



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

September 7, 2016

Group Chairman's Weather Study Report

METEOROLOGY

ERA15FA215

Table Of Contents

A.	ACCIDENT	3
B.	METEOROLOGY GROUP	3
C.	SUMMARY	3
D.	DETAILS OF THE INVESTIGATION	3
E.	FACTUAL INFORMATION	4
1.0	Synoptic Situation.....	4
1.1	Surface Analysis Chart	4
1.2	Upper Air Charts.....	5
2.0	Storm Prediction Center Products.....	10
3.0	Surface Observations	12
4.0	Upper Air Data.....	17
5.0	Satellite Data	19
6.0	Radar Imagery Information.....	21
6.1	Volume Scan Strategy.....	21
6.2	Beam Height Calculation.....	22
6.3	Reflectivity.....	23
6.4	Base Reflectivity	24
6.5	3-Dimensional Radar Reflectivity Data.....	27
7.0	Pilot Reports.....	29
8.0	SIGMET and CWSU Advisory	30
9.0	CCFP and CAWS	33
10.0	AIRMETs.....	35
11.0	Area Forecast	36
12.0	Terminal Aerodrome Forecast	38
13.0	National Weather Service Area Forecast Discussion	39
14.0	Pilot Weather Briefing.....	43
15.0	Astronomical Data	43
16.0	FIS-B Regional NEXRAD with Flight Path.....	44
17.0	XM Weather Data	47
F.	LIST OF ATTACHMENTS	50

A. ACCIDENT

Location: 4 miles north of Saltville, Virginia
Date: May 18, 2015
Time: approximately 1238 eastern daylight time (1638 UTC¹)
Aircraft: BE-55, registration: N5816S

B. METEOROLOGY GROUP

Paul Suffern
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C. SUMMARY

For a summary of the accident, refer to the *Accident Summary* report, which is available in the docket for this investigation.

D. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's (NTSB) Meteorologist was not on scene for this investigation and gathered all the weather data for this investigation from the NTSB's Washington D.C. office and from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the National Centers for Environmental Information (NCEI). All times are eastern daylight time (EDT) on May 18, 2015, and are based upon the 24-hour clock, where local time is -4 hours from UTC, and UTC=Z (unless otherwise noted). Directions are referenced to true north and distances in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles.

The accident site was located at latitude 36.94° N, longitude 81.77° W, elevation: 4,395 feet.

¹ UTC – is an abbreviation for Coordinated Universal Time.

E. FACTUAL INFORMATION

1.0 Synoptic Situation

The synoptic or large scale migratory weather systems influencing the area were documented using standard NWS charts issued by the National Center for Environmental Prediction (NCEP) and the Weather Prediction Center (WPC), located in College Park, Maryland. These are the base products used in describing synoptic weather features and in the creation of forecasts and warnings for the NWS. Reference to these charts can be found in the joint NWS and Federal Aviation Administration (FAA) Advisory Circular “Aviation Weather Services”, AC-0045G CHG 2.

1.1 Surface Analysis Chart

The NWS Surface Analysis Chart for 1400 EDT is provided as figure 1 with the approximate location of the accident site marked. The chart depicted a surface trough² east of the accident site located along the eastern side of the Appalachian Mountains stretched north to south from central Virginia to southern Georgia. The station models around the accident site depicted air temperatures in the low 70’s to low 80’s Fahrenheit (F), with temperature-dew point spreads of 8° F or more, variable winds under 10 knots, partly cloudy skies, and surface stations reporting precipitation, from light rain, to heavy rain and thunderstorms. With the relatively warm surface temperatures, unstable air (section 4.0), and the lifting mechanisms provided by the mountains and surface trough, rain shower activity and some thunderstorm would be expected. Given no large scale lifting mechanism (section 1.2), the rain shower and thunderstorm activity would be expected to be scattered in coverage area.

² Trough – An elongated area of relatively low atmospheric pressure or heights.

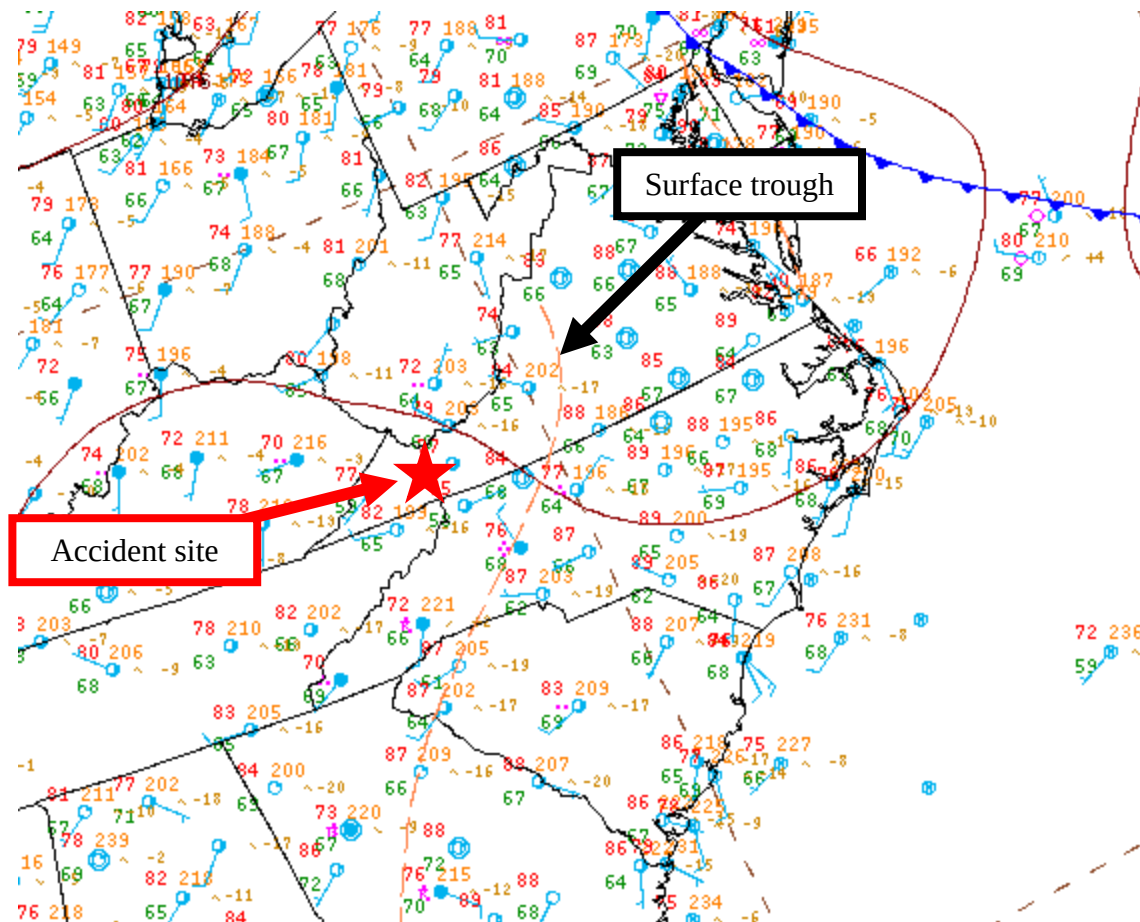


Figure 1 – NWS Surface Analysis Chart for 1400 EDT

1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 0800 EDT at 925-, 850-, 700-, 500-, and 300-hectopascals (hPa) are presented in figures 2 through 6. The upper air charts indicated an environment favorable for clouds and precipitation with a mid-level trough just southwest of the accident site at 500-hPa (figure 5). Areas near troughs and low pressure centers are considered favorable locations for clouds and precipitation. The wind field remained relatively light from 925- to 300-hPa with a southwest to northwest wind under 20 knots. With a relatively light wind field from the surface through 300-hPa no large scale thunderstorm activity would be expected.

