

Chicago/Romeoville County Warning Area Strong-Violent Tornadoes: 1880-2010

A Study in Trends, Climatology, and History

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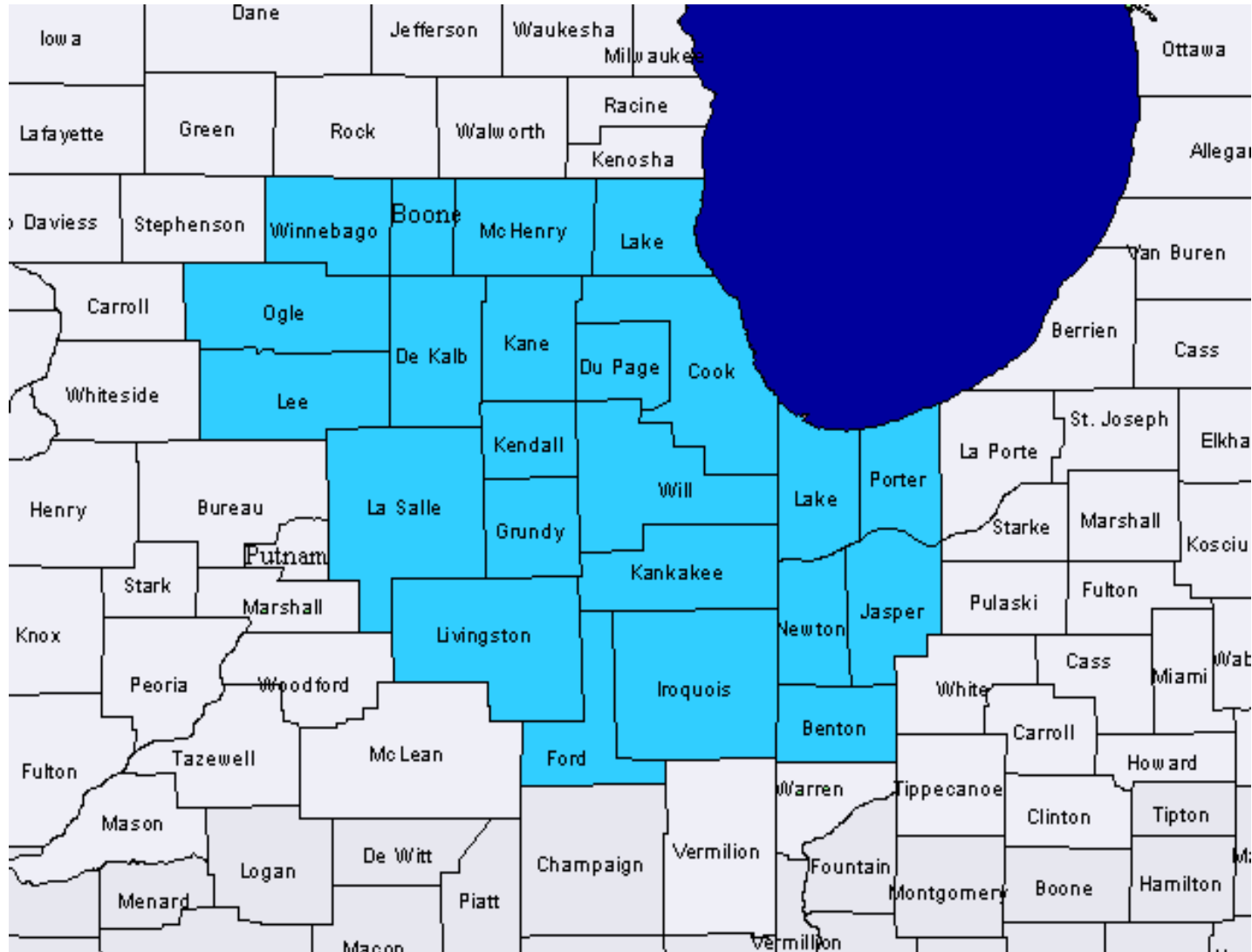
Purpose

- Chicago Metropolitan Area strong-violent (F2/EF2-F5/EF5) tornado climatology has been established
- Area does not *only* cover Chicago Metro Area
- Focusing on such a small area could lead to misconceptions about region's true vulnerability to strong-violent tornado occurrences
- Attempt to establish a strong-violent tornado climatology for the entire County Warning Area
- Search for useful trends in strong-violent tornado data

Methodology

- Search Grazulis' *Significant Tornadoes: 1680-1991* and SeverePlot 3.0 from the Storm Prediction Center to catalog all strong-violent tornadoes in the Chicago/Romeoville County Warning Area since 1880

Chicago/Romeoville County Warning Area

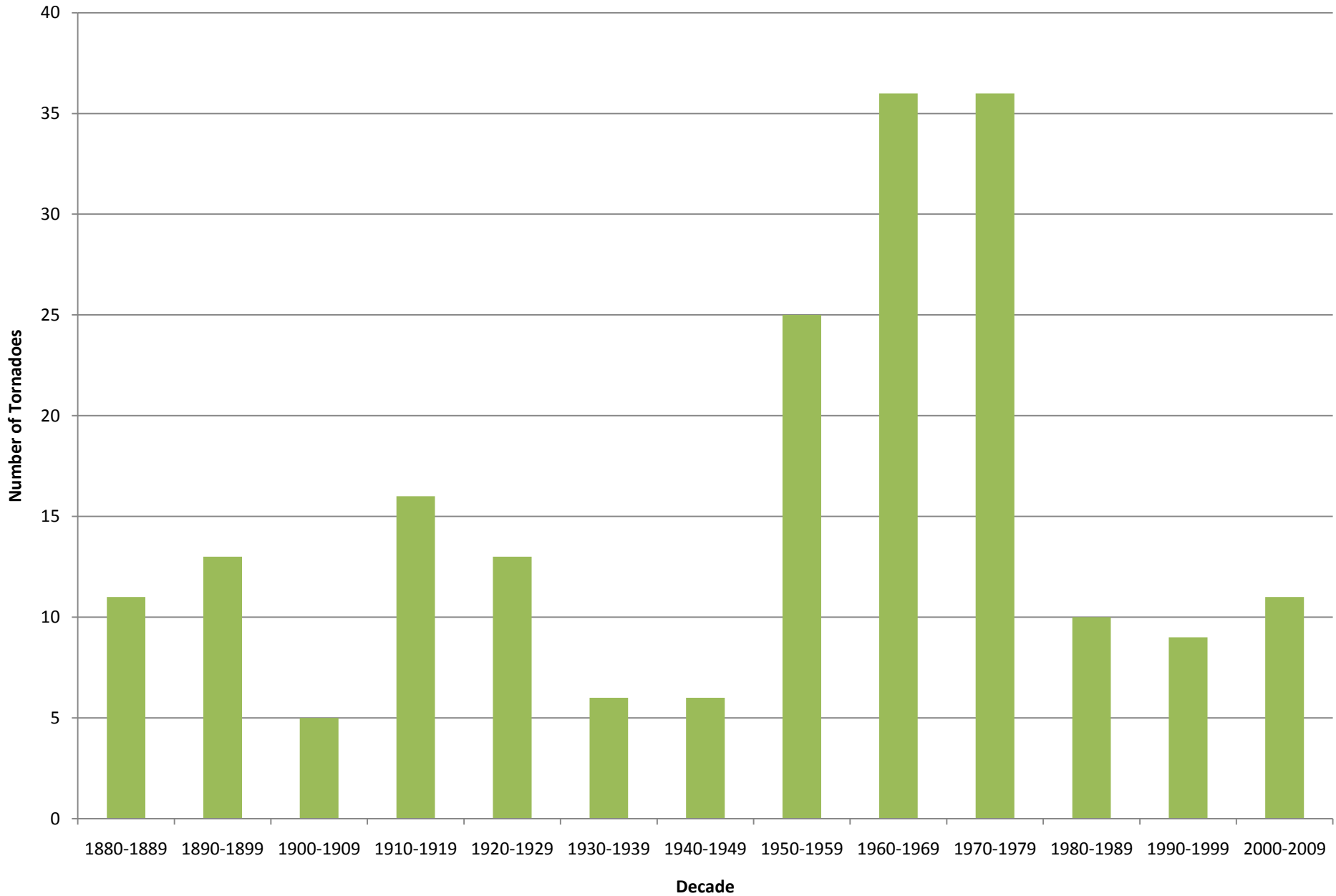


Strong-Violent Tornadoes 1880-2010:

