CRARP 24.1 A Severe Weather Climatology for the La Crosse, WI County Warning and Forecast Area

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1. Introduction

The National Weather Service (NWS) at La Crosse, WI issues severe weather warnings for a three-state area covering northeast Iowa, southeast Minnesota and parts of southwest, central and north central Wisconsin (Fig. 1). Severe convective storms are common in the 28 county warning and forecast area (CWFA) during the late spring and summer, but are rare during autumn and winter.

2. Purpose

The purpose of this paper is to document a climatology for the CWFA for the occurrences of severe hail, damaging winds, tornadoes and flash floods. This will not only allow a better understanding of the time of day and year these events occur, but provide a basis for severe weather staffing considerations, such as the implementation of a radar shift. This information will also be useful for the media, emergency managers and NWS officials to establish severe weather awareness promotions. In addition, NWS staff, especially those new to the area, will gain valuable knowledge to heighten awareness of severe weather occurrences based on climatology.

3. Methodology

a. Data Sources

The primary resource used in this paper was the Storm Prediction Center (SPC) climatological severe weather archive. This data set contained tornado statistics from 1950 to 1994 and damaging wind and severe hail statistics from 1955 to 1994. The same information for 1995 through 1999 was obtained from Storm Data publications (Storm Data 1983-1999). It should be noted that damaging wind and hail statistics were not available from the SPC database for 1972. Damaging winds are considered 50 knots (58 mph) or greater, while severe hail is considered 3/4 inch or larger in diameter. Since the SPC data set did not include flash floods, these data were gleaned from Storm Data publications for 1983 to 1999. Tornado, damaging wind, severe hail and flash flood reports were compared against the time of day and time of year. Additionally, flash flood reports were referenced with respect to duration of the event.

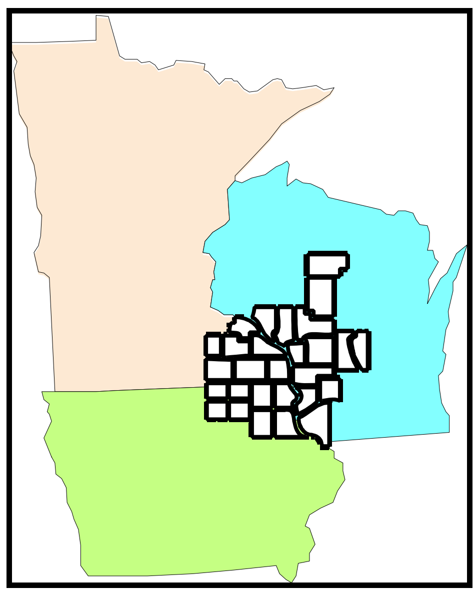

Fig. 1. County warning and forecast area of the National Weather Service at La Crosse, WI.

b. Data Limitations

It should be noted that this data has some limitations. First of all, severe weather reports increase near heavily populated areas and in locations of organized spotter networks. Even these reports could be influenced by the observers as well. For example, a study correlating probability of severe hail (POSH) with actual severe hail reports (Baumgardt and King, 1998) indicated a bias toward reporting dime and golf ball size hail with little else reported.

Another factor influencing the severe weather database was the part-time operation of the La Crosse NWS from 1950 to 1995. During this period, there was no radar data originating from the office and the extent of severe weather operations was limited by a staff of one to three persons. Radar information was based on data from NWS radar sites in Waterloo, IA, Rochester MN and Madison, WI, which have since closed. In addition, the CWFA consisted of only seven counties in southwest Wisconsin. All of these factors likely caused a bias toward fewer severe weather reports overall, especially in the late-night and early morning hours from 2200 to 0600 CST when the office was closed.

4. Data Analysis

a. Damaging Winds

With respect to time of year, damaging winds occur most often during June, followed by July and May (Fig. 2). These months are more favorable due to surface fronts and upper level disturbances interacting with the return of deeper layered moisture and, thus, greater instability. For the period 1955-1999 (Fig. 3), damaging wind reports peak during the time of maximum heating and instability, generally between 1600 (4 p.m.) and 0800 (8 a.m.) CST.

