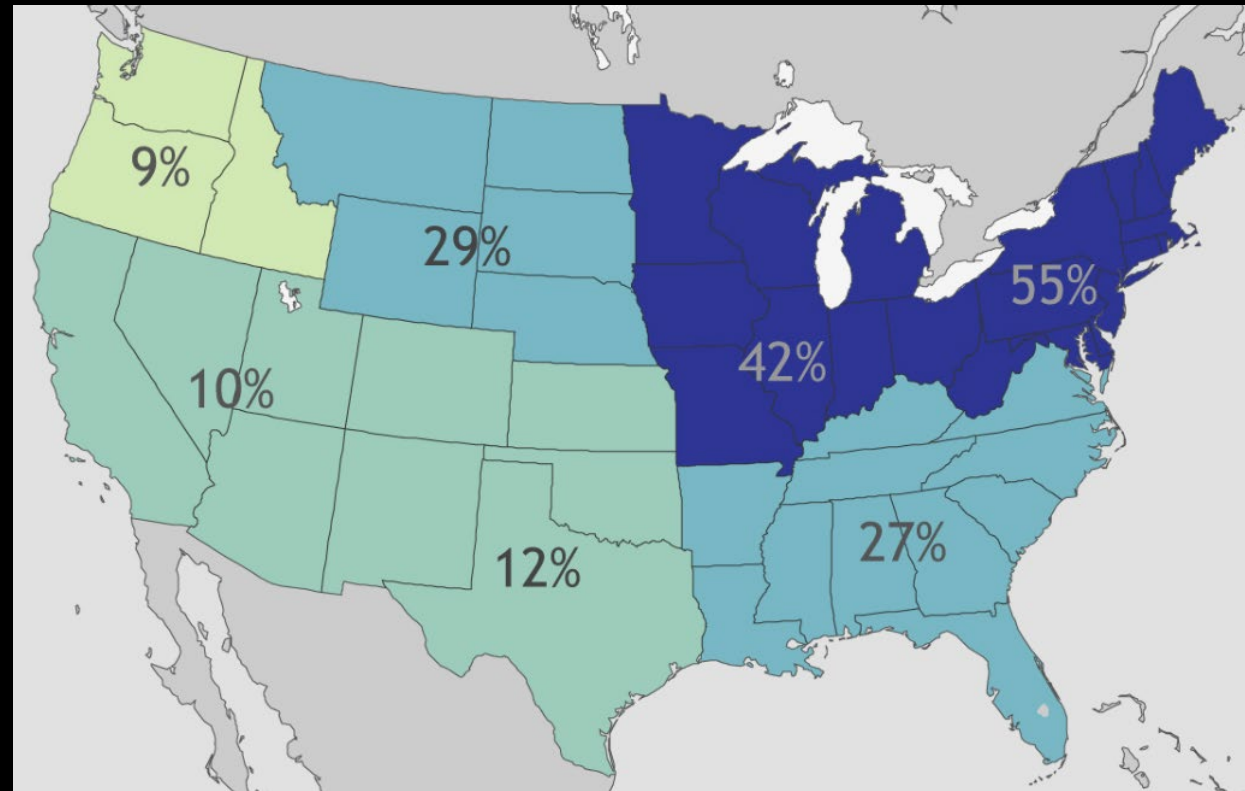


Sep 2, 2021  
24-Hour RP



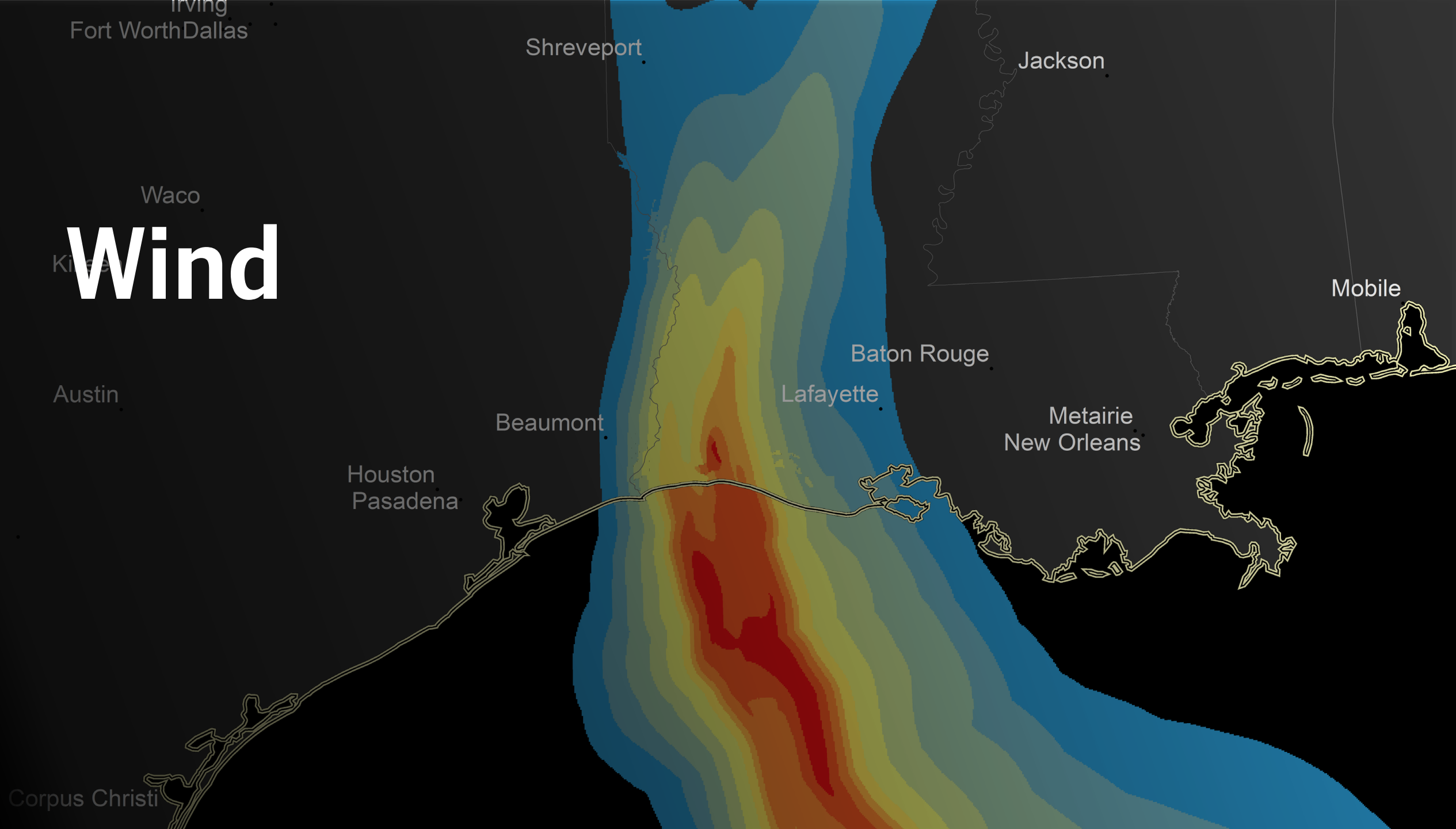
# Observed Recent Change in Extreme Precipitation

