P2.2 A LOOK AT THE TORNADO REPORT AND WATCH CLIMATOLOGY FOR THE CONTINENTAL UNITED STATES FROM 1986-2005

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1. INTRODUCTION

This study is an update to the Imy et al (1998) tornado watch climatology. Tornado watch issuances are examined for the two 10-year periods 1986-1995 and 1996-2005. Tornado watches typically cover roughly 65,000 km^2, or about one third the size of Iowa, are typically valid for 6 to 8 hours, and are issued in the shape of a parallelogram or rectangle (Ostby 1992). Even though the National Weather Service watch-by-county program (Okulski et al. 2004) was fully implemented in November 2005, parallelograms approximating the watch area are still issued with each watch issuance. Tornado watches represent those areas where environments were deemed to be favorable for tornado development

To complement the tornado watch climatology, the tornado report distribution during the same two 10-year periods was also examined, in order to explore the evolution in tornado report distribution during the past 20 years. The combination of the tornado reports and watch frequency should also provide a useful description of when and where tornadoes and favorable tornadic environments (as determined by human forecasters) occurred most frequently during these two 10-year periods.

In the analysis below, events that occur from November through March are grouped together as a representation of cool season tornado activity. Similarly, events that occur from July through October are grouped together as a representation of late summer tornado activity. Since tornado activity peaks in the spring and monthly sample sizes are larger, the months of April, May, and June are considered individually.

2. PROCEDURE

To compute the number of tornadoes across the continental U.S. for the 1986-1995 and 1996-2005 periods, a 10 km grid was used Each tornado report that fell within 160 km (approximately 100 statue miles) of a grid point was counted as a tornado event for that grid box. The climatology was developed in this manner to more closely relate the report counts to the average size of a tornado watch as well as partially smooth the spatial distribution of the tornado events. The number of tornado reports for each grid box were summed monthly and also for the two 10-year periods. For the tornado watch climatology, any grid boxes that were located within a watch parallelogram were counted and then summed monthly and for the two 10-year periods.

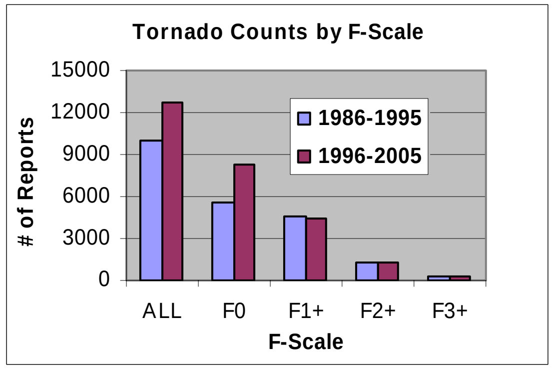

Figure 1: Tornado counts by F-scale for the periods 1986-1995 and 1996-2005. F1+, F2+, F3+ indicate the number of tornadoes rated as F1 or above, F2 or above, and F3 or above, respectively.

3. TORNADO WATCH AND REPORT CLIMATOLOGY

Overall tornado numbers increased during the 1996-2005 period when compared to 1986-1995. Figure 1 shows a greater than 25% increase in the total number of tornado reports, with this due entirely to the number of F0 reports. There has been virtually no change in the number of F1-F5 tornado reports (4511 in the first decade compared to 4496 in the second).

Figures 2-6 and 8 are four-panel plots showing maps of tornado report and tornado watch counts across the continental U.S. for the periods 1986-1995 and 1996-2005. Overall totals are shown in Figure 2, cool season (November through March) totals are shown in Figure 3, late summer (July through October) totals are shown in Figure 4, and monthly totals for April, May, and June are shown in Figures 5, 6, and 8, respectively. It is expected that tornado maxima will generally be associated with tornado watch maxima, but there is not necessarily a linear relationship between watch counts and report counts, since a watch may verify with dozens of reports or just a few reports.

