Rare February Tornadoes in Mid-Atlantic: Focus on tornadoes in Appomattox and Patrick Counties of Virginia, February 24, 2016

(Written Feb 26, 2016; as of this date reports are still considered preliminary)

Overview

On 24 February 2016, a very strong low pressure system tracked through the Ohio Valley bringing a cold front through the Appalachians from the west and warm and unstable air into the region from the south ahead of the cold front. At the same time, a sharp warm front on the southern edge of very cold and stable air (associated with cold air damming) was moving north across the Appalachians and Piedmont regions. The combination of unstable air moving rapidly into the region from the south, the very strong wind shear associated with the entire system in advance of the cold front, and the enhanced low-level shear associated with the warm frontal boundary, brought all the right ingredients together for severe and tornadic weather in the Appalachian and Mid-Atlantic region. In fact, this combination of ingredients coming together the way they did is rare enough in the spring months, but especially rare for the month of February. Figure 1 is a surface map showing frontal positions with some observations at 1pm EST, soon after the severe weather had begun in our area.

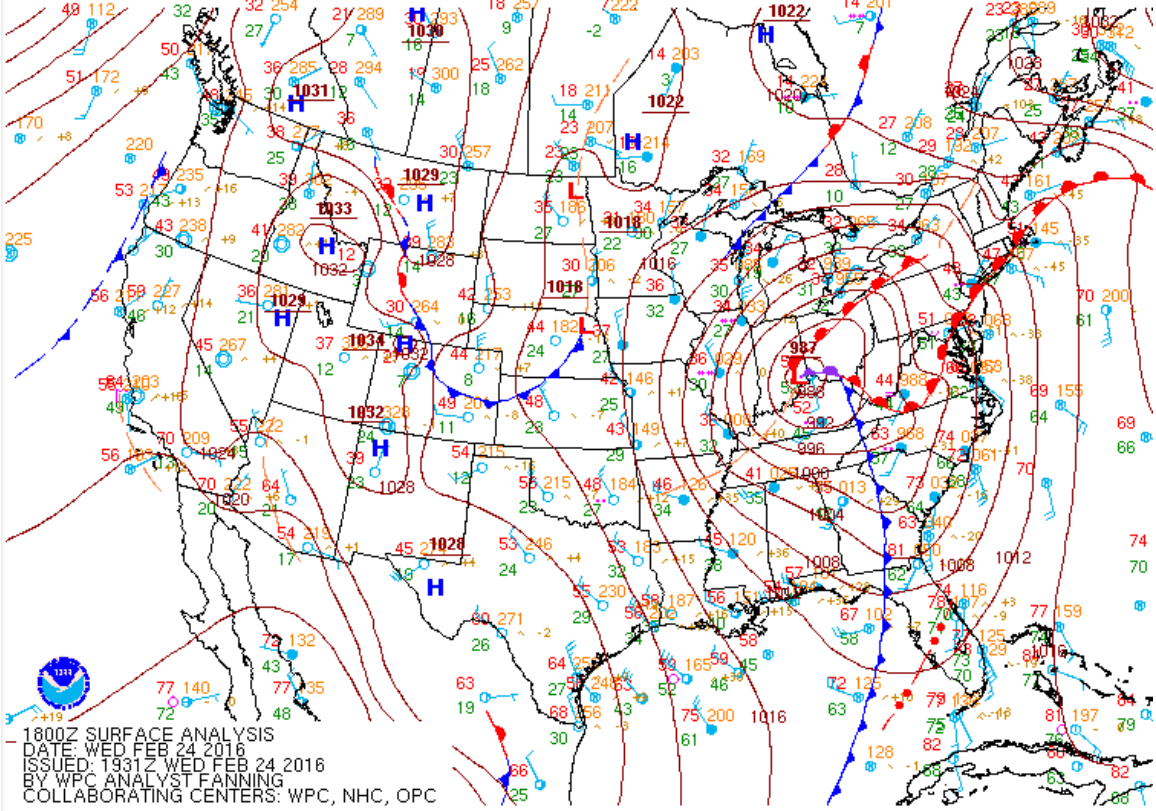

Fig. 1. Surface analysis at 1800Z (or 1pm EST) showing the cold front pushing into the western Carolinas and the warm front lifting north across southwestern Virginia.

The result was an outbreak of severe weather including several tornadoes (some of which were strong), from North Carolina to Pennsylvania (see Figure 2. In the 40-county warning area that the Blacksburg National Weather Service office covers, there were two tornadoes. One was a very strong EF3 tornado in Appomattox County, VA, (which unfortunately resulted in one fatality and seven injuries) and the other was an EF1 tornado in southwest Patrick County, VA (no injuries). More details about these two tornadoes are in the next section, followed by some radar images, and then a summary of statistics illustrating the rarity of the EF3 in Appomattox County. Virginia experienced seven other tornadoes, mainly in the eastern part of the Commonwealth.

