

2018 U.S. Hurricane Season in Review

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Meet the Presenters



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Agenda

Season Overview

Seasonal Forecast Verification

Climate Impacts

Significant Storms of 2018

Reflections on the 2018 Season

Damage Survey Findings

AIR's View of 2018 Industry Loss Estimates

Season Overview

The 2018 U.S. Hurricane Season via Satellite



Noteworthy Records in 2018

- 3 Category 4 hurricanes have made continental U.S. landfall in the past two years: Harvey, Irma, and Michael
- Hurricane season with most Atlantic named storms on record to form September 1-12
- Hurricane Florence broke statewide rainfall records from a TC for both North Carolina (35.93") and South Carolina (23.63")
- Hurricane Michael was the first Category 4 hurricane on record to make landfall in the Florida panhandle
- General increase in naming subtropical systems: 7 of the 2018 Atlantic named storms were classified as subtropical at some point



**Flood waters from Hurricane Florence
Fayetteville, NC**

Source: Getty Images

Seasonal Forecast Verification

Seasonal Forecasts

- Season predictions for:
 - Named storms
 - Hurricanes
 - Major hurricanes (Saffir-Simpson Category 3 and higher)
 - Accumulated Cyclone Energy (ACE)
- Often with ranges of uncertainty
- Forecasts updated throughout the season

Hurricane Michael

2018 Atlantic Hurricane Season Recap

	2018	Avg.
Named Storms	15	12
Hurricanes	8	6
Major Hurricanes	2	3
Landfalls	2	1-2
Major Hurricane Landfalls	1	<1

2018 tropical cyclone tracks in the Atlantic basin.

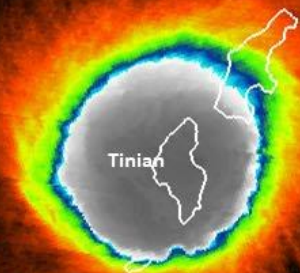
Source: NHC/NOAA

Early Season Forecasts Were Actually More Accurate

- Early season forecasts were for average activity
- August updates trended downward in anticipation of a developing El Niño
- Season ended above average

Forecaster	May	August	Actual
TSR 	12/6/2	11/5/1	15/8/2
CSU 	14/7/3	12/5/1	
NOAA 	13/7/2	11/5/1	

2018 Northern Hemisphere TC Activity Highly Elevated



Super Typhoon Yutu
October 24, 2018

2018 Northern Hemisphere TC Activity Highly Elevated

Relative Change in Activity over Climatology

Basin	Named Storms	Hurricanes	Major Hurricanes	ACE
N Atlantic	+27%	+27%	-26%	+24%
NE Pacific	+39%	+46%	+133%	+141%
NW Pacific	+12%	+1%	+8%	+20%
N Indian	+43%	+208%	+43%	+79%
Northern Hem.	+25%	+27%	+83%	+52%



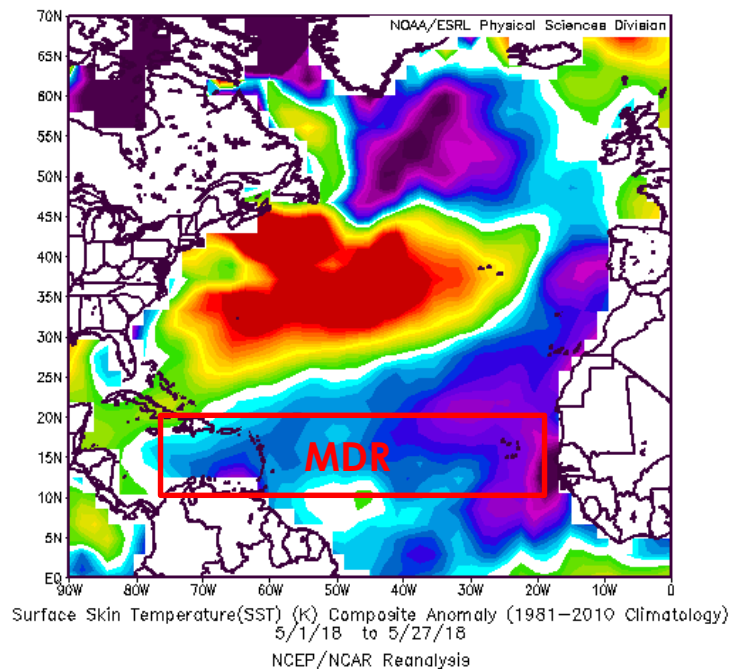
Super Typhoon Yutu
October 24, 2018

Climate Impacts

Atlantic Basin Sea Surface Temperature (SST) Warmed Slightly

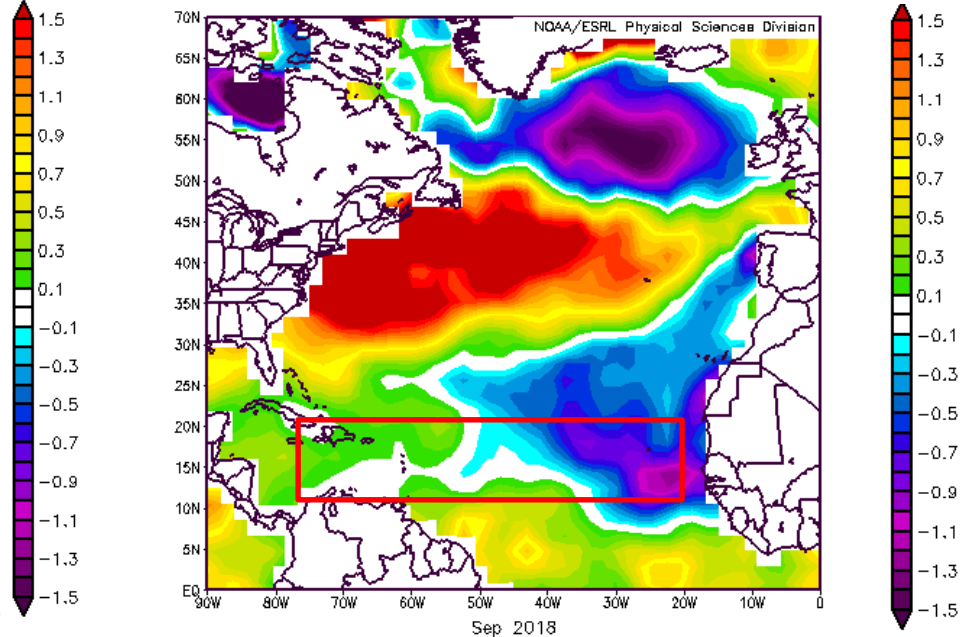
North Atlantic SST Anomaly

May 2018



©2018 AIR Worldwide

September 2018



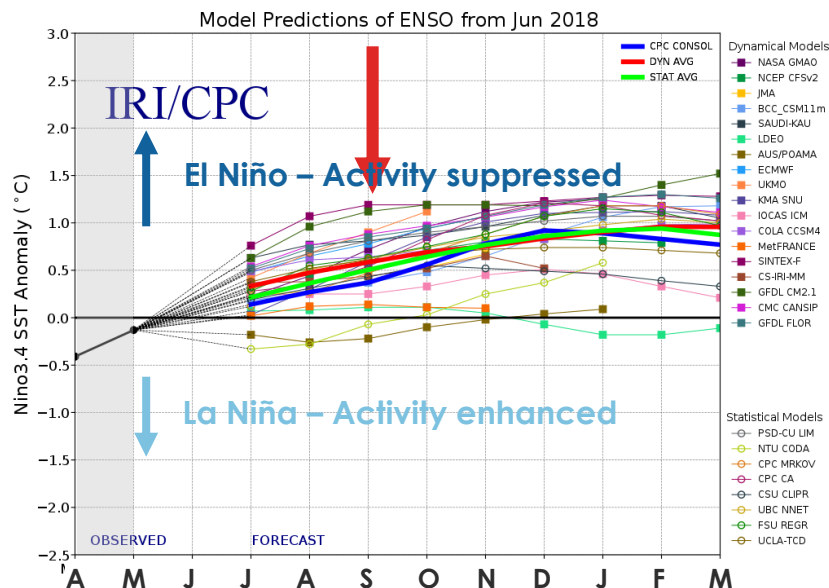
Source: NOAA/ESRL

14

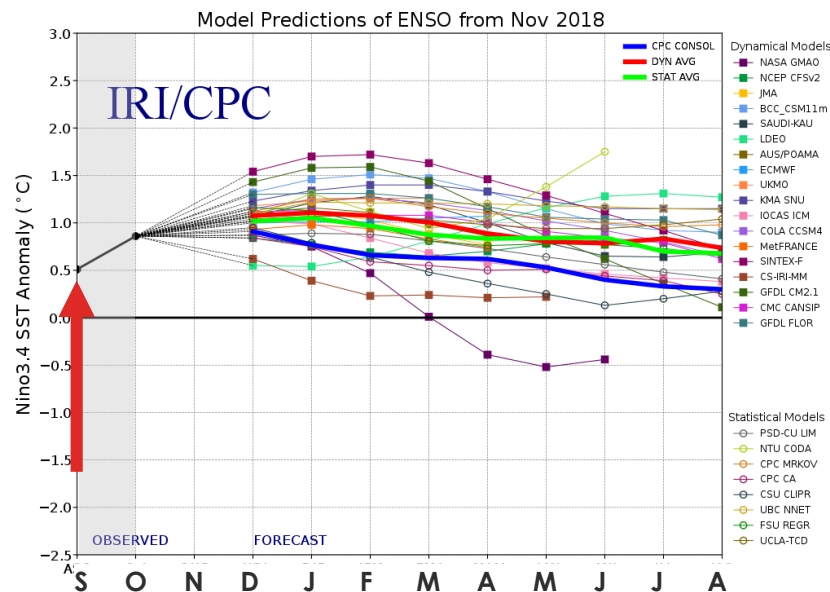


Predictions of a Weak El Niño Were Accurate

Early Season Forecast

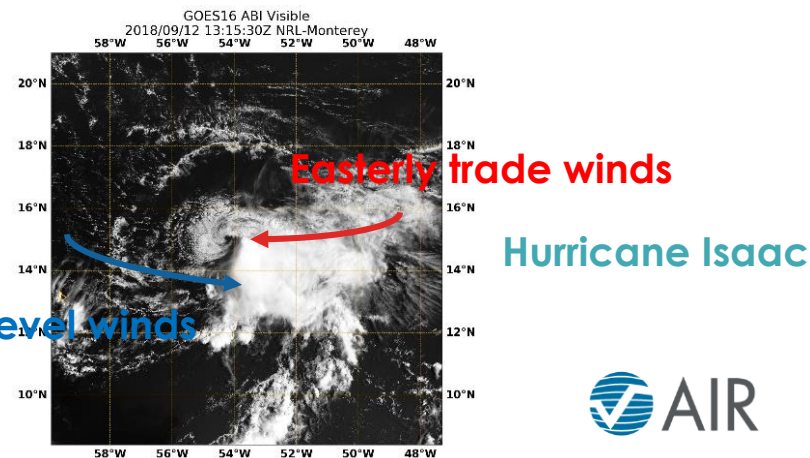
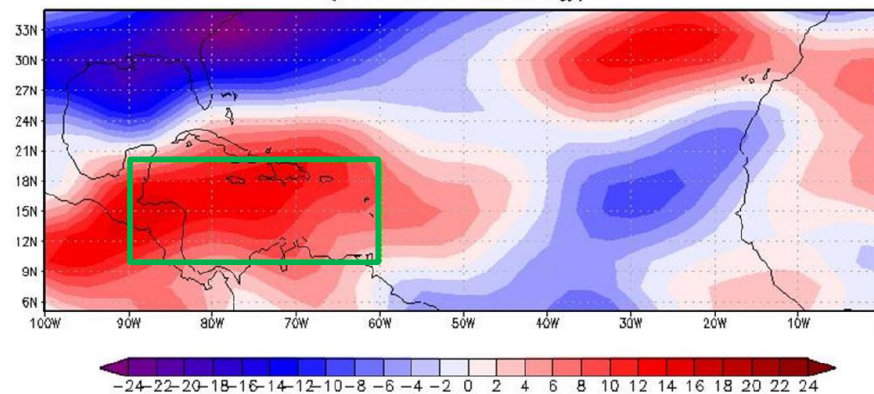
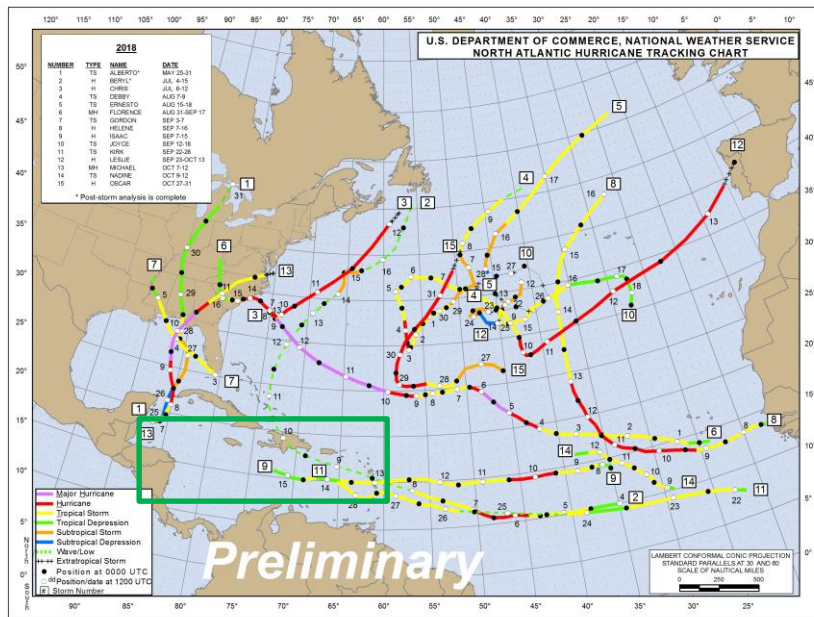