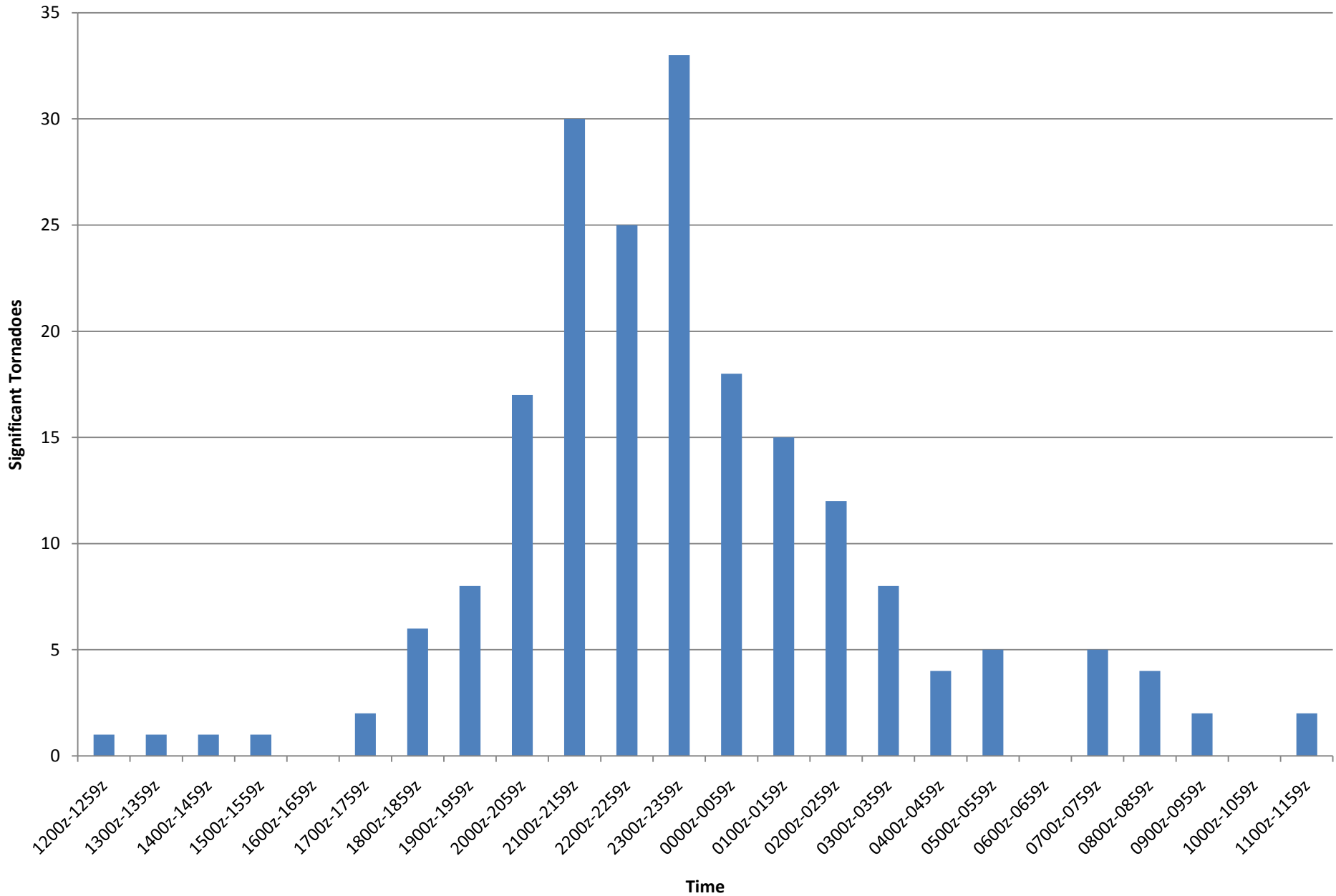
The Raw Numbers

- There have been 202 F2/EF2-F5/EF5 tornadoes in the Chicago/Romeoville CWA between 1880-2010
 - 134 F2s/EF2s
 - 43 F3s/EF3s
 - 24 F4s/EF4s
 - 1 F5 (Plainfield, 8/28/1990)
- These F2/EF2-F5/EF5 tornadoes were responsible for 289 fatalities and 3,751 injuries
- Average path length of 13.0 miles
- Average path width of 197 yards

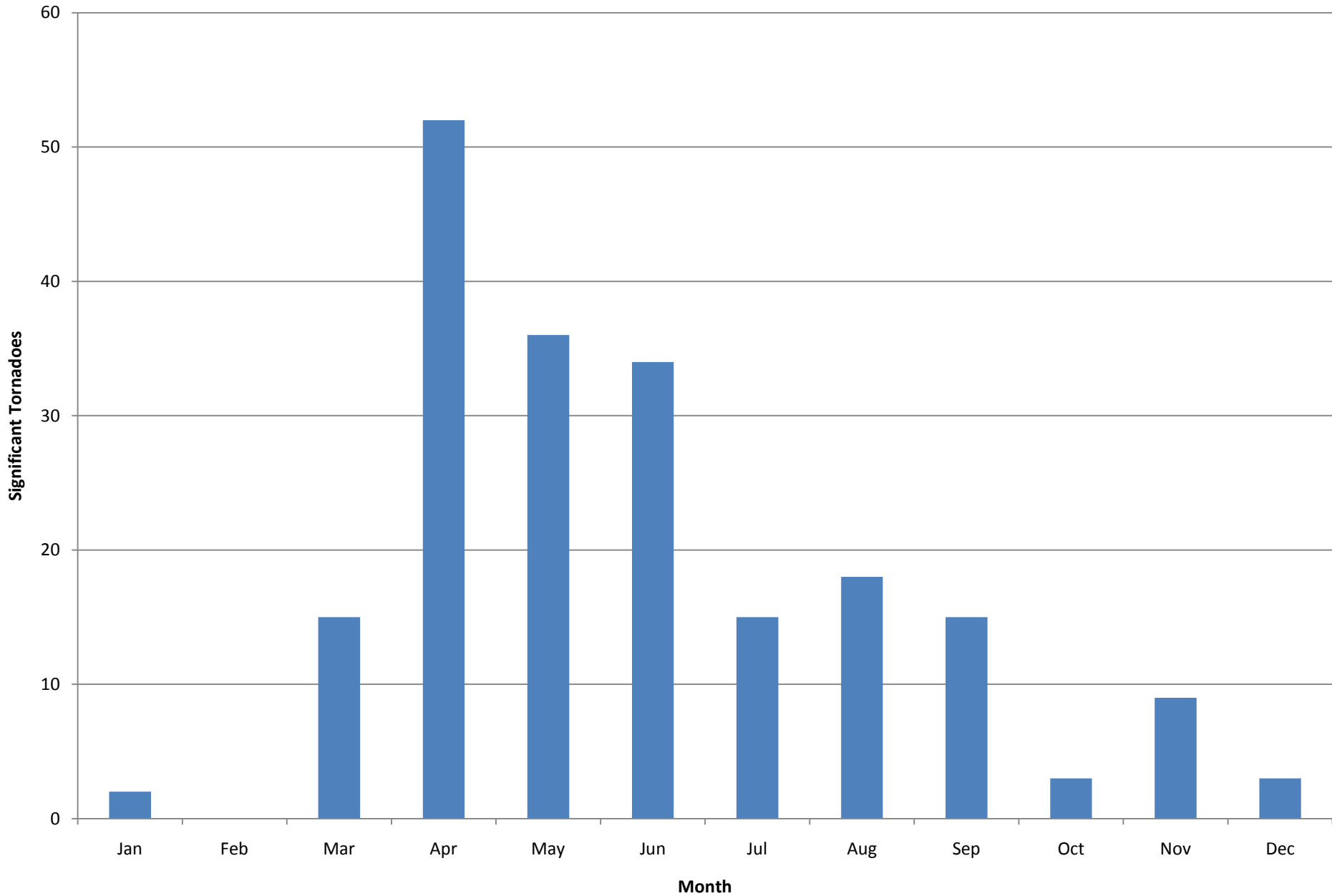
Chicago/Romeoville County Warning Area Strong-Violent Tornadoes by Decade



Total Chicago/Romeoville County Warning Area Strong-Violent Tornadoes by Hour 1880-2010



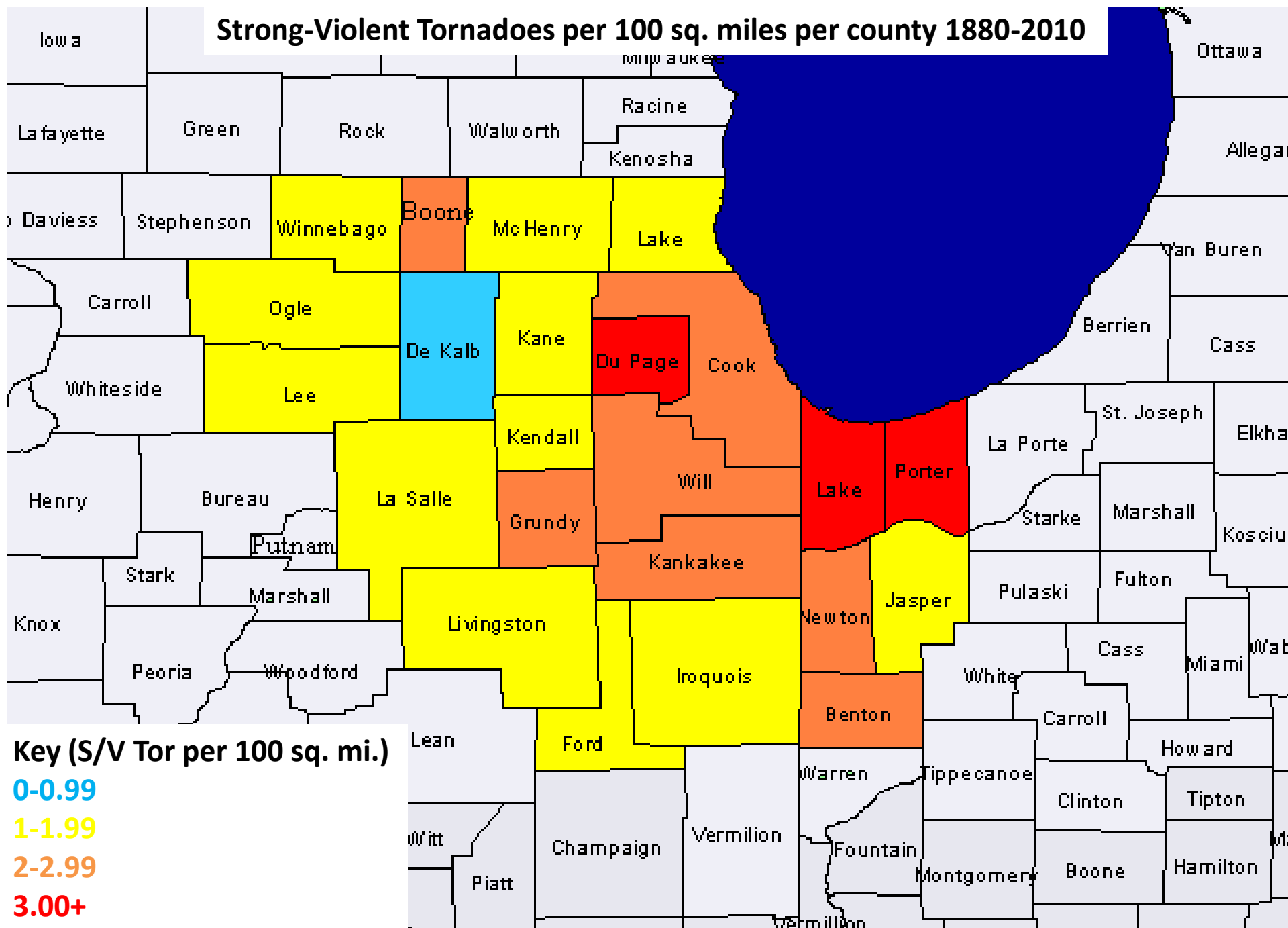
Chicago/Romeoville County Warning Area Strong-Violent Tornadoes by Month 1880-2010