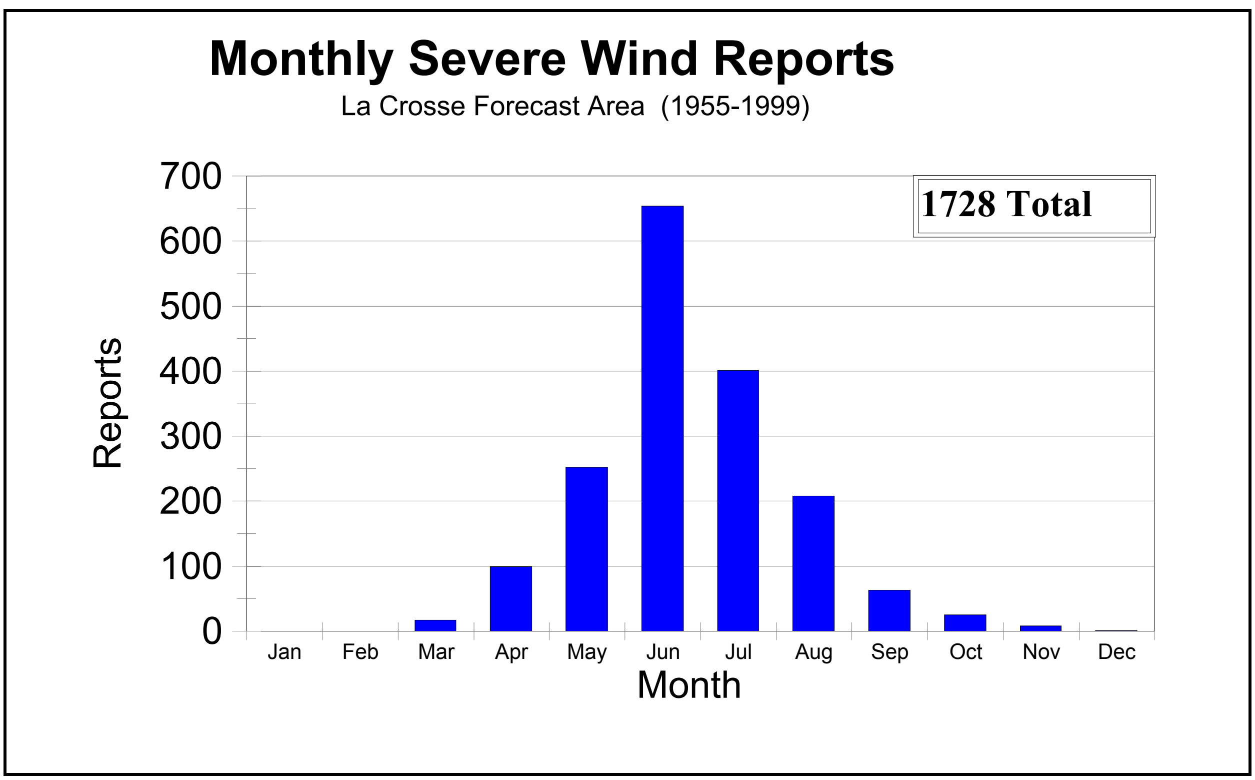

Fig. 2. 45-year total of severe wind reports versus month (1955-1999).

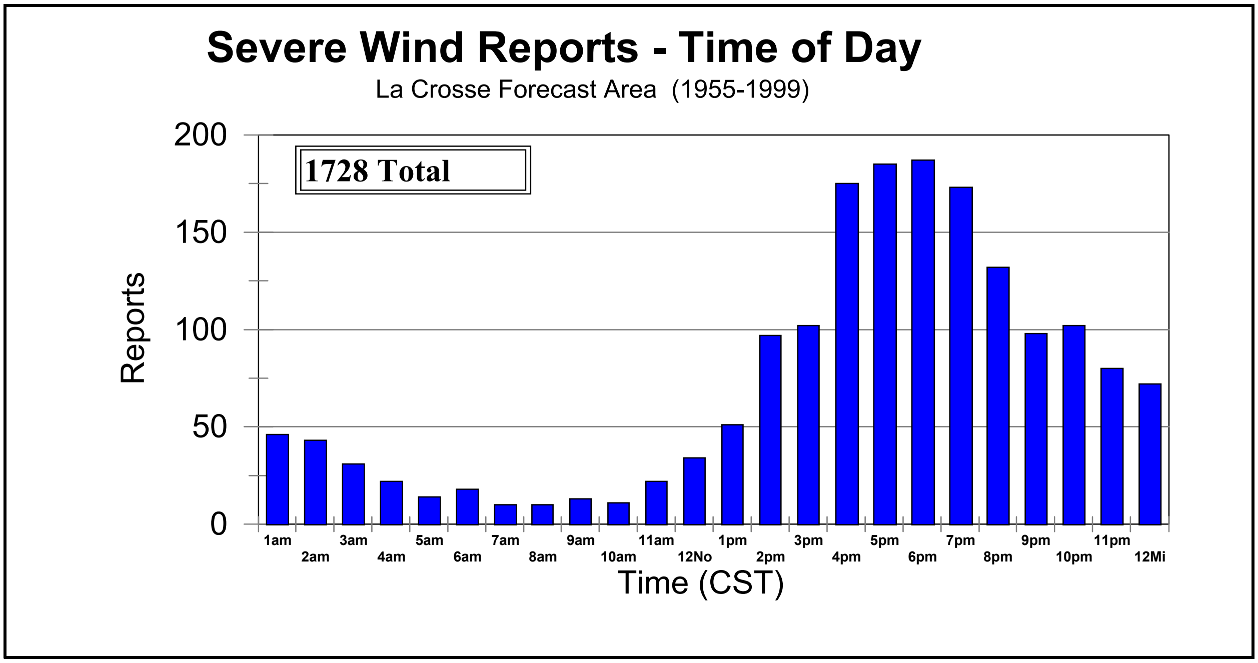

Fig. 3. 45-year total of severe wind reports versus time of day (1955-1999).