End of Season Result



Wind Shear in the Western Atlantic Was Anomalously High

August 15 Through October 13, 2018 Average
Zonal (200–850 mb) Vertical Wind Shear Anomaly (kts)
(1981–2010 Climatology)

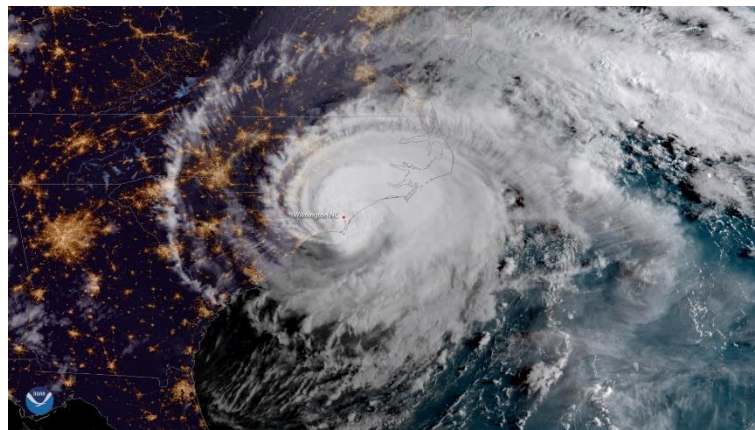


Significant Storms of 2018

Hurricane Florence

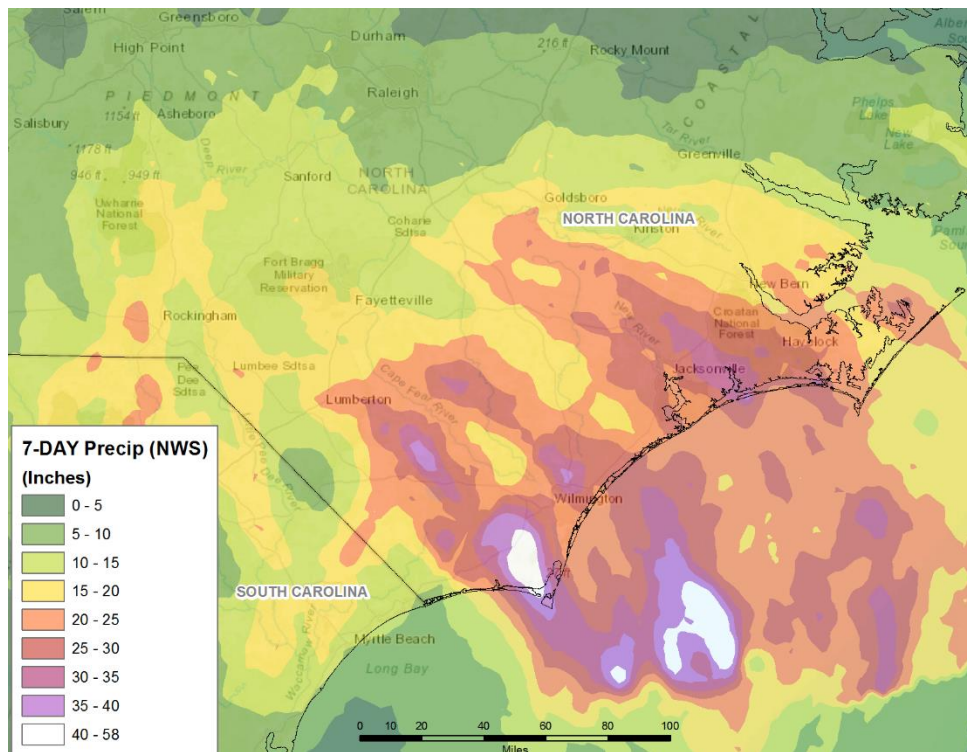
Hurricane Florence

- Made landfall as Cat-1 near Wrightsville Beach, NC
- Initially forecast to be a major hurricane at landfall
- Record flooding event for both NC and SC
 - NC: 35.93"
Was 24.06" (Hurricane Floyd, 1999)
 - SC: 23.63"
Was 18.51" (TS Jerry, 1995)

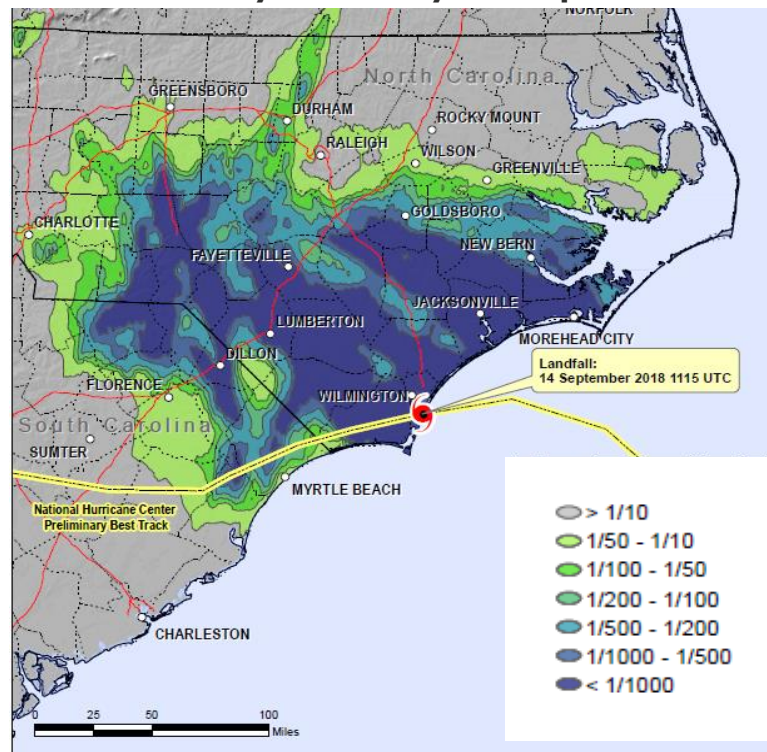


Florence was the Wettest TC in the Carolinas

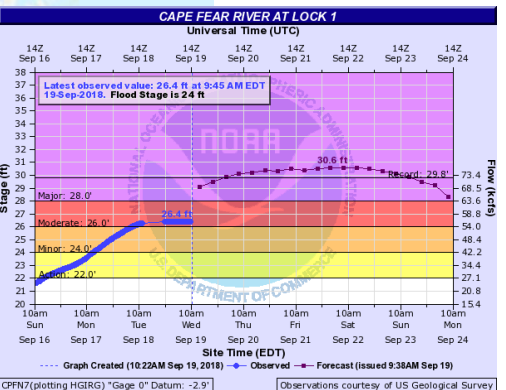
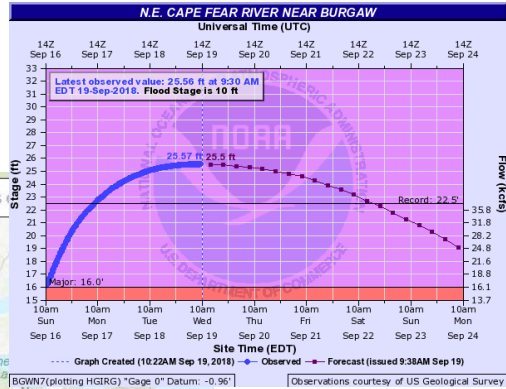
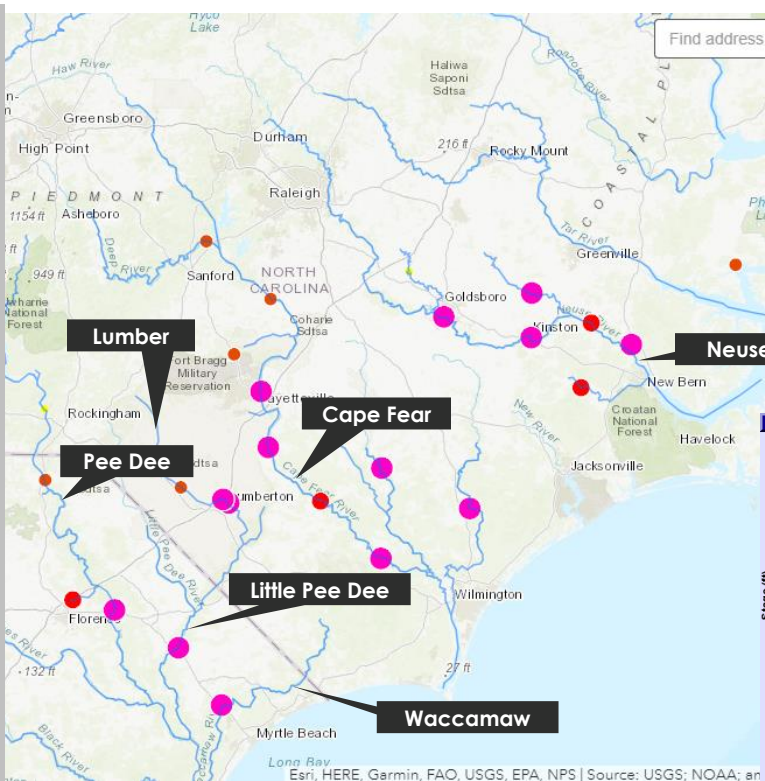
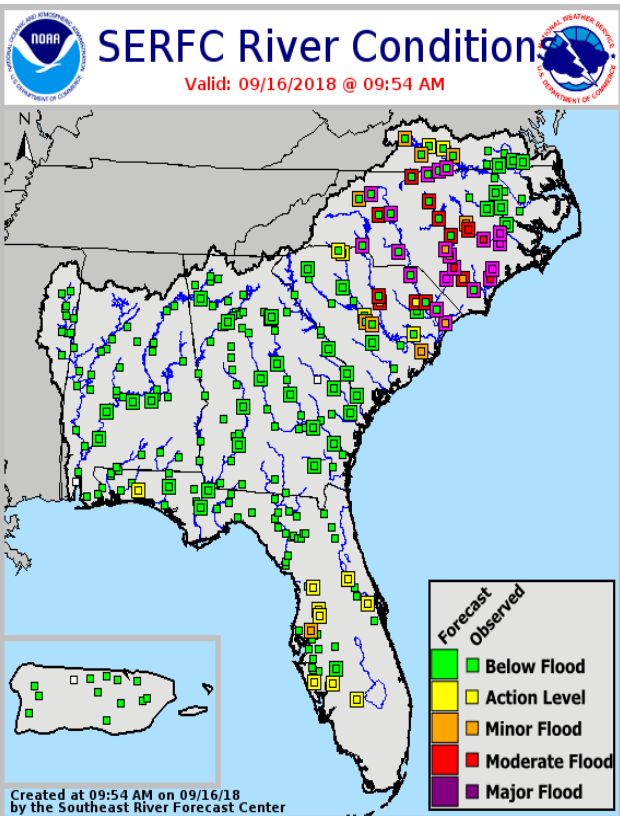
Florence Total Precipitation