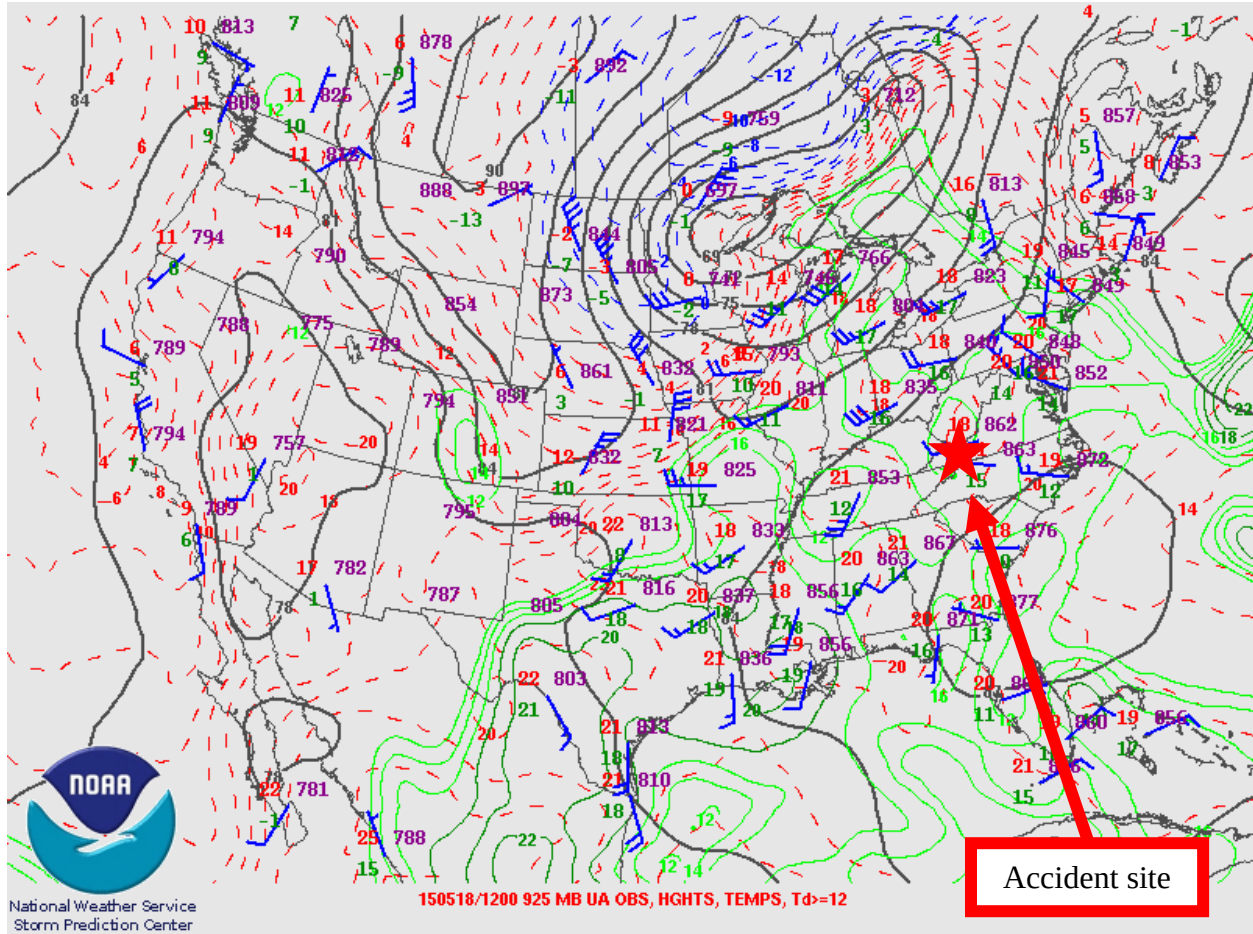


Figure 2 – 925-hPa Constant Pressure Chart for 0800 EDT

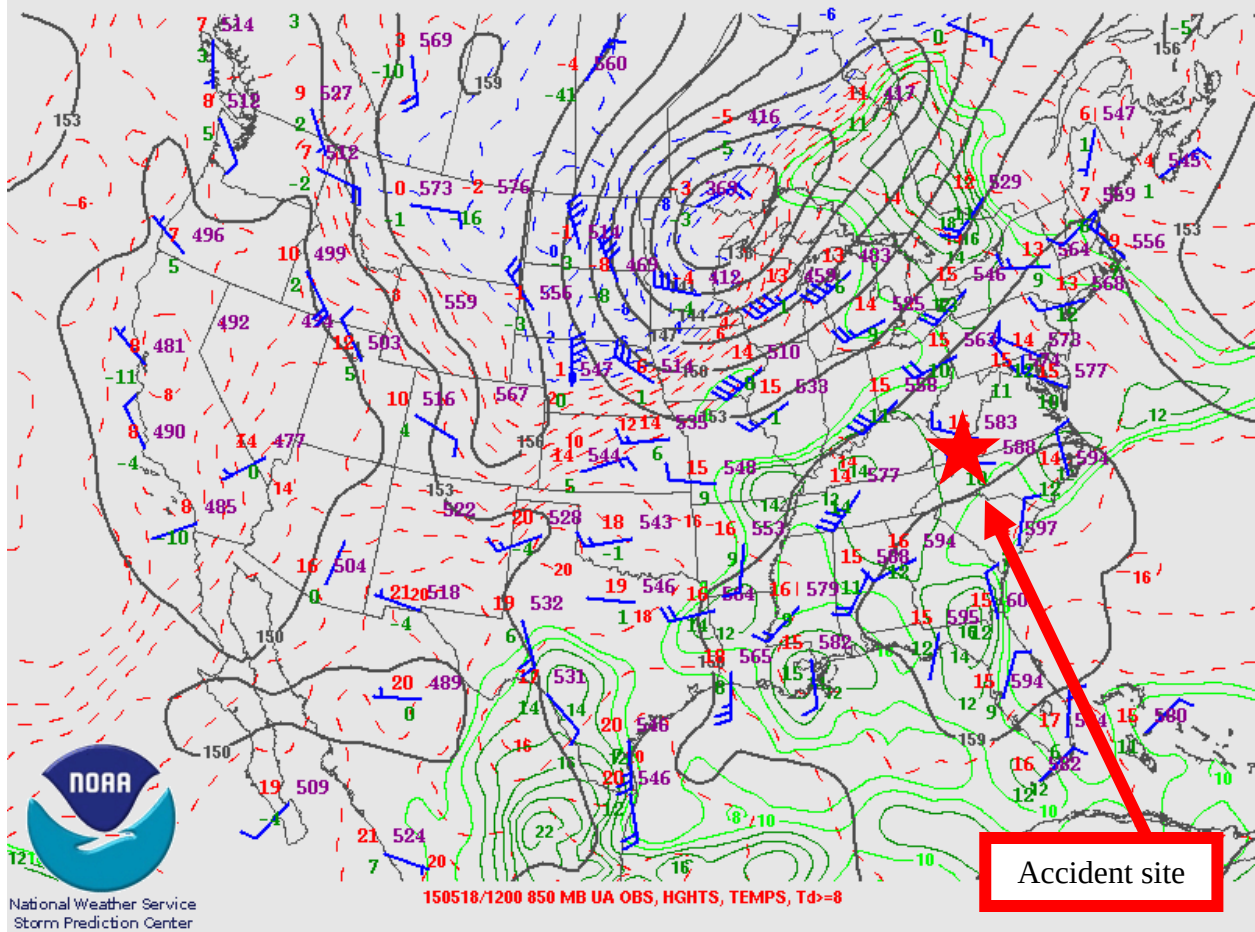


Figure 3 – 850-hPa Constant Pressure Chart for 0800 EDT

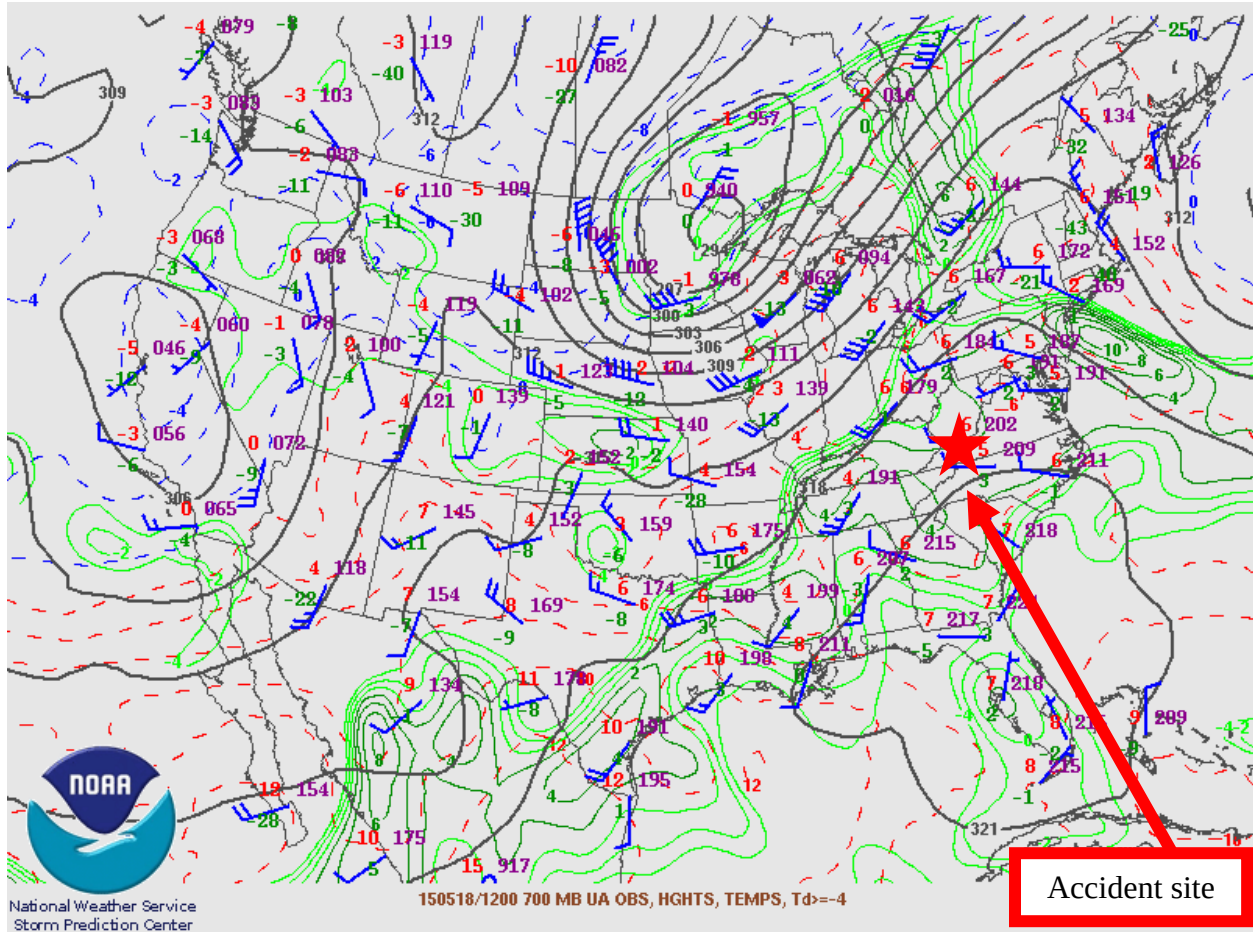


Figure 4 – 700-hPa Constant Pressure Chart for 0800 EDT

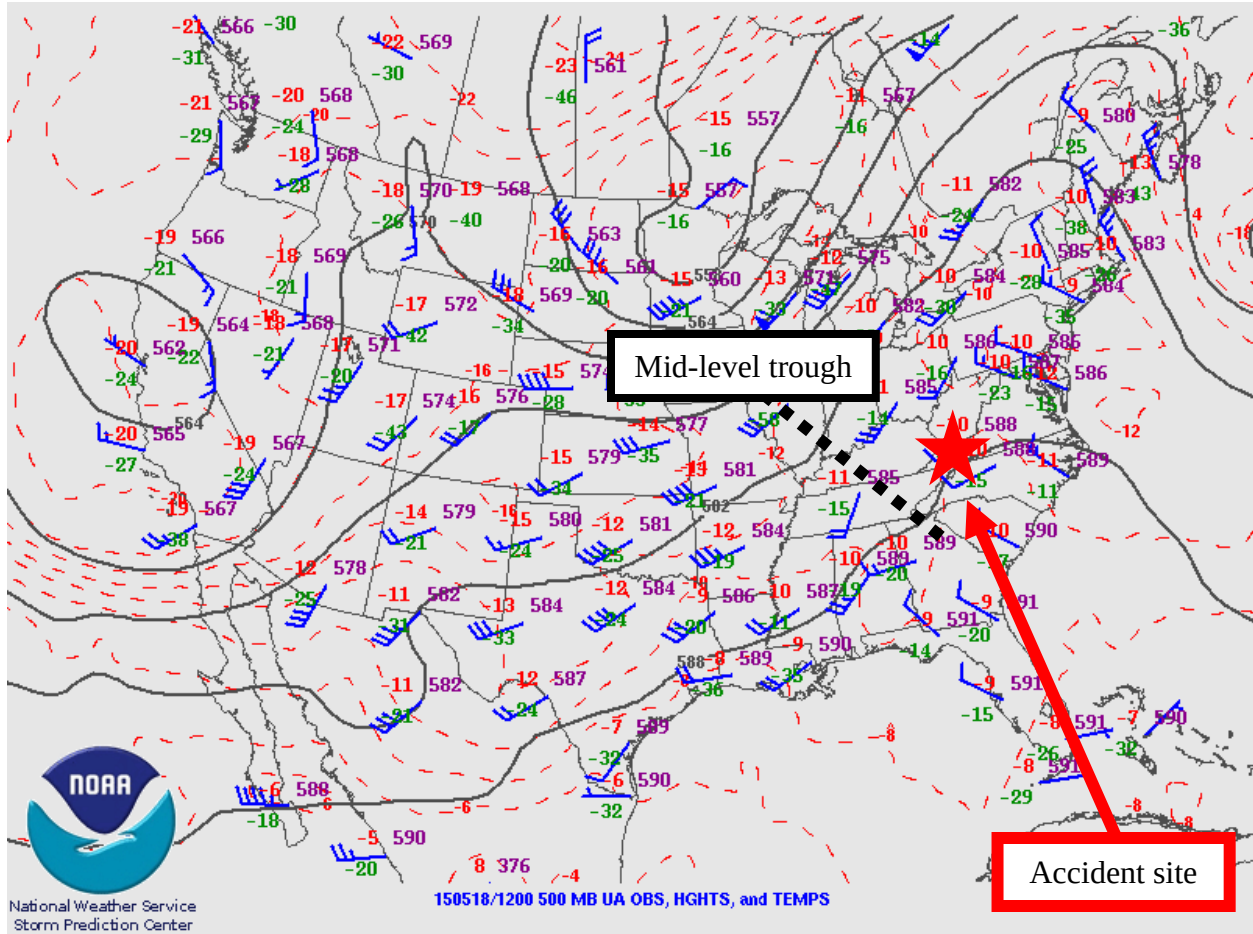


Figure 5 – 500-hPa Constant Pressure Chart for 0800 EDT

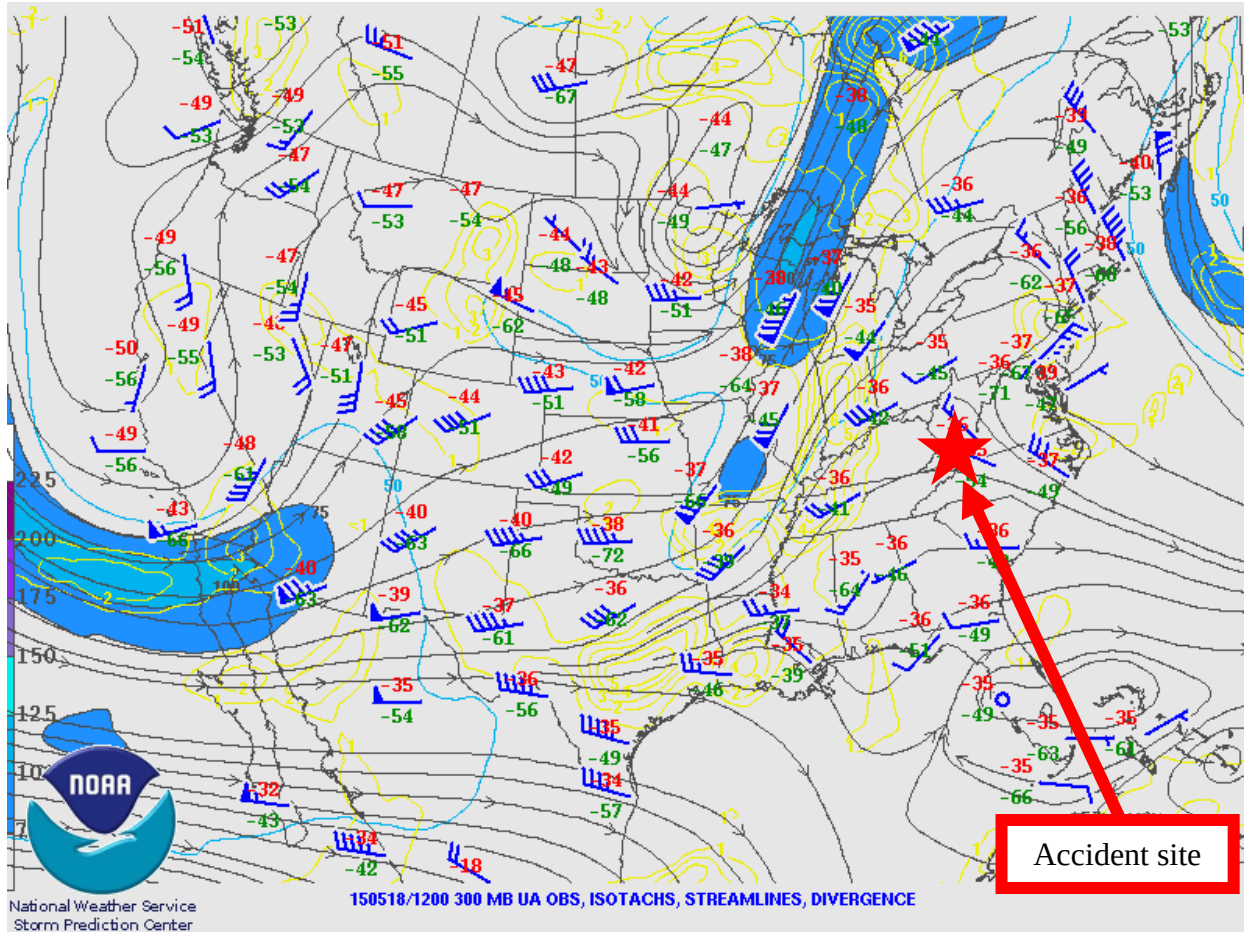


Figure 6 – 300-hPa Constant Pressure Chart for 0800 EDT

2.0 Storm Prediction Center Products

SPC issued the following Day 1 Convective Outlook at 1229 EDT (figure 7) with areas of thunderstorms forecasted for the accident site with the chance for severe thunderstorms remaining over western Texas and New Mexico. A similar Day 1 Convective Outlook was issued at 0846 EDT with general thunderstorms forecast for the accident area at the accident time:³

SPC AC 181629

DAY 1 CONVECTIVE OUTLOOK
NWS STORM PREDICTION CENTER NORMAN OK
1129 AM CDT MON MAY 18 2015

VALID 181630Z - 191200Z

...THERE IS A SLGT RISK OF SVR TSTMS THIS AFTERNOON/EVENING FOR SE

³ The bold sections in this NWS product and the rest of products in the weather study report are to highlight the individual sections that directly reference the weather conditions that are or will affect the accident location around the accident time.

NM AND SW TX...

...THERE IS A MRGL RISK OF SVR TSTMS FROM CENTRAL TX TO THE SRN HIGH PLAINS...

...SUMMARY...

ISOLATED SEVERE THUNDERSTORMS ARE EXPECTED TO DEVELOP ACROSS THE SOUTHERN HIGH PLAINS FROM SOUTHWEST TEXAS INTO SOUTHEAST NEW MEXICO. LARGE HAIL AND STRONG WINDS ARE THE PRIMARY THREATS.

...SW TX AND SRN HIGH PLAINS THROUGH TONIGHT...

WITHIN THE PERSISTENT SPLIT FLOW REGIME OVER THE WRN US AND CANADA...A SRN STREAM SHORTWAVE TROUGH WILL MOVE GENERALLY EWD FROM SRN CA TO WRN NM BY EARLY TUESDAY. WEAK LEE CYCLOGENESIS IS EXPECTED ACROSS SE NM THROUGH TONIGHT...WHICH WILL DRAW RICH LOW-LEVEL MOISTURE NWWD UP THE RIO GRANDE VALLEY INTO THE PECOS VALLEY THIS AFTERNOON. THIS MOISTENING WILL OCCUR BENEATH A PLUME OF MIDLEVEL LAPSE RATES NEAR 8 C/KM...SUCH THAT MLCAPE SHOULD INCREASE TO NEAR 2500 J/KG BY MID-LATE AFTERNOON. THE COMBINATION OF BUOYANCY AND EFFECTIVE BULK SHEAR NEAR 40 KT WILL SUPPORT A RISK FOR SUPERCELLS CAPABLE OF PRODUCING ISOLATED HAIL GREATER THAN TWO INCHES IN DIAMETER LATER THIS AFTERNOON/EVENING ACROSS THE PECOS VALLEY OF SW TX.

THE INITIAL CONVECTION WILL LIKELY FORM IN RESPONSE TO DAYTIME HEATING/MIXING IN CONJUNCTION WITH LOCAL TERRAIN CIRCULATIONS ACROSS SW TX...AND THEN POTENTIALLY EVOLVE INTO A CLUSTER OR TWO INTO EARLY TONIGHT. FARTHER SE...STORMS COULD ALSO FORM OVER THE DEL BURROS OF NE MEXICO AND APPROACH THE DRT AREA THIS EVENING. OTHER CONVECTION WILL LIKELY CONTINUE TO DEVELOP NWD WITH TIME ACROSS ERN NM AS LOW-LEVEL MOISTURE SPREADS NWWD...AND AS LOW-LEVEL WAA AND FORCING FOR ASCENT INCREASE AS THE SHORTWAVE TROUGH APPROACHES LATE IN THE PERIOD. INCREASINGLY WIDESPREAD RAIN/CONVECTION OVERNIGHT WILL REINFORCE THE SURFACE FRONT NOW ACROSS THE TX PANHANDLE/NW OK...WHICH WILL TEND TO LIMIT THE NRN EXTENT OF THE HAIL/WIND RISK OVERNIGHT.

...SRN LA/MS THIS AFTERNOON...

AN ONGOING MCS FROM THE SABINE RIVER EWD TO SW MS WILL LIKELY PERSIST AND DEVELOP SLOWLY SEWD INTO A VERY MOIST AND MODERATELY UNSTABLE ENVIRONMENT. VERTICAL SHEAR IS WEAK OVER THIS AREA...SO STORM MOTION AND PERSISTENCE WILL BE DRIVEN BY STORM OUTFLOW INTERACTIONS...WITH LOCALLY HEAVY RAINFALL THE MAIN THREAT.

...ELSEWHERE...

SCATTERED THUNDERSTORMS ARE EXPECTED IN A BROAD AREA FROM THE OH/TN VALLEYS TO THE APPALACHIANS...WITH THE SOMEWHAT MORE CONCENTRATED CONVECTION EXPECTED IN A N-S BAND FROM CENTRAL NY TO ERN PA AND MD ALONG A BACKDOOR FRONT. OTHER SCATTERED THUNDERSTORMS WILL OCCUR THROUGH THE PERIOD ACROSS THE AREA FROM THE GREAT BASIN TO THE CENTRAL ROCKIES...WITHIN A ZONE OF ASCENT AND MOISTENING TO THE N-NE OF THE SRN STREAM TROUGH OVER CA.

..THOMPSON/MOSIER.. 05/18/2015

CLICK TO GET WUUS01 PTSDY1 PRODUCT

NOTE: THE NEXT DAY 1 OUTLOOK IS SCHEDULED BY 2000Z

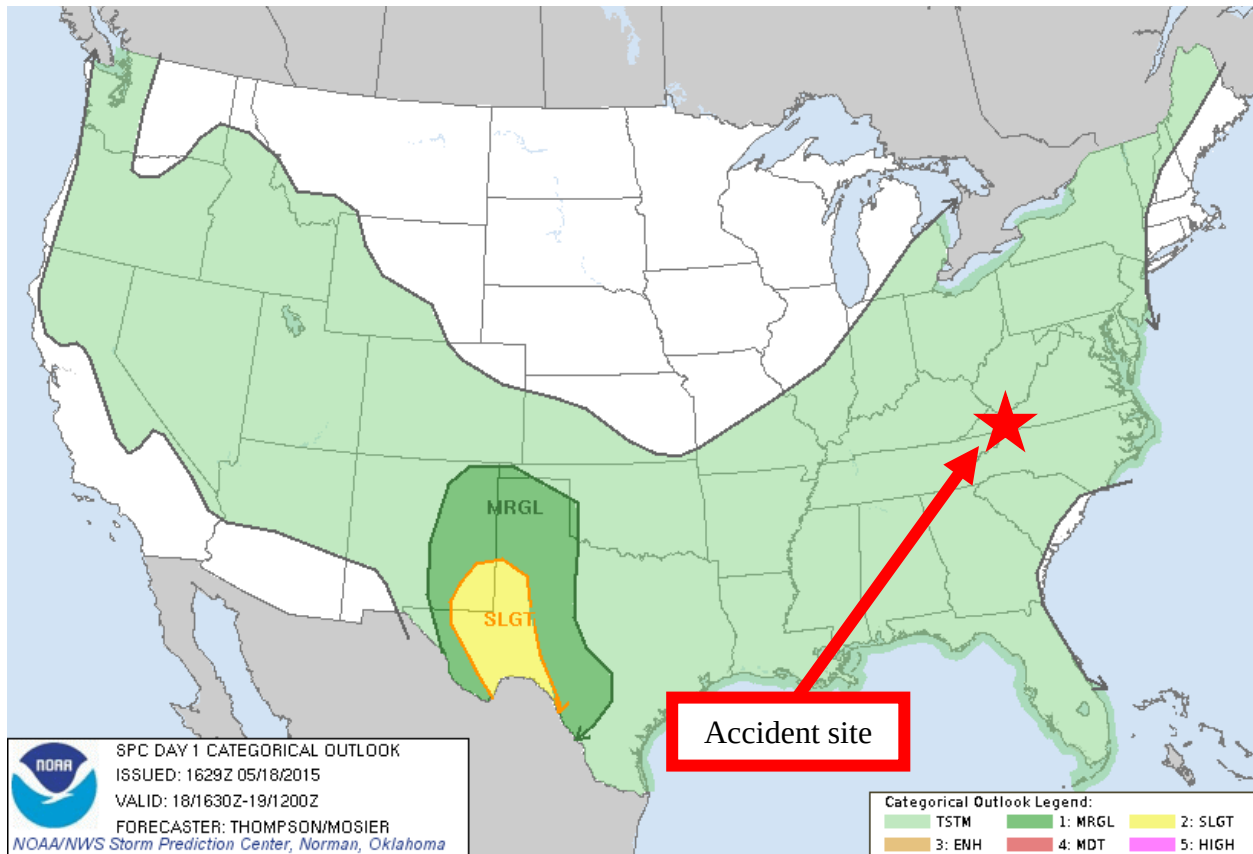


Figure 7 – Storm Prediction Center day 1 Convective Outlook valid at the time of the accident

3.0 Surface Observations

The area surrounding the accident site was documented utilizing official NWS Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). The following observations were taken from standard code and are provided in plain language.

