



# **National Transportation Safety Board**

**Office of Aviation Safety  
Washington, D.C. 20594-2000**

**February 10, 2015**

**WEATHER STUDY  
ERA16FA006**

## **A. Accident**

Location: Erwin, Tennessee

Date: October 9, 2015

Time: about 1919 eastern daylight time (2319 UTC<sup>1</sup>)

Aircraft: Columbia Aircraft LC41; N1058S

## **B. Meteorological Specialist**

Mike Richards

Senior Meteorologist

National Transportation Safety Board

Operational Factors Division, AS-30

Washington, DC 20594-2000

## **C. Details of the Investigation**

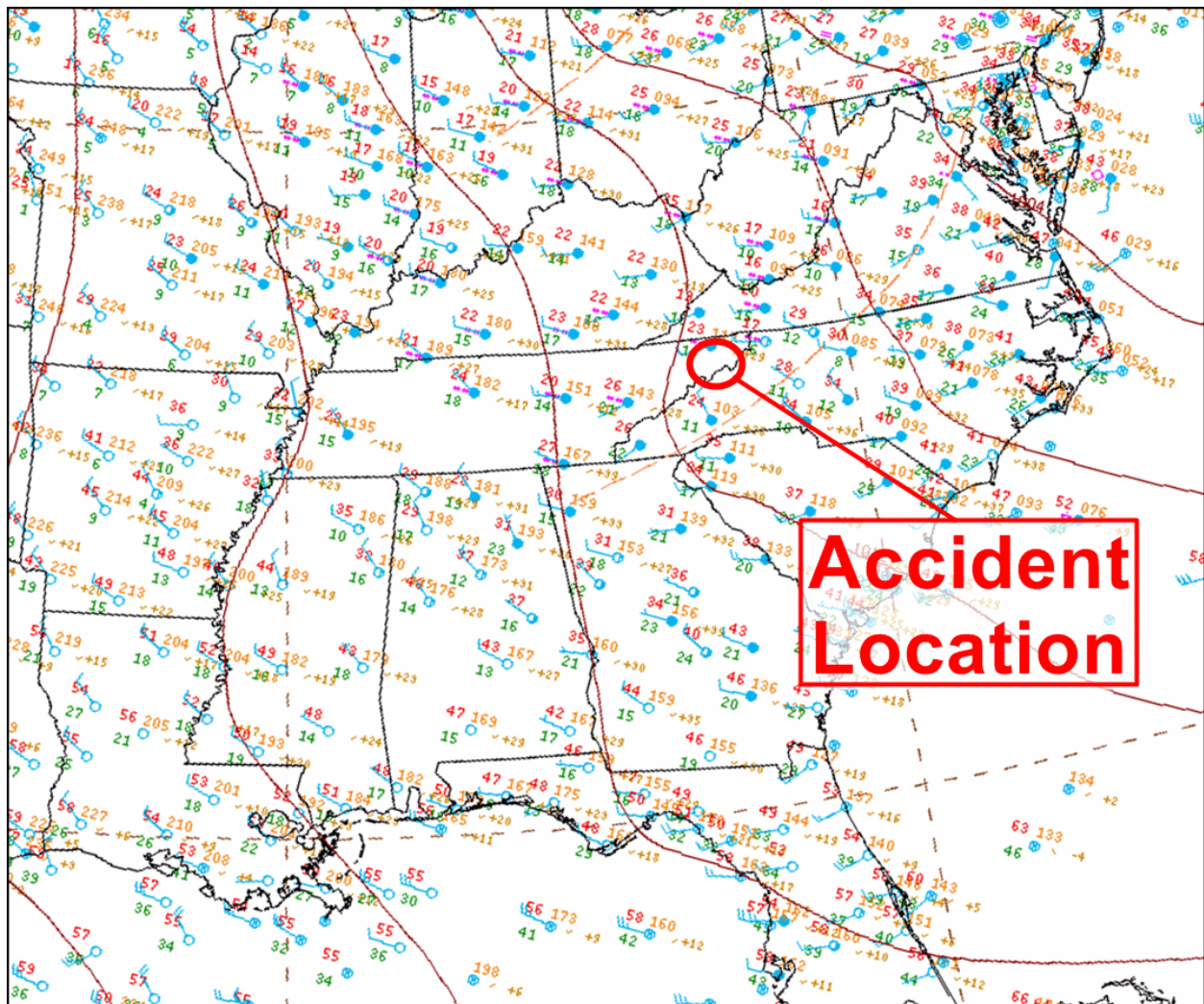
The National Transportation Safety Board's meteorological specialist did not travel in support of this accident investigation and gathered all weather data remotely. Unless otherwise noted, all times are in eastern daylight time (EDT) for October 9, 2015 (based upon the 24-hour clock), directions are referenced to true north, distances are in nautical miles and heights are above mean sea level (msl).

Coordinates used for the accident location: 36.210° North latitude, 82.375° West longitude, elevation of approximately 2,800 feet.

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<sup>1</sup> UTC – abbreviation for Coordinated Universal Time

