ANNUAL SUMMARY

The Tornado Season of 1985

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ABSTRACT

A review of tornado activity in the United States during 1985 is presented. Annual statistics are compared with both recent and long-term values. Month-by-month highlights of tornado events are summarized. Meteorological patterns associated with three noteworthy tornado outbreaks are examined.

1. The year 1985 in statistics

The annual total of 684 tornadoes for 1985 represents the fewest tornadoes reported in the United States in any year since 653 occurred in 1970. Even though the number of tornadoes fell by almost 25% from the previous year, 1985 was not without a major tornado outbreak. On 31 May, violent tornadoes struck Ohio and Pennsylvania causing 76 fatalities and more than 900 injuries. Among these killer tornadoes was only the third F5 (Fujita, 1981) tornado to occur in the United States since 1977. This one tornado caused 18 fatalities and 310 injuries along a 75-km path of destruction from eastern Ohio into western Pennsylvania.

Overall, eight months during 1985 had below average tornado activity. June, with 82 tornadoes, had the fewest tornadoes for that month since 73 occurred in 1959. July, with 51 tornadoes, had the fewest tornadoes for that month since 42 occurred in 1960. In contrast, 108 tornadoes in August more than doubled the 35-year (1950–84) mean of 52. During this month, several states set monthly records. The 22 tornadoes that occurred in Alabama broke that state's August record of two set in 1983. Also, the first tornado-related fatality in Alabama during August since reliable records began in 1950 was recorded. Additional records were set for August in Louisiana (seven breaking the 1954 record of four), in South Dakota (ten breaking the 1982 record of six) and in Tennessee (five breaking the 1983 record of one).

There were 94 tornado-related fatalities in 1985. Of these, 78 occurred during the month of May, and 76 occurred on 31 May. The 65 fatalities in Pennsylvania on 31 May greatly exceeded both monthly and annual records of two for that state. The monthly distributions of tornadoes and related fatalities are listed in Table 1.

For the first time, detailed records concerning circumstances of tornado-related fatalities were kept by the National Weather Service. As examples, 60% of the victims were females, the majority of victims were over 60 years of age, and 43% of the fatalities occurred in personal homes. Although no conclusions can be derived from a single year's data, trends in these statistics will be helpful in future improvement of warning and preparedness efforts.

Texas was the state with the highest number of tornadoes (90), followed by South Dakota with 55 and then Nebraska with 52. Although Texas again had the most tornadoes of any state during 1985, a total of 90 was its smallest annual total in Texas since 77 occurred in 1966. Pennsylvania recorded an all-time annual maximum of tornadoes with 33, breaking the record of 23 set in 1976. In August, Rhode Island recorded only its second tornado since reliable records began in 1950, and its annual total of one tied the previous record set in 1972. The annual total of eight in New York tied the record first set in 1983. In contrast, Maryland had no tornadoes during the year, the first annual total of zero since 1970. Geographic distributions of tornadoes and fatalities for 1985 are depicted in Fig. 1.

There were 20 killer tornadoes in 1985. Ten killers that struck Ohio and Pennsylvania on 31 May caused 80% of the annual total of fatalities. Facts concerning these killer tornadoes are listed in Table 2.

The geographic distribution of strong (F2 or F3) and violent (F4 or F5) tornadoes in 1985 is depicted in Fig. 2. As shown in Table 3, strong and violent tornadoes represented a small percentage of the annual total (17%), but caused a very high percentage of the fatalities (99%). There were nine violent tornadoes during 1985. Data concerning these violent tornadoes are listed in Table 4. All of them occurred in May and were characterized by long tracks. For example, the F5 tornado in Ohio and western Pennsylvania on 31 May had a 75-km track, while on the same day, an F4 tornado traveled 110 km across western and central Pennsylvania. Another violent (F4) tornado that passed near Agra, Kansas on 10 May, had a path length of 90 km.

TABLE 1. Monthly distributions of tornadoes, tornado fatalities and killer tornadoes.

	Tornadoes			Fatalities			Killer tornadoes	
	1985	1984	1950–84 mean	1985	1984	1950–84 mean	1985	1984
Jan	2	1	13	0	0	3	0	0
Feb	7	27	20	0	0	7	0	0
Mar	38	73	48	2	64	14	1	12
Apr	134	176	101	5	33	34	3	10
May	182	169	155	78	6	20	11	2
Jun	82	242	144	3	14	14	2	4
Jul	51	72	77	0	0	2	0	0
Aug	108	47	52	3	0	2	2	0
Sep	40	17	34	0	0	2	0	0
Oct	18	49	22	0	4	2	0	4
Nov	19	30	21	3	1	1	1	1
Dec	3	4	19	0	0	3	0	0
Totals	684	907	706	94	122	104	20	33

2. Monthly summaries

a. January

Cold, arctic air dominated most of the United States during January. Winter storm systems produced locally heavy snow over much of the Plains with record breaking amounts of up to 14 inches reported in south-central Texas from a storm on 12–13 January. The cold temperature and lack of significant moisture moving north from the Gulf of Mexico kept severe local storms to a minimum.

