January 29-30th Squall Line Impact on Kentucky Mesonet Sites

Joseph Wilson, Jane Marie Wix, Zachary Brown, Megan Ferris, and Stuart Foster
Kentucky Mesonet
Department of Geography and Geology
Western Kentucky University

Abstract

On the evening of January 29th, 2008, a squall line developed ahead of a powerful cold front, sweeping through the Ohio Valley. This damaging line of storms brought over 100 reports of wind damage to the state of Kentucky alone. This project will look at the synoptic and mesoscale conditions that led to the formation of the squall line and why the storms produced straight line wind damage and not a major tornado outbreak. The type of squall line will be examined as well. The project also will compare this cold weather event with others to see what differences , if any, occurred. Data collected by the Kentucky Mesonet will be used to study the meteorological effects of the squall line as it moved across Kentucky. There are six Mesonet sites that recorded data for this event. Combined with traditional observation platforms such as ASOS stations, upper air soundings, radar, and satellite, the Mesonet data allows a higher spatial and temporal study of the meteorological effects recorded across the Commonwealth. The goal of this study is to use the data from the Mesonet to better understand weather phenomena that commonly impacts Kentucky.

Introduction

A squall line is a linear oriented zone of thunderstorms. There are two main types of squall lines, progressive and serial. Progressive lines are generally shorter and have a more defined curve. The bulging or bowing which can occur with this type of squall line is associated with downbursts. Serial squall lines are much longer, and are generally associated with dynamically fueled cool season events. These are common across the country east of the Rocky Mountains, and usually form in the spring season. Severe squall lines are very common across the Ohio Valley. A bow echo is an arch or bowed out portion of the squall line associated with straight line wind damage. Tornadoes can also form in the bow echoes; however these are shorter in duration and weaker when compared with tornadoes that develop in super cell thunderstorms.

Squall Line Discussion

The squall line that affected our area on the evening of January 29, 2008 was typical for a cold season event. This powerful squall line was associated with an intense low pressure system and cold front with embedded bow echo segments. The upper level jet steam provided the main forcing for this event. The divergence/convergence zones were able to overcome the lack of instability and moisture in the atmosphere. Even the pattern of the squall line was indicative of a cold season event, being in a very long serial pattern, which included embedded bow echoes and the formation of a few weak tornadoes. This serial pattern is also associated with dynamically forced storms, as was this particular event .

Table 1. Mesonet data from the available sites showing Maximum Wind Speed (Mph), drop in Temperature (F), and the Squall Line Precipitation totals (In).

Mesonet Sites	Max Wind Speed (Mph)	Temperature Drop (F)	Squall line Precipitation (In)
Calloway County	59.95	17.76	0.14
Ohio County	48.08	16.37	0.05
Logan County	41.58	14.21	0.12
Warren County	51.29	13.39	0.12
Casey County	60.08	16.69	0.13
Rowan County	45.16	12.88	0.11

Conclusion

The squall line that affected the Ohio Valley from January 29-30 was not an unusual storm for the area. Even though the perfect meteorological conditions for severe weather were not all in place, such as an abundance of warm air advection, and a moist unstable atmosphere, there was still enough upper atmospheric forcing to produce the energy needed for the formation of the squall line which impacted the Commonwealth. With the Mesonet data we were able to see the drastic changes in temperature, wind speed and direction and precipitation in almost real time as this squall line and accompanying front passed over our area.