From 1996 through 1999 (Fig. 4), the La Crosse NWS was staffed for 24 hour operations, including on-site WSR-88D Doppler radar. It is interesting to note that severe wind reports show a similar diurnal climatological maximum and minimum in spite of a smaller sampling period than in Fig. 3. More importantly, a subtle, yet important peak is observed around 2400 (midnight) CST, which is thought to represent Plains-initiated convection propagating east into the CWFA during the late night hours.

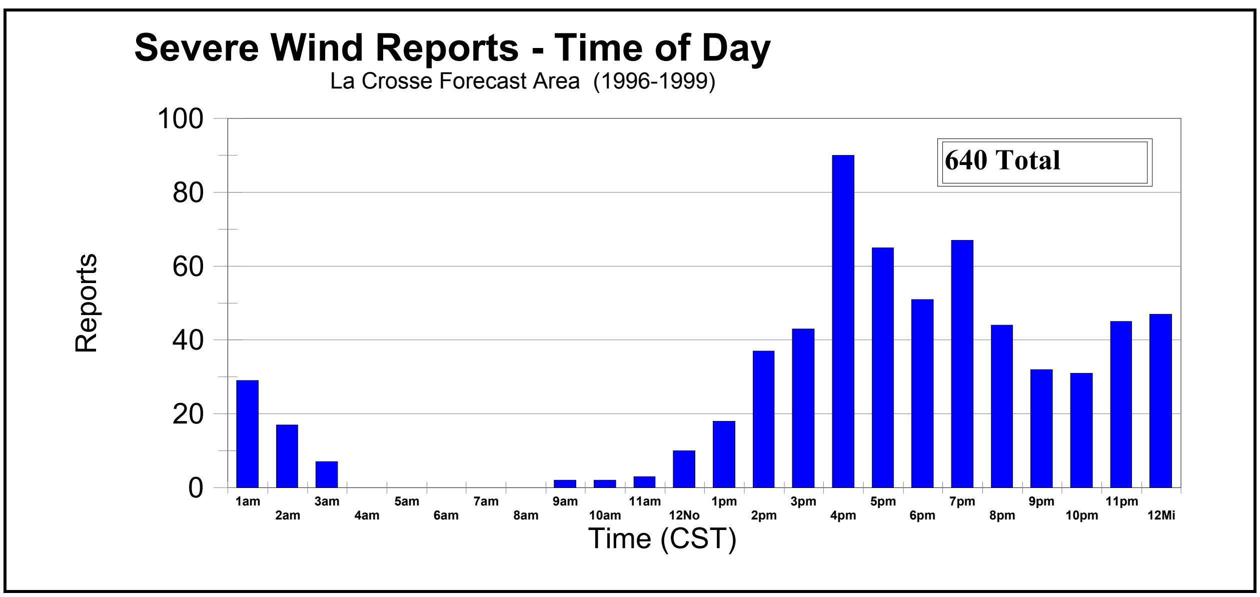

Fig.4. Four-year total of severe wind reports versus time of day (1996 - 1999).

b. *Severe Hail*

The occurrence of severe hail rises significantly during the month of May and June (Fig. 5). This is due to initiation and propagation of strong convection in relatively low wet bulb zero environments during late spring and early summer. Reports of severe hail decline in July and August as freezing levels climatologically increase. Hail reports favor the afternoon and evening hours, peaking generally between 1600 (4 p.m.) and 2000 (8 p.m.) CST (Fig. 6).

