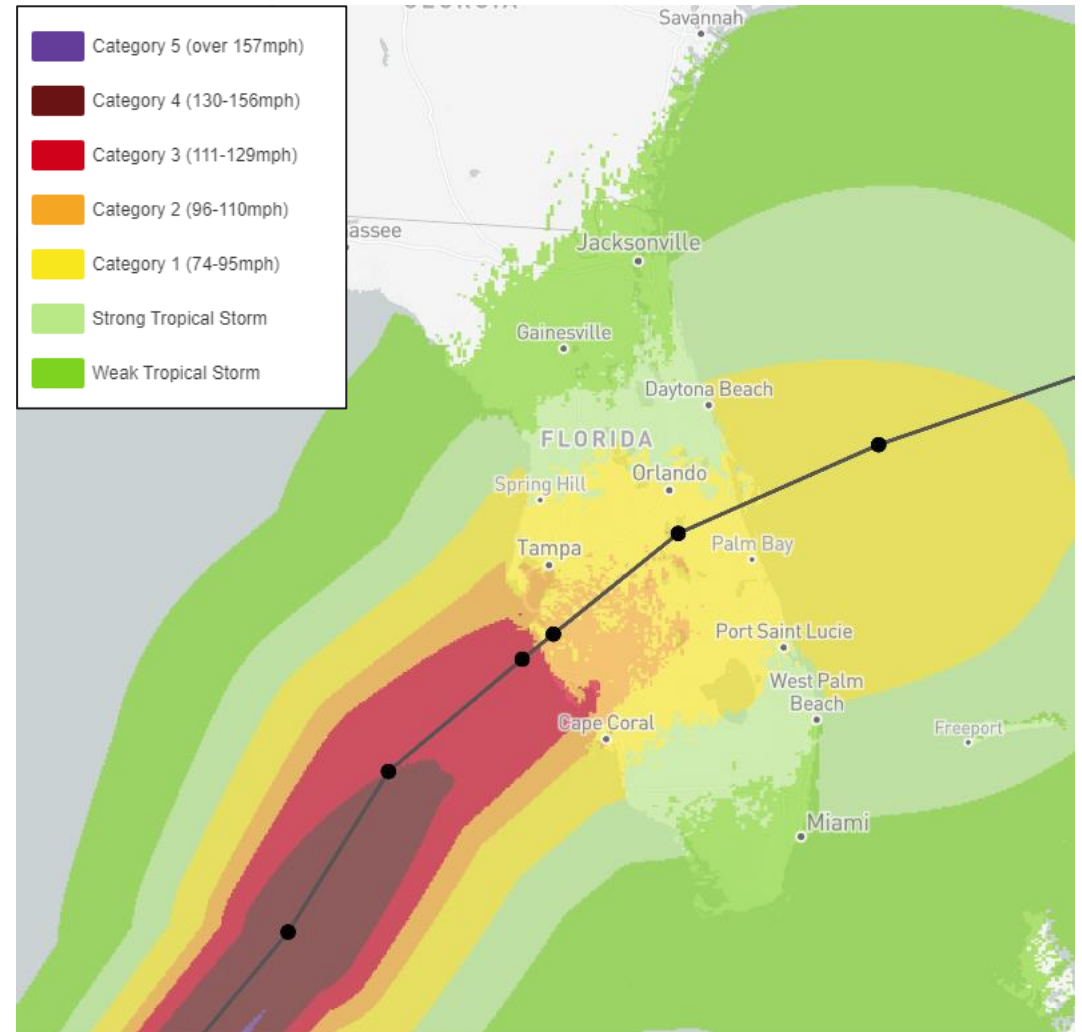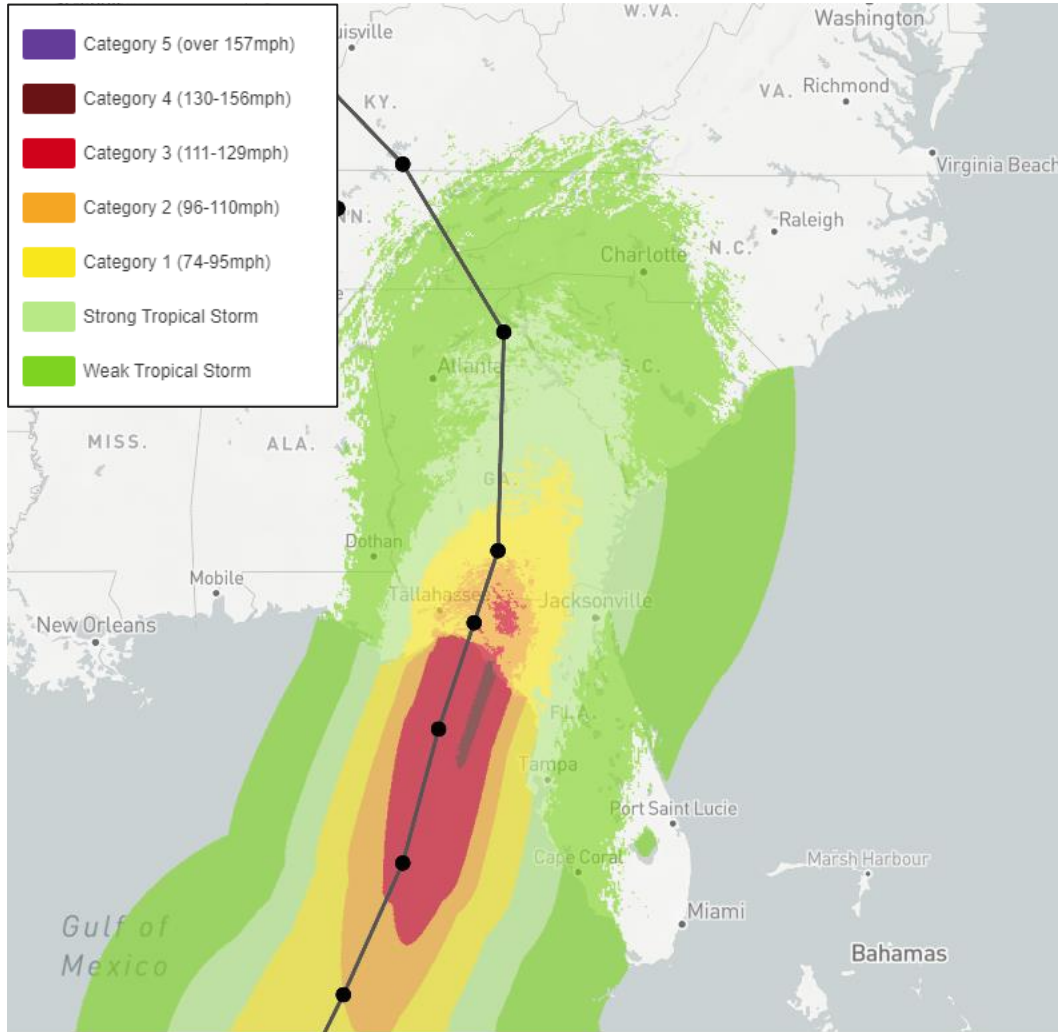GuyCarpenter