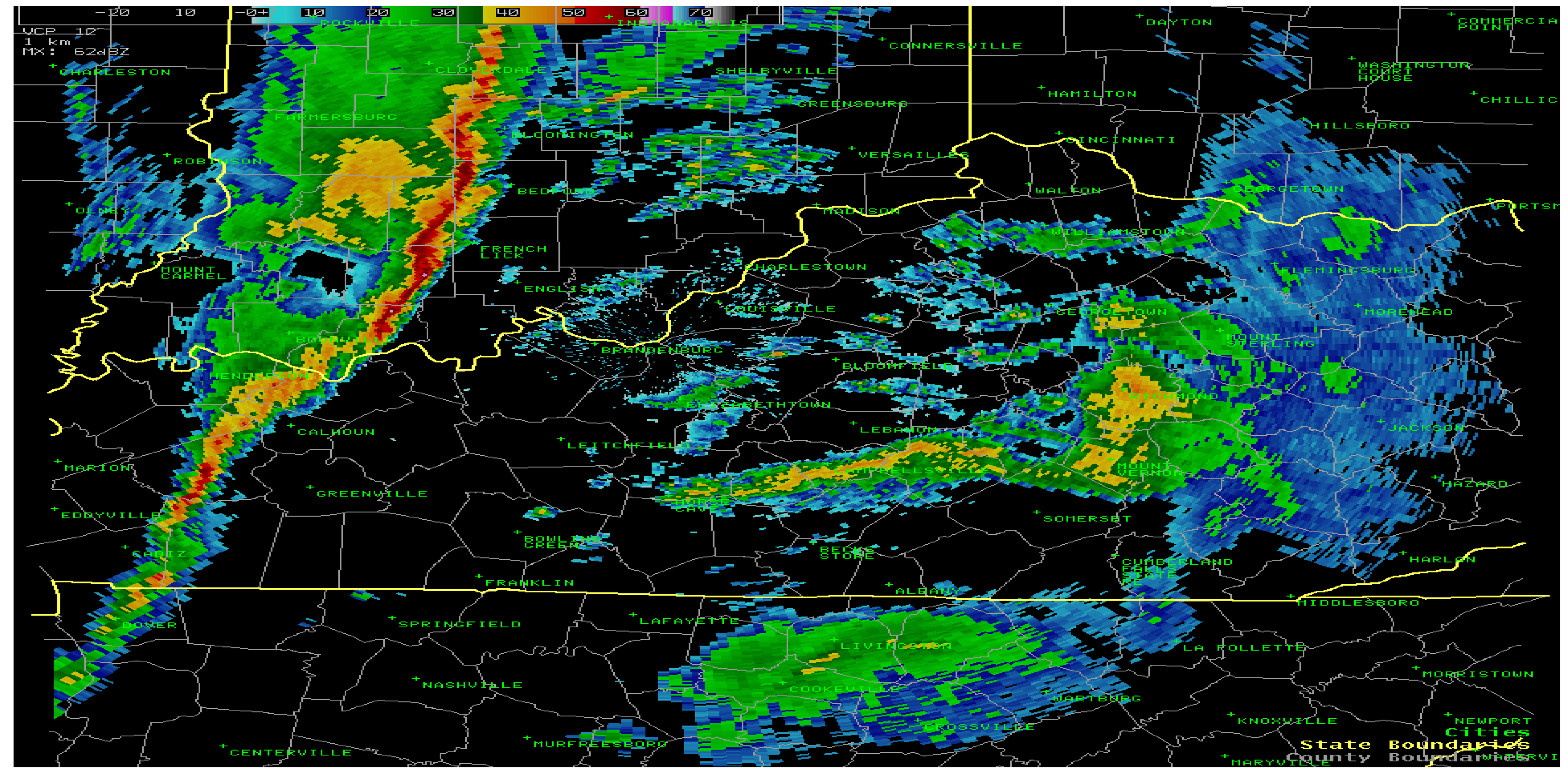

Figure 1. January 29, 2008 Squall line affecting Kentucky.