The first tornado in 1985 occurred at 0515 CST 17 January when a weak (F0) tornado moved through a ten block area in Panama City Beach, Florida causing roof damage to several homes. For the third consecutive year, the first tornado reported began as a waterspout and moved on shore. On the last day of the month, a tornado touched down in a wooded area about 16 km northwest of Montgomery, Alabama. The total of two tornadoes during the month was well below the average of 13.

b. February

A winter theme continued to prevail during the month with temperatures averaging below normal over most of the Nation west of the Appalachian Mountains. Tornadoes were, again, below average in number with only seven reported, while 20 is average.

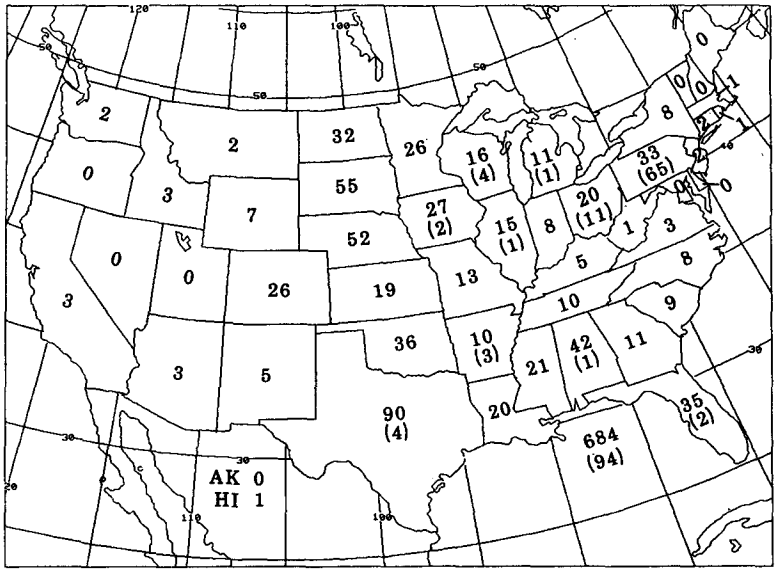

FIG. 1. Geographic distribution of tornadoes in 1985. (Total summed over states gives 694 because of "border crossers".) Figures in parentheses are tornado deaths.

TABLE 2. Killer tornadoes during 1985.

Date	Time (CST)	Location	Deaths	Intensity	Remarks
17 Mar	0300	Venice, FL	2	F3	1 Camper
5 Apr	0458	Clarmin, IL	1	F2	1 Mobile home
21 Apr	1730	5 SE Elbert, TX	3	F3	
28 Apr	2000	5 N Shep, TX	1	F2	
30 May	2130	Elkader, IA	2	F3	
31 May	1505	Albion, Crainesville, PA	12	F4	3 Mobile home
31 May	1510	Linesville, PA	1	F2	1 Camper
31 May	1520	Atlantic, N. Cherry, PA	16	F4	10 Mobile home/1 camper
31 May	1545	Centreville, PA	2	F3	
31 May	1700	German Hill, PA	7	F4	
31 May	1700	Niles, Hubbard, OH/Wheatland, PA	18	F5	
31 May	1745	Fallsburg, OH	1	F3	
31 May	1810	Beaver Falls, Saxonburg, PA	9	F3	
31 May	1830	Kane, PA	4	F4	
31 May	1930	Elimsport, Watsontown, PA	6	F3	4 Mobile home
8 Jun	1920	Willow Reservoir, WI	2	F3	1 Mobile home
8 Jun	2012	16 W Stephenson, MI	1	F1	
12 Aug	1910	New Lisbon, WI	2	F2	2 Mobile home
16 Aug	1000	Parrish, AL	1	F2	1 Mobile home
18 Nov	2112	Ralph, Rea Valley, AR	3	F3	

Mississippi and Oklahoma each reported two tornadoes. The tornadoes in Oklahoma were the first to strike that state so early in the year since 1977. One of these was the first strong (F2) tornado in 1985 and the first to result in injuries. This twister caused damage estimated at $400 000 and injured three people in the small community of Harmony as it produced a 16-km intermittent path just north of the Red River in southeast Oklahoma. Alabama, California and Florida each reported one tornado in February.

c. March

Although tornadoes occurred in 13 states during March, the total of 38 was 10 below the monthly average. Ohio led the nation and set an all-time record for March with six tornadoes. Florida, Oklahoma and Texas followed with five each. The three tornadoes in Arizona were the most ever reported in that state during March.

