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CLIMATOLOGICAL MAPPING OF U.S. TORNADOES DURING 1916-80

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1. INTRODUCTION

Computer generation of tornado path lengths into grid-print maps has been found to be a better measure of tornado activity than touchdown frequencies. This is done through the use of the DAPPL (Damage Area Per Path Length) computer tape produced and being updated at the University of Chicago. This tape contains data on 26,704 tornadoes from 1916-1980.

2. PATH LENGTHS OF TORNADOES, 1916-1980

Figure 1 shows an example of 160 grid-print maps which have been produced. Path length in each subbox is coded with the symbols shown in the figure inset. It is seen from the figure that there is a band of relatively low path lengths along a slanted line extending from southernmost Texas to upper Michigan.

An attempt was made to compute the total path length within narrow bands (15 min longitude wide) parallel to the slanted line in Fig. 1. In order to avoid the inclusion of the Great Lakes and the Gulf, the statistical area was limited between 30°N and 42°N.

3. EASTERN AND WESTERN TORNADOES

The total path length (in miles) within each narrow band (15 min longitude wide) between the Rockies and the Appalachians is presented in Fig. 2. Path lengths were computed by F-scale and

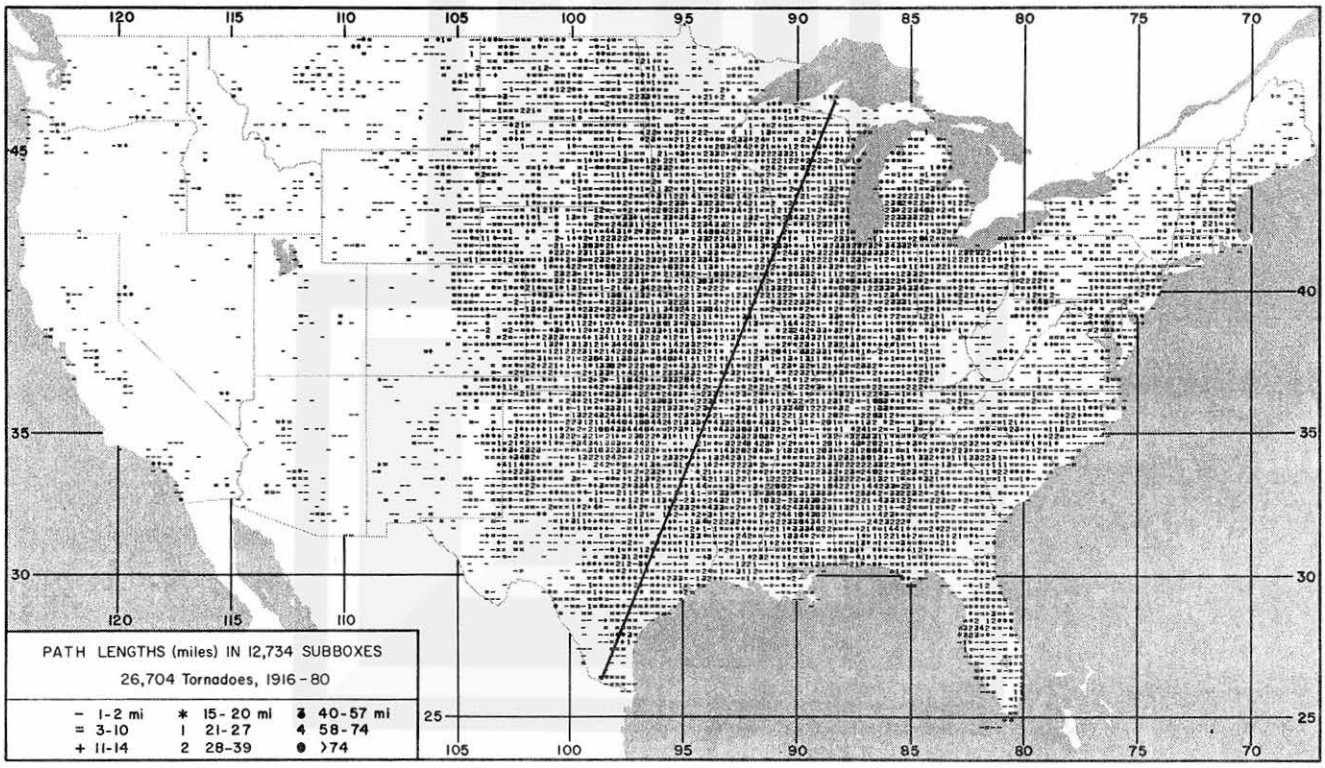

Fig. 1. Path lengths (miles) in 12,734 subboxes in the United States for the period 1916-1980. There were 26,704 tornadoes reported.

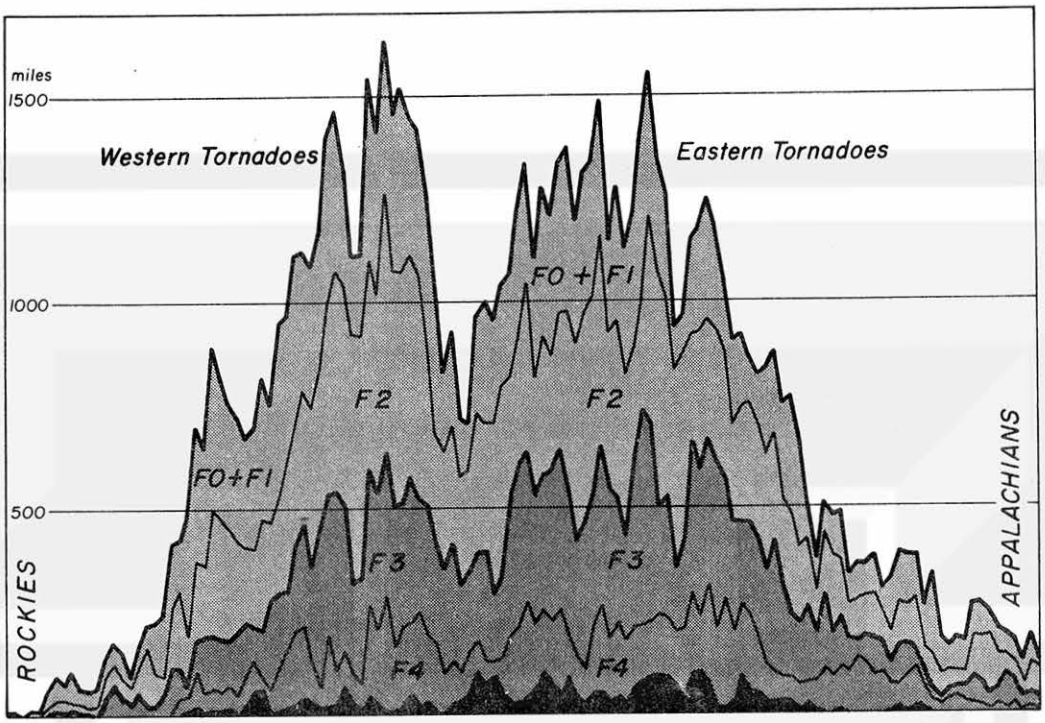

Fig. 2. Path lengths (miles) of western and eastern tornadoes for every F-scale within each narrow band (15 min longitude wide) from 30°N to 42°N, along a diagonal slope (2° latitude high and 1° longitude wide).

cumulative path lengths, such as for all tornadoes (F0+...+F5), F2 or stronger (F2+...+F5), etc.,were plotted in the figure. The result shows that there are two major peaks in excess of 1,500 miles per narrow band separated by a deep trough at the location of the slanted line in Fig. 1. To emphasize these two peaks and the distinct trough, the tornadoes to the east of the slanted line are grouped as "Eastern Tornadoes" and those to the west, as "Western Tornadoes".

4. EFFECT OF POPULATION

Do population and other man-made parameters induce the slanted "trough" line? Figure 3 was produced in relating the population (community) distribution with the slanted line. The community index, which is inversely proportional to the number of communities in each subbox, was mapped instead of the population, since tornadoes are likely to be reported by each community and not by each individual resident.