The overall tornado watch report climatology (Figure 2) from 1986-1995 to the 1996-2005 period showed that a tornado maximum remained across the central portions of the country from north Texas into Iowa throughout the two periods. In addition, a new maximum had also evolved from Illinois southward across western Tennessee/Kentucky, Alabama, southeast Missouri, and Arkansas. The only area across this region not showing an increase in the number of tornadoes was Missouri (except for the southeast corner), where a relative tornado minimum was located.

For tornado watches, a maximum was located near the Red River area of Texas and Oklahoma during the

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first 10-year period. During the second 10-year period, the tornado watch numbers decreased across much of Texas, while the maxima had shifted eastward to the central Gulf of Mexico coastal states. Watch numbers also increased across all of the Mississippi River Valley Region, in the same areas where an increase in tornado activity was noted.

From November through March, the main change was an increase in the number of tornado reports and tornado watches from Arkansas northeast into southeast Missouri and western Tennessee/Kentucky (Figure 3). From July through October (Figure 4), there was a notable increase in the number of tornado reports and watches over the southeast U.S., due mainly to the locations and inland tracks of landfalling tropical cyclones.

Meanwhile, a notable change in the number of tornado reports and watches occurred during the spring months of April, May, and June. During this period, both watches and number of tornadoes shifted further northward and eastward from the first 10-year period.

In April (Figure 5), the tornado number increase was most notable across Iowa/Illinois and the western portions of the lower Ohio and Tennessee Valleys. The number of tornado watches also increased across this same region, especially from Arkansas eastward into Kentucky. On the other end of the spectrum, a decrease in the number of tornado watches and reports was evident across much of Texas, except in the Texas panhandle.

In May (Figure 6), the number of tornadoes and watch issuances increased during the 1996-2005 period from Oklahoma northward into Nebraska and eastward across the mid Mississippi Valley Region into the Ohio and Tennessee Valleys. For the same time period, a relative tornado minimum was located across portions of southern Missouri downstream from the Ozarks. The number of watches decreased significantly across much of Texas and Louisiana with areas of northeast Texas averaging nearly 50% less watches. Figure 6 shows the number of days in May with F1 or greater tornado occurrences for the two time periods. Note that at least 50% fewer tornado days occurred from eastern Colorado southward into far eastern New Mexico/Texas, indicative of a less active dryline. A decrease was also noted further east from central Texas into southern Louisiana.

In June (Figure 7), fewer tornado watches and tornado events were noted from the front range of Colorado southward into west Texas. This consequently shifted the June tornado maximum from Colorado northeastward into southwestern Minnesota and southeast South Dakota.

4. CONCLUSION

The cool season tornado climatology changed little during the 1996-2005 period, compared to the previous 10 years, except for a northeastward expansion of activity from the Gulf States into Arkansas, southeast Missouri, Tennessee and Kentucky. The tornado distribution during the months of July through October was heavily dependent on the tropical cyclone activity. A notable change in tornado numbers and watch issuances was seen during the most active tornado months of the year, April, May and June. While a tornado maximum still remained across the traditional “tornado alley” (Concannon et al. 2000) from northwest Texas northward into western Iowa, a new maximum had also evolved from Iowa and Illinois southward into western Kentucky and Tennessee, northeast Arkansas and southeast Missouri.