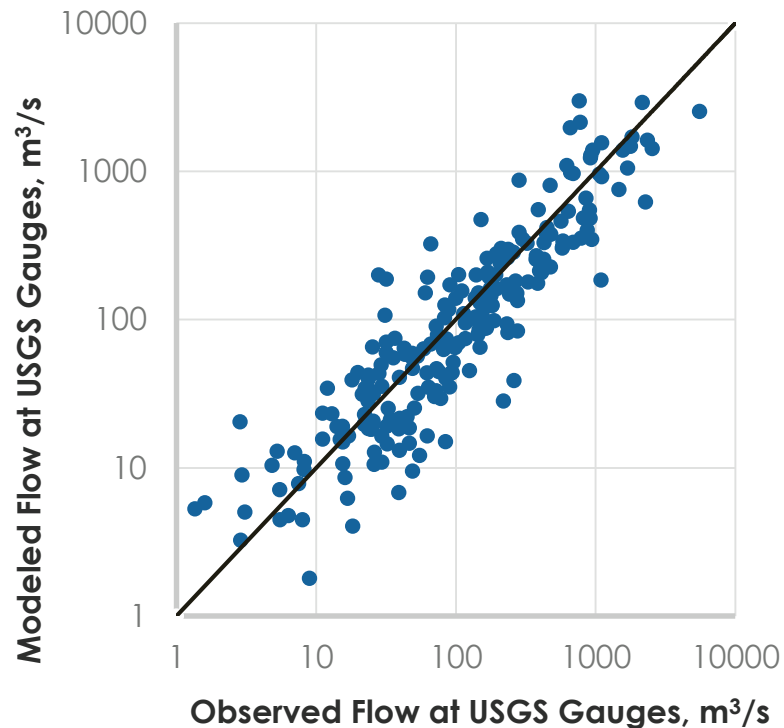
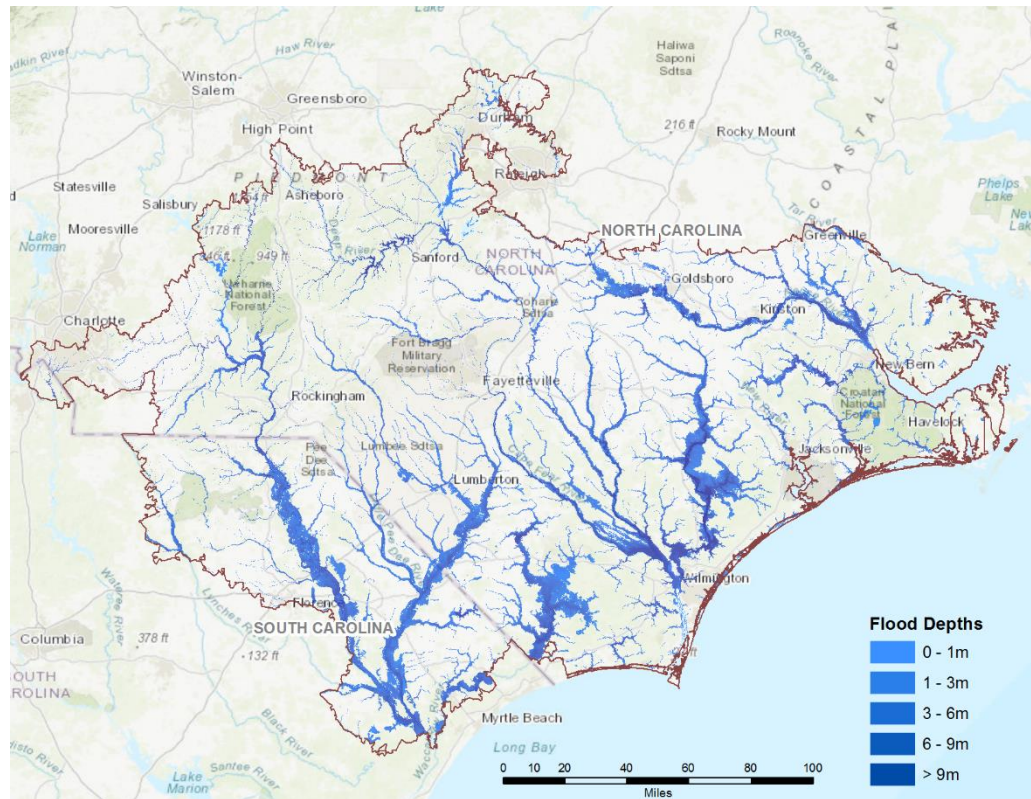
Probability of 3-Day Precipitation



Many USGS Streamflow Stations Were in "Major Flooding" Category



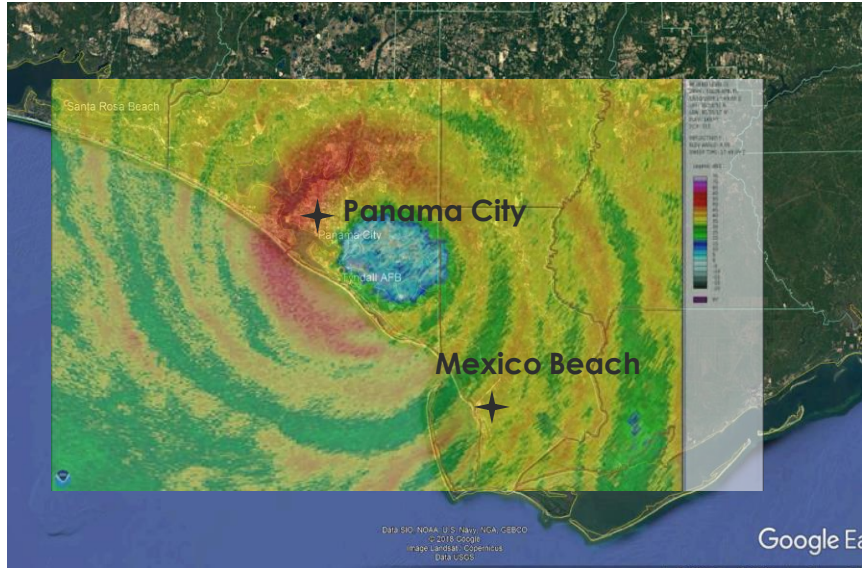
AIR Modeled Flows and Flood Extents Using NLDAS Precipitation



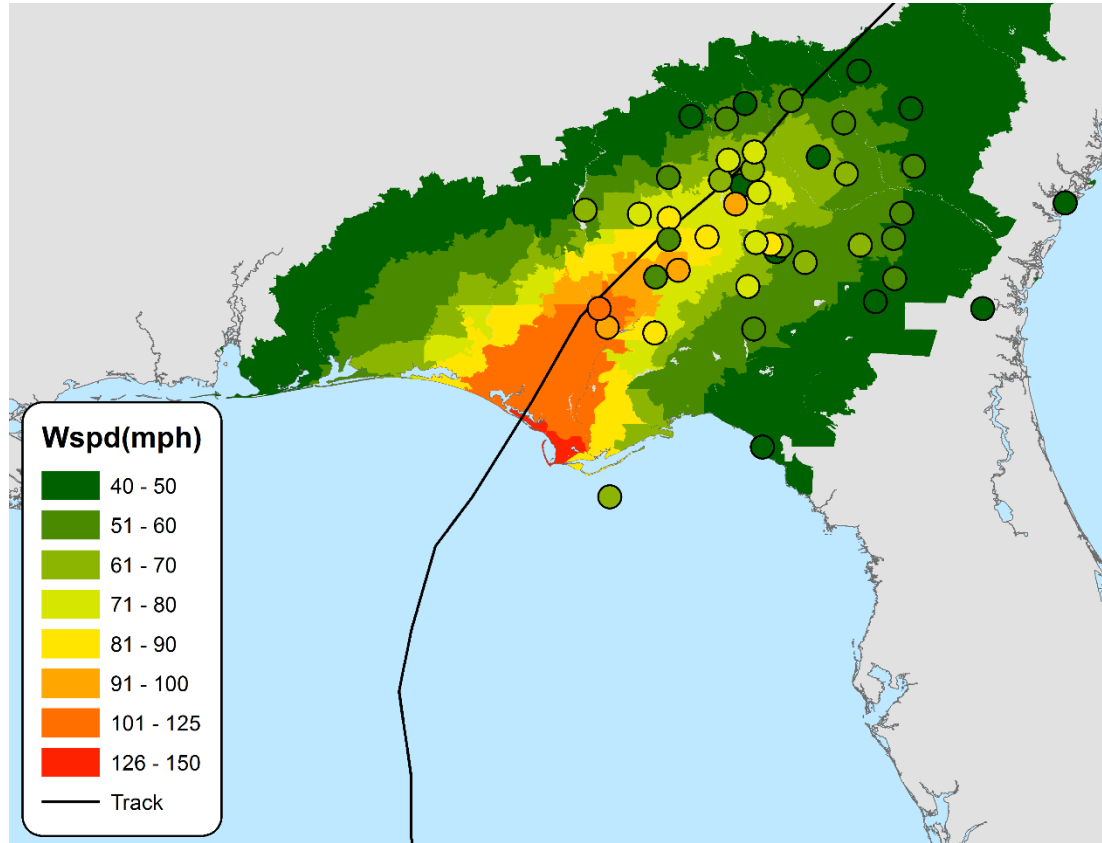
Hurricane Michael

Hurricane Michael

- Strongest hurricane to strike the Florida Panhandle
- 3rd most intense landfalling storm in terms of minimum central pressure (919 mb)
- 4th most intense storm in terms of maximum wind speed (150 mph)



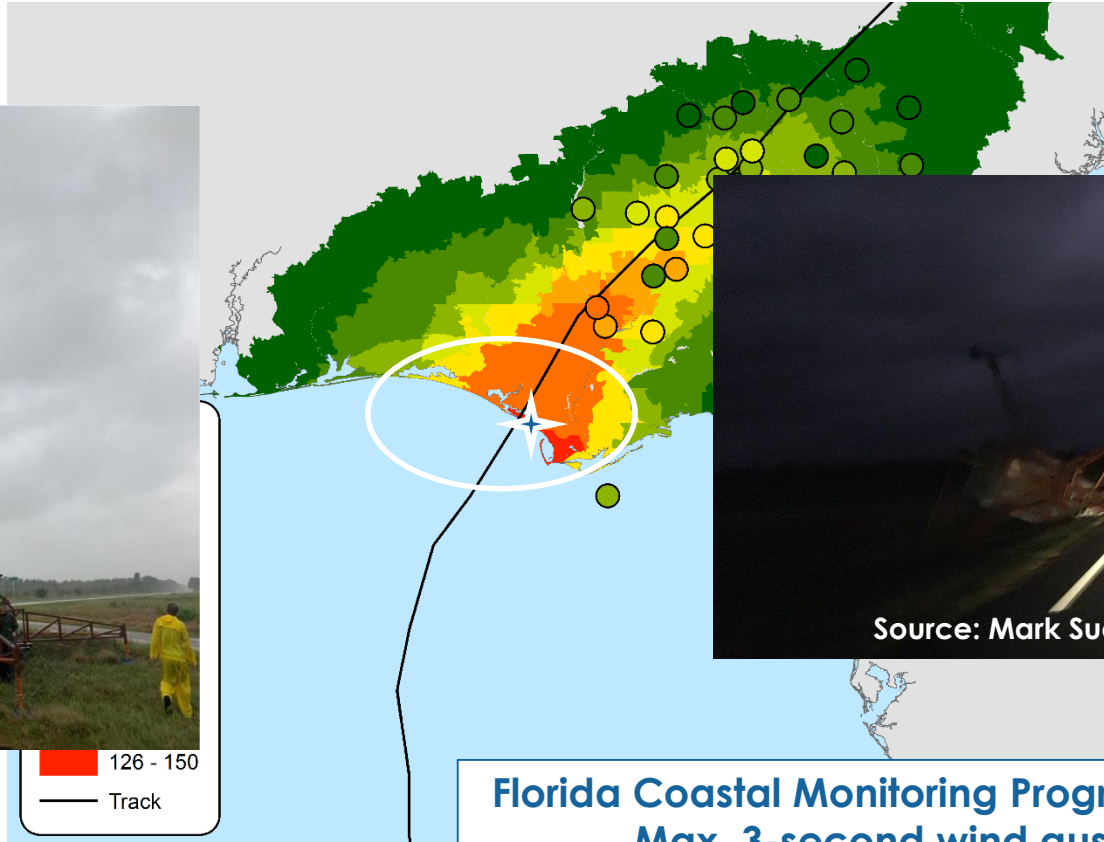
Hurricane Michael Landfall Wind Footprint