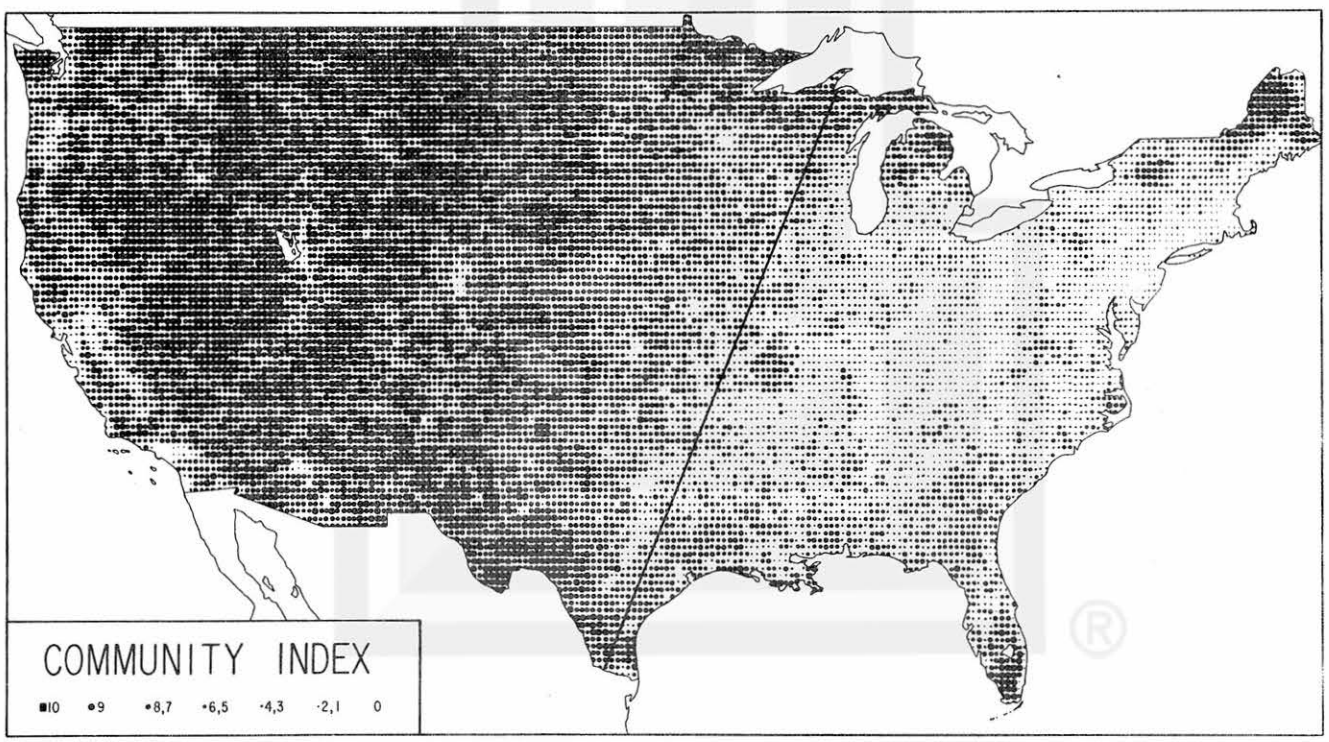

Fig. 3. Community index for the U.S. Painted circle or square appears in each subbox, as appropriate.

An examination of the distribution of the community index reveals that there is no trough in the communities along the slanted line. Instead, the community index increases gradually from east to west across the slanted line.

5. SEASONAL VARIATION OF EASTERN AND WESTERN TORNADOES

Peak activities of the eastern and western tornadoes can be revealed by generating grid-print maps by season, month, or week. The DAPPL tape can readily be used for this purpose. Presented in Figs. 4 through 11 are semi-monthly distributions of tornado path lengths in subboxes. These path lengths are coded as follows: 1 (1 to 5 mi), 2 (6 to 10 mi), 3 (11 to 15 mi),.., 9 (41 to 45 mi), A (46 to 50 mi), B (51 to 55 mi),...,etc. The path length in each subbox is the total length left behind by all tornadoes reported during the 65-year period from 1916-1980.