- Linear trends in rainfall (1958 – 2016)
- Northeast U.S. is experiencing the greatest increase
- Louisiana is experiencing a 27% increase



Source: *Climate.gov*, Adapted from  
4<sup>th</sup> National Climate Assessment

# Wind





# PROGRESSION OF DAMAGE



Roof cover, soffits, fascia

Wall cover

Roof sheathing, roof structure

Total collapse

# SEVERE CONVECTIVE STORMS

A wide-angle landscape photograph capturing a dramatic sky. The upper two-thirds of the image are dominated by dark, heavy, grey-blue storm clouds that appear to be rolling in from the right. On the left side, a bright, golden-yellow light from the sun is breaking through the clouds, creating a strong contrast and illuminating the lower part of the scene. Below the horizon line, a paved road stretches from the bottom center towards the distance. To the left of the road, there are several utility poles with power lines extending across the frame. In the foreground on the left, the skeletal structure of a large agricultural irrigation system is visible. The ground is a mix of green grass and brown earth, suggesting a rural or agricultural setting. The overall mood is one of tension and impending weather.

# Severe Convective Storm Hazards and Loss

Loss by SCS Hazard from Risk Management Solutions



## Hail

Hail accounts for 70% of annual average loss. In any given year hail is 60-80% of the damage produced by severe convective storms



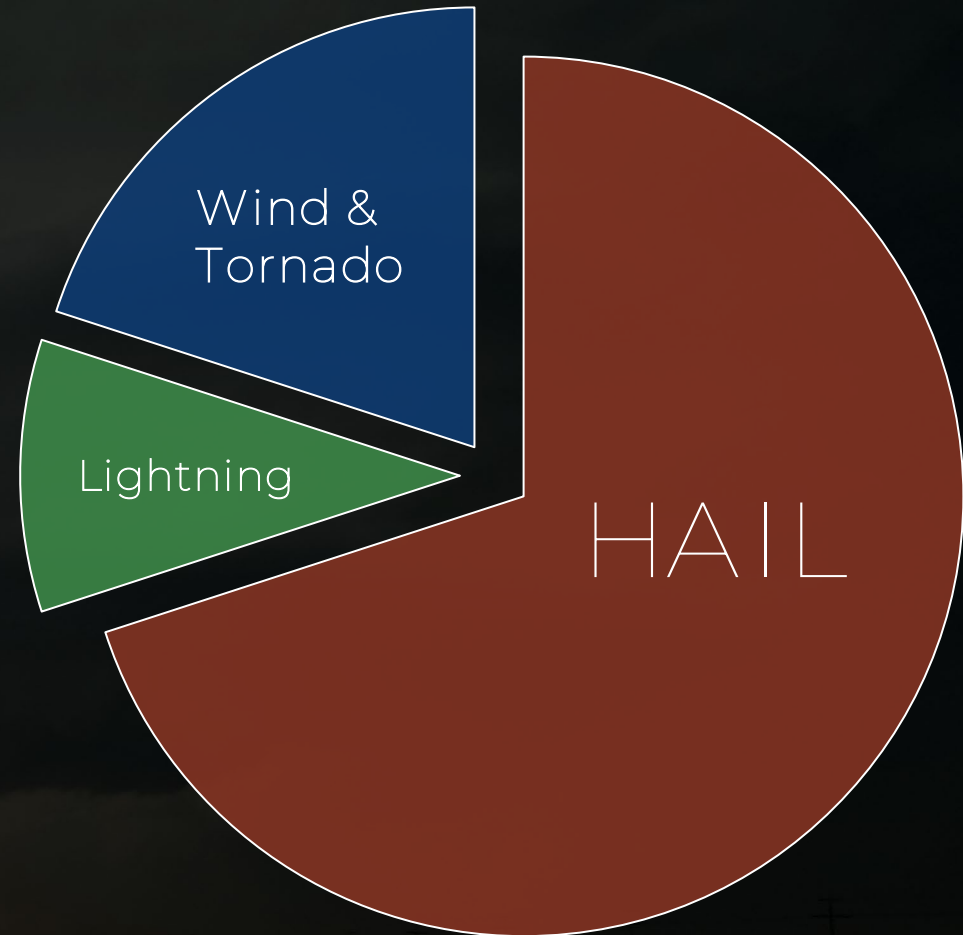
## Wind & Tornadoes

Severe winds both from straight-line wind events and tornadoes account for about 20% of average annual loss.