On 17 March, the first killer tornado of 1985 occurred when a strong F3 twister struck Venice, Florida.

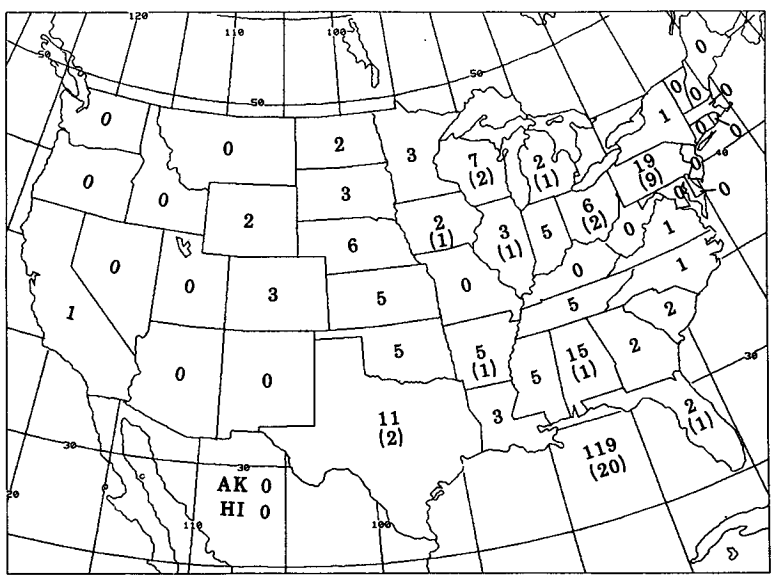

FIG. 2. Geographic distribution of "strong" and "violent" (intensity F2 or greater) tornadoes in 1985. (Total summed over states gives 127 because of "border crossers".) Figures in parentheses are killer tornadoes. (Total summed over states gives 21 because of "border crossers".)

TABLE 3. Tornado frequency and deaths by intensity category: 1985

Category	F Scale	Number	Frequency (%)	Deaths
Weak	0–1	565	82.6	1
Strong	2–3	109	15.9	30
Violent	4–5	10	1.5	63

An inhabitant of a camper vehicle was killed and a second person lost his life as he stood watching the storm from his front porch. Forty-five people were injured as the tornado produced a 5-km long path of destruction that destroyed 55 houses and caused major damage to an additional 120. Several business establishments were destroyed or incurred major damage. Pieces of a supermarket roof were carried one km and a coin-operated water dispenser was carried from the store and blown through the wall of a house three blocks away. In a residential area, a piece of window frame was driven completely through a small child's bed while she was visiting a friend's house.

d. April

Tornado activity increased dramatically in April with the first major outbreak of the year occurring early in the month. On 5 April a line of strong thunderstorms that developed in advance of a fast-moving cold front produced numerous reports of severe weather in the east-central and southern portions of the nation. Twenty tornadoes were reported in the following states: Alabama (6), Georgia (5), Indiana (4), Illinois (2), Louisiana (2) and Tennessee (1). Three of the six tornadoes in Alabama were F3 in intensity. An early morning tornado that struck Clarmin, Illinois (about 64 km southeast of St. Louis) claimed the life of an occupant of a mobile home and injured three as the storm ripped through a trailer park.

A strong (F3), multivortex, tornado touched down about 80 km southwest of Wichita Falls, Texas on 21 April. As the tornado passed east of the town of Elbert, it demolished a frame dwelling and killed an elderly couple and their son. One week later, a woman was killed near Shep, Texas when a tornado destroyed her farm home. This brought the total number of tornado fatalities for the year to seven, well below the national average of 58 for the first four months.

There was a total of 134 tornadoes reported during April. Almost one-third (41) of the total occurred in Texas. This was the greatest number of tornadoes in Texas during April since 1976 and only the third time in the past 35 years that more than 40 have been reported in Texas during any one month. Fifteen tornadoes in Nebraska broke the April record of 14 that was set in 1974, and 12 tornadoes in South Dakota exceeded the old monthly record of 9 that was established in 1955.

e. May

The number of tornadoes continued to be above average in May and significant outbreaks plagued several states during the month. On 10 May, the first violent (F4) tornado in 1985 struck north-central Kansas near the town of Webster. Shortly thereafter, a second F4 tornado touched down near Agra, Kansas and began a 90-km track that ended just north of Blue Hill, Nebraska. Although this powerful storm was more than 900 m wide in places, it missed heavily populated areas and there were no fatalities. There were four people injured and damage to farm houses and outbuildings was estimated at $3.5 million in Kansas alone.

