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SOME CHARACTERISTICS OF NORTHEAST KANSAS SEVERE WEATHER 1963-1984

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1. INTRODUCTION

Severe weather events occurring in northeast Kansas were examined for the period 1963 through 1984. From these reports, general characteristics of severe weather in northeast Kansas have been determined.

Because of its geographical location, the state of Kansas is frequently subject to severe convective weather in the spring and summer. Several of the more famous tornadoes in the United States have occurred in Kansas. One of these was the June 8, 1966 tornado which cut a swath of destruction from southwest to northeast across the heart of Topeka and killed 17 persons. Though much smaller in size and intensity, another storm occurred the evening of June 17, 1978. That evening a small tornado dipped from a thunderstorm and overturned the "Whippoorwill" showboat out for an evening cruise on Lake Pomona in eastern Kansas. Seventeen persons drowned. Large hailstones and strong gusty winds accompany many severe thunderstorms in Kansas. Heavy rain and flash flood events are also common occurrences.

Because of the frequency of severe convective weather in Kansas, it seems appropriate to study the characteristics of such events. In particular this paper will focus on severe convective weather in northeast Kansas. This area is shown in Fig. 1.

2. METHOD

The source of information for this study was the NOAA publication "Storm Data." Data were gathered beginning with January 1963 and ending with December 1984. The date and time of occurrence along with the type of weather event was logged for each day severe weather occurred. Since times of events were often listed in general terms (e.g., "three inch diameter hail fell near Lawrence the afternoon and evening of the 10th") no attempt was made to characterize daily temporal distributions of severe weather in northeast Kansas.

Before proceeding further, a few definitions are in order. A "severe weather day" is defined as a day on which severe weather occurred regardless of the number of severe weather events on that day. A "severe weather event" is defined as the occurrence of a

tornado, funnel cloud, hail 18 millimeters diameter or greater, surface wind speed 25 meters per second or greater, or a heavy rain/flash flood situation affecting at least one county. (NOTE: This is slightly different from the standard National Weather Service (NWS) definition of severe weather. Hereafter the phrase "severe weather" refers to severe convective weather.) From the gathered data, general characteristics of severe weather in northeast Kansas were determined.

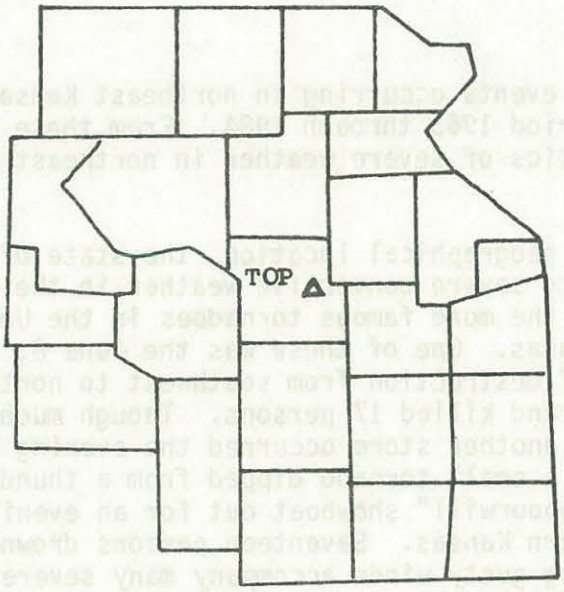


Fig. 1. Map of northeast Kansas showing the geographical area in which the study was conducted.

3. SEVERE WEATHER CHARACTERISTICS

Severe weather in northeast Kansas is most likely to occur in June and least likely in January although it has occurred in each month of the year. Table 1 shows the frequency of occurrence by months. May and June are the two months with highest frequency of severe weather. This is the time of year when the lower atmosphere is warming up considerably while the upper air warms more slowly. This results in decreased stability at a time when upper dynamics still remain in the area. There is an abrupt drop off in severe activity in July and August, probably due to the fact that upper dynamics have receded well to the north. There is no increase in activity in the autumn. This is due to a turn to colder weather in the lower atmosphere while the upper air remains relatively warm thus resulting in a more stable atmosphere. There is an average of 21 severe weather days per year and an average of 3.3 events per severe weather day. Table 2 shows the frequency of occurrence of the number of severe weather events per severe weather day. As can be seen from Table 2 most of the severe weather days have only one severe weather

event and about one severe weather day each year can be expected to produce as many as seven severe weather events. Thus, major outbreaks are relatively infrequent.