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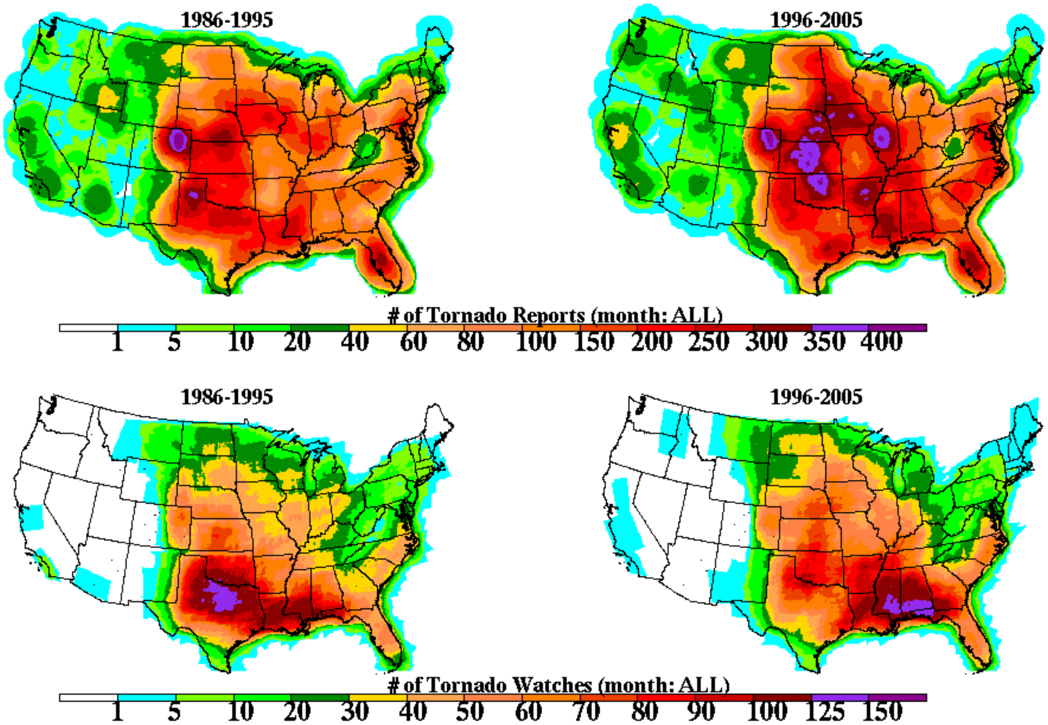

Figure 2: The tornado report (above) and tornado watch (below) distribution for the periods 1986-1995 (left) and 1996-2005 (right).

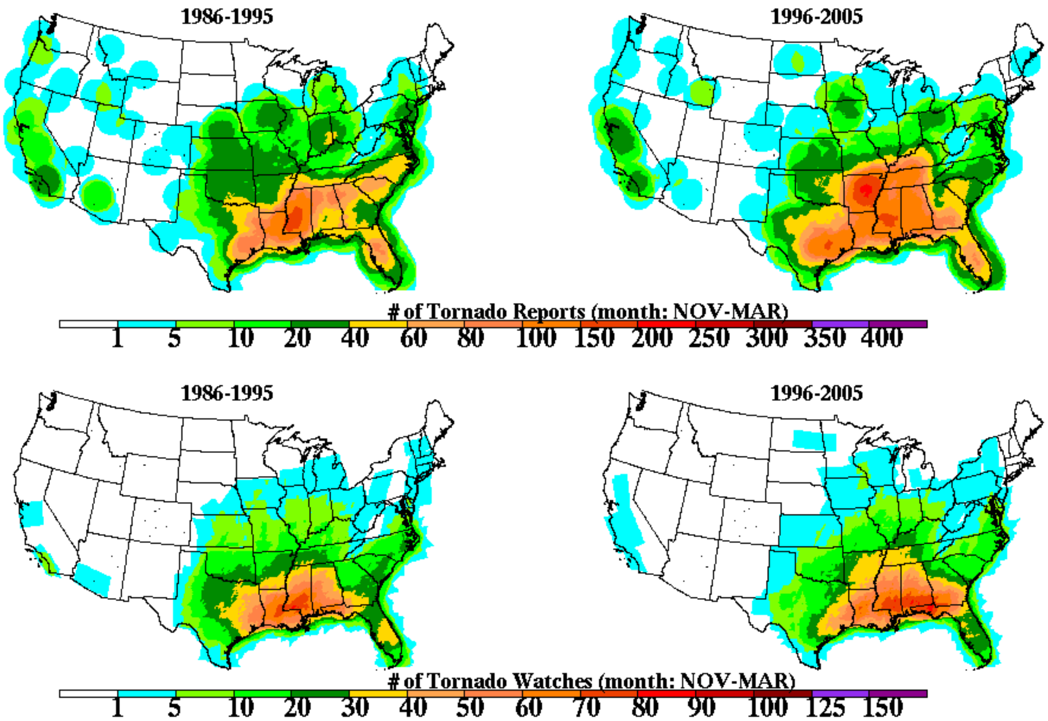

Figure 3: The cool season (November through March) tornado report (above) and tornado watch (below) distribution for the periods 1986-1995 (left) and 1996-2005 (right).