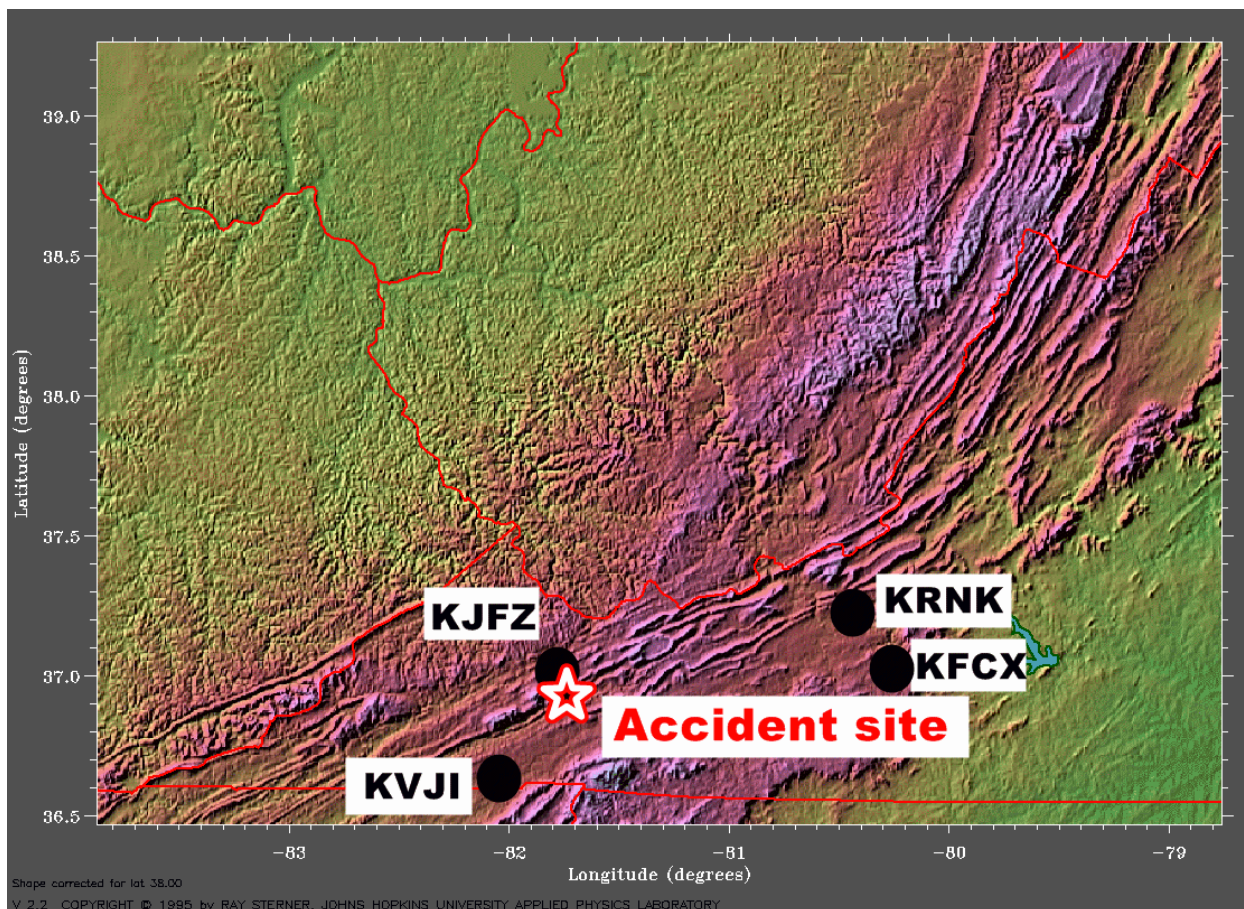


Figure 8 – Map of Virginia with the location of the accident site, surface observation sites, upper air sounding site, and weather radar location

Tazewell County Airport (KJFZ) was the closest official weather station to the accident site. KJFZ was located 2 miles south of Richlands, Virginia, and had an Automated Weather Observing System (AWOS⁴) whose reports were not supplemented. KJFZ was located 8 miles north of the accident site, at an elevation of 2,653 feet, and had a 6° westerly magnetic variation (figure 8). The following observations were taken and disseminated during the times surrounding the accident:

[1115 EDT] KJFZ 181515Z AUTO 22004KT 10SM SCT026 SCT033 23/18
A3028 RMK AO2 T02340176=

[1135 EDT] KJFZ 181535Z AUTO 22004KT 10SM SCT028 BKN033 BKN120
24/17 A3028 RMK AO2 T02420170=

[1155 EDT] KJFZ 181555Z AUTO 22004KT 10SM SCT028 BKN035 OVC120
25/17 A3027 RMK AO2 T02460169=

⁴ AWOS – Automated Weather Observing System is equipped with meteorological instruments to observe and report temperature, dewpoint, wind speed and direction, visibility, cloud coverage and ceiling up to twelve thousand feet, and altimeter setting.

***[1215 EDT] KJFZ 181615Z AUTO 21007KT 10SM SCT032 SCT055 BKN120
25/18 A3026 RMK AO2 T02460175=***

***[1235 EDT] KJFZ 181635Z AUTO 21005KT 10SM SCT029 SCT036 BKN080
24/18 A3026 RMK AO2 T02410177=***

ACCIDENT TIME 1238 EDT

***[1255 EDT] KJFZ 181655Z AUTO 21003KT 10SM SCT027 SCT048 BKN080
25/18 A3025 RMK AO2 LTG DSNT W T02490183=***

***[1315 EDT] KJFZ 181715Z AUTO 24008KT 10SM SCT031 SCT065 BKN080
25/17 A3025 RMK AO2 LTG DSNT NW T02480173=***

***[1335 EDT] KJFZ 181735Z AUTO 27008KT 10SM -RA SCT023 BKN029 OVC090
21/18 A3026 RMK AO2 LTG DSNT N AND W T02110177=***

***[1355 EDT] KJFZ 181755Z AUTO 28004KT 10SM RA BKN023 BKN038 OVC050
20/18 A3026 RMK AO2 LTG DSNT NE T02030177 10254 20186=***

***[1415 EDT] KJFZ 181815Z AUTO 00000KT 10SM SCT035 SCT055 BKN090
21/19 A3025 RMK AO2 LTG DSNT NE T02080188=***

***[1435 EDT] KJFZ 181835Z AUTO 00000KT 10SM BKN080 BKN090 BKN110
22/18 A3024 RMK AO2 LTG DSNT NE T02170182=***

KJFZ weather at 1215 EDT, wind from 210° at 7 knots, 10 miles visibility, scattered clouds at 3,200 feet above ground level (agl), scattered clouds at 5,500 feet agl, a broken ceiling at 12,000 feet agl, temperature of 25° Celsius (C), dew point temperature of 18° C, and an altimeter setting of 30.26 inches of mercury. Remarks: automated station with a precipitation discriminator, temperature 24.6° C, dew point temperature 17.5° C.

KJFZ weather at 1235 EDT, wind from 210° at 5 knots, 10 miles visibility, scattered clouds at 2,900 feet agl, scattered clouds at 3,600 feet agl, a broken ceiling at 8,000 feet agl, temperature of 24° C, dew point temperature of 18° C, and an altimeter setting of 30.26 inches of mercury. Remarks: automated station with a precipitation discriminator, temperature 24.1° C, dew point temperature 17.7° C.

KJFZ weather at 1255 EDT, wind from 210° at 3 knots, 10 miles visibility, scattered clouds at 2,700 feet agl, scattered clouds at 4,800 feet agl, a broken ceiling at 8,000 feet agl, temperature of 25° C, dew point temperature of 18° C, and an altimeter setting of 30.25 inches of mercury. Remarks: automated station with a precipitation discriminator, lightning distant⁵ west, temperature 24.9° C, dew point temperature 18.3° C.

⁵ Distant indicated that the lightning was beyond 10 miles but less than 30 miles from the center of the airport (or

KJFZ weather at 1315 EDT, wind from 240° at 8 knots, 10 miles visibility, scattered clouds at 3,100 feet agl, scattered clouds at 6,500 feet agl, a broken ceiling at 8,000 feet agl, temperature of 25° C, dew point temperature of 17° C, and an altimeter setting of 30.25 inches of mercury. Remarks: automated station with a precipitation discriminator, lightning distant northwest, temperature 24.8° C, dew point temperature 17.3° C.

Virginia Highlands Airport (KVJI) was the next closest official site, located 2 miles west of Abingdon, Virginia, and had an AWOS whose reports were not supplemented. KVJI was located 20 miles southwest of the accident site, at an elevation of 2,087 feet, and had a 5° westerly magnetic variation (figure 8). The following observations were taken and disseminated during the times surrounding the accident:

[1115 EDT] KVJI 181515Z AUTO 28003KT 10SM BKN021 OVC026 24/19
A3026 RMK AO2 T02400193=

[1135 EDT] KVJI 181535Z AUTO 31005KT 10SM BKN022 OVC030 25/19
A3027 RMK AO2 T02460194=

[1155 EDT] KVJI 181555Z AUTO 29005KT 10SM OVC022 25/19 A3026 RMK
AO2 T02450194=

**[1215 EDT] KVJI 181615Z AUTO 27004KT 10SM BKN022 BKN028 OVC039
25/19 A3026 RMK AO2 T02460194=**

**[1235 EDT] KVJI 181635Z AUTO 26007KT 10SM BKN022 BKN042 OVC050
25/19 A3025 RMK AO2 T02490190=**

ACCIDENT TIME 1238 EDT

**[1255 EDT] KVJI 181655Z AUTO 28006KT 10SM BKN024 BKN050 OVC075
25/20 A3024 RMK AO2 T02530196=**

**[1315 EDT] KVJI 181715Z AUTO 28006KT 10SM SCT028 BKN041 OVC080
25/19 A3024 RMK AO2 T02490189=**

[1335 EDT] KVJI 181735Z AUTO 24004KT 10SM SCT025 SCT040 BKN095
26/20 A3023 RMK AO2 LTG DSNT N T02610200=

[1355 EDT] KVJI 181755Z AUTO 21006KT 10SM SCT027 SCT033 BKN095
27/20 A3022 RMK AO2 T02690197 10269 20197=

[1415 EDT] KVJI 181815Z AUTO 24005KT 10SM SCT029 27/19 A3021 RMK
AO2 T02690194=

airport location point, ALP).

[1435 EDT] KVJI 181835Z AUTO 24008KT 210V270 10SM SCT033 SCT075
BKN090 26/19 A3020 RMK AO2 LTG DSNT N T02640191=

KVJI weather at 1215 EDT, wind from 270° at 4 knots, 10 miles visibility, a broken ceiling at 2,200 feet agl, broken skies at 2,800 feet agl, overcast skies at 3,900 feet agl, temperature of 25° C, dew point temperature of 19° C, and an altimeter setting of 30.26 inches of mercury. Remarks: automated station with a precipitation discriminator, temperature 24.6° C, dew point temperature 19.4° C.

KVJI weather at 1235 EDT, wind from 260° at 7 knots, 10 miles visibility, a broken ceiling at 2,200 feet agl, broken skies at 4,200 feet agl, overcast skies at 5,000 feet agl, temperature of 25° C, dew point temperature of 19° C, and an altimeter setting of 30.25 inches of mercury. Remarks: automated station with a precipitation discriminator, temperature 24.9° C, dew point temperature 19.0° C.

KVJI weather at 1255 EDT, wind from 280° at 6 knots, 10 miles visibility, a broken ceiling at 2,400 feet agl, broken skies at 5,000 feet agl, overcast skies at 7,500 feet agl, temperature of 25° C, dew point temperature of 20° C, and an altimeter setting of 30.24 inches of mercury. Remarks: automated station with a precipitation discriminator, temperature 25.3° C, dew point temperature 19.6° C.

KVJI weather at 1315 EDT, wind from 280° at 6 knots, 10 miles visibility, scattered clouds at 2,800 feet agl, a broken ceiling at 4,100 feet agl, overcast skies at 8,000 feet agl, temperature of 25° C, dew point temperature of 19° C, and an altimeter setting of 30.24 inches of mercury. Remarks: automated station with a precipitation discriminator, temperature 24.9° C, dew point temperature 18.9° C.

The observations from KJFZ indicated VFR⁶ ceilings at the surface at the time of the accident with no visibility restrictions. Lightning distant to the west was reported in the surface observation from KJFZ directly following the accident time, with light rain reported two observations later around 1335 EDT. The observations from KVJI indicated MVFR⁷ ceilings at the surface at the time of the accident. Given the background environment (sections 1.1 and 1.2), scattered rain shower and thunderstorm activity would be expected around the accident site at the accident time. The exact flight track and weather radar information will be further discussed in section 6.0 and beyond, and this will examine if the accident flight likely encounter instrument meteorological conditions and rain showers.

⁶ Visual Flight Rules – Refers to the general weather conditions pilots can expect at the surface. VFR criteria means a ceiling greater than 3,000 feet agl and greater than 6 miles visibility.

⁷ Marginal Visual Flight Rules – Refers to the general weather conditions pilots can expect at the surface. MVFR criteria means a ceiling between 1,000 and 3,000 feet agl and/or 3 to 5 miles visibility.

4.0 Upper Air Data

The closest official upper air sounding to the accident site was from Roanoke, Virginia (KRNK), with a site number 72318, located 67 miles east-northeast of the accident site at an elevation of 2,126 feet (figure 8). The 2000 EDT sounding from KRNK was plotted on a standard Skew-T log P diagram⁸ with the derived stability parameters included in figure 9 (with the chart plotted from the surface to 400-hPa, or 24,000 feet msl). This data was analyzed utilizing the RAOB⁹ software package. The sounding depicted the Lifted Condensation Level (LCL)¹⁰ at 3,928 feet msl, a Convective Condensation Level (CCL)¹¹ of 7,265 feet, and a Level of Free Convection (LFC)¹² at 5,252 feet. The freezing level was located at 13,674 feet. The precipitable water value was 1.39 inches.

⁸ Skew T log P diagram – is a standard meteorological plot using temperature and the logarithmic of pressure as coordinates, used to display winds, temperature, dew point, and various indices used to define the vertical structure of the atmosphere.

⁹ RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamoras, Pennsylvania.

¹⁰ Lifting Condensation Level (LCL) - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

¹¹ Convective Condensation Level (CCL) – The level in the atmosphere to which an air parcel, if heated from below, will rise dry adiabatically, without becoming colder than its environment just before the parcel becomes saturated.

¹² Level of Free Convection (LFC) – The level at which a parcel of saturated air becomes warmer than the surrounding air and begins to rise freely. This occurs most readily in a conditionally unstable atmosphere.

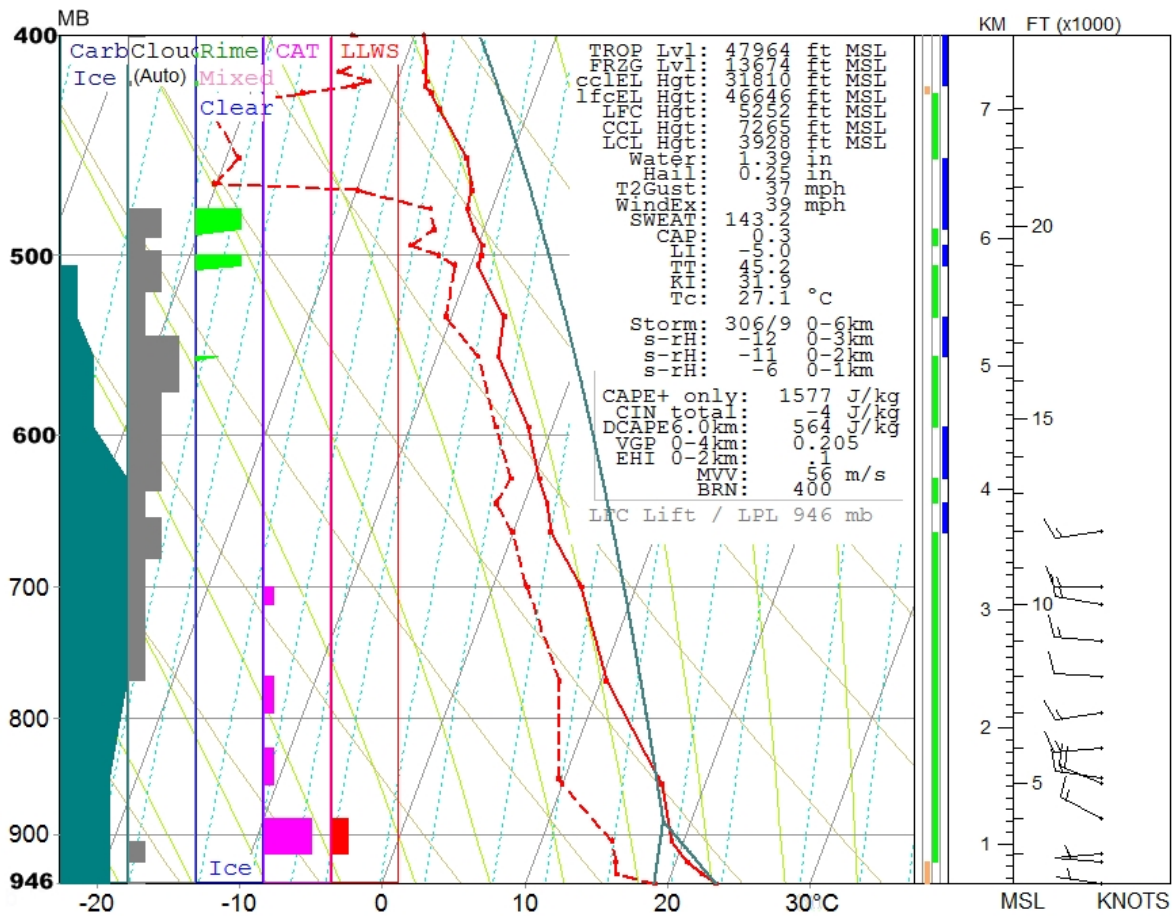


Figure 9 – 2000 EDT KRNK sounding

The 2000 EDT KRNK sounding indicated a relatively moist conditionally unstable environment with 1,577 J/kg of CAPE¹³ lifting a parcel from the ground. This environment would have been supportive of cloud formation, rain showers, and thunderstorms. The maximum vertical velocity (MVV) possible within rain showers or thunderstorm updrafts was 56 meters per second (m/s) or 109 knots given the 2000 EDT KRNK sounding environment. Any atmospheric lifting mechanism (sections 1.1 and 1.2) would have been enough to release the conditionally unstable air in the vertical environment and help produce clouds, rain showers, and thunderstorms at the accident time. RAOB identified the possibility of clouds near 3,000 feet msl, then the possibility of clouds between the 8,000 feet and 21,000 feet. Icing was likely in a layer between 18,000 and 21,000 feet.