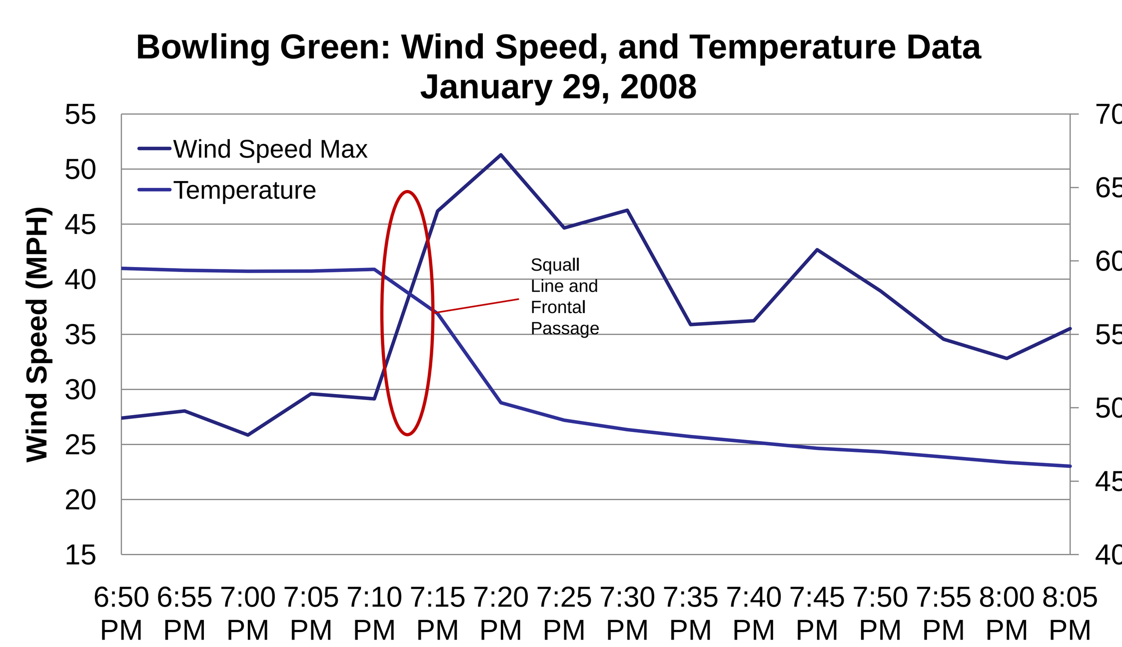

Figure 2. Wind speed and Temperature data collected from the Bowling. Green Mesonet site.

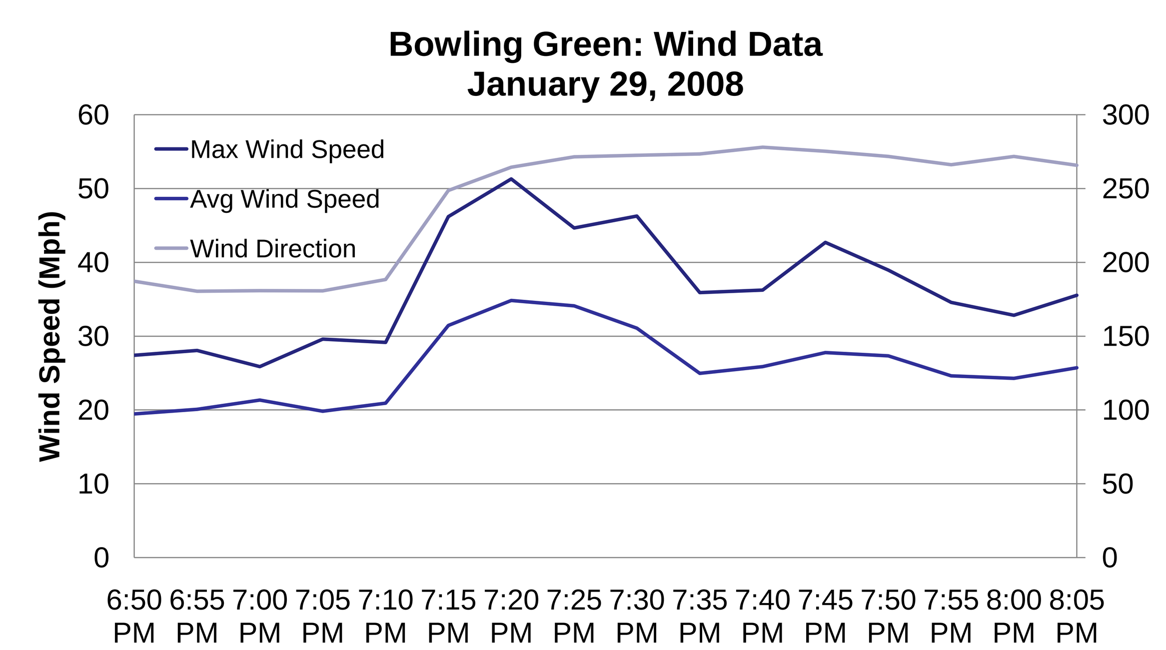

Figure 3. Maximum wind speed (Mph), Average wind speed (Mph), and Wind Direction (Az) from the Bowling Green Mesonet Site.