Apparently, tornadoes become active in and around Mississippi in late February (see Fig. 4). Then they spread northward, reaching Illinois and Indiana in early March (see Fig. 5).

The peak activities of the eastern tornadoes appear to be from late March to early April (see Figs. 6 and 7) when violent tornadoes had occurred in significant outbreaks (Tri-state outbreak of 18 March 1925, Palm Sunday outbreak of 11 April 1965, Super-outbreak of 3-4 April 1974, etc.).

Western tornadoes become active in early April (see Fig. 7), intensifying rapidly in late April (see Fig. 8), reaching their peak in May (see Figs. 9 and 10). During June, activity decreases gradually while the activity center moves north toward the Canadian border (see Fig. 11).

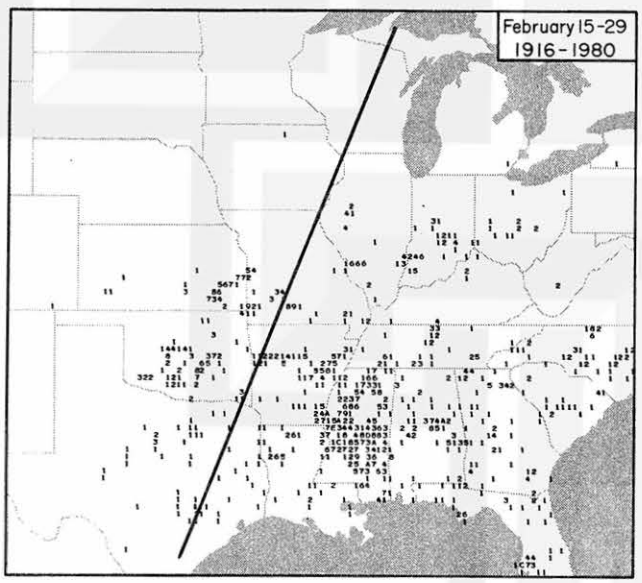

Fig. 4. Path length distribution (miles). February 15-29. (Symbols explained in text)

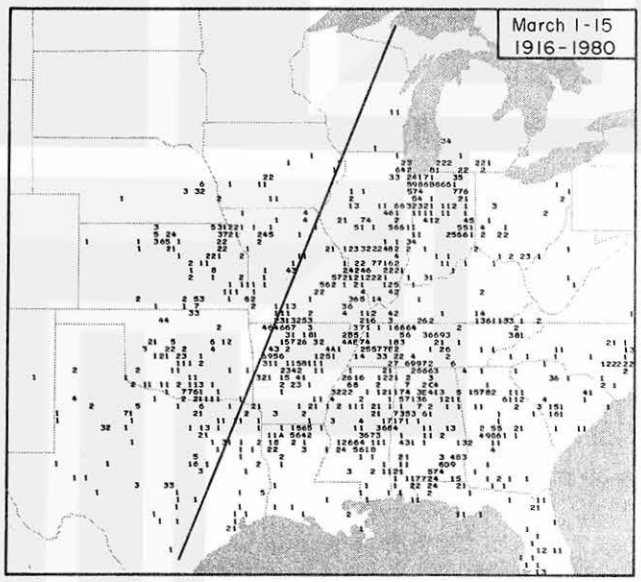

Fig. 5. Path length distribution (miles). March 1-15. (Symbols explained in text)