¹³ Convective Available Potential Energy (CAPE) – CAPE is a measure of the amount of energy available for convection and is directly related to the maximum potential vertical speed within an updraft.

The sounding wind profile indicated a surface wind from 280° at 3 knots with the wind remaining out of the west through 12,000 feet msl. Between the surface and 12,000 feet msl the wind speed remained at or below 18 knots. The possibility of low-level wind shear (LLWS) was indicated by RAOB around 3,000 feet msl with several layers of possible clear-air turbulence between 3,000 feet and 10,000 feet msl. Given the background wind environment the accident aircraft would likely have more turbulence or wind shear issues when near any rain shower or thunderstorm activity, while flying outside of any convective activity the air would have been relatively smooth.

5.0 Satellite Data

Visible and infrared data from the Geostationary Operational Environmental Satellite number 14 (GOES-14) data was obtained from the NCEI and processed with the NTSB's Man-computer Interactive Data Access System workstation. Visible and infrared imagery (GOES-14 band 1 and 4) at wavelengths of 0.65 microns (μm) and 10.7 μm retrieved brightness temperatures for the scene, respectively. Satellite imagery surrounding the time of the accident, from 1000 EDT through 1600 EDT at approximately 1-minute intervals, was reviewed and the closest images to the time of the accident are documented here.

Figures 10 and 11 present the GOES-14 visible imagery from 1238 and 1240 EDT at 2X magnification with the accident site marked by a red square. The visible imagery indicated abundant cloud cover over and around the accident site at the accident time with that cloud cover moving from west to east. The most abundant and well developed cloud cover was along and within the Appalachian Mountains. Attachment 1 provides visible satellite animation from 1208 to 1300 EDT with the accident site marked with a red dot and the accident flight track location marked¹⁴ with a blue dot through the accident time. The 1208 to 1300 EDT visible satellite animation indicated that the accident flight encountered a more developed line of cumuliform clouds while travelling northward through southwestern Virginia. The cumuliform nature of the clouds would be consistent with the conditionally unstable air (section 4.0). Figure 12 presents the GOES-14 infrared imagery from 1238 EDT at 6X magnification. Inspection of the infrared imagery indicated cloud cover over the accident site at the accident time. The more enhanced bands (yellows and reds, higher cloud tops) were west of the accident site at the accident time over Kentucky and Ohio. Based on the brightness temperatures above the accident site and the vertical temperature profile provided by the 2000 EDT KRNK sounding, the approximate cloud-top heights over the accident site were 8,000 feet at 1238 EDT.

¹⁴ For more information see the ATC data.

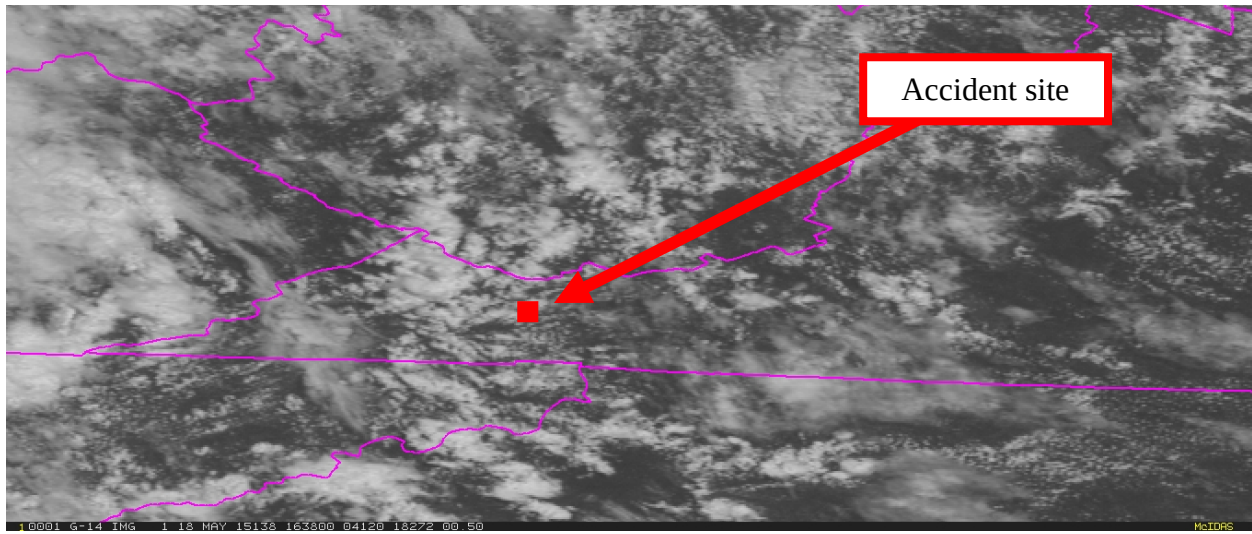


Figure 10 – GOES-14 visible image at 1238 EDT

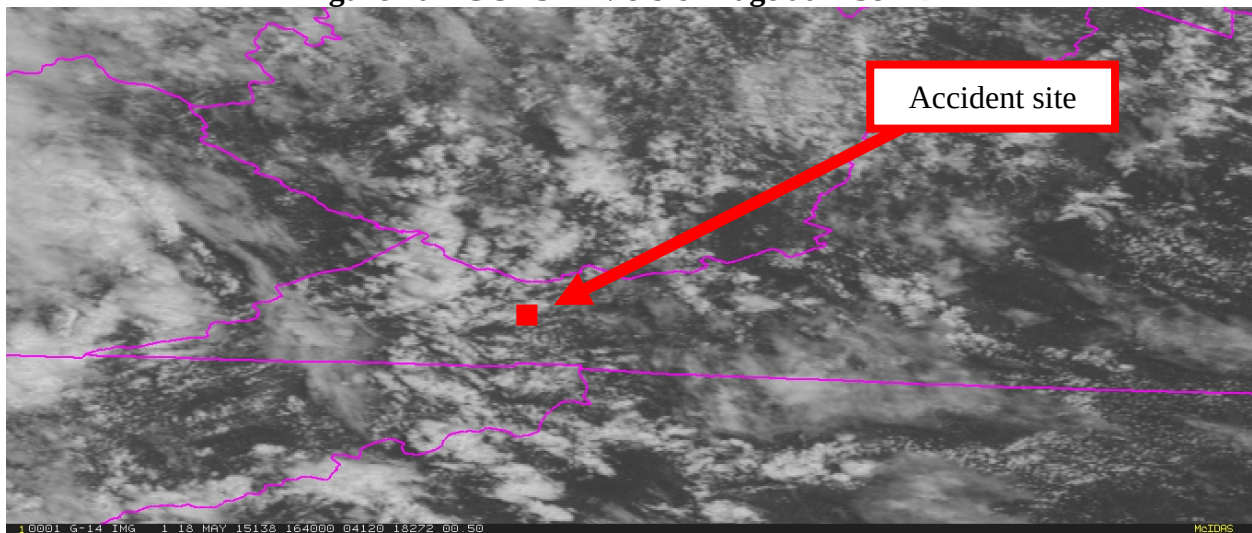


Figure 11 – GOES-14 visible image at 1240 EDT

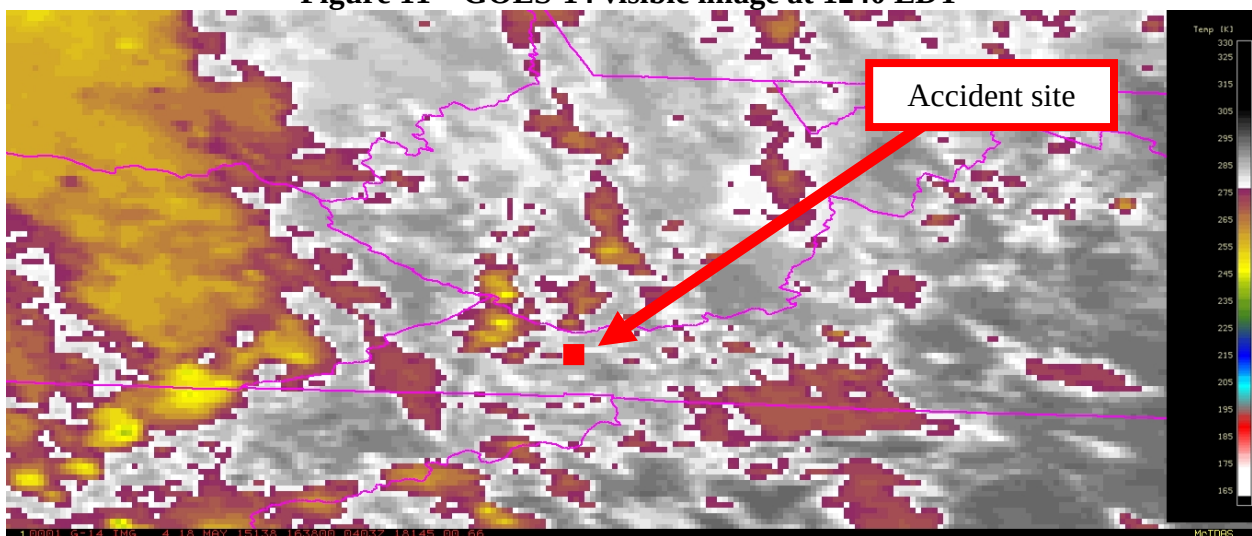


Figure 12 – GOES-14 infrared image at 1238 EDT

6.0 Radar Imagery Information

The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D)¹⁵ was from KFCX, in Roanoke, Virginia, which was located 72 miles east of the accident site with an elevation of 2,868 feet (figure 8). Level II and III archive radar data was obtained from the NCEI utilizing the NEXRAD Data Inventory Search and displayed using the NOAA's Weather and Climate Toolkit software.

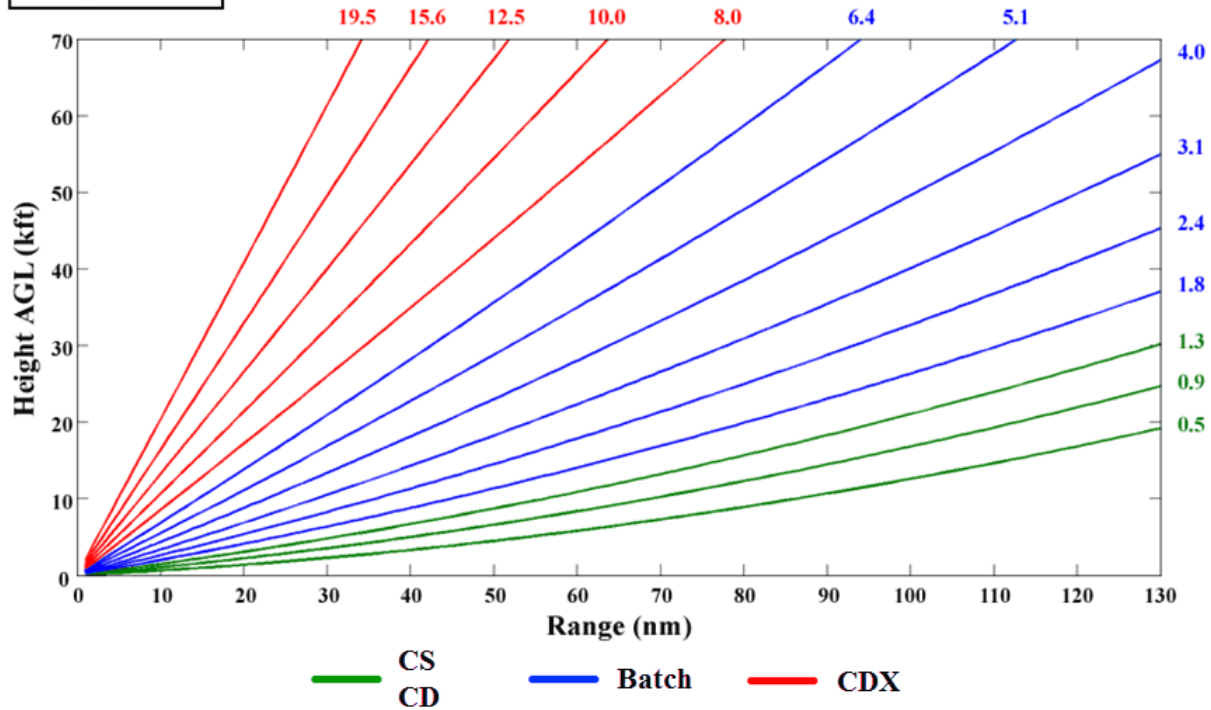
6.1 Volume Scan Strategy

The WSR-88D is a computer-controlled radar system, which automatically creates a complete series of specific scans in a specific sequence known as a volume scan. Individual elevation scans are immediately available on the WSR-88D's Principle Users Processor (PUP). Products that require data from multiple elevation scans are not available until the end of the five to ten minute volume scan.

The WSR-88D operates in several different scanning modes, identified as Mode A and Mode B. Mode A is the precipitation scan and has two common scanning strategies. The most common is where the radar makes 14 elevation scans from 0.5° to 19.5° about every four minutes. This particular scanning strategy is documented as volume coverage pattern 12 (VCP-12). Mode B is the clear-air mode, where the radar makes 5 elevation scans during a ten minute period (VCP-32). During the period surrounding the accident, the KFCX WSR-88D radar was operating in the precipitation mode (Mode A, VCP-12). The following chart provides an indication of the different elevation angles in this VCP, and the approximate height and width of the radar beam with distance from the radar site.

¹⁵ The WSR-88D is an S-band 10-centimeter wavelength radar with a power output of 750,000 watts, and with a 28-foot parabolic antenna that concentrates the energy between a 0.87° and 0.96° beam width. The radar produces three basic types of products: base reflectivity, base radial velocity, and base spectral width.

VCP 12



VCP-12 Precipitation Mode Scan Strategy

6.2 Beam Height Calculation

Assuming standard refraction¹⁶ of the WSR-88D 0.95° wide radar beam, the following table shows the approximate beam height and width¹⁷ information¹⁸ of the radar display over the site of the accident. The heights have been rounded to the nearest 10 feet.

ANTENNA ELEVATION	BEAM CENTER	BEAM BASE	BEAM TOP	BEAM WIDTH
0.5°	10,450 feet	6,900 feet	14,000 feet	7,100 feet

Based on the beam heights, the 0.5° elevation scan depicted the conditions between 6,900 feet and 14,000 feet msl over the accident site and these are the closest altitudes¹⁹ to the accident flight level before the accident occurred.

¹⁶ Standard Refraction in the atmosphere is when the temperature and humidity distributions are approximately average, and values set at the standard atmosphere.

¹⁷ Beam width – A measure of the angular width of a radar beam.

¹⁸ Beamwidth values are shown for legacy resolution products. Super resolution products would have an effective beamwidth that would be approximately half these values.

¹⁹ For more information please see the ATC data.

6.3 Reflectivity

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors²⁰ it is a function of the drop size distribution, number of particles per unit volume, physical state (ice or water), shape, and aspect. Reflectivity is normally displayed in decibels (dBZ²¹), and is a general measure of echo intensity. The chart below relates the NWS video integrator and processor (VIP) intensity levels versus the WSR-88D's display levels, precipitation mode reflectivity in decibels, and rainfall rates.