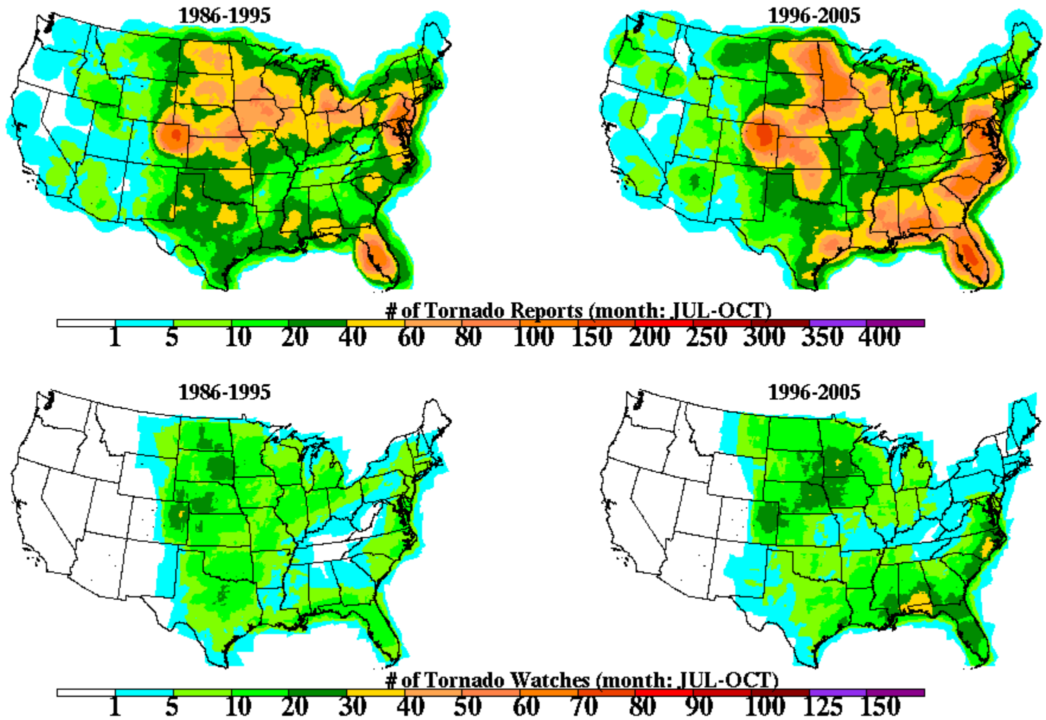

Figure 4: The tornado report (above) and tornado watch (below) distribution for July through October for the periods 1986-1995 (left) and 1996-2005 (right).