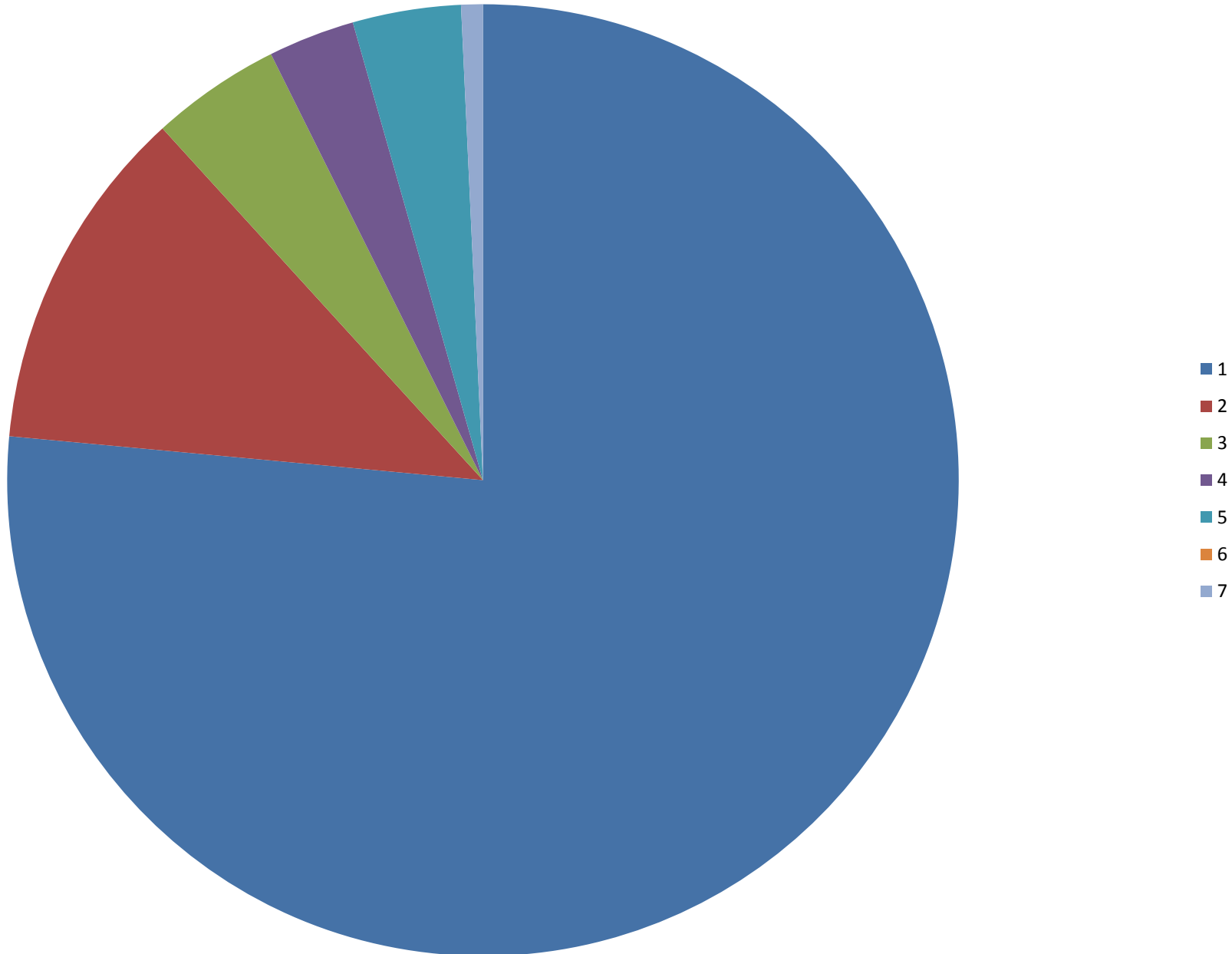
Strong-Violent Tornadoes by County

County	Strong-Violent Tornadoes per 100 square miles
DuPage	3.90
Lake IN	3.62
Porter	3.59
Newton	2.99
Boone	2.84
Cook	2.64
Will	2.63
Benton	2.46
Grundy	2.38
Kankakee	2.22
Jasper	1.96
La Salle	1.94
Livingston	1.82
Iroquois	1.79
Winnebago	1.75
McHenry	1.66
Lake IL	1.56
Kendall	1.56
Kane	1.54
Ogle	1.45
Lee	1.38
Ford	1.23
DeKalb	0.95

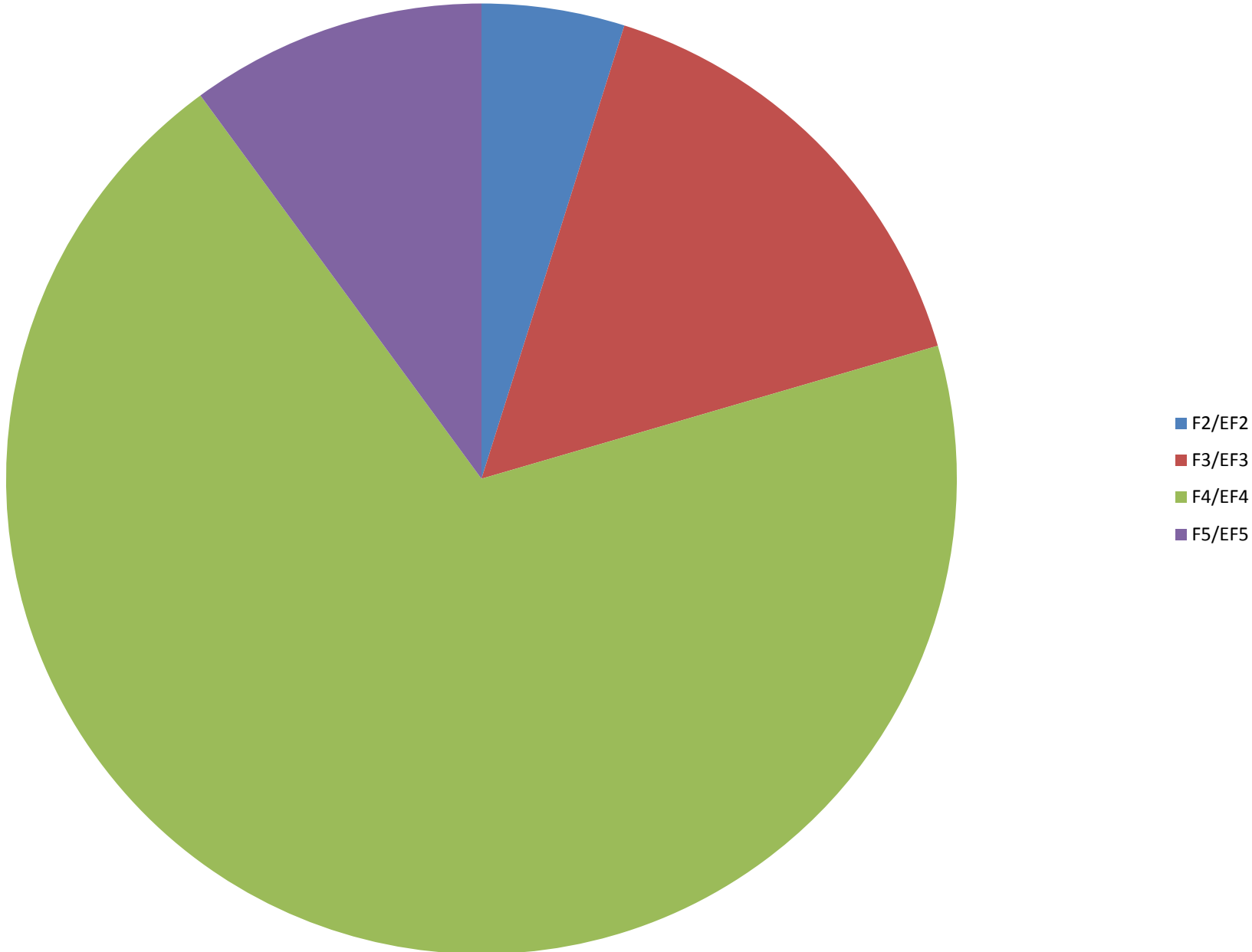
Strong-Violent Tornadoes per 100 sq. miles per county 1880-2010



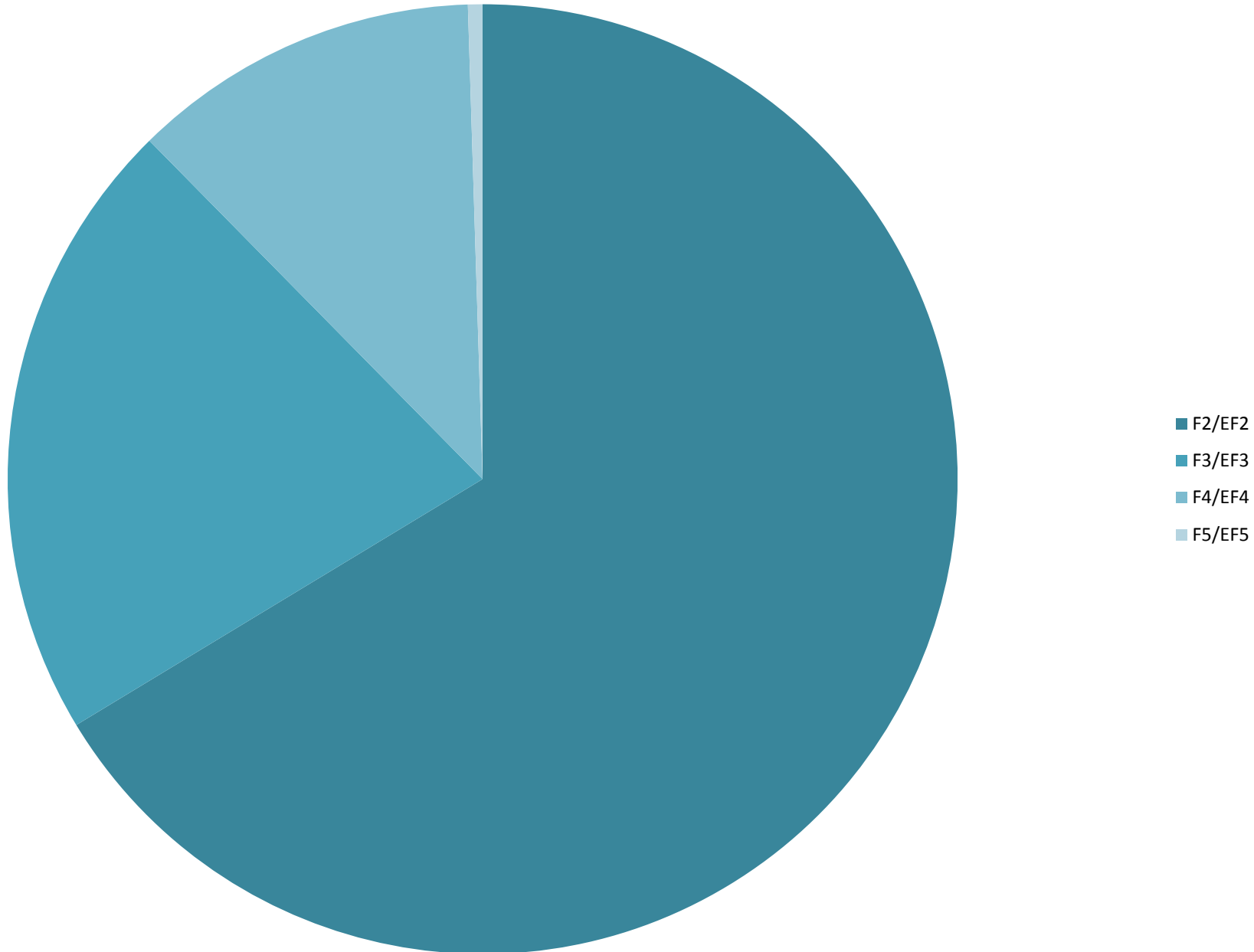
Number of Events with Given Number of Strong-Violent Tornadoes per Outbreak for the Chicago/Romeoville County Warning Area 1880-2010