NWS VIP/DBZ CONVERSION TABLE

NWS VIP	WSR-88D LEVEL	PREC MODE DBZ	RAINFALL
0	0	< 5	
	1	5 to 9	
	2	10 to 14	
1 Very Light	3	15 to 19	.01 in/hr
	4	20 to 24	.02 in/hr
	5	25 to 29	.04 in/hr
2 Light to Moderate	6	30 to 34	.09 in/hr
	7	35 to 39	.21 in/hr
3 Strong	8	40 to 44	.48 in/hr
4 Very Strong	9	45 to 49	1.10 in/hr
5 Intense	10	50 to 54	2.49 in/hr
6 Extreme	11	55 to 59	>5.67 in/hr
	12	60 to 64	
	13	65 to 69	
	14	70 to 74	
	15	> 75	

²⁰ Hydrometeors are any product of condensation or sublimation of atmospheric water vapor, whether formed in the free atmosphere or at the earth's surface; also, any water particles blown by the wind from the earth's surface. Hydrometeors are classified as; (a) Liquid or solid water particles suspended in the air: cloud, water droplets, mist or fog. (b) Liquid precipitation: drizzle and rain. (c) Freezing precipitation: freezing drizzle and freezing rain. (d) Solid (frozen) precipitation: ice pellets, hail, snow, snow pellets, and ice crystals. (e) Falling particles that evaporate before reaching the ground: virga. (f) Liquid or solid water particles lifted by the wind from the earth's surface: drifting snow, blowing snow, blowing spray. (g) Liquid or solid deposits on exposed objects: dew, frost, rime, and glazed ice.

²¹ dBZ – A non-dimensional “unit” of radar reflectivity which represents a logarithmic power ratio (in decibels , or dB) with respect to radar reflectivity factor, Z.

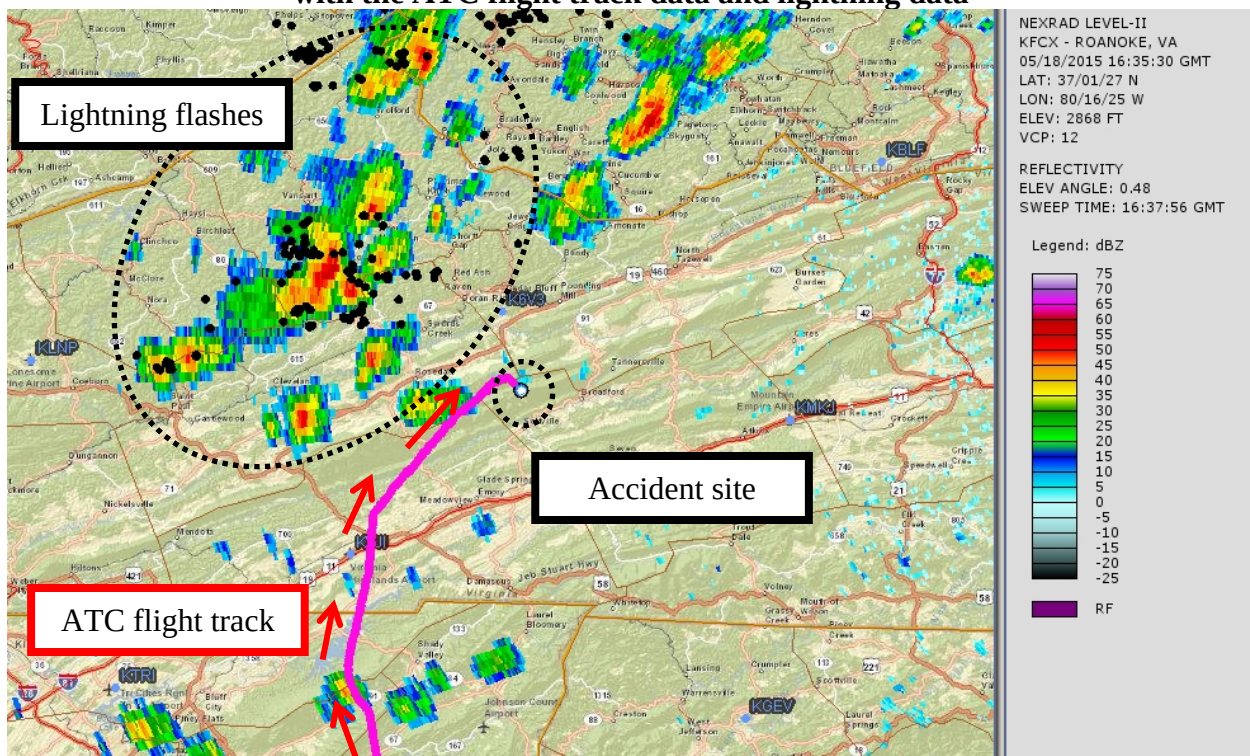
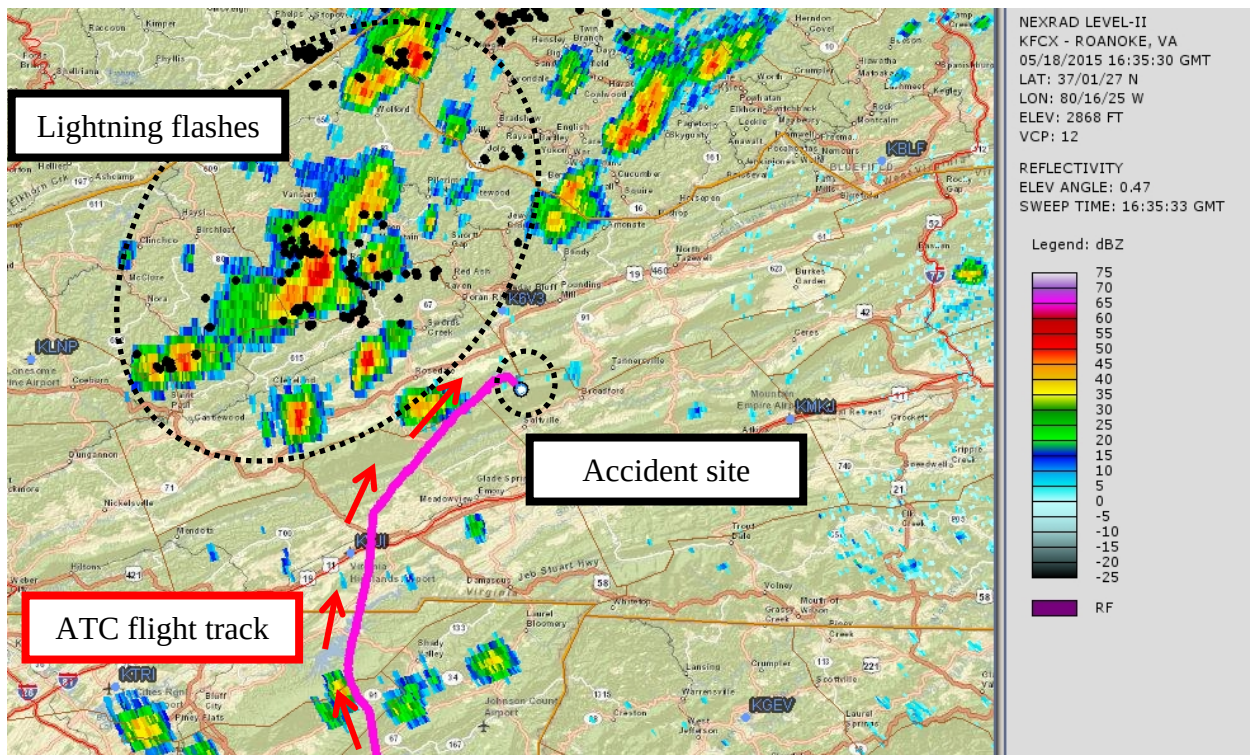
The Federal Aviation Administration (FAA) Advisory Circular AC 00-24B titled “Thunderstorms” dated January 2, 1983, also defines the echo intensity levels and potential weather phenomena associated with those levels. If the maximum VIP Level is 1 “weak” and 2 “moderate”, then light to moderate turbulence is possible with lightning. VIP Level 3 is “strong” and severe turbulence is possible with lightning. VIP Level 4 is “very heavy” and severe turbulence is likely with lightning. VIP Level 5 is “intense” with severe turbulence, lightning, hail likely, and organized surface wind gusts. VIP Level 6 is “extreme” with severe turbulence, lightning, large hail, extensive surface wind gusts and turbulence.

6.4 Base Reflectivity

Figures 13, 14, 15, and 16 present the KFCX WSR-88D base reflectivity images for the 0.5° elevation scans initiated at 1235, 1238, 1240, and 1242 EDT with a resolution of 0.5° X 250 m. There were rain showers and thunderstorms to the north and west of the flight track (accident aircraft’s flight track obtained from ATC²², pink line). At 1238 and 1240 EDT reflectivity targets start to increase in coverage and intensity right at the accident site at the accident time. By 1242 EDT, the reflectivity values are between 10 and 30 dBZ at the over the accident site, indicative of very light to moderate echoes. It is likely that a rain shower developed right in the path of the accident flight at the accident time. All the lightning flashes²³ and strikes were north and west of the flight track between 1143 and 1334 EDT.

²² For more information see the ATC data.

²³ Lightning Flash – This is one contiguous conducting channel and all the current strokes/pulses that flow through it. There are two types of flashes: ground flashes and cloud flashes.



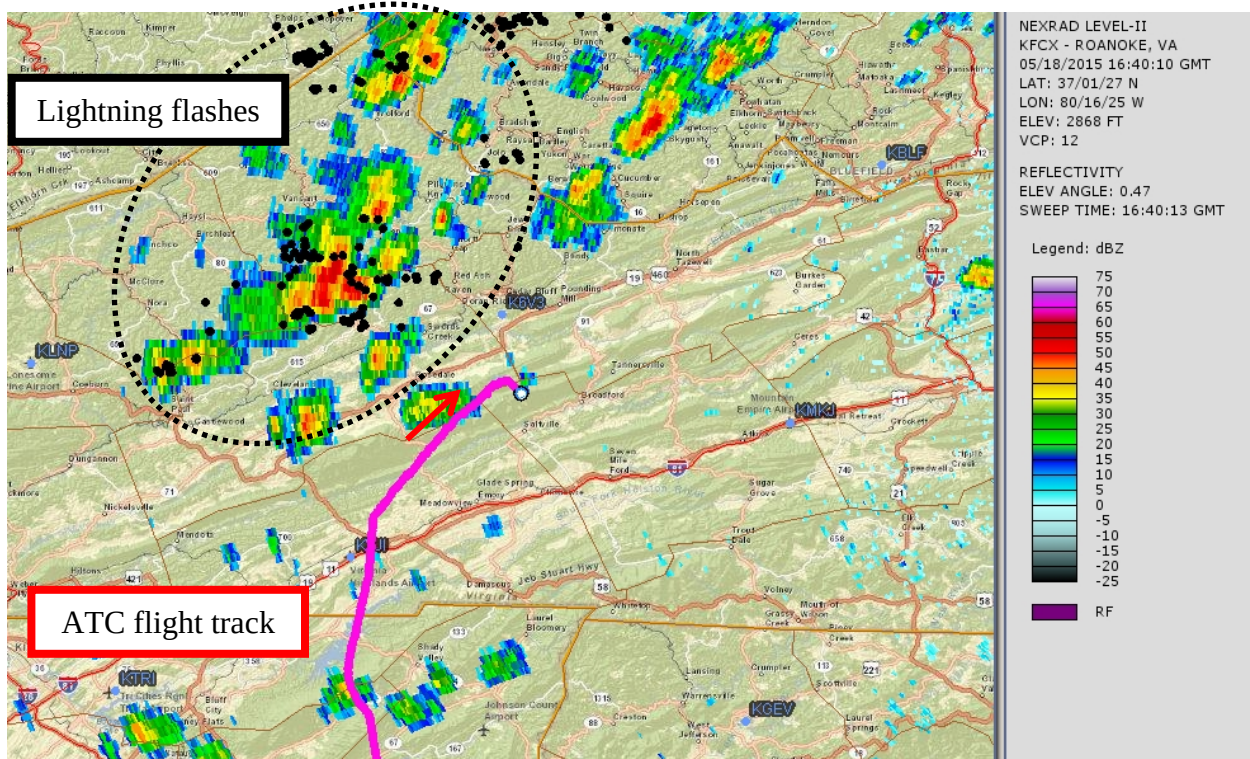


Figure 15 – KFCX WSR-88D reflectivity for the 0.5° elevation scan initiated at 1240 EDT with the ATC flight track data and lightning data

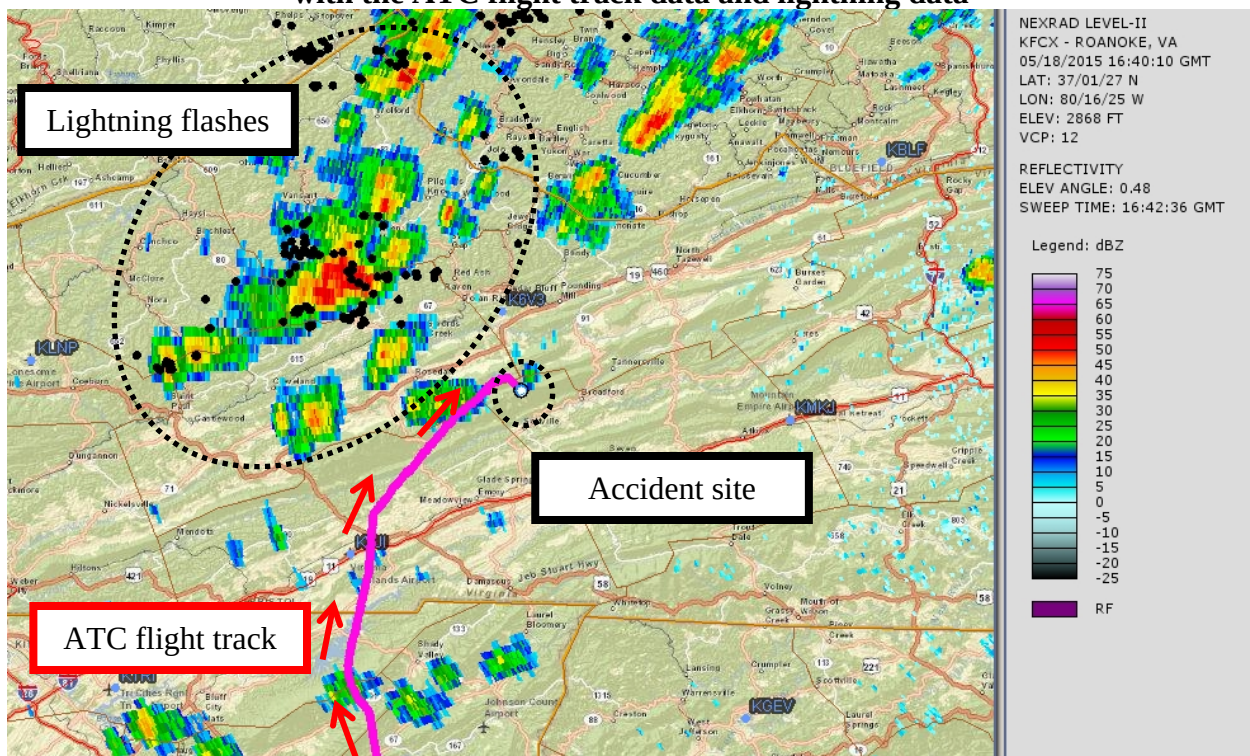


Figure 16 – KFCX WSR-88D reflectivity for the 0.5° elevation scan initiated at 1242 EDT with the ATC flight track data and lightning data

6.5 3-Dimensional Radar Reflectivity Data

Figures 17 and 18 present a 3-dimensional view of the KFCX WSR-88D base reflectivity for the elevation scans initiated at 1240 EDT (figure 17) and 1245 EDT (figure 18). The accident aircraft's flight track obtained from ATC was also plotted on the Google Earth image for a time comparison with the base reflectivity images. The images showed the accident flight accident site located within greater than 5 dBZ values at 1240 EDT with that area of greater than 5 dBZ expanding in coverage and height by 1245 EDT. Before the 1240 EDT base reflectivity scans the area of greater than 5 dBZ located in the accident flight track does not show up. It is likely that the accident flight flew into a developing rain shower and updraft around the accident time.