TABLE 1

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
.05	.09	.73	2.55	3.95	5.27	2.77	2.55	1.73	.82	.32	.09
1	2	16	56	87	116	61	56	38	18	7	2

Top line is average number of severe weather days per month. Bottom line shows the total number of severe weather days occurring each month during the 22 year period 1963 through 1984.

TABLE 2

# EVENTS PER DAY	FREQ (DAYS)	# EVENTS PER DAY	FREQ (DAYS)
1	180	16	3
2	93	17	-
3	53	18	-
4	33	19	-
5	16	20	-
6	19	21	-
7	22	22	1
8	9	23	2
9	6	24	-
10	4	25	-
11	3	26	-
12	5	27	-
13	7	28	-
14	2	29	1
15	-		

The average date of the first severe weather day is March 26 and the average date of the last is October 23, a span of nearly 7 months. Hail is the most likely severe weather event to occur with an average frequency of 25 occurrences per year followed by strong winds (24 occurrences per year), combined tornadoes/funnel clouds (23.5 occurrences per year), and heavy rain/flash floods (2.9 occurrences per year).

Most tornadoes are short-lived. The average path length of all northeast Kansas tornadoes during the period was 10.8 km (6.75 miles). Long-lived tornadoes (path length greater than or equal to 16 km (10 miles) occur about 1.7 times per year. There were 37 such

tornadoes during the 22 year period and they averaged 41.3 km (25.8 miles) in path length. Table 3 shows the frequency by month of long-lived tornadoes. They are most frequent in April and June.

TABLE 3

MAR	APR	MAY	JUN	OCT	DEC
1	13	7	13	2	1

Total by month of long lived tornadoes in northeast Kansas 1963 through 1984.

The total number of severe weather days per year and the total number of each type of severe weather event per year are shown in Fig. 2. From the graphs it can be seen that the years 1974 through 1981 were a time of relative lull in severe weather in northeast Kansas.

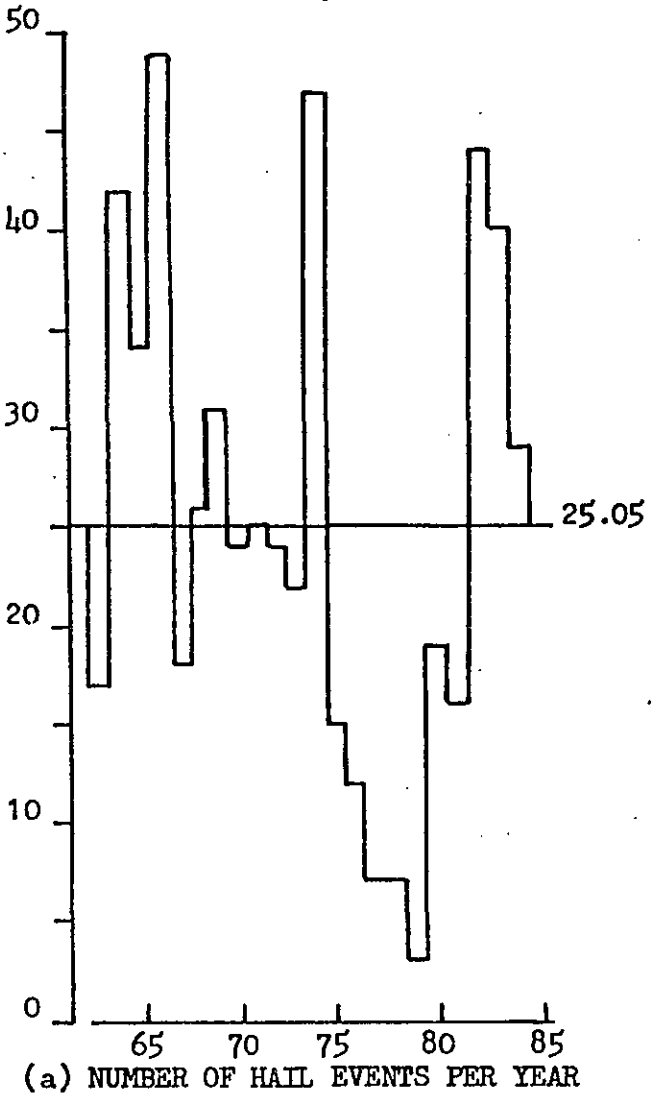
Monthly average temperatures and precipitation for Topeka for the months of greatest severe weather frequency (April through September) were plotted. Comparisons were made between months with above normal severe weather and those with below normal activity. From Fig. 3 it can be seen that severe weather shows good correlation with average monthly precipitation but little or no correlation is evident to average monthly temperature.