Chicago/Romeoville County Warning Area Fatalities from Strong-Violent Tornadoes by F/EF Rating (1880-2010)



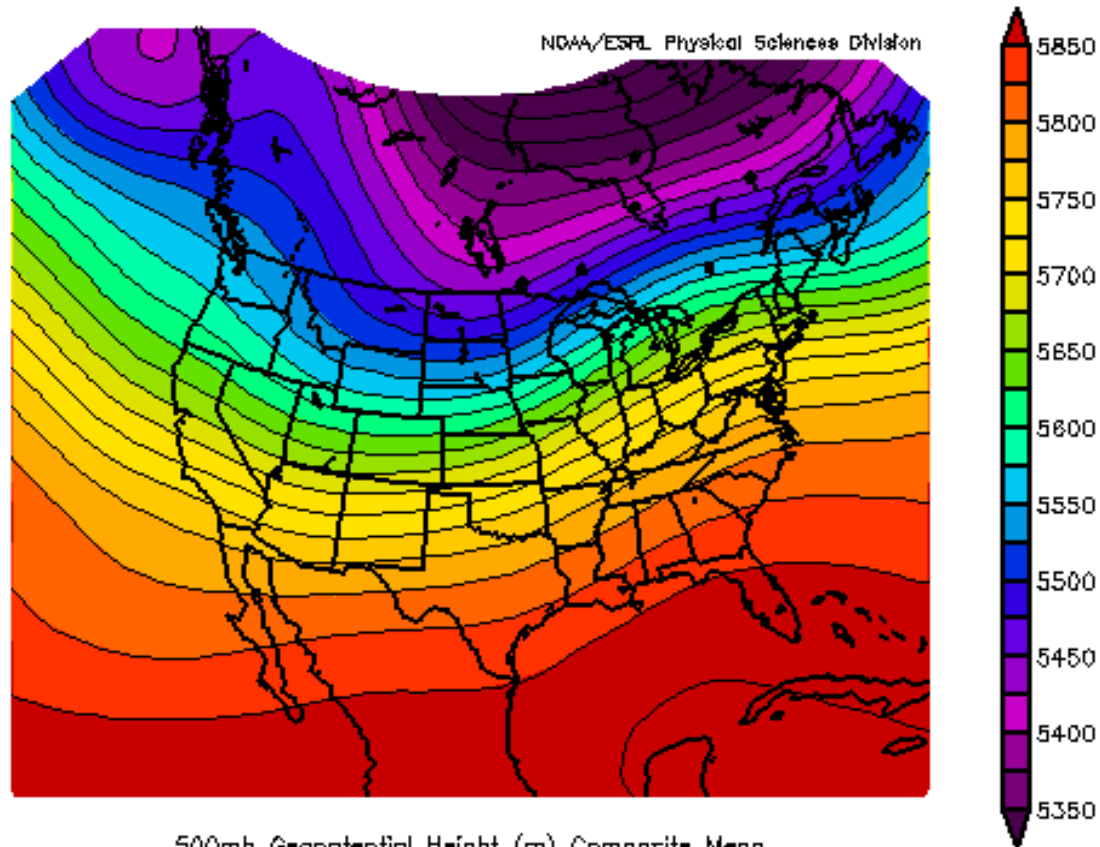
Chicago/Romeoville County Warning Area Strong-Violent Tornadoes by F/EF Rating 1880-2010



Top Ten Outbreaks (by Number of Strong-Violent Tornadoes) since 1880

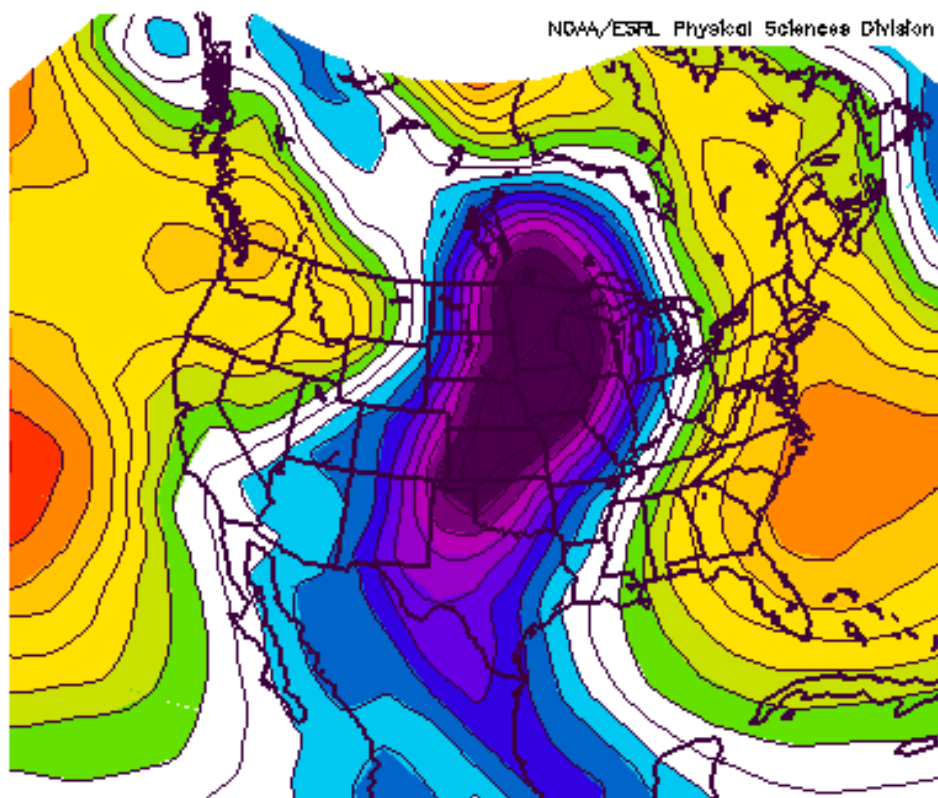
Date	EF2 Tornadoes	EF3 Tornadoes	EF4 Tornadoes	EF5 Tornadoes	Total S-V Tornadoes
April 21 st , 1912	3	3	1	0	7
May 18 th , 1898	1	0	4	0	5
November 12 th , 1965	4	1	0	0	5
April 21 st , 1967	2	0	3	0	5
March 12 th , 1976	2	2	1	0	5
June 5 th , 2010	3	2	0	0	5
May 25 th , 1896	1	2	1	0	4
July 17 th , 1903	1	3	0	0	4
March 28 th , 1920	2	1	1	0	4
June 7 th , 2008	4	0	0	0	4

Composite Maps for Top 5 Outbreaks since 1948



500mb Geopotential Height (m) Composite Mean
11/12/85 04/21/87 03/12/78 06/07/08 06/05/10
NCEP/NCAR Reanalysis

NOAA/ESRL Physical Sciences Division



Sea Level Pressure (mb) Composite Mean
11/12/85 04/21/87 03/12/76 06/07/08 06/05/10
NCEP/NCAR Reanalysis

Top Ten Outbreaks (by Number of Strong-Violent Tornadoes) since 1880

- Our top-ten outbreaks consist of all outbreaks with at least 4 strong-violent tornadoes
- April 21st, 1912, had the highest number of strong-violent tornadoes (7)
- Of the 10 outbreaks, 2 were in March, 2 in April, 2 in May, 2 in June, 1 in July, and 1 in November
- Outbreaks usually caused by strong shortwave disturbance with surface low positioned to the west-northwest

Top Ten Outbreaks (by Number of Strong-Violent Tornadoes) since 1880

- There appears to be a pattern in major outbreak occurrences
 - The first five outbreaks occurred in 1896, 1898, 1903, 1912, and 1920
 - Then, 45 years passed until the next outbreak in 1965
 - The 1965 outbreak was quickly followed by the 1967 and 1976 outbreaks
 - Finally, an additional 32 years passed until the 2008 and 2010 outbreaks
- Is there a significance to this pattern?