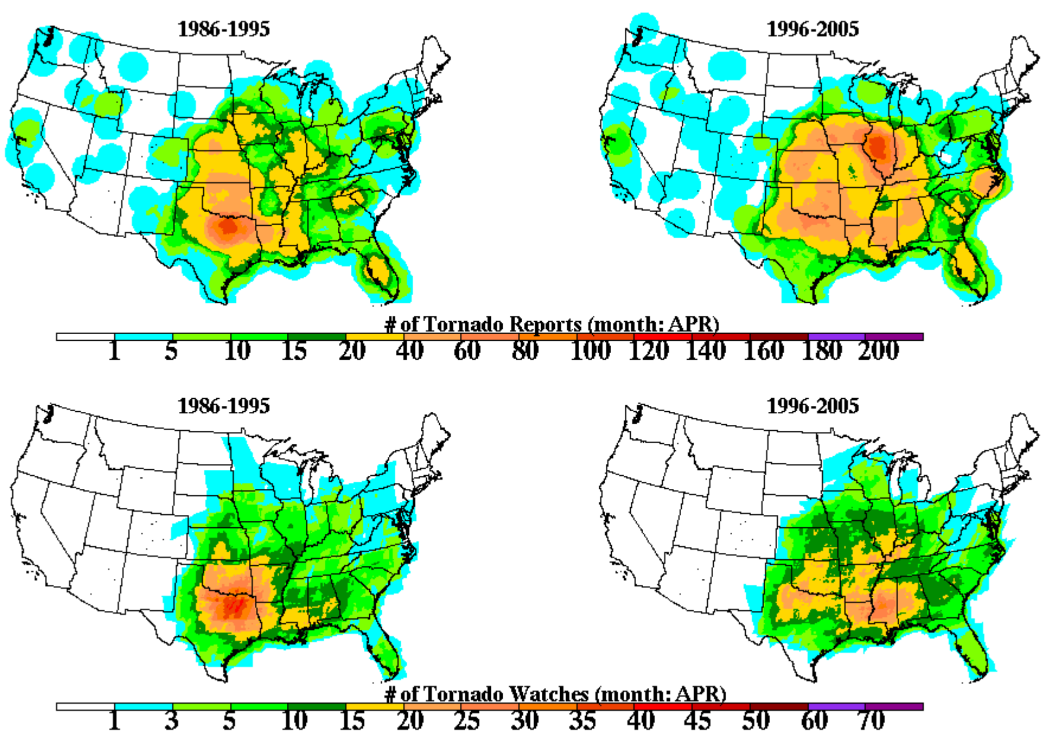

Figure 5: The tornado report (above) and tornado watch (below) distribution for April for the periods 1986-1995 (left) and 1996-2005 (right).

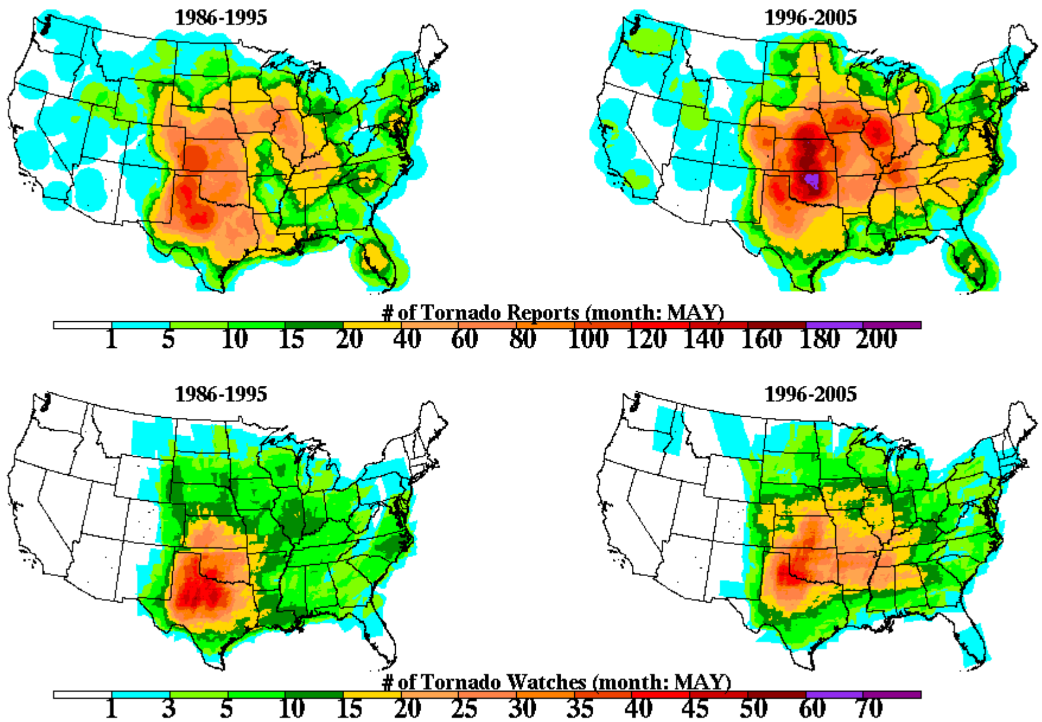

Figure 6: The tornado report (above) and tornado watch (below) distribution for May for the periods 1986-1995 (left) and 1996-2005 (right).