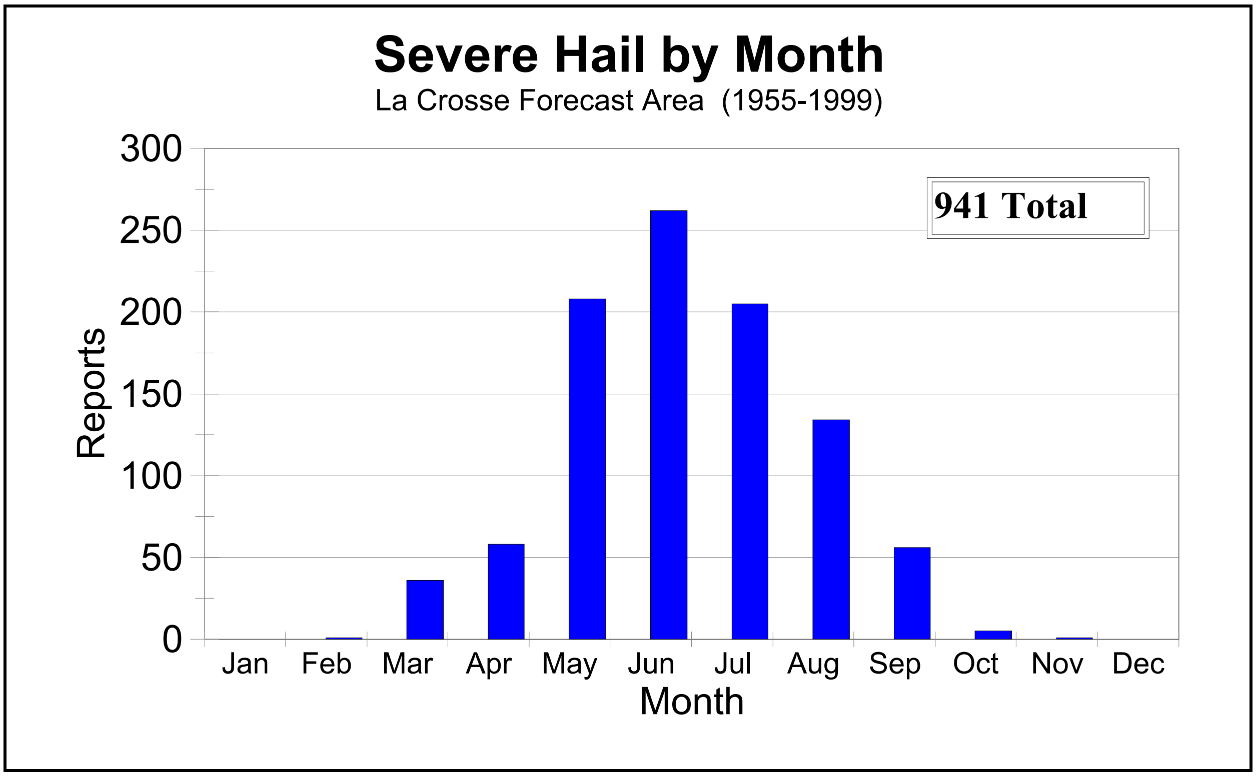

Fig. 5. 45-year total of severe hail reports versus month (1955-1999).

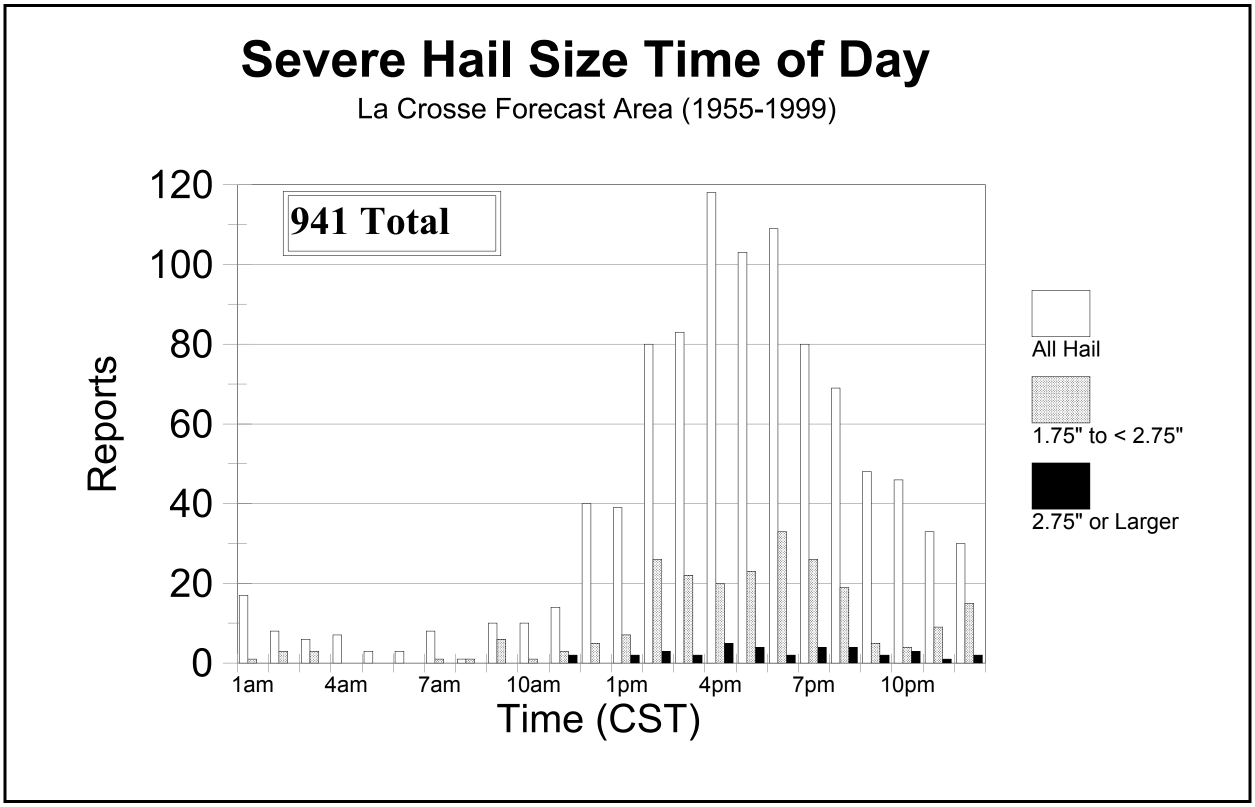

Fig. 6. 45-year total of severe hail reports versus time of day (1955-1999).