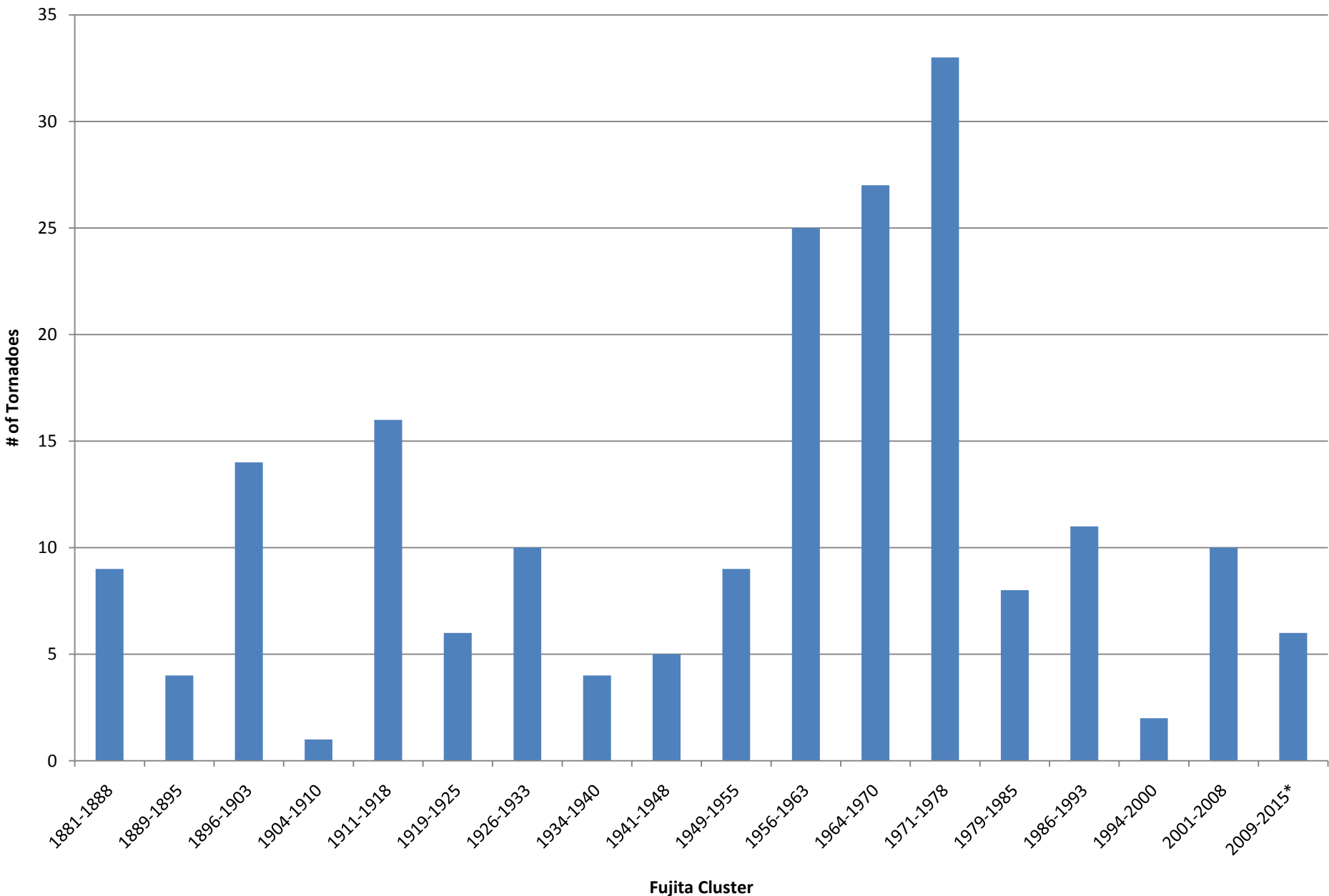
Fujita et. al., 1975

- “Long-Term Fluctuation of Tornado Activities”
- Established a roughly 45-year cycle of tornado fatality maximum centered around Piggott, Arkansas
- Maxima for the Chicago/Romeoville County Warning Area included 1919-1925 and 1964-1970, with other maxima nearby (1911-1918 in Iowa and 1971-1974 in Ohio)
- Next projected maximum (according to Chicago Tribune article dated April 16th, 1975) for the Chicago/Romeoville County Warning Area was to arrive around 2009
- Problem: Fujita et. al. were never able to establish a cause for the traveling maximum

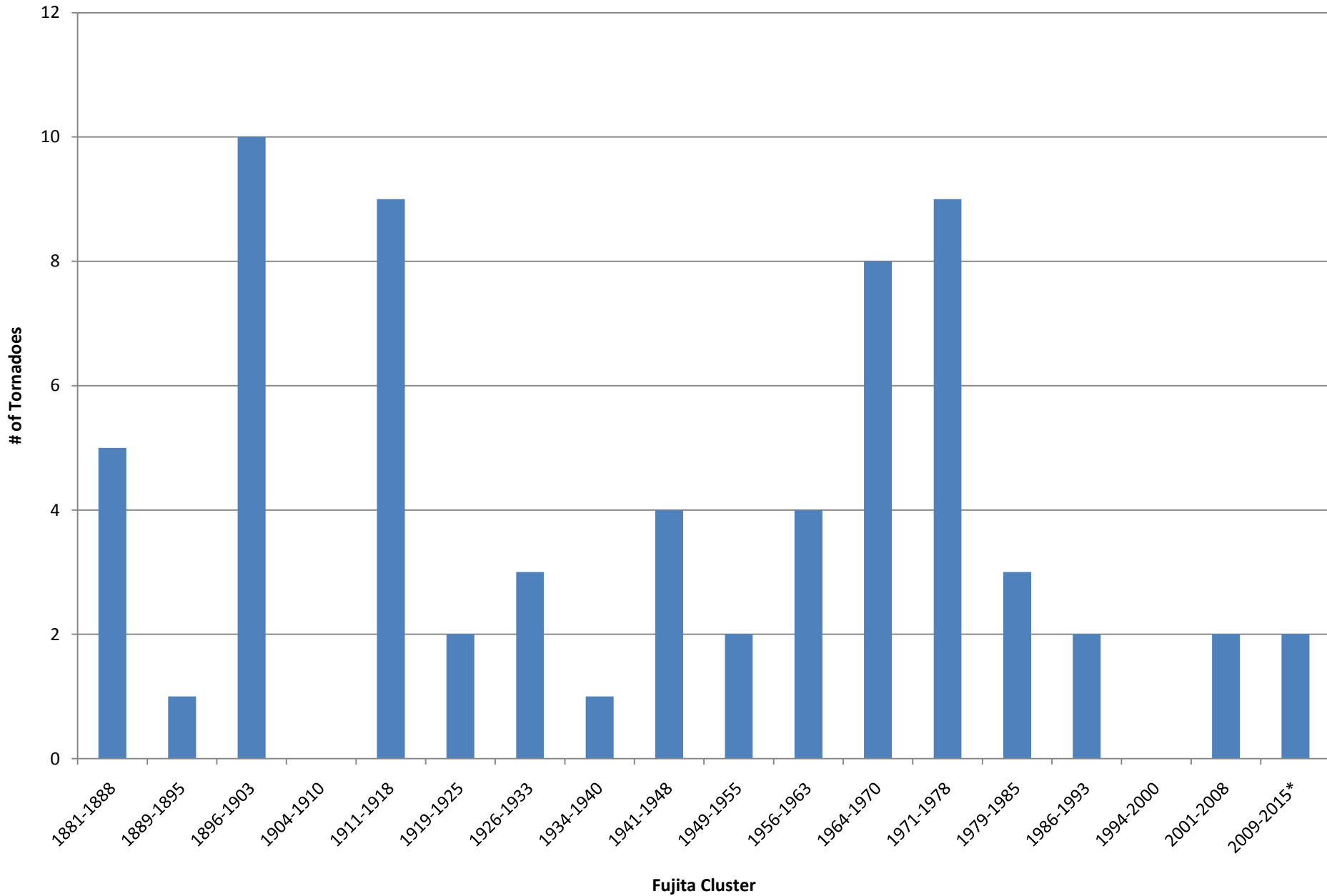
A Closer Look

- Does the data post-1975 continue to suggest the existence of a rotating tornado fatality maximum?
- Does the Fujita cycle apply to the rest of the Chicago/Romeoville strong-violent tornado dataset?
- If it does apply, what could be a potential driving factor behind the cycle?

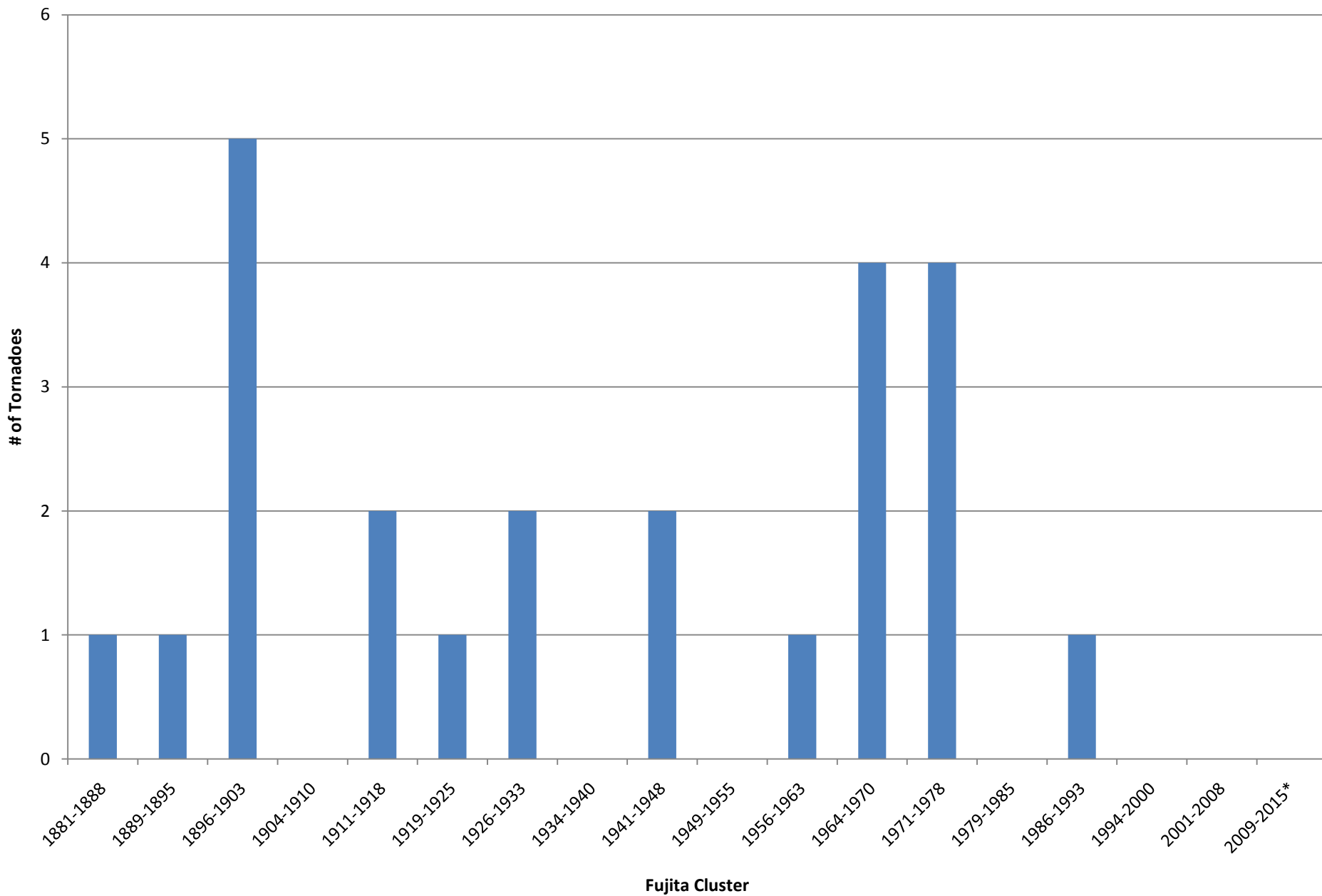
Strong-Violent Tornadoes for the Chicago/Romeoville County Warning Area by Fujita Cluster, 1881-2010