Hurricane Michael Landfall Wind Footprint



Source: FCMP/UF

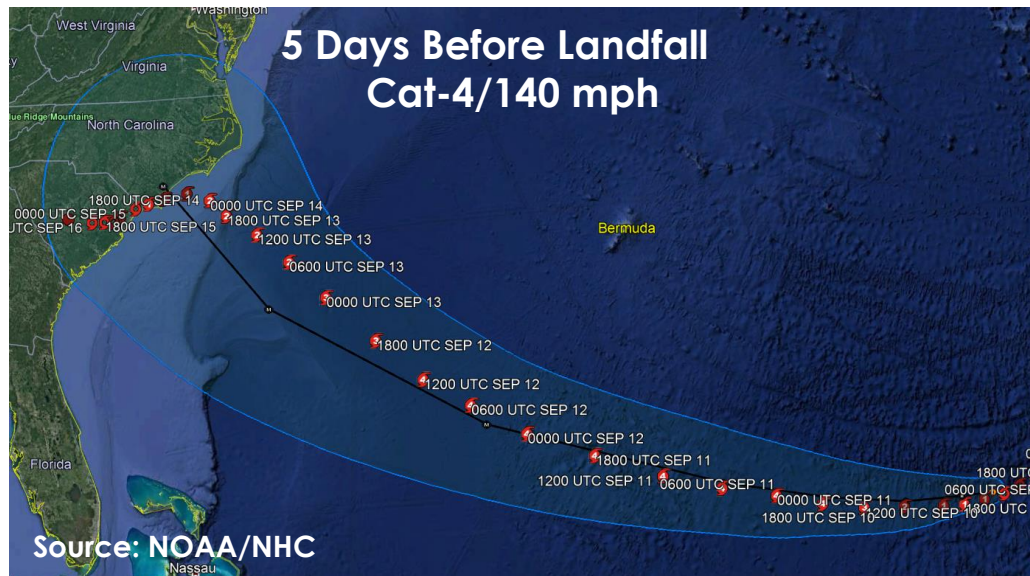


Source: Mark Suddath/hurricanetrack.com

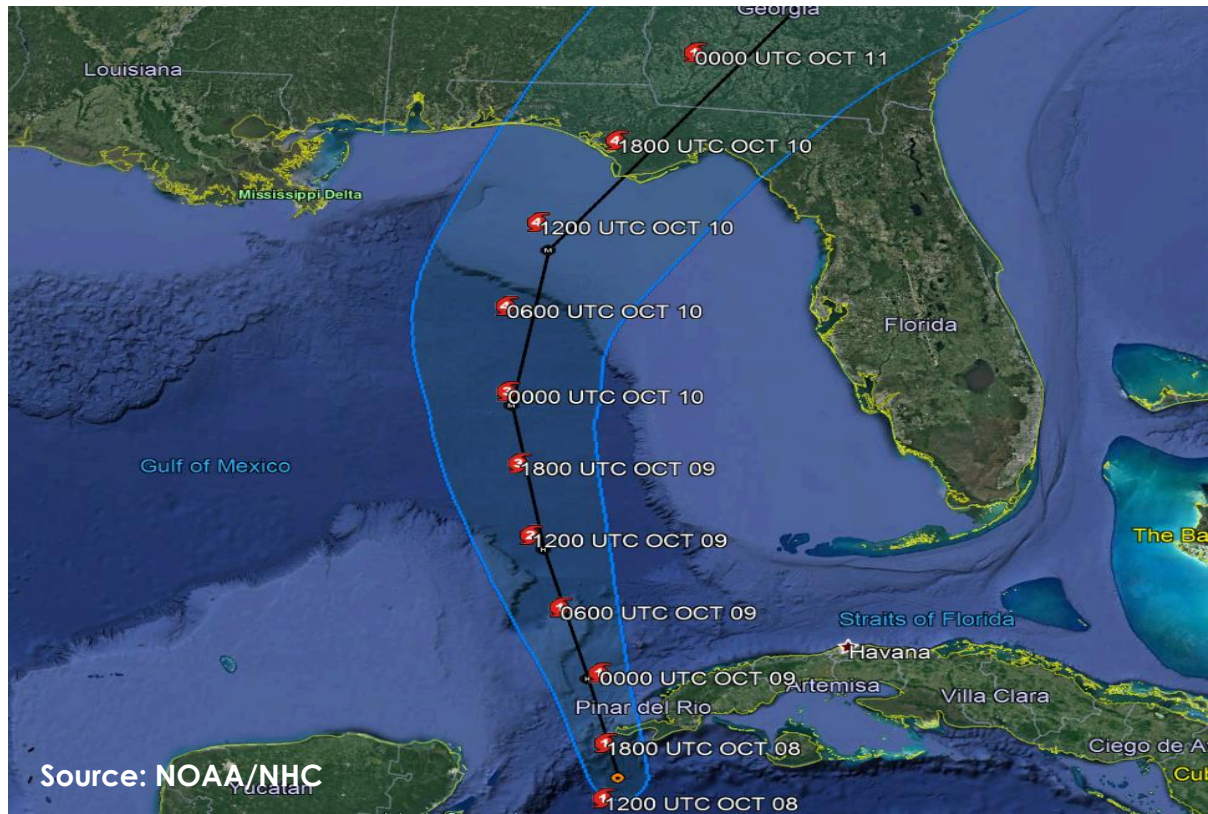
Florida Coastal Monitoring Program (FCMP) Tower-3
Max. 3-second wind gust of 129 mph

Reflections on the 2018 Season

Florence: Track Forecasts Excellent; Intensity Not So Much

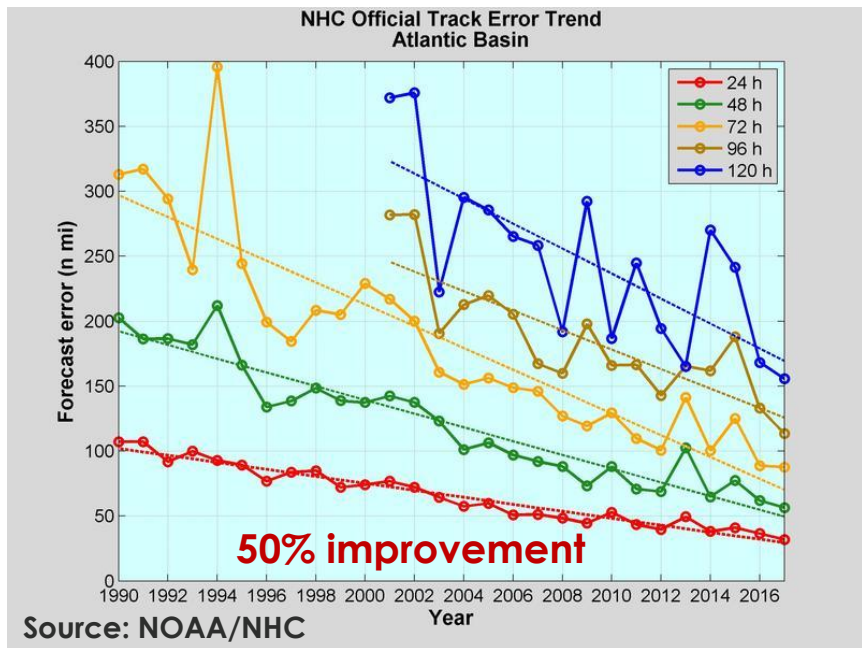


Michael: Track Forecasts Excellent; Intensity Not So Much

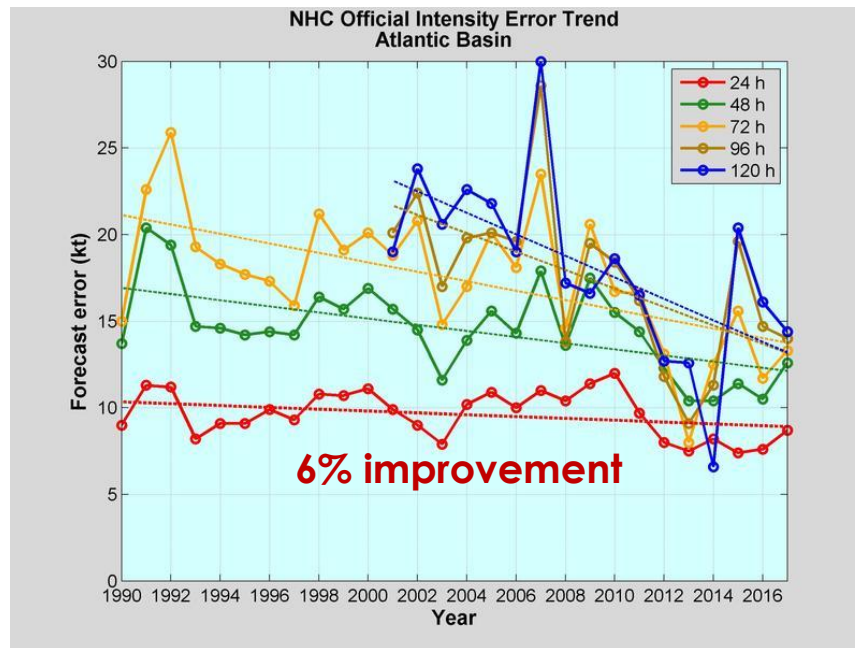


Improvements in TC Forecasting

Track forecasts have dramatically improved

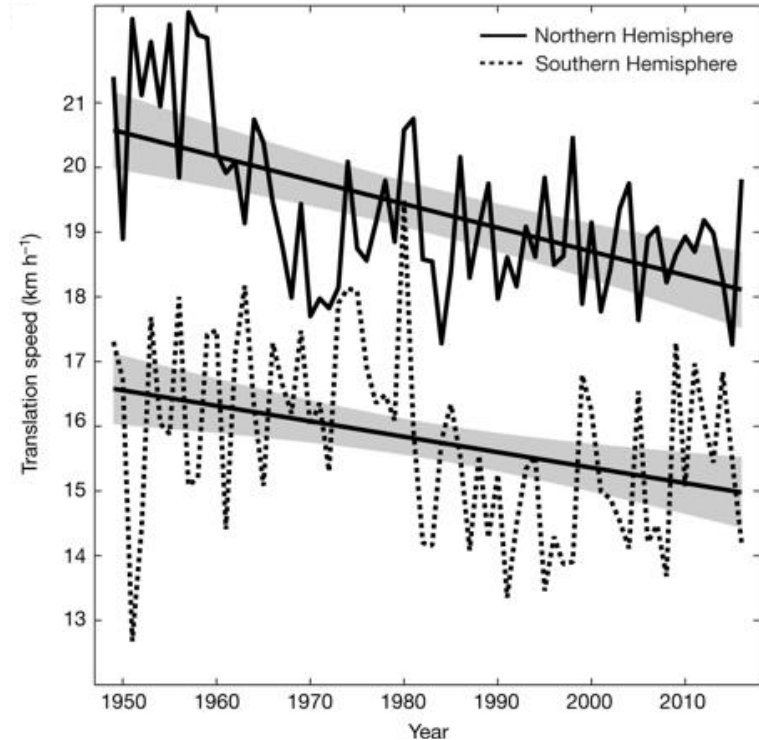


Intensity forecast improvements have been slower



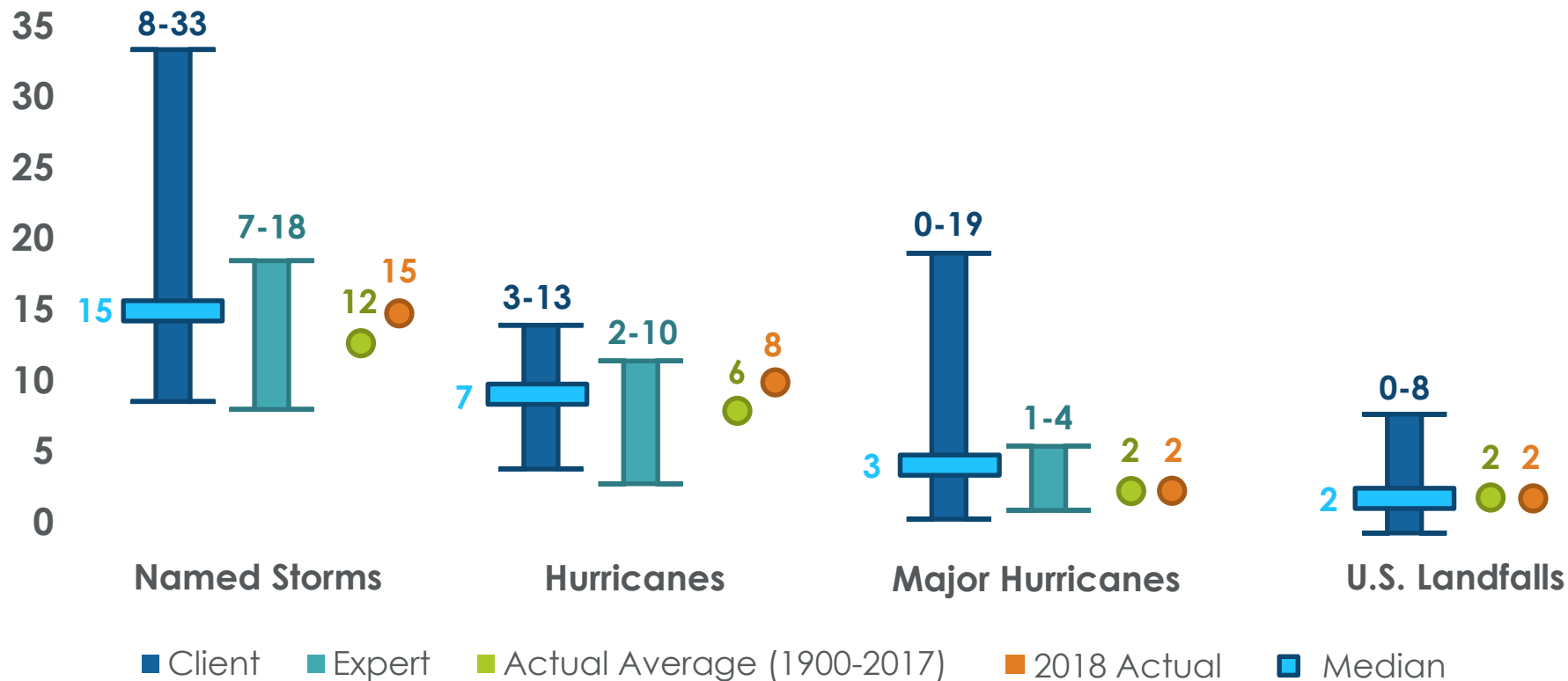
Are Tropical Cyclones Slowing Down?

- The last 2 years have produced storms with record flooding—slowing or stalled motion is the primary cause
- Could we experience more severe flooding from TCs in the future?