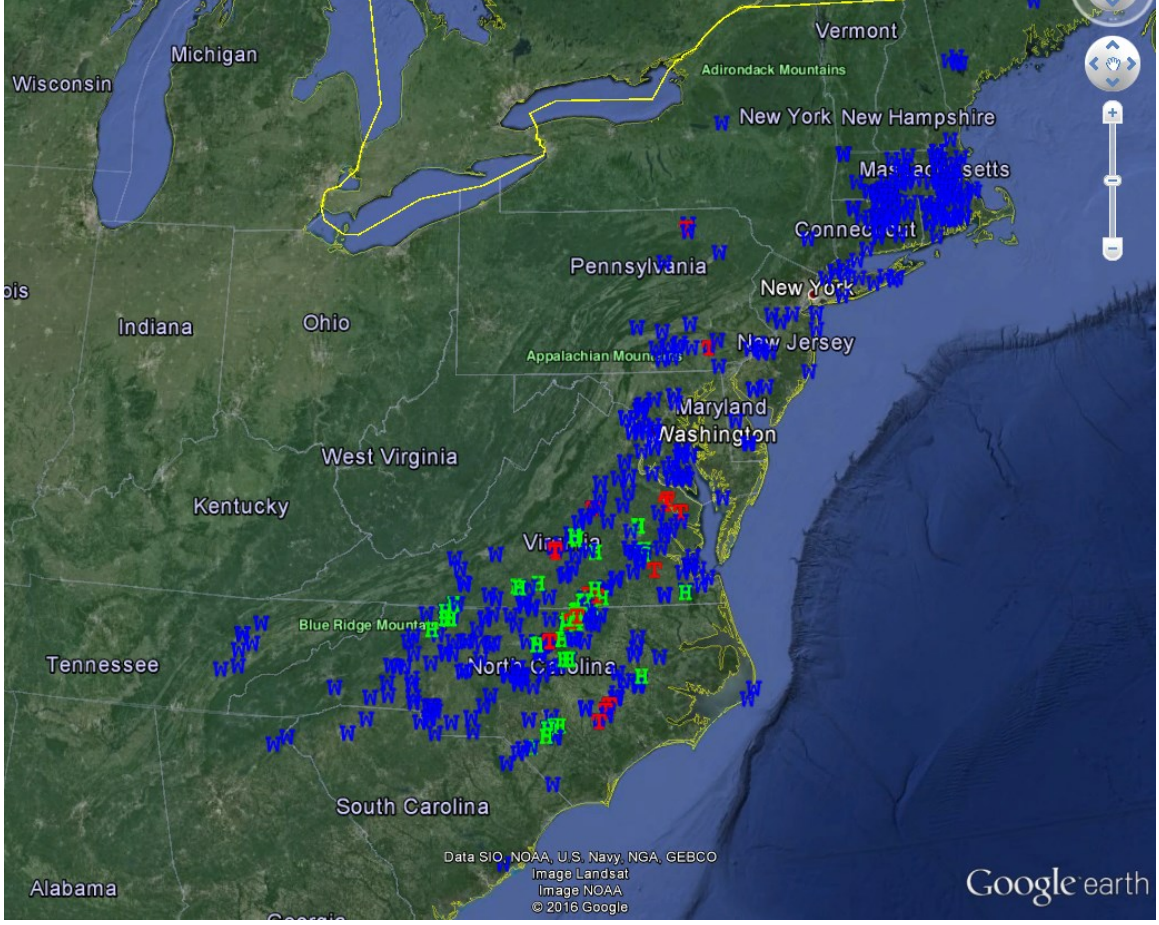

Fig. 2. Preliminary reports from the 24 February 2016 severe weather and tornado outbreak. Note that a few of the initial wind damage reports (in blue) were later determined to be tornadoes following damage surveys (such as in SW Patrick Co, VA, which does not show up on this map).

The tornadoes in the NWS Blacksburg area of responsibility.

One of the tornadoes confirmed by the NWS in the Blacksburg area of responsibility was an EF1 in Ararat, Patrick Co., VA, which touched down at 12:45pm and was only on the ground for less than 2 miles, and for about 2 minutes. This produced primarily roof damage to several homes in the area, and numerous trees, many large, were snapped off or uprooted along the path. The damage path and a few photos of the damage or shown in Figures 3 and 4, with the summary report following the damage survey in Figure 5. Less than an hour before the tornado touched down, this local region had been in the cool, stable air north of the warm front. Just before the warm frontal boundary moved through, and when the storm moved near this retreating boundary, the additional shear was likely an important factor in providing addition vorticity (a measure of spin potential) that was needed to develop the tornado.

