

NOAA Technical Memorandum  
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## **SEVERE WEATHER CLIMATOLOGY FOR THE COLUMBIA, SC WFO COUNTY WARNING AREA**

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September 2003

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## TABLE OF CONTENTS

1. Introduction.....	1
2. Data.....	1
3. Topography and Demographics of the County Warning Area .....	1
4. Tornado Climatology.....	1
4.1 Magnitude.....	1
4.2 Monthly Frequency.....	1
4.3 Hourly Frequency.....	2
4.4 Associated With Tropical Systems.....	2
5. Hail Climatology.....	2
5.1 Monthly Frequency.....	2
5.2 Hourly Frequency.....	2
6. Severe Thunderstorm Wind Climatology.....	2
6.1 Monthly Frequency.....	2
6.2 Hourly Frequency.....	3
7. Conclusion.....	3
Acknowledgments.....	3
References.....	4
Figures.....	5

## **1. INTRODUCTION**

The National Weather Service (NWS) Warning Forecast Office (WFO) located in Columbia, South Carolina has forecast and warning responsibility for 23 counties (Fig. 1). These counties cover an area of central South Carolina known as the Midlands, and a portion of east-central Georgia known as the Central Savannah River Area. This part of the southeastern United States can often have a very active severe weather season. The combination of abundant low-level moisture from both the Atlantic Ocean and the Gulf of Mexico along with frontal boundaries that interact with this moisture often set the stage for strong to severe thunderstorm development.

## **2. DATA**

The data included for this study were from 1950 to 2001. Data for this paper were collected from the National Climatic Data Center (NCDC) Storm Events database. This database contains documented severe weather events from 1993 to the present. Although the months of June and July of 1993 are missing from this database, additional data were used from the NWS Storm Prediction Center (SPC), which includes tornadoes from 1950 to 1992, thunderstorm winds from 1959 to 1992 and hail from 1959 to 1992. During this period there were 2710 documented severe weather events across the county warning area (CWA) (Fig. 2). All of the times that are referenced throughout the paper are referenced to Eastern Standard Time.

## **3. TOPOGRAPHY AND DEMOGRAPHICS OF THE COUNTY WARNING AREA**

The topography of the CWA varies greatly across the Midlands and Central Savannah River Area. The western portion of the CWA is much like the Piedmont region that borders the area to the west, which is made up of rolling land composed of clay-laden soil. The central portion of the CWA contains the sand hills that run from southwest to northeast across the area. The eastern portion of the CWA shifts from slightly rolling to flat land where it transitions to the Coastal Plain and is composed mostly of sand and clay soil.

The CWA encompasses more than 13,000 square miles (Fig. 3) with a population greater than 1,500,000 people (Fig. 4). The average population density across the area is 120 people per square mile (Fig. 5). The area contains many river basins and several large man-made lake systems.

## **4. TORNADO CLIMATOLOGY**

### **4.1 Magnitude**

Tornadoes are classified by intensity based on the extent of the damage and associated wind speed. This is done according to the Fujita scale (Table 1), which rates tornadoes from F0, least destructive, to F5, most destructive. Of the 278 tornadoes that were documented during the 51 year period from 1950 to 2001, there were no F5 tornadoes, 6 F4 tornadoes (2%), 18 F3 tornadoes (7%), 53 F2 tornadoes (19%), 103 F1 tornadoes (37%), and 98 F0 tornadoes (35%) (Fig. 6).

### **4.2 Monthly Frequency**

During the period from 1950 to 2001, 278 tornado occurrences were recorded. A graph of these occurrences by month (Fig. 7), shows there are 3 peak periods for activity during the year. The first peak appears during the months of March, April and May. This corresponds to the historical severe weather season that is experienced across the southeastern United States. The most active month was May with 41 recorded occurrences. A secondary peak occurs during the months of July and August. This is most likely related to tropical phenomena such as hurricanes, tropical storms, and tropical depressions that have traveled close to or across portions of the CWA. There is a third peak that occurs during the month of November. This is most likely related to systems developing across the southeastern U.S. due to the warm and moist air still in place across the region and the intrusion of colder and drier air from Canada. Of the 24 tornadoes that were reported as Severe (F3) or

Devastating (F4), 13 (54%) of them occurred during the peak period from March through May.

### **4.3 Hourly Frequency**

The hourly distribution of tornado occurrences (Fig. 8), shows that the majority of tornadoes occur from noon through 8 PM. The peak occurs between 2 PM and 6 PM. There is also a minor secondary peak that occurs late at night between 10 PM and 2 AM. Of the 24 tornadoes that were reported as Severe (F3) or Devastating (F4), 17 (71%) of them occurred during the peak period of 4 PM to 8 PM (Fig. 9).

### **4.4 Associated with Tropical Systems**

Tornadoes associated with tropical systems have a large impact on the occurrence of tornadic activity during the months of July through September. Many of the tornado events recorded during this period likely originated from either the remnants of a tropical system, tropical storm, or hurricane. The graph depicting tornado events by month (Fig. 7), shows a secondary peak in the months of July and August. This peak is strongly influenced by the tornado outbreak associated with the remnants of Tropical Storm Beryl on August 16, 1994. This outbreak produced 15 tornadoes across the CWA, the largest outbreak during the period from 1950-2001. This one event accounted for 60% of the tornadoes recorded during the month of August for the 51 year period. During the months of July, August and September of the 51 year period, 63 tornadoes occurred, and 28 (44%) of those were related to tropical systems. During the middle to late Summer period, the wind fields across the southeast are typically weak and lack the vertical wind shear structure needed to support tornadic activity. Tropical systems often provide this necessary component, as they track in proximity to the CWA.

## **5. HAIL CLIMATOLOGY**

### **5.1 Monthly Frequency**

The occurrence of severe hail (hail with a diameter of 3/4 of an inch or greater) can take place anytime of the year. However, the data (Fig. 10) shows that there is a distinct season that begins in March and continues through July, with a peak during the month of May. During the month of May there were 210 (28%) severe hail events. During the peak period from April through June there were 530 (71%) events. The occurrence of hail is very infrequent in the Fall and early Winter. During the period from September through December there were only 31 (4%) events. Convective activity, in general, is historically low during this period across the CWA.

### **5.2 Hourly Frequency**

The hourly distribution of severe hail events (Fig. 11) shows that most events tend to occur during the afternoon and evening hours. This corresponds well with the diurnal cycle of thunderstorm activity during the convective season. The most active period occurs from noon through 8 PM, with the peak occurring between 2 PM to 6 PM. During the period from noon through 8 PM there were 603 (80%) events. The peak period from 2 PM through 6 PM there were 385 (51%) events. The occurrence of hail is very infrequent during the overnight hours. During the overnight period from 2 AM to 8 AM, there were 13 (2%) hail events.

## **6. SEVERE THUNDERSTORM WIND CLIMATOLOGY**

### **6.1 Monthly Frequency**

The occurrence of severe thunderstorm winds (winds of 50 knots or greater) is most common between the months of May and August (Fig. 12) with a peak during the month of June. During the peak period from May to August there were 1,106 (66%) severe thunderstorm wind events that occurred during the 51 year period. The occurrence of severe thunderstorm winds decreased dramatically in the Fall and early Winter. There were only 126 (8%) events from October through December. Again, this corresponds well to the historical convective season across the CWA.

## **6.2 Hourly Frequency**

As was the case with severe hail, the hourly distribution of thunderstorm winds corresponds to the diurnal cycle of convective activity. The most active period (Fig. 13) exists from noon through 10 PM with a peak period from 2 PM to 6 PM. During the peak period, 828 (49%) severe wind events occurred.

## **7. CONCLUSION**

By studying the climatology of severe weather that occurs across the Midlands of South Carolina and the Central Savannah River area of Georgia, the staff at WFO CAE will be better prepared to anticipate when events are likely to occur. An awareness of the spatial and temporal distribution of past severe weather events can aid forecasters in evaluating severe weather potential and assist local management in assigning staffing and forecaster duties throughout the year. In addition, this climatology will also provide valuable information that can be used in our local outreach efforts.

## **ACKNOWLEDGMENTS**

The author would like to thank Mike Cammarata, Science Operations Officer, of WFO Columbia, SC for his valuable input, patience and review. The author would also like to thank Ron Jones, former Data Acquisition Program Manager, of WFO Columbia, SC for his graphical expertise and Steve Naglic, Warning Coordination Meteorologist, of WFO Columbia, SC for the acquisition of local storm data.



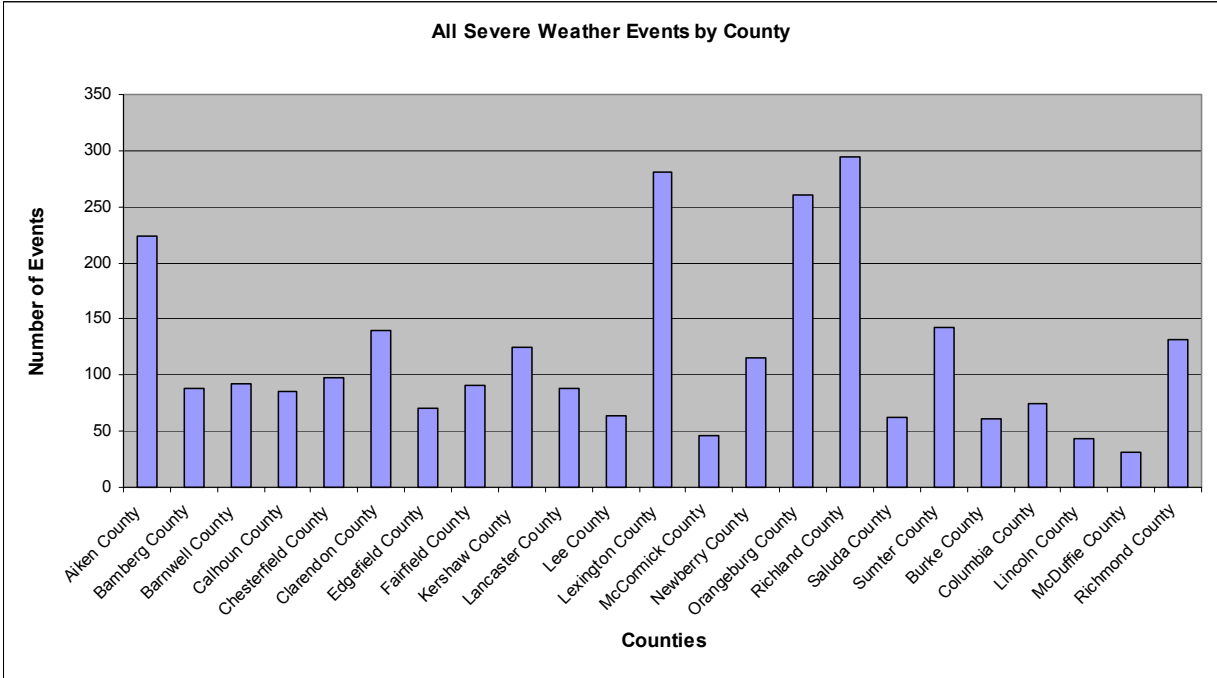
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Figures



Figure 1. Map of WFO Columbia, SC County Warning Area.



**Figure 2.** Total number of severe weather events by county from 1950 through 2001.

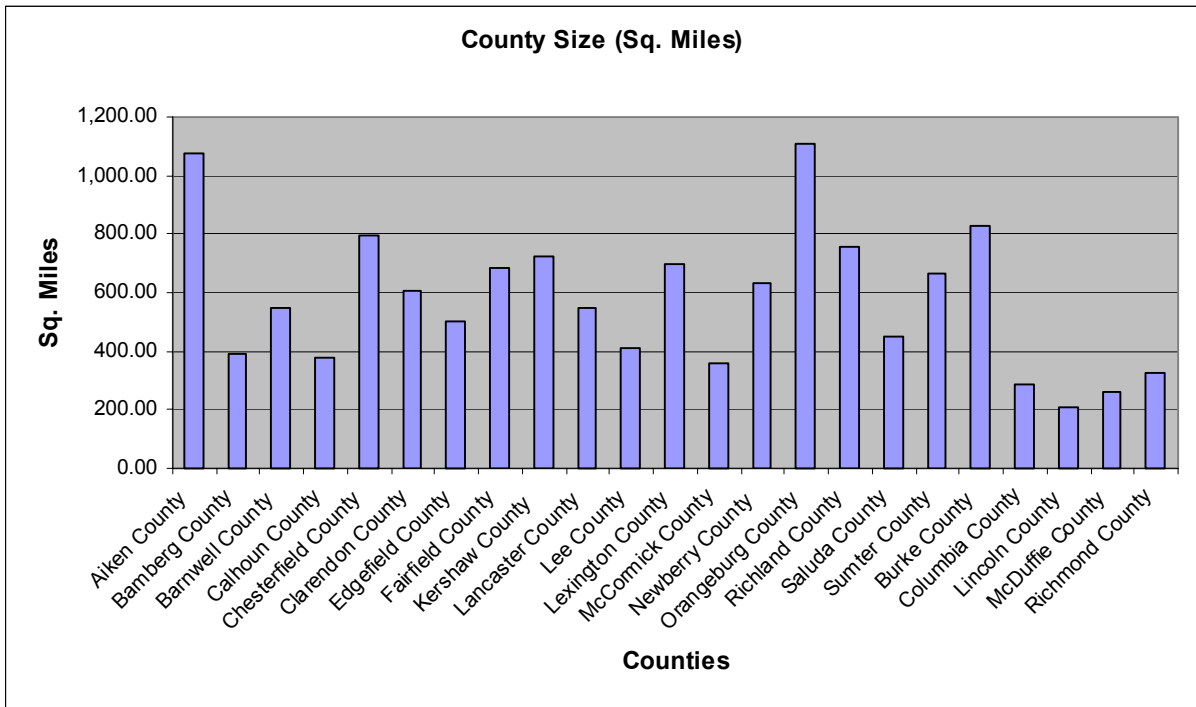


Figure 3. County size in square miles.

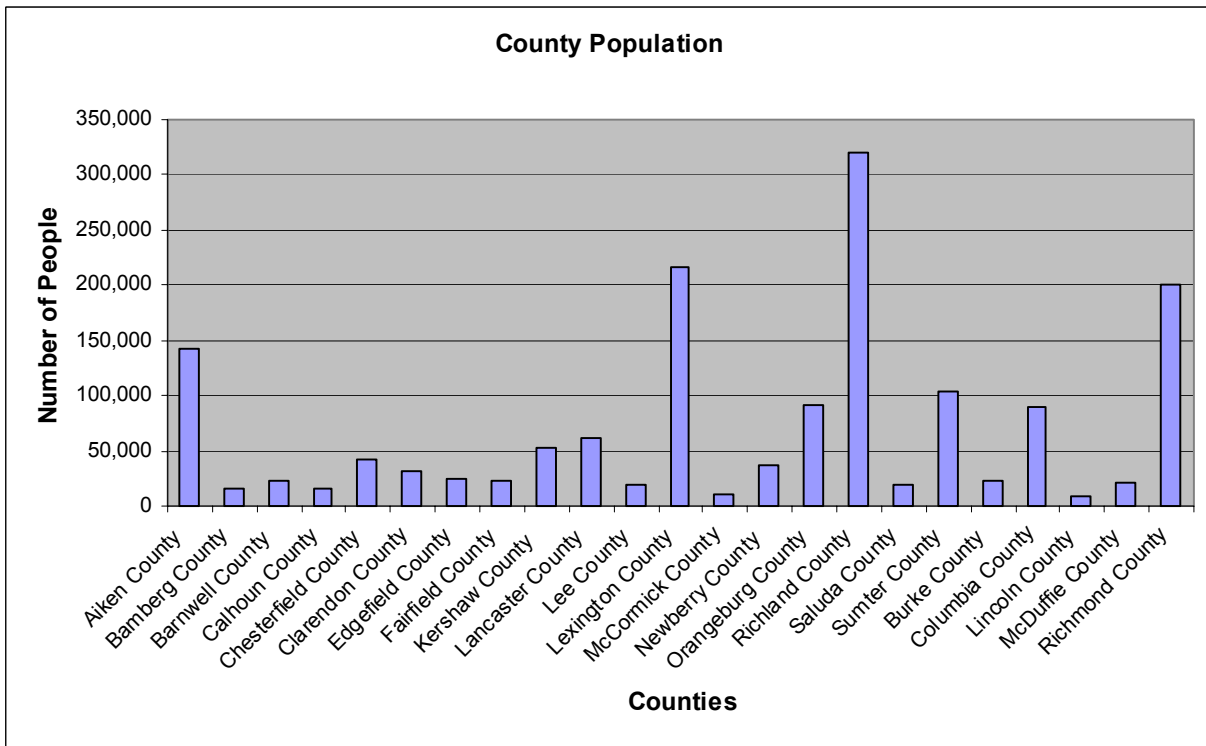


Figure 4. County population based on 2000 Census Data.

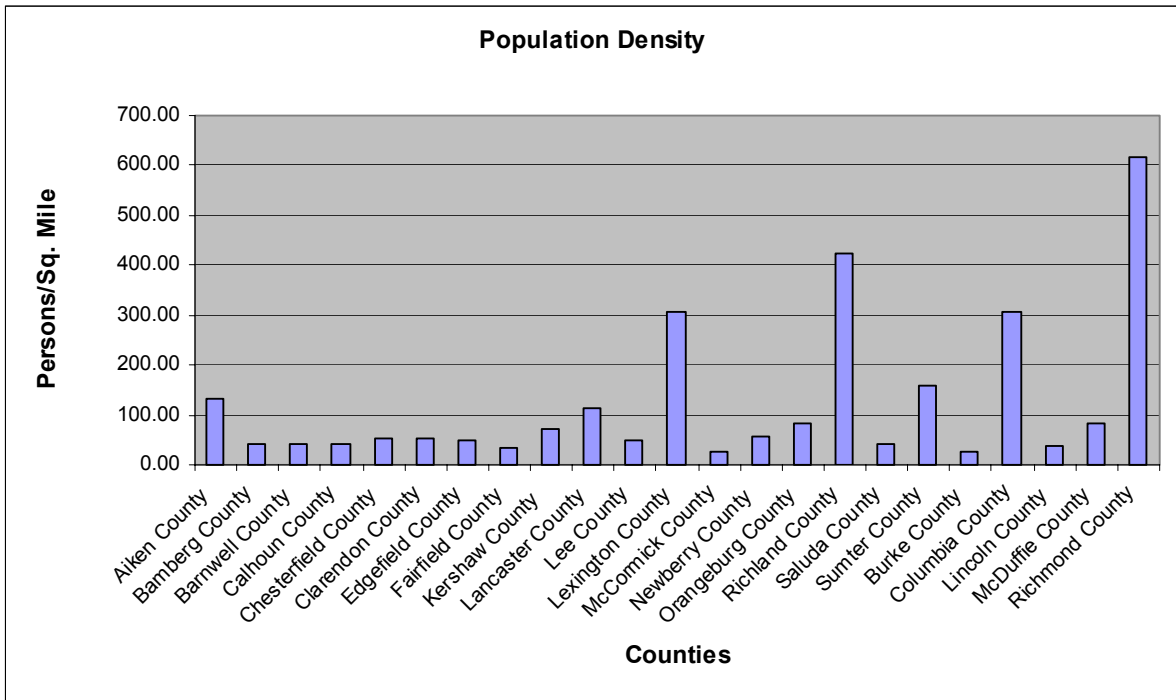


Figure 5. County population density (persons per square mile) based on 2000 Census Data.

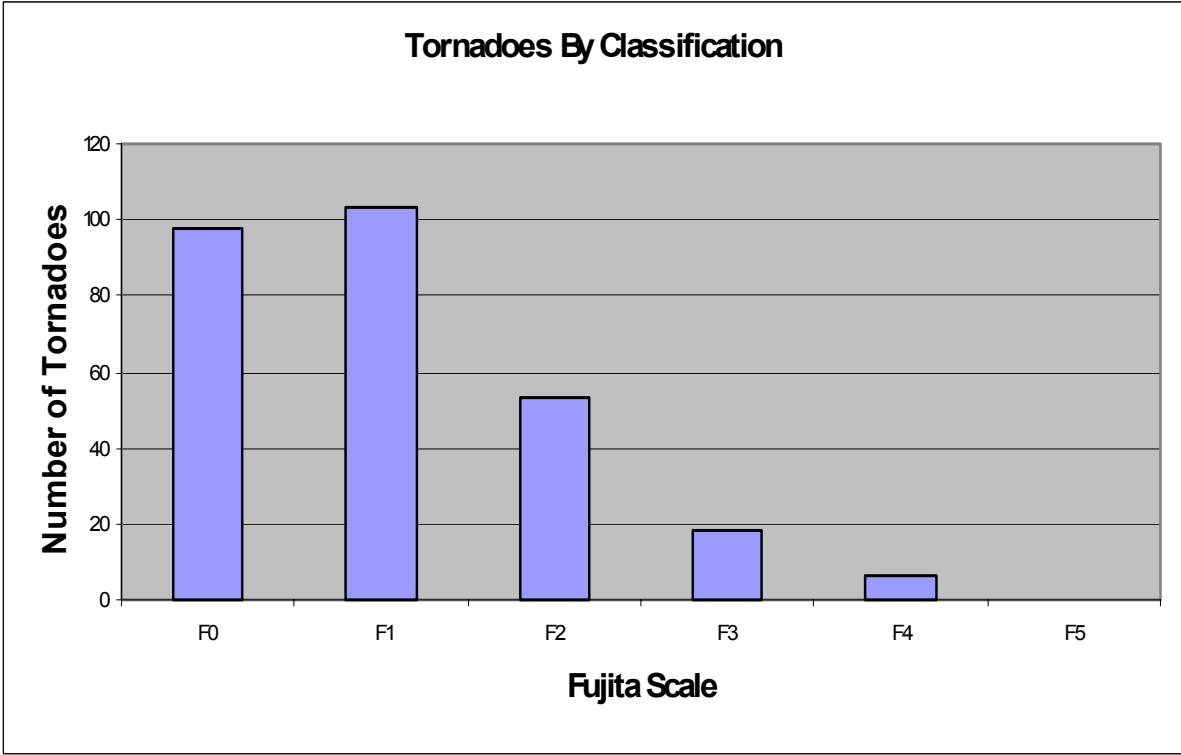
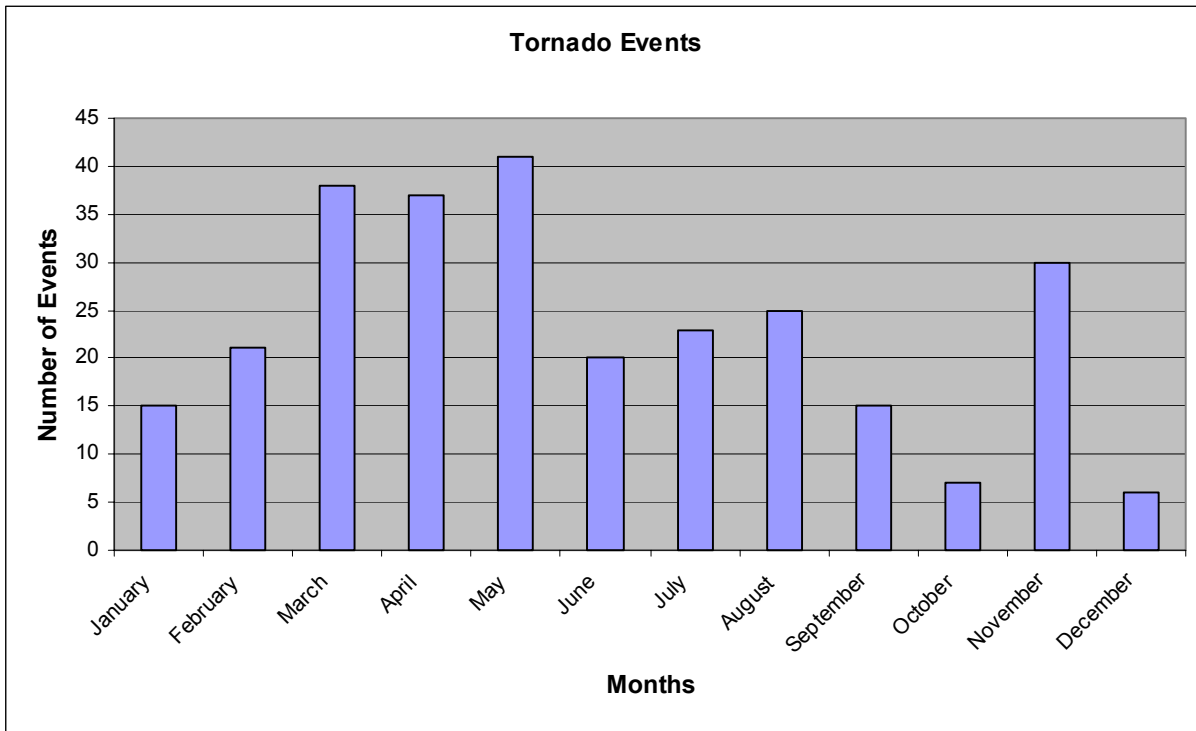
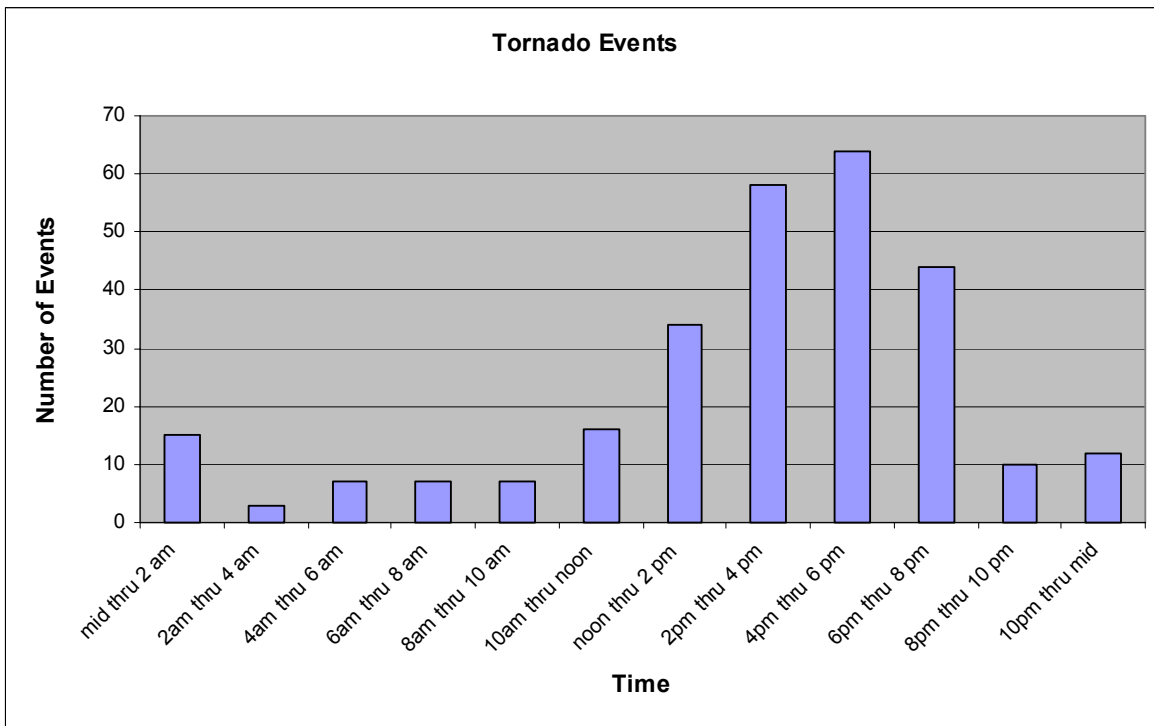


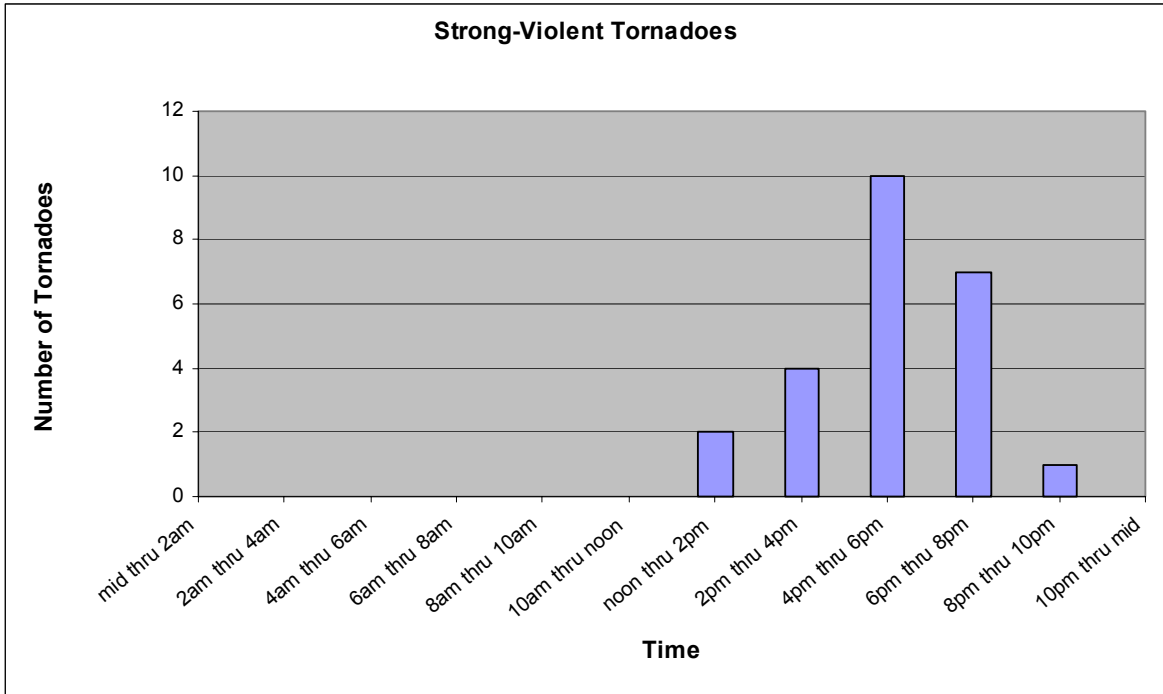
Figure 6. Distribution of Tornadoes by the Fujita Scale (F0-F5) (1950-2001).



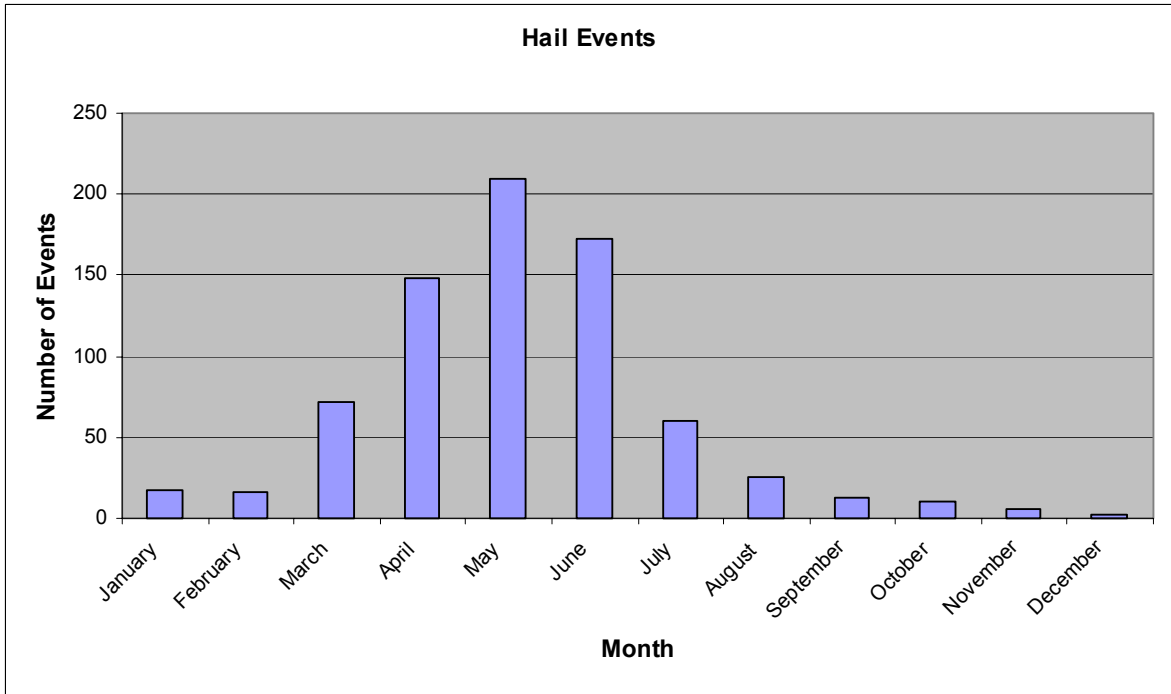
**Figure 7.** The distribution of tornado events by month (1950-2001).



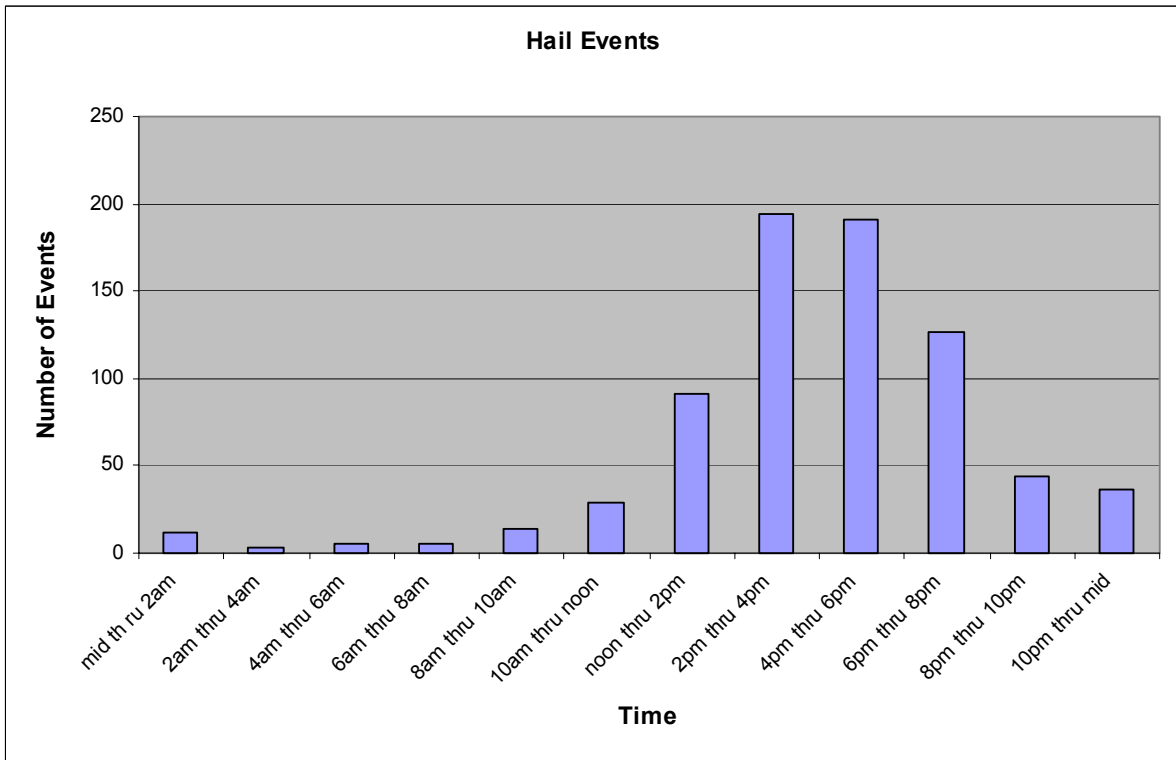
**Figure 8.** The distribution of tornado events by hours (1950-2001).



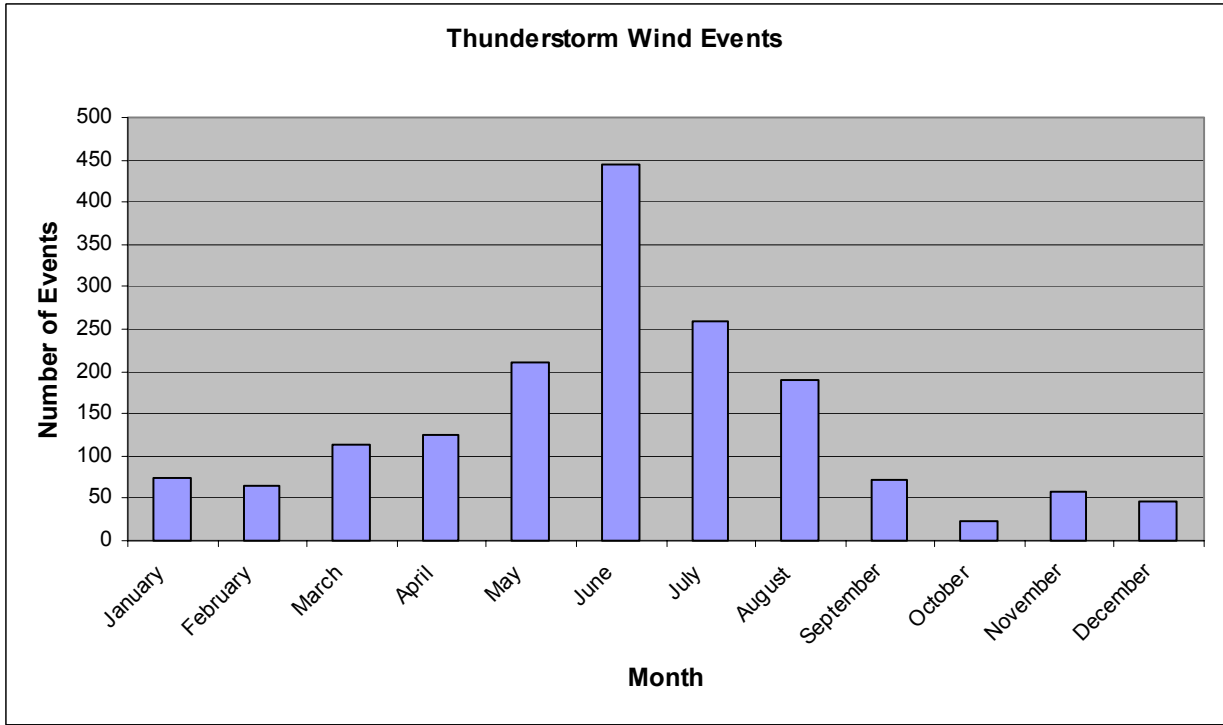
**Figure 9.** Distribution of strong-violent tornadoes (F3-F5) (1950-2001).



**Figure 10.** The distribution of hail events by month (1950-2001).

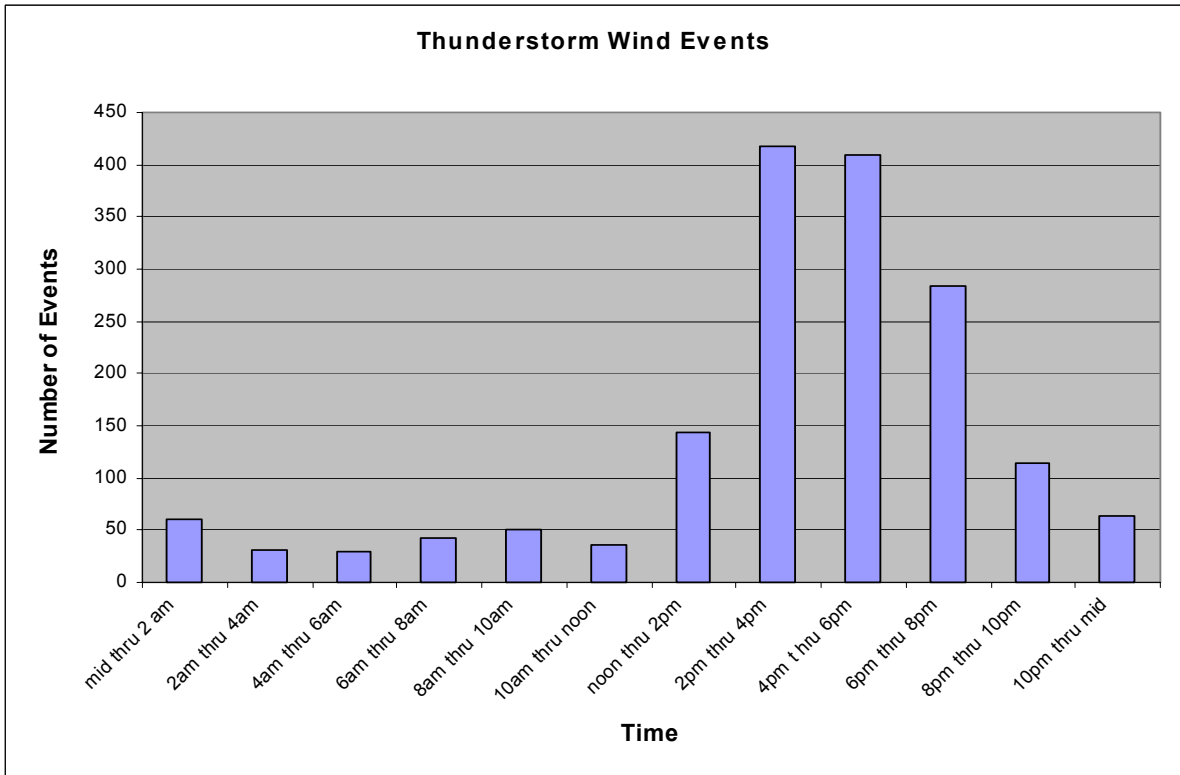


**Figure 11.** The distribution of hail events by hour (1950-2001).



**Figure 12.** The distribution of severe thunderstorm winds by month (1950-2001).





**Figure 13.** Distribution of severe thunderstorm winds by hour (1950-2001).

**Table 1. The Fujita Scale:**

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Scale	Wind Speed	Tornado Character
0	40-72 mph	Gale Tornado (weak)
1	73-112 mph	Moderate Tornado (weak)
2	113-157 mph	Significant Tornado (strong)
3	158-206 mph	Severe Tornado (strong)
4	207-260 mph	Devastating Tornado (violent)
5	261-318 mph	Incredible Tornado (violent)

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NWS ER 95 A Severe Weather Climatology for the Charleston, South Carolina, WFO County Warning Area. Stephen Brueske, Lauren Plourd, Matthen Volkmer. July 2002.

NWS ER 96 A Severe Weather Climatology for the WFO Wakefield, VA County Warning Area. Brian T. Cullen. May 2003. (PB2003-105462)

NWS ER 97 Severe Weather Climatology for the Columbia, SC WFO County Warning Area. Leonard C. Vaughan. September 2003.

## NOAA SCIENTIFIC AND TECHNICAL PUBLICATIONS

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