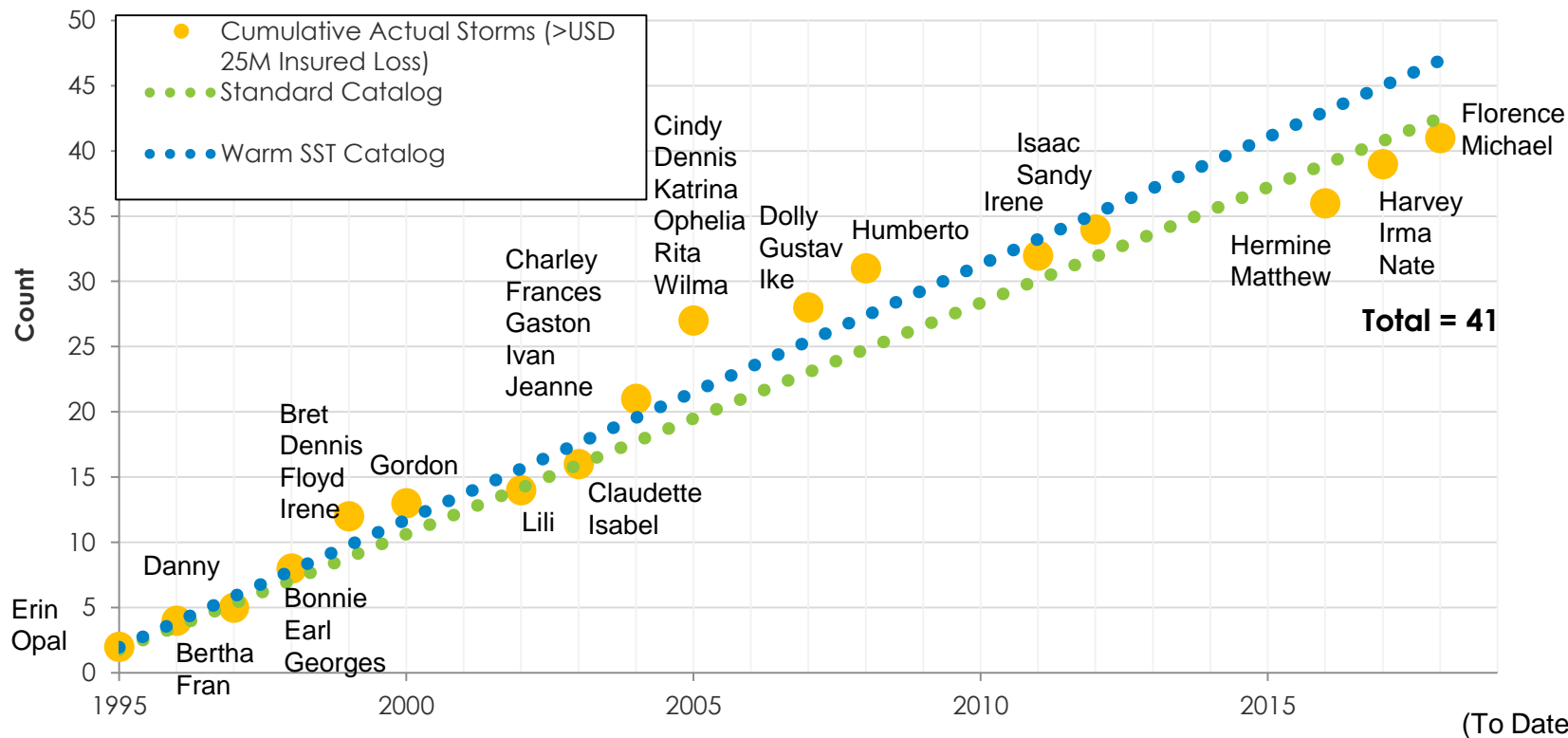


Kossin, J. P. (2018): A global slowdown of tropical-cyclone translation speed, *Nature* (v.558)

AIR Hurricane Contest: Early Results!



Recent Hurricane Activity Aligns with Long-Term Averages





AIR Damage Assessments and Modeled Losses for 2018 Hurricanes

*Parker, FL
Source: AIR Worldwide*

AGENDA



Lumberton, NC
Source: AIR Worldwide

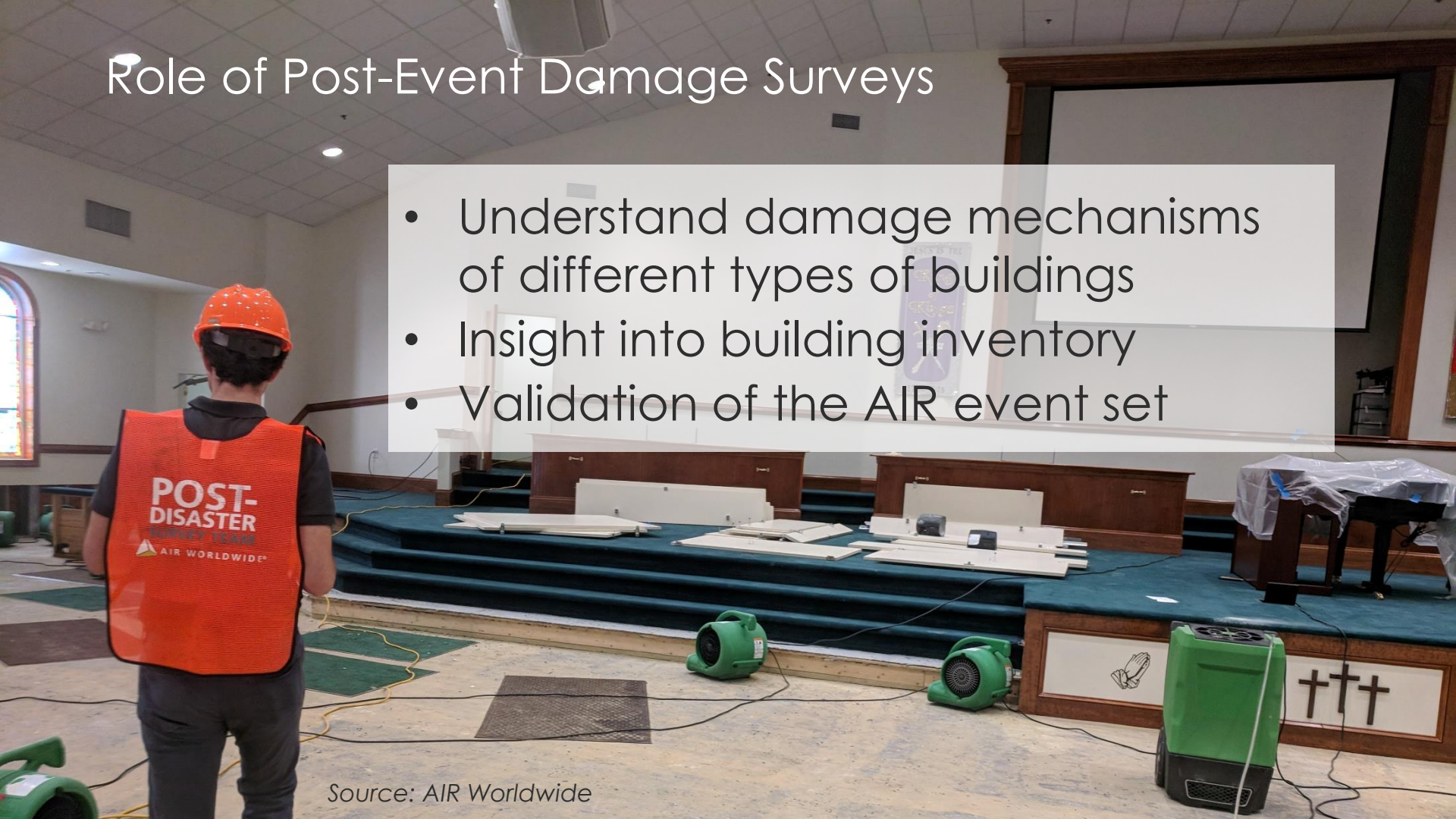


Panama City, FL
Source: AIR Worldwide

- I. Findings from Damage Surveys for Hurricanes Florence and Michael
 - Wind and storm surge impacts
 - Damage to various building components and lines of business
- II. AIR's View of Industry Loss Estimates from Hurricanes Florence and Michael

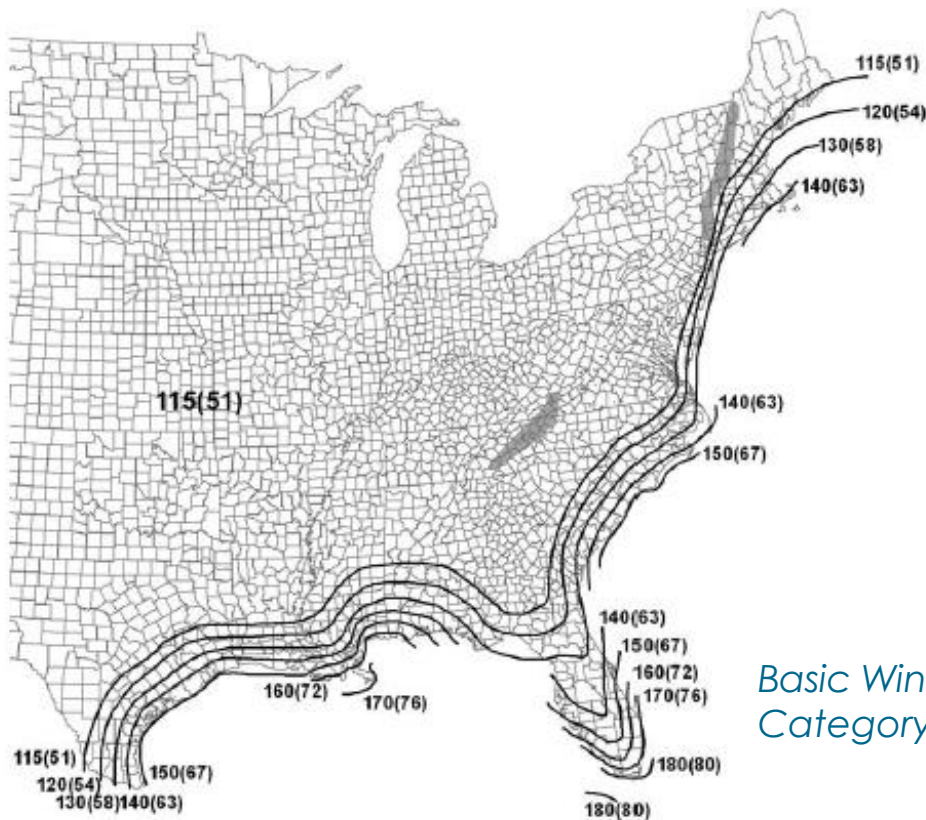
Role of Post-Event Damage Surveys

- Understand damage mechanisms of different types of buildings
- Insight into building inventory
- Validation of the AIR event set



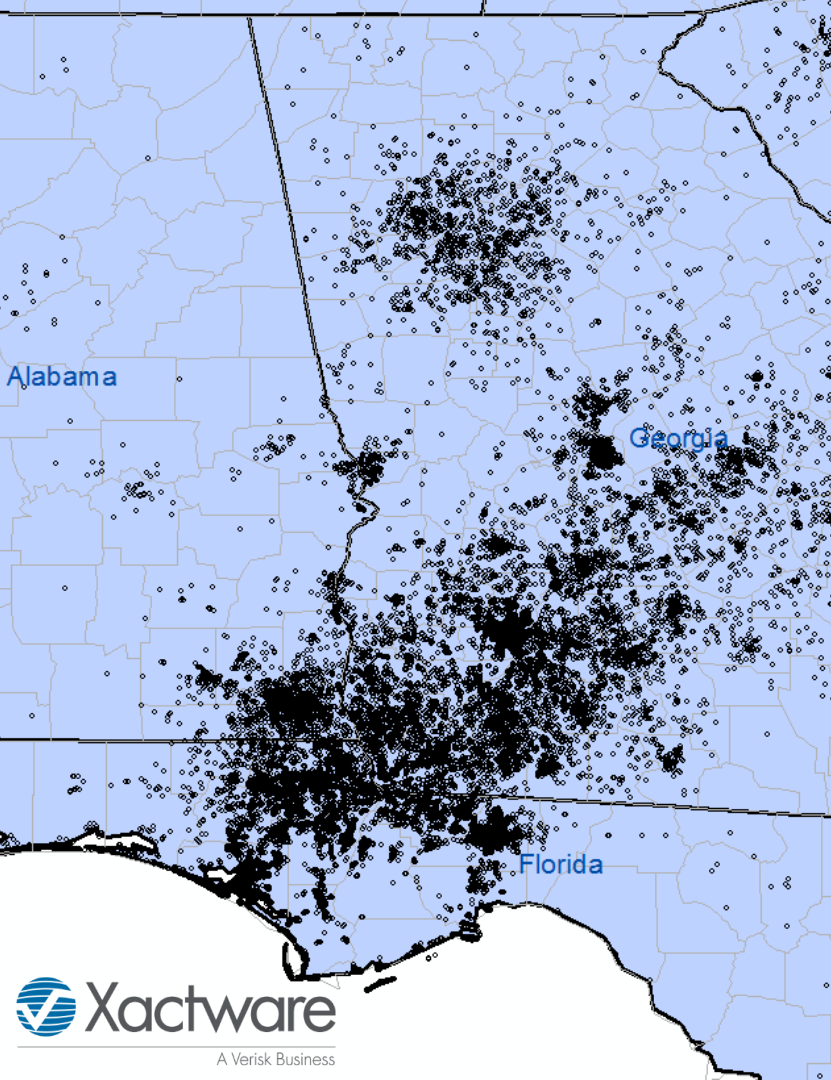
Source: AIR Worldwide

Hurricane Michael Produced Wind Speeds that Reached Design Levels in the Florida Panhandle



- This is not the case when we look at Hurricane Florence or 2017 Hurricane Irma in southern Florida