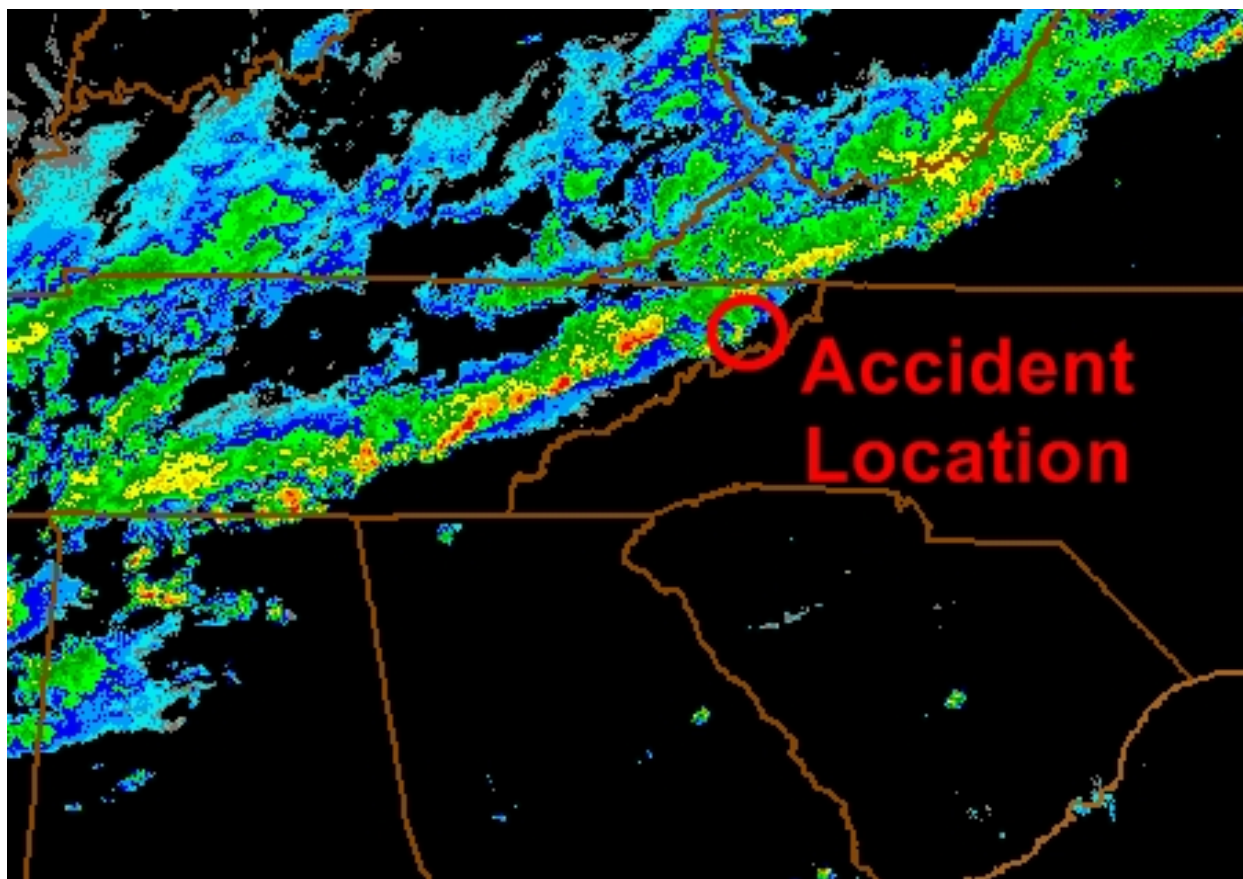
## Synoptic Conditions



**Figure 1** – NWS Surface Analysis Chart for 2000 EDT.

Figure 1 presents the National Weather Service (NWS) Surface Analysis Chart for 2000 EDT. A WSR-88D regional radar composite reflectivity mosaic obtained from the National Mosaic and Multi-Sensor (NMQ) Project<sup>2</sup> at 1916 EDT (figure 2) identified a reflectivity pattern consistent with a line of convection through eastern Tennessee.

<sup>2</sup>The NMQ project is a joint initiative between the National Severe Storms Laboratory, Federal Aviation Administration, National Weather Service/Office of Hydrologic Development, the Office of Climate, Water and Weather Services and the University of Oklahoma Cooperative Institute in Mesoscale Meteorological Studies.



**Figure 2** – NMQ NEXRAD mosaic from 1916 EDT.

### **Surface Observations**

An official surface observation station was located at Tri-Cities Regional Airport (TRI) in Bristol, Tennessee, which was located about 16 miles north of the accident location at an elevation of 1,518 feet. Human-augmented reports from BFL during the times surrounding the accident time are presented here:

[1753 EDT] METAR KTRI 092153Z 22005KT 10SM SCT043 23/17 A3001 RMK AO2 SLP139 TCU DSNT NW T02330167=

[1853 EDT] METAR KTRI 092253Z 25006KT 10SM -RA SCT080 OVC110 22/17 A3001 RMK AO2 RAB51 SLP143 P0000 T02220167=

**[1937 EDT] SPECI KTRI 092337Z VRB03KT 6SM -TSRA BR SCT023CB BKN060 OVC110 19/17 A3005 RMK AO2 TSB31 OCNL LTGICCG AT AP TS VC MOV E P0006 T01890167=**

[1953 EDT] METAR KTRI 092353Z 36006KT 7SM TSRA SCT023CB BKN060 OVC110 18/16 A3006 RMK AO2 TSB31 SLP162 OCNL LTGICCG DSNT TS DSNT E P0009 60009 T01780156 10244 20178 53018=

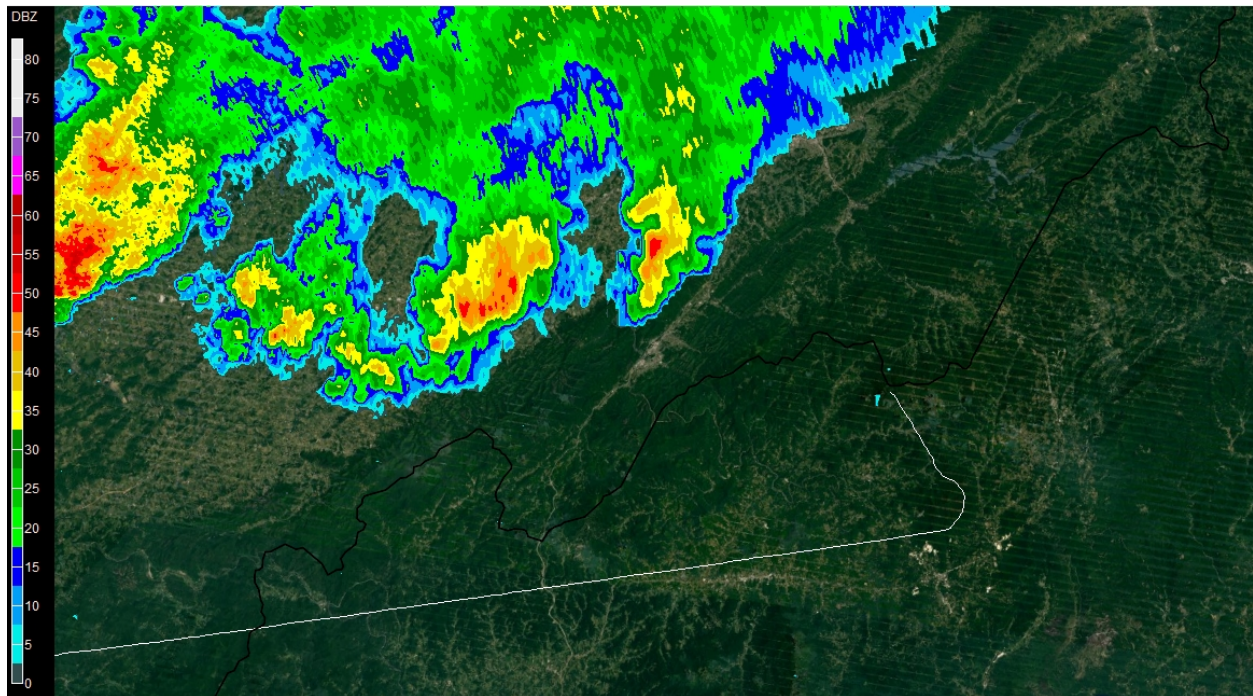
At 1937 EDT, TRI reported a variable wind at 3 knots, visibility of 6 statute miles, thunderstorm with light rain, mist, scattered cloud bases of cumulonimbus type at 2,300 feet above ground level (agl), ceiling broken at 6,000 feet agl, overcast cloud base at 11,000 feet agl, temperature of

19° Celsius (C) and a dew point temperature of 17°C, altimeter setting of 30.05 inches of mercury; remarks included: station with a precipitation discriminator, thunderstorm began at 1931 EDT, occasional in-cloud and cloud-to-ground lightning at airport, thunderstorms within 5 miles of the airport moving east.