WEATHER & CLIMATE OVERVIEW 2024 IN PERSPECITVE

Joint Claim Executives Association
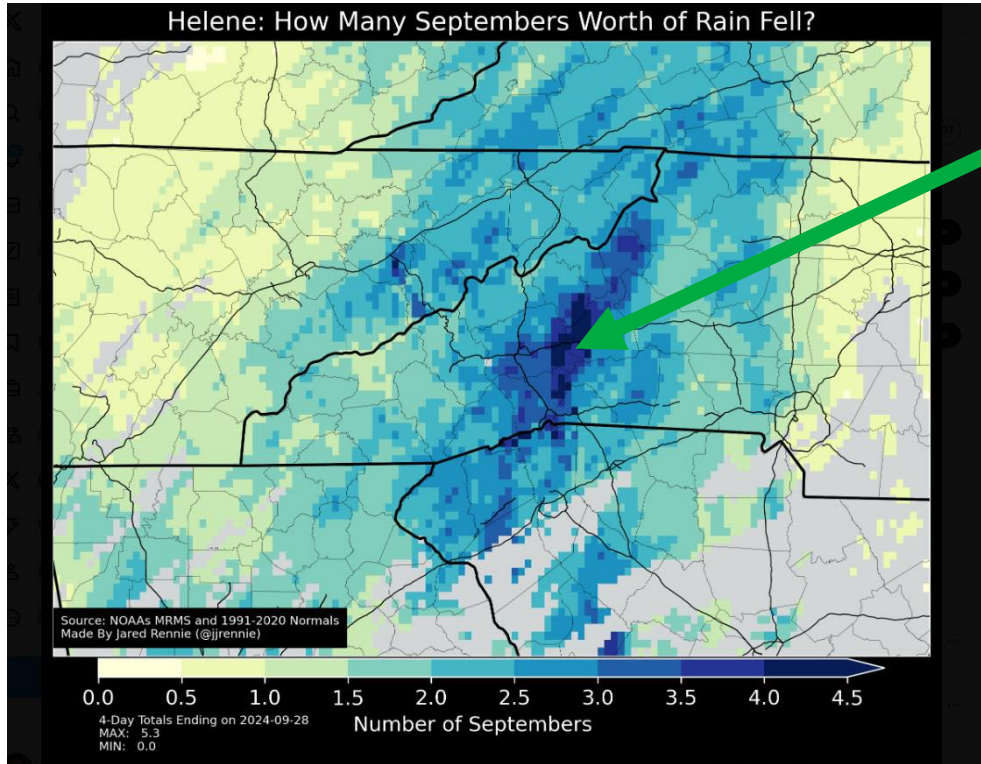
November, 2024

James Waller, PhD
Research Meteorologist
GC Global Analytics & Advisory
Guy Carpenter & Co., LLC
james.waller@guycarp.com

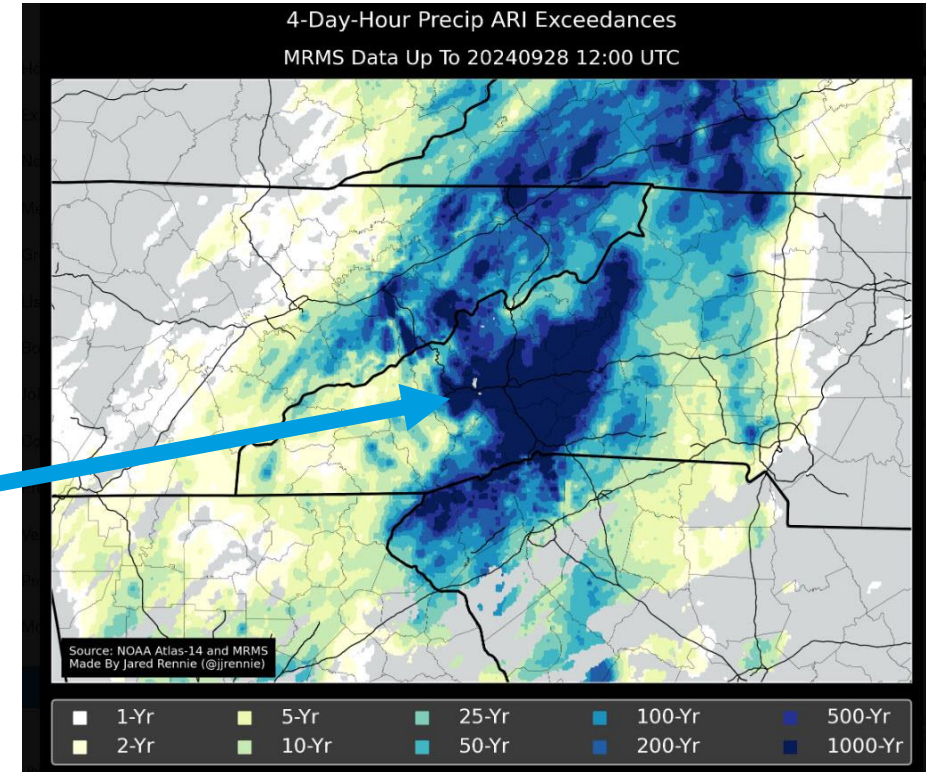# Hurricane Wind Footprints for Helene (Left) & Milton (Right)

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Record High River Crests in Helene

Helene: How Many Septembers Worth of Rain Fell?

Source: NOAAs MRMS and 1991-2020 Normals
Made By Jared Rennie (@jjrennie)

4-Day Totals Ending on 2024-09-28
MAX: 5.3
MIN: 0.0

Number of Septembers

5.3X of normal September rainfall in four days

4-Day-Hour Precip ARI Exceedances
MRMS Data Up To 20240928 12:00 UTC

Source: NOAA Atlas-14 and MRMS
Made By Jared Rennie (@jjrennie)

1-Yr | 5-Yr | 25-Yr | 100-Yr | 500-Yr
2-Yr | 10-Yr | 50-Yr | 200-Yr | 1000-Yr

Wide region in excess of 1,000 year return period

South Carolina River Gauge	Record Crest Height (feet)	Year	Helene Forecast Crest Height	Helene Rank
Saluda River Greenville, SC	19.4	1949	20.23	1
Wateree River Camden, SC	40.4	1916	38.75	4
Catawba River Catawba, SC	24.7	2020	27.65	1

North Carolina River Gauge	Record Crest Height (feet)	Year	Helene Forecast Crest Height	Helene Rank
Pigeon River Canton, NC	22.8	2004	25.9	1
Swannanoa River Biltmore, NC	20.7	1916	26.1	1
French Broad River Asheville, NC	23.1	1916	24.67	1
French Broad River Fletcher, NC	20.1	2004	30.31	1

Tennessee River Gauge	Record Crest Height (feet)	Year	Helene Forecast Crest Height	Helene Rank
French Broad River Newport, TN	24	1867	23.3	2
Pigeon River Newport, TN	23.4	1902	28.9	1

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Source: NOAA, Jared Rennie
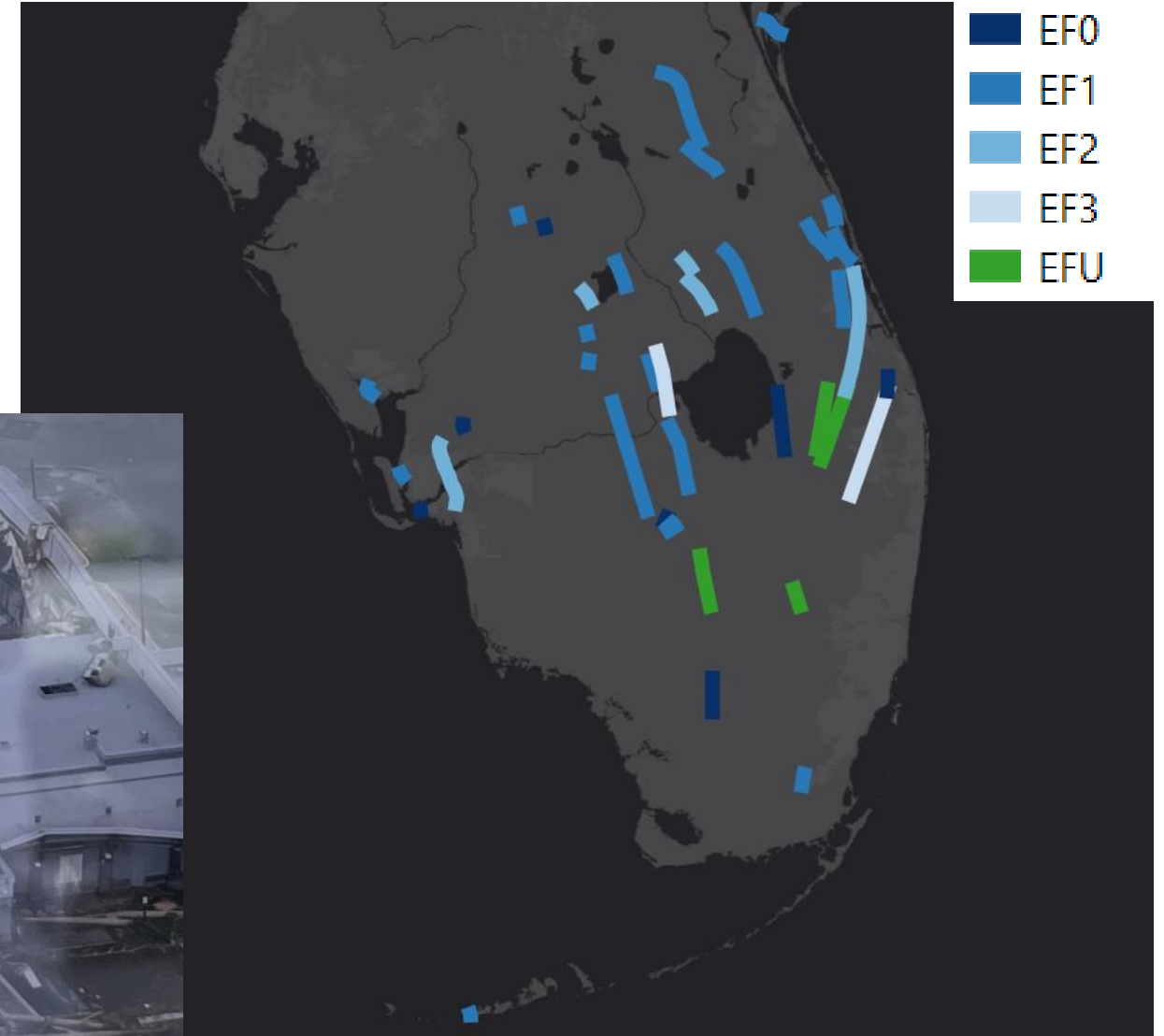
3