*Basic Wind Speeds for Occupancy
Category II Buildings as per ASCE 7-10*

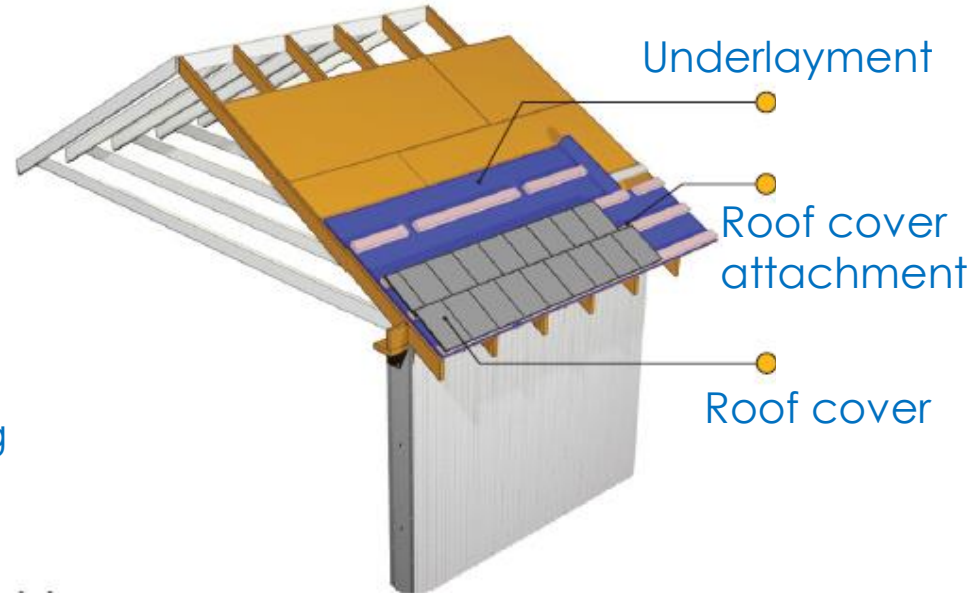
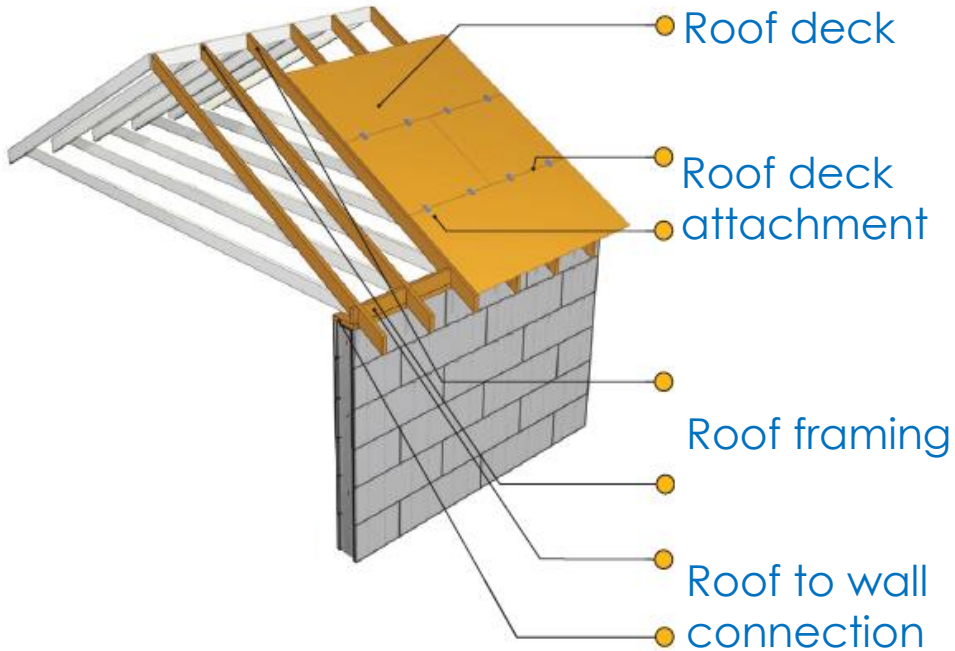


Hurricane Michael Caused Damage in the Florida Panhandle and Georgia

- Wind damage to residential and commercial structures in Albany, Georgia, and environs

Location-level claims for Hurricane Michael

Anatomy of a Home in a High-Wind Area



Source: Resilient Design Guide, FLASH

Most Observed Wind Damage Confirmed Expected Behavior

Lack of proper connections leads to load path discontinuity and member failure



*Panama City, FL
Source: AIR Worldwide*

Most Observed Wind Damage Confirmed Expected Behavior



Parker, FL
Source: AIR Worldwide

Failures Due to Wind-Induced Suction Pressures



*Lynn Haven, Panama City, FL
Source: AIR Worldwide*

Dawson, GA

Source: AIR Worldwide

Performance of Roof Systems

Absence of roof deck



Performance of Roof Covers

- 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



Parker, FL
Source: AIR Worldwide

Performance of Metal Roof Covers in Commercial High-Rise Buildings

*Panama City Beach, FL
Source: AIR Worldwide*



Relatively Poor Performance of Metal Roofs in Hurricane Michael Impacted Areas



*Albany, GA
Source: AIR Worldwide*

Significant Damage to Commercial Built-Up Roofs



Panama City Beach, FL
Source: AIR Worldwide

Significant Damage to Commercial Built-Up Roofs



*Albany, GA
Source: AIR Worldwide*

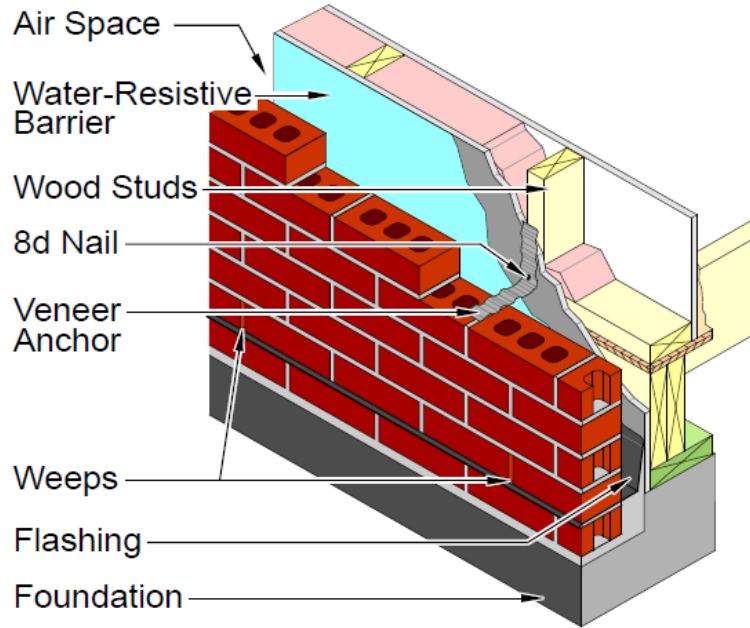
Performance of Wall Siding

Surf City, NC

Source: AIR Worldwide



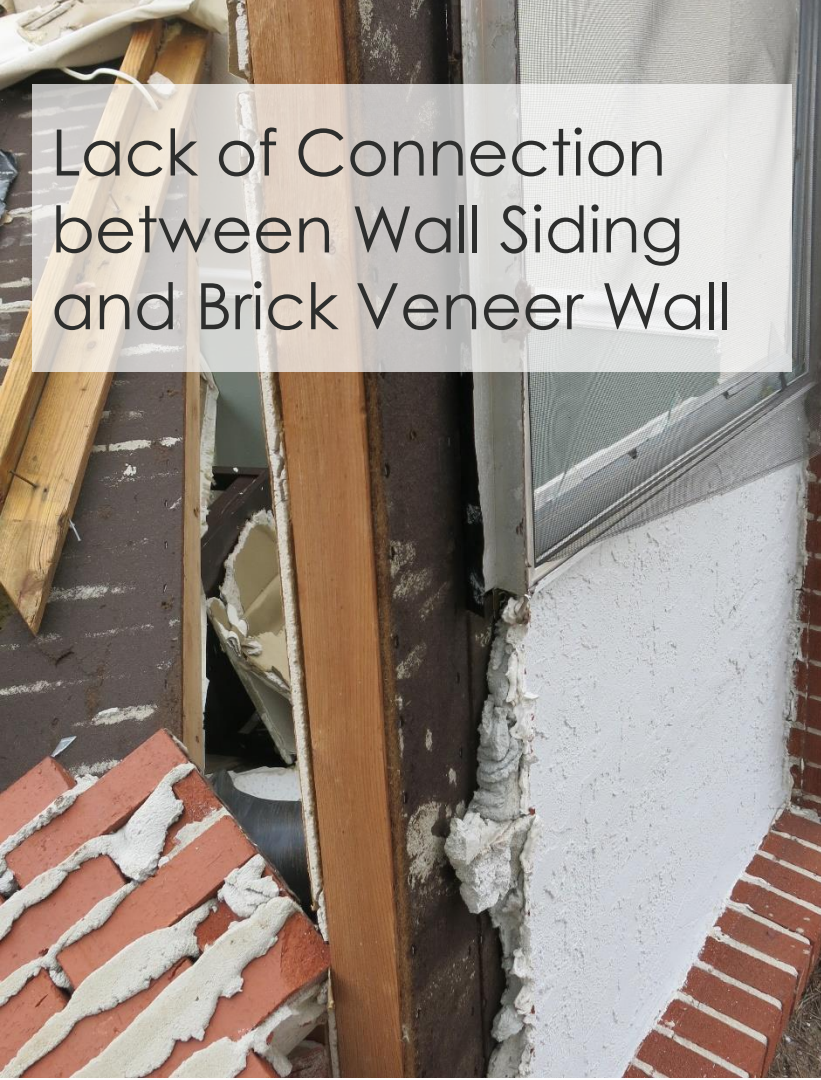
Brick Veneer – Wooden Stud Wall System



- Space anchors no more than 18" vertically (as per IBC)
- Space additional anchors within 12" of openings larger than 16" at a maximum spacing of 3 feet
- **Secure anchors to the studs through the sheathing and not to the sheathing alone**

Source: The Brick Industry Association

Lack of Connection between Wall Siding and Brick Veneer Wall



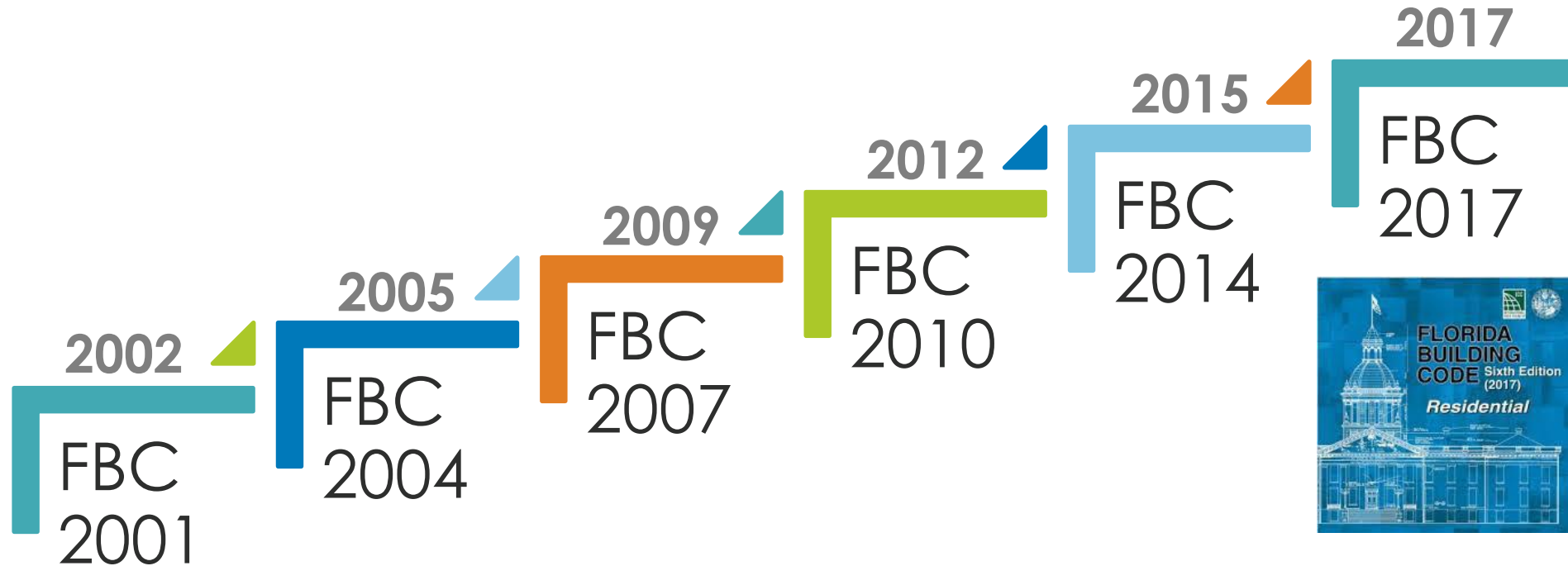
Lynn Haven, Panama City, FL
Source: AIR Worldwide