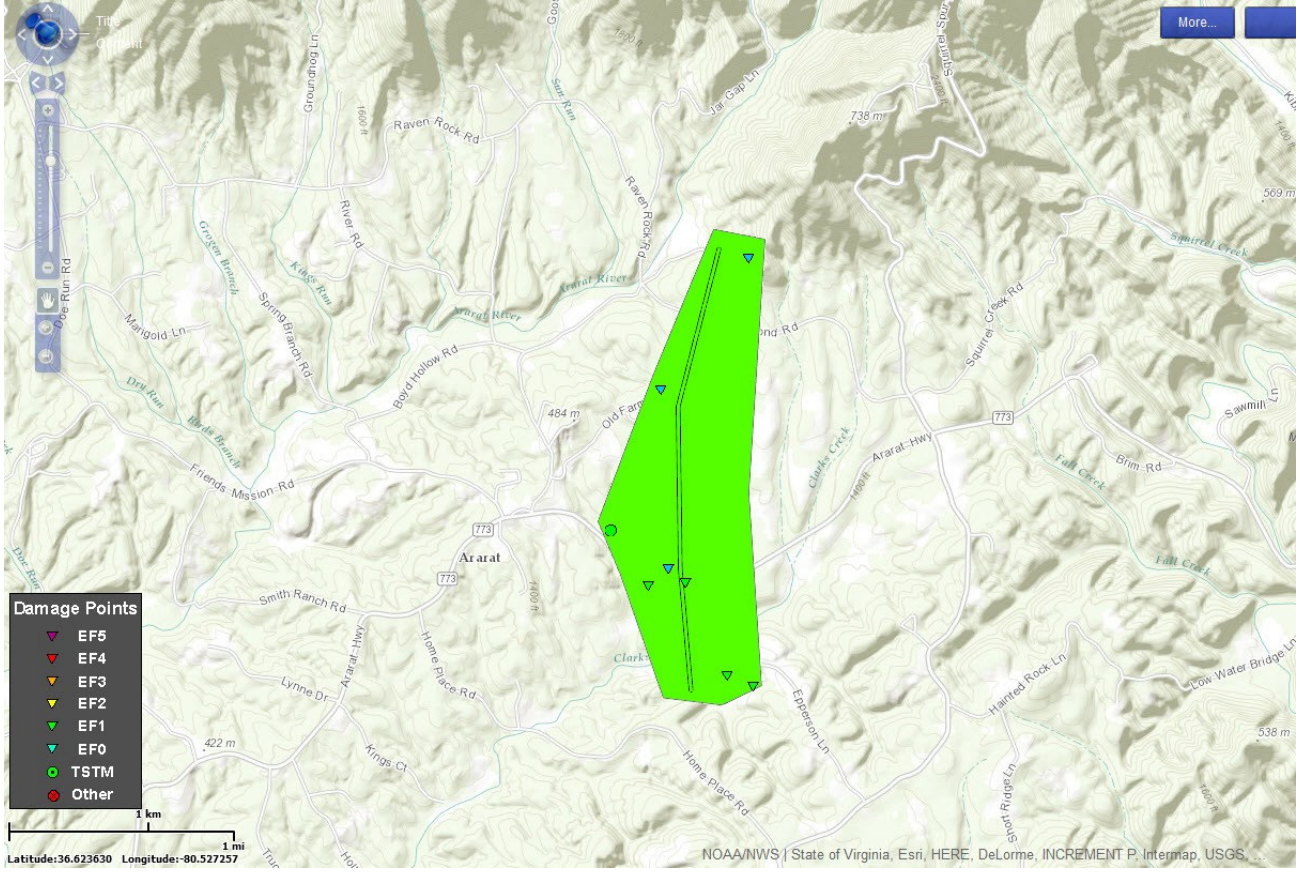

Fig. 3. The approximate path of the EF1 tornado damage near Ararat, VA, which widened to about a half mile as it crossed Ararat Highway. It weakened and lifted just before the storm moved up the Blue Ridge (top of image).

Fig. 4a. Damage along Ararat Highway.

Fig. 4b. Same as Fig. 4a.

Fig. 4c, Same as Fig. 4a and 4b.

PUBLIC INFORMATION STATEMENT
NATIONAL WEATHER SERVICE BLACKSBURG VA
311 PM EST THU FEB 25 2016

...TORNADO CONFIRMED NEAR ARARAT IN PATRICK COUNTY VIRGINIA...

LOCATION...ARARAT IN PATRICK COUNTY VIRGINIA
DATE...02/24/2016
ESTIMATED TIME...12:45PM EST
MAXIMUM EF-SCALE RATING...EF-1
ESTIMATED MAXIMUM WIND SPEED...95 - 105MPH
MAXIMUM PATH WIDTH...0.5 MILES
PATH LENGTH...1.75 MILES
* FATALITIES...0
* INJURIES...0

* THE INFORMATION IN THIS STATEMENT IS PRELIMINARY AND SUBJECT TO CHANGE PENDING FINAL REVIEW OF THE EVENT(S) AND PUBLICATION IN NWS STORM DATA.