The years 1975, 1979, and 1980 each recorded only 10 severe weather days -- less than half the normal per year. In 1975 there were no severe weather days in June or July. Two of the 10 severe weather days that year occurred out of season -- one in November and one in December.

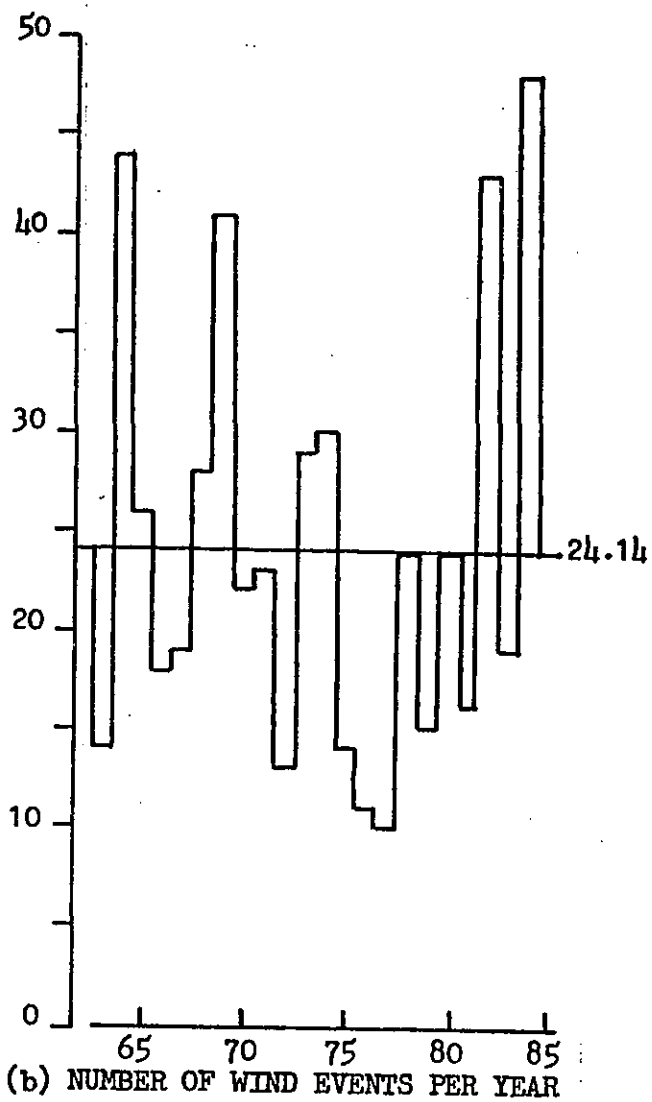
The year 1980 was also unusual. The severe weather season that year did not begin until May 31, over two months later than the average. There was only one severe weather day in each month (May, June and July) which is 25 percent of the normal for this period.

Average surface conditions occurring with severe weather between noon and 8:00 pm LST were determined from 21Z surface observations (or the latest observation prior to frontal passage on days cold frontal passage occurred) at Topeka. These averages are shown in Fig. 4.

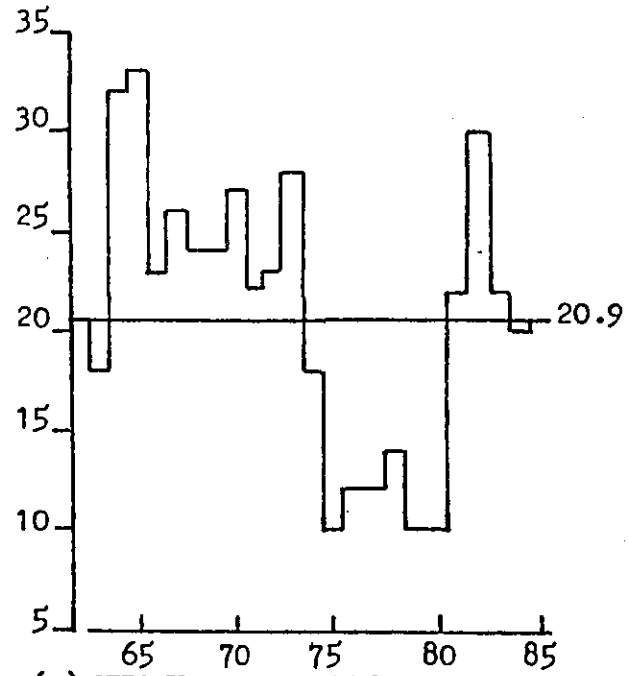
Williams (1976) studied average surface conditions associated with tornadoes. His study used data 0 to 3 hours prior to tornado occurrence (regardless of day or night). This is a little different from the northeast Kansas study which utilized 3:00 pm LST surface data to measure average conditions associated with all types of severe weather between noon and 8:00 pm LST.