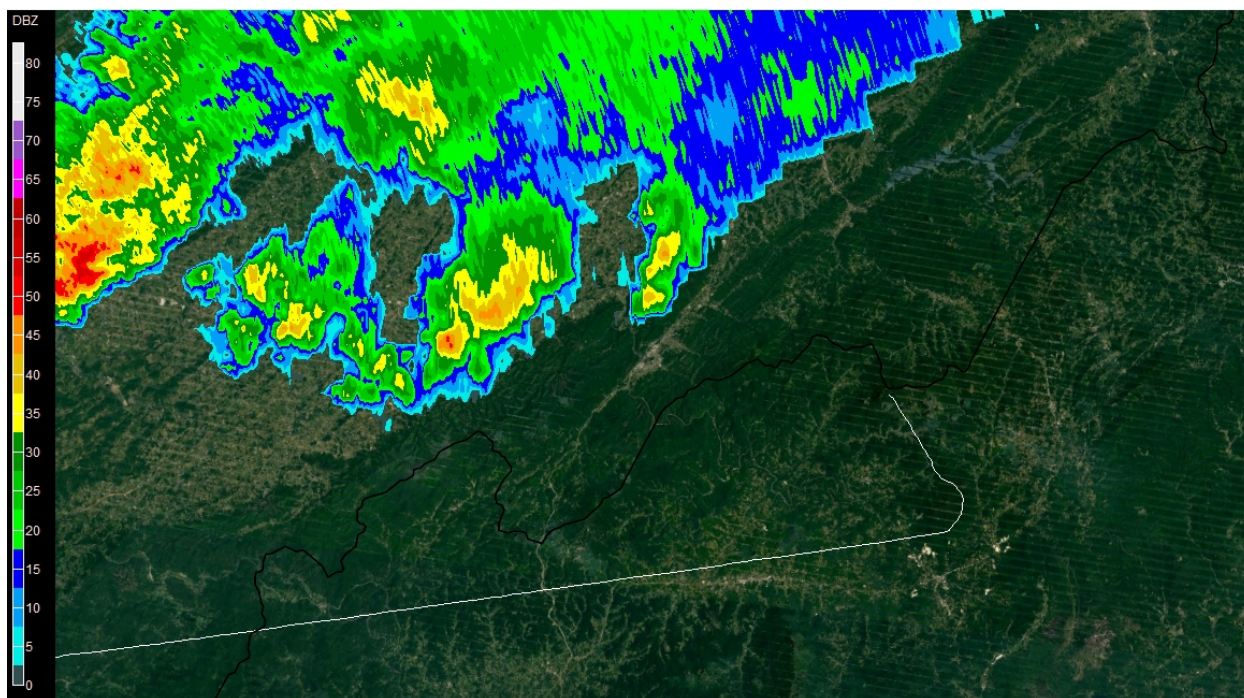
## **Weather Radar**

Graphically smoothed WSR-88D Level-II weather radar imagery from Knoxville, Tennessee (KMRX), is presented in figures 3-8. KMRX was located approximately 50 miles west of the accident site at an elevation of about 1,335 feet. Assuming standard refraction and considering the 0.95° beam width for the WSR-88D radar beam, the KMRX 1.4° tilt would have “seen” altitudes between about 7,900 and 12,900 feet above msl at the accident location. The KMRX 2.4° tilt would have “seen” altitudes between about 13,200 and 18,200 feet above msl at the accident location. The KMRX 3.4° tilt would have “seen” altitudes between about 18,500 and 23,500 feet above msl at the accident location.

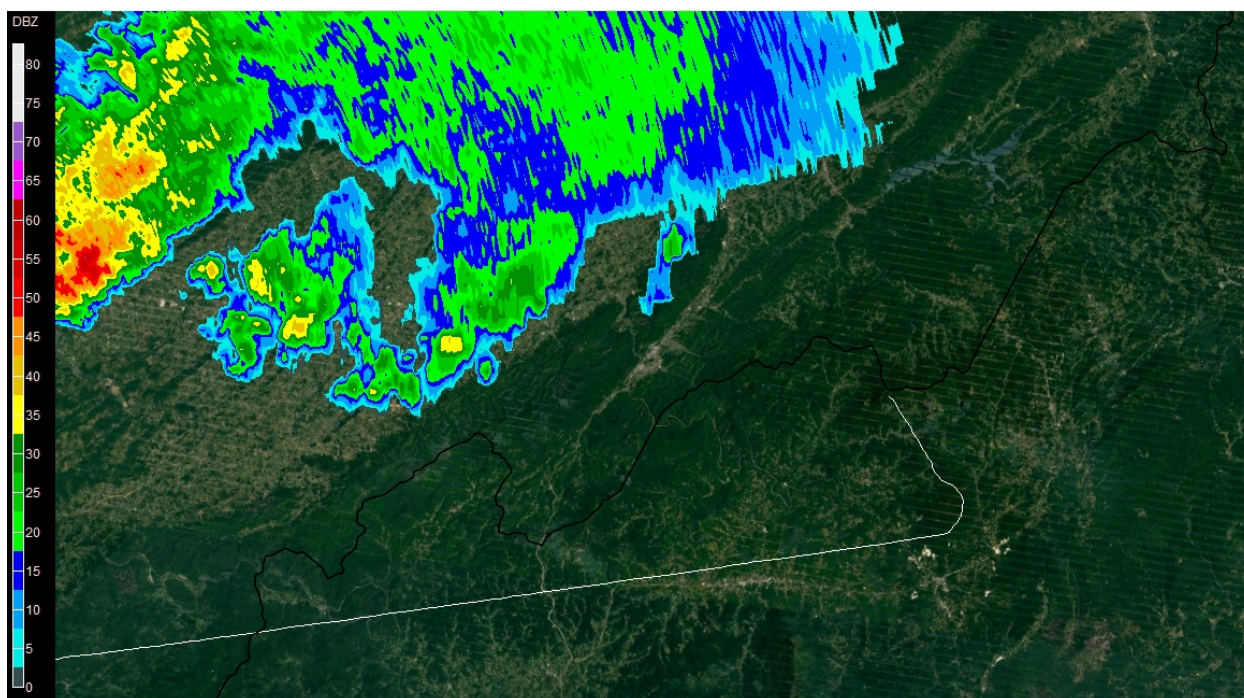
The KMRX 1.4° (figures 3 and 6) and 2.4° (figures 4 and 7) weather radar data are able to identify a discrete convective “cell” that was coincident with the accident location at the accident time. According to the color bar used, both 1.4° scans retrieved reflectivity values greater than 47.5 dBZ. Pixel-level inspection of the non-smoothed 1.4° data for this cell at these times did not identify reflectivity values greater than 52.5 dBZ.



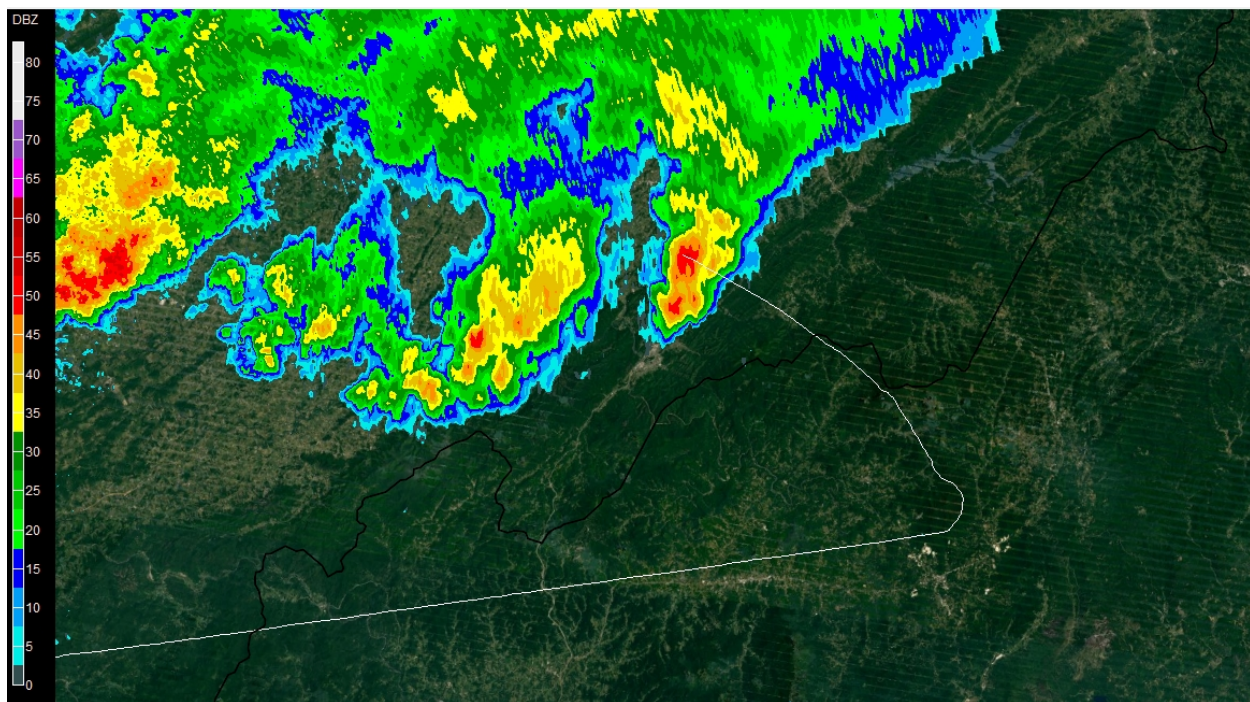
**Figure 3** – KMRX 1.4° Level-II reflectivity product initiated at 1909:37 EDT. Accident aircraft position at 1912 EDT identified by white line (aircraft heading northwestward).