c. Tornadoes

Tornadoes have occurred in every month of the year except January, February and December in the La Crosse CWFA (Fig. 7). It is interesting to note that June is the peak month for tornadoes in Minnesota and Wisconsin, while May is the peak month in Iowa (Grazulis 1993). May is also the peak month for tornadoes in the CWFA. In fact, some of the most violent tornadoes have occurred in May (Grazulis 1993), such as the killer tornado that hit Charles City, Iowa in 1968. With respect to the Fujita scale, nearly 90 percent of all tornadoes are F0 through F2, with F1 being the most predominant (Fig. 8). Peak tornado occurrence is between 1600 (4 p.m.) and 2000 (8 p.m.) CST (Fig. 9).

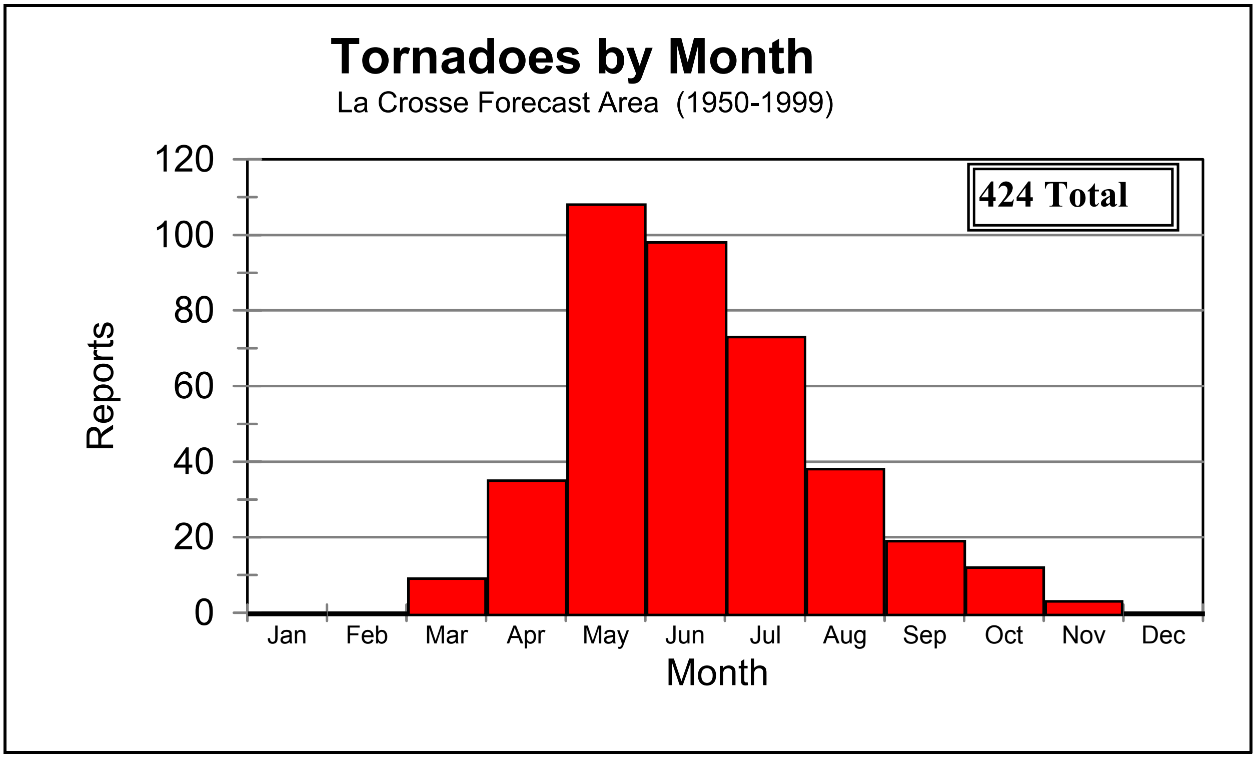

Fig. 7. 45-year total of tornado reports versus month (1950-1999).