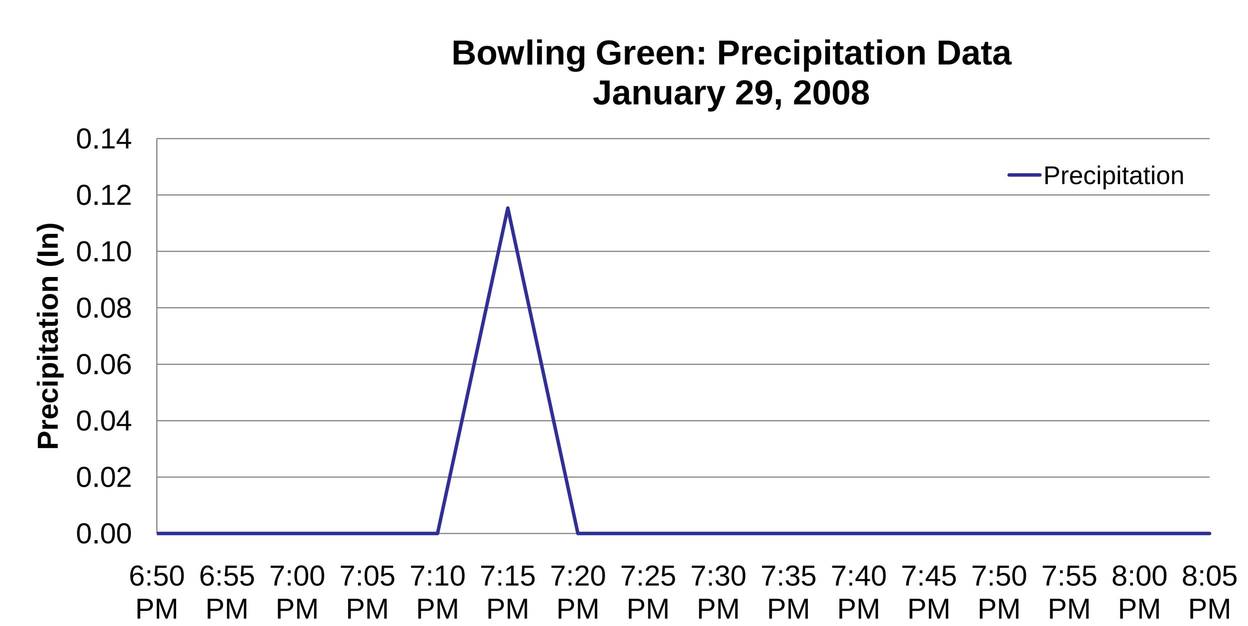

Figure 4. Precipitation (In) data from the Bowling Green Mesonet Site.