...SUMMARY...
THE NATIONAL WEATHER SERVICE IN BLACKSBURG VA HAS CONFIRMED A TORNADO NEAR ARARAT IN PATRICK COUNTY VIRGINIA ON 02/24/2016.

A TORNADO TOUCHED DOWN NEAR THE END OF EPPERSON LANE AS AN EF-1 AND CONTINUED ACROSS ARARAT HIGHWAY WHERE ABOUT A HALF-DOZEN HOMES HAD MINOR ROOF DAMAGE. SEVERAL OUTBUILDINGS AND FENCES WERE DESTROYED ALONG WITH NUMEROUS LARGE TREES WHICH WERE EITHER SNAPPED OR UPROOTED. ONE POORLY STRUCTURED OLD HOUSE HAD A ROOF COMPLETELY BLOWN OFF. THE TORNADO PROCEEDED ACROSS POND ROAD WHERE A MOBILE HOME WAS BLOWN OFF ITS FOUNDATION AND FURTHER TREE DAMAGE OCCURRED. THE TORNADO WAS ON THE GROUND FOR APPROXIMATELY TWO MINUTES WITH A PATH LENGTH OF ABOUT 1.75 MILES.

A SPECIAL THANK YOU GOES OUT TO EVERYONE WHO ASSISTED WITH THIS DAMAGE SURVEY.

THIS INFORMATION CAN ALSO BE FOUND ON OUR WEBSITE AT WEATHER.GOV/RNK.

FOR REFERENCE...THE ENHANCED FUJITA SCALE CLASSIFIES TORNADOES INTO THE FOLLOWING CATEGORIES:

EF0...WIND SPEEDS 65 TO 85 MPH.
EF1...WIND SPEEDS 86 TO 110 MPH.
EF2...WIND SPEEDS 111 TO 135 MPH.
EF3...WIND SPEEDS 136 TO 165 MPH.
EF4...WIND SPEEDS 166 TO 200 MPH.
EF5...WIND SPEEDS GREATER THAN 200 MPH.

Fig. 5. Summary report of Ararat EF1 tornado.

The second tornado was much more significant. It touched down just before 3:30pm EST southeast of the community of Evergreen in Appomattox County, VA (it actually touched down barely in Campbell County before crossing into Appomattox Co.). This was also very near the warm frontal boundary mentioned before as it retreated northward, and some analysis (not shown) suggested very strong low-level shear right along the boundary. This tornado was on the ground for about 17 miles and lasted 17 minutes, and produced EF3 rated damage (136-165 mph) in the Evergreen area, before passing just west of Holiday Lake State Park and then eventually dissipating before Buckingham County. There was considerable damage to over 100 homes, including some well-built brick homes, as well as many snapped and downed trees. More on the rarity of this occurrence will be provided in the Summary section. The path of the damage, a few photos of damage and one of the tornado itself, as well as the summary report, are shown below in Figures 6-9.

