Excessive Rainfall Outlook High Risks (2010-2020)

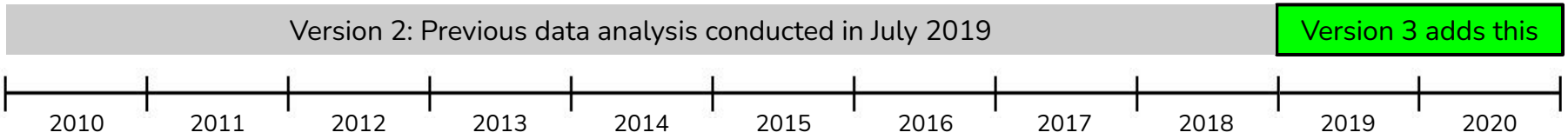
Version 3: Updated statistics and new perspectives

Points of Contact

Alex Lamers; Warning Coordination Meteorologist, WPC — alex.lamers@noaa.gov
Ashton Robinson Cook, PhD; Meteorologist, WPC — ashton.robinson@noaa.gov

Harvey Flooding; Wikimedia Commons, user Kaldari

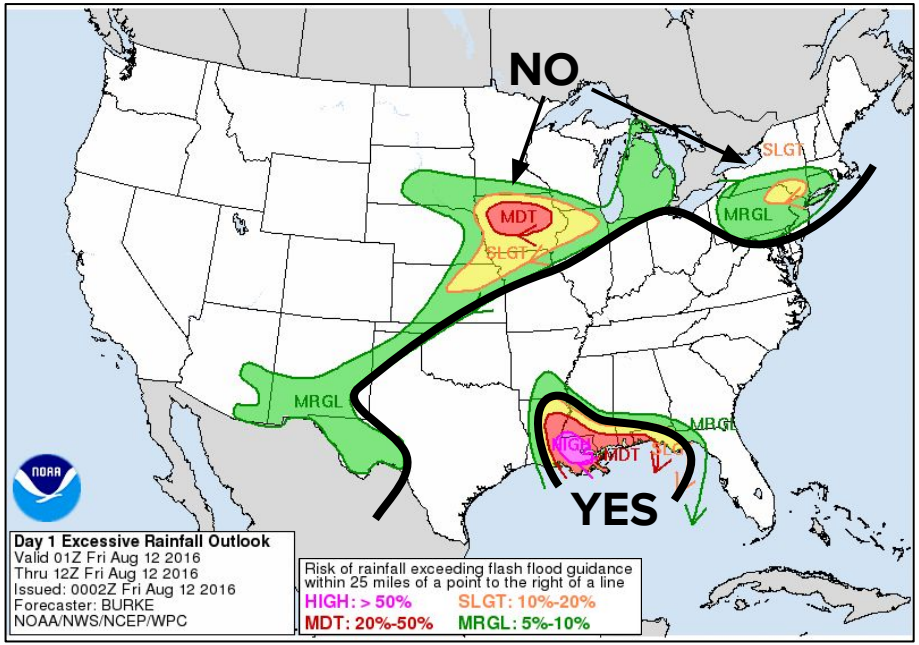
What is New in Version 3?



- This update of the ERO High Risk statistics extends the period of record by two years, and it now includes a full decade worth of data
- Findings in version 3 are fairly consistent overall with previous versions
- New statistical perspectives have been added via new research
- A few important reminders and some outreach material has been added to the end of this slide deck for additional ERO-related information

Methodology for High Risk Days Calculation

- Reports from High Risk areas and adjacent Slight and Moderate Risk areas are used.
- Measures the entire regional event or “flash flood outbreak” that occurs on a High Risk day.
- For High Risks issued after the beginning (12 GMT) of a forecast period, reports are not counted until the High Risk was in effect.
- Flooding is less discrete temporally than other weather hazards. It can linger and pose a threat hours after the heavy rain ends. Precise time of damage or fatalities in Storm Data can be unclear – using adjacent risk areas helps.
- Storm Data report types used include flash flood, flood, heavy rain, and debris flow.

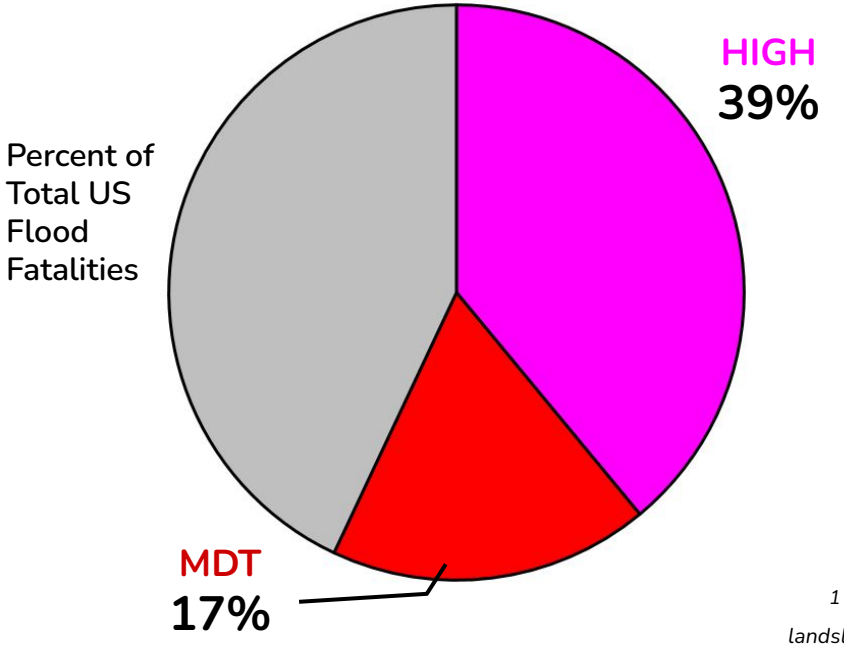


Only evaluate risk areas contiguous to the High Risk to look at the same causative system

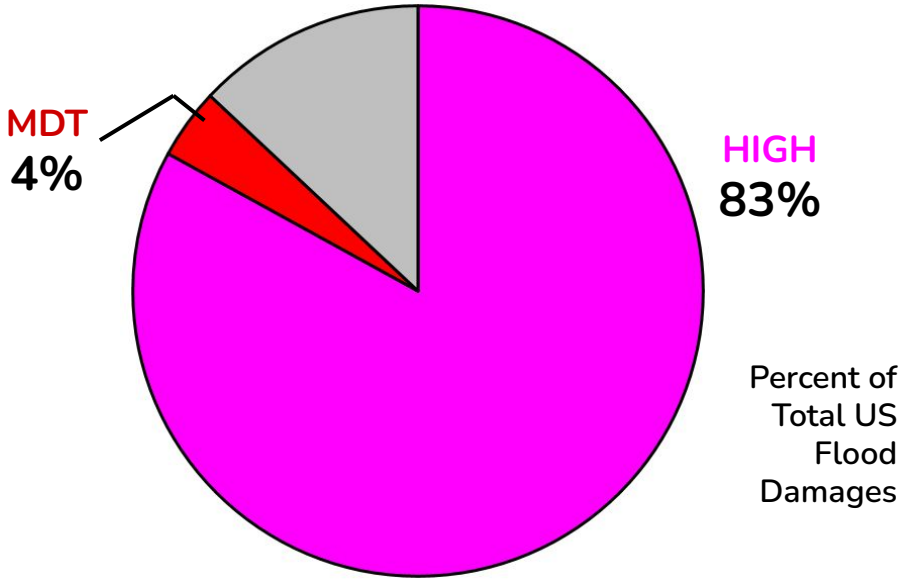
WPC High Risk Days are a BIG DEAL

High Risks are only issued by WPC on ~4% of days, but "High Risk Days" have accounted[1] for:

2/5 of ALL Flood-related **Fatalities**

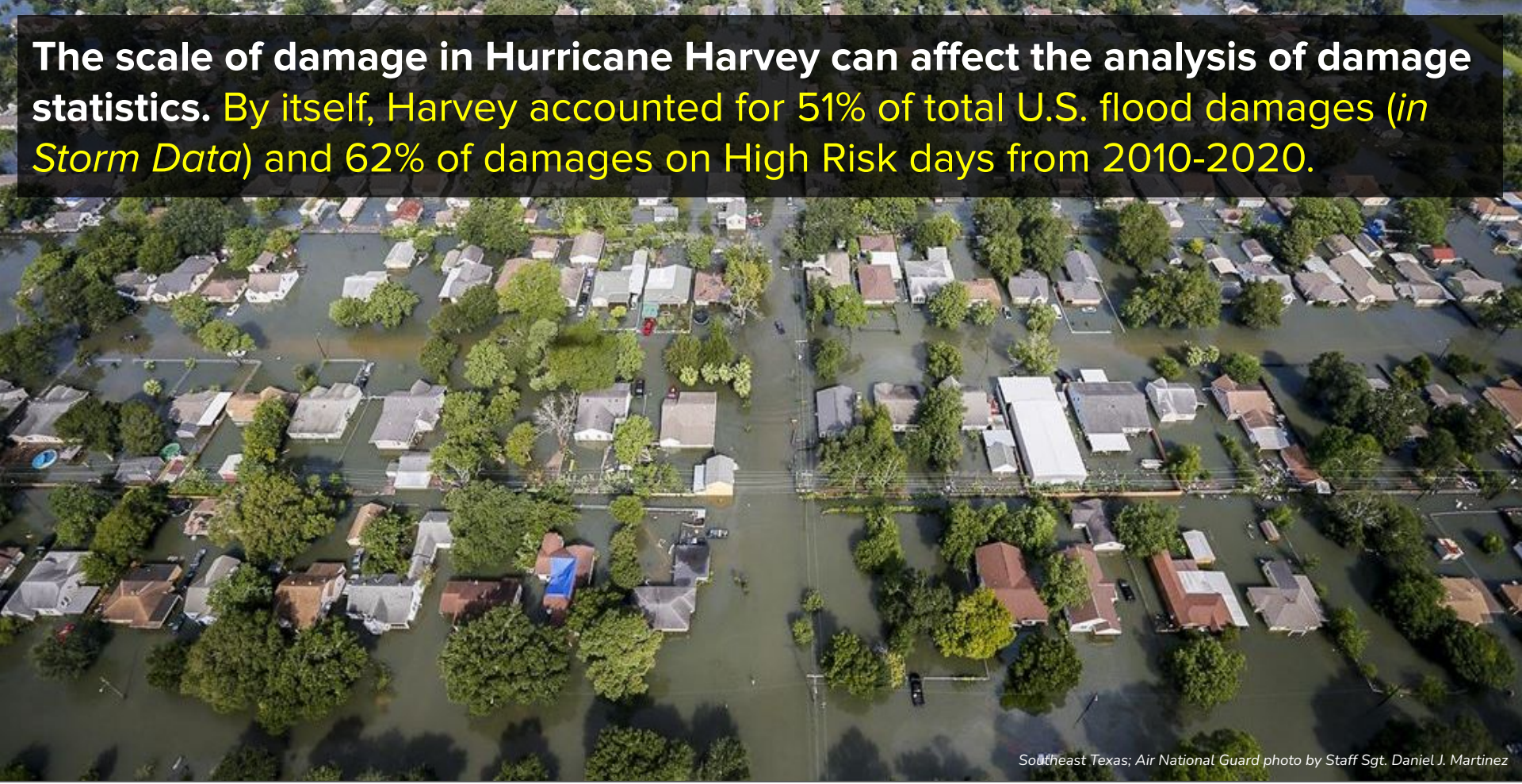


4/5 of ALL Flood-related **Damages**



[1] *From 2010 to 2020. Includes flood, flash flood, heavy rain, and debris flow Storm Data. Excludes Oso, WA landslide which occurred well after rainfall and on a sunny day. Damage estimate used for Montecito debris flow.*

The scale of damage in Hurricane Harvey can affect the analysis of damage statistics. By itself, Harvey accounted for 51% of total U.S. flood damages (*in Storm Data*) and 62% of damages on High Risk days from 2010-2020.

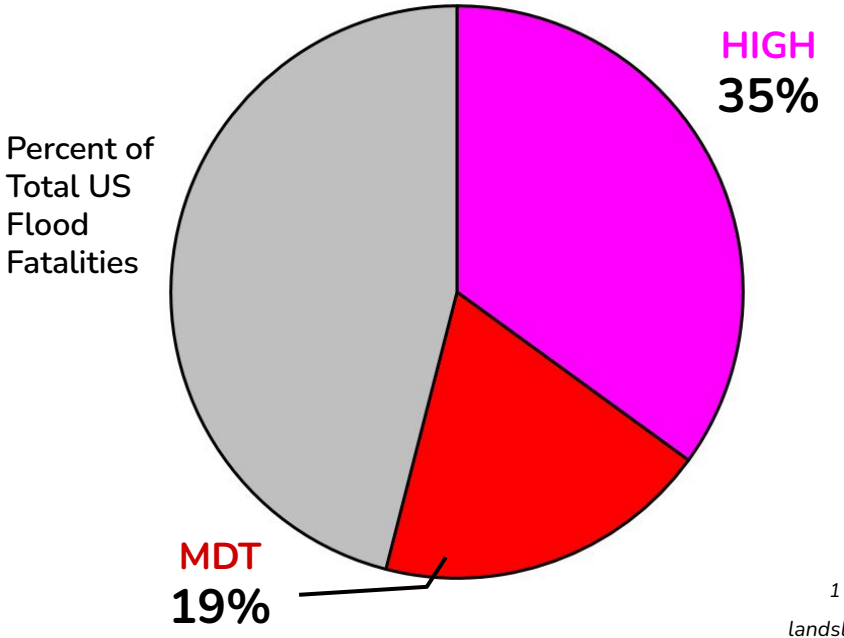


Southeast Texas; Air National Guard photo by Staff Sgt. Daniel J. Martinez

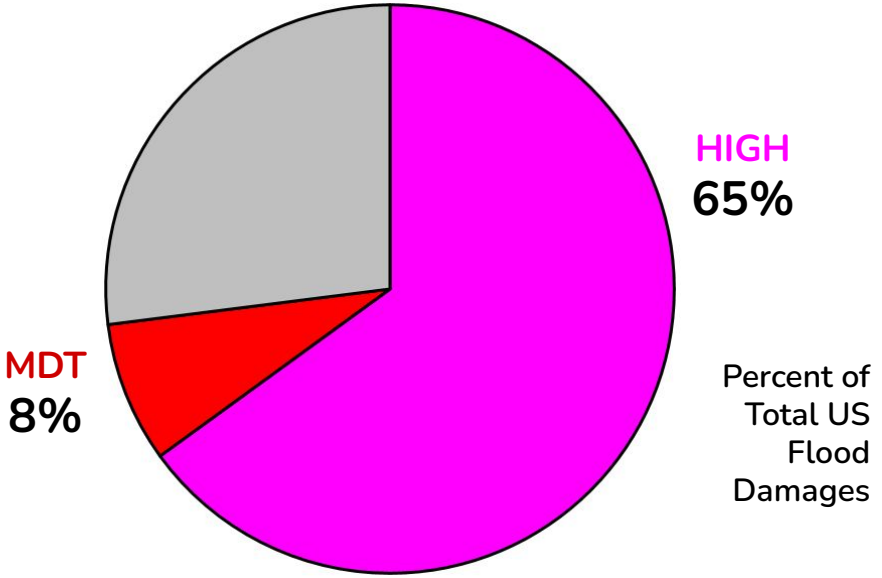
Numbers Still Significant When Removing Harvey

Hurricane Harvey fatality and damage figures (and associated High Risks) do skew the percentages slightly

1/3 of ALL Flood-related **Fatalities**



2/3 of ALL Flood-related **Damages**



[1] *From 2010 to 2020. Includes flood, flash flood, heavy rain, and debris flow Storm Data. Excludes Oso, WA landslide which occurred well after rainfall and on a sunny day. Damage estimate used for Montecito debris flow.*

11 Years of High Risk Days by the Numbers

171 High Risk Days

$70.6B Damages in NWS Storm Data

410 Total Fatalities

28 NOAA Billion Dollar Disasters

(High Risk Day occurred during a Billion Dollar Disaster in which flooding was a significant factor)

Nichols, SC; Flickr, S.C. Air National Guard

Characterizing High Risk Days

Hurricane Matthew SAR; FEMA Photo

Based on records over the past 11 years, we can say:

WPC High Risks are a strong indicator of a potentially deadly and damaging flash flood day

46% have **at least 1 fatality or injury**

Compared to 23% for Moderate Risk Days

62% have **at least $1 million in damages**

Compared to 33% for Moderate Risk Days

Categorizing by Tropical Cyclone

The number of cases are listed in parentheses (#) for each category; years 2010-2020

All Tropical Cyclones (45)

In order to qualify as a tropical cyclone High Risk day, the National Hurricane Center had to have a valid advisory product (TCP) with most of the rain being delivered by the storm itself.

Tropical Cyclones without Harvey Included (38)

The same criteria as above applies, but Harvey was subtracted from these statistics.

Remnants of Tropical Cyclones, Unnamed Systems, Moisture Plumes (23)

In these cases, the National Hurricane Center either ceased advisories, but the remnant low was still producing rain, the system was a tropical disturbance or unnamed low, or a moisture plume from a T.C. well away from land was affecting the CONUS.

Non-Tropical Cases (103)

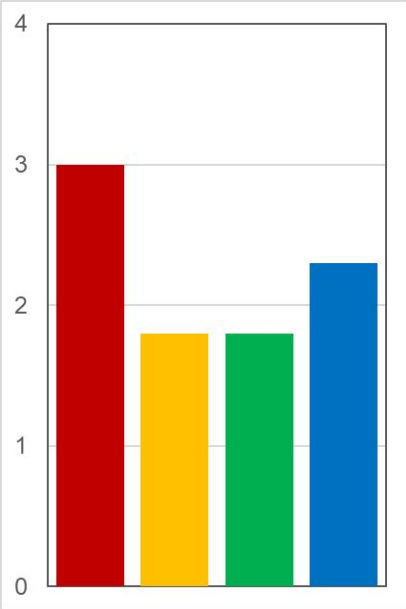
No tropical cyclone was involved in these cases.

Does a Tropical Cyclone Make a Difference?

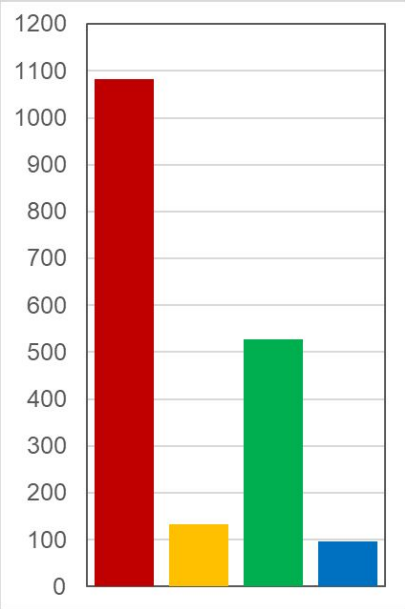
All Tropical Cyclones | T.C. Remnant/Unnamed | T.C. minus Harvey | Non-Tropical

The short answer is not really. Harvey inflates the averages, but if you remove that storm there is not much of a difference between the other categories.

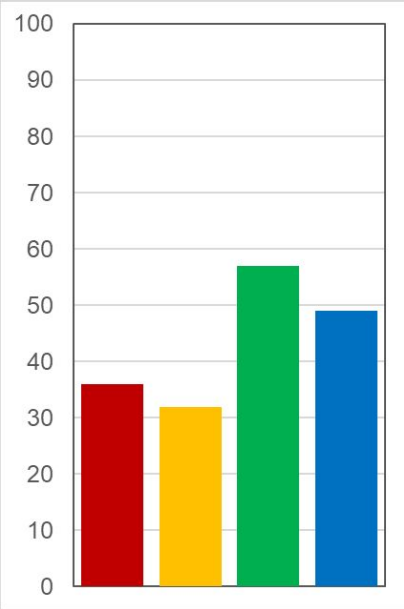
Average Fatalities
Per High Risk Day



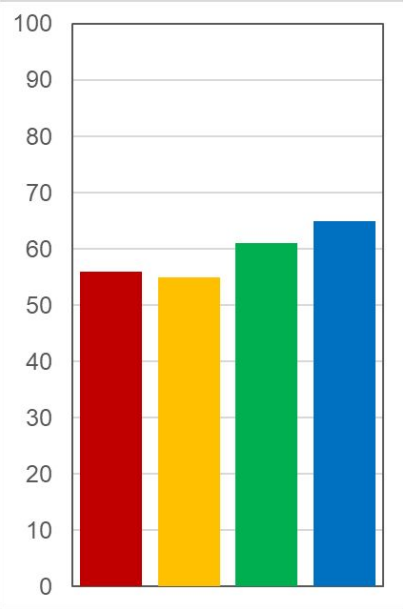
Average Damage ($M)
Per High Risk Day



Percent High Risk Days with 1+ Casualty



Percent High Risk Days with $1M Damage

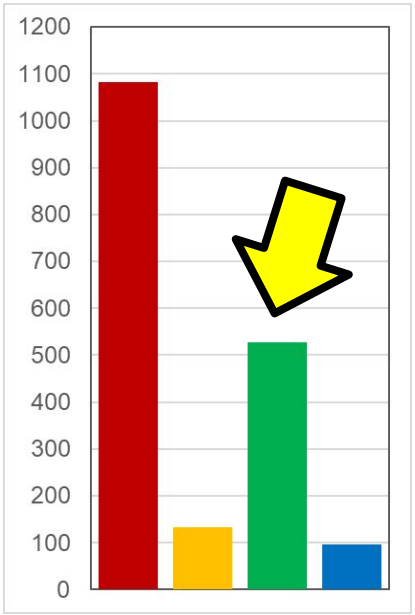


Why the Notable Increase with Remnants?

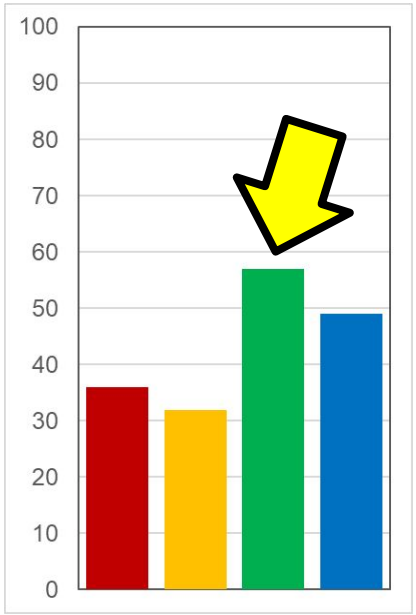
All Tropical Cyclones | T.C. Remnant/Unnamed

T.C. minus Harvey | Non-Tropical

Average Damage ($M)
Per High Risk Day



Percent High Risk Days with 1+ Casualty

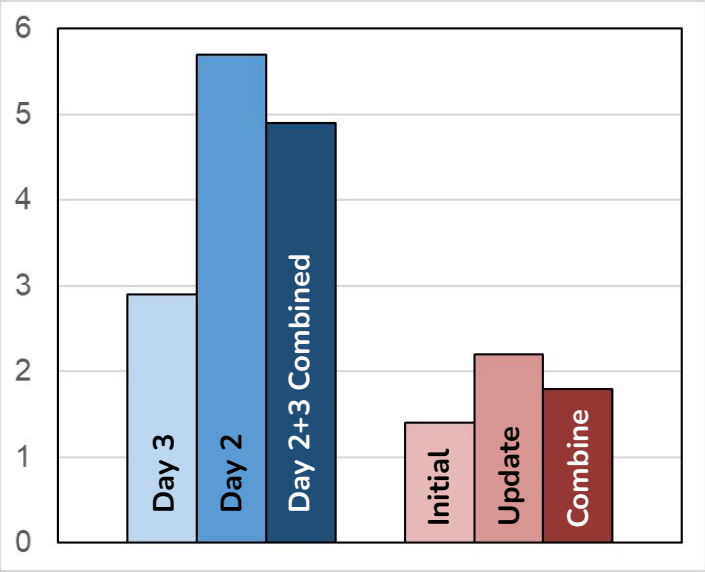


This remains a somewhat open question. It could be that remnants of tropical cyclones, tropical disturbances, and related moisture plumes deliver deep, tropical moisture to areas that do not typically experience them. For decaying cyclones, there are also typically weaker winds which can lead to slower storm motions.

More Impacts With High Risks Issued on Day 2-3

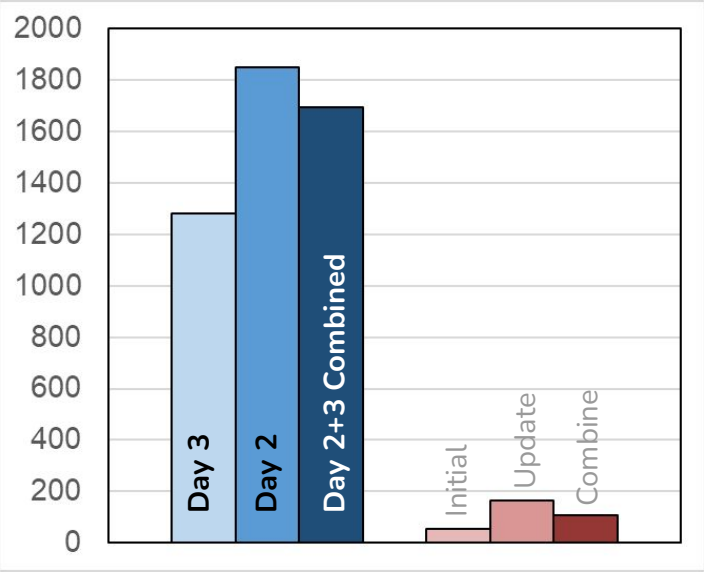
High Risks are issued in advance when there is considerable confidence in significant impacts

Average Fatalities



Stratified by initial High Risk issuance

Average Damage ($M)



Stratified by initial High Risk issuance

Sample Size

(# of Days)

- Day Three (9)
- Day Two (24)
- Day One Initial (74)
- Day One Updates (64)

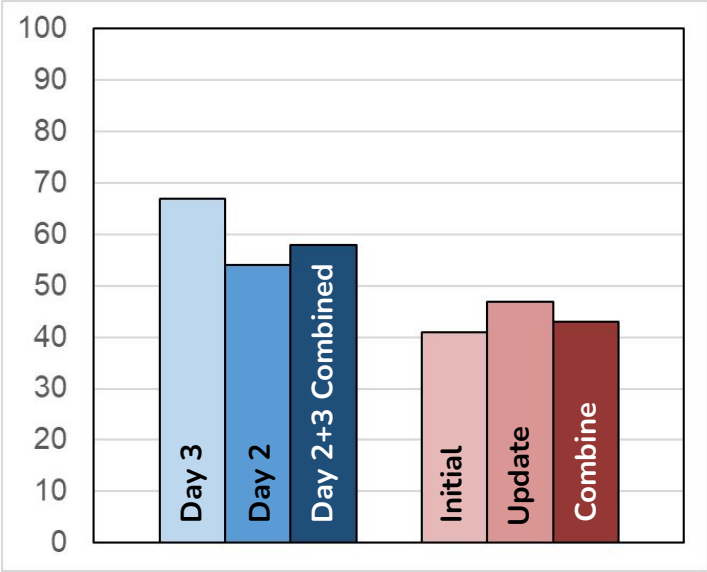
Day 1 initial issuances are defined as 94e products issued prior to 12Z for the relevant 12Z-12Z period. Updates are any 94e products sent during the 12Z-12Z period.

Hurricane Harvey not included so as not to inflate any averages

Rates of Significant Impacts are More Similar

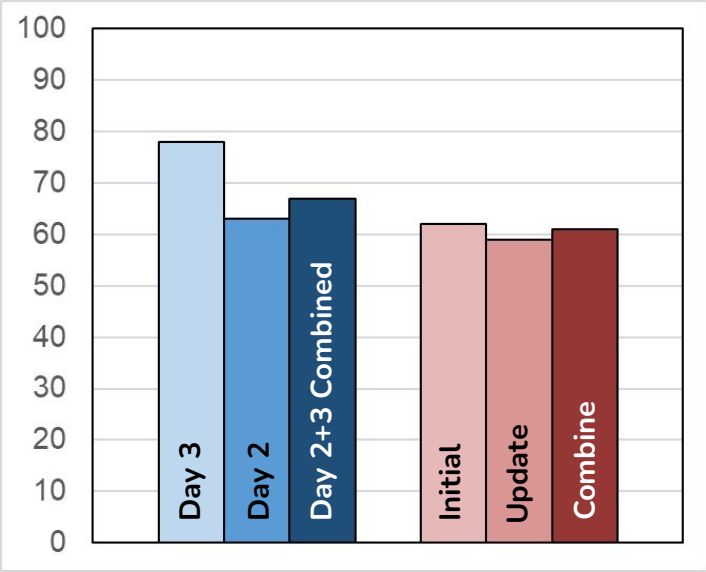
High Risks see AT LEAST 1 casualty and $1M damages at similar rates regardless of lead time

Percent Days with 1+ Casualty



Stratified by initial High Risk issuance

Percent Days with $1M Damage



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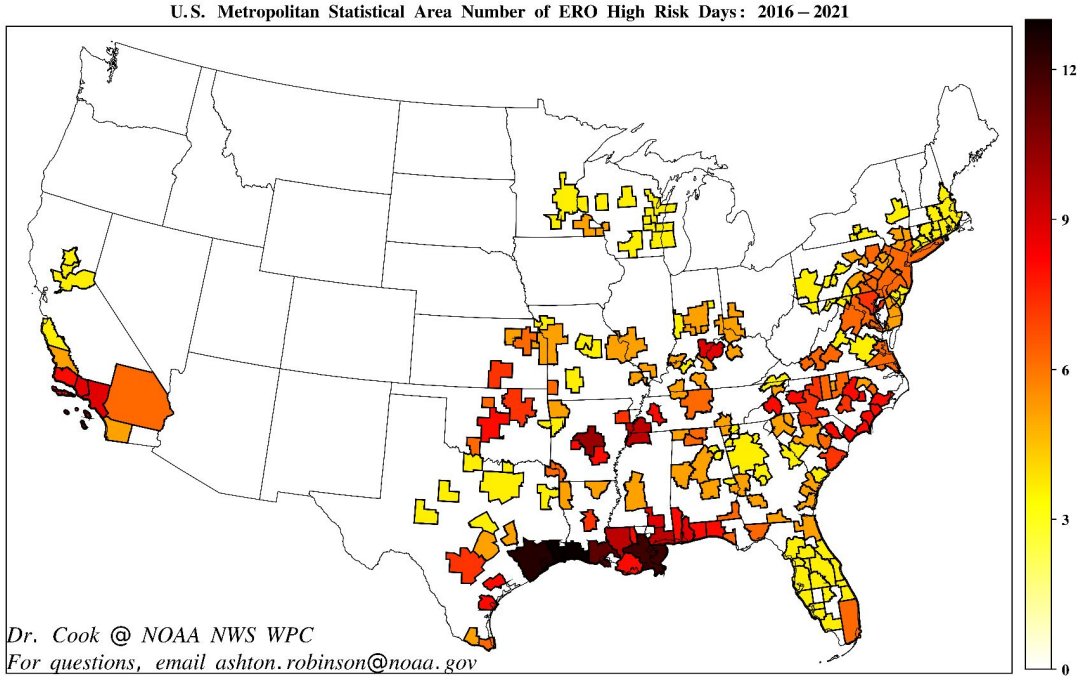
High Risk Hotspots 2016-2021

Top 10 Metropolitan Statistical Areas[1] Ranked by High Risk Days

T1.	**15**	**Beaumont-Port Arthur, TX**
T1.	**15**	**Lake Charles, LA**
3.	12	Houston, TX
4.	11	New Orleans-Metairie, LA
5.	10	Lafayette, LA
6.	8	Little Rock, AR
T7.	7	Baton Rouge, LA
T7.	7	Gulfport-Biloxi, MS
T7.	7	Memphis, TN
T10.	6	Los Angeles, CA
T10.	6	Oxnard-Ventura, CA
T10.	6	Hattiesburg, MS
T10.	6	Daphne-Fairhope-Foley, AL

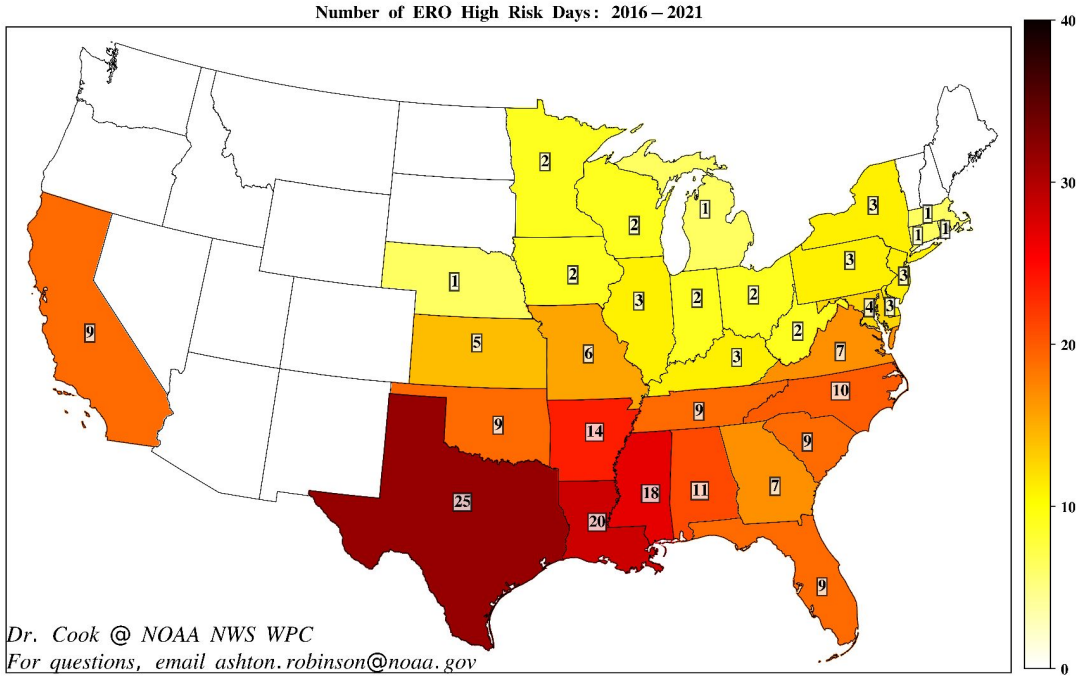


[1] *Metropolitan Statistical Areas as defined by the U.S. Census Bureau*

Most Active States by High Risk Frequency

Top 10 Most Active CONUS States Ranked by High Risk Days 2016-2021

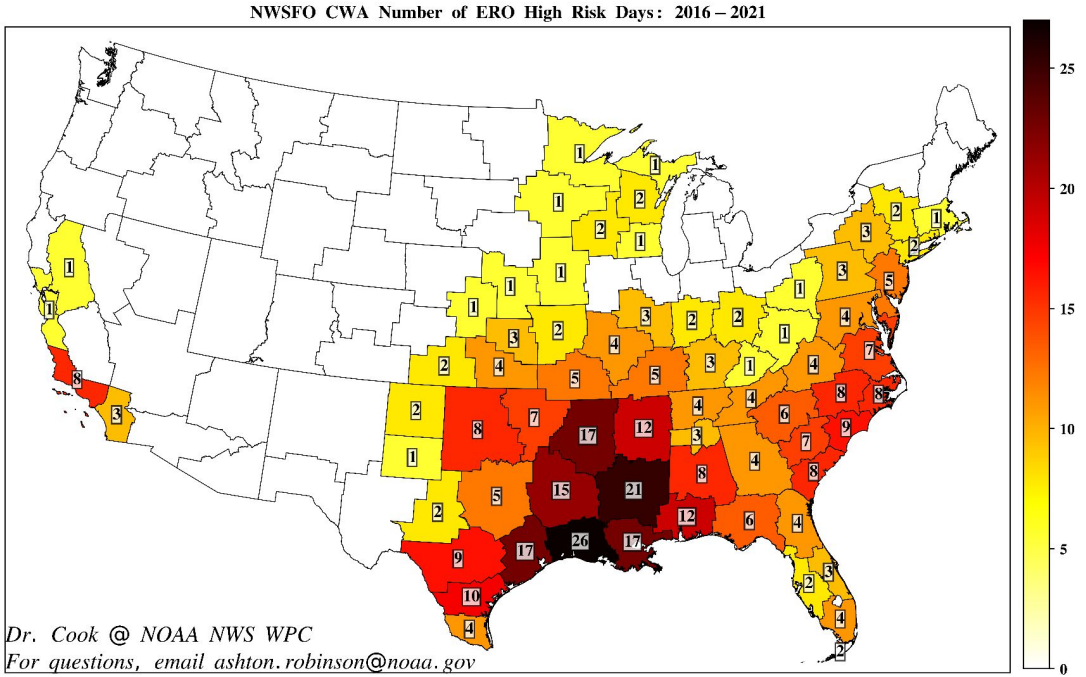
1.	**25**	**Texas**
2.	20	Louisiana
3.	18	Mississippi
4.	14	Arkansas
5.	11	Alabama
6.	10	North Carolina
T7.	9	South Carolina
T7.	9	California
T7.	9	Florida
T7.	9	Tennessee
T7.	9	Oklahoma



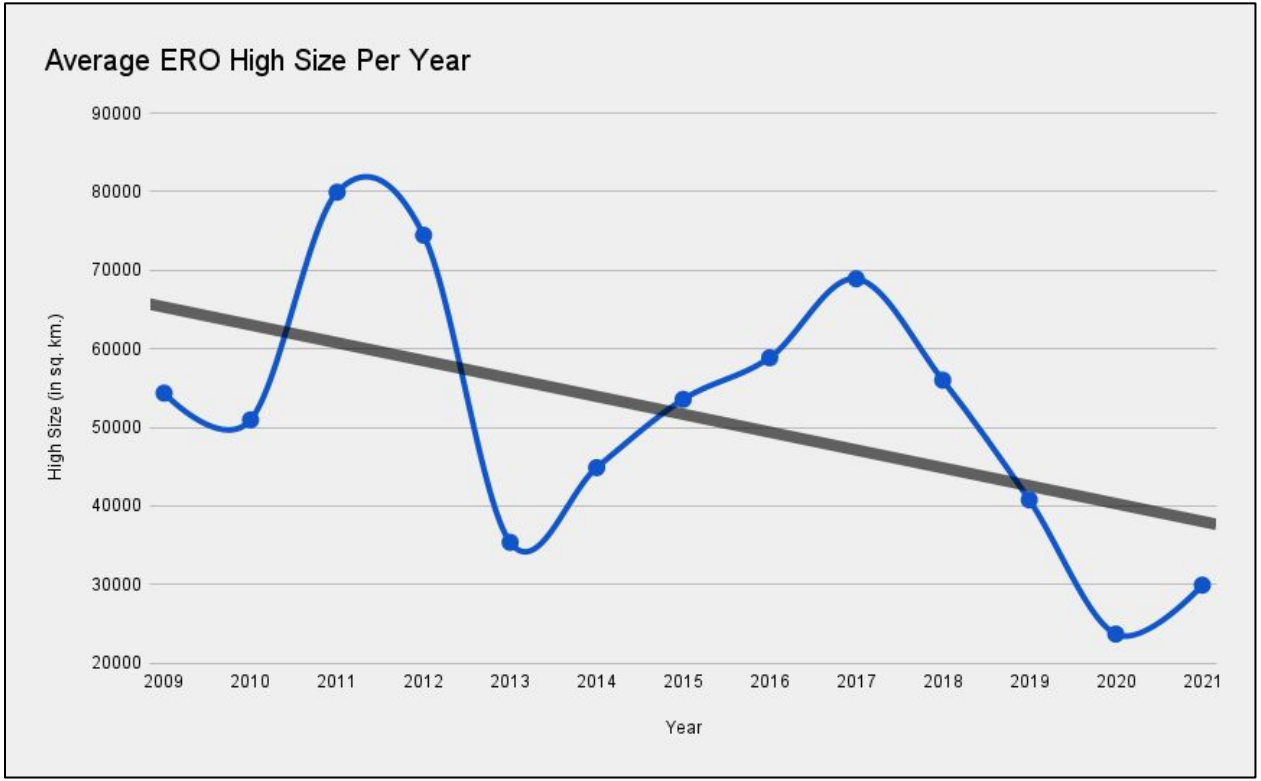
Greatest Frequency of High Risks by NWS Office

Top 10 Most Active NWS Offices Ranked by High Risk Days 2016-2021

1.	**26**	**WFO Lake Charles, LA**
2.	21	WFO Jackson, MS
T3.	17	WFO Houston-Galveston, TX
T3.	17	WFO New Orleans, LA
T3.	17	WFO Little Rock, AR
6.	15	WFO Shreveport, LA
T7.	12	WFO Memphis, TN
T7.	12	WFO Mobile, AL
9.	10	WFO Corpus Christi, TX
T10.	9	WFO Austin-San Antonio, TX
T10.	9	WFO Wilmington, NC



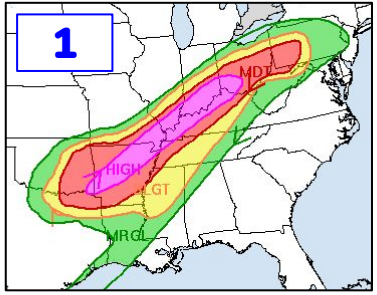
High Risks are Becoming More Precise



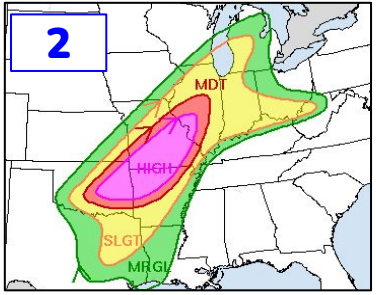
- In the recent years, the average High Risk is about half the size as what was drawn about a decade ago
- Improvements in numerical weather prediction models, and increased understanding of extreme rainfall events have allowed forecasters to pinpoint areas of concern with more precision
- Year-to-year fluctuations depending on overall activity levels (driven by things like landfalling tropical cyclones)

Largest High Risks 2016-2021

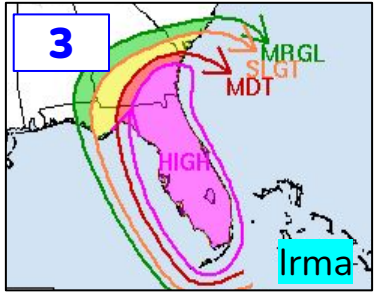
24 February 2018
64,311 sq. miles



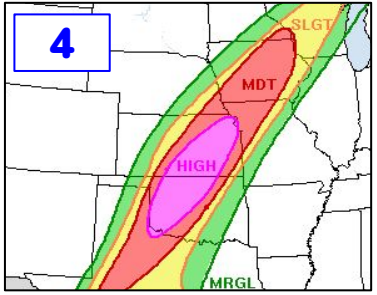
29 April, 2017
62,964 sq. miles



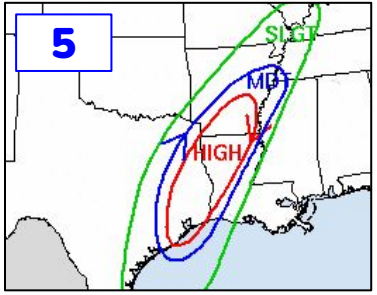
10 September 2017
51,166 sq. miles



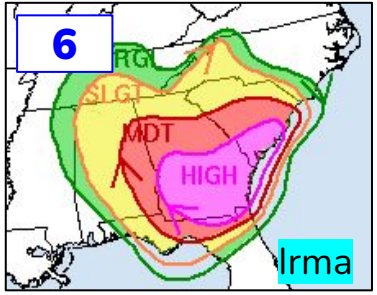
8 October 2018
47,230 sq. miles



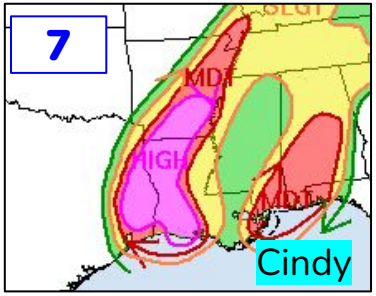
9 March 2016
46,202 sq. miles



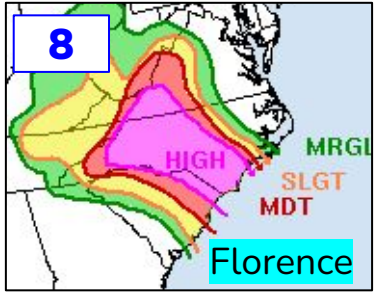
11 September 2017
38,530 sq. miles



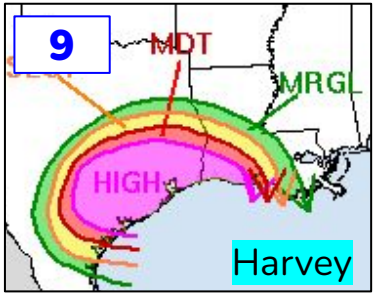
22 June 2017
37,541 sq. miles



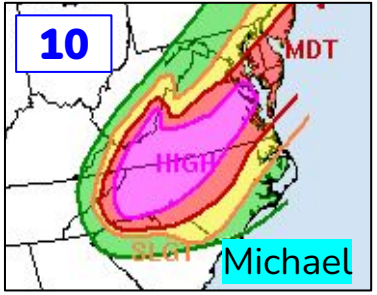
16 September 2018
36,078 sq. miles



27 August 2017
35,171 sq. miles



11 October 2018
35,145 sq. miles



WEATHER PREDICTION CENTER
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

ERO High Risk Statistics, Version 3
Updated February 12, 2022

Summary of Key Findings

- **High Risks are a strong indicator of a potentially deadly and damaging flash flood day.** About half the time WPC issues a High Risk there is at least one fatality or injury, and about two out of every three times there is at least $1 million in damage.

- **The signal is even stronger with High Risks issued at least 12 hours in advance, on Day 2 or Day 3.** Without including Harvey, these are only 26 cases but they alone account for one-half (46%) of all non-Harvey U.S. flood damages in the past eleven years.

- **We average about 4 fatalities per day and several hundred million dollars in damage with Day 2 and 3 High Risks.** These are non-Harvey stats, and they are more than double amounts for Day 1 Highs.

- **In general, there has not been a significant difference in impacts** (exclusive of Harvey) **between High Risks issued for tropical cyclones and in other scenarios.**

- **High Risk days are a big deal.** Days with a High Risk on the ERO account for around 2 out of every 5 flood-related fatalities in the CONUS, and about 80% of flood-related damage.