A major severe storm system raked the Midwest on 12–13 May producing numerous reports of wind damage, hail and tornadoes in Texas, Oklahoma, Kansas, Arkansas and Missouri. North Texas was hardest hit on the morning of 13 May when a line of strong thun-

TABLE 4. Violent tornadoes in 1985.

Date	Time (CST)	Location	Intensity	Path length (km)	Mean path width (m)	Deaths	Injuries
10 May	1640	Webster, KS	F4	51	550	0	0
10 May	1800	Agra, KS	F4	90	550	0	1
31 May	1501	Albion/Cranesville, PA	F4	22	367	12	82
31 May	1517	Atlantic/Cochranton/ Copperstown, PA	F4	90	321	16	125
31 May	1525	Corry, Union City, PA Columbus, NY	F4	45	275	0	Unknown
31 May	1630	German Hill, PA	F4	46	734	7	30
31 May	1740	Charleston/Newton Falls, Niles/Coalburg, OH Wheatland, PA	F5	75	404	18	310
31 May	1735	6 WSW Pennfield, PA	F4	110	2294	0	0
31 May	1800	Sheffield, Kane, PA	F4	46	917	4	40
31 May	2025	Bastress, Watsontown, PA	F4	30	835	6	60+

derstorms developed southwest of Dallas and raced northeast at more than 25 m s^{-1}. The first tornado touched down in De Soto, a suburb of Dallas, and caused considerable damage. As the storm continued northeast toward southeast Dallas, 16 children were injured when strong thunderstorm winds struck the Lake June School. Twenty-three people were injured in Greenville, Texas when a strong (F2) tornado passed through a heavily populated area of the city.

Shortly after noon CST, another F2 tornado struck Paris, Texas and injured eight people. This weather system accounted for 47 injuries from tornadoes and three from strong thunderstorm winds, but there were no tornado fatalities. The only weather related death was due to lightning striking a tree beneath which several construction workers were eating lunch. Ironically, the storm struck the part of the city that had been rebuilt after a violent (F4) tornado leveled the area on 10 April 1982.

On 30 May, an intense low pressure system moved eastward through the upper midwest. A line of strong thunderstorms produced severe weather from Missouri to Wisconsin. Hail up to 7.6 cm in diameter knocked out automobile windshields and caused extensive roof damage in the Kansas City area while a tornado south of St. Joseph, Missouri injured five people. During this tornado, a woman took her small child to the basement just before the house was ripped off the foundation. The woman and child were injured when they were slammed into the basement wall. Two people were killed later in the day when a strong (F3) tornado struck the County Care Facility near the town of Elkader in northeast Iowa. Twenty-seven people were injured as this tornado produced a 35-km track in Iowa, crossed the Mississippi River and stayed on the ground for an additional 18 km in Wisconsin.

On the last day of the month, the worst tornado outbreak, in terms of fatalities, to strike the nation since the super outbreak of 3–4 April 1974 devastated parts of Ohio, Pennsylvania and New York. The outbreak began between Lake Ontario and Georgian Bay in southern Ontario. Thirteen tornadoes were reported and a total of 12 people were killed in Canada. Lines of thunderstorms explosively developed southward into Ohio. In less than 8 hours this violent weather system spawned 30 tornadoes in the United States that produced a total path length of almost 880 km. Thirteen (43%) of these tornadoes were strong in intensity, seven (23%) were violent and ten (33%) were killer storms that claimed the lives of 76 people (11 in Ohio and 65 in Pennsylvania). There were more than 900 injuries. This was the greatest death toll from one storm ever recorded in Pennsylvania and this outbreak was the worst to strike this section of the nation since 23 June 1944 when 147 people were killed in West Virginia (103) and Pennsylvania (44).

The first tornado of this outbreak to strike the United States touched down at 1450 CST, 3 km west of the Pennsylvania border in northeast Ohio and moved east-northeast into Pennsylvania where it strengthened to F4 intensity as it struck the town of Albion. Nine people were killed in Albion, three in Cranesville and 82 injured as this twister produced a 19-km path of destruction.

The most deadly tornado was a violent (F5) that touched down midway between Akron and Warren, Ohio and moved east causing near total destruction in its 75-km path that ended 22 km east of the Pennsylvania border near the town of Mercer. The tornado traveled that distance with an average forward speed of over 20 m s^{-1}. Ten people were killed in Niles and Hubbard, Ohio and eight in Wheatland, Pennsylvania. Four airplanes were destroyed when the Hermitage airport was demolished. One of the aircraft wings was later found 19 km east in the town of Mercer. This was the most powerful tornado in 1985 and only the third since 1977 to reach F5 intensity.

