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A CLIMATOLOGY OF NON-CONVECTIVE HIGH WIND FOR AMARILLO, TEXAS FROM 1993-2000

Steven Cobb
Weather Forecast Office
Amarillo, TX

Scientific Services Division
Southern Region
Fort Worth, Texas

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1. Introduction

Any forecaster in the southern High Plains will likely say an accurate wind forecast is one of the most challenging tasks they face operationally. Many factors can spoil an otherwise reliable depiction of surface wind speed and direction, including, but not limited to atmospheric mixing, synoptic and mesoscale boundaries, and movement and depth of surface cyclones. While a thorough understanding of these transitory features is critical, a knowledge of local climatology is a very important part of the forecast process. A National Weather Service Training Center Web page states, "...a knowledge of climatology can be used by local forecasters to become familiar with the range of possible atmospheric phenomena associated with current observations. Using climatology as a baseline, they can further investigate why various types of (severe) weather occur with greater (or lesser) frequency, at certain times of the day, or certain seasons of the year."

The purpose of this study is to provide forecasters with this baseline knowledge as it relates to forecasting non-convective high winds in the Texas Panhandle. A frequency of wind events by month, year, time of day and direction is given. A comparison of time of day and season versus direction is also presented. Finally, the events are classified into similar synoptic settings which may give forecasters additional help in recognizing conditions favorable for high winds.

2. Data

For this study a "high wind event" is defined as a calendar day during which the two-minute average wind speed equaled or exceeded 30 mph. Officially, the Amarillo NWS office issues a wind *advisory* when speeds above 34 mph are expected. A high wind *warning* is issued for sustained winds greater than 39 mph, or non-convective wind gusts greater than or equal to 58 mph. The lower limit for defining an event was chosen in order to accommodate a larger data set, since only 138 events met the criteria for wind advisory.

The data set for high wind cases was derived from monthly Local Climatological Data forms published by the National Climatic Data Center from 1993 to 2000. The Automated Surface Observing System (ASOS) was commissioned at Amarillo in November 1992, providing additional data for two months, which were included in all except the monthly and yearly statistics. In order to limit the data set to only non-convective events, daily F6 forms were reviewed for observations of thunder and the time of the fastest two-minute wind. If thunder was reported within three hours of the fastest two-minute time, then the high wind was assumed to be associated with convection and the case was not included. To accommodate events which spanned two days, the times of occurrence were reviewed for consecutive events surrounding midnight. The higher wind speed of the two days was chosen for the climatology, or in the case of equal speeds, the latter event was used.

3. Yearly Distribution

A total of 434 high wind days, or events, were identified from 1993 to 2000 at Amarillo. Figure 1 shows the number of events by year. There were 79 high wind events in 1993, while less than

half that many (36) occurred in 1998. The average number of events for the eight-year period was 54. The number of events in 1996 interrupts what might be interpreted as a downward, then upward trend over the eight years, but most likely the period is too short to draw conclusions.

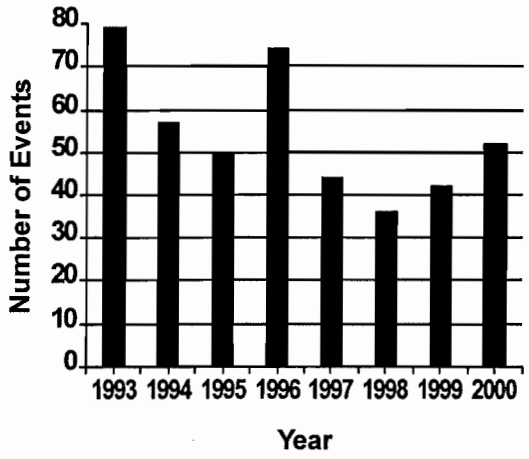

Figure 1. High wind events by year at Amarillo, Texas from 1993 to 2000.

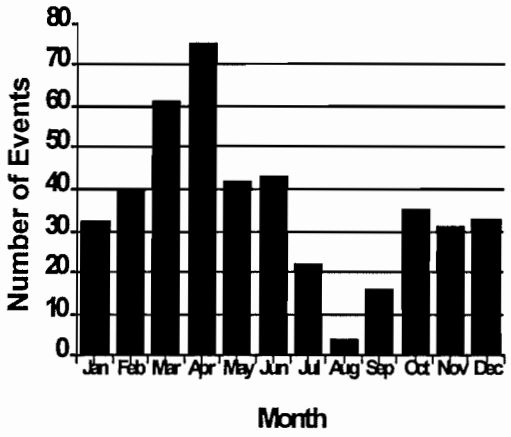

Figure 2. High wind events by month for Amarillo, Texas from 1993 to 2000.