## Lightning

Lightning, including fires started by lightning accounts for about 10%



**Hail is less dense than an ice cube in your freezer**

**It can range in strength from slushy to very strong**

**Layers are caused by alternating growth processes**

**Some hailstones are so strong it takes a force of several hundred pounds to fracture them**

# HAIL





## Kinetic Energy

Heymsfield et al. 2014



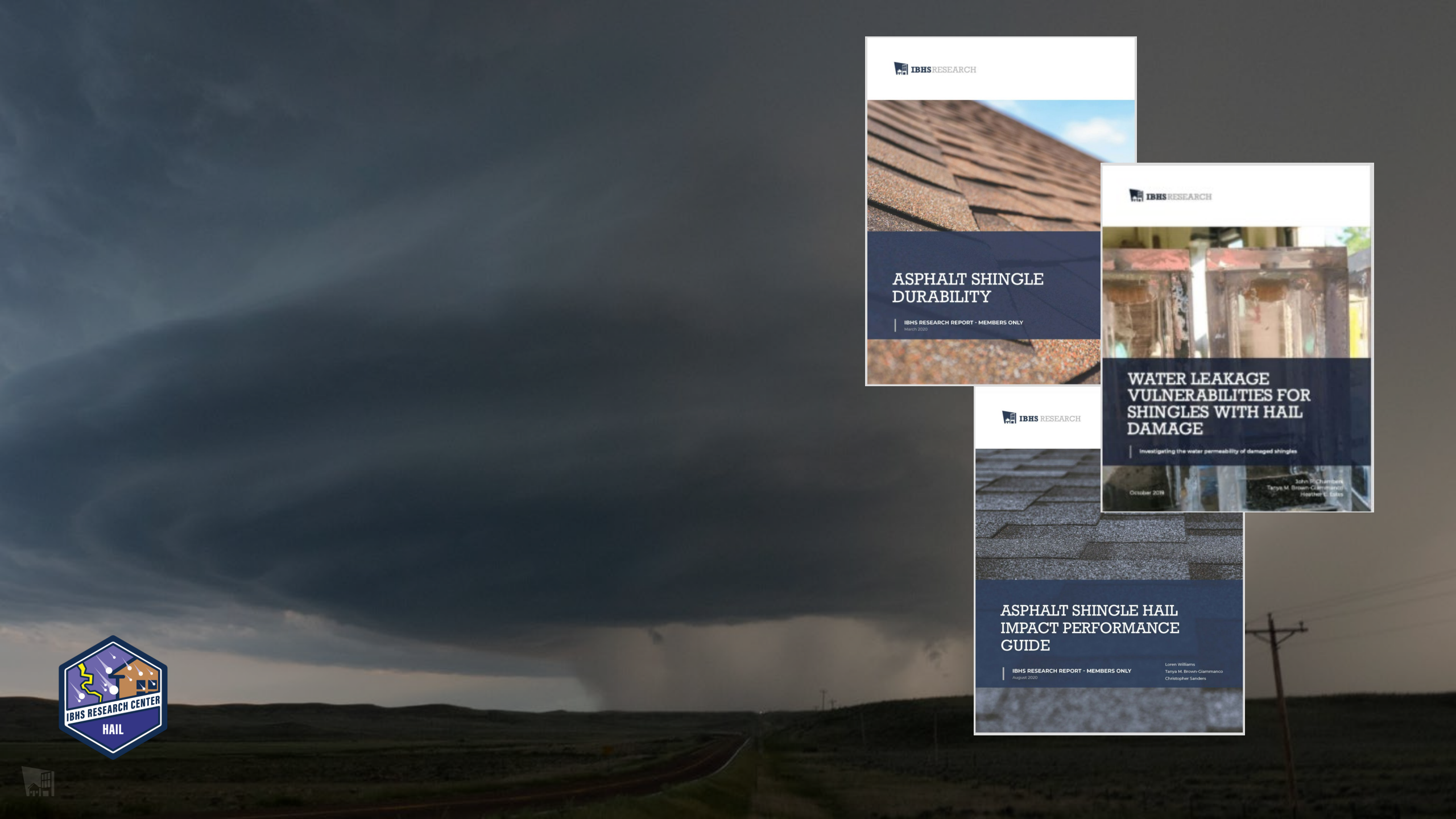
## Size – Mass

IBHS Field Study data 2012-2017



## Strength

Giammanco et al. 2015



 **IBHS** RESEARCH



## ASPHALT SHINGLE DURABILITY

IBHS RESEARCH REPORT - MEMBERS ONLY  
March 2020



 **IBHS** RESEARCH



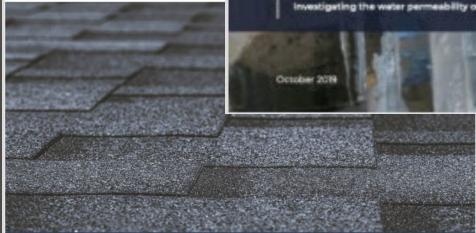
## WATER LEAKAGE VULNERABILITIES FOR SHINGLES WITH HAIL DAMAGE

Investigating the water permeability of damaged shingles

October 2019

John P. Chamberlain  
Tanya M. Brown-Giammarco  
Heather E. Coles

 **IBHS** RESEARCH











































## ASPHALT SHINGLE HAIL IMPACT PERFORMANCE GUIDE

IBHS RESEARCH REPORT - MEMBERS ONLY  
August 2020

Loren Williams  
Tanya M. Brown-Giammarco  
Christopher Sanders



## ROOF SHINGLE HAIL IMPACT RATINGS

Manufacturer/ Brand	Overall Rating	Dents/ Ridges	Tears	Granule Loss
 <b>StormMaster® Shake</b>				
 <b>NorthGate®</b>				
 <b>Legacy®</b>				
 <b>Vista®</b>				
 <b>Timberline® ArmorShield™ II</b>				
 <b>TruDefinition® WeatherGuard® HP</b>				
 <b>Landmark® IR</b>				
 <b>Cambridge™ IR</b>				

Key  Excellent  Good  Marginal  Poor



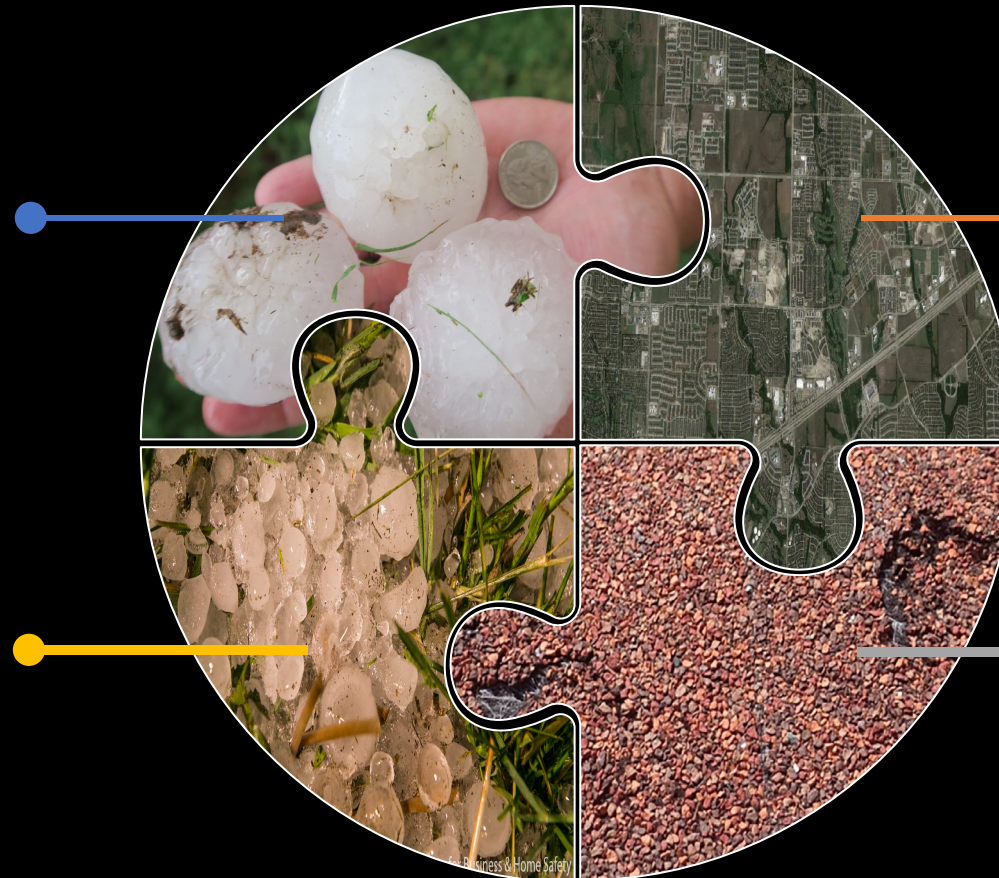
# Ingredients for a Catastrophic Hailstorm