A long-track violent (F4) tornado touched down in Ohio near the Pennsylvania border and covered a distance of 90 km. Sixteen people were killed by this relentless twister.

A tornado in Pennsylvania, which tracked from near Darlington, to just south of Sarver, picked up a van on Interstate 79 and carried it one-half kilometer from the road. The van was demolished, but the occupants were thrown free and survived.

The fury of this incredibly violent storm system subsided shortly before midnight CST with 21 tornadoes tallied in Pennsylvania (four entered the state from Ohio), 11 in Ohio and three in New York (one crossed the border from Pennsylvania). A total of 182 tornadoes were reported in the nation during May. Although this was only 27 above average, several records were broken. Pennsylvania not only set a record for the month of May with 21 (previous record was 5, set in 1983), but never had they reported more than 10 in any month. North Dakota tied its May record with 10 tornadoes. South Dakota led the nation with 28 tornadoes, followed by Texas with 27 and Pennsylvania with 21.

f. June

In contrast with June 1984, when an all-time record number of tornadoes (242) occurred, there were only 82 reported in June 1985; the fewest in June since 1959. The total of 82 tornadoes during the month was only 57% of the June normal of 144. These tornadoes were spread among 26 states, and no state total reached double digits. A Wisconsin tornado on 8 June was the only tornado to reach F3 intensity. South Dakota, after a very active May, reported no tornadoes in June for the first time since 1958. Colorado and North Dakota each reported nine followed by eight in Iowa and seven in Pennsylvania.

On 8 June, one day after the first anniversary of the Barneveld, Wisconsin tornado that killed 9 people and

injured 200, a strong thunderstorm complex developed in northwest Wisconsin and produced hail as large as 15 cm in diameter and widespread damage over the northern third of the state. A long-track (109 km) tornado resulted in two fatalities 40 km west of Rhinelander. A man drowned when the tornado lifted his house and deposited it in a lake, and a woman was killed when a tree crushed the vehicle in which she was seeking refuge. Later that evening, a man was killed 24 km north of Menominee, Michigan when a tornado tossed a tree on the tent in which he was camping. This brought the total tornado fatalities for the first six months of the year to 88.

g. July

Tornadic activity continued below normal during July with 51 twisters being reported. Most tornadoes were weak with only one reaching F3 intensity. This tornado was one of three produced by the remnants of Hurricane Bob as it moved through Virginia on 25 July. The F3 tornado touched down briefly about 32 km north northeast of Charlottesville damaging a grocery store and two houses.

On Independence day, a tornado developed within a thunderstorm downburst region and hit Evanston, Illinois, a suburb of Chicago. Damage was limited to trees and homes. Twelve sailboats were flipped over and damaged as the tornado moved over lakefront beaches before becoming a waterspout over Lake Michigan.

Fifty-one tornadoes during the month were the fewest reported in July since 1960 when 42 occurred. For the second consecutive month, Colorado led the nation with a total of 9 tornadoes. There were no tornado-related fatalities during July.

h. August

A relatively quiet two-month period ended as 108 tornadoes occurred in August. This was more than double the monthly average of 52 and ranked second to the record high of 128 that was established in 1979. Alabama, with 22 tornadoes, led the nation followed by South Dakota (10), Florida (9) and Kansas and Louisiana with 7 each.

On 12 August, a strong (F2) tornado produced a 35-km track that began about 64 km east of La Crosse, Wisconsin near the town of Kendall. This tornado became a killer storm as it moved northeast and struck a trailer court in New Lisbon. A woman was killed, her husband died a few days later, and 22 people were injured as the tornado destroyed 17 of the 35 mobile homes in the park. The following morning, a severe thunderstorm in northern Kansas produced golfball size hail that was driven by winds in excess of 32 m s^{-1}. All vegetation was literally stripped in an 11-km by 6-km swath near the town of Logan. Road graders were called in to remove hail drifts that were up to one meter deep on highways.

Thirty-nine of the 108 tornadoes in August were associated with Hurricane Danny and its remnants as it moved across the southeastern United States in the middle of the month. On 16 August, Alabama reported 21 tornadoes from this storm system. A total of 16 people were injured during the outbreak and a woman was killed when a tornado struck about 48 km northwest of Birmingham near Parrish and destroyed her mobile home. A man was seriously injured when the tornado overturned his truck.

Several records were broken in August. Twenty-two tornadoes in Alabama shattered the previous monthly record of two that was set in 1983. It is interesting to note that the 21 tornadoes that occurred in a six hour period on 16 August were more than double the maximum number of 9 that had been reported in August since reliable records began in 1950. The tornado fatality was the first ever reported in Alabama during the month of August.