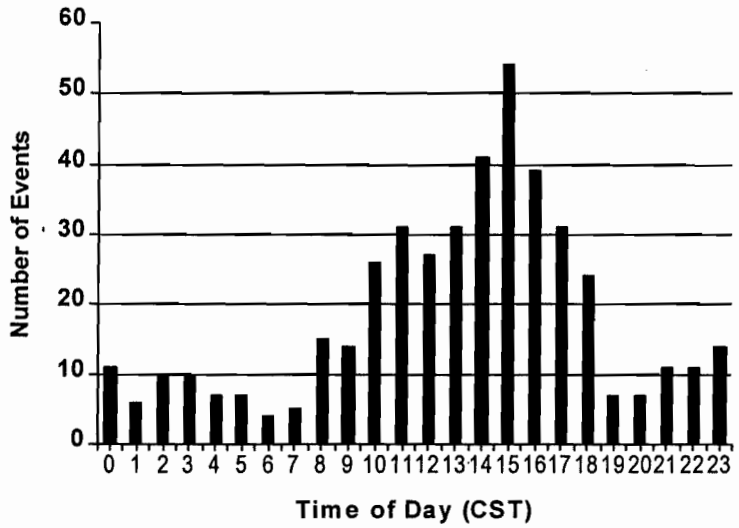

Figure 3. Hourly distribution of high wind events for Amarillo, Texas from 1993 to 2000.

4. Monthly Distribution

The highest number of events occurred during the spring months of March and April, making up roughly a third of all cases (Fig. 2). The most for any individual month was April with 75. There was a distinct decline in the summer with only four events recorded in August. The number of events increased again with the onset of fall and then became steady through January.

5. Hourly Distribution

Figure 3 shows a steady rise in the number of high wind events at Amarillo from around daybreak through the mid-afternoon hours. There is a close correlation of non-convective high winds with the diurnal heating cycle, supporting vertical mixing as the cause. The number of events dropped sharply after 6 p.m. CST, further tying into the connection. The largest number of events occurred at the time of peak heating around 3 p.m. CST. A second, more subtle rise can be seen in the data from late evening into the early morning, possibly coupled to the onset of the nocturnal low-level jet.

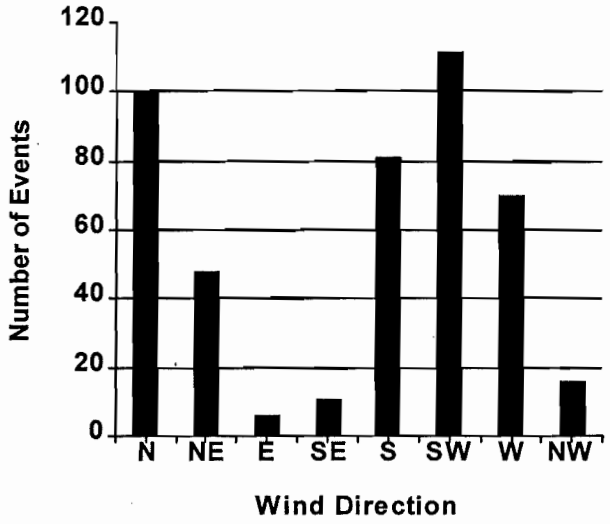

Figure 4. Distribution of wind direction associated with high wind events for Amarillo, Texas from 1993 to 2000.

6. Direction

More than 200 events were associated with wind directions from southwest and north (Fig. 4). In fact, the octal wind direction from south through west plus north, accounted for 83% of the high wind cases. High wind events from the east, southeast and northwest are relatively rare for Amarillo.

7. Time of Day vs. Direction

Figure 5 shows the relationship between time of day (day or night) and direction for high wind events. High winds from the north were more widely distributed throughout the day, with nearly as many events occurring at night (6 p.m. to 6 a.m.) as during the day (6 a.m. to 6 p.m.). Only the northeast and east wind events predominately occurred during the night. High wind events from southeast through south to northwest were predominately daytime events.