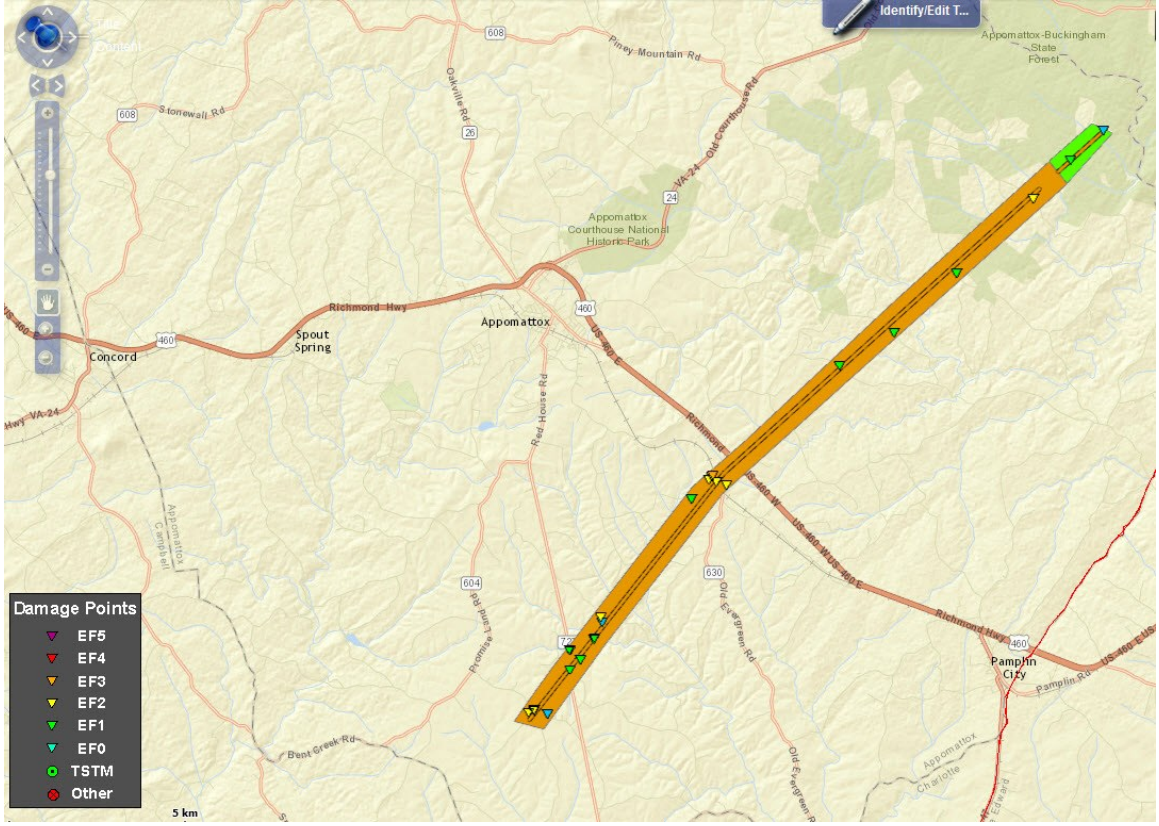

Fig. 6. Damage path of EF3 tornado in Appomattox Co., VA.

Fig. 7a. Damage to a home just south of Evergreen, VA near the start of the tornado track.

Fig. 7b. Numerous trees blown down just south of Evergreen.

Fig. 7c. Damage to a home in the Evergreen area.

Fig. 7d. Damage to structures and trees, as well as a truck in Evergreen.

Fig. 8. Photo of the tornado in the Evergreen area taken by Jason Smith.

PUBLIC INFORMATION STATEMENT
NATIONAL WEATHER SERVICE BLACKSBURG VA
406 PM EST FRI FEB 26 2016

...TORNADO CONFIRMED NEAR EVERGREEN IN APPOMATTOX COUNTY
VIRGINIA...

LOCATION...FROM EXTREME NORTHEAST CAMPBELL COUNTY THROUGH
EVERGREEN INTO FAR NORTHEAST APPOMATTOX COUNTY IN VIRGINIA
DATE...02/24/2016
ESTIMATED TIME...3:27PM EST TO 3:44PM EST
MAXIMUM EF-SCALE RATING...EF-3
ESTIMATED MAXIMUM WIND SPEED...140 TO 145 MPH
MAXIMUM PATH WIDTH...400 YD (PRELIMINARY)
PATH LENGTH...17 MILES (PRELIMINARY)
BEGINNING LAT/LON...37.229, -78.864
ENDING LAT/LON...37.403, -78.648
* FATALITIES...1
* INJURIES...7

* THE INFORMATION IN THIS STATEMENT IS PRELIMINARY AND SUBJECT TO
CHANGE PENDING FINAL REVIEW OF THE EVENT(S) AND PUBLICATION IN
NWS STORM DATA.

...SUMMARY...
THE NATIONAL WEATHER SERVICE IN BLACKSBURG VA HAS CONFIRMED A
TORNADO FROM EXTREME NORTHEAST CAMPBELL COUNTY THROUGH EVERGREEN
IN APPOMATTOX COUNTY INTO FAR NORTHEAST APPOMATTOX COUNTY IN VIRGINIA
ON 02/24/2016.

A TORNADO TOUCHED DOWN JUST INSIDE THE CAMPBELL AND APPOMATTOX
COUNTY LINE JUST SOUTH OF COUNTY LINE ROAD. THIS TORNADO CONTINUED
TO TRACK NORTHEAST PASSING JUST TO THE SOUTHEAST OF THE TOWN OF
APPOMATTOX IMPACTING THE COMMUNITY OF EVERGREEN BEFORE ENDING
AROUND HOLIDAY LAKE STATE PARK. THIS TORNADO WAS ON THE
GROUND FOR 17 MILES WITH A WIDTH OF 400 YARDS...AND DAMAGED OVER
100 HOMES AND STRUCTURES...INCLUDING ONE WELL-BUILT BRICK
HOUSE. ONE FATALITY AND SEVEN INJURIES RESULTED FROM THIS
TORNADO.

A SPECIAL THANK YOU GOES OUT TO APPOMATTOX EMERGENCY MANAGEMENT,
VIRGINIA DEPARTMENT OF EMERGENCY MANAGEMENT, AND THE CENTRAL
VIRGINIA ALL-HAZARDS INCIDENT MANAGEMENT TEAM...WHO PROVIDED
CRUCIAL SERVICES DURING THIS ASSESSMENT PROCESS.