New monthly records were also established in Louisiana with 7 (old record 4, set in 1954), South Dakota with 10 (old record 6, set in 1982) and 9 in North Dakota tied the earlier record that was set in 1983. A tornado in Rhode Island on 26 August was the first August tornado and only the second to occur in that state.

i. September

Although a greater than normal number of tornadoes (40 vs 34) was reported in September, there were no fatalities and only five injuries. Nebraska reported the most tornadoes (7) while six occurred in Mississippi. One of the more significant tornadoes touched down in south-central Alabama about 32 km north of the Florida line on 23 September. This strong (F2) tornado produced a 35-km intermittent path from near London to Fairview and resulted in four injuries. Hurricane Gloria spawned a tornado in New Jersey and another in Massachusetts as she moved along the coast on 27 September.

Seven tornadoes in Nebraska exceeded the previous record for September of five that was set in 1977, and six in Mississippi broke the old record of four that was established in 1982.

j. October

October began a trend of below normal tornado activity that continued through the remainder of 1985. Six states reported a total of 18 tornadoes (normal is 22). Seven of the 18 tornadoes reported during October occurred in Florida while Texas and Alabama each had 3.

Many of these tornadoes were embedded in bands of intense thunderstorms associated with Hurricane Juan as it moved erratically in the Gulf of Mexico late

in the month. Six people were injured by two of the tornadoes that struck Florida on 28 October. A man was hurt when a tornado tossed him from his home in Fort Walton Beach, and five people were injured in Walton County when a tornado struck a mobile home park in the town of Villa Tasso.

k. November

Nineteen tornadoes occurred during the month of November. The last tornado fatalities in 1985 occurred on 18 November when a strong (F3) tornado began a 54-km track that began about 43 km east of Harrison, Arkansas. Two fatalities in Ralph and one in Rea Valley brought the death toll for the year to 94.

Illinois and Oklahoma each reported four tornadoes in November while Arkansas, North Carolina, South Carolina, and Tennessee had two each. A tornado that struck near Pickens in southeast Oklahoma on 18 November caused an estimated $200 000 damage and injured four people.

l. December

Only three tornadoes were reported in the nation during December. Texas reported two on 10 December. At 1400 CST on 11 December, a tornado that touched down near Covington, Louisiana was the 684th, and last, tornado in 1985. This tornado destroyed a house and caused damage to power lines.

3. Noteworthy tornado outbreaks

There were few concentrated tornado outbreaks during 1985. However, tornadoes on 31 May killed more people than any outbreak since 1974. Brief discussions of the progression of meteorological patterns are presented in the following review of three noteworthy tornado outbreaks that occurred during the year. Also, a composite chart, depicting the relative positions of some key meteorological fields, is shown for each outbreak.

Outbreaks of 5 April and 31 May were associated with strongly baroclinic environments characterized by well-defined jet streams and intensifying synoptic-scale systems. Although the mesoscale structure and evolution of these two cases were different, both were representative of dynamically-forced springtime severe local storm outbreaks. In contrast, the tornado outbreak of 16 August was associated with a tropical warm-core system characterized by deep moisture and relatively weak tropospheric winds.

a. 5 April 1985

Severe local storms occurred ahead of a strong cold front from Indiana to Ohio and from Louisiana to Georgia and northwestern South Carolina. Twenty tornadoes occurred, with six in Alabama and five in Georgia. Three of the six tornadoes in Alabama were rated F3 in strength. Also, surface wind gusts up to 40 m s^{-1} were reported at Bremen, Georgia and Fairfield, Illinois.

A composite chart for 0600 CST on 5 April is shown in Fig. 3. A surface low of 993 hPa was located in southern Illinois. A slow-moving cold front extended southwestward from the low across southeastern Missouri, Arkansas, and into central Texas. At 850 hPa a low-level jet of speeds up to 27 m s^{-1} was bringing warm, moist air northeastward ahead of the front. Lifted Index (Prosser and Foster, 1966) values were as low as −10 in southeastern Texas. At 500 hPa the polar jet was flowing around a trough over the Great Plains. Another southwesterly jet at 500 hPa was evident from the Gulf Coast across Louisiana into southern Tennessee.