## Big Hail

Damage to structures begins often at hail sizes above 1.5 inches (3.8 cm)

Lots of Hail + Wind

High concentrations of hail embedded in strong winds make even small hailstones damaging



## Major metro

Our suburban environment is growing quickly. We build larger and closer together than ever before

## Vulnerable Roof Covers

U.S. & Canada only countries that the dominant roof cover is asphalt shingles

Most building materials are not designed to resist large hail

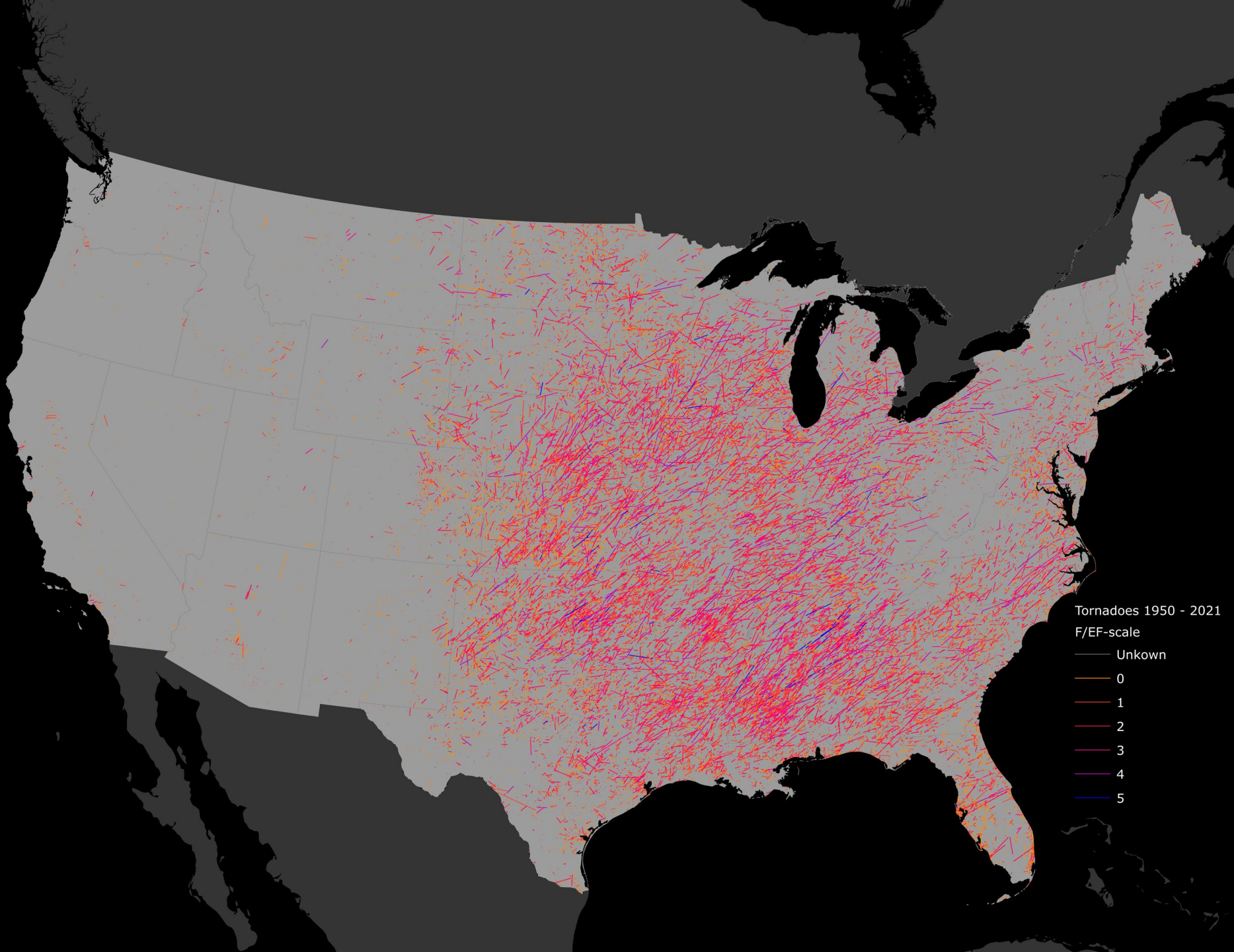




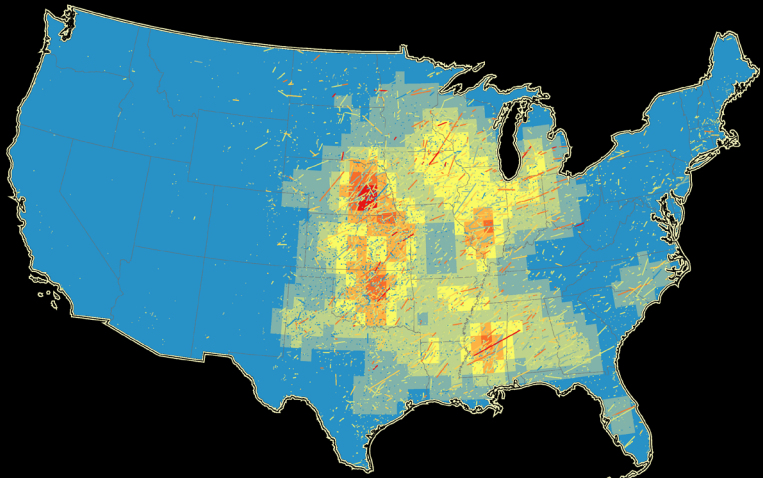
**Tornadoes...**



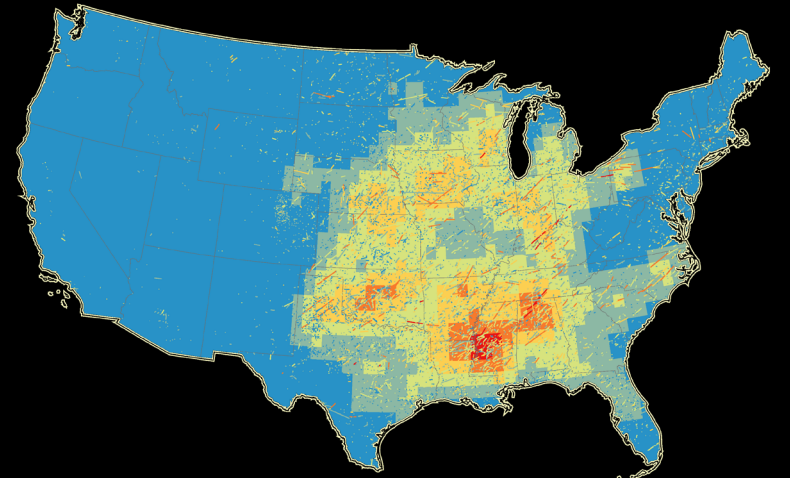
# United States Tornadoes 1950-2021



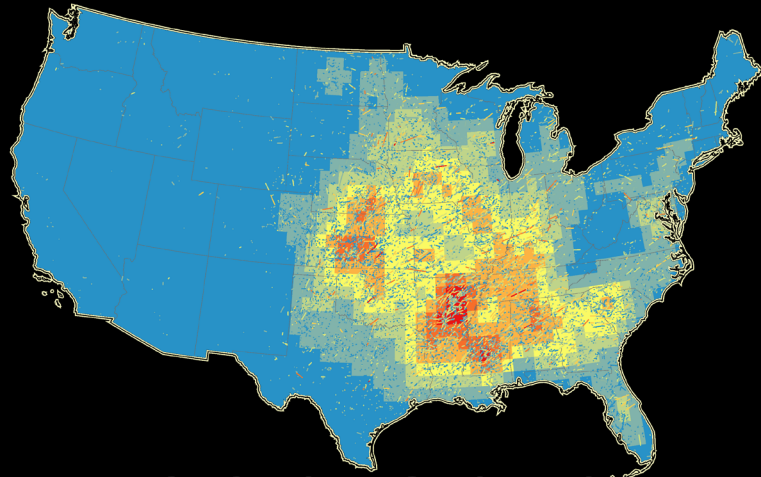