Intense (F3/EF3-F5/EF5) Tornadoes in the Chicago/Romeoville County Warning Area by Fujita Cluster 1881-2010



Violent (F4/EF4-F5/EF5) Tornadoes in the Chicago/Romeoville County Warning Area by Fujita Cluster 1881-2010



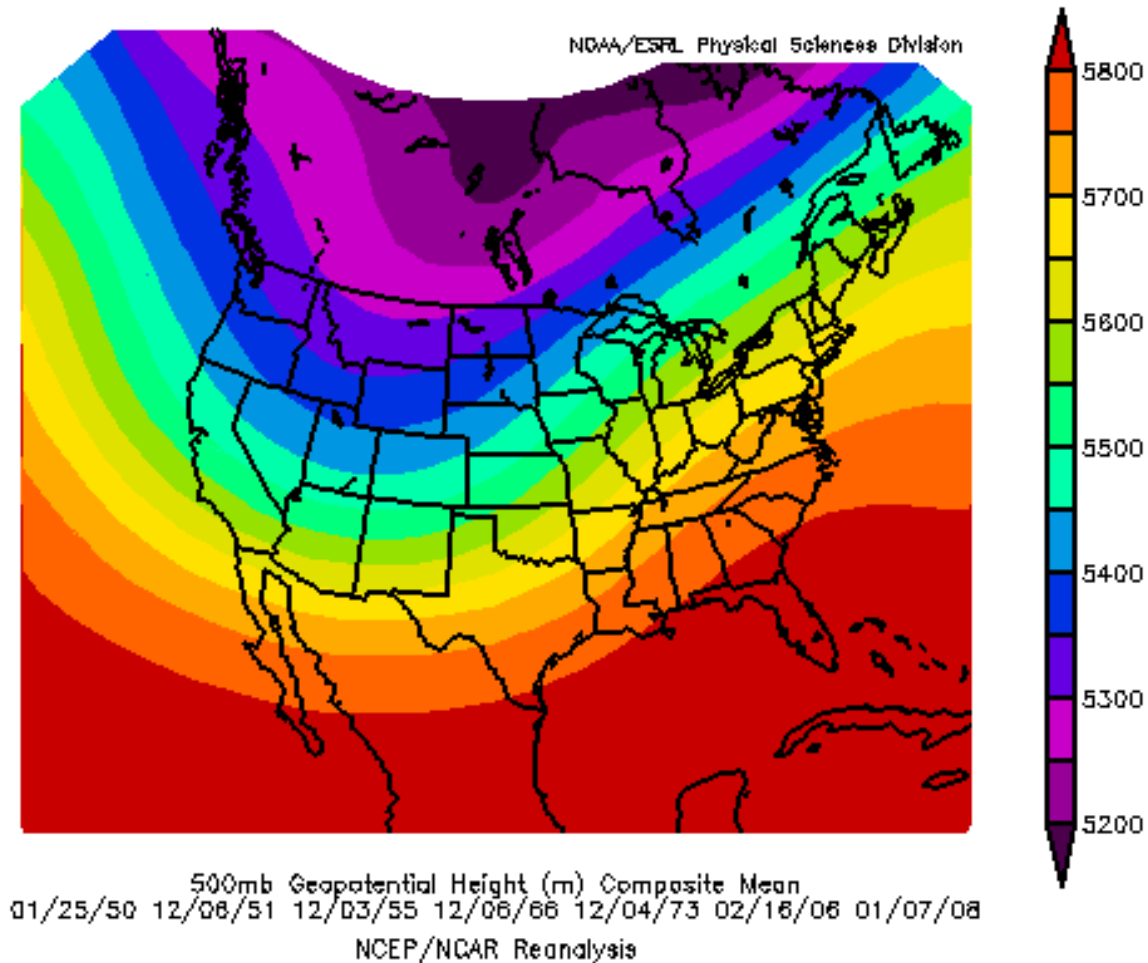
Local Data Trends

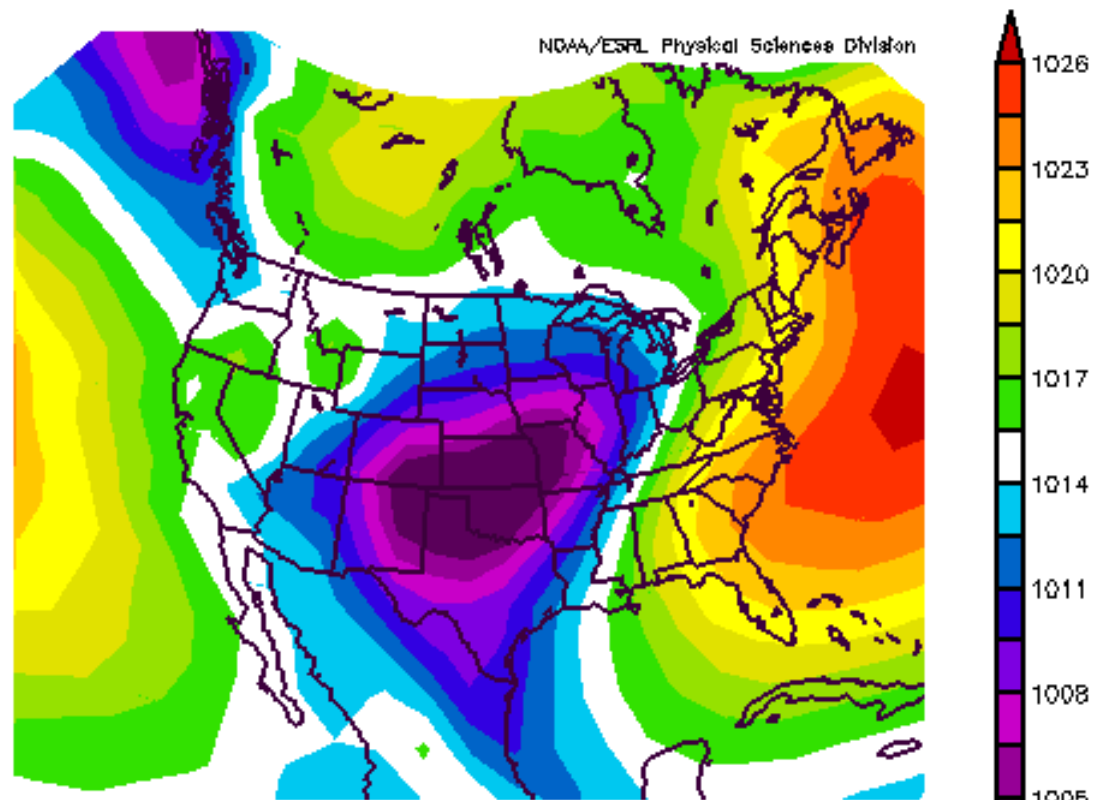
- The F2-F5, F3-F5, and F4-F5 data appears to support a *local pattern* in strong-violent tornado activity
- Dataset too small to establish a true pattern
- Same issue holds true for national data

Wintertime Tornadoes

- 8 wintertime (Dec-Feb) tornadoes have struck the Chicago/Romeoville County Warning Area since 1950
 - January 26th, 1950 – F2
 - December 6th, 1951 (2) – F1, F3
 - December 3rd, 1955 – F2
 - December 8th, 1966 – F2
 - December 4th, 1973 – F1
 - February 16th, 2006 – F1
 - January 7th, 2008 – EF3