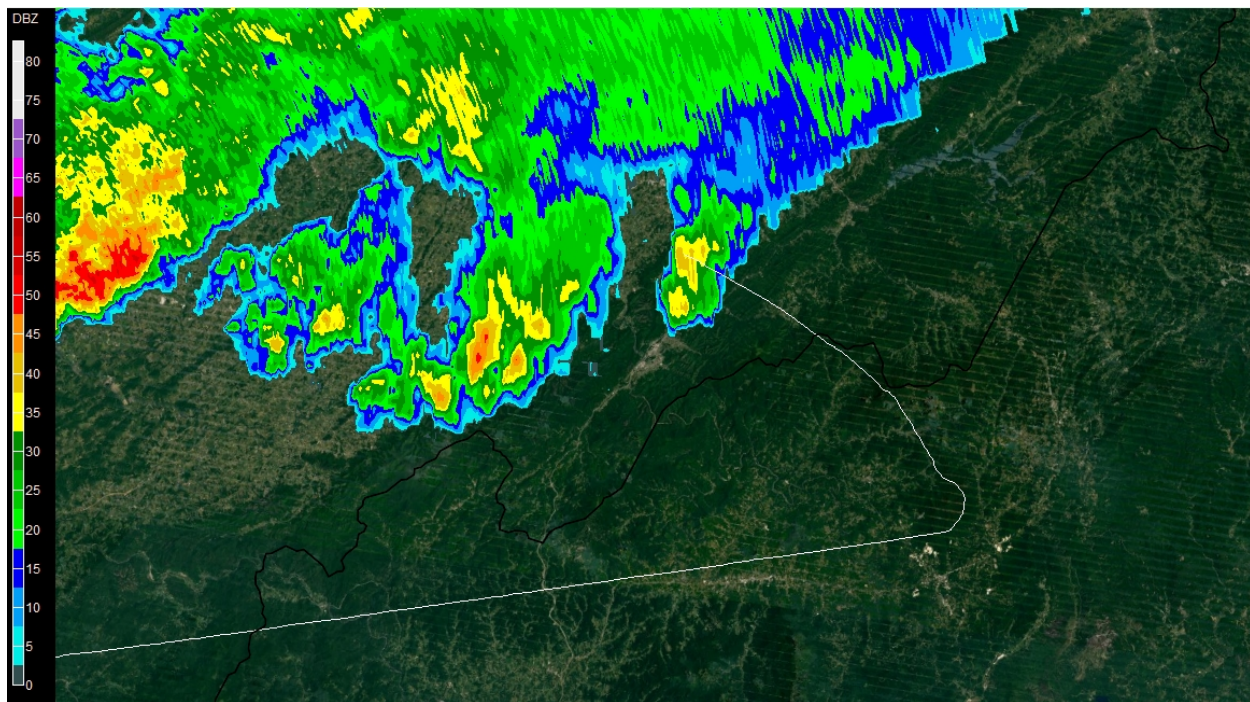
**Figure 4** – KMRX 2.4° Level-II reflectivity product initiated at 1910:41 EDT. Accident aircraft position at 1912 EDT identified by white line (aircraft heading northwestward).



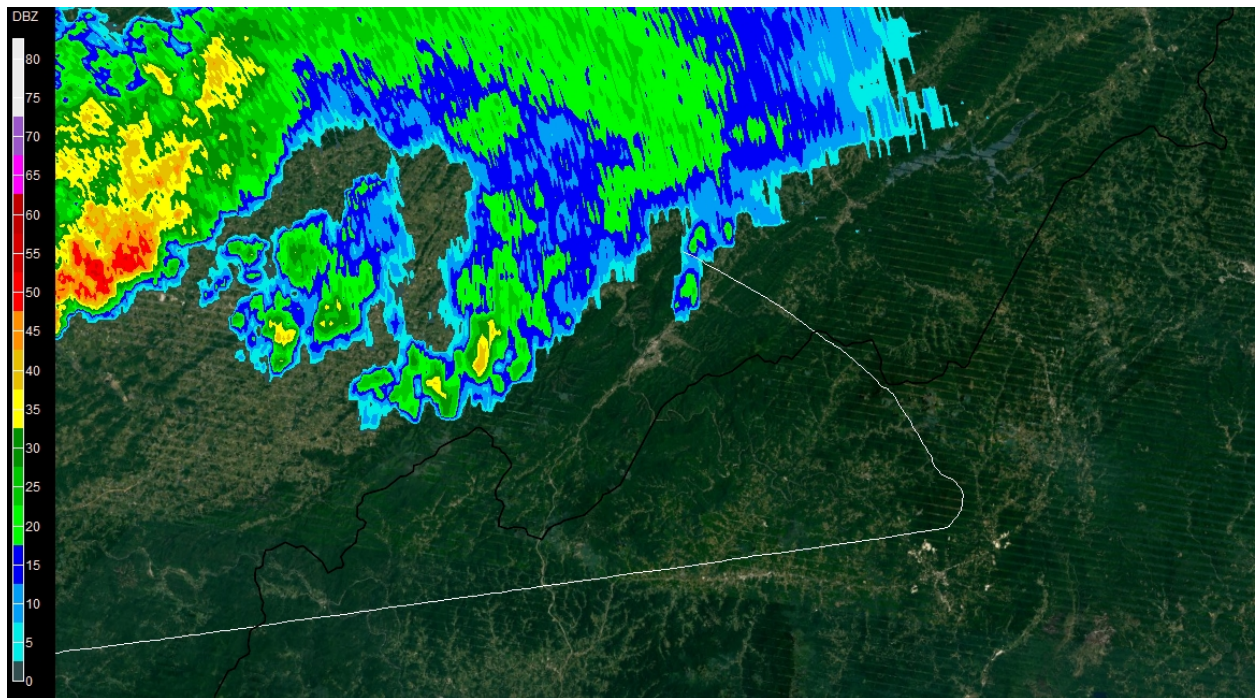
**Figure 5** – KMRX 1.4° Level-II reflectivity product initiated at 1911:14 EDT. Accident aircraft position at 1912 EDT identified by white line (aircraft heading northwestward).



**Figure 6** – KMRX 1.4° Level-II reflectivity product initiated at 1915:23 EDT. Accident aircraft position at 1917 EDT identified by white line (aircraft heading northwestward).

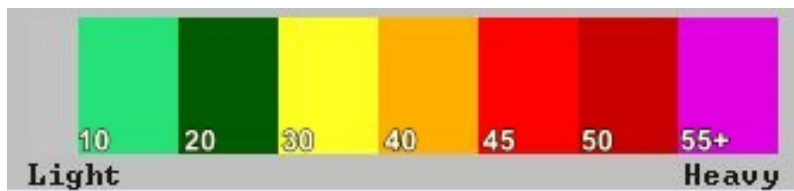


**Figure 7** – KMRX 2.4° Level-II reflectivity product initiated at 1916:27 EDT. Accident aircraft position at 1917 EDT identified by white line (aircraft heading northwestward).