# Tornado Track Density



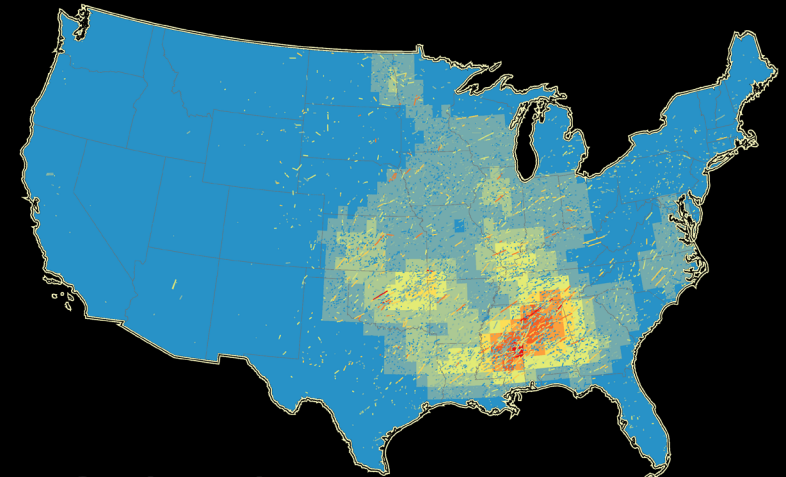
1950-1970



1970-1990



1990-2010



2010-present





Human perception:  
Nothing we can do to prevent damage

# FIELD



April 13, 2020 Chattanooga, TN  
EF-3 Tornado

# IBHS

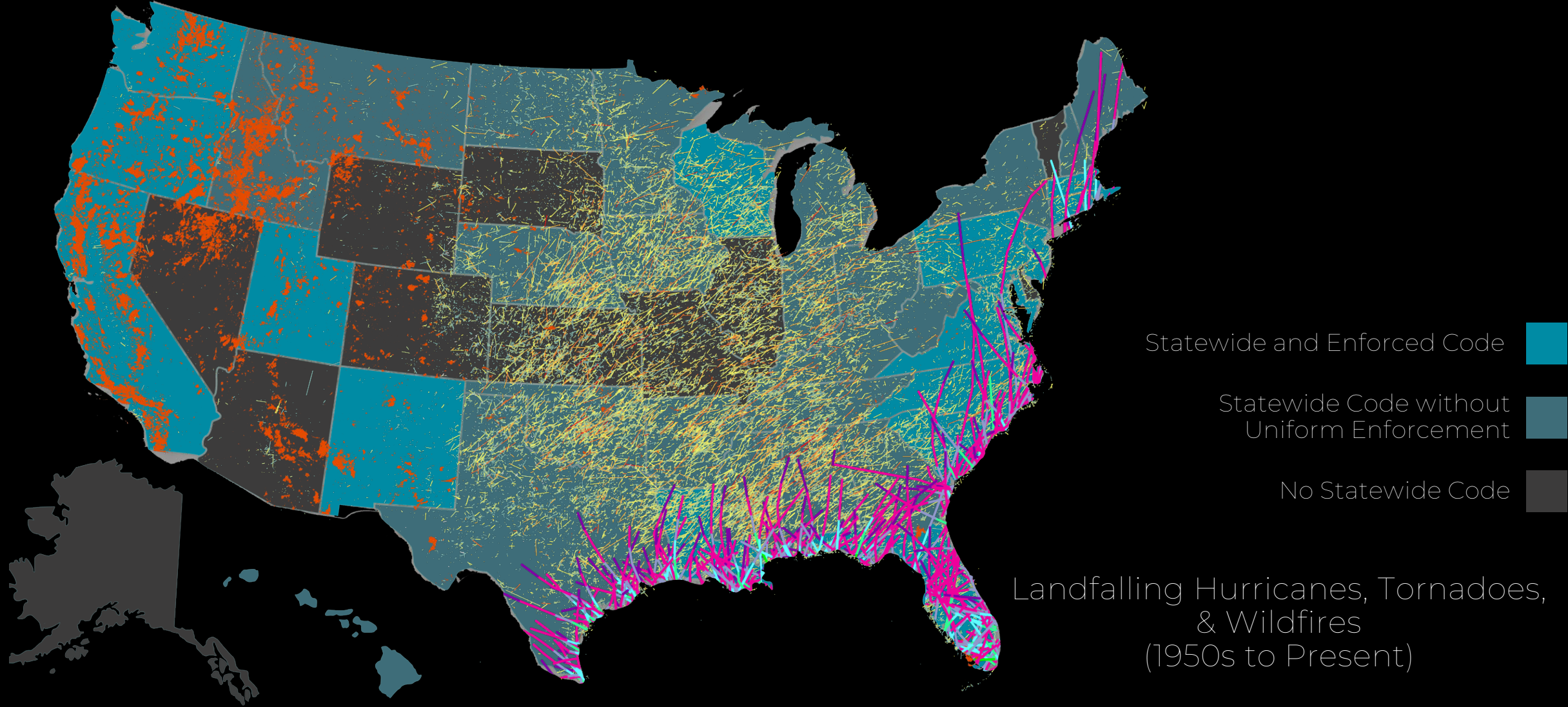







Engineers are not surprised by damage modes.

# Statewide Building Codes

ACROSS THE CONTINENTAL UNITED STATES



- Statewide and Enforced Code 
- Statewide Code without Uniform Enforcement 
- No Statewise Code 

Landfalling Hurricanes, Tornadoes,  
& Wildfires  
(1950s to Present)





**Frankie Shepherd**  [@wx\\_Frankie](#)

Drone images from Rolling Fork, Mississippi. The #tornado damage here is BAD.