WE WOULD ALSO LIKE TO THANK AUTONOMOUS FLIGHT TECHNOLOGIES FOR
AERIAL PHOTOS AND VIDEOS.

THIS INFORMATION CAN ALSO BE FOUND ON OUR WEBSITE AT
WEATHER.GOV/RNK.

FOR REFERENCE...THE ENHANCED FUJITA SCALE CLASSIFIES TORNADOES
INTO THE FOLLOWING CATEGORIES:

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EF5...WIND SPEEDS GREATER THAN 200 MPH.

Fig. 9. Summary report for the Appomattox/Evergreen EF3 tornado.

Radar depiction of tornadoes

The storm that produced the Ararat tornado in Patrick County was not necessarily a textbook tornadic type of storm. The storm was not especially large, and was beginning to weaken slightly as it approached the Virginia border moving north-northeast out of North Carolina. However, it did show some low-level circulation at about this time (seen on the right side of Figure 10 just below the label “Ararat” and identified with the black arrow). This was just minutes before the tornado touchdown, which was probably aided by shear and lift along the warm frontal boundary in this area as the storm crossed it. The circulation signature and storm continued weakening after this time. Recall that the tornado was only on the ground for about two minutes.

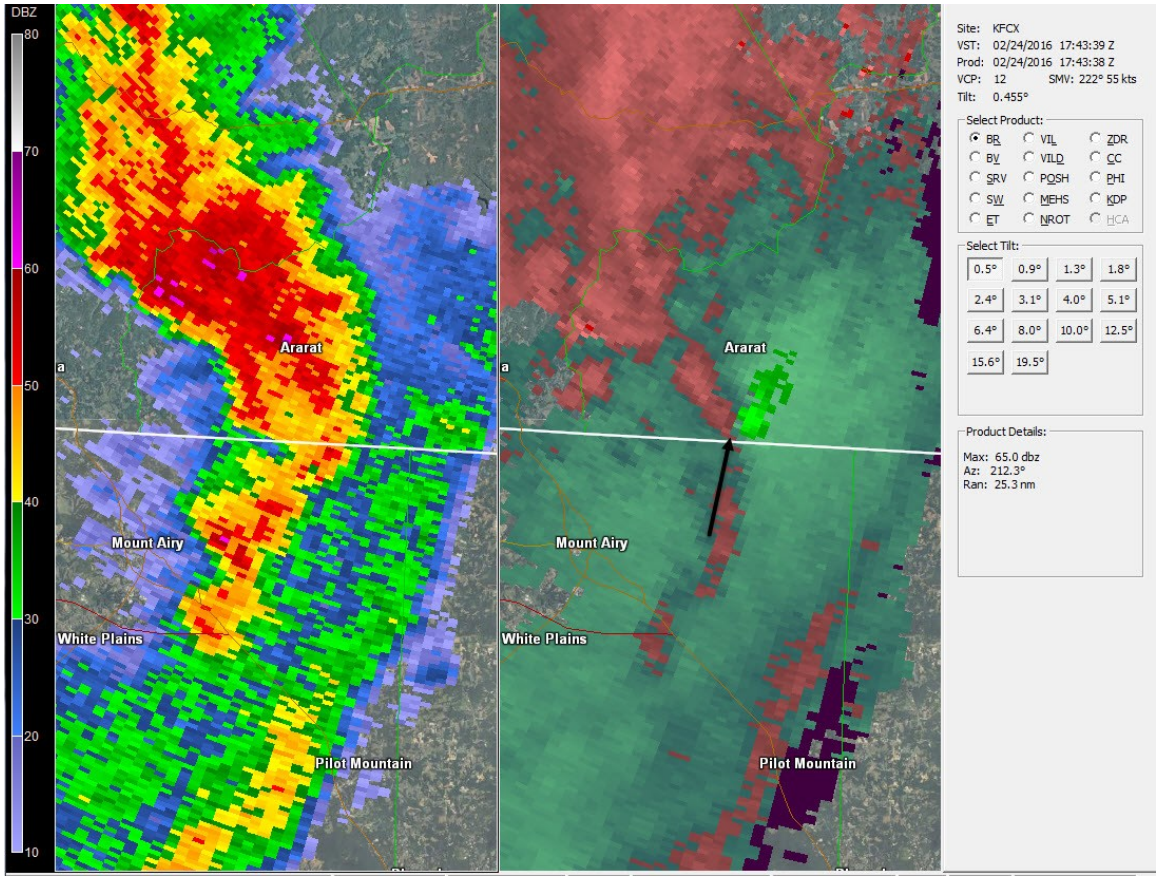

Fig. 10. Lowest elevation angle of Doppler radar reflectivity (left) and storm-relative velocity (right) at 12:43pm EST (1743 Z) just a couple minutes before the tornado touchdown. Image from the Gibson Ridge Analyst Software, Ver 2.