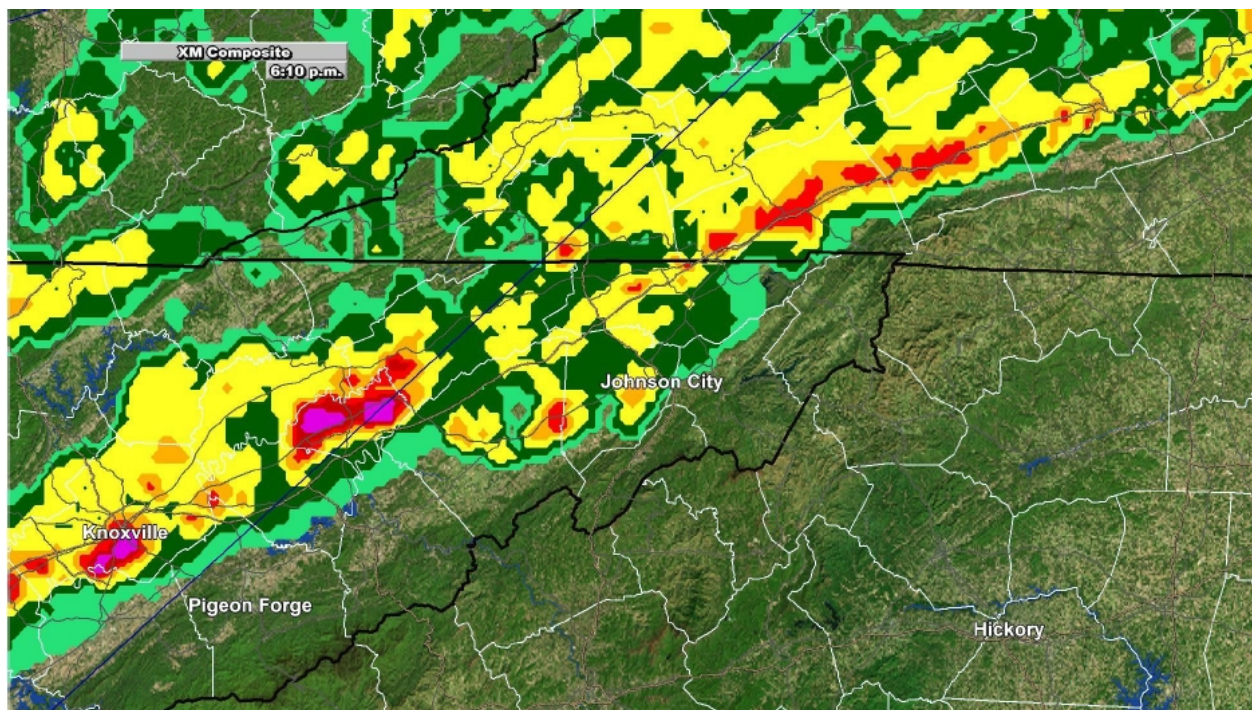


**Figure 8** – KMRX 3.4° Level-II reflectivity product initiated at 1917:00 EDT. Accident aircraft position at 1917 EDT identified by white line (aircraft heading northwestward).

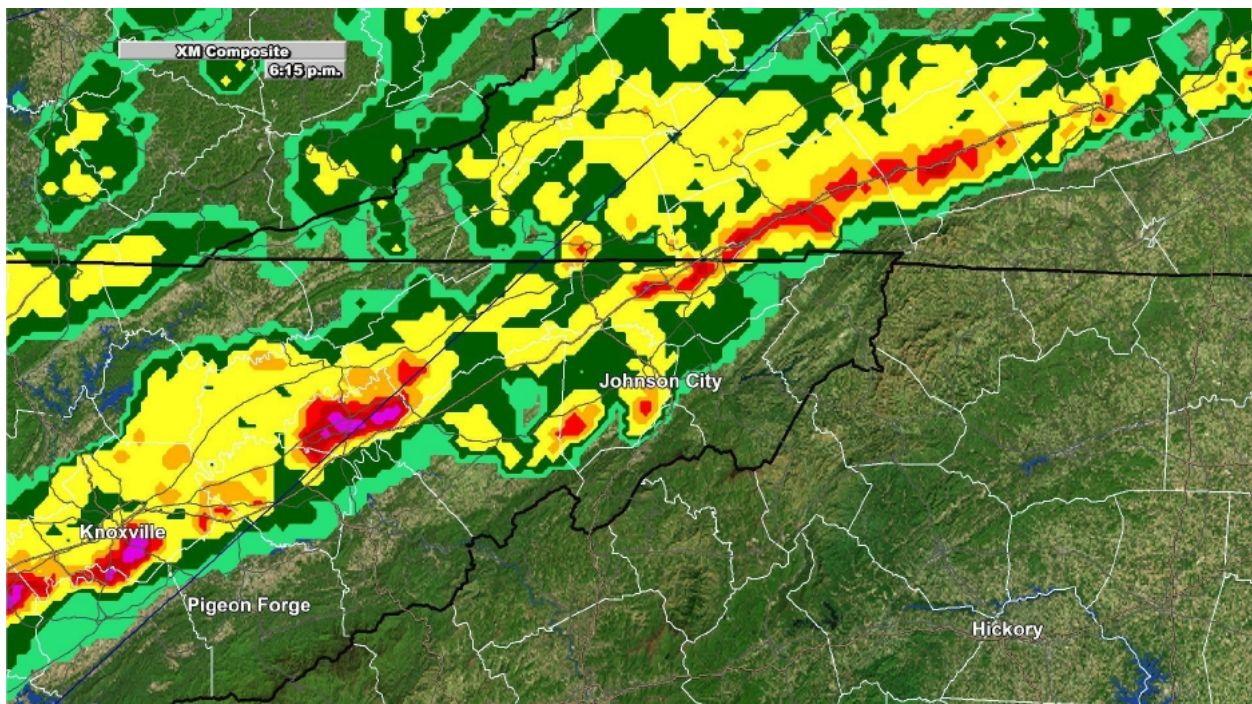
Figures 10-11 are representations of the composite weather radar mosaic delivered by XM (satellite) that would have been available in the cockpit. Figure 9 provides the color bar for these images. According to Baron, the creator of the mosaic, the radar mosaics would have been delivered to the user about 1 minute after the creation time.