Homes destroyed, vehicles tossed.

Just wow.

[@VortexChasing](#)

11:47 AM · Mar 25, 2023 · 74.2K Views


241 Retweets 44 Quotes 618 Likes

13 Bookmarks

 Tweet your [Reply](#)



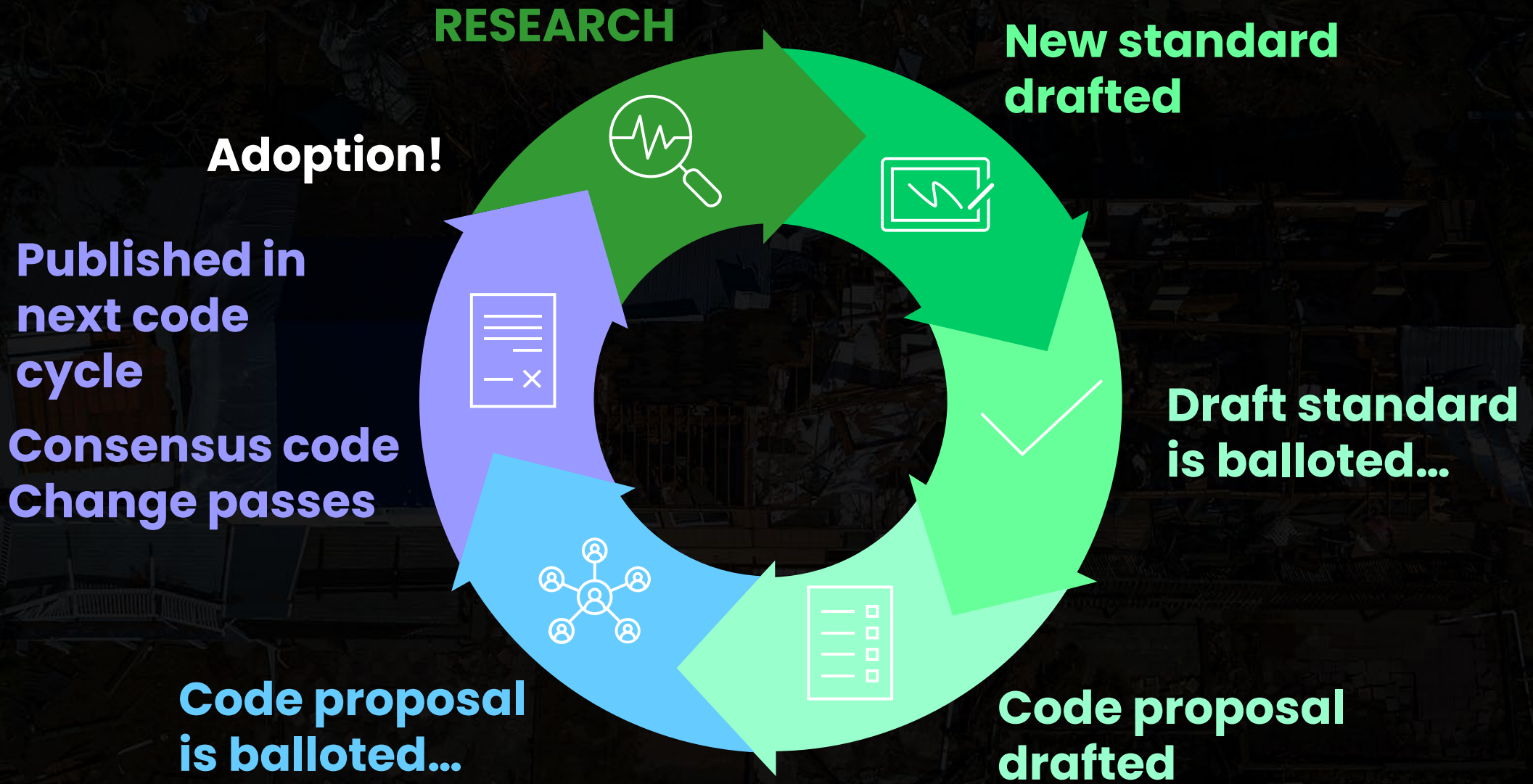
**Jeff Piotrowski**  [@Jeff\\_Piotrowski](#)

NW side of Amory MS. This house took a direct hit from the tornado total loss. Seven family members were able to get storm shelter before it hit. The advance warning by the [@NWSMemphis](#) with the tag tornado emergency saved lives in Amory MS. [#mswx](#) [#Amory](#) [#tornado](#)



Outdated and improper construction







Keep the roof on and water out.  
Enhanced by a sealed roof deck  
and a high performing wind rated  
roof cover.