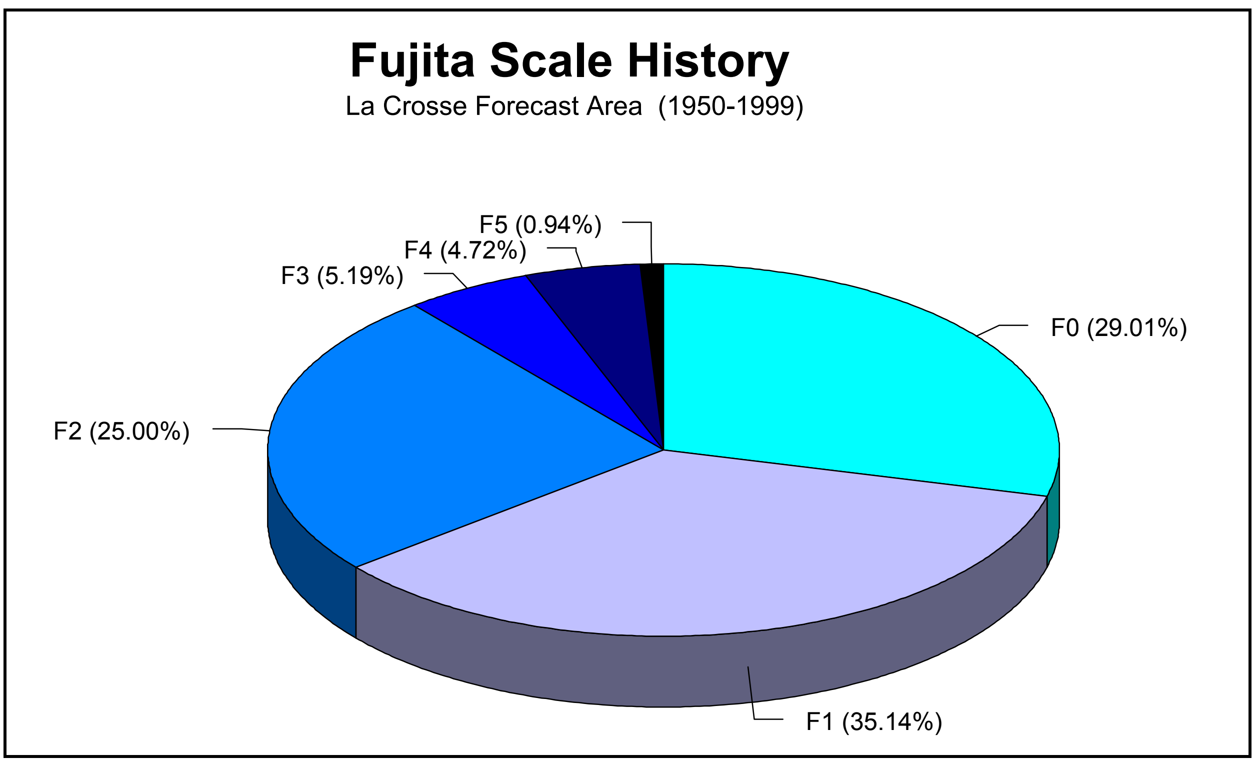

Fig. 8. Percentage of tornado reports versus Fujita scale (1950-1999).

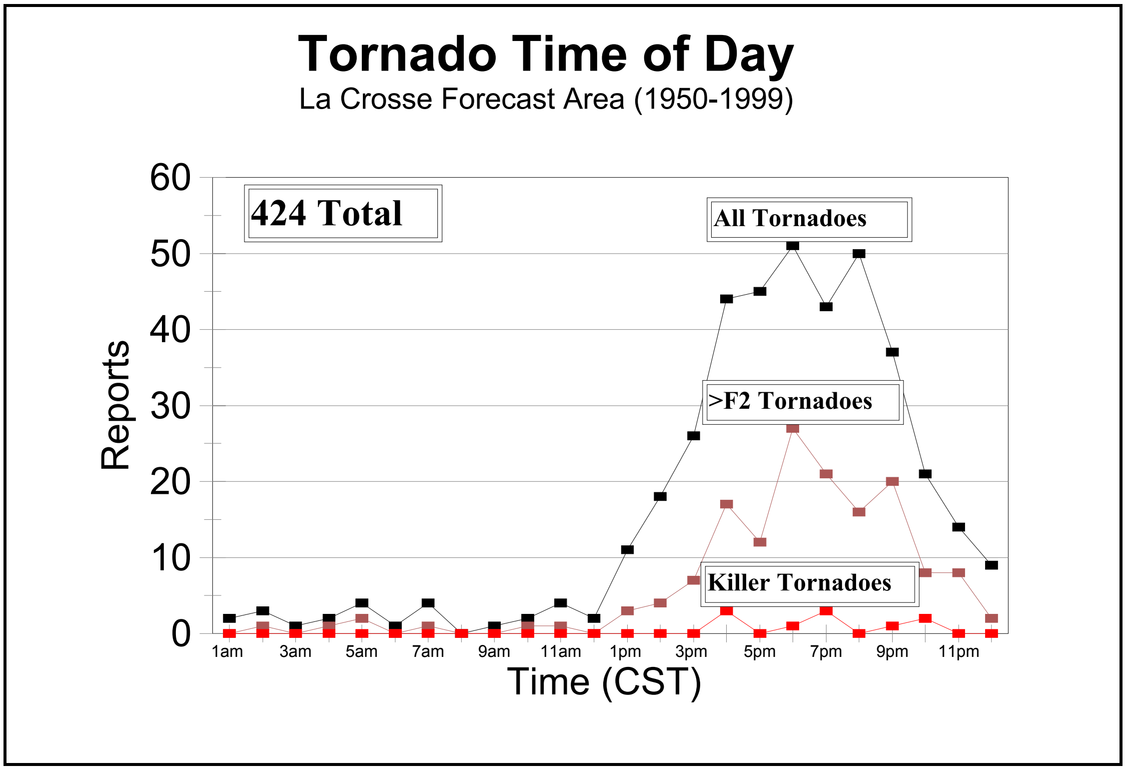

Fig
. 9. 50-year total of tornado reports versus time of day (1950 - 1999).