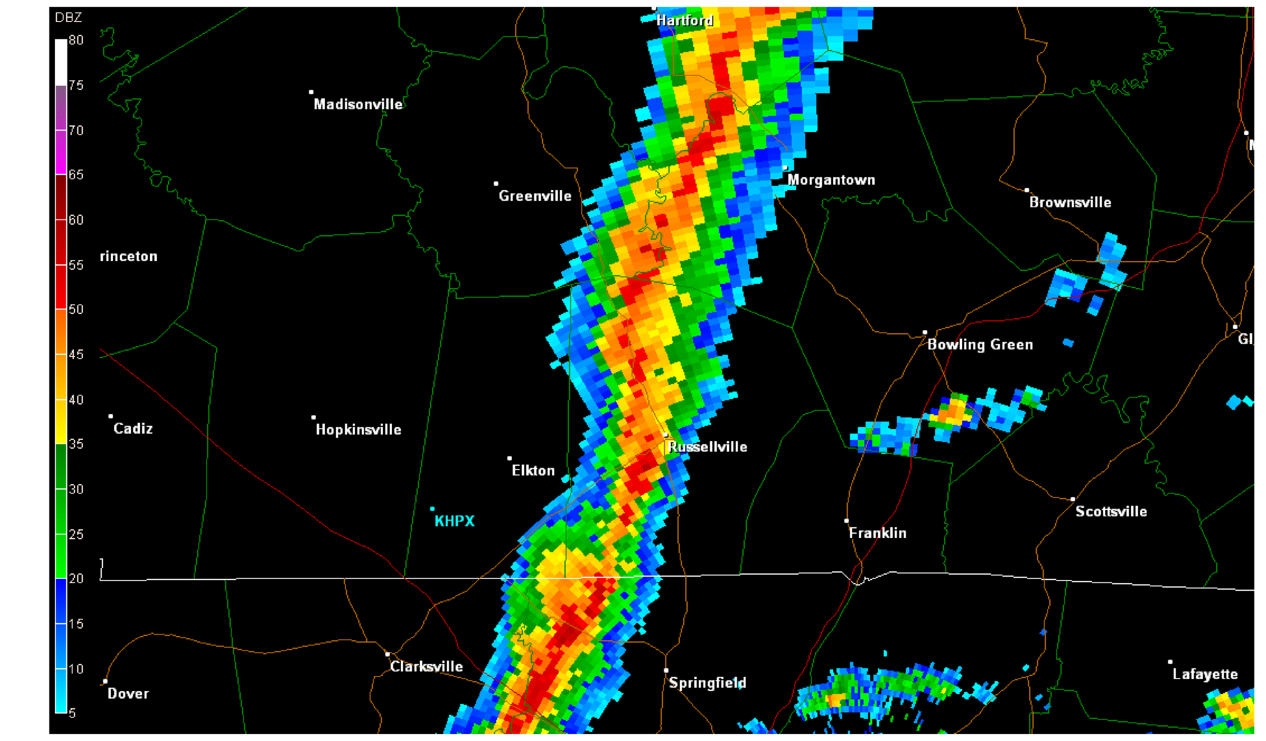

Figure 5. Radar image of the squall line passing through Russellville, this site recorded the highest winds.