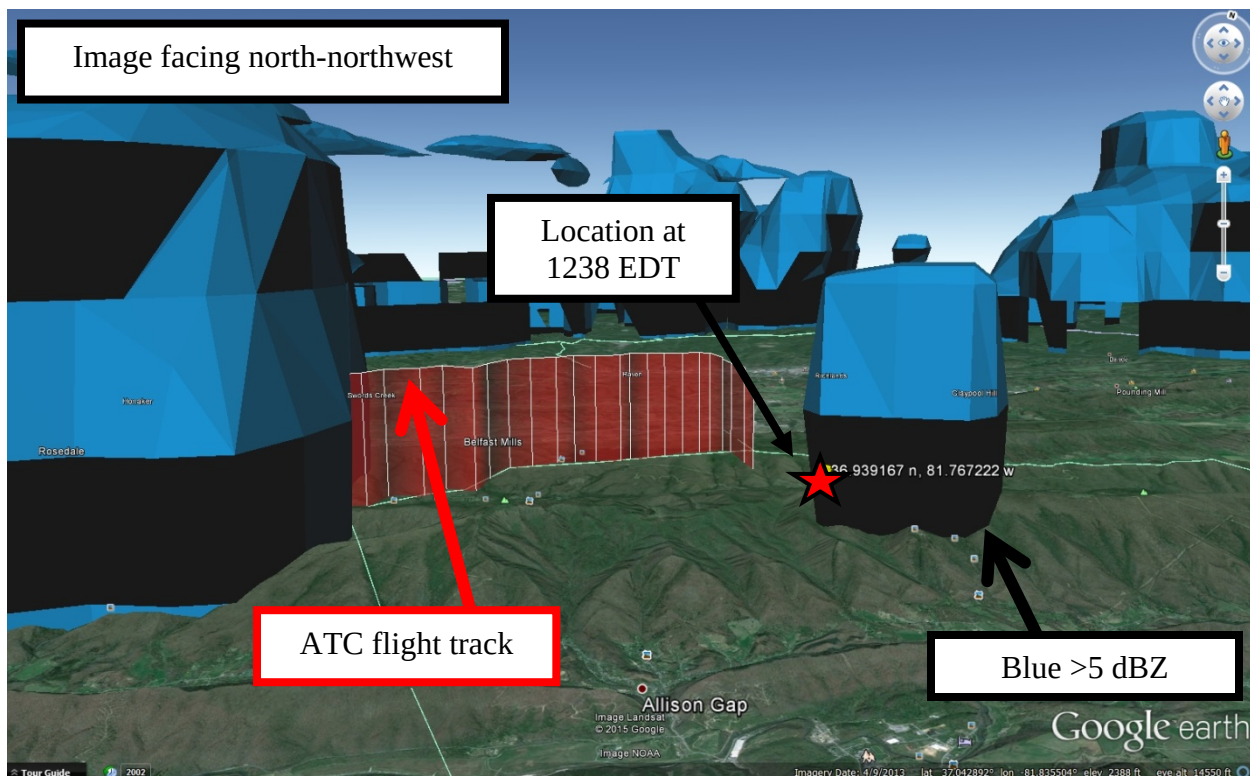


Figure 17 – 3-dimensional KFCX WSR-88D base reflectivity from the scan initiated at 1240 EDT and the ATC Flight Track

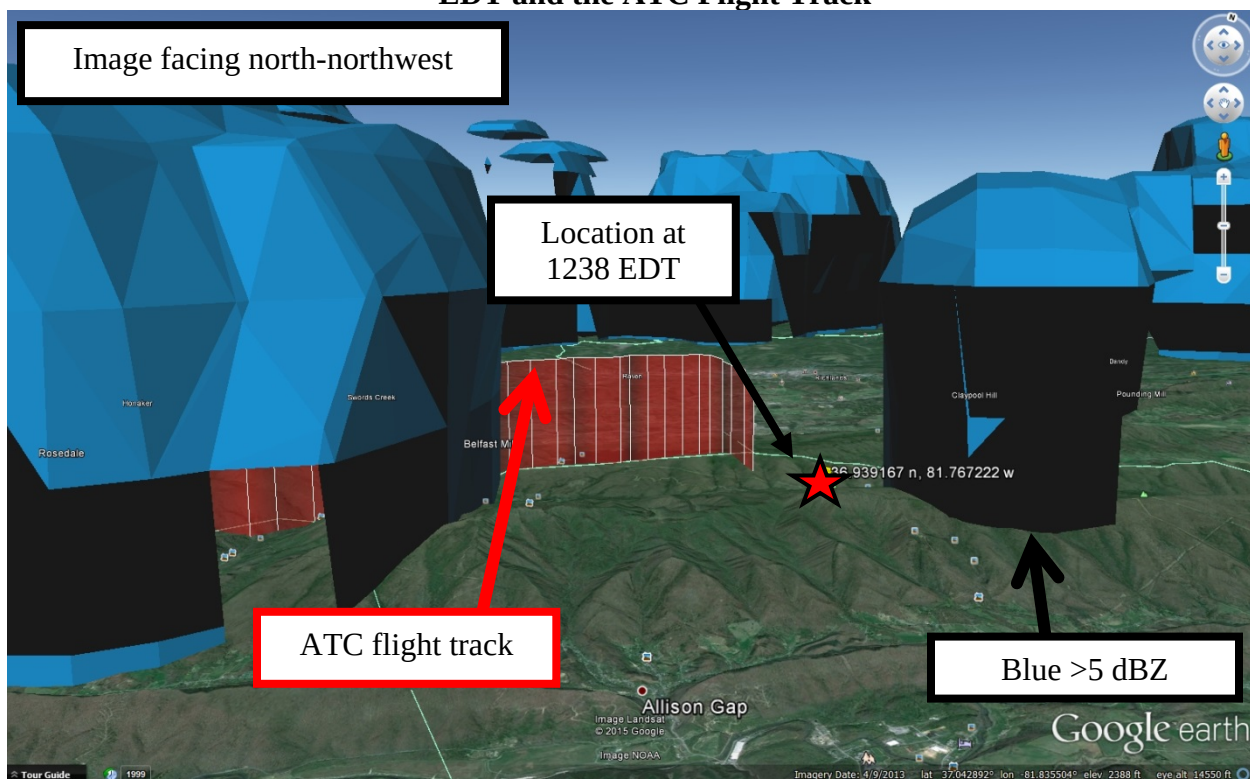


Figure 18 – 3-dimensional KFCX WSR-88D base reflectivity from the scan initiated at 1245 EDT and the ATC Flight Track

7.0 Pilot Reports

All pilot reports (PIREPs) were reviewed close to the accident site for below 25,000 feet msl from around three hours prior to the accident time to around two hours after the accident time and are displayed below:

CSV UA /OV CSV270003 /TM 1414 /FL170 /TP SR22 /SK OVC-TOP156 /WV 24023KT /TB LGT CHOP /RM STORMS ON EITHER SIDE=

BKW UA /OV GZG345020/TM 1509/FL170/TP DH8C/TA M07/IC LGT RIME

PBX UA /OV ECB180021/TM 1706/FL070/TP SR22/TB LGT/RM -RA

BKW UA /OV AZQ290020/TM 1716/FL180/TP CRJ2/TA M03/IC LGT MX/RM FROM 180-195

KLWB UA /OV LWB/TM 1740/FL5100/TP SF34/SK BASES 5100

TYS UA /OV VXV160020/TM 1745/FL150/TP PA32/TA 00/IC LGT RIME 150/RM CWSU ZTL=

Routine pilot report (UA); 3 miles from Crossville, Tennessee, on the 270° radial; Time – 1014 EDT (1414Z); Altitude – 17,000 feet; Type aircraft – Cirrus SR-22; Sky – Overcast with tops at 15,600 feet msl; Wind – From 240° at 23 knots; Turbulence – Light chop; Remarks – Storms on either side.

Routine pilot report (UA); 20 miles from Blackford, Virginia, on the 345° radial; Time – 1109 EDT (1509Z); Altitude – 17,000 feet; Type aircraft – De Havilland Dash 8; Temperature – -7° C; Icing – Light rime.

Routine pilot report (UA); 21 miles from Newcombe, Kentucky, on the 180° radial; Time – 1306 EDT (1706Z); Altitude – 7,000 feet; Type aircraft – Cirrus SR-22; Turbulence – Light; Remarks – Light rain.

Routine pilot report (UA); 20 miles from Hazard, Kentucky, on the 290° radial; Time – 1316 EDT (1716Z); Altitude – 18,000 feet; Type aircraft – Bombardier CRJ-700; Temperature – -3° C; Icing – Light mixed; Remarks – From 18,000 to 19,500 feet.

Routine pilot report (UA); Over Lewisburg, West Virginia; Time – 1340 EDT (1740Z); Altitude – 5,100 feet; Type aircraft – Saab 340; Sky – Bases at 5,100 feet.

Routine pilot report (UA); 20 miles from Knoxville, Tennessee, on the 160° radial; Time – 1345 EDT (1745Z); Altitude – 15,000 feet; Type aircraft – Piper PA-32; Temperature – 0° C; Icing – Light rime at 15,000 feet.

ATC tapes were reviewed and no additional PIREPs were given to air traffic control.

8.0 SIGMET and CWSU Advisory

No SIGMET was valid for the accident site at the accident time. A SIGMET was issued for the accident area at 1248 EDT (figure 19). SIGMET 13E warned of a developing area of thunderstorms moving from 250° at 10 knots with tops to FL370²⁴:

WSUS31 KPCI 181655
SIGE
_MKCE WST 181655

2015138 1648

CONVECTIVE SIGMET 13E
VALID UNTIL 1855Z
VA WV KY
FROM 40S HNN-20NE BKW-20NNE HNV-30NNW HNV-40S HNN
DVLPG AREA TS MOV FROM 25010KT. TOPS TO FL370.

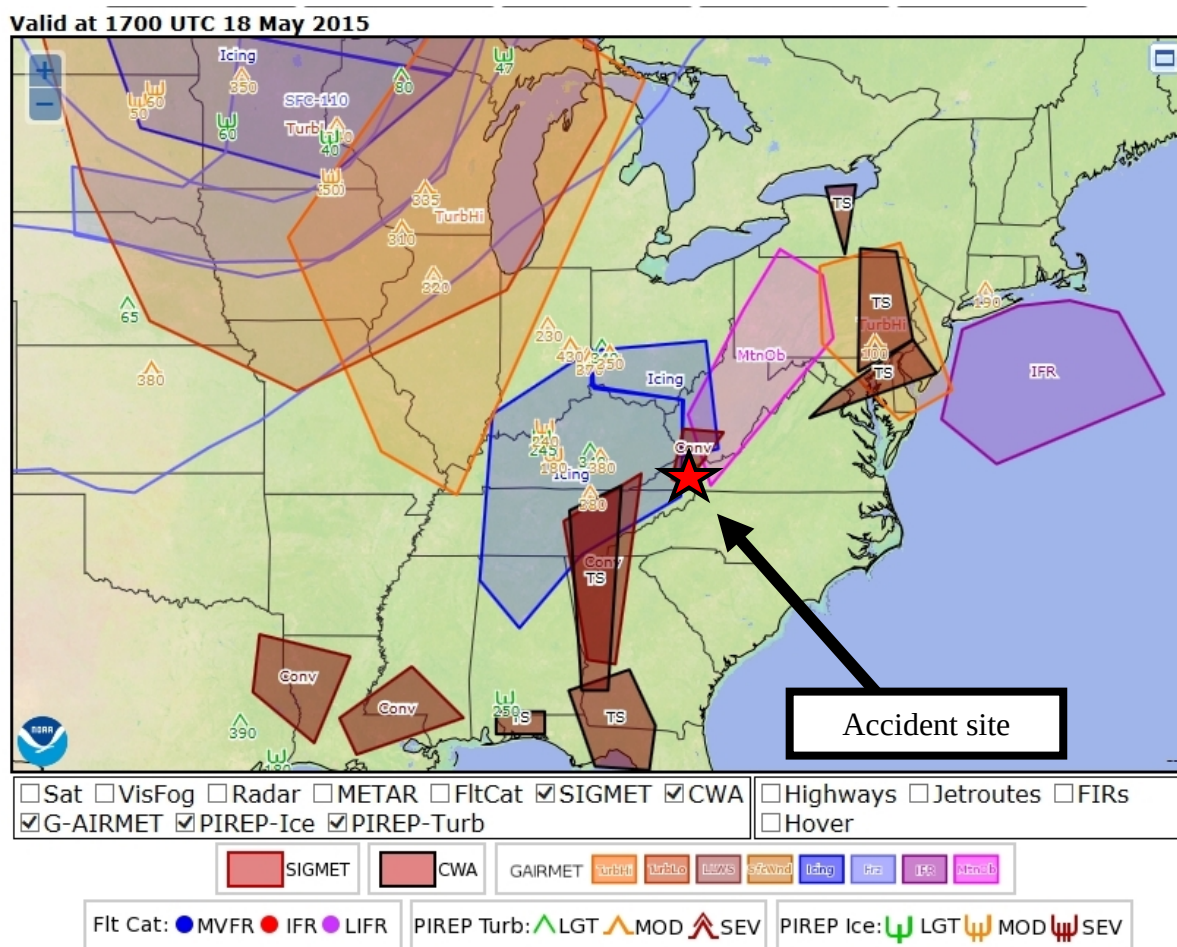


Figure 19 – SIGMETs, CWAs, and AIRMETs valid for the accident area at 1300 EDT

²⁴ Flight Level – A Flight Level (FL) is a standard nominal altitude of an aircraft, in hundreds of feet. This altitude is calculated from the International standard pressure datum of 1013.25 hPa (29.92 inHg), the average sea-level pressure, and therefore is not necessarily the same as the aircraft's true altitude either above mean sea level or above ground level.

A meteorological impact statement (MIS) was valid for the accident area at the accident time. The MIS was issued at 0748 EDT and valid through 1400 EDT. It forecasted isolated embedded thunderstorms through 1100 EDT with a gradual increase to scattered coverage of thunderstorms after 1100 EDT. The maximum thunderstorm tops were forecast to be to FL350 through 1100 EDT then up to FL430 through 1400 EDT with thunderstorm movement from 230° at 20 knots:

FAUS20 KZID 181148
ZID MIS 01 VALID 181150-181800
...FOR ATC PLANNING PURPOSES ONLY...
ACROSS ZID OCNL MOD RIME/MXD ICG IN PCPN 130-FL260.
IN ZID E OF A LINE FWA-IND-40SW TTH ISOL EMBD TS THRU
15Z THEN TS GRADU INCREASE TO SCT COVERAGE. MAX TOPS
FL350 THRU 15Z THEN TOPS TO FL430. TS MOVE FROM 23020KT.=

No CWSU Advisory (CWA) was valid for the accident site at the accident time. A CWA was valid for west of the accident flight track between 1204 and 1305 EDT (figure 20) and the CWA warned of areas of heavy to extreme precipitation in isolated thunderstorms moving from 230° at 10 knots with maximum tops to FL400. The coverage and intensity were expected to increase through the period:

FAUS22 KZTL 181603
ZTL2 CWA 181604
ZTL CWA 202 VALID UNTIL 181705
FROM 50N VXV-PZD-40W PZD-60E BNA-50N VXV
AREA HVY-EXTRM PCPN IN ISOLD TS. MOVG FM 23010KTS. MAX TOPS NR
FL400. EXP INCR IN COVG/INTST THRU PD.
=

Valid at 1600 UTC 18 May 2015

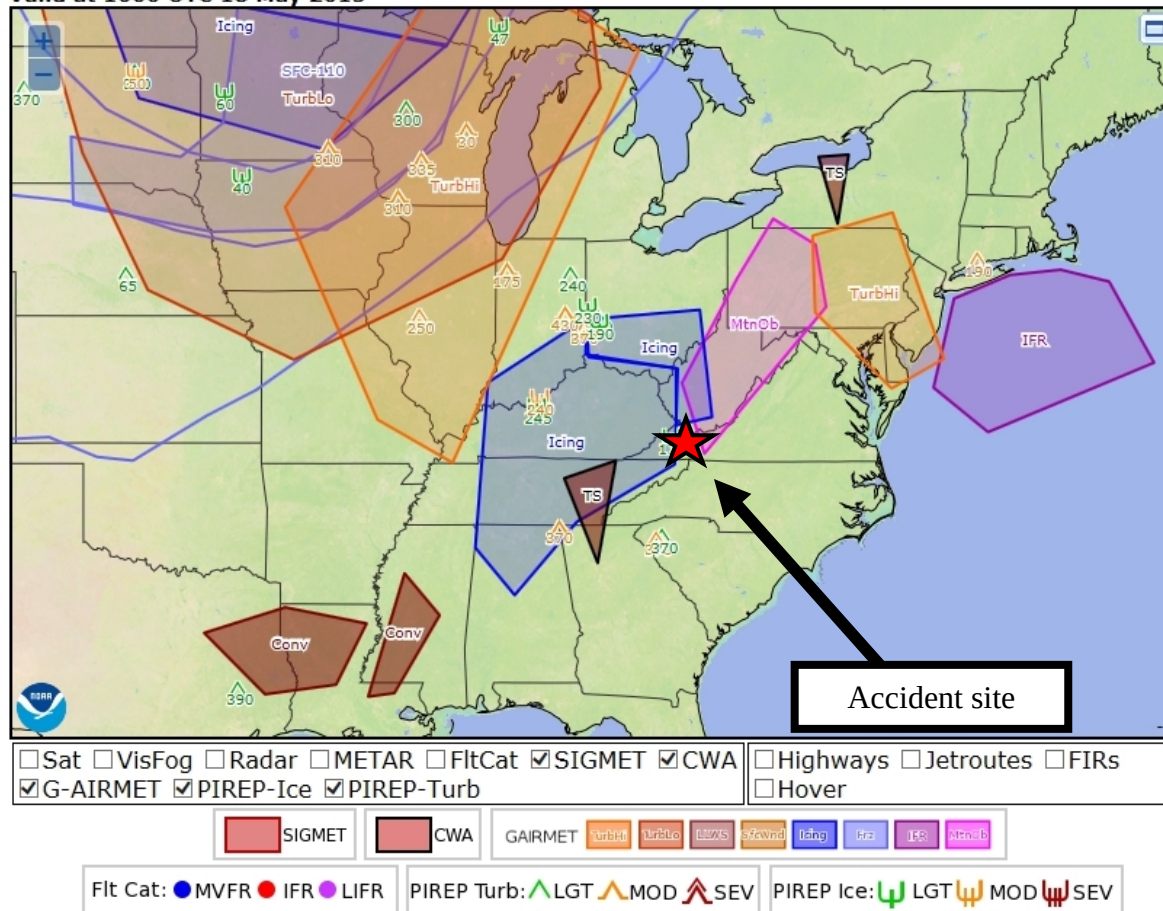


Figure 20 – SIGMETs, CWAs, and AIRMETs valid for the accident area at 1200 EDT

In addition, both the Center Weather Service Units at Atlanta (ZTL) and Indianapolis (ZID) Air Route Traffic Control Centers produced internal graphical products that forecasted scattered rain shower and thunderstorm activity along the accident flight track and those graphics are provided in attachments 2 through 5. The ZTL Weather Bulletin produced at 0628 EDT forecasted scattered thunderstorm and rain shower activity across the western and northern ZTL areas (including the accident flight route), with the 1235 EDT Weather Bulletin forecasting similar conditions (attachments 2 and 3). ZID produced a similar forecast with their stand up graphics for 0700 EDT (attachment 4), and their updated morning weather graphics (attachment 5) produced at 0750 EDT (icing chart), 0909 EDT (Terminal Aerodrome Forecast “TAF” chart), 0942 EDT (thunderstorm chart), and 1138 EDT (turbulence chart). ZID forecasted widely scattered thunderstorms with tops to FL430 on the 0700 EDT morning graphic. The thunderstorm activity was updated to scattered by the 0942 EDT ZID forecast graphic with tops to FL450 and thunderstorm activity expected to diminish after 1900 EDT.