Milton Confirmed Tornado Tracks

Most significant hurricane-tornado outbreak in recorded history (including Katrina 2005, Ivan 2004).

Two destructive EF-3 tornadoes.

Statewide tornado warnings rivalled April 27, 2011.

Tornado activity in outermost bands well away from center.

Florida Building Codes notably offset damage.

EF0
EF1
EF2
EF3
EFU

Milton tornado tracks (right)
Unfinished Publix in Palm Beach Gardens (left).
Source: NOAA/NWS

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Climate Change Contribution to Milton and Helene

Storm surge, heavy rainfall, rapid intensification consistent with expectations.

Storm Surge

Record seawater inundation western Florida
Roughly 10" increase in sea level last 75 years
Projected 1-2 feet increase by 2050s
FEMA Elevated Foundations

Excessive Rainfall

Record-shattering rainfall both Milton & Helene
~3-4% water vapor increase for each +1ºF
Projected increase by 2050s
Stormwater management, flood control

Rapid Intensification

Helene/Milton 55/95 mph gain in 24 hours
Notable trend since 1980s
Observed/Projected ocean temperature increase
Projected increase CAT4+ hurricanes by 2050s
Wind codes - IBHS Fortified Standards

Hurricane Frequency

Active period since 1995
Long term observed trends indeterminate
Projected trends unclear

2024 North Atlantic Hurricane Season Summary

| Hurricane	Date	Winds	State
Beryl	July 8	80 mph (CAT1)	Texas
Debby	August 5	80 mph (CAT1)	Florida
Francine	September 11	100 mph (CAT2)	Louisiana
Helene	September 26	140 mph (CAT4)	Florida
Milton	October 9	120 mph (CAT3)	Florida

2024 US Hurricane Landfalls. Source: NOAA/NHC, Colorado State University.

	CSU (August 6)	NOAA (August 8)	Observed (October 31)	1950-2023 Average	1995-2023 Average
Named Storms	23	17-24	15	12	16
Hurricanes	12	8-13	10	6	8
Major Hurricanes	6	4-7	4	3	4
US Landfalls	-	-	5	1.5	1.8

2024 Tropical Activity for the North Atlantic Basin. Source: NOAA/NHC, Colorado State University.

Continental U.S. Landfalling Hurricanes (1900-2023)
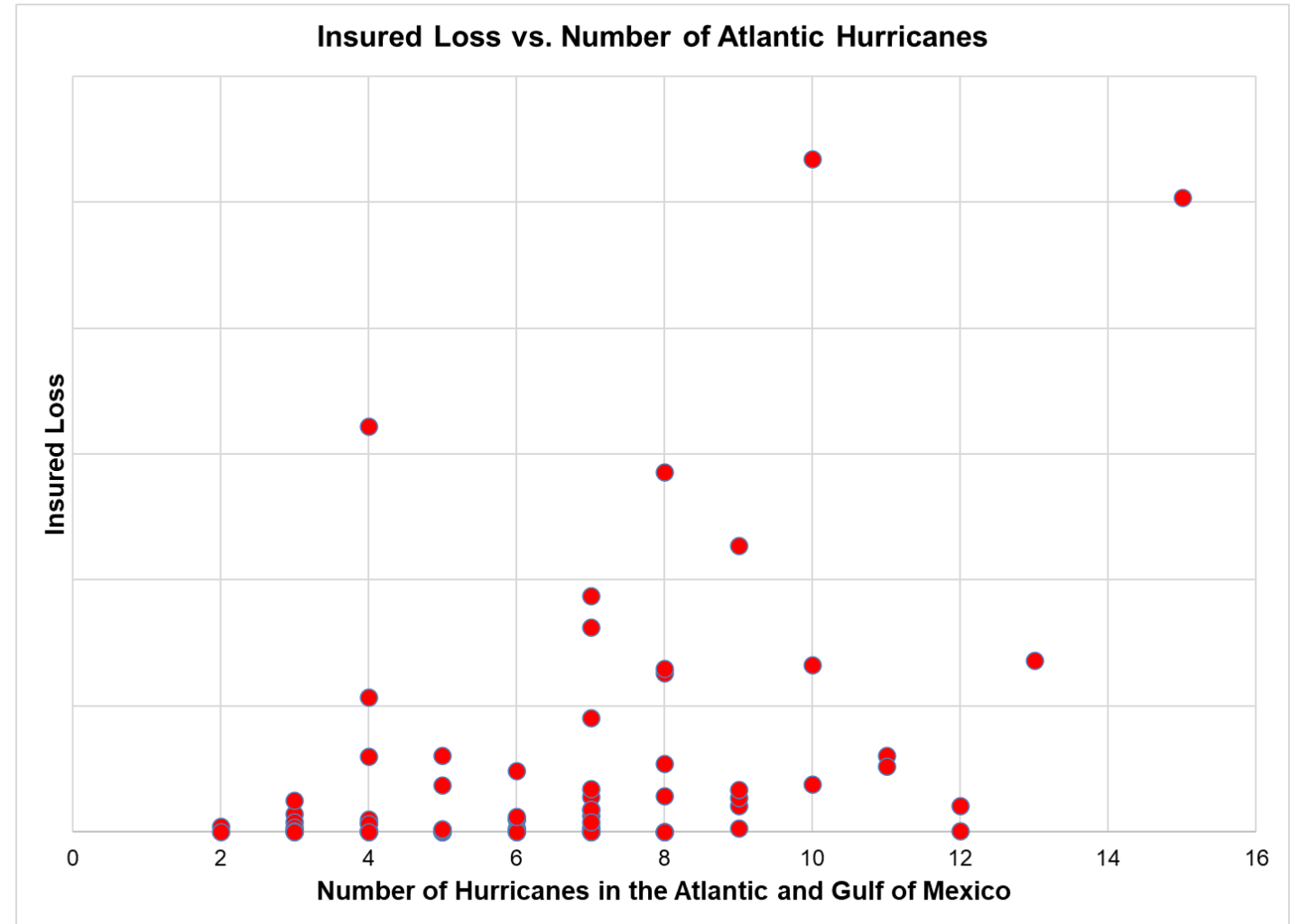## Busy since 1995. Variability. No apparent long-term trend.

Continental U.S. Landfalling Hurricanes (1900-2023)

Source: NOAA/NHC.