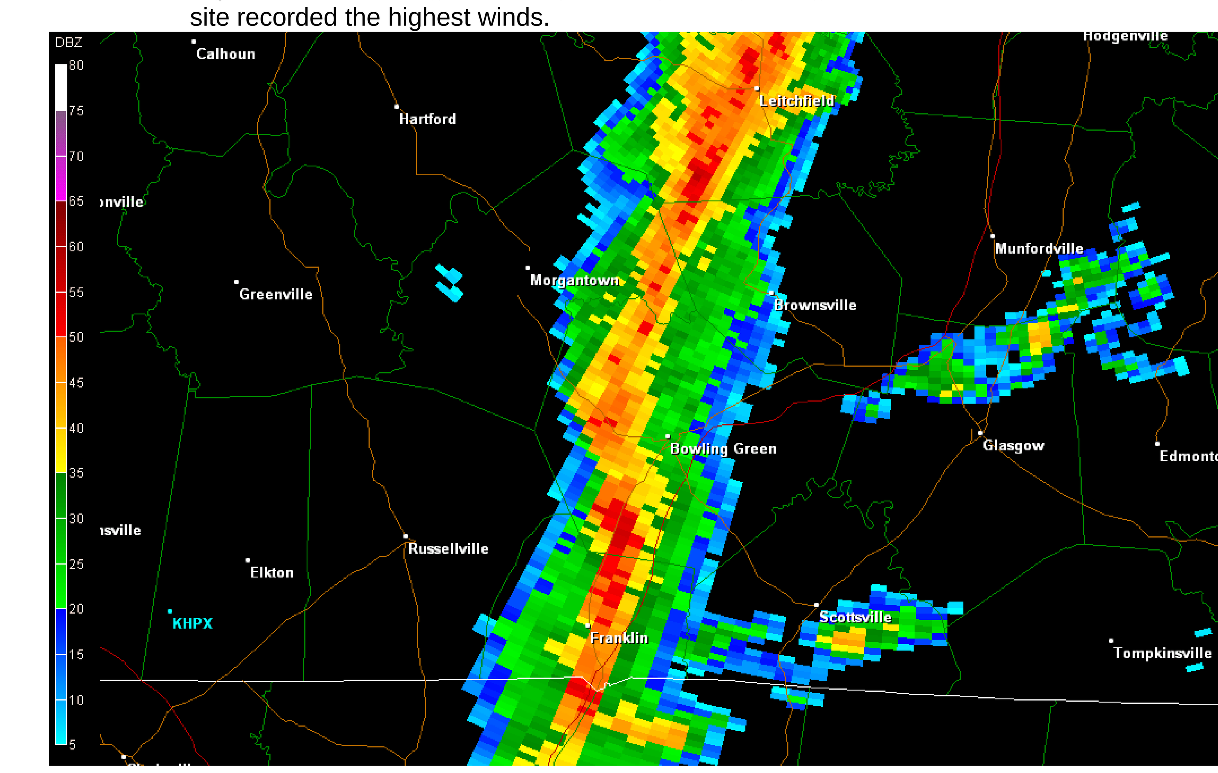

Figure 6. Radar image of the squall line passing through Bowling Green.

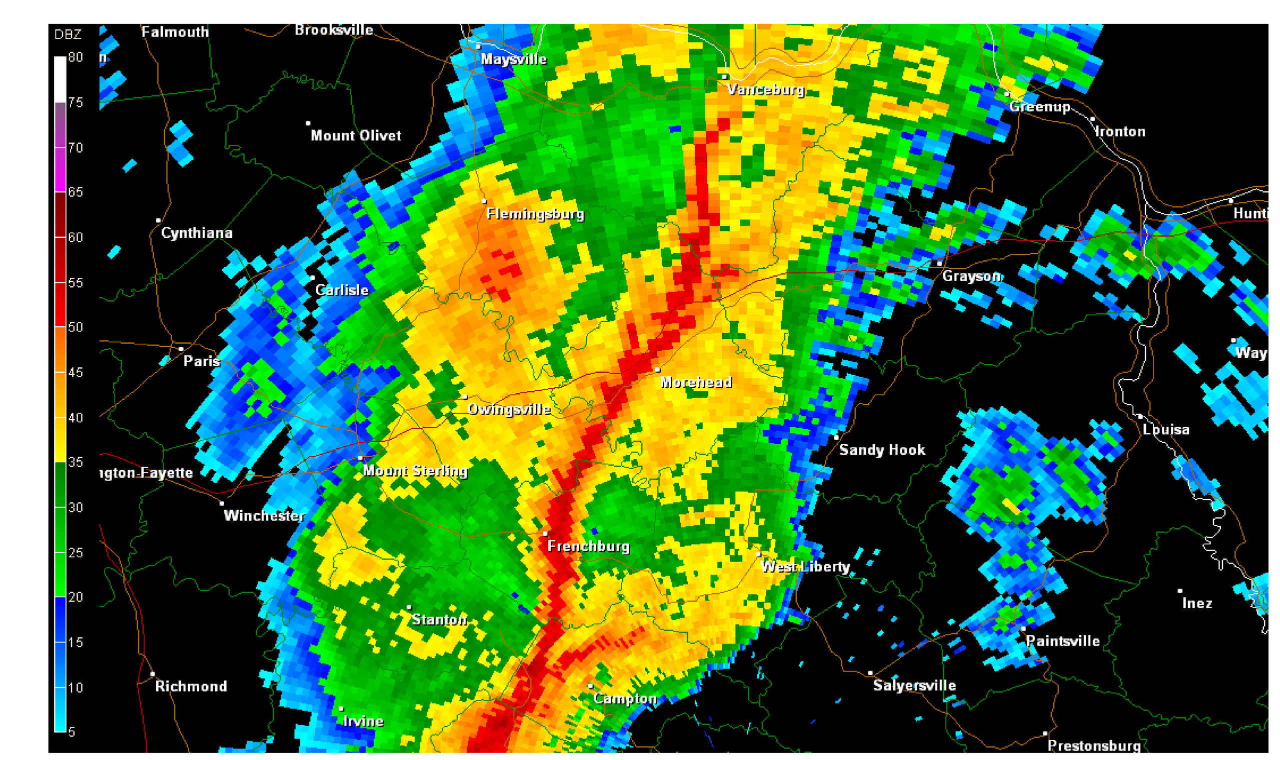

Figure 7. Radar image of the squall line passing through Morehead, bow echo starting to form around Frenchburg.

References

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