Keep the roof on, water out.  
Reduce damage amplifiers:  
Strengthen gable walls & porches.  
Strengthen garage door openings.  
Protect openings against debris impact



Keep the roof on, water out  
Reduce damage amplifiers  
Keep the entire building intact with a  
continuous load path & protect against  
debris impact

# FORTIFIED Home™



# FORTIFIED Performs Against Hurricanes

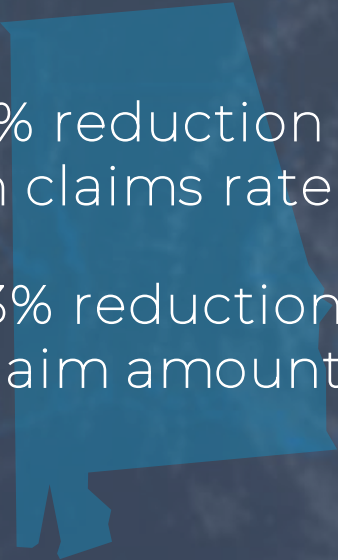
SALLY



7% reduction in claims rate



13% reduction in claim amount



ALABAMA

MATTHEW, FLORENCE, DORIAN, ISAIAS



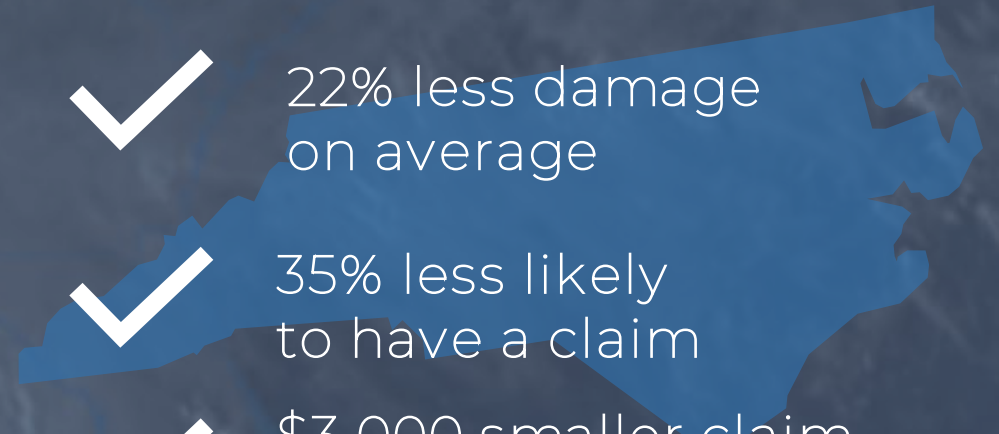
22% less damage on average



35% less likely to have a claim

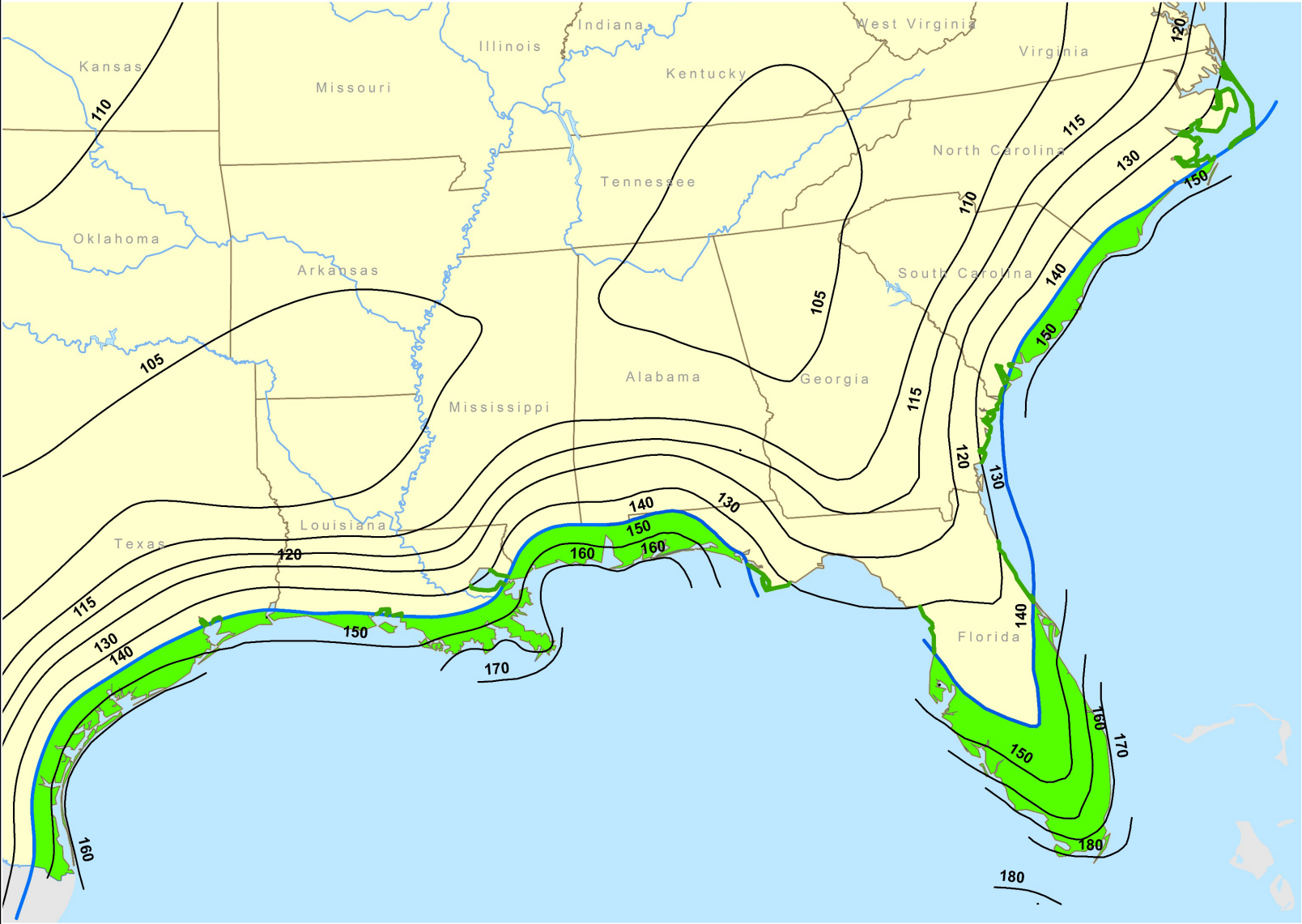


\$3,000 smaller claim on average



NORTH CAROLINA

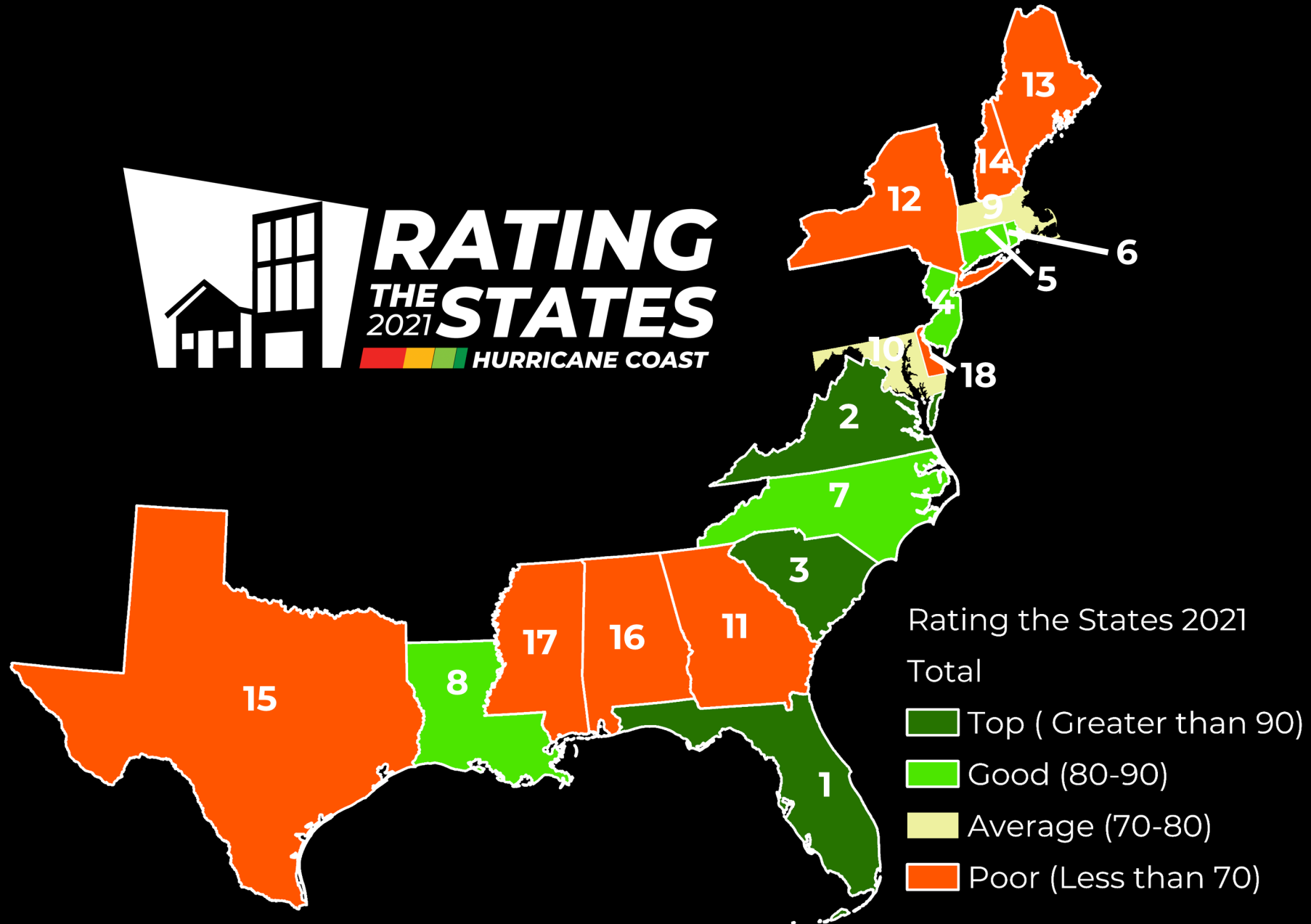
# TAKING FORTIFIED™ Into Building Codes





# RATING THE STATES 2021

HURRICANE COAST



Code adoption:

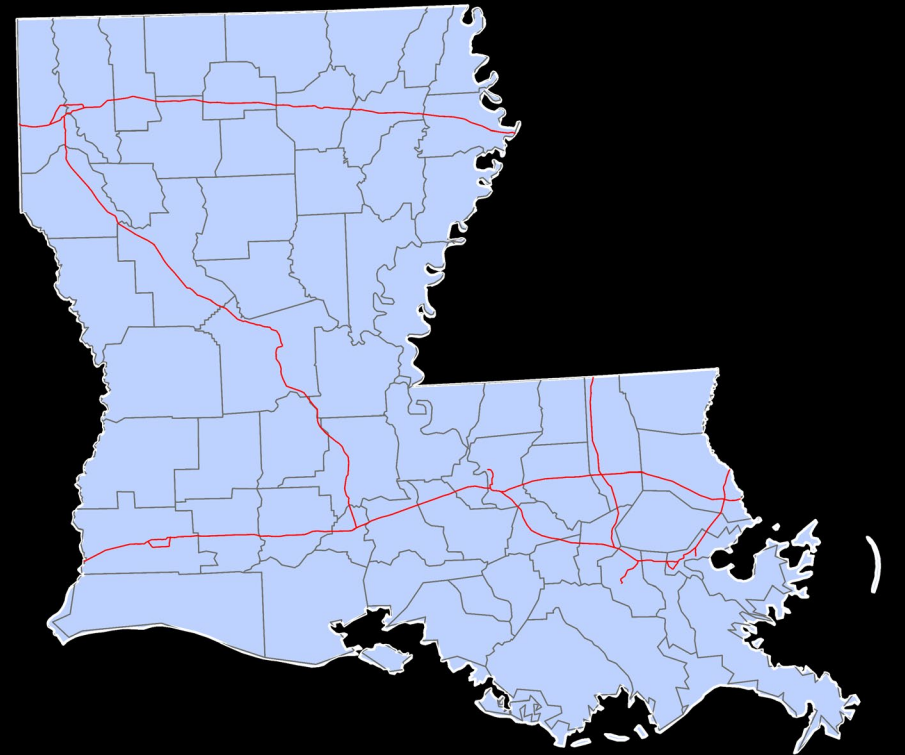
46 out of 50

Code enforcement &  
administration:

14 out of 25

Contractor licensing &  
training:

22 out of 25





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 IBHS.org