**Figure 9** – Reflectivity (units of dBZ) color bar figures 10-11.

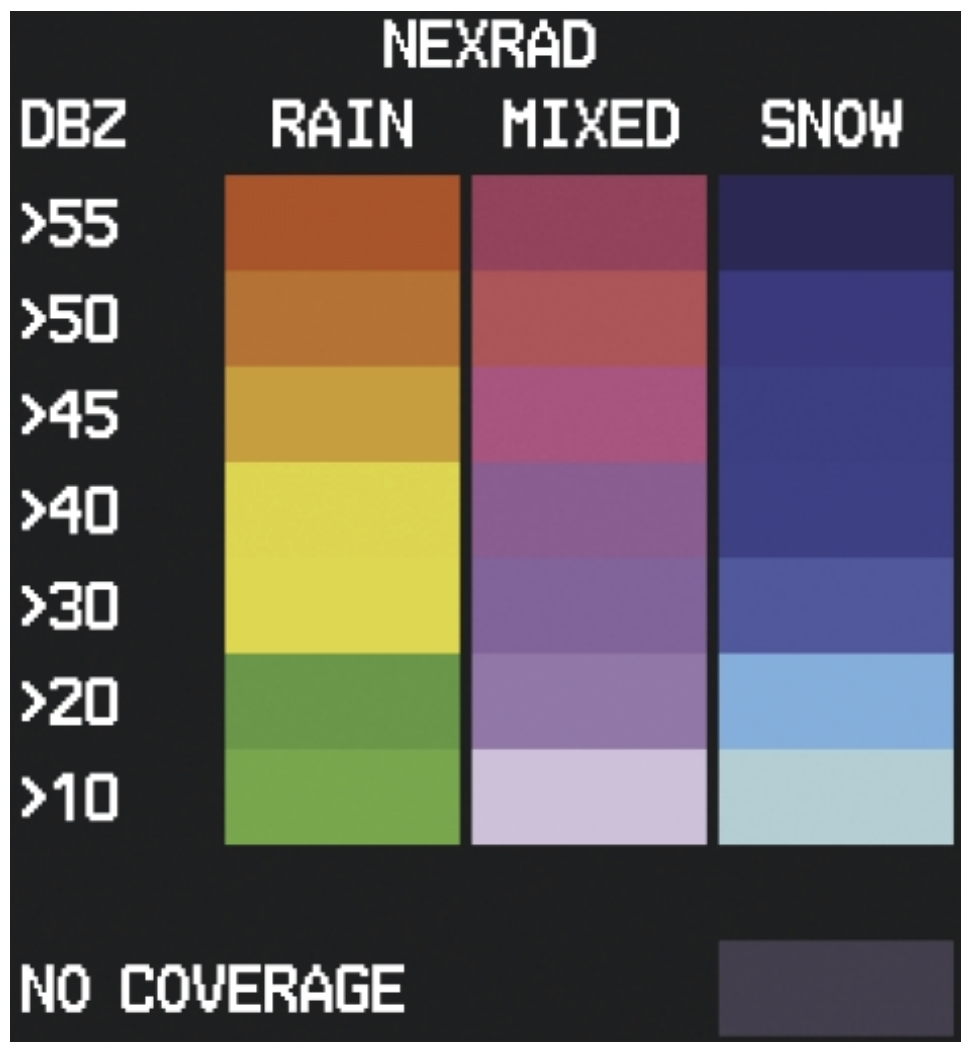


**Figure 10** – XM weather radar mosaic created at 1910 EDT.



**Figure 11** – XM weather radar mosaic created at 1915 EDT.

Figure 12 presents the color bar used in the Garmin G1000 and G2000 components for display of XM weather radar imagery. According to this scale, all reflectivity values up to 55 dBZ would be presented as “orange” to the user.

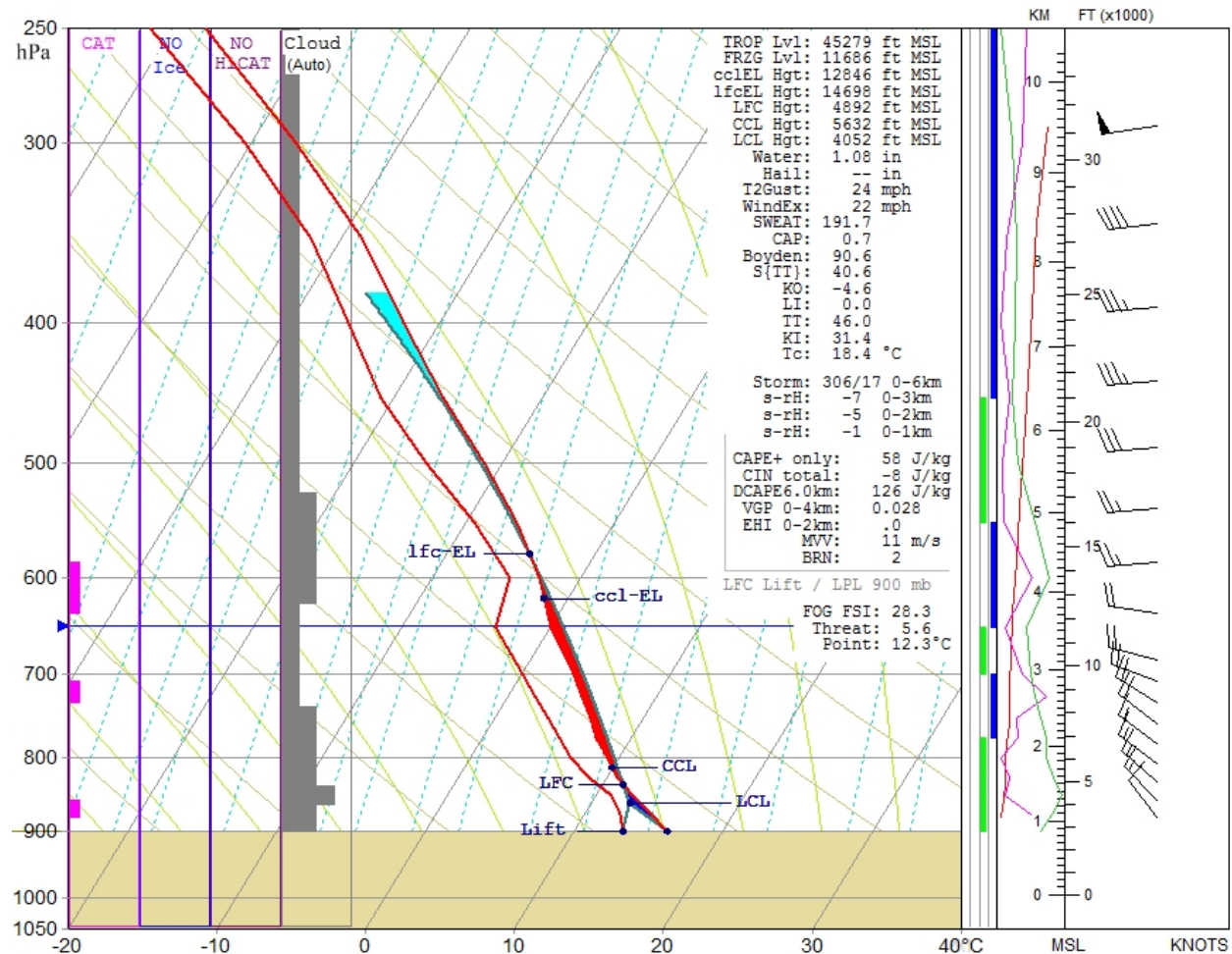


**Figure 12** – Weather radar color bar used in the Garmin G1000 and G2000 components.

### **Upper Air Sounding**

A North American Mesoscale (NAM) model sounding (figure 13) for the accident location at 2000 EDT was retrieved from the National Oceanic and Atmospheric Administration’s Air Resources Laboratory. The near-surface wind was from the northwest at about 10 knots. Above this level the wind backed with height through about 14,000 feet, where the wind was westerly at 25 knots. The freezing level was at approximately 11,700 feet. The RAwinsonde OBservation program (RAOB) for this sounding did not identify any areas of significant icing or turbulence,

outside of convection. The most-unstable Convective Available Potential Energy (CAPE)<sup>3</sup> parameter was 58 Joules/kilogram (from 900 hPa). The Lifting Condensation Level<sup>4</sup> (LCL) and Level of Free Convection<sup>5</sup> (LFC) were calculated to be 4,052 feet and 4,892 feet, respectively.



**Figure 13** – NAM model sounding data in SkewT/LogP format for 2000 EDT at the accident site, approximately surface to 250 hPa.