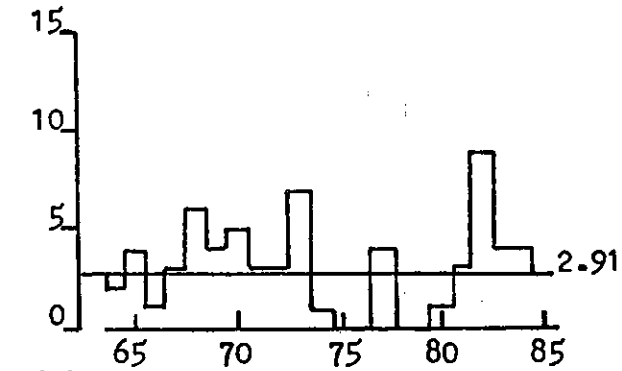
(a) NUMBER OF HAIL EVENTS PER YEAR



(b) NUMBER OF WIND EVENTS PER YEAR

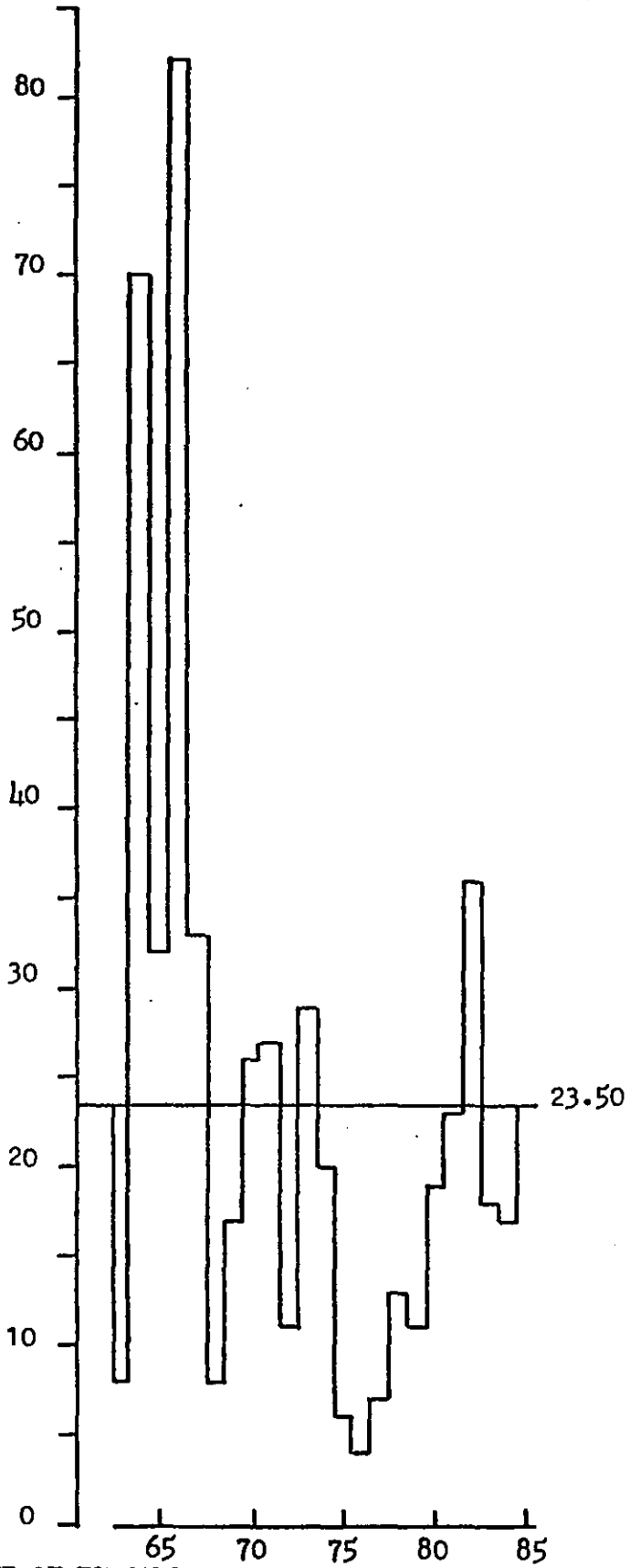


(c) NUMBER OF SEVERE WEATHER DAYS PER YEAR



(d) NUMBER OF RAIN EVENTS PER YEAR

Fig. 2. A plot by years of: (a) the number of hail events per year; (b) the number of wind events; (c) the number of severe weather days per year; (d) the number of heavy rain/flash floods per year; and (e) the number of tornadoes and funnel cloud events per year.