9.0 CCFP and CAWS

The Collaborative Convective Forecast Product (CCFP) guidance is an automated forecasting tool available via the Aviation Weather Center website that forecast areas of convective (thunderstorm) activity for the United States. The CCFP issued at 0700 EDT valid for 1300 EDT forecasted low confidence of scattered coverage of thunderstorm activity for the accident site (figure 21). A similar CCFP forecast was issued at 0900 EDT for scattered thunderstorm activity for the accident site valid at 1300 EDT (figure 22). By the 1100 EDT CCFP forecast the confidence had improved to medium or above of scattered thunderstorm activity across much of the southern United States and Tennessee Valley with the accident flight track right along the eastern edge of the forecast for scattered thunderstorm activity (figure 23).

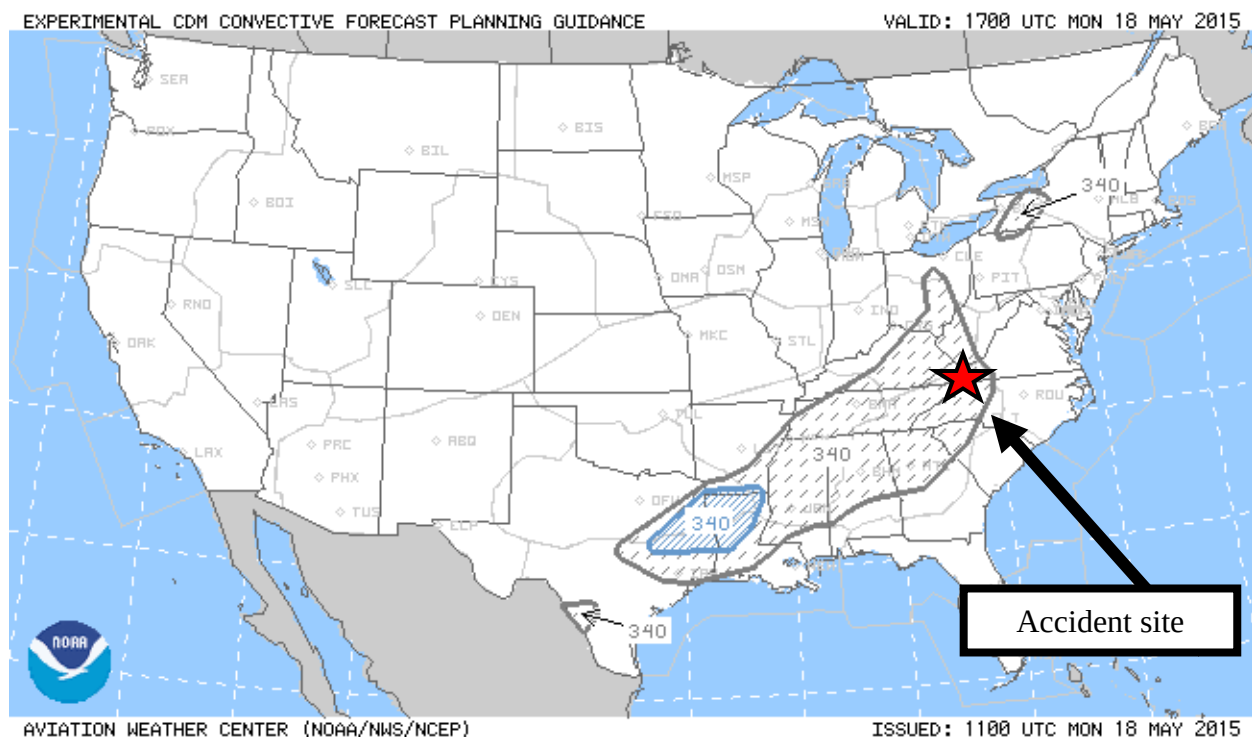


Figure 21 – CCFP issued at 0700 EDT valid at 1300 EDT



AVIATION WEATHER CENTER (NOAA/NWS/NCEP)

ISSUED: 1300 UTC MON 18 MAY 2015

Figure 22 – CCFP issued at 0900 EDT valid at 1300 EDT

AVIATION WEATHER CENTER (NOAA/NWS/NCEP)

ISSUED: 1500 UTC MON 18 MAY 2015

Figure 23 – CCFP issued at 1100 EDT valid at 1300 EDT

In addition to the CCFP, the Aviation Weather Center issued two Collaborative Aviation Weather Statements (CAWS)s valid for the accident site at the accident time. CAWS 002 was issued at 0928 EDT and valid through 1500 EDT. It forecasted scattered thunderstorms developing by 1300 EDT moving northeast to east at 15 knots with tops to FL450 (figure 24). CAWS 005 was issued at 1204 EDT and it forecasted scattered thunderstorms across the accident site, western Pennsylvania, West Virginia, and western Virginia by 1600 EDT with tops to FL400-FL450 with those thunderstorms moving eastward at 10 knots (figure 25). The texts for CAWS 002 and 005 are below:

Collaborative Aviation Weather Statement 002
NWS Aviation Weather Center Kansas City MO
1328 UTC Mon 18 May 2015

Weather: Thunderstorms
Valid: 1328-1900Z

ARTCCs affected: ZBW, ZDC, ZID, ZNY, ZOB
Terminals affected: KBWI, KDCA, KIAD, KPHL

SUMMARY: Scattered thunderstorms developing by 17Z.

DISCUSSION: Warm, moist air over the northeast today will allow development of scattered thunderstorms by 17Z. Storms will move northeast to east around 15 kts with tops above FL450.

BOUNDING BOX: 45.43,-88.90 37.10,-88.38 35.20,-72.98 44.64,-71.11 45.43,-88.90

Collaborative Aviation Weather Statement 005
NWS Aviation Weather Center Kansas City MO
1604 UTC Mon 18 May 2015

Weather: Thunderstorms
Valid: 1604-2000Z

ARTCCs affected: ZBW, ZDC, ZID, ZME, ZNY, ZOB, ZTL
Terminals affected: KBWI, KDCA, KIAD, KPHL

SUMMARY: Thunderstorm coverage focused in three areas from the Ohio River Valley to central NY through eastern VA.

DISCUSSION: Unstable airmass across the Northeast is producing isolated thunderstorms. Expect increasing coverage through 1700Z and expansion of areas through the period. These are higher confidence forecasts than depicted by CCFP.

BOUNDING BOX: 44.50,-77.92 38.81,-89.65 35.12,-91.10 32.78,-82.24 38.45,-73.13 45.09,-70.48 44.50,-77.92

10.0 AIRMETS

AIRMET Sierra issued at 1045 EDT, and valid at the accident time, was the only AIRMET valid for the accident site at the accident time at the accident flight level. AIRMET Sierra forecasted mountains obscured by clouds, precipitation, and mist (figures 19 and 20):

WAUS41 KPCI 181445
WA1S

_BOSS WA 181445
 AIRMET SIERRA UPDT 2 FOR IFR AND MTN OBSCN VALID UNTIL 182100

.

AIRMET IFR...NY PA
 FROM 20SE BUF TO 30NE SLT TO JST TO 40NE EWC TO 20W JHW TO 20SE
 BUF
 CIG BLW 010/VIS BLW 3SM BR. CONDS ENDG 15-18Z.

.

AIRMET IFR...NH MA RI CT NY NJ PA AND CSTL WTRS
 FROM 40WSW CON TO 30SSE CON TO 20WSW ACK TO 50ESE ACK TO 70SE
 ENE TO 140ENE ACK TO 200SE ACK TO 160SE SIE TO 50SSE SIE TO 20W
 SAX TO 40ESE HNK TO 40SE ALB TO 20E JFK TO 40SSW PVD TO 40WSW CON
 CIG BLW 010/VIS BLW 3SM BR. CONDS CONTG BYD 21Z THRU 03Z.

.

AIRMET MTN OBSCN...ME NH VT MA NY
 FROM 70NW PQI TO MLT TO CON TO 30SSE ALB TO 30E PLB TO YSC TO
 70NW PQI
 MTNS OBSC BY CLDS/BR. CONDS ENDG 15-18Z.

.

**AIRMET MTN OBSCN...NY PA WV MD VA
 FROM 40ESE BUF TO 60WSW HNK TO 30N HAR TO 40W EMI TO 20ESE PSK
 TO HNV TO HNN TO EWC TO JHW TO 40ESE BUF
 MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 21Z THRU 03Z.**

.

OTLK VALID 2100-0300Z
 AREA 1...IFR ME NH VT MA RI CT NY NJ PA MD DE AND CSTL WTRS
 BOUNDED BY 30ESE BGR-50NNE ACK-140E ACK-200SE ACK-160SE SIE-20N
 SBY-20ENE HAR-30ENE SYR-40S PLB-BDL-50N ENE-30ESE BGR
 CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG THRU 03Z.

.

AREA 2...MTN OBSCN ME NH VT MA NY PA WV MD VA
 BOUNDED BY 60E YQB-MLT-CON-40W EMI-40SSE PSK-HNV-HNN-30ESE AIR-
 SYR-MSS-YSC-60E YQB
 MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG THRU 03Z.

....

11.0 Area Forecast

The Area Forecast issued at 1011 EDT, valid at the accident time, forecasted scattered clouds at 5,000 feet msl with a broken ceiling at 10,000 feet with layered clouds to FL250. Widely scattered thunderstorms were not forecast until 1500 EDT in the 1011 EDT Area Forecast:

FAUS41 KPCI 181411 AAA
 FA1W
 _BOSC FA 181411 AMD
 SYNOPSIS AND VFR CLDS/WX
 SYNOPSIS VALID UNTIL 190300
 CLDS/WX VALID UNTIL 182100...OTLK VALID 182100-190300
 ME NH VT MA RI CT NY LO NJ PA OH LE WV MD DC DE VA AND CSTL WTRS

.

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...09Z WRMFNT ALG A YYZ-40SW HNK LN...CONTG AS A CDFNT
ALG A 40SW HNK-CYN-180SE SIE LN. 03Z CDFNT ALG A DXO-IIU LN.
CDFNT ALG AN ECG-CSN-PSB LN...CONTG AS A WRMFNT ALG A PSB-YOW LN.

.
ME

N HLF...OVC015 TOPS 050. BECMG 1215 SCT030. 17Z SCT CI.
OTLK...VFR.
SW QTR...OVC015 TOPS 060. VIS 3-5SM BR. 14Z SCT025. OTLK...VFR
01Z IFR CIG.
SE QTR...OVC015 TOPS 050. 16Z SCT025 SCT050. OTLK...VFR.

.
NH

BKN020 TOPS 060. 14Z SCT025 SCT050. OTLK...VFR.

.
VT

SCT025. OCNL VIS 5SM BR. BECMG 1214 SCT035-040 SCT CI.
OTLK...VFR.

.
MA RI CT

W HLF MA/NRN CT...BKN030 TOPS 060. TIL 12Z OCNL VIS 3SM BR. BECMG
1517 BKN050. OTLK...VFR THRUT EXC MVFR CIG EXTRM WRN MA.
SRN CT...OVC010 TOPS 060. VIS 3SM BR. OCNL -DZ. BECMG 1619
BKN015-025. OTLK...IFR CIG BR.
CAPE COD AND ISLANDS...BKN010 TOPS 040. VIS 3SM BR. BECMG 1518
BKN010-015. OTLK...IFR CIG 23Z VFR.
RMNDR E HLF MA/RI...OVC010-015 TOPS 060. VIS 3-5SM BR. BECMG 1316
BKN040-045. OTLK...VFR.

.
NY LO...UPDT

EXTRM SERN NY...BKN-OVC015 TOPS 070. TIL 15Z VIS 3SM -DZ BR.
OTLK...MVFR CIG.
EXTRM NERN NY...SCT CI. OCNL SCT020 WITH VIS 3-5SM BR. BECMG 1215
SCT CI. OTLK...VFR SHRA.
RMNDR ERN NY...SCT015 SCT CI. OCNL VIS 3-5SM BR. 12Z SCT040
BKN-SCT CI. BECMG 1516 BKN040 TOPS 070. OTLK...VFR 00Z SHRA.
CNTRL NY/ERN LO...SCT050 SCT-BKN CI. OCNL VIS 3-5SM BR. 14Z
SCT-BKN050 TOPS 120. BECMG 1619 SCT035 BKN060 LYRD FL250. SCT
-TSRA. CB TOPS FL400. OTLK...MVFR SHRA BR.
WRN NY/WRN LO...BKN020-030 TOP 120. BECMG 1618 BKN040 TOP FL220.
WDLY SCT -SHRA/TSRA. CB TOP FL400. OTLK...N HLF VFR TIL 02Z SHRA
TSRA S HLF MVFR CIG SHRA TSRA.

.
PA NJ

W HLF PA...SCT025-030 SCT100. TIL 15Z VIS 3-5SM BR. BECMG 1518
BKN050-060 LYRD FL200. WDLY SCT -SHRA/-TSRA. CB TOPS FL400.
OTLK...VFR SHRA TSRA.
NERN QTR PA...SCT020 SCT-BKN040 TOPS 100. TIL 13Z VIS 3SM BR WRN
SXNS. 18Z BKN045 TOPS 120. WDLY SCT -TSRA. CB TOPS FL400.
OTLK...VFR TSRA.
SE QTR PA/NJ...SCT020 BKN050 TOPS 120. VIS 3-5SM BR. BECMG 1315
BKN015-025. WDLY SCT -SHRA. 18Z SCT -SHRA. WDLY SCT -TSRA. CB
TOPS FL400. OTLK...MVFR CIG SHRA 01Z IFR CIG SHRA BR.

.
OH LE

N HLF OH/LE...SCT035 SCT-BKN060 BKN120 TOPS 140. TIL 13Z OCNL VIS
4SM BR. 18Z BKN050 LYRD FL250. WDLY SCT -TSRA. CB TOPS FL400.

OTLK...VFR TSRA.
 S HLF OH...SCT030 SCT100 SCT-BKN CI. OCNL VIS 3-5SM BR. BECMG
 1315 BKN045 LYRD FL250. WDLY SCT -SHRA/-TSRA. BECMG 1720 BKN050.
 SCT -SHRA. WDLY SCT -TSRA. CB TOPS FL400. OTLK...VFR SHRA TSRA.
 .
 WV
 NW HLF...SCT015 BKN-SCT100 LYRD FL220. OCNL VIS 4SM BR. BECMG
 1315. SCT-BKN050. WDLY SCT -TSRA. CB TOPS FL400. 18Z BKN050. SCT
 -TSRA. OTLK...VFR TSRA.
 NRN MTNS...BKN035 TOPS 050. VIS 3SM BR. 14Z BKN060 LYRD FL220.
 18Z SCT -TSRA. CB TOPS FL400. OTLK...MVFR TSRA.
 RMNDR SE HLF...SCT030 SCT-BKN100 LYRD FL250. TIL 14Z OCNL VIS
 3-5SM BR. 18Z SCT045 BKN060. SCT -SHRA/-TSRA. CB TOPS FL400.
 OTLK...VFR SHRA TSRA.
 .
 MD DC DE VA
 N HLF...SCT-BKN045 BKN080 LYRD FL200. OCNL VIS 3-5SM BR. 13Z
 BKN045. 16Z SCT025 BKN045. SCT -SHRA. WDLY SCT -TSRA. CB TOPS
 FL400. OTLK...VFR SHRA THRUT EXC MVFR CIG SHRA BR ERN SXNS.
SW QTR...SCT015 SCT100 SCT-BKN CI. VIS 3-5SM BR. BECMG 1315
SCT050 BKN100 LYRD FL250. 19Z WDLY SCT -TSRA. CB TOPS FL400.
OTLK...VFR TSRA.
 SE QTR...SCT080 BKN150 TOPS FL200. BECMG 1619 BKN060 BKN150.
 OTLK...VFR TSRA.
 .
 CSTL WTRS
 NEW ENG/NY...BKN-OVC010 TOPS 050. OCNL VIS 3-5SM BR. OTLK...IFR
 CIG.
 RMNDR...SCT-BKN040 BKN070 TOPS 140. OTLK...VFR THRUT...SHRA
 NRSHR.

12.0 Terminal Aerodrome Forecast

Mercer County Airport (KBLF), located near Bluefield, West Virginia, was the closest site with a NWS TAF. KBLF is located 34 miles northeast of the accident site. The TAF valid at the time of the accident was issued at 0722 EDT and was valid for a 24-hour period beginning at 0800 EDT. The TAF forecast for KBLF was as follows:

TAF KBLF 181122Z 1812/1912 **26007KT P6SM VCSH BKN035 BKN070 OVC250**
 FM181700 28008KT P6SM VCTS BKN035CB OVC070
 TEMPO 1818/1822 3SM TSRA BR SCT015 BKN025CB
 FM182200 28007KT 5SM -SHRA BR VCTS SCT015 BKN030CB
 FM190200 29005KT 4SM -SHRA BR BKN015 OVC035
 FM190400 29005KT 4SM BR VCSH BKN004 OVC015=

The forecast expected wind from 260° at 7 knots, greater than 6 miles visibility, vicinity²⁵ showers, a broken ceiling at 3,500 feet agl, broken skies at 7,000 feet agl, and overcast skies at 25,000 feet agl.