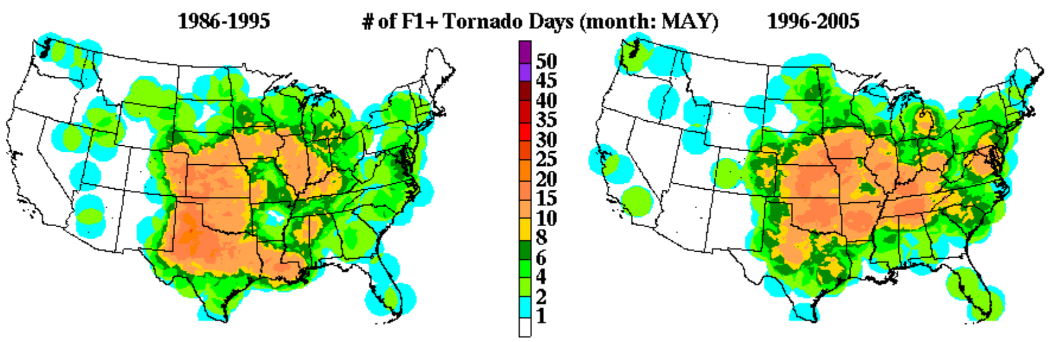

Figure 7: A comparison between the number of F1+ tornado days in May for the periods 1986-1995 (left) and 1996-2005 (right).

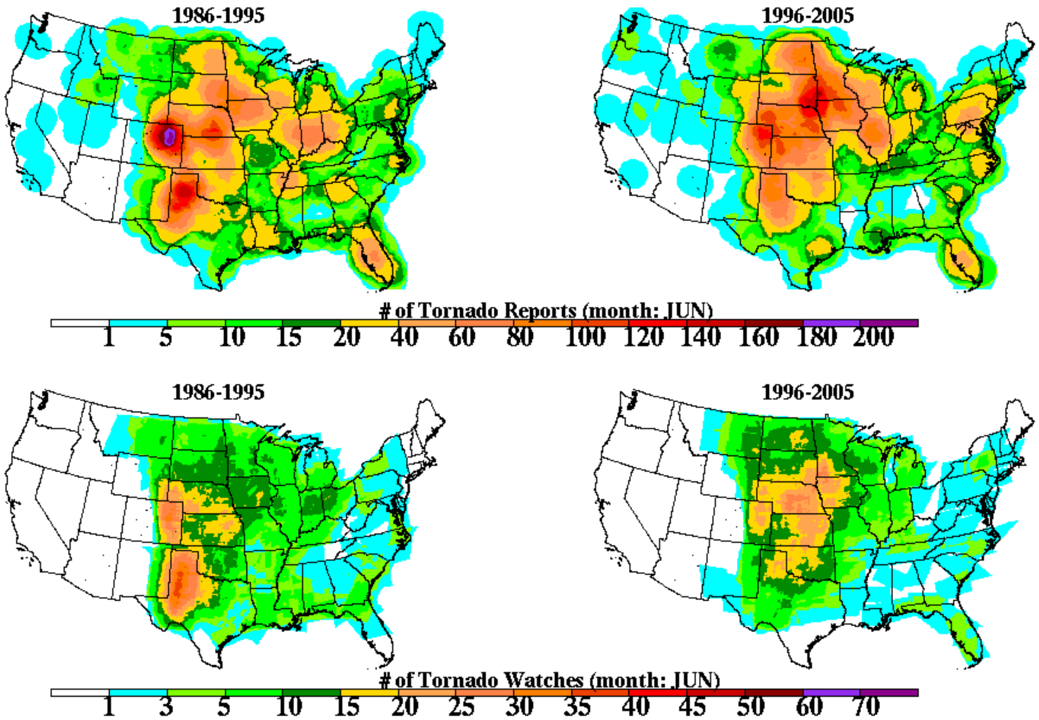

Figure 8: The tornado report (above) and tornado watch (below) distribution for June for the periods 1986-1995 (left) and 1996-2005 (right).

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