The storm that produced the Appomattox/Evergreen tornado had a more classic supercell structure, despite being at some distance from any of the NWS Doppler radars (over 70 miles away from the Floyd County radar). The reflectivity pattern (left side of Figure 11) suggested a strong updraft in the storm with the donut shape at about 7,000ft in elevation (left side). The velocity pattern (right side of Fig. 11) showed a very strong rotational signature at this same time a few minutes before tornado touchdown at this same location, which is just to the southwest of Evergreen (south-southeast of Appomattox). This storm had a weaker rotational signature earlier but was steadily strengthening as it approached Appomattox Co.

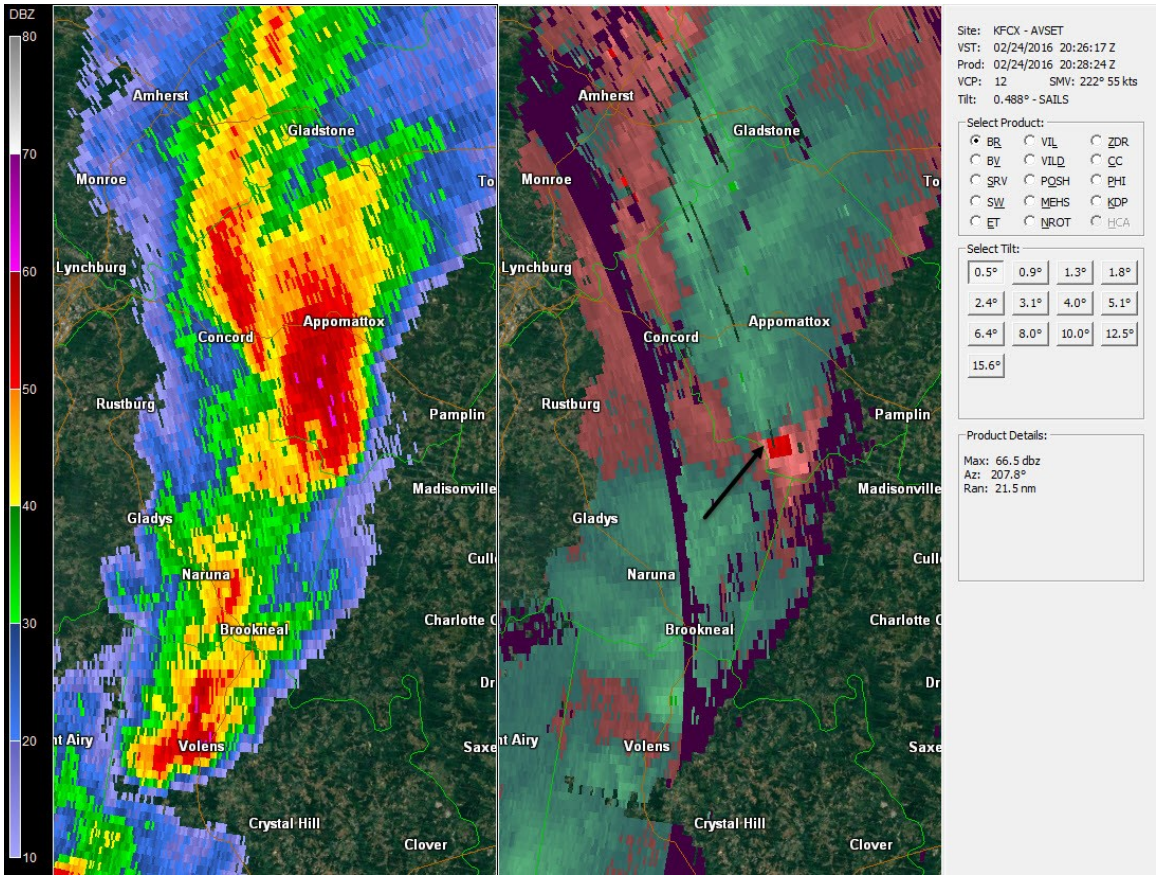

Fig. 11. Lowest elevation angle of Doppler radar reflectivity (left) and storm-relative velocity (right) at 3:28pm EST, about the touchdown time of the tornado just southeast of Evergreen, which was on the ground for 17 miles and produced up to EF3-rated damage. Image from the Gibson Ridge Analyst Software, Ver 2.

Not only were the reflectivity and velocity signatures impressive given the range from the radar and height above the ground, but several minutes later there were signatures observed in “Dual-Polarization” data from the radar that could be considered unprecedented in our area. Figure 12 shows what is very likely a “tornado-debris signature”, with low values of correlation coefficient (“CC”) in the low-left (indicated by the black arrow), along with some relatively low “ZDR” values in the same area (lower-right). These indicate that particles near the circulation center at this altitude (almost 10,000 ft) consist of many sizes and shapes, and some more vertical in shape and some more horizontal; in other words flying debris rather than precipitation particles. This is rarely seen at this range from a NWS Doppler radar unless there is significant amount of debris at

this height, and thus a significant tornado. We hope we do not see this again for a very long time!