Composite Maps for All CWA Winter Tornado Cases



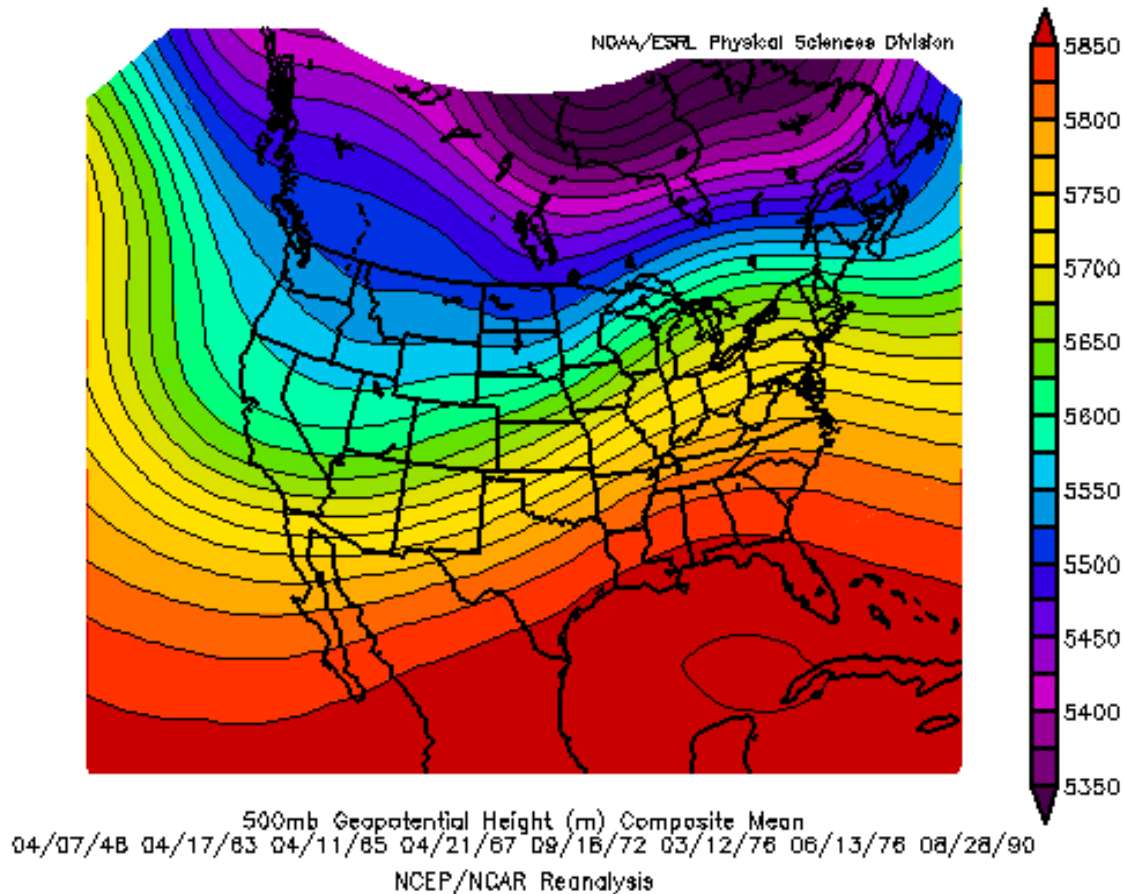


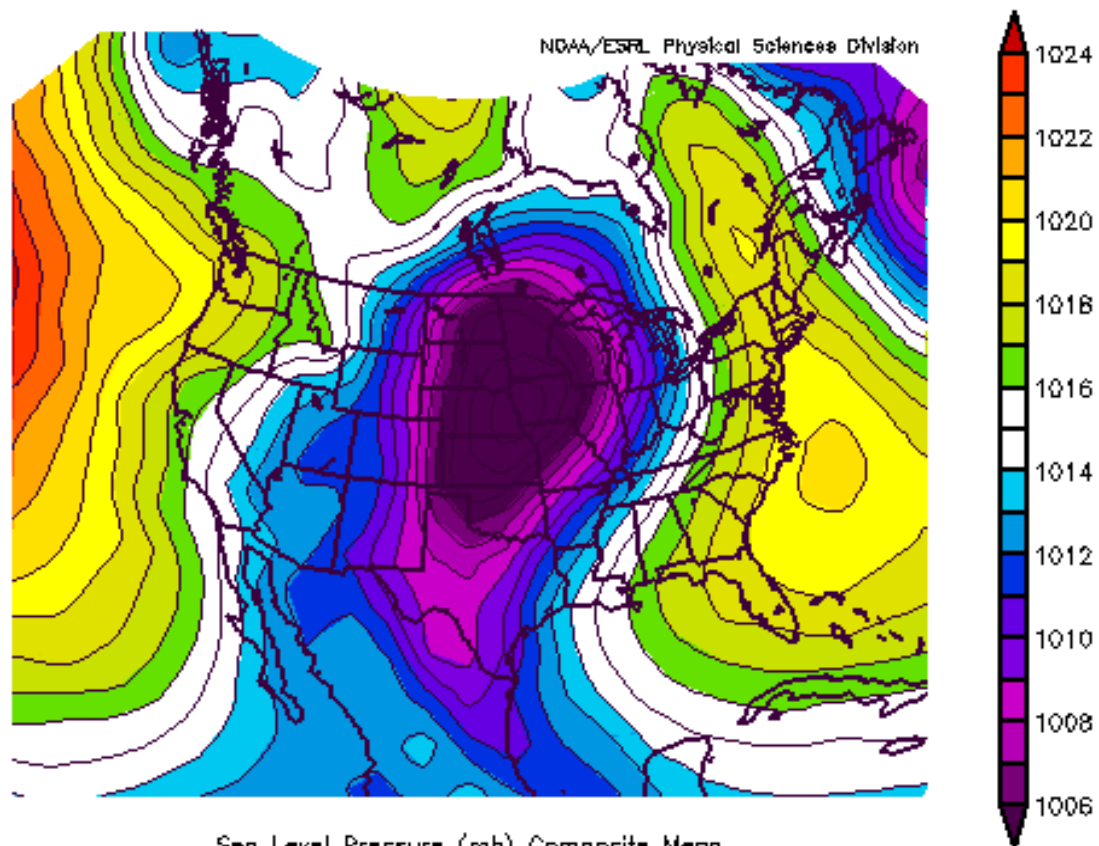
Sea Level Pressure (mb) Composite Mean
01/25/50 12/08/51 12/03/55 12/06/66 12/04/73 02/16/06 01/07/08
NCEP/NCAR Reanalysis

Violent Tornadoes by County

County	Number of Violent Tornadoes
Boone	4
Cook	4
Lake IN	4
McHenry	4
Lake IL	3
Lee	3
Ogle	3
Will	3
Winnebago	3
Jasper	2
Kankakee	2
Newton	2
Porter	2
Benton	1
DeKalb	1
DuPage	1
Ford	1
Iroquois	1
Kane	1
Kendall	1
La Salle	1
Grundy	0
Livingston	0

Composite Maps for Violent Tornado Events from 1948-2010





Sea Level Pressure (mb) Composite Mean
04/07/48 04/17/63 04/11/85 04/21/67 09/16/72 03/12/76 06/13/78 08/28/90
NCEP/NCAR Reanalysis

Return Frequency

- F2/EF2: once per year
- F3/EF3: once every three years
- F4/EF4: once every five-and-a-half years
- Overall: once every eight months/three every two years

Summary/Concluding Thoughts

- Strong-violent tornadoes are typically late afternoon-early evening events
- Four top months are April, May, June, and August
- Area across Grundy, Will, Kankakee, Lake IN, Newton, Benton, and Porter Counties has a higher rate of significant tornado occurrences that cannot completely be attributed to population

Date	Counties	Path Length (mi)	Path Width (yards)	F/EF Rating	Fatalities	Injuries	Start Time
8/18/1880	Winnebago/Rock	15	500	F4	1	20	2230z
9/29/1881	Kendall	7	50	F2	0	0	2300z
5/18/1883	Boone/McHenry/Walworth	17	200	F4	4	15	2350z
5/19/1883	Livingston	4		F3	1	4	0515z
5/19/1883	Will	2		F2	0	2	0545z
6/11/1883	McHenry	4	100	F2	0	1	2330z
5/12/1886	Livingston	2	150	F3	1	5	2145z
5/13/1886	Iroquois	3	100	F3	1	4	0400z
9/18/1886	Will	3	70	F2	0	20	0115z
5/11/1888	Stephenson/Winnebago	16		F3	0	4	0045z
5/19/1889	DeKalb	3	70	F2	0	3	0400z
6/10/1890	Will			F2	0	0	0315z
6/20/1890	Lee/DeKalb	25	200	F4	13	60	2030z
6/20/1890	Livingston	4	400	F2	0	10	2110z
3/28/1896	Ogle	9	300	F2	0	0	2140z
5/25/1896	Ogle	10	200	F4	4	5	0700z
5/25/1896	Ogle/DeKalb/Boone	15		F3	3	10	0730z
5/25/1896	Ogle			F2	0	0	0730z
5/25/1896	Cook	4.5	400	F3	0		0750z
5/18/1898	Cedar/Clinton/Jackson/Carroll/Ogle	85	1000	F4	28	150	2245z

5/18/1898	Ogle/Winnebago/Boone	40	600	F4	4	30	2330z
5/19/1898	Bureau/Lee	40	400	F4	0	10	0000z
5/19/1898	Ogle	5	300	F2	1	0	0000z
5/19/1898	Bureau/Lee	20	400	F4	1	10	0030z
7/17/1903	Marshall/Putnam/La Salle	30	50	F2	0		2230z
7/17/1903	La Salle	8	70	F3	4	20	2300z
7/17/1903	Livingston	17		F3	1	6	2300z
7/18/1903	La Salle	8	250	F3	6	30	0000z
5/26/1907	Iroquois	3		F2	0		
6/10/1911	Ogle	9	100	F2	1	5	
11/11/1911	DuPage	4		F2	0		2330z
11/12/1911	Lake IN/Porter	30	150	F3		5	2200z
4/21/1912	La Salle/Grundy	20	200	F3	0	37	2200z
4/21/1912	Livingston/Kankakee	26	200	F3	5	16	2235z
4/21/1912	Livingston	6	50	F2	0	10	2335z
4/22/1912	Iroquois/Newton	25	200	F4	9	22	0000z
4/22/1912	Kankakee/Lake IN	13	100	F2	0	20	0000z
4/22/1912	Iroquois	10	70	F2	0	5	0100z
4/22/1912	Jasper	7		F3	1	4	0100z
4/24/1914	McLean/Livingston/Iroquois/Kankakee	55		F3	0		2315z
4/25/1914	Iroquois/Kankakee	20		F2	1	2	0030z
3/22/1916	Iroquois	5	100	F2	0		0230z

5/26/1917	Will/Lake IN	33	400	F4	3	60	2245z
5/26/1917	Lake IN/Porter	7	100	F4	1	1	2340z
5/10/1918	Ogle/Winnebago/Boone	35	100	F3	0	19	0200z
3/28/1920	DeKalb	12	100	F2	0	0	1800z
3/28/1920	Kane	20	500	F3	8	100	1805z
3/28/1920	Will/Cook	53	100	F4	20	300	1815z
3/28/1920	Cook	10	100	F2	0	6	1910z
4/17/1922	Newton		100	F2	2	2	0900z
9/11/1925	DuPage	7	300	F2	0	1	0700z
5/18/1926	Cook	3	100	F2	0	6	2300z
4/19/1927	Sangamon/Logan/DeWitt/McLean/Ford	65	600	F4	10	60	1910z
5/9/1927	Porter			F2	0	0	0900z
7/12/1927	Porter		100	F2	0	0	2040z
7/21/1928	Woodford/Livingston	1	75	F2	0	0	2300z
9/29/1928	La Salle	16	50	F2	0	0	1915z
9/14/1928	Winnebago/Boone	26	150	F4	14	100	2122z
5/5/1930	Cook		30	F2	0	0	2115z
5/27/1930	Livingston/La Salle	15		F3	0	4	2330z
4/30/1933	Kane	2.5	100	F2	0	3	1800z
11/19/1934	Lee	1	250	F2	0	0	0000z
6/10/1939	Iroquois/Benton/Newton	25	300	F2	0	19	2130z
6/21/1939	Winnebago			F2	0	0	2100z