Damage To Wall Siding and Envelope Elements in Commercial High-Rise Buildings



Panama City Beach, FL
Source: AIR Worldwide

Emergence of the Florida Building Code



Florida Panhandle Has a Unique WBDR History

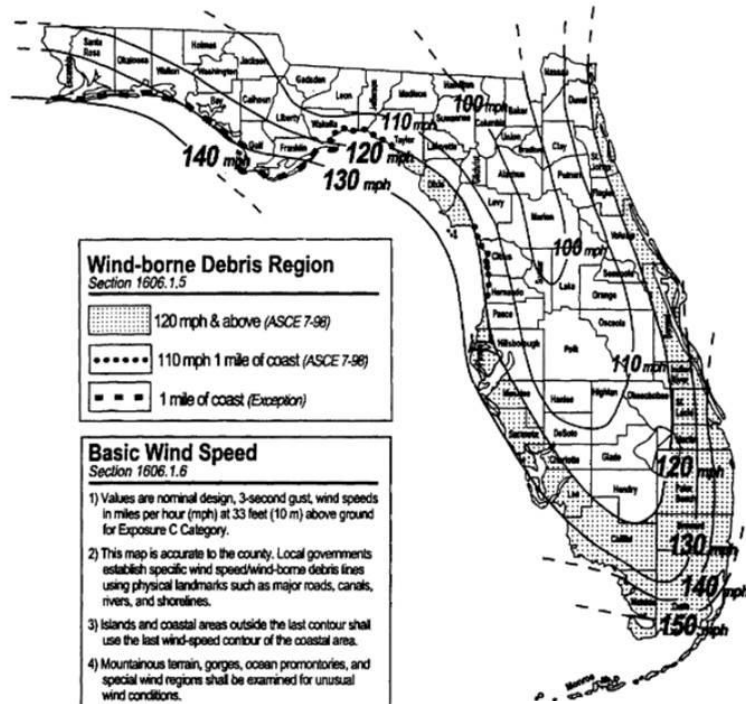


FIGURE 1606
STATE OF FLORIDA
WIND-BORNE DEBRIS REGION & B

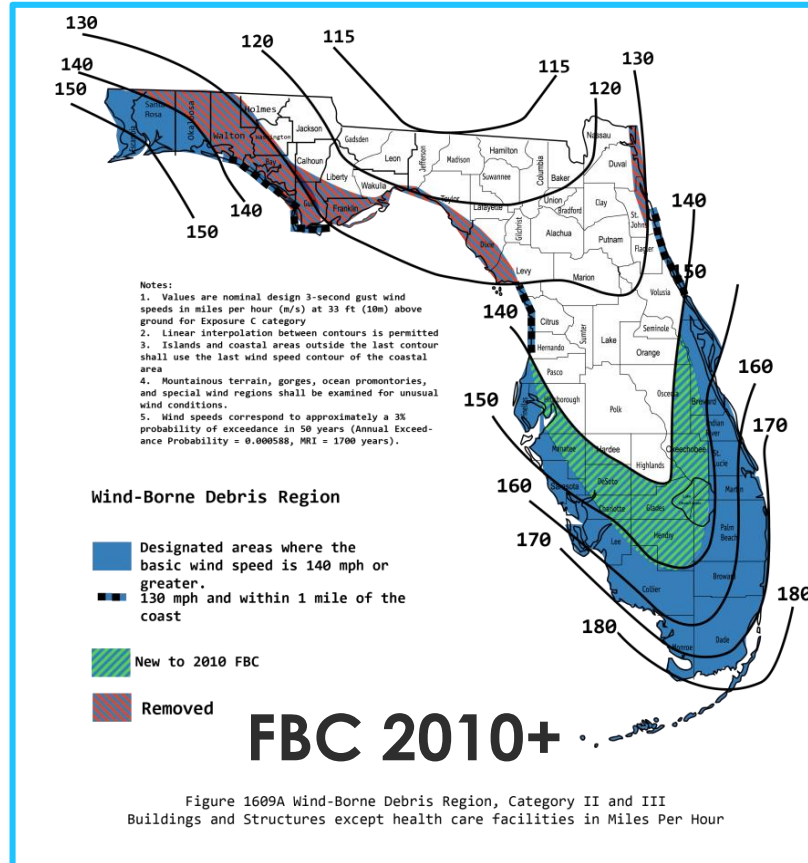
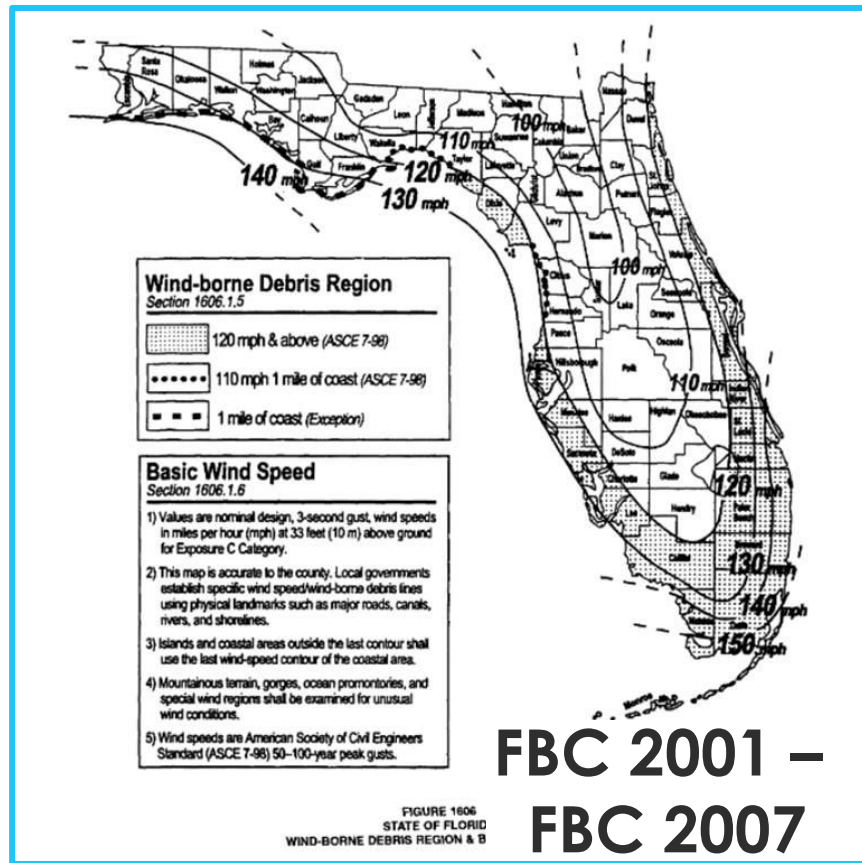
**FBC 2001 –
FBC 2007**

What defines the Wind-Borne Debris Region (WBDR)?

1. Areas with design wind speed ≥ 120 mph
2. Areas with design wind speed ≥ 110 mph and within 1 mile of the coastline

FBC 2001 made a political decision to exclude large swaths of the panhandle from WBDR. Although that reversed in FBC 2004, FBC 2010 and later significantly reduced the WBDR in this region.

Florida Panhandle Has a Unique WBDR History



Consequences of Unprotected Openings

Panama City, FL

Source: AIR Worldwide





Consequences of Unprotected Openings



*Panama City Beach, FL
Source: AIR Worldwide*

Associated Content and Business Interruption Losses



Panama City
Beach, FL
Source: AIR
Worldwide

Industrial Buildings Suffered Wind Damage



Springfield, Panama City, FL
Source: AIR Worldwide



Industrial Buildings Suffered Wind Damage

*Springfield,
Panama City, FL
Source: AIR Worldwide*

Flood Damage

- Significant water damage to unelevated homes
- Crawlspace and slab foundations are bad performers
- Damage to interiors, MEP, contents



Mitigating Building Damage Could Still Cause Significant Business Interruption



Lumberton, NC
Source: U.S. Flood Control



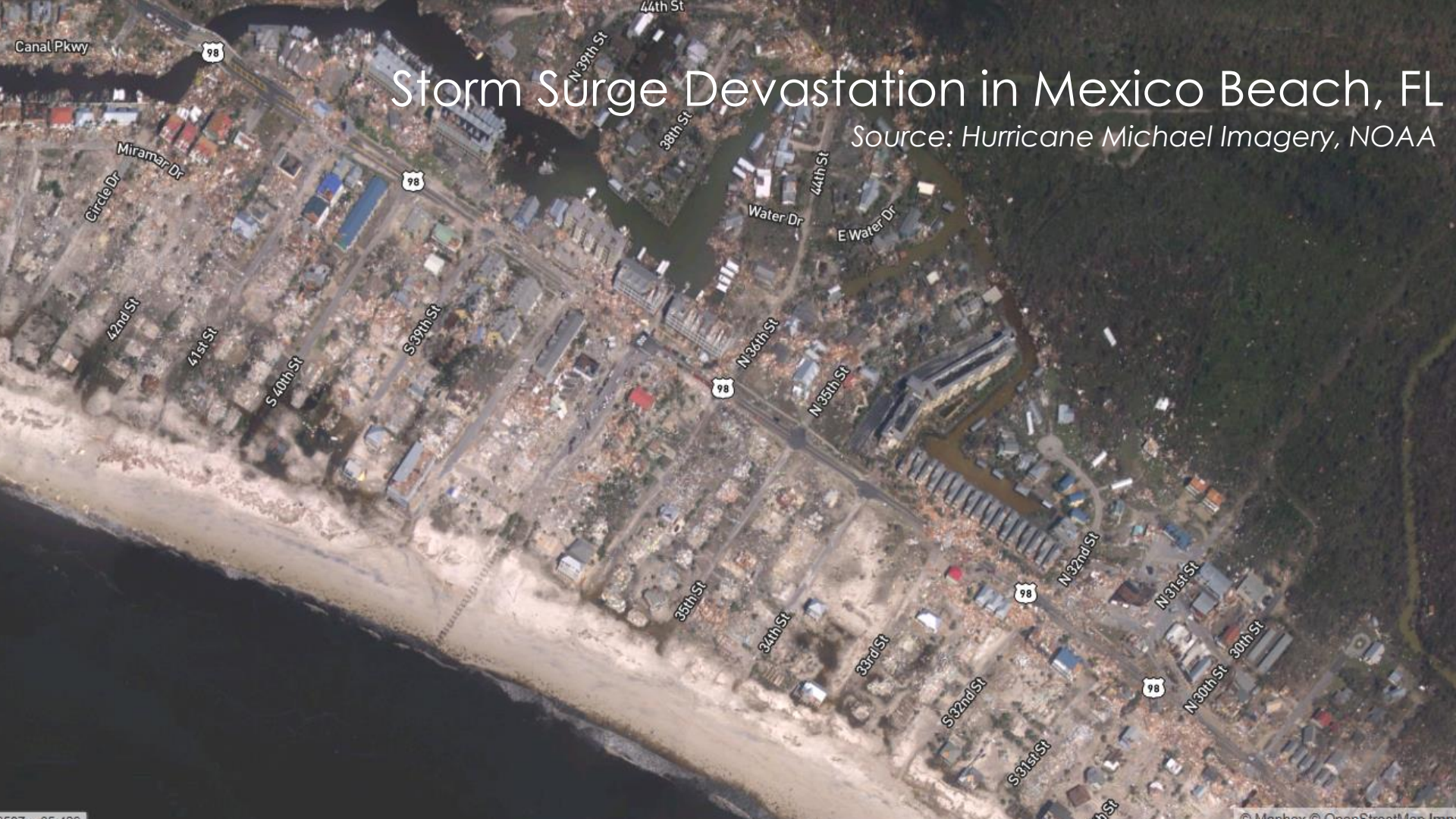
FEMA Flood Map for the City of Mexico Beach, FL

Source: FEMA, National Flood Hazard Layer (NFHL) Viewer

Storm Surge Devastation in Mexico Beach, FL



Source: *The New York Times*, Hurricane Michael: One Mile of Devastation in Florida

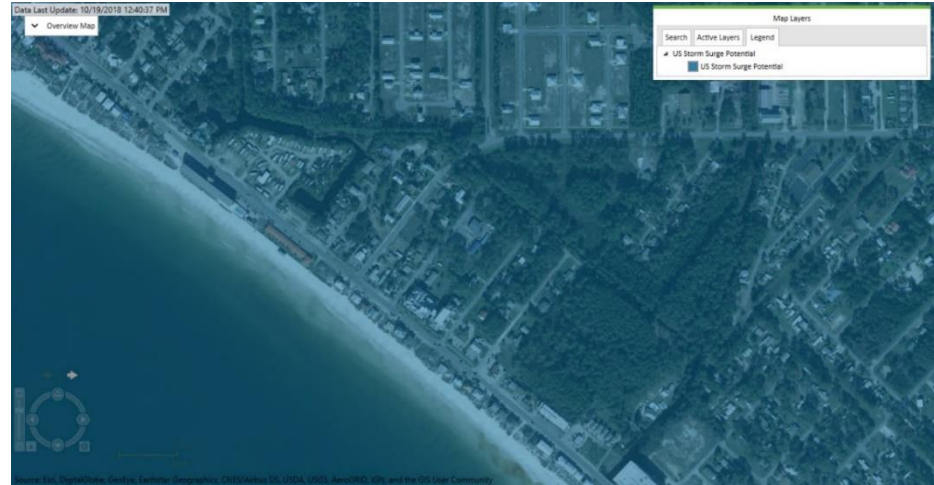


Storm Surge Devastation in Mexico Beach, FL

Source: Hurricane Michael Imagery, NOAA

How Did the FEMA Flood Maps Fare in Areas Worst Affected by Michael's Storm Surge?