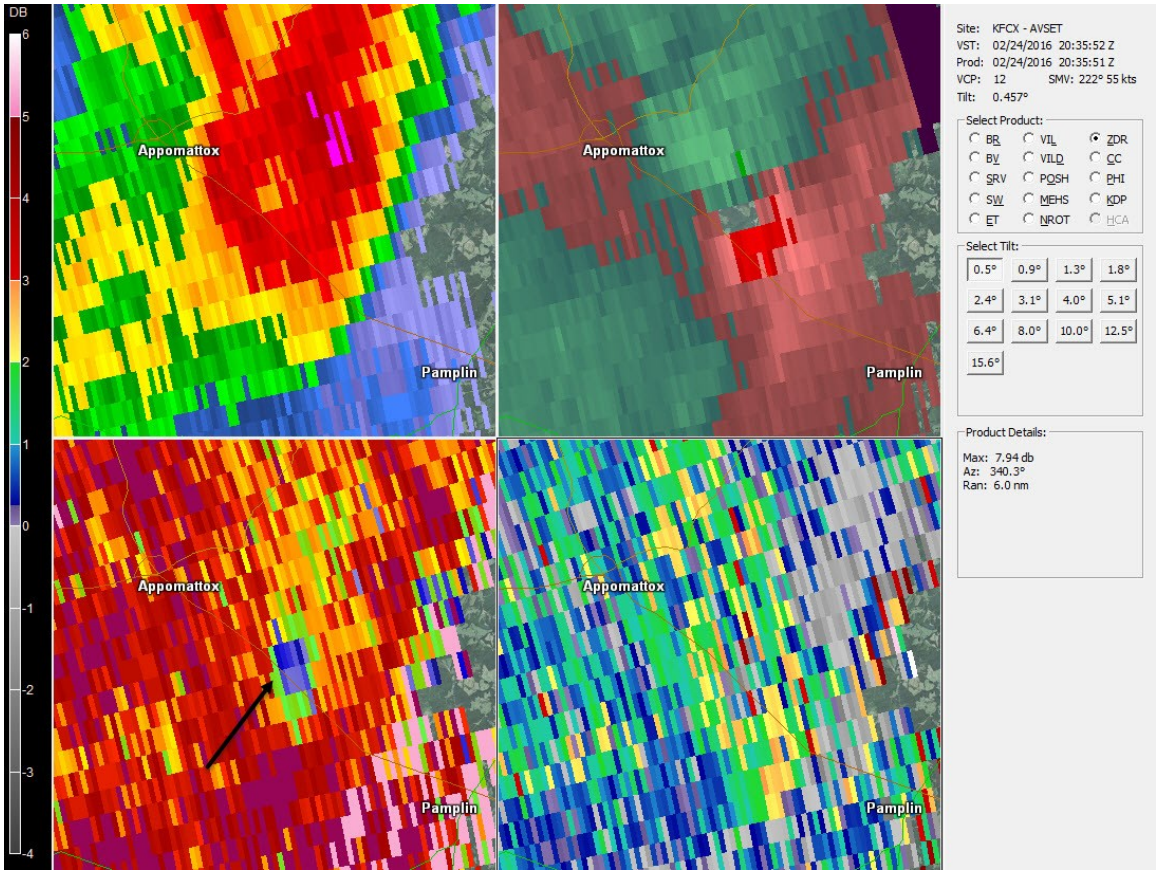

Fig. 12. Doppler radar signature at 335pm including "Dual-Pol" products which suggest the likelihood of lofted debris from the tornado (lower-left panel especially) coincident with the strong circulation (upper-right). The tornado had been on the ground for about 5 minutes by this time. Image from the Gibson Ridge Analyst Software, Ver 2.

Summary

This event was a rather unusual severe weather outbreak for the month of February in this region, and an especially rare tornadic event by several standards, considering when reliable tornado records began in 1950. Specifically:

1) Only six tornadoes had been previously recorded in our 40-county warning area in the month of February (now there have been eight).
2) This was the first EF3 in the month of February in our warning area.
3) This was the first EF3 tornado ever in Appomattox County
4) This was only the third tornado ever in Appomattox County
5) This was the first EF3 to impact our area of responsibility since March 28, 1998 (Stoneville, NC).

Given that we are not yet at the beginning of our typical severe weather season, and some signs are pointing to a very active season, we urge everyone to review tornado and severe weather safety practices now, and make sure you know how you will receive important watch and warning messages from the National Weather Service. You can find severe weather safety information, which includes tornadoes, severe thunderstorms and lightning, as well as flash flooding, at the following site:

http://www.nws.noaa.gov/om/severeweather/index.shtml