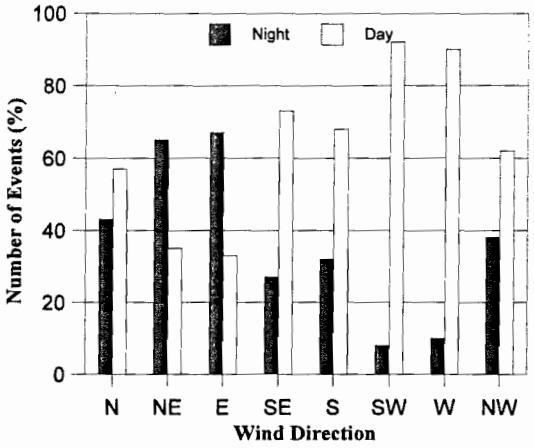

Figure 5. Comparison of events by time of occurrence (day or night) vs. direction for Amarillo, TX from 1993 to 2000.

8. Season vs. Direction

Finally, a comparison was done between the direction of non-convective high wind events and the season in which they occurred. Figure 6 shows high wind events from the west through north occurred most often in winter and spring (with about the same frequency); seldom in summer and fall, suggesting they may be associated with frontal passage. High wind events from the east, southeast and south were predominately spring and summer events. Events from the southwest were more evenly distributed throughout the year.

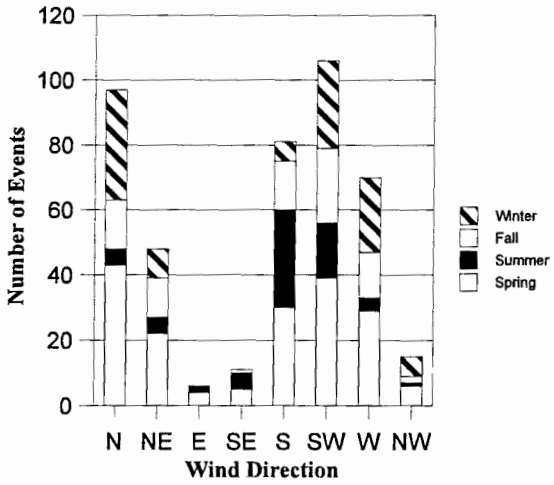

Figure 6. Distribution of seasonal occurrence vs. wind direction for Amarillo, TX from 1993 to 2000.

A general cross-section of the 434 high wind events from 1993 to 2000 was chosen and reviewed using Daily Weather Maps. Five distinct weather patterns were found which produced the non-convective high wind events across the Texas Panhandle:

- The most common pattern, closed upper lows lifting out or digging across the southwest United States. A deepening surface low to the lee of the Rockies accompanied these systems, resulting in high winds with directions anywhere from the south to northwest, depending on the track of the mid level center.

- Disturbances which dive south out of Canada into the central United States. These storms bring large areas of surface high pressure with them, resulting in strong north to northeast winds following the frontal passage.

- Open waves moving in westerly flow aloft which cause tight mid-level height gradients. Decreased stability behind a passing surface trough or Pacific cold front allows strong winds to be mixed downward to the surface.

- The development of the nocturnal low-level jet, or a dryline retreating west with the loss of daytime heating. These events occurred under weak flow aloft or in the presence of a subtropical high pressure center common from the spring into the fall.

- Short wave troughs which induced cyclogenesis across southwest and west-central Texas along a frontal boundary. These rare, strong easterly winds were common in a post-frontal environment with large surface high pressure centers often to the north.

9. Conclusion

Non-convective high wind events were reviewed for Amarillo, Texas from 1993 to 2000 and a climatology was developed which shows noticeable trends in the monthly and hourly distributions. High wind events from the southwest were most common, with a peak in the mid-afternoon. Wind events were at a minimum in the early evening and mid-morning, coincident with the reversal in the diurnal heating cycle. Further distinction between the preferred directions was derived by comparing them with the time of day and season of prevalence. High wind events during the night predominately occurred from the northeast and east with other directions preferred during the daytime. A seasonal bias was found for winds from most directions, but events from the southwest were more-or-less evenly distributed through the year. The directions with the fewest number of events (east, southeast and northwest) were overall more seasonally dependent.

While at first this study may appear to be of only local interest, in rankings of windiest cities in the United States (Amarillo being ranked third), seven of the top ten locations are within the same climatological boundary, the Great Plains. Even if results of this study are not directly applicable, they may suggest similar patterns exist elsewhere in the Plains.

Acknowledgments

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