²⁵ Vicinity – Weather phenomena between 5 and 10 statute miles of the point(s) of observation.

13.0 National Weather Service Area Forecast Discussion

The National Weather Service Office in Blacksburg, Virginia, issued the following Area Forecast Discussion at 1114 EDT (closest AFD to the accident time), which discussed slow moving rain shower and thunderstorm activity expected across southwestern Virginia and southern West Virginia with rain shower activity present at the time of the AFD issuance (1114 EDT). There was medium or greater confidence in the aviation forecast this day:

000
FXUS61 KRNK 181514
AFDRNK

AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE BLACKSBURG VA
1114 AM EDT MON MAY 18 2015

.SYNOPSIS...

HIGH PRESSURE OFFSHORE WILL MAINTAIN A MOIST SOUTHERLY FLOW OF AIR ACROSS THE REGION TODAY. A COLD FRONT WILL SLOWLY APPROACH FROM THE WEST TONIGHT...MOVING THROUGH THE REGION TUESDAY. COOLER...DRIER AIR WILL FILTER INTO THE REGION BY THE MID PART OF THE WEEK BEHIND THE FRONT.

&&

.NEAR TERM /THROUGH TONIGHT/...
AS OF 1100 AM EDT MONDAY...

MORNING RNK/GSO SOUNDINGS WERE MOIST WITH PWATS NEAR 1.50 INCHES...2-3 STANDARD DEVIATIONS ABOVE NORMAL. AIRMASS IS UNSEASONABLY JUICY FOR THE DATE AND PRETTY MUCH SETS THE TONE FOR THE FORECAST WHICH ENTERTAINS SLOW MOVING SHOWERS AND THUNDERSTORMS WITH POTENTIAL FOR HEAVY RAIN.

FORECAST AREA REMAINS UNDERNEATH A VERY SHARP UPPER LEVEL RIDGE...WHICH IS PROMOTING VERY LIGHT STEERING WINDS...0-8KM MEAN WIND OF ONLY 11 KTS...FROM 290 DEGREES. THIS UPPER RIDGE IS EXPECTED TO WEAKEN AS WE TRANSITION THROUGH THE DAY...WITH THE RIDGE SHOWING SIGNS OF FLATTENING AS A DEEP LOW PASSES ACROSS THE NORTHERN PLAINS. AT THE SURFACE...A COLD FRONT WILL BE ENTERING THE OHIO VALLEY FROM THE UPPER MID WEST. AS THE FRONT MOVES ACROSS THE OHIO VALLEY TODAY IT WILL BEGIN TO FOCUS THE DEEPER MOISTURE FROM THE OH/TN VALLEYS INTO THE WEST SIDE OF THE APPALACHIANS. THIS SQUEEZE PLAY OF DEEPER MOISTURE IN ADDITION TO HEATING AND INSTABILITY OVER THE MOUNTAINS SHOULD RESULT IN GREATER COVERAGE OF SHOWER AND THUNDERSTORM ACTIVITY FOR OUR CWA FOR THIS AFTERNOON AND EVENING.

SHOWERS WILL LIKELY DEVELOP EARLY AFTERNOON...BEGINNING ALONG THE RIDGE LINES WHERE OROGRAPHICS WILL PROVIDE THE BEST LIFT...COVERAGE THEN INCREASING AS WE TRANSITION THROUGH THE AFTERNOON. WESTERLY WIND FLOW WILL HELP PUSH SOME OF THESE SHOWERS AND THUNDERSTORMS EAST ACROSS THE PIEDMONT DURING LATE AFTERNOON AND THE EVENING. MODEL CAPES OF 1500-2000 J/KG ARE FORECAST...SO STORMS SHOULD BE A LITTLE MORE ROBUST THAN WHAT WE EXPERIENCED

OVER THE WEEKEND...BUT BELIEVE WE WILL STILL LACK THE DYNAMICS FOR ANYTHING ORGANIZED WITH THE MAIN THREAT BEING HEAVY RAIN AND THE POTENTIAL FOR LOCALIZED FLASH FLOODING.

COVERAGE AND INTENSITY OF SHOWER AND THUNDERSTORM ACTIVITY WILL DECREASE DURING THE EVENING WITH THE LOSS OF DAYTIME HEATING. HOWEVER...WITH THE COLD FRONT CONTINUING ITS APPROACH OVERNIGHT...DO NOT EXPECT THE RAINFALL THREAT TO GO AWAY ALTOGETHER. HAVE THEREFORE KEPT MENTION OF SHOWER AND THUNDERSTORM ACTIVITY IN THE FORECAST FOR THE OVERNIGHT TONIGHT.

HELD PRETTY CLOSE TO MET/MAV GUIDANCE...WHICH WERE SIMILAR FOR TEMPERATURES TODAY AND TONIGHT. EXPECT UPPER 70S AND LOW 80S ACROSS THE MOUNTAINS FOR AFTERNOON HIGHS...WHILE TEMPERATURES ACROSS THE PIEDMONT WILL RISE INTO THE MID AND UPPER 80S. LOW TO MID 60S ARE EXPECTED AREAWIDE TONIGHT.

&&

.SHORT TERM /TUESDAY THROUGH THURSDAY NIGHT/...
AS OF 415 AM EDT MONDAY...

LONG AWAITED FRONTAL SYSTEM WILL BE ON OUR DOORSTEP AT 12Z TUESDAY. THIS IS A LATER ARRIVAL TIME THAN ADVERTISED BY THE MODELS A FEW DAYS BACK AS UPPER SUPPORT/LOW PRESSURE TROUGH IS WANING...SHEARING OUT ACROSS THE GREAT LAKES/NORTHEAST. AS A RESULT...HAVE RETAINED POPS LONGER AND FURTHER WEST THAN IN PREVIOUS FORECAST PACKAGES. WOULD STILL EXPECT A GOOD CHANCE OF CONVECTION...EVEN IN THE MORNING HOURS TUESDAY...AS THE BETTER DYNAMICS DRIFT INTO THE REGION WITH THE FRONT AND UPPER TROUGH. BY AFTERNOON...THE FOCUS FOR CONVECTION SHOULD SHIFT EAST OF THE BLUE RIDGE...WHERE THUNDERSTORMS REMAIN POSSIBLE. SHEAR REMAINS WEAK...BUT INSTABILITY REMAINS HEALTHY...SO A FEW STRONG STORMS REMAIN POSSIBLE DURING THE AFTERNOON EAST OF THE BLUE RIDGE. SPC HAS CURRENTLY BACKED OFF THE MARGINAL RISK AREA THAT PREVIOUSLY EXTENDED DOWN INTO CENTRAL VA...PULLING IT BACK FURTHER NORTH INTO THE NORTHERN MID-ATLANTIC/NEW ENGLAND. SIGNIFICANT SVR VALUES ARE SLIGHTLY LESS THAN ADVERTISED BY THE MODELS YESTERDAY. BY 00Z WED...THE CHANCE OF ANY REMAINING CONVECTION SHOULD BE LIMITED TO THE FAR SOUTHEAST COUNTIES OF THE CWA. TEMPERATURES WILL STILL BE QUITE WARM...ESPECIALLY IN THE EAST TUESDAY...WHICH SHOULD HELP FUEL CONVECTION ACROSS THAT REGION...BUT BY AFTERNOON...DRIER/SLIGHTLY COOLER AIR SHOULD FILTER INTO THE WESTERN/NORTHERN AREAS.

WEDNESDAY APPEARS TO OFFER A BRIEF WINDOW OF OPPORTUNITY FOR A BREAK FROM THE CONVECTION. HOWEVER...THIS WINDOW KEEPS GETTING SMALLER WITH EACH MODEL RUN. THE KEY FEATURE THROUGH THIS TIME FRAME IS A DEEPENING UPPER LOW ACROSS SOUTHEAST CANADA INTO THE CANADIAN MARITIMES...ALMOST A WINTERLIKE PATTERN. THIS LEAVES AN UNSTABLE NORTHWEST FLOW ACROSS OUR REGION...WHICH AT THIS TIME OF YEAR CAN QUICKLY GIN UP CONVECTION. FOR SEVERAL DAYS NOW...THE MODELS HAVE BEEN ADVERTISING A NORTHWEST FLOW SHORT WAVE TO TRACK ACROSS THE REGION THURSDAY. THE LATEST MODEL RUNS ALL DEPICT THE SHORT WAVE...BUT WITH WIDELY VARYING DEGREES OF INTENSITY AND RESULTANT MOISTURE/PRECIPITATION. THE SPECTRUM RANGES FROM THE

FLAT/WEAK/DRY GFS TO THE DEEPER/WETTER NAM/CANADIAN. THE ECMWF SEEMS TO BE THE BEST COMPROMISE AND IS GENERALLY THE WAY WPC HAS LEANED WITH THIS SYSTEM AS WELL. THEREFORE...HAVE EXPANDED POPS NORTHWARD AND INTO THE MID-CHANCE RANGE WED NIGHT IN THE WEST AND ACROSS THE CWA THU. MODELS VARY CONSIDERABLY WITH THE NORTHWARD EXTENT OF THIS PRECIPITATION...SO FOR NOW HAVE GENERALLY BROAD BRUSHED POPS ACROSS THE CWA...WITH THE HIGHER CHANCES ACROSS THE SOUTHERN HALF WHERE MOISTURE IS EXPECTED TO BE A LITTLE DEEPER. THIS SHORT WAVE WILL EXIT TO THE SOUTHEAST THU NIGHT AS SFC HIGH PRESSURE SLIDES FROM THE PLAINS TO THE GREAT LAKES. OVERALL...THE AIR MASS APPEARS TO BE TOO STABLE AND DRY IN THE LOWER LEVELS TO SUPPORT THUNDER WITH THIS EVENT. HOWEVER...A NOSE OF INSTABILITY DOES POKE UP INTO THE SOUTHERN PARTS OF THE PIEDMONT WITH DAYTIME HEATING THU AFTERNOON...SO HAVE INTRODUCED A SLIGHT CHANCE OF THUNDER GENERALLY SOUTH OF U.S. 460 AND EAST OF THE BLUE RIDGE THU AFTERNOON.

THE MOST NOTABLE DIFFERENCE WED-THU WILL BE IN THE TEMPERATURE/HUMIDITY DEPARTMENT...WITH DEWPOINTS DROPPING FROM CURRENT READINGS WELL INTO THE 60S DOWN INTO THE 40S WEST AND 50S EAST. MAX TEMPERATURES WILL DROP BACK INTO THE 60S ACROSS THE MOUNTAINS...70S THROUGH MUCH OF THE CWA...TO NEAR 80 ACROSS THE SOUTHEAST PART OF THE CWA...WITH LOWS FALLING INTO THE 40S MOUNTAINS AND 50S PIEDMONT. THIS WILL BE A PLEASANT CHANGE.

&&

.LONG TERM /FRIDAY THROUGH SUNDAY/...
AS OF 430 AM EDT MONDAY...

MOISTURE...WARMTH...AND HUMIDITY ARE POISED TO RETURN FAIRLY QUICKLY THROUGH THE WEEKEND AND INTO EARLY NEXT WEEK AS YET ANOTHER DEEP UPPER LOW BUILDS INTO THE SOUTHWEST U.S...THE NORTHEAST U.S. TROUGH SHIFTS EASTWARD INTO THE NORTHERN ATLANTIC...AND AN ELONGATED RIDGE BETWEEN THESE TWO LOW PRESSURE AREAS DRIFTS INTO OUR REGION. THE MID-WEEK FRONTAL BOUNDARY WILL BEGINS TO RETURN NORTHWARD BY SATURDAY AS CANADIAN HIGH PRESSURE SHIFTS OFF THE MID-ATLANTIC COAST. SOME MODELS ARE ADVERTISING A WEDGE DEVELOPING ACROSS THE REGION OVER THE WEEKEND WITH OVERRUNNING PRECIPITATION DEVELOPING FROM THE WEST. THIS IS EVIDENT VIA SOME FAIRLY HEALTHY SFC PRESSURE RISES ACROSS THE NORTHERN INTO THE CENTRAL MID-ATLANTIC REGION SAT-SUN. HOWEVER...THERE IS ALSO A TENDENCY WITH TIME FOR THE SFC HIGH TO SHIFT FURTHER SOUTH...PUTTING THE CWA INTO A WARMER/SOUTHWEST FLOW REGIME. THE UPPER RIDGE WILL SHIFT SOUTHEAST BY MONDAY...ALLOWING AN ACTIVE BAROCLINIC ZONE TO SHIFT SOUTH AND EAST INTO THE REGION FROM THE OH/TN VALLEY. DID NOT MAKE ANY SIGNIFICANT CHANGES TO THE WEEKEND GRIDS AT THIS TIME...WITH SAT STILL LOOKING MOSTLY DRY...AND CHC POPS CREEPING BACK INTO THE WEST BY SUN. TEMPERATURES APPEAR SEASONABLE WITH A SLOW WARMING TREND AND SLOWLY INCREASING HUMIDITY AS WELL.

&&

.AVIATION /15Z MONDAY THROUGH FRIDAY/...
AS OF 730 AM EDT MONDAY...

A VERY MOIST AIR MASS REMAINS ACROSS THE REGION STUCK UNDER AN UPPER RIDGE AS THE PAST SEVERAL DAYS. HOWEVER...THE PATTERN IS FINALLY ABOUT TO CHANGE. THE UPPER LOW THAT HAS PLAGUED THE CENTRAL U.S. THE PAST SEVERAL DAYS IS SHEARING OUT AND MOVING TOWARD THE GREAT LAKES WHERE IT WILL AID IN THE DEVELOPMENT OF A DEEP UPPER LOW ACROSS SOUTHEAST CANADA BY MIDWEEK. THIS WILL PUSH A FRONT INTO OUR REGION BY EARLY TUESDAY...THEN EAST OF THE REGION BY TUE EVENING.

FOR TODAY...SCATTERED TO NUMEROUS SHOWERS AND THUNDERSTORMS ARE EXPECTED IN ADVANCE OF THE UPPER TROUGH/FRONT. THE ACTIVITY WILL LIKELY EXTEND FURTHER EASTWARD THAN IN PREVIOUS DAYS AS WELL. ALREADY SEEING SCATTERED LIGHT RAIN SHOWERS ACROSS THE REGION EVEN AT THIS HOUR OF THE DAY. DURING THE AFTERNOON/EVENING...THUNDERSTORMS SHOULD BE MOST NUMEROUS WEST OF THE BLUE RIDGE...SOME WITH LOCALLY HEAVY RAINFALL AND A FEW STRONG DURING THE HEAT OF THE DAY. THE THUNDERSTORMS WILL BE ACCOMPANIED BY MVFR CIGS AND BRIEF PERIODS OF MVFR-IFR VSBYS.

SHOWERS/THUNDERSTORMS WILL DECREASE AFTER SUNSET...BUT GIVEN THE SYNOPTIC PATTERN WOULD EXPECT SOME ACTIVITY TO LINGER ALL NIGHT ACROSS MUCH OF THE CWA. WITH WINDS BECOMING NW...UPSLOPE MVFR CIGS APPEAR LIKELY ACROSS EASTERN WV INTO FAR SOUTHWEST VA. MVFR VSBYS WILL ALSO PREVAIL IN MANY AREAS OVERNIGHT IN A NEAR SATURATED BOUNDARY LAYER WITH MOIST/WET GROUND AND LIGHT WSW-WNW WINDS.

THE OTHER ISSUE TO DEAL WITH THIS MORNING IS POCKETS OF RADIATIONAL FOG THAT DEVELOPED AND PERSISTED AT THE USUAL SPOTS OVERNIGHT. PRINCIPALLY THIS HAS ONLY IMPACTED BCB/LWB...WITH OCCASIONAL IFR-LIFR VSBYS/CIGS. THESE CONDITIONS WILL IMPROVE AFTER 13Z IF THEY HAVE NOT ALREADY.

WINDS SW-WSW 5-8KTS THROUGH THE DAY...BECOMING WNW 5-7KTS TOWARD EVENING/OVERNIGHT.

**MEDIUM CONFIDENCE IN CIGS AND VSBYS THROUGH THE TAF VALID PERIOD.
MEDIUM TO HIGH CONFIDENCE IN WIND SPD/DIR THROUGH THE TAF VALID PERIOD.
MEDIUM TO HIGH CONFIDENCE IN THUNDERSTORM POTENTIAL THROUGH THE TAF VALID PERIOD.**

EXTENDED AVIATION DISCUSSION...

LOOKING INTO TUESDAY...A COLD FRONT WILL MOVE THROUGH THE AREA DURING THE MORNING. MOST CONVECTION ALONG THE FRONT SHOULD DEVELOP IN THE EASTERN SECTIONS TUESDAY AFTERNOON WITH ONLY KLYH/KDAN POSSIBLY SEEING A PERIOD OF MVFR IN SHRA BEFORE THE DRIER AIR SWEEPS EAST. BEHIND THE COLD FRONT...DRIER/COOLER CONDITIONS ARE EXPECTED WEDNESDAY. AN UPPER DISTURBANCE WILL LIKