

Actuarial Weather Extremes Series

Mississippi Tornadoes - March 24, 2023

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Event Summary

In the late evening of Friday 3/24/23, a strong storm system moved eastward through the Mississippi River Valley, bringing heavy rain and tornadoes [1]. Based on preliminary reports, two EF-3 (Enhanced Fujita Scale rating-3 [The Enhanced Fujita Scale \(EF Scale\) \(weather.gov\)](#)) and one EF-4 tornadoes caused catastrophic damage in western Mississippi. According to NPR, at least 25 people have been reported killed so far. Subsequently, the governor declared a state of emergency and the president declared it a federal disaster [1].

This paper examines the historical frequency of violent tornadoes in March in both Mississippi and the U.S. at large.

Data Sources

Two data sources were used in the following analysis: Automated Surface Observing System (ASOS) and the National Oceanic and Atmospheric Administration's (NOAA) Storm Events database. ASOS stations provide automated, hourly precipitation totals all across the world, typically at airports. The Storm Events database tracks notable atmospheric events since 1950.

Detailed analysis data can be found in Source [2] listed at the end of this report.

Methodology

First, we retrieved all recorded tornadoes in the U.S. in March since 1950. Then, we examined the time series of EF-3, EF-4, and EF-5 tornadoes in Mississippi and in the U.S. since 1950. For precipitation, we identified two ASOS stations in Mississippi with heavy rainfall on 3/24/23. We then retrieved all daily precipitation totals for these two stations since 2002 and ranked the 3/24/23 total against all March records.

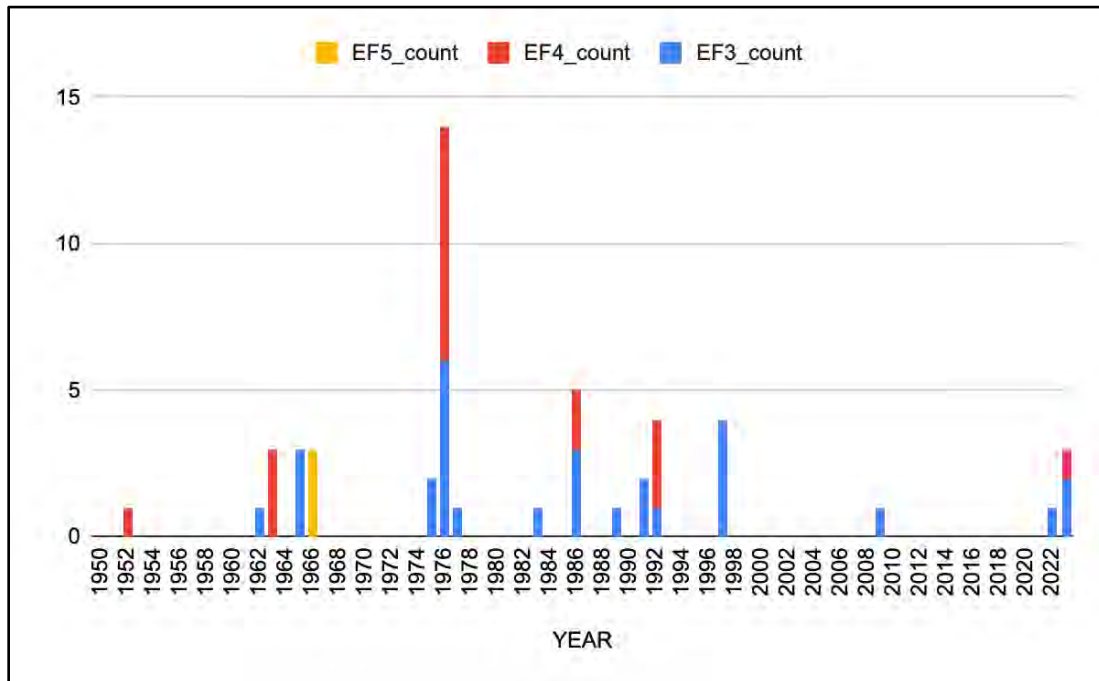
Results

Graph 1 shows the frequency of EF-3+ tornadoes in Mississippi since 1950, as recorded in NOAA's Storm Events database [3]. On 3/24/23, two EF-3 tornadoes and one EF-4 tornadoes were observed, according to preliminary reports. The last EF-4 tornado to hit Mississippi in March was in 1992, 31 years ago. While EF-3 tornadoes are more common, there have only been two in Mississippi in March since 1998.

Caveat and Disclaimer

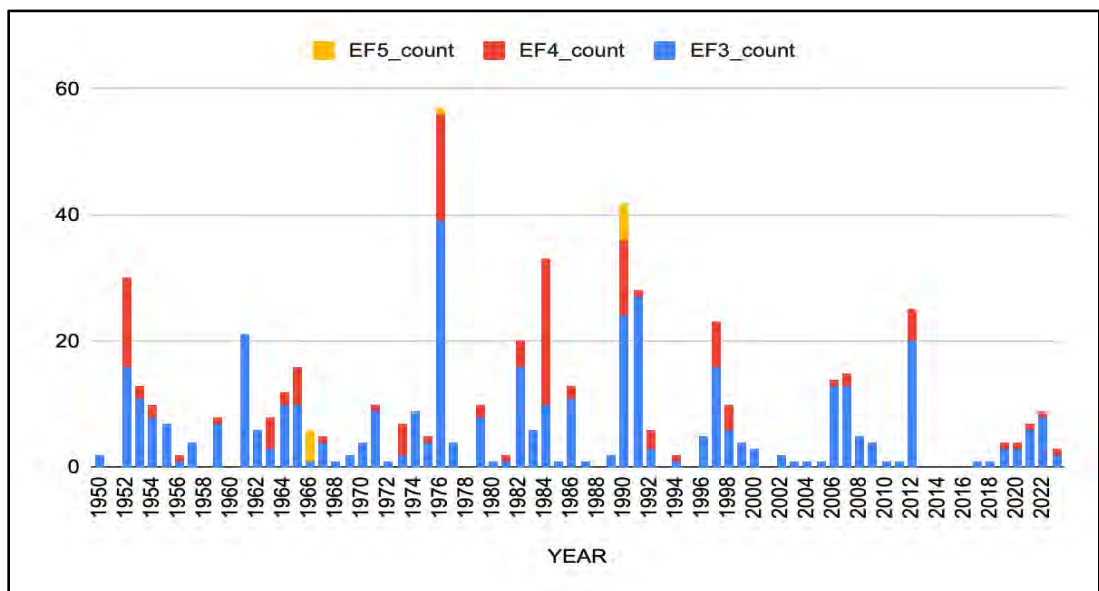
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Graph 1
MARCH TORNADO COUNT IN MISSISSIPPI BY YEAR AND EF RATING



Graph 2 shows a similar time series as Graph 1 but aggregates the March tornado count across all U.S. states. Across the US, we see an increase in the number of strong tornadoes in March when compared to Mississippi’s records. There has been exactly one EF-4 tornado in March every year in 2019-2023, although only 3 years had EF-4 tornadoes in March in the 1999-2018 period.

Graph 2
MARCH TORNADO COUNT IN THE UNITED STATES BY YEAR AND EF RATING



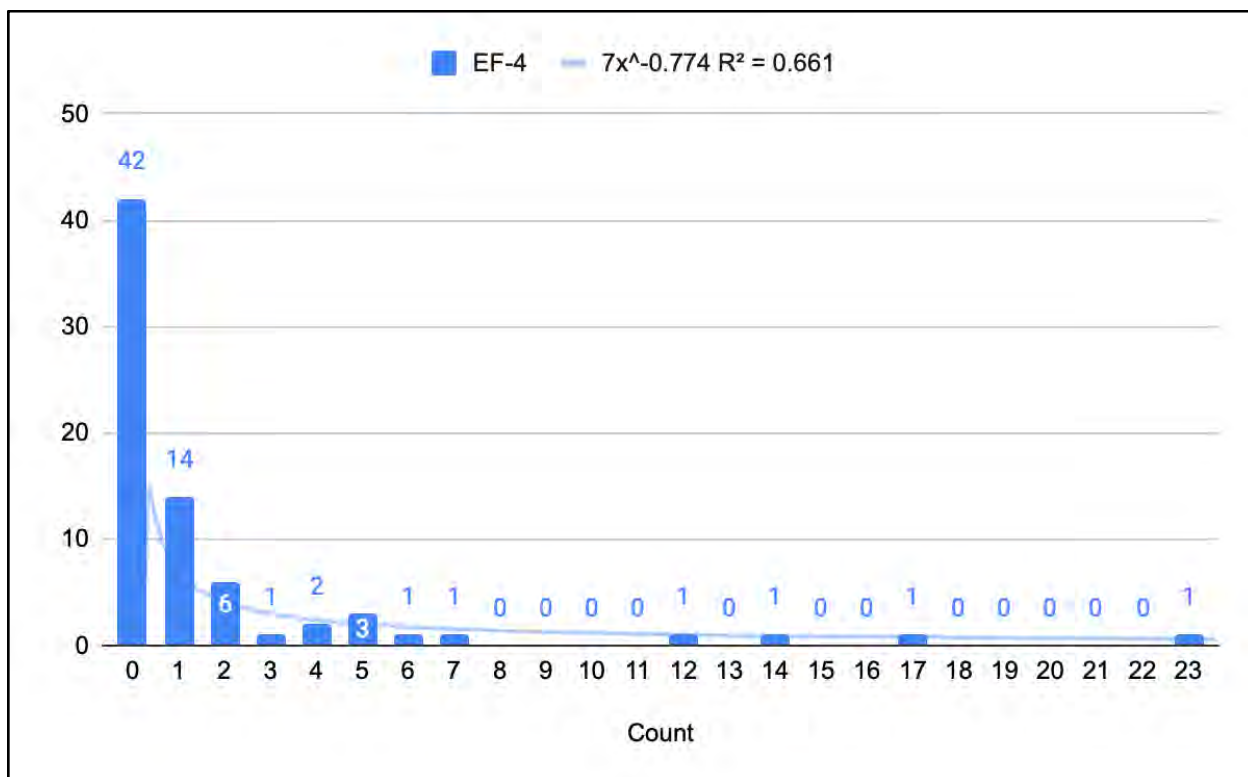
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As a random variable, the number of EF-4 tornadoes in March has high volatility and exhibits behavior consistent with heavy-tailed distributions. These characteristics are illustrated in Graph 3 below, with the majority (57%) of years seeing no EF-4 tornado in March and the number of EF-4 tornadoes observed ranging from 1 to 23. Such behavior creates great difficulty in predicting the number of violent tornadoes that might occur in a coming year. This difficulty is increased by the localized nature of tornadoes, which are much smaller than larger phenomena like hurricanes on both spatial and temporal scales.

Graph 3

DISTRIBUTION OF EF-4 TORNADO COUNTS IN THE U.S. IN MARCH SINCE 1950



As an example of the challenge of estimating the frequency of EF-4 tornadoes, we have fit a power series distribution to the Annual EF-4 Counts since 1950, shown by the solid line in Graph 3. With an R-Squared of 0.661, this distribution fits the data reasonably well. While the estimates of the 0, 1, and 2 values are low, the estimates for 3-23 are more aligned with the observations. However, the “jumps” in the observations from 7 to 12 and from 17 to 23 indicate a highly variable distribution and reiterate the challenge of estimating extreme events.

NOTE: The equation for the fitted power series referenced in the paragraph and in Graph 3 above is produced by Excel’s functionality for fitting a data series to a probability distribution.

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Lastly, Table 1 below highlights historical rankings of daily precipitation totals in March since 2002, as reported by ASOS [4]. Both stations in western Mississippi, Greenwood/Leflore (GWO) and Corinth (CRX), had high precipitation totals on 3/24/23, with the Corinth station (CRX) its 7th highest daily precipitation total in March since 2002.

Table 1
TOP 23 DAILY PRECIPITATION RECORDS IN MARCH SINCE 2002

Rank	GWO	CRX
1	5.01	3.06
2	2.69	1.87
3	2.40	1.82
4	2.11	1.75
5	1.98	1.53
6	1.88	1.51
7	1.87	1.44
8	1.82	1.40
9	1.77	1.29
10	1.76	1.27
11	1.62	1.23
12	1.60	1.19
13	1.54	1.17
14	1.46	1.13
15	1.43	1.02
16	1.41	1.01
17	1.39	0.98
18	1.36	0.90
19	1.31	0.89
20	1.25	0.84
21	1.24	0.82
22	1.23	0.81
23	1.19	0.75

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Sources

- **[1] Mississippi and Alabama face a painful recovery after storms and a tornado killed 26**
 - National Public Radio
 - <https://www.npr.org/2023/03/26/1166124889/mississippi-and-alabama-face-a-painful-recovery-after-storms-and-a-tornado-kill>
 - Date Published: 3/26/2023.
- **[2] Source Data Analysis**
 - [202303 Tornadoes](#)
 - Date Created: 3/26/2023.
 - This Google Sheet is available to the public via the link.
- **[3] Historical Tornado Counts**
 - National Oceanic and Atmospheric Administration’s Storm Events Database
 - <https://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=-999%2CALL>
 - Date Accessed: 3/26/2023.
- **[4] ASOS Precipitation Totals**
 - Automated Surface Observing System (ASOS): Iowa State Mesonet
 - https://mesonet.agron.iastate.edu/request/asos/hourlyprecip.phtml?network=MS_ASOS
 - Date Accessed: 3/26/2023.

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