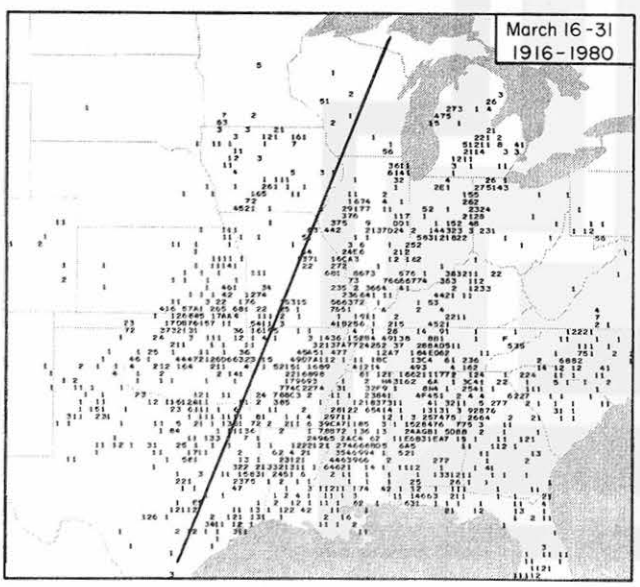

Fig. 6. Path length distribution (miles). March 16-31. (Symbols explained in text).

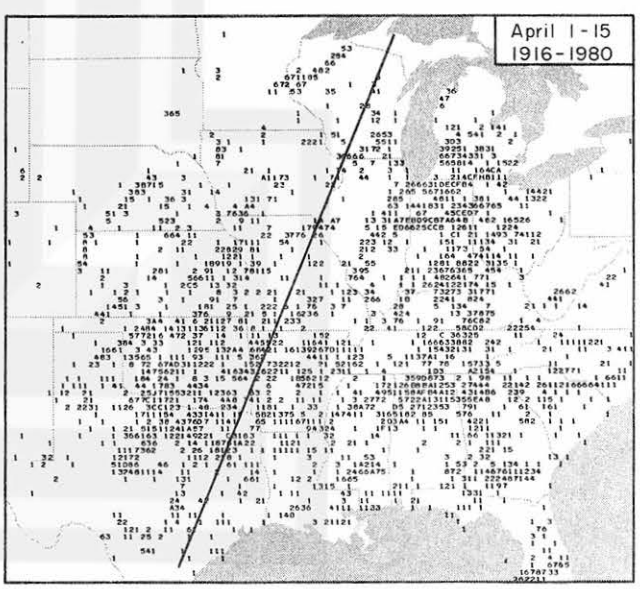

Fig. 7. Path length distribution (miles). April 1-15. (Symbols explained in text)

6. CONCLUSIONS

It has been found that grid-print maps generated from the DAPPL tornado tape with 15' x 15' subbox resolution is very useful in mapping automatically the distribution of both path lengths and touchdowns. These parameters have been printed out by hour, month, year, F-scale, direction, path width, deaths, etc..

One of the most interesting results revealed by these grid-print maps is the grouping of U.S. tornadoes into the eastern and western tornadoes, which are separated by a slanted line extending from southernmost Texas to upper Michigan. Intensive efforts are now being made to determine the characteristics of the narrow band on both sides of the slanted line. These characteristics include topography, population, community, forest, etc.

Meanwhile, meteorological conditions which could give rise to the low activity of tornadoes along the slanted line are studied in a further attempt to determine the tornado genesis in the Midwestern United States.

Acknowledgement

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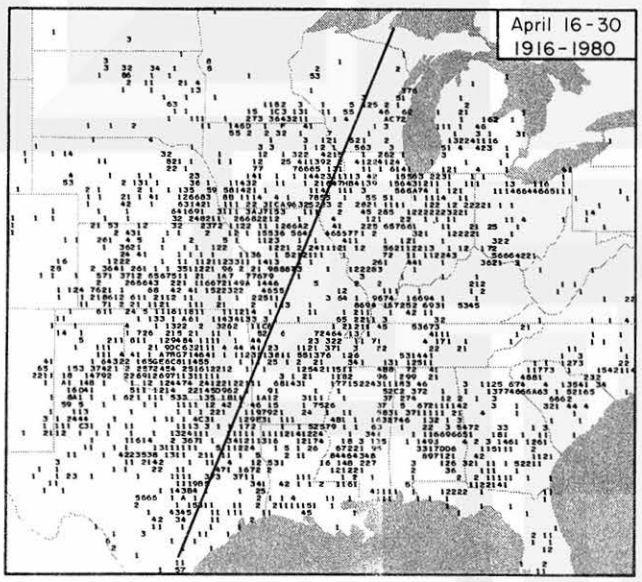