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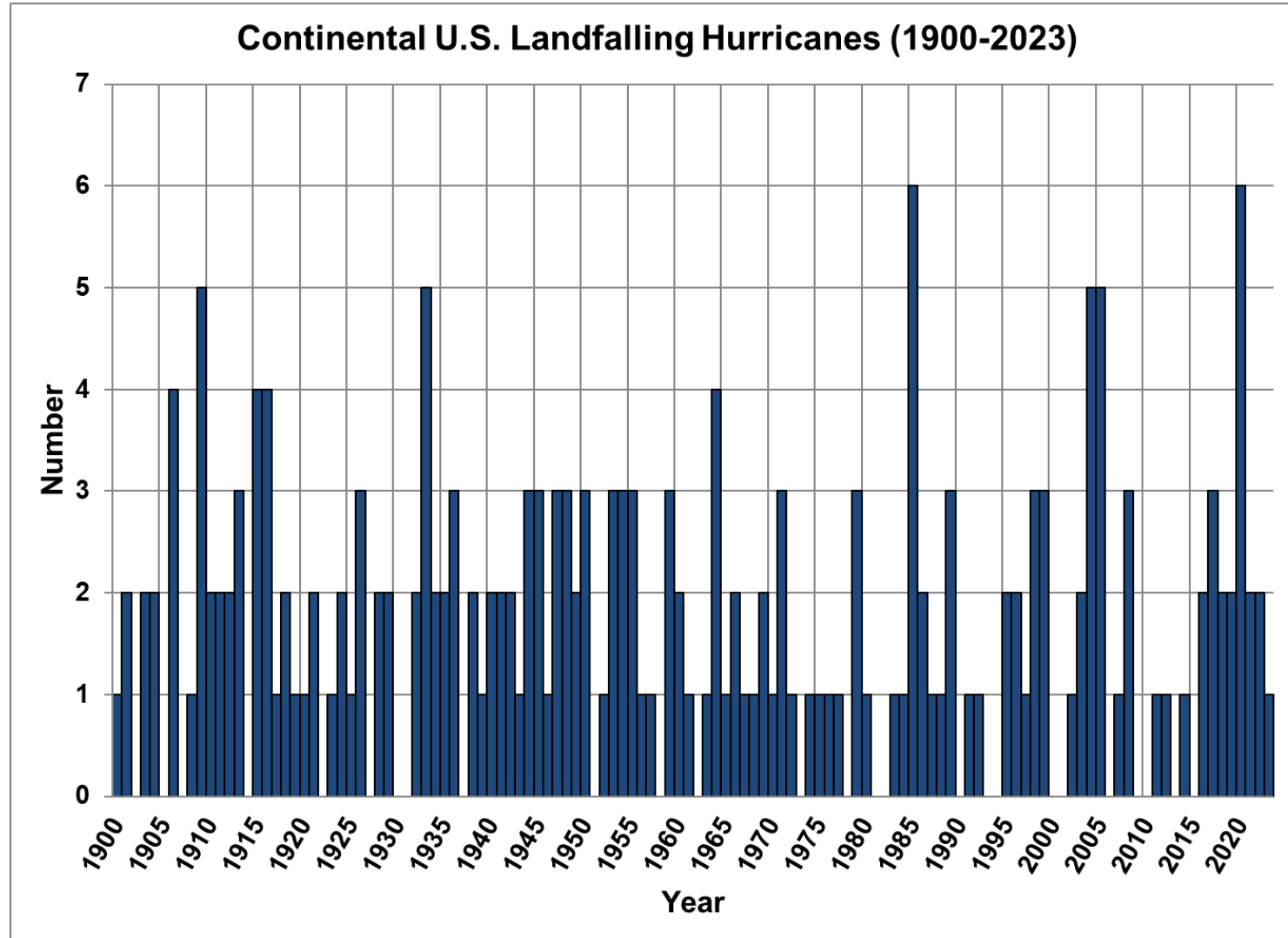
Historical Benchmarks

- Atlantic basin produced a seasonal range of 2-15 hurricanes between 1950-2023.

- Insured losses for a given season range from marginal to over USD 100 billion.

- Basin activity can serve as a rough view of *directionality* of insured losses for a season.

BUT

- Basin activity is *not* a reliable predictor of insured loss (variability season to season).

- Landfall to basin ratio ranges between 0%-86% (average between 20%-25%).

- Insured losses are determined by hurricane *landfalls* in a given season, affected population centers, construction characteristics, portfolio makeup and policy terms (to name a few).
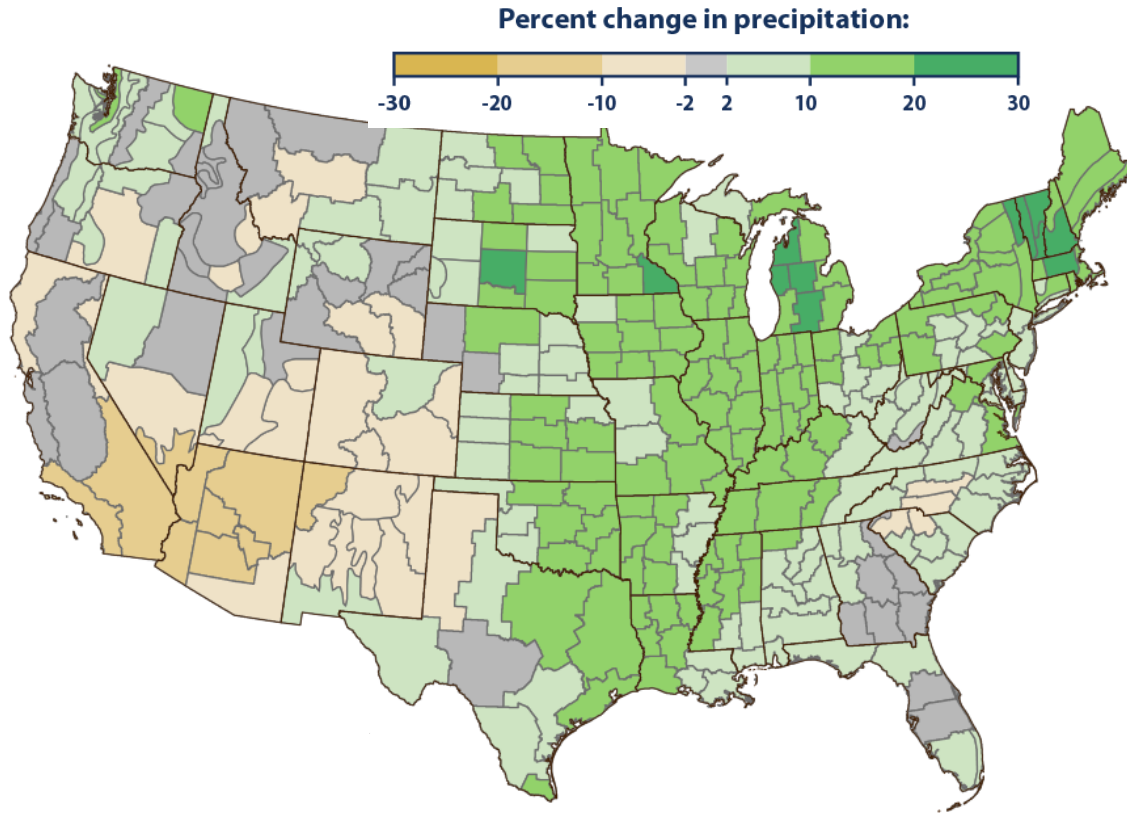

Insured Loss vs. Number of Atlantic Hurricanes

Insured Loss (y-axis)

Number of Hurricanes in the Atlantic and Gulf of Mexico (x-axis)

Insured loss versus number of Atlantic Basin hurricanes 1950-2023
Trended for inflation & population
SOURCES: NOAA/HRD, Verisk PCS

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Florida OIR Claims Comparison
## Higher ratio of claims closed without payment (unmet deductible, flood on wind only policy, others)

	Milton (2024)	Helene (2024)	Ian (2022)	Michael (2018)	Irma (2017)
Residential Property					
# Claims	210,021	57415	558,299	101,932	955,852
% Claims closed	26.6%	51.4%	89%	95%	95%
% Claims closed w/o payment	60%	65%	27%	15%	32%
Commercial Property					
# Claims	9257	3,084	33,010	11,873	62,949
% Claims closed	11.2%	14%	73%	84%	94%
% Claims closed w/o payment	80%	77%	53%	28%	52%

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US Flood Risk is Shifting

Percent change in precipitation:

-30 -20 -10 -2 2 10 20 30

The Midwest is getting wetter

Estimated average yearly change in peak flow of water (in cubic feet per second) measured at 200 USGS stream gauges from 1917 to 2017

ESTIMATED AVG. YEARLY CHANGE (ft^3/sec)

-50 +50
-100 +100
-200 +200
-300 +300

The estimated yearly average changes are calculated by fitting a linear time trend on annual peak streamflow for each USGS gauge.

FiveThirtyEight
SOURCE: U.S. GEOLOGICAL SURVEY

- Precent change in annual precipitation 1901/2023
- Warmer atmosphere holds more water vapor, can produce more precipitation
- *Also* national increase in extreme precipitation events..
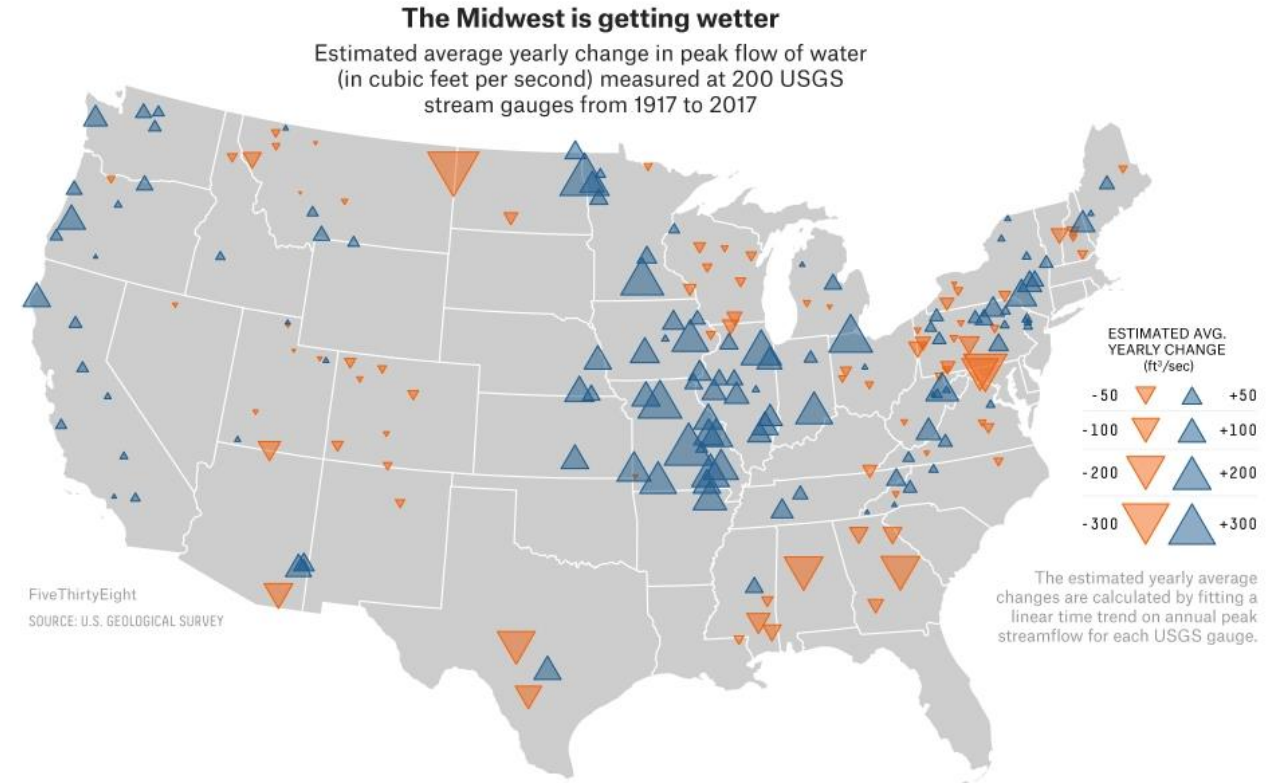
- Average yearly change in peak gauge flow 1917-2017
- Gauge flow is increasing in the Midwest and to a lesser extent in the Northeast.

Sources: https://www.epa.gov/climate-indicators/climate-change-indicators-us-and-global-precipitation; *Slater, L. J., and G. Villarini (2016), Recent trends in U.S. flood risk, Geophys. Res.Lett., 43, 12,428–12,436*

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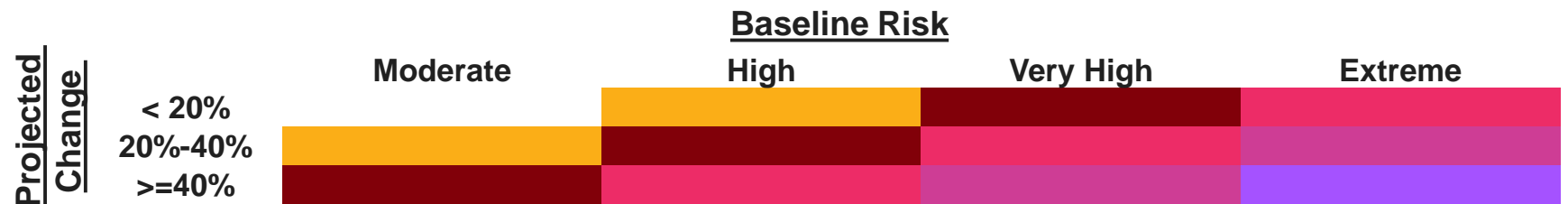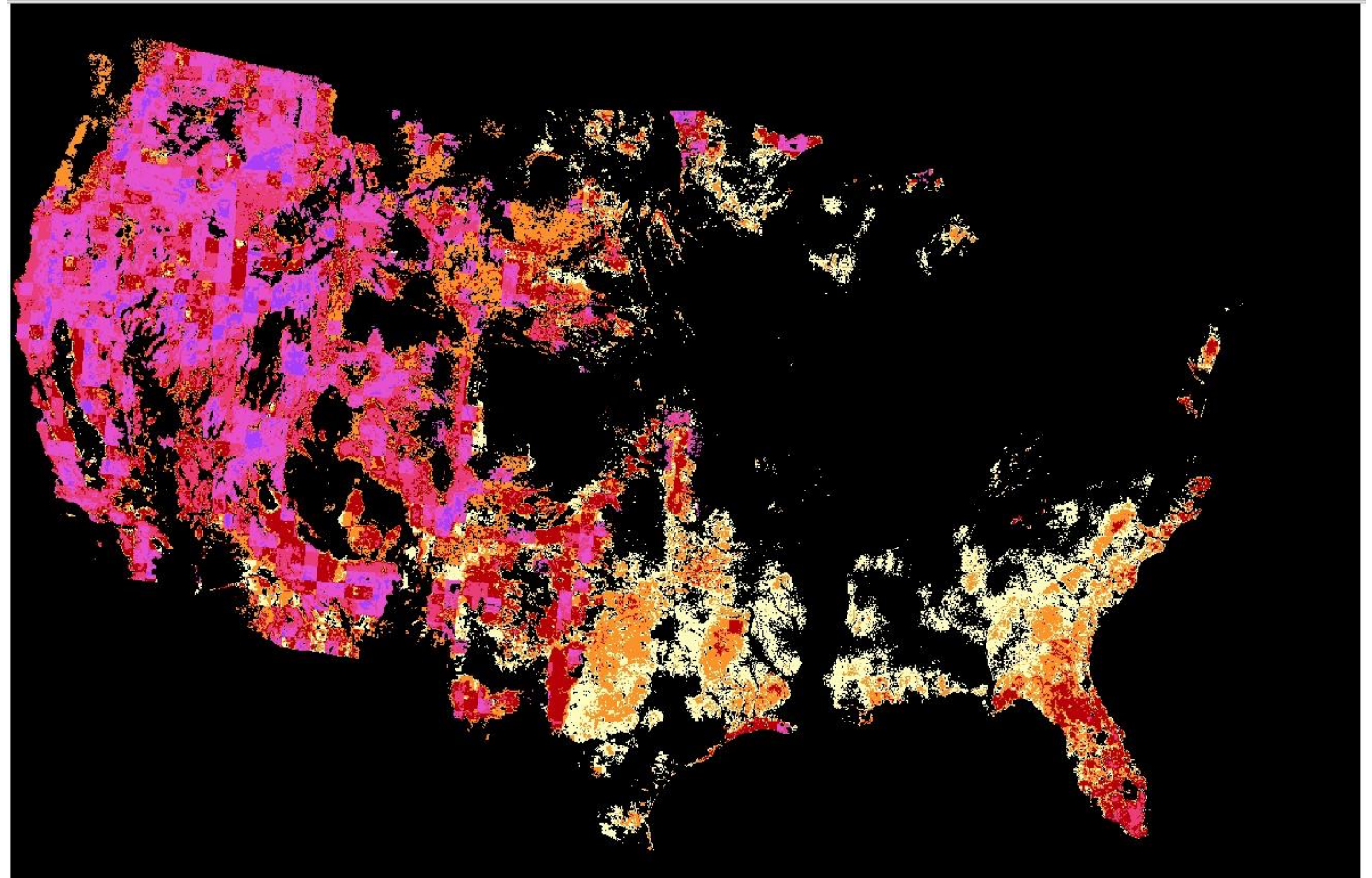# Observed Increase in WF Environments Projected to Continue

Map shows projected change in wildfire hazard relative to current-day baseline hazard.