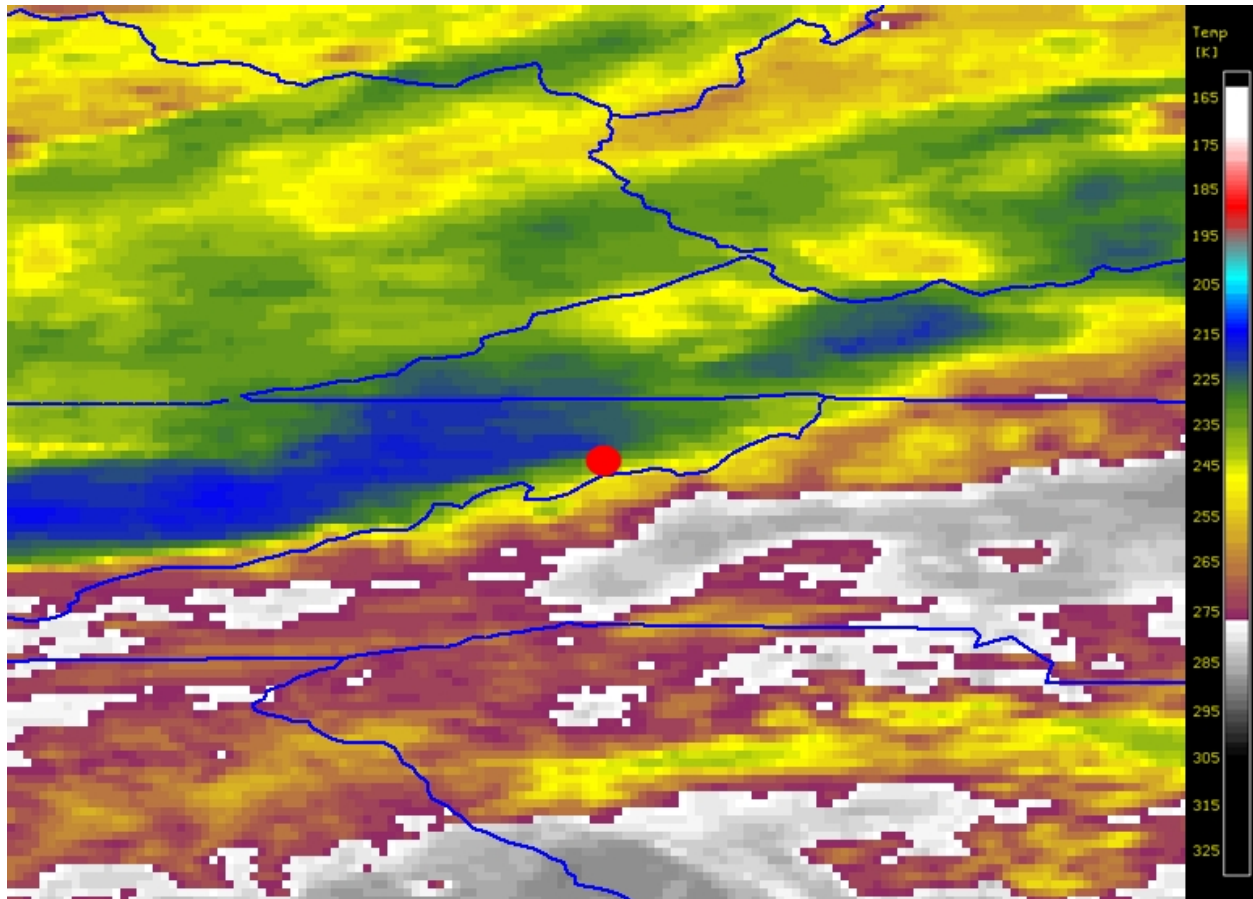
<sup>3</sup> Convective Available Potential Energy - A measure of the amount of energy available for convection. CAPE is directly related to the maximum potential vertical speed within an updraft; thus, higher values indicate greater potential for severe weather. 471 Joules/kilogram would be considered relatively weak.

<sup>4</sup> Lifting Condensation Level - The level at which a parcel of moist air lifted dry-adiabatically would become saturated.

<sup>5</sup> Level of Free Convection - The level at which a parcel of air lifted dry-adiabatically until saturated and saturation-adiabatically thereafter would first become warmer than its surroundings in a conditionally unstable atmosphere. On a thermodynamic diagram the level of free convection is given by the point of intersection of the process curve, representing the process followed by the ascending parcel, and the sounding curve, representing the lapse rate of temperature in the environment.

## **Satellite Imagery**

Geostationary Operational Environmental Satellite (GOES)-13 infrared ( $10.7\mu\text{m}$ ) data were obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison. Imagery from 1915 EDT is presented in figure 14. The GOES-13 infrared cloud-top temperatures varied between approximately  $-20^{\circ}\text{C}$  and  $-53^{\circ}\text{C}$  in the accident region. When considering the NAM model sounding,  $-20^{\circ}\text{C}$  and  $-53^{\circ}\text{C}$  corresponded to heights of approximately 22,600 feet and greater than 35,000 feet, respectively. It should be noted these figures have not been corrected for any parallax error.



**Figure 14** – GOES-13  $10.7\mu\text{m}$  (infrared) imagery from 1915 EDT. Red dot denotes accident location.

## **Area Forecast**

An Area Forecast that included the state of Tennessee was issued at 1445 EDT by the Aviation Weather Center in Kansas City, Missouri. Cloud heights are above msl. The portion of the Area Forecast directed toward the eastern half of Tennessee forecasted for the accident time: scattered clouds at 4,000 feet, ceiling broken at 6,000 feet, with clouds layered to FL250<sup>6</sup>, scattered thunderstorms with light rain and light rain showers, cumulonimbus cloud tops to FL350.

<sup>6</sup> Flight Level (FL) - standard nominal altitude of an aircraft, in hundreds of feet. This altitude is calculated from the International standard atmosphere using 1013.25 hPa (29.92 in.Hg) for surface pressure.

FAUS44 KPCI 091845

FA4W

\_DFWC FA 091845

SYNOPSIS AND VFR CLDS/WX

SYNOPSIS VALID UNTIL 101300

CLDS/WX VALID UNTIL 100700...OTLK VALID 100700-101300

OK TX AR TN LA MS AL

.

SEE AIRMET SIERRA FOR IFR CONDS AND MTN OBSCN.

TS IMPLY SEV OR GTR TURB SEV ICE LLWS AND IFR CONDS.

NON MSL HGTS DENOTED BY AGL OR CIG.

.

SYNOPSIS...CDFNT ERN TN-NW AL-NRN MS-SRN AR-NRN TX-E CNTRL  
NM. 13Z CDFNT NRN GLFMEX-SRN TX-XTRM SERN NM.

.

TN

W HLF...SCT050 BKN100 LYRD FL300. SCT -TSRA/-SHRA. CB TOP FL380.

02Z SCT025 BKN050. WDLY SCT -SHRA. 06Z SKC. OTLK...VFR.

**E HLF...SCT040 BKN060 LYRD FL250. SCT -TSRA/-SHRA. CB TOP FL350.**

BECMG 0203 OVC020-025. VIS 3-5SM -RA BR. OTLK...IFR CIG RA BR.

### **Aviation Section of the Area Forecast Discussion**

The Aviation section of an Area Forecast Discussion was issued at 1400 EDT by the NWS Weather Forecast Office in Morristown, Tennessee.

FXUS64 KMRX 091800

AFDMRX

AREA FORECAST DISCUSSION

NATIONAL WEATHER SERVICE MORRISTOWN TN

200 PM EDT FRI OCT 9 2015

.AVIATION...

VFR CONDITIONS WILL CONTINUE THIS AFTERNOON AS A COLD FRONT GRADUALLY APPROACHES THE REGION. CIGS/VIS WILL GRADUALLY LOWER TO MVFR LEVELS BY EARLY THIS EVENING...AS -SHRA/TSRA MOVE INTO THE AREA. -RA/SHRA WILL CONTINUE OVERNIGHT AND INTO THE EARLY MORNING HOURS AS VIS/CIGS FURTHER LOWER TO PREVAILING IFR TO LIFR CONDITIONS FROM LIGHT FOG...BEFORE LIFTING TO MVFR LEVELS BY LATE MORNING AS PRECIPITATION TAPERS OFF AND DRIER AIR SLOWLY ERODES CLOUD COVER.

## AIRMETs

There were no Airmen's Meteorological Information (AIRMET) advisories active for the accident location at the accident time below FL240. The accident site was located adjacent to an AIRMET for mountain obscuration.

## SIGMETs

There were no non-convective Significant Meteorological Information (SIGMET) advisories active for the accident location at the accident time.

At 1855 EDT a convective SIGMET was issued advising of a line of thunderstorms 50 miles wide along a line that went through the accident region (see figure 15). This line was identified to be moving from 260 at 30 knots, with cloud tops to FL440.