Fig. 8. Path length distribution (miles). April 16-30. (Symbols explained in text)

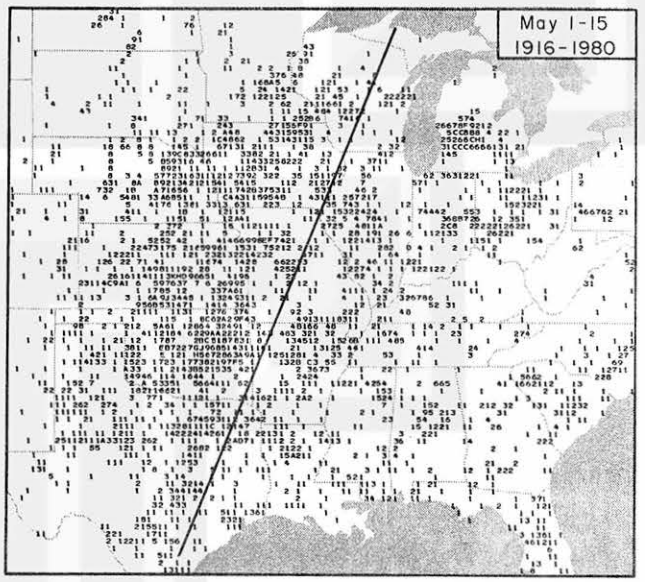

Fig. 9. Path length distribution (miles). May 1-15. (Symbols explained in text)

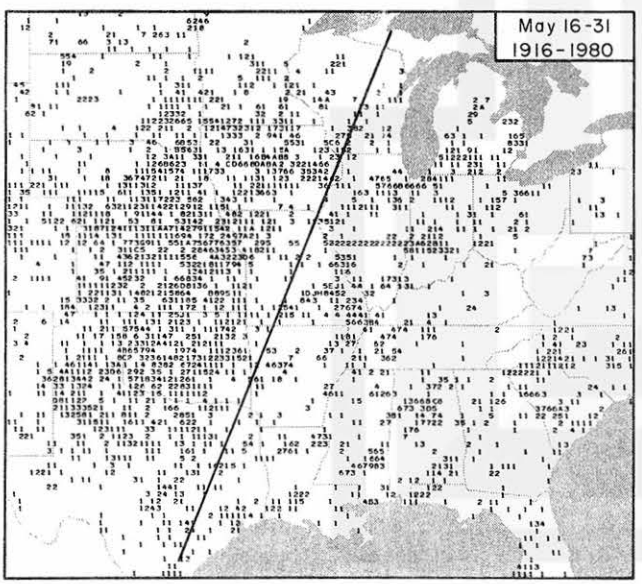

Fig. 10. Path length distribution (miles). May 16-31. (Symbols explained in text)

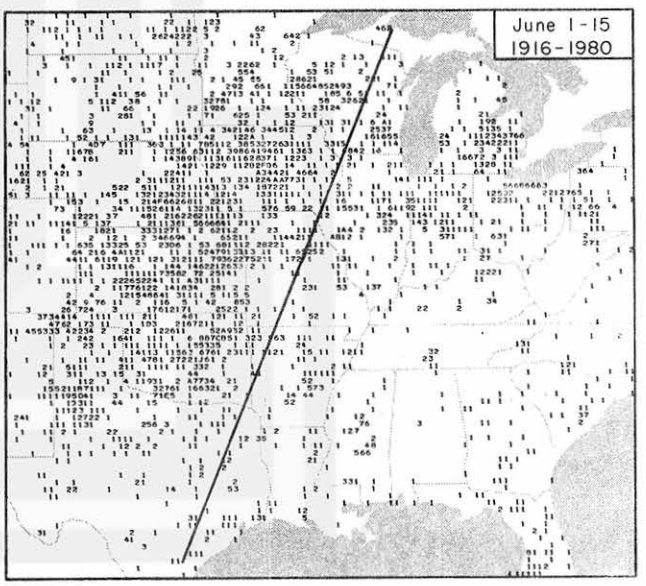

Fig. 11. Path length distribution (miles). June 1-15. (Symbols explained in text)