- The extent of storm surge went well beyond FEMA designated V, A zones and into the X zones (areas of minimal flood hazard)



*Storm Surge Potential for Mexico Beach
Source: AIR Hurricane Model for the U.S.*

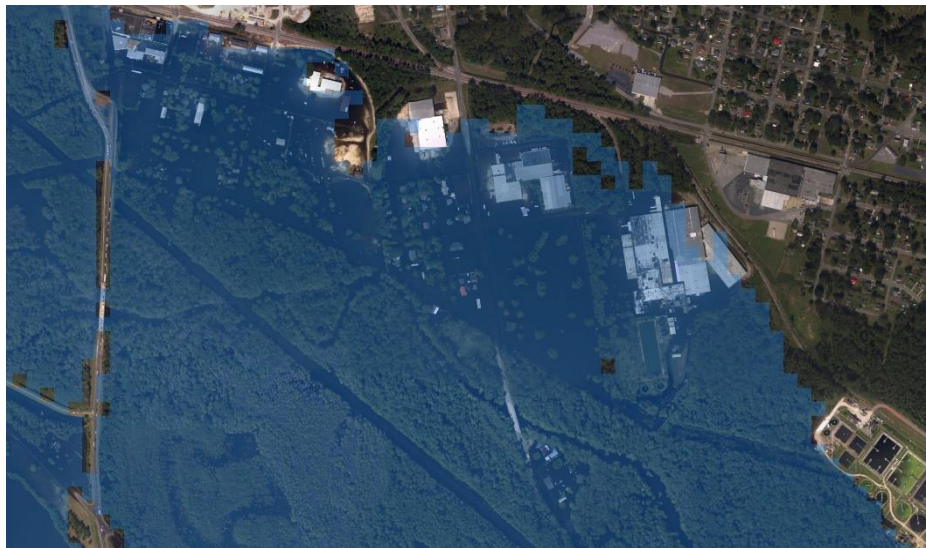
AIR's View of Modeled Losses for the Industry

Hurricanes Florence and Michael

Validating Modeled Hazard Footprints



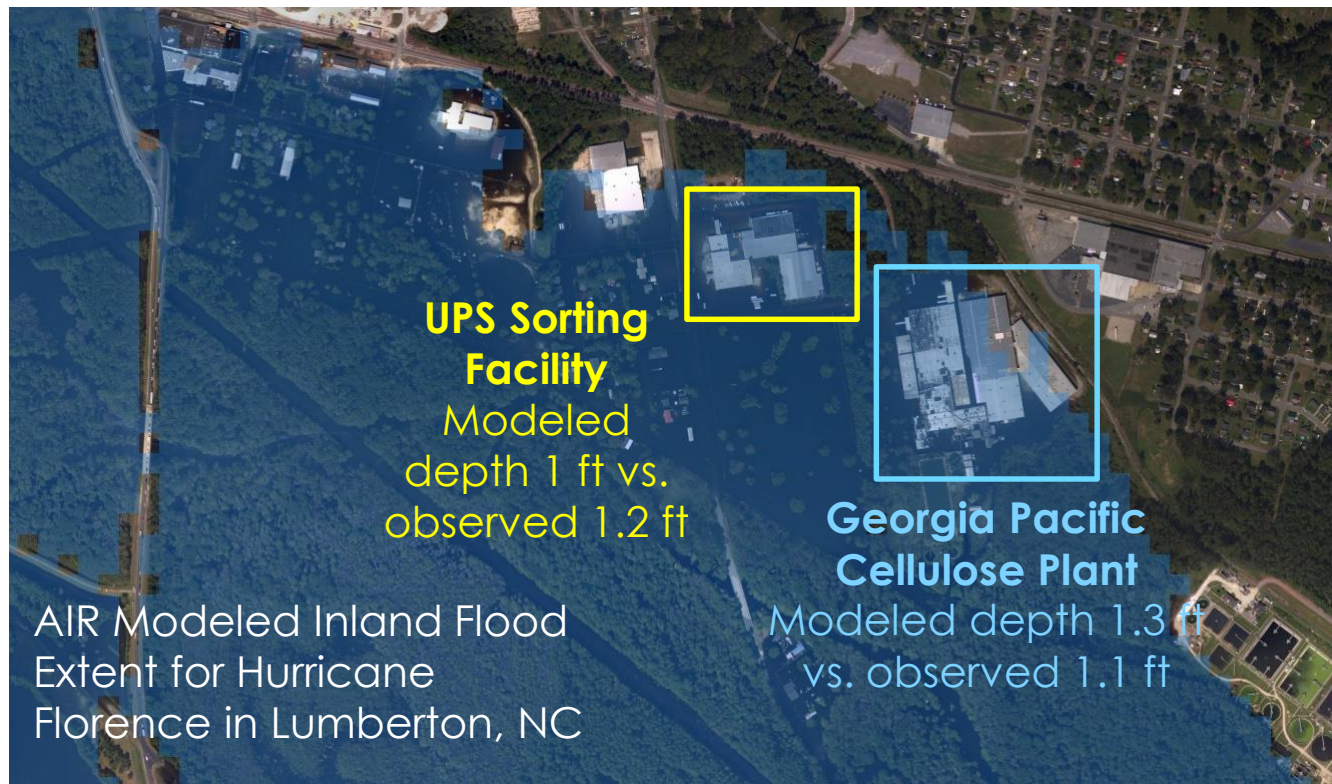
NOAA Imagery – 09/19/2018



AIR Modeled Extent

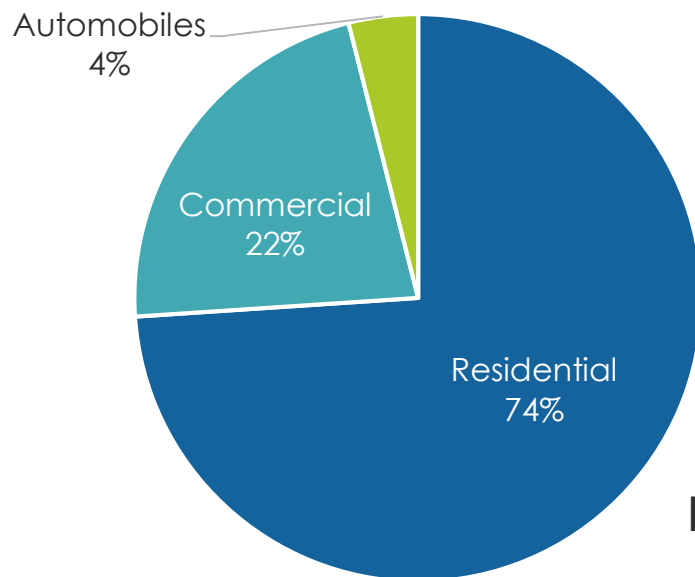
Comparison of Hurricane Florence Flood Extents from the AIR Model with NOAA Aerial Imagery for Lumberton, NC

Validating Modeled Hazard Footprints



AIR's View of Industry Insured Loss Estimates: Hurricane Florence

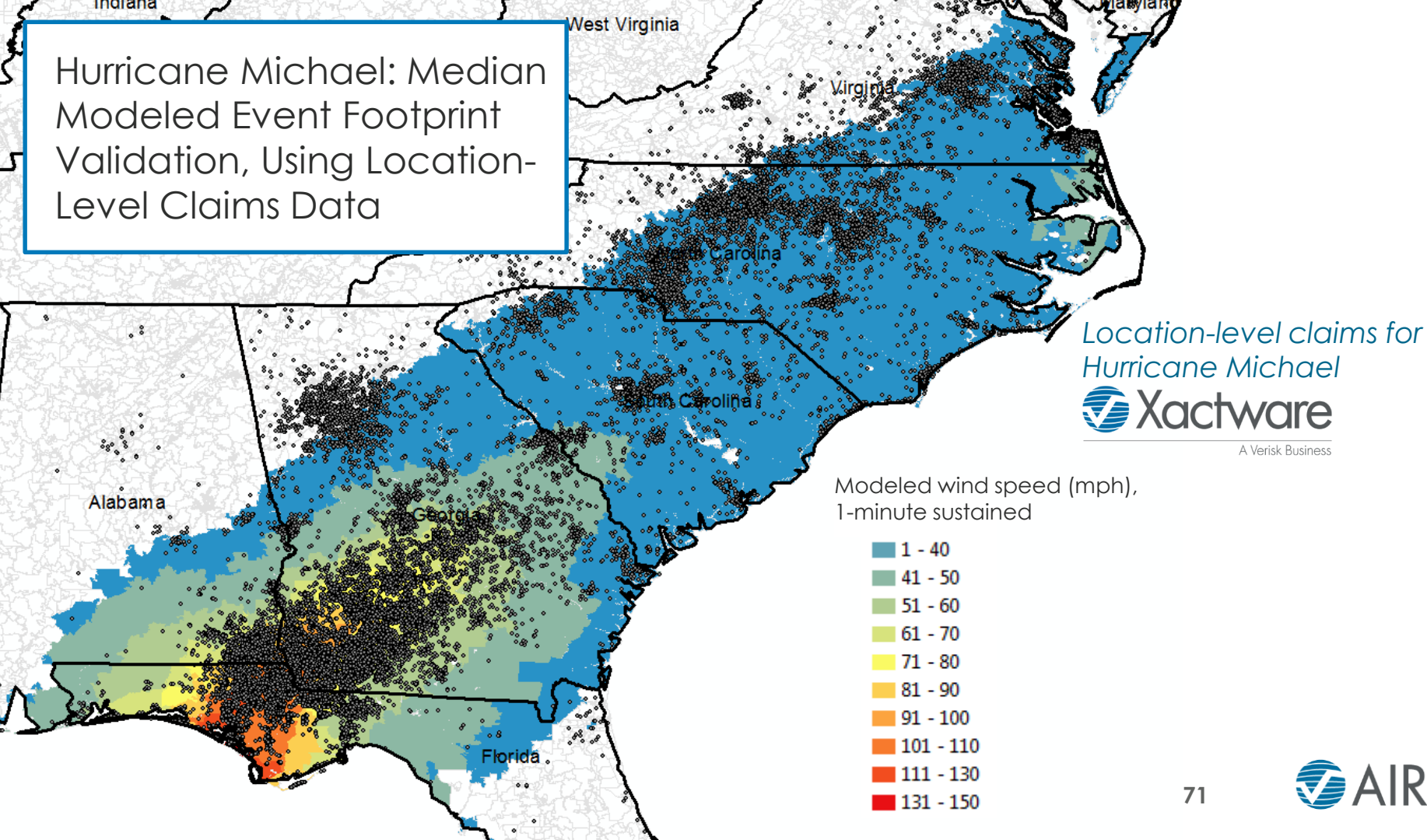
Industry insured wind and storm surge gross loss range
USD 1.7 – 4.6 Billion



Surge Contribution
3.7%

**Breakdown by
Line of Business**

Hurricane Michael: Median Modeled Event Footprint Validation, Using Location-Level Claims Data



AIR's View of Industry Insured Loss Estimates: Hurricane Michael

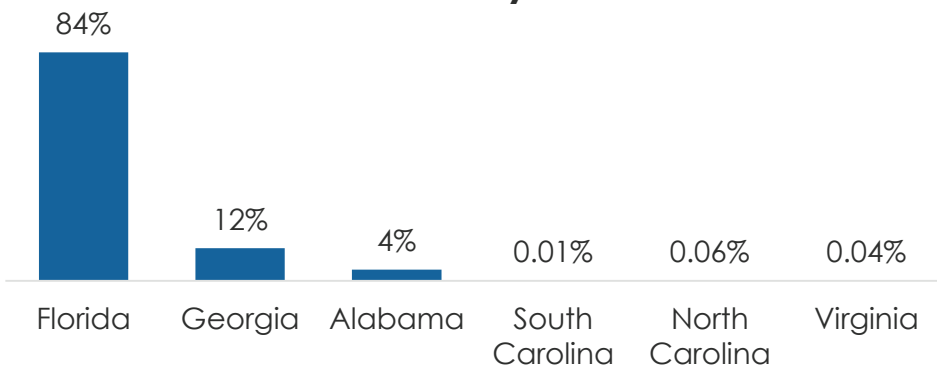
Industry insured wind and storm surge
gross loss range with demand surge

USD 6 – 10 Billion

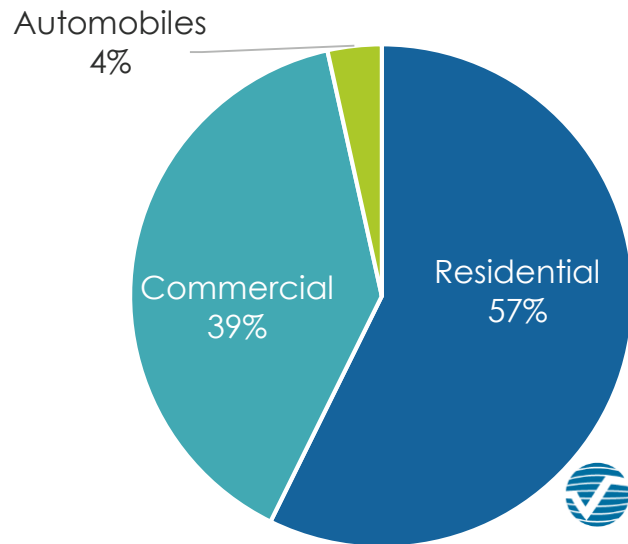


Surge Contribution
0.9%

Contribution by State



Breakdown by Line of Business



ALERT: AIR Loss Estimates in Real Time

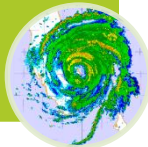
- Monitor basin-wide TC events
- Continuous meteorological data acquisition

Prior to
Landfall



- Early meteorological analysis of parameters and uncertainties
- Gather media reports of damage

At
Landfall



- Does event exceed loss threshold for a full ALERT posting?
- Develop perturbed event scenarios to capture meteorological uncertainties
- Simulate expected and perturbed events to estimate insured loss range

Post-
Landfall



- Release 5 events within 72 hours of event completion
- Refine event footprint for catalog:
 - Damage surveys
 - Claims analyses
 - Additional data sources

Post-
Event



Thank You!

A recording of today's webinar and the slide deck will be distributed shortly.

Thank you for submitting your questions online—they helped to shape today's content!

If your question isn't covered during Q&A, please reach out to your account rep or airconference@air-worldwide.com