d. Flash Floods

Flash flooding is a threat to the CWFA due to the variability in terrain. This is especially true for areas bordering the Mississippi River, where steep hills and narrow valleys predominate. In addition, mesoscale convective complexes (MCCs) are common during the late spring and summer. Flash floods occur most often during June, followed by a secondary peak during September (Fig. 10).

Flash floods typically begin between 2000 (8 p.m.) and 2200 (10 p.m.) CST (Fig. 11), which correlates to the diurnal stabilization of the boundary layer and strengthening of the nocturnal low level jet (Maddox 1980). As a result, flash flood events initiate and continue, while reports of severe hail, damaging winds and tornadoes diminish. An exception to this behavior can be seen in Fig. 11 where a modest peak occurs between 0600 (6 a.m.) and 1000 (10 a.m.) CST. This is due to numerous reports of flash flooding in central and southwest Wisconsin on 14 and 16 September 1992.

Flash flood duration is usually four to six hours (Fig. 12). This implies issuing flash flood warnings for a similar time period would be a good operating practice at the NWS LaCrosse office.

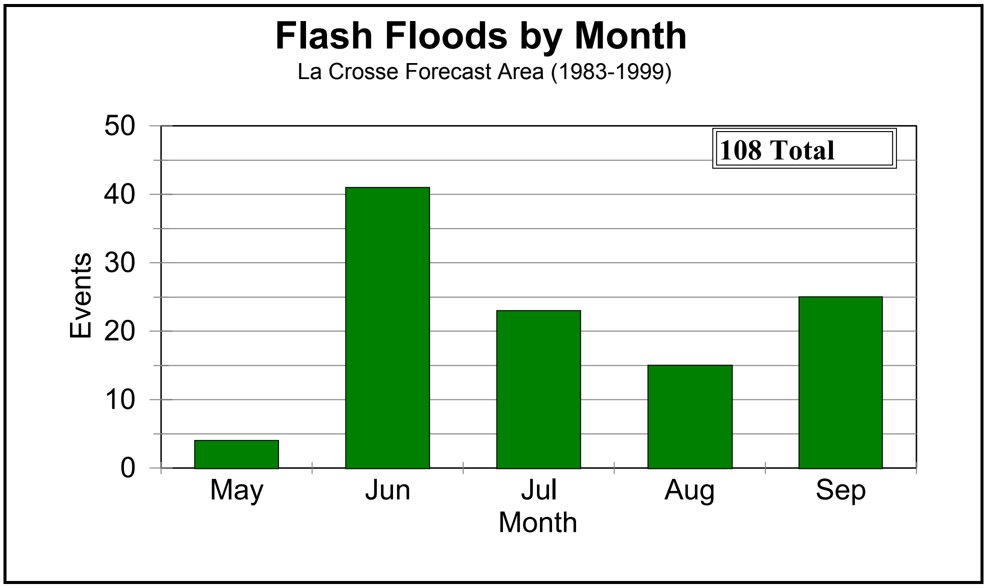

Fig. 10. Flash flood events versus month (1983-1999).

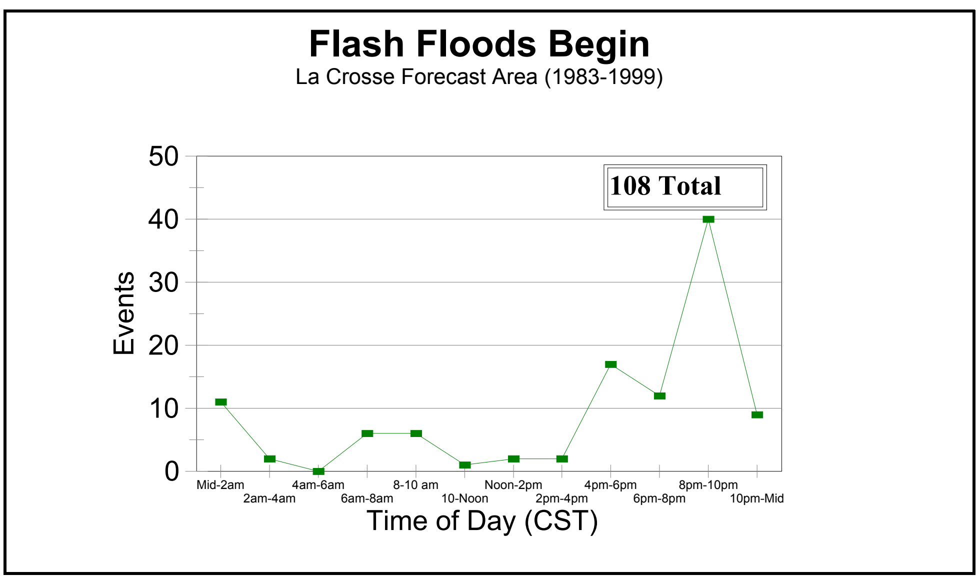

Fig. 11. Flash flood events versus time of initiation (1983-1999).