Evaluated with factors including wildfire environments (hot & dry conditions), fuel characteristics, for present & projected climates.

Observed increase in wildfire environments projected to continue.

*IBHS Wildfire recommendations.*

CA Building Codes.

Baseline Risk

Projected Change		Moderate	High	Very High	Extreme
< 20%					
20%-40%					
>=40%					

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Active Tornado Year in 2024 – Most Active Since 2011
Very active season in Great Lakes, Midwest, Texas, Florida

Tornado Warning Rank of Event Count (1=lowest) by WFO
Issued between 01 Jan 2024 00:00 - 29 Oct 2024 23:59 UTC, based on VTEC: TO.W , Period of Record: 2002-2024
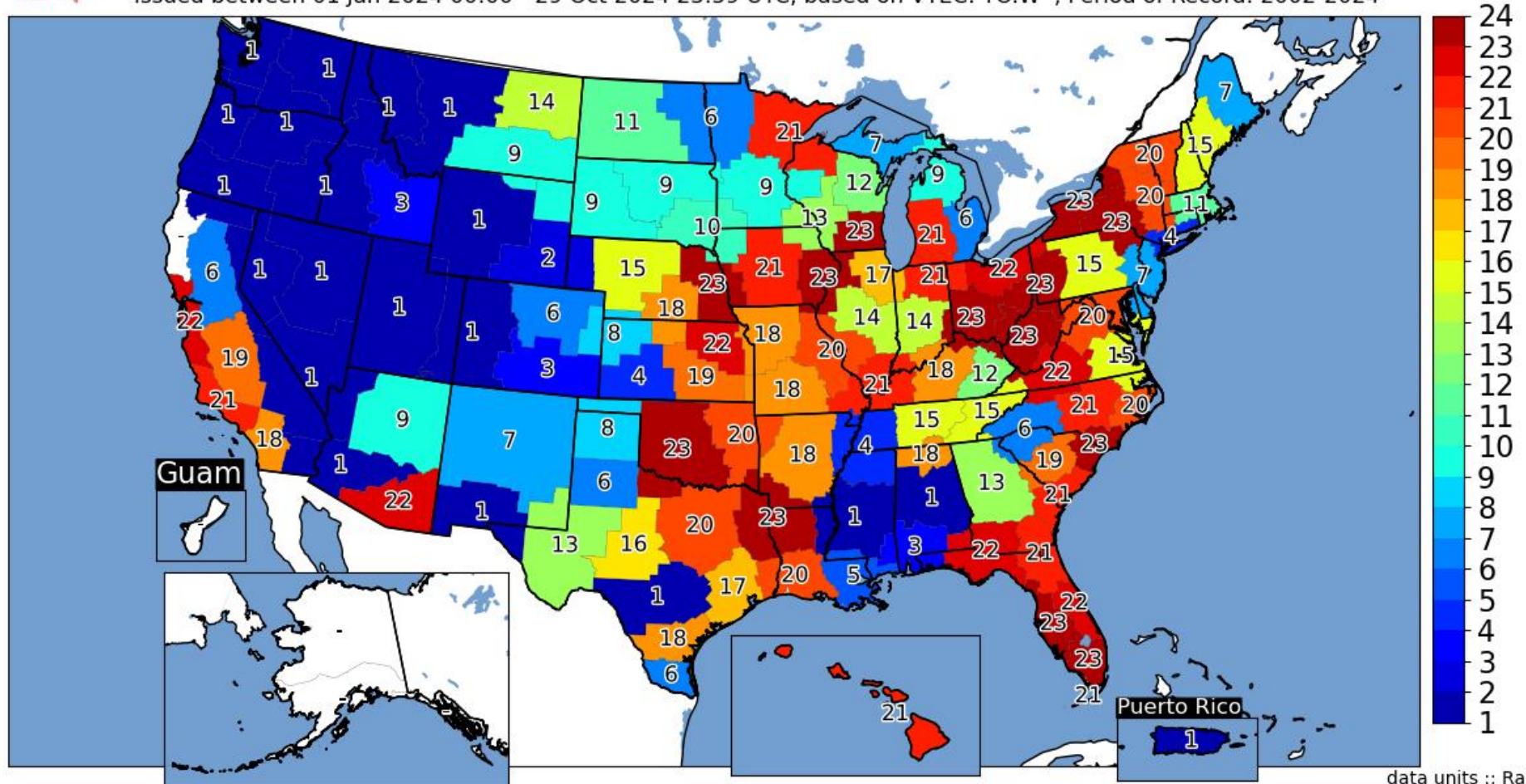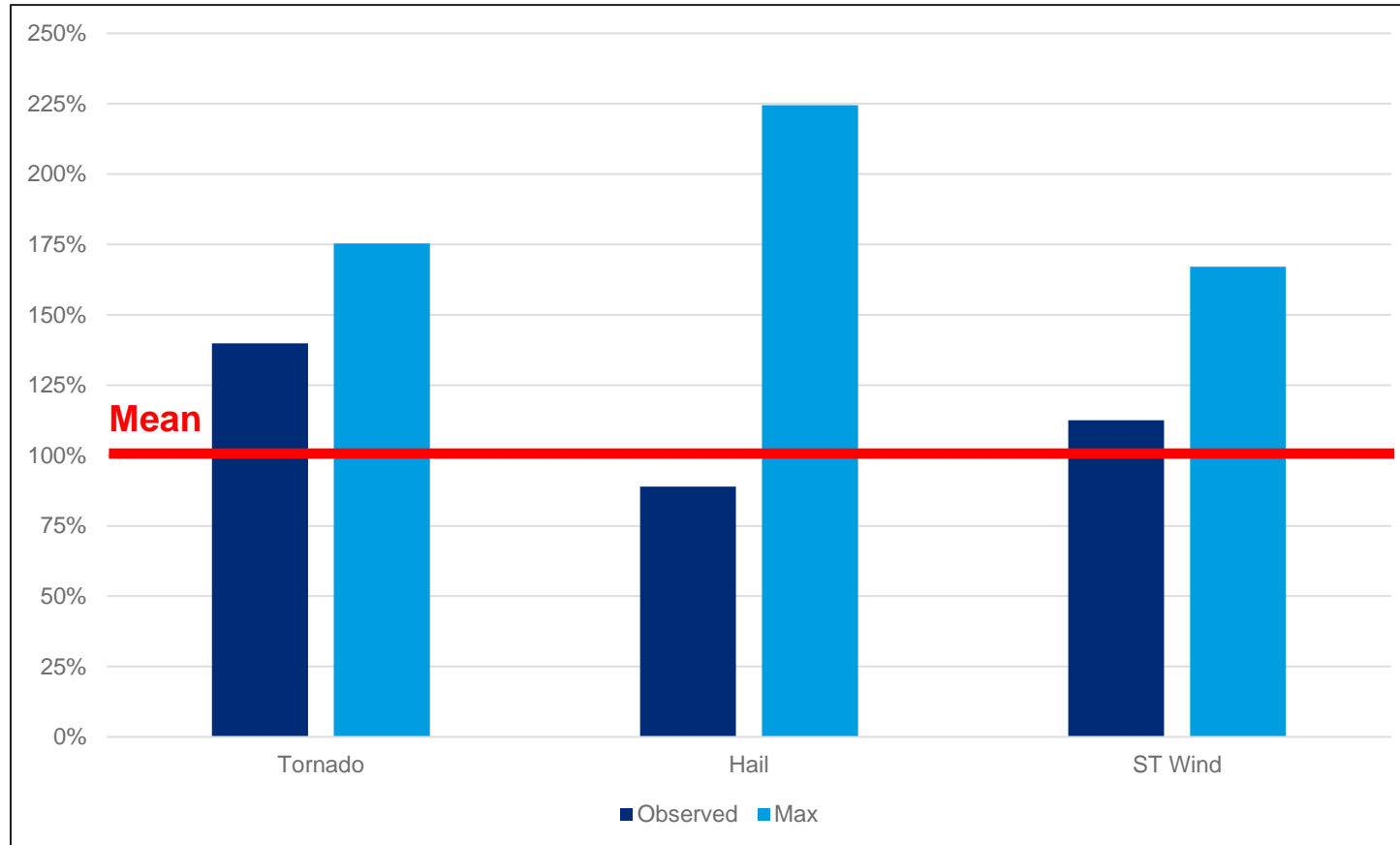
Generated at 29 Oct 2024 9:26 AM CDT in 5.59s

data units :: Rank
IEM Autoplot App #109

Annual rank of tornado warning counts: (1/1/24-10/29/24 ; 23 means highest)
(Source: Iowa Mesonet)