During the next 12 hours the trough at 500 hPa deepened rapidly. This intensification was reflected in a 500 hPa height fall of 220 gpm at Peoria, Illinois before 1800 CST. In response, the surface low moved from southern Illinois to southwestern Michigan and deepened to a sea level pressure of 958 hPa. As the cold front accelerated rapidly southeastward, an intense squall line that produced tornadoes developed ahead of the cold front in the tongue of moist, unstable air. Both moved across the southern states and the lower Ohio Valley.

b. 31 May 1985

The largest outbreak of tornadoes in the United States during 1985 occurred on 31 May in Ohio, Pennsylvania and New York. A total of 30 tornadoes occurred. Seven of them were violent and ten killer tornadoes caused 76 fatalities. Also, 13 tornadoes occurred and 12 people were killed in the province of Ontario in Canada.

At 0600 CST on 31 May a strong trough at middle and upper levels was deepening as it moved across southern Canada. Winds at 500 hPa were up to 25 m s^{-1} across the lower Great Lakes. As the system continued to deepen, winds at 500 hPa increased to 35 m s^{-1} just north of Ohio and Pennsylvania by 1800 CST.

During the day a surface low moved from northern Wisconsin to a position northeast of Lake Huron. Strong warm advection at 850 hPa occurred in Ohio and western Pennsylvania as the southwesterly flow ahead of a cold front increased. As westerly winds increased at the 700 hPa level, drier air pushed rapidly across the lower Great Lakes. This process of differential advection enhanced the potential instability of the airmass. In midafternoon broken lines of thunderstorms explosively developed southwestward from Ontario into Ohio, and tornadoes began to form. Synoptic features at 1800 CST are depicted in Fig. 4. At this time a cold front bulged through eastern Ohio. Ahead of the front, surface dewpoints were above 18°C

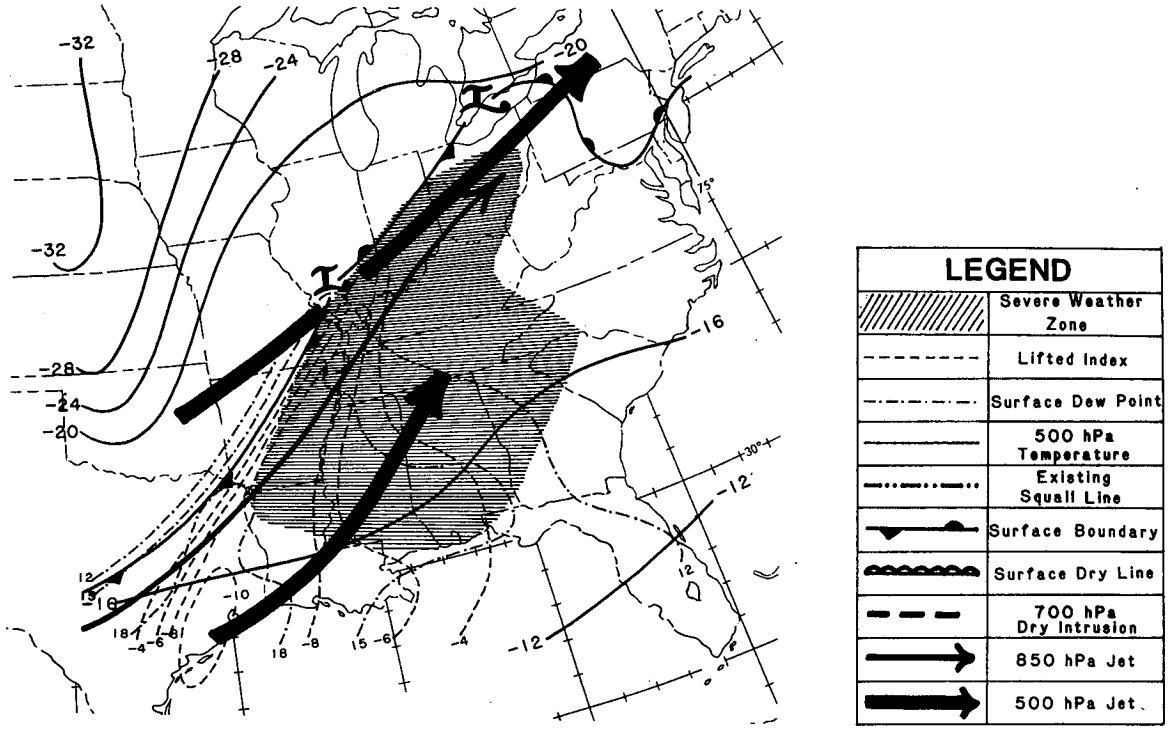

FIG. 3. Composite chart depicting significant synoptic features for 0600 CST 5 April 1985.

as far north as central New York. A Lifted Index value of −10 was computed at Pittsburgh, Pennsylvania. At 1800 CST four tornadoes were on the ground in western Pennsylvania.

c. 16 August 1985

As tropical depression Danny moved across northern Mississippi on 16 August, 27 tornadoes formed. Of