4/29/1940	Livingston	8	80	F3	1	17	2245z
6/28/1945	Bureau/La Salle	35	1000	F4	0	34	0445z
5/24/1946	Porter/LaPorte/St. Joseph/Berrien	40	500	F3	0	5	2135z
4/7/1948	Grundy/Will	5	300	F3	0	1	2240z
4/7/1948	Kankakee/Lake IN/Porter/Jasper	40	250	F4	4	40	2320z
4/7/1948	Cook/Lake IN/Porter/LaPorte	30	70	F2	0	11	2330z
1/26/1950	Newton	0.1	100	F2	0	0	0300z
11/13/1951	Lake IN	0.3	400	F2	0	0	2200z
12/7/1951	Bureau/La Salle/Lee	21.9	150	F3	1	1	0000z
4/7/1954	Livingston/Ford/Kankakee	42.6	400	F3	1	13	2100z
5/28/1954	Kane/DuPage	7.9	200	F2	0	0	0030z
5/31/1954	Iroquois	24.2	400	F2	0	2	2115z
6/1/1954	Lake IN	0.1	10	F2	0	0	0800z
6/1/1954	Benton	0.1	10	F2	0	0	0800z
12/4/1955	La Salle/Livingston/Grundy	32.0	10	F2	0	0	0200z
3/6/1956	Iroquois	9.4	500	F3	0	6	2355z
3/7/1956	Benton	0.4	250	F2	0	3	0140z
4/3/1956	Ford	2.0	50	F2	0	0	2200z
5/22/1956	Iroquois	2.0	70	F2	0	0	0345z
8/23/1956	Kane	0.1	40	F2	0	0	2000z
8/23/1956	Cook	0.1	40	F2	0	3	2040z
8/31/1956	Lee	0.1	17	F2	0	0	0500z

7/13/1957	Lake IN	0.1	27	F2	0	0	0200z
6/9/1958	Jasper	0.1	10	F2	0	0	0300z
8/6/1958	Kane	2.0	70	F2	0	0	2310z
8/15/1958	Lee/DeKalb/La Salle/Grundy/Will	74.5	100	F2	0	0	0800z
8/31/1958	Winnebago	0.1	10	F2	0	0	0150z
10/9/1958	Stephenson/Winnebago/Boone/McHenry/Lake IL	81.0	10	F2	1	0	0530z
9/26/1959	La Salle	5.1	10	F2	0	0	2250z
9/26/1959	DuPage/Cook	9.3	10	F2	0	0	2345z
10/8/1959	McHenry	2.0	90	F2	0	1	2130z
3/4/1961	Cook	7.9	100	F2	1	115	2304z
4/23/1961	Will/Kankakee/Lake IN/Newton	51.7	10	F3	0	4	2145z
4/30/1962	Jasper	0.1	10	F2	0	0	2000z
4/30/1962	Porter	0.1	10	F3	0	0	2015z
4/30/1962	Newton	0.1	10	F2	0	5	2024z
5/8/1962	Whiteside/Lee	7.2	10	F2	0	0	0230z
6/23/1962	Cook	0.5	100	F2	0	10	2252z
7/20/1962	Lake IN/Porter	14.9	10	F2	0	0	2100z
4/17/1963	Kankakee/Newton/Jasper/Pulaski	57.3	130	F4	1	70	2155z
4/19/1963	McHenry	0.1	10	F2	0	0	2345z
4/11/1965	McHenry/Lake IL	9.1	400	F4	6	75	2120z
4/11/1965	Lake IL	4.5	200	F2	0	0	2150z
4/11/1965	Porter/LaPorte	33.1	10	F3	0	0	2310z

5/26/1965	DuPage/Cook	13.8	70	F2	0	11	1305z
5/26/1965	Cook	1.0	50	F2	0	0	1402z
9/14/1965	McLean/Ford	11.5	77	F2	0	2	2215z
9/15/1965	Iroquois	1.0	50	F2	0	2	0035z
11/12/1965	La Salle/Livingston/Grundy	32.1	17	F2	0	0	2005z
11/12/1965	Grundy/Will/Cook	35.9	120	F2	2	90	2035z
11/12/1965	DuPage	1.0	20	F2	0	0	2048z
11/12/1965	Putnam/La Salle	8.7	50	F2	0	0	2155z
11/12/1965	Lake IN	4.1	40	F3	0	14	2253z
4/20/1966	DuPage	0.5	40	F2	0	0	0427z
6/9/1966	Cook	2.5	10	F2	1	30	1100z
6/9/1966	Cook	0.1	10	F2	0	0	1105z
7/13/1966	Lake IN	0.1	10	F2	0	0	1504z
12/8/1966	Jasper	0.1	10	F2	0	1	1200z
4/21/1967	Boone/McHenry	25.5	1200	F4	24	450	2150z
4/21/1967	Lee	5.6	77	F2	0	0	2202z
4/21/1967	Kane/Cook/McHenry/Lake IL	8.8	150	F4	1	100	2300z
4/21/1967	Kane/Cook	0.3	10	F2	0	0	2310z
4/21/1967	Cook	15.0	200	F4	33	500	2324z
9/27/1967	Jasper	0.5	10	F2	0	1	0210z
10/24/1967	Lake IN/Porter	0.1	10	F3	0	0	2153z
5/15/1968	Iroquois	7.1	400	F3	0	0	2350z

9/4/1969	Kankakee	2.5	10	F2	0	0	2320z
4/30/1970	Cook	4.9	10	F2	0	9	2125z
8/25/1971	DuPage	1.0	83	F2	0	2	0215z
4/7/1972	Ogle/Lee	17.5	50	F2	1	9	0045z
4/7/1972	Will	6.8	50	F2	1	22	0210z
4/7/1972	Will	5.1	50	F2	0	0	0230z
7/17/1972	Marshall/Putnam/La Salle/Grundy/Kendall/Will	81.5	200	F3	0	0	2245z
7/18/1972	DuPage	0.1	10	F2	0	0	0110z
8/26/1972	Cook	1.8	200	F2	0	1	0330z
9/18/1972	Lake IL	5.2	220	F4	0	20	2355z
4/1/1973	Iroquois	0.1	10	F2	0	0	0000z
4/19/1973	Grundy	0.1	10	F2	0	0	2345z
4/22/1973	DuPage	0.2	10	F2	0	0	0300z
4/3/1974	Warren/Benton	25.9	700	F3	0	0	2130z
4/3/1974	Benton/Tippecanoe/White/Pulaski/Fulton/Marshall IN/Kosciusko/Elkhart/Noble/Lagrange	108.7	1760	F4	18	285	2145z
6/21/1974	Lake IN	4.5	150	F3	0	5	0110z
9/12/1974	La Salle	0.1	10	F2	0	0	2134z
5/20/1975	Grundy	2.0	50	F2	0	1	2150z
5/24/1975	Iroquois	0.1	10	F2	0	0	2125z
6/14/1975	La Salle	1.0	167	F2	0	0	2035z
6/17/1975	Cook	1.5	20	F2	0	0	1754z

6/18/1975	DeKalb	4.7	27	F2	0	1	1800z
3/12/1976	Kendall/Will/DuPage	22.6	30	F3	0	3	1850z
3/12/1976	DuPage/Cook	15.1	150	F2	2	66	1920z
3/12/1976	Iroquois/Kankakee/Newton/Jasper/Porter	38.5	250	F3	1	15	1935z
3/12/1976	Lake IN/Porter	5.6	200	F2	0	0	2000z
3/12/1976	Lake IN/Porter/LaPorte	25.0	200	F4	0	7	2000z
4/21/1976	Lake IL	0.8	50	F2	0	2	0145z
4/23/1976	Iroquois	0.1	67	F2	0	0	2135z
4/23/1976	Iroquois	0.1	10	F2	0	0	2145z
6/13/1976	Cook/DuPage	3.3	1760	F4	2	23	2218z
6/30/1977	Lake IN/Porter	6.8	300	F2	0	1	2053z
6/25/1978	Livingston	16.4	400	F2	0	0	1908z
6/25/1978	La Salle	0.9	300	F2	0	0	1930z
8/16/1978	McHenry	2.0	100	F2	0	0	0145z
8/5/1979	Ogle	5.7	67	F3	0	0	2245z
8/18/1979	Winnebago	0.5	50	F2	0	0	0240z
6/7/1980	Livingston/Ford	34.5	880	F2	0	0	2000z
7/16/1980	Kane	1.4	440	F2	0	0	0805z
4/3/1982	Kankakee	12.0	750	F3	0	15	0540z
8/24/1982	McLean/Ford	23.5	300	F2	0	0	1925z
4/27/1984	Kendall/Will	9.0	200	F3	1	5	2339z
7/10/1985	La Salle	0.5	167	F2	0	8	0130z

9/29/1986	Livingston	9.0	50	F2	0	0	2234z
7/6/1987	Newton	0.9	250	F2	0	3	2302z
8/17/1987	La Salle	1.0	10	F2	0	0	0315z
4/6/1988	Grundy/Will	30.0	50	F2	0	0	0200z
6/22/1990	Kankakee/Iroquois	3.0	100	F2	0	0	2325z
8/28/1990	Kendall/Will	16.4	600	F5	29	350	2030z
3/27/1991	Will/Cook	15.0	200	F3	0	7	2155z
8/8/1991	Benton/Warren	9.0	127	F2	0	0	2043z
6/17/1992	Iroquois	0.1	20	F2	0	1	2140z
7/8/1993	Lee	0.3	30	F2	0	0	1759z
8/15/1993	Will	0.2	20	F2	0	0	2235z
4/20/1996	Lake IL	2.0	100	F2	0	2	0432z
5/19/1997	Lake IL	6.0	73	F2	0	0	0018z
4/20/2004	Putnam/La Salle	15.8	880	F3	8	12	2244z
4/20/2004	La Salle	9.0	400	F2	0	0	2310z
4/21/2004	Kankakee	3.0	50	F2	0	0	0018z
5/24/2004	McLean/Livingston	13.1	240	F2	0	0	0120z
1/7/2008	Boone/McHenry	13.2	100	EF3	0	5	2130z
6/7/2008	Kankakee/Will	14.5	200	EF2	0	0	2218z
6/7/2008	Will	2.2	400	EF2	0	0	2251z
6/7/2008	Will	3.7	150	EF2	0	0	2255z
6/7/2008	Will/Cook	6.5	150	EF2	0	6	2313z
8/4/2008	Lake IN	2.7	30	EF2	0	0	0127z
8/20/2009	Porter	4.0	60	EF2	0	0	0032z
6/6/2010	Putnam/La Salle*	9.5	880	EF2	0	0	0110z
6/6/2010	Marshall/LaSalle*	16.8	800	EF2	0	17	0135z
6/6/2010	Livingston*	8.6	440	EF3	0	0	0158z
6/6/2010	Livingston*	6.0	300	EF2	1	5	0212z
6/6/2010	Kankakee*	7.8	175	EF3	0	0	0318z

*All Data from 2010 is Preliminary