WSUS31 KPCI 092255

SIGE

\_MKCE WST 092255

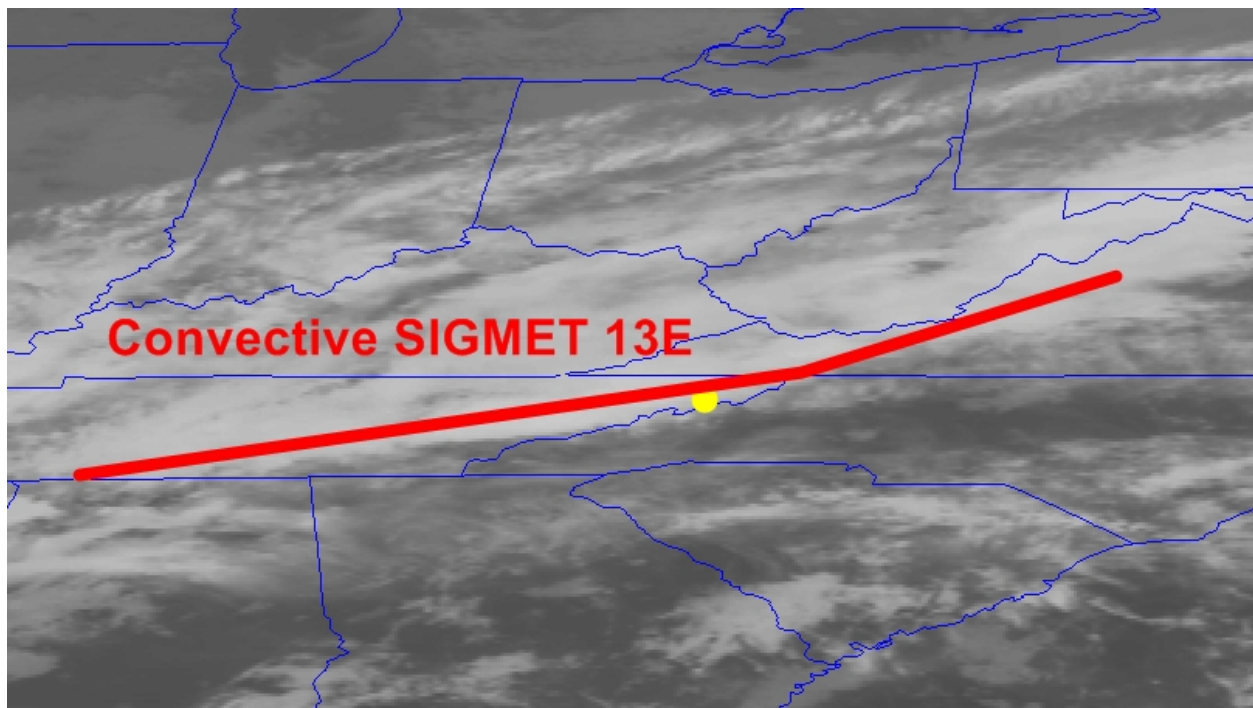
CONVECTIVE SIGMET 13E

VALID UNTIL 0055Z

VA NC WV TN AL

FROM 60SE EKN-30ENE HNV-20N MSL

LINE TS 50 NM WIDE MOV FROM 26030KT. TOPS TO FL440.



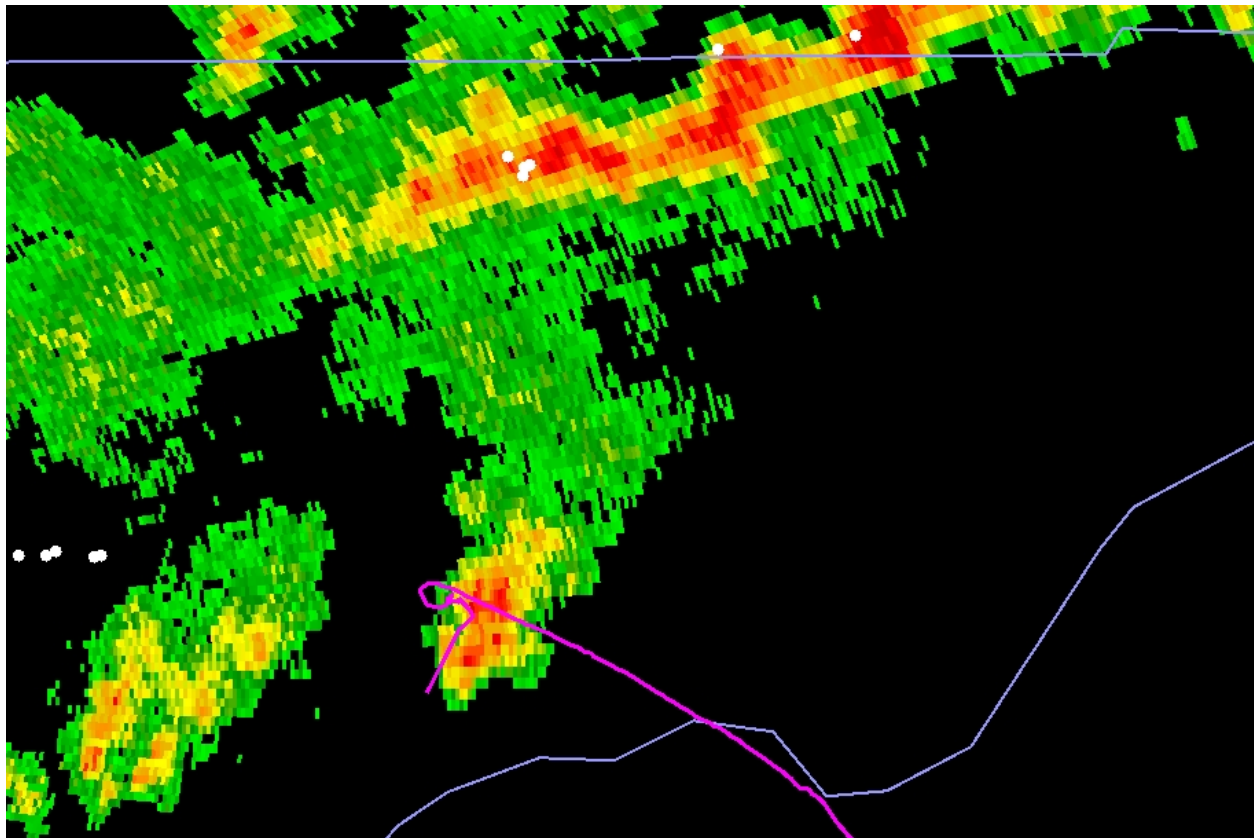
**Figure 15** – Convective SIGMET 13E. Accident location denoted by yellow dot.

## **CWSU Products**

There were no Center Weather Advisories or Meteorological Impact Statements issued by the Center Weather Service Unit (CWSU) at the Atlanta Air Route Traffic Control Center that were active for the accident location at the accident time.

## **Lightning**

Total lightning data retrieved from the Earth Networks Total Lightning Network (ENTLN) between 1900 EDT and the accident time for the accident area is presented in figure 16. Lightning activity (white dots) is present in the region, however there was no lightning activity associated with the cell that was coincident with the accident location at the accident time.



**Figure 16** – ENTNLN lightning activity (white dots) between 1900 EDT and the accident time. Accident aircraft flight path presented as pink line.

## **Astronomical Data**

The astronomical data obtained from the United States Naval Observatory for 36° 13' north latitude and 82° 22' west longitude, indicated the following:

### **SUN**

|                    |          |
|--------------------|----------|
| Sunset             | 1902 EDT |
| End Civil Twilight | 1923 EDT |

### **MOON**

|         |          |
|---------|----------|
| Moonset | 1725 EDT |
|---------|----------|

*Submitted by: Mike Richards  
NTSB, AS-30*