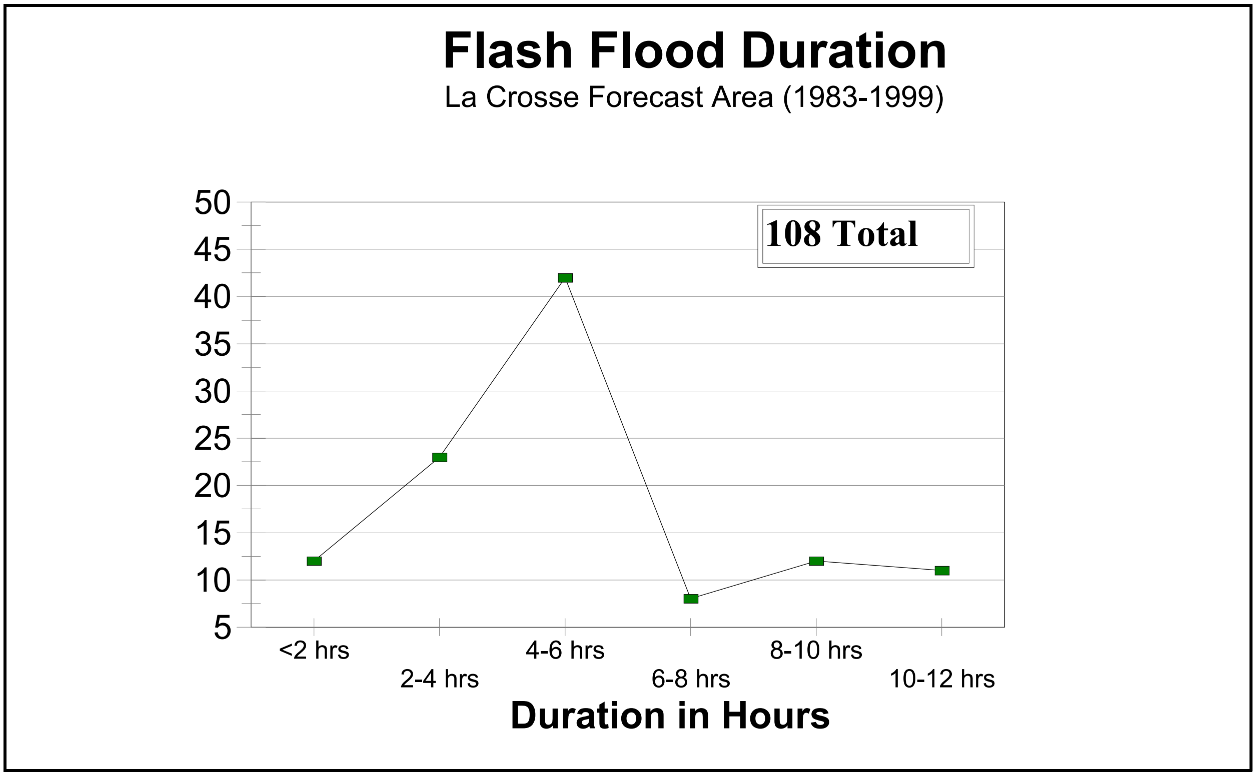

Fig. 12. Flash flood events versus duration in hours (1983-1999).

5. Conclusions

Severe convective storms in the La Crosse CWFA are mainly confined to the late spring and summer, specifically May through August. June has the most reports of severe hail, damaging winds and flash floods, while May has the most occurrences of tornadoes. Overall, severe weather reports peak between 1600 (4 p.m.) and 2000 (8 p.m.) CST, although damaging winds have a secondary peak around 2400 (midnight) CST. Flash floods are most likely to begin between 2000 (8 p.m.) and 2200 (10 p.m.) CST and have a duration of four to six hours.

Based on the above information, considerations may be given to severe weather staffing in the late spring and summer. For example, a radar shift might be feasible from May through August from 1500 (3 p.m.) until 2300 (11 p.m.) CST, which covers the highest potential for severe weather occurrences. This information will also be useful to the media, public, emergency managers, storm spotters and NWS staff to increase awareness about the time of day and year severe weather events occur climatologically.

Acknowledgments

The author would like to thank Glenn Lussky, Meteorologist in Charge, Dan Baumgardt, Science and Operations Officer and Todd Shea, Warning and Coordination Meteorologist, at NWS La Crosse for their suggestions, critique and encouragement in preparation of this paper.

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