(e) NUMBER OF TORNADO AND FUNNEL CLOUDS PER YEAR

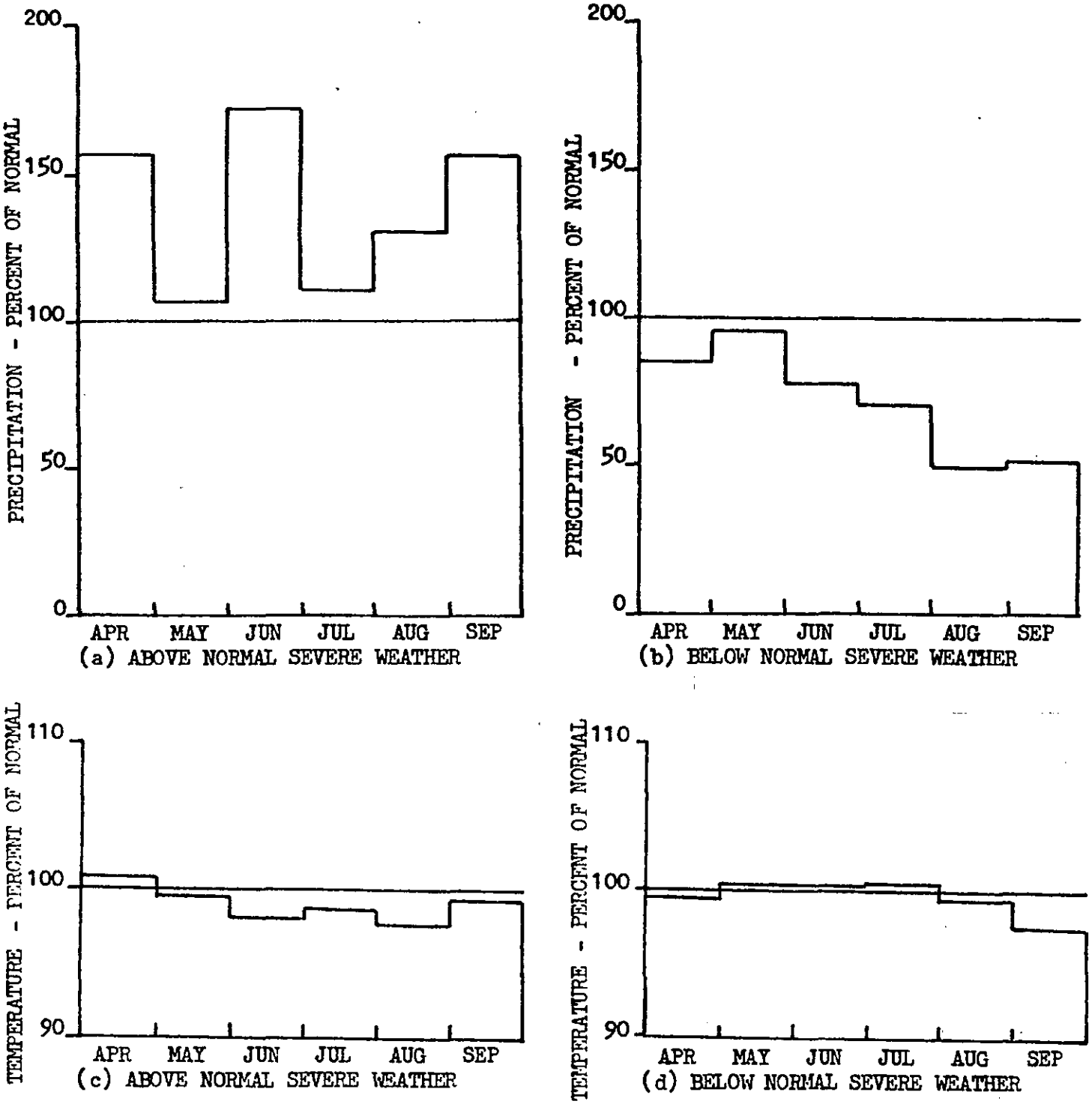


Fig. 3. Comparisons of monthly temperatures and precipitation for months of high severe weather occurrence (a,c) with months of low severe weather occurrence (b,d).

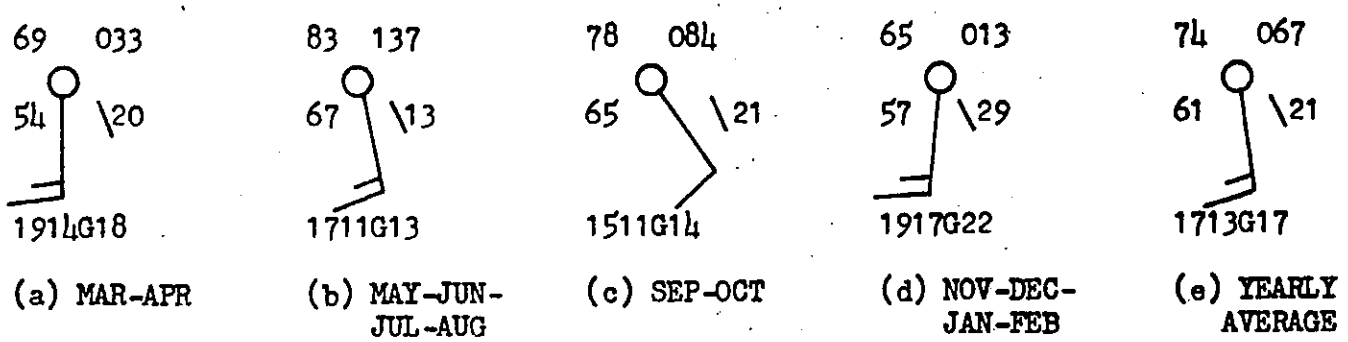


Fig. 4. Mean surface conditions at Topeka at approximately 21Z for severe convective weather occurring in northeast Kansas between noon and 8:00 p.m. LST for the months of: (a) March and April; (b) May, June, July and August; (c) September and October; (d) November, December, January and February; and (e) the average over the entire year.

A comparison of the northeast Kansas averages with the Kansas state average (compare Fig. 4 with Williams' Fig. 5) shows good agreement with temperature, dew point and wind direction while pressure and wind speed are somewhat higher than the Kansas average.

A comparison of average seasonal conditions in northeast Kansas was made with Williams' seasonal averages for the south central states (see his Figs. 6 through 9). (NOTE: His seasonal definitions differed somewhat from the seasonal definitions in the northeast Kansas study.) Temperatures and dew points averaged lower in spring in northeast Kansas but warmer than the south central states in summer and autumn. Except for spring, wind directions agreed well with Williams' averages while wind speeds in northeast Kansas were considerably higher throughout the year. Surface pressures were 2 millibars lower in the spring and 5 millibars higher in the summer than averages for the south central states. Reasonable agreement occurred in the autumn and winter. The best overall agreement occurred in the winter season. In the winter season nearly all severe weather would likely occur in the daytime or early evening which would lead to a similar data collection time for both studies. At other seasons some severe weather would also occur at night and the slight difference in data collection method probably accounts for the larger disparity in results at those times.

4. SUMMARY AND CONCLUSIONS

Severe weather is a frequent visitor to northeast Kansas and occurs an average of 21 days each year. A typical severe weather season begins March 26 and ends October 23. One or two long-lived tornadoes are possible each year, most likely in April or June.

Severe weather appears to occur in cycles and is closely related to cycles of monthly precipitation. But, in spite of general characteristics, individual years can show a wide variance from the norm.

5. ACKNOWLEDGEMENTS

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6. REFERENCE

Williams, R.J., 1976: Surface parameters associated with tornadoes. Mon. Wea. Rev., 104, 540-545.