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The Bumpy Severe Thunderstorm Road Continues

Tornado most active since 2011. Hail below average. ST wind above average.

Preliminary ST Reports Through 10/30/2024

Relative to the 2010-2023 Period
Source: NOAA/SPC

Tornado activity most active since 2011.

Hail below average, wind above average.

Heavy CAT events sparse. Low/Mid range events continue to be impactful in the aggregate (largely retained losses).

Escalating industry insured losses in recent years from population growth, elevated cost of building materials & labor with inflation, and changes in the physical hazard.

Observations show a tornado shift from the Southern Plains to the Mississippi Valley, with an increase in hail east of the Mississippi.

Projections indicate longer SCS season, busier spring, quieter summer. Specifics by subperil are unclear – active research.
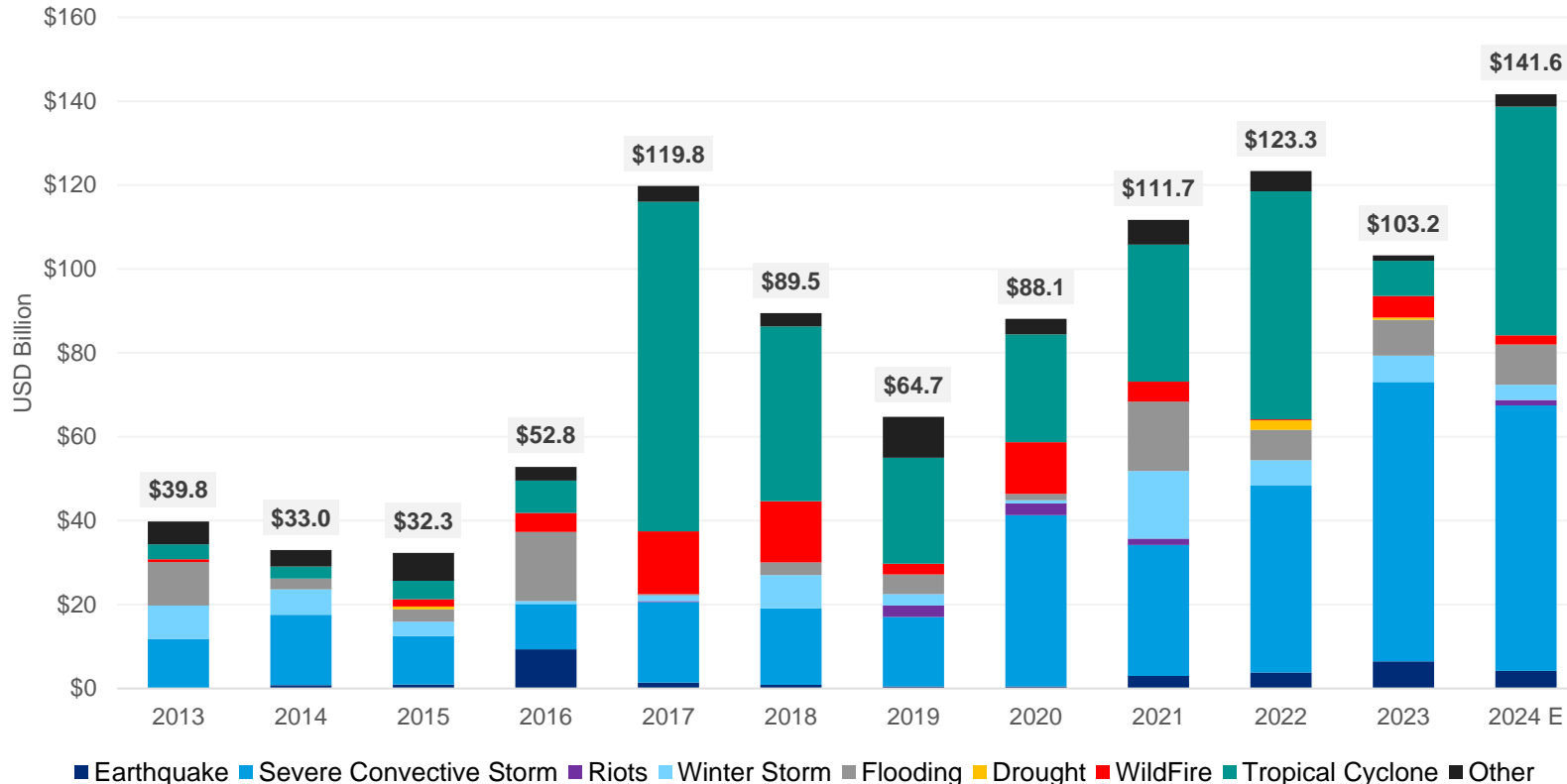
Wind Codes – IBHS Fortified Standard

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Global Insured Losses 2013-2024*
US Hurricane and Severe Thunderstorm could bring record year
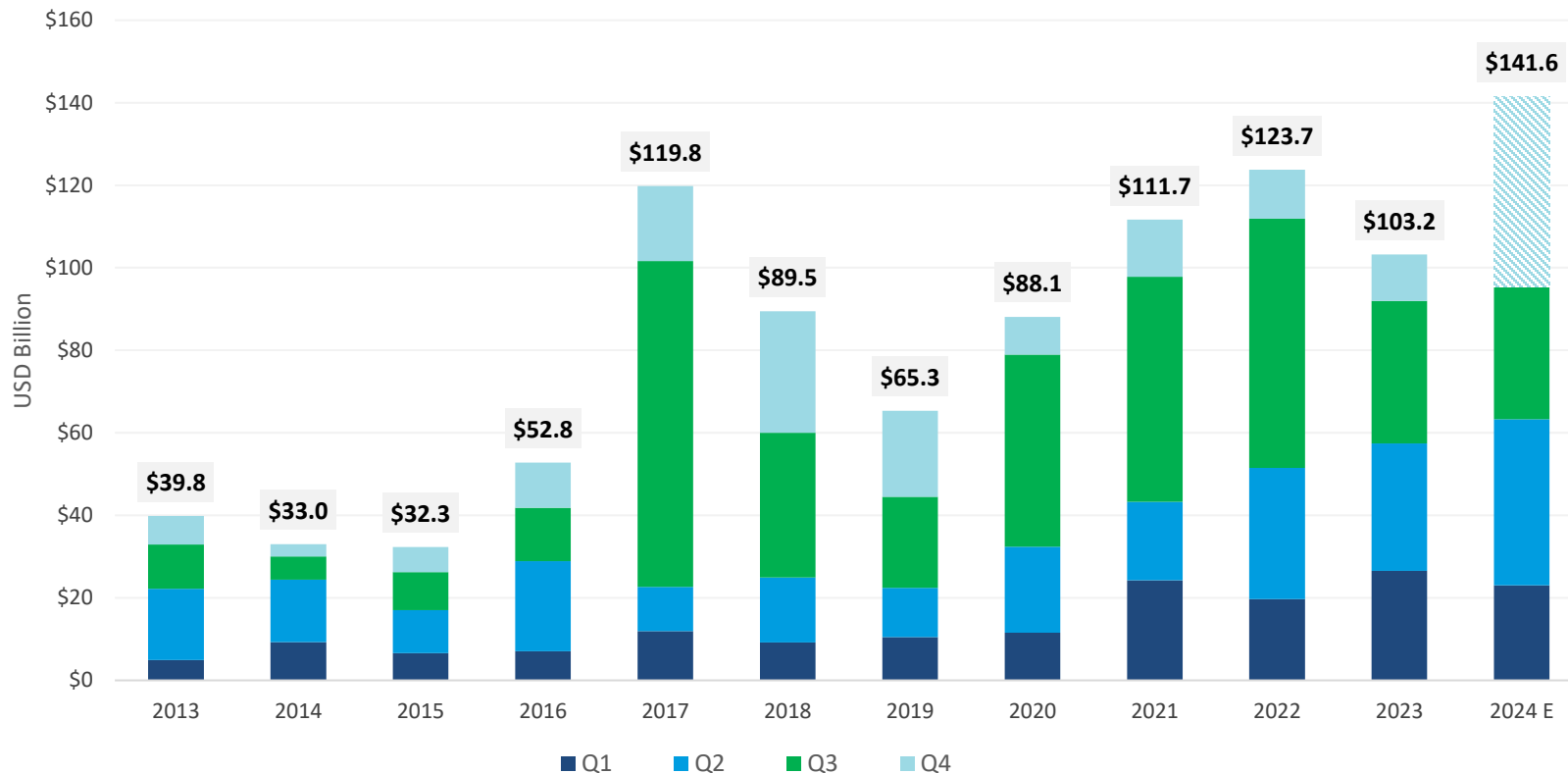
Significant Insured Losses by Peril - Global

USD Billion

Year	Value
2013	$39.8
2014	$33.0
2015	$32.3
2016	$52.8
2017	$119.8
2018	$89.5
2019	$64.7
2020	$88.1
2021	$111.7
2022	$123.3
2023	$103.2
2024 E	$141.6

Legend: ■ Earthquake ■ Severe Convective Storm ■ Riots ■ Winter Storm ■ Flooding ■ Drought ■ WildFire ■ Tropical Cyclone ■ Other

- 2024 Global insured losses could be **in excess of USD 140 billion**

- Loss estimates from Helene and Milton are highly varied among sources. There will be surprises with loss development – **hurricane losses account for ~38% of total**

- **US severe thunderstorm continues to be a dominant mode accounting for ~ 45% of total**

- International contributions include Japan & Taiwan EQ, Germany Spain and UAE flood. Japan hailstorms

- Baltimore bridge collapse

- After Q3 and including Milton a total of 29 separate events exceeding USD 1 billion dollars have been confirmed compared to 31 events for the full year of 2023

*Significant insured losses for events > USD 100M - Unadjusted
Source: PCS, PERILS, Verisk, ICA, GC; 2024 insured losses includes estimated 4Q losses.
Data is updated as of 10/14/2024

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Global Insured Losses 2013-2024*
Severe thunderstorm Q2, Hurricane Q4 with uncertain loss development

Significant Insured Losses (Nat Cat + Other Perils)

USD Billion

Year	Total
2013	$39.8
2014	$33.0
2015	$32.3
2016	$52.8
2017	$119.8
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2023	$103.2
2024 E	$141.6

Legend: ■ Q1 ■ Q2 ■ Q3 ■ Q4

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Industry Landscape
Towards Equilibrium

Reinsurance Markets

Loss-unaffected programs flat or slight decline
Severe thunderstorm still challenging
2024 Hurricane events believed manageable
New capital

Insurance Companies

Rate assessment consistent with risk
Profitability threat assessment
Legislative developments in Florida
Policyholder strain certain states

Tools

Hazard scores for portfolio management
Deterministic analysis - overconcentration threat
Catastrophe models for unobserved/tail events
Loss experience

Resilience

Wind mitigation credits
Building codes
FEMA recommendations, infrastructure renewal
IBHS (www.ibhs.org)

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Climate Change Perspective

Global Warming is Scientifically Unequivocal

Increasing observed surface temperature

Increasing ocean heat content

Retreating ice caps and glaciers

Increasing sea levels

Ice core chemistry and tree ring proxies

Global climate models

The human contribution cannot be ruled out as statistical noise

Global climate models project a range of warming scenarios through the 2100s

Depends on CO_2 levels in the atmosphere

Weather & climate effects are clear for some hazards; more subtle or unclear for others
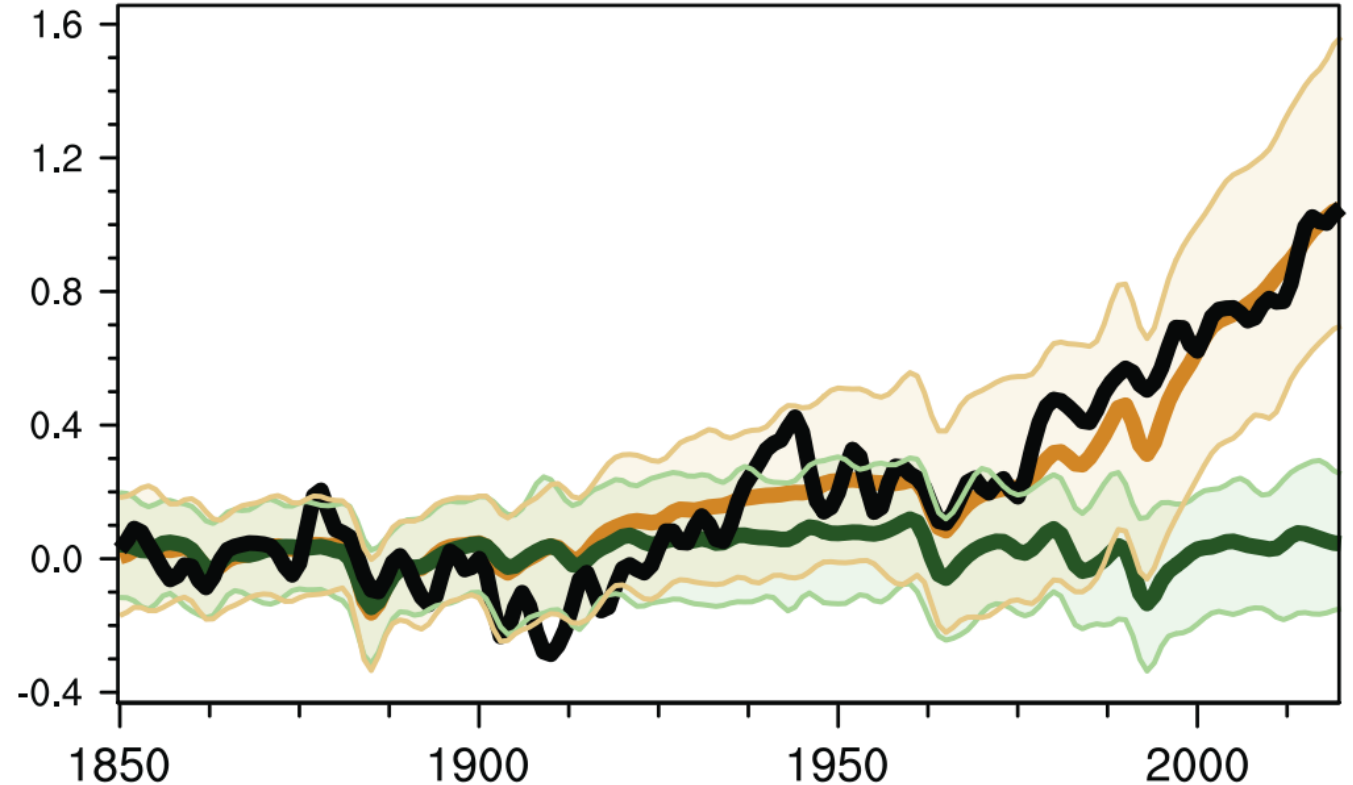
Change in global mean air temperature (deg C) (relative 1850-1900)

- **Orange** – Multi-Model Estimate with Human and Natural Forcing.
- **Green** – Multi-Model Estimate with Natural Forcing only.
- **Black** – observed
- 5th and 95th percentiles shaded for multi-model estimates.

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A business of Marsh McLennan

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