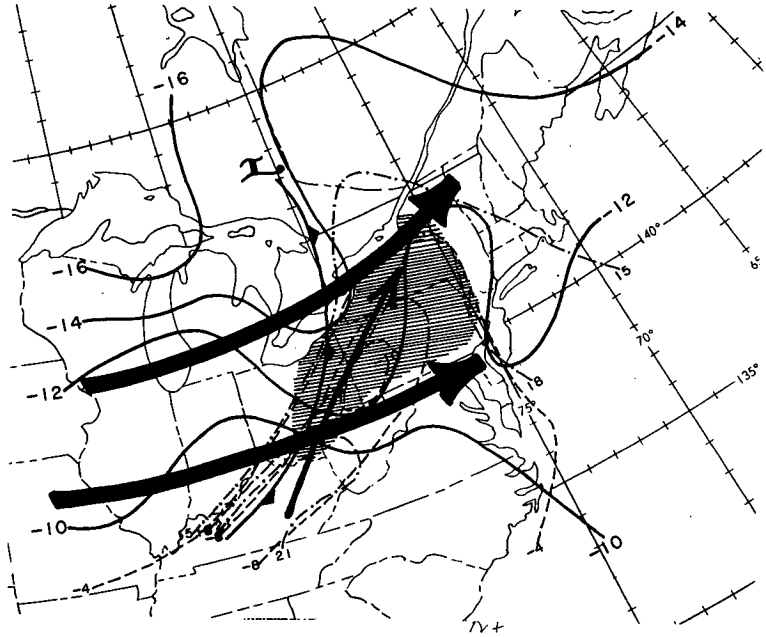

FIG. 4. As in Fig. 3 but for 1800 CST 31 May 1985.

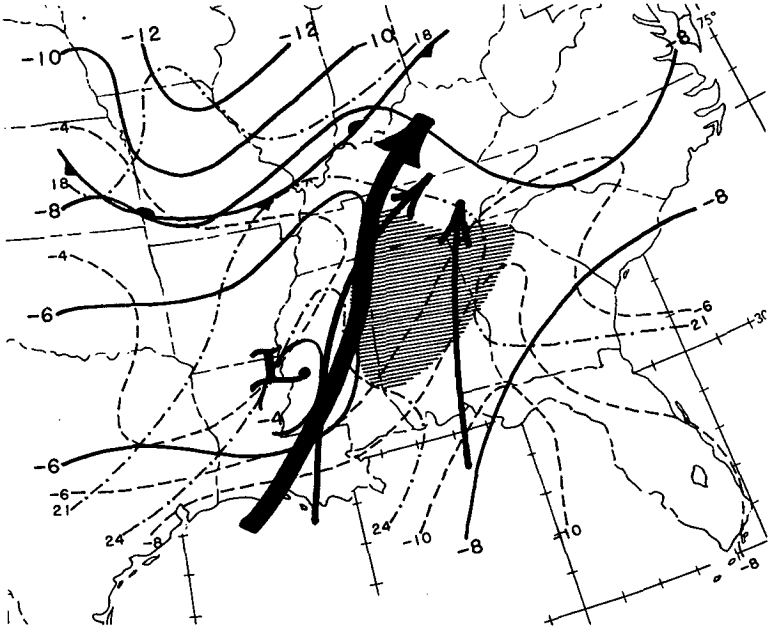

FIG. 5. As in Fig. 3 but for 0600 CST 16 August 1985.

these, 21 were in Alabama, 2 were in Mississippi, and 4 were in Tennessee. Overall, these tornadoes caused 16 injuries and one fatality.

At 0600 CST on 16 August the tropical depression was located near the intersection of Arkansas, Louisiana and Mississippi. The central sea level pressure was 1002 hPa. As shown in Fig. 5, a composite chart for 0600 CST, the tropical nature of the atmosphere surrounding the storm was very evident. Surface dewpoints were above 24°C across Louisiana and Mississippi. Also, a 500 hPa temperature of −4°C was reported at Jackson, Mississippi. Lifted Index values of −6 were prevalent across most of Alabama and all of Georgia. A striking feature was the rapid vertical change in wind speeds within low levels of the storm's circulation. For example, the surface wind at Jackson, Mississippi at 0600 CST was south-southeast at 7 m s^{-1}, while the wind at 850 hPa was southwest of 28 m s^{-1}. Similarly, the surface wind at Centreville, Alabama at this time was 5 m s^{-1}, while the 850 hPa wind was 16 m s^{-1}. As discussed by Novlan and Gray (1974), such strong low-level wind shear is frequently evident in tropical cyclones that spawn tornadoes. Tornadoes formed from midmorning through afternoon as the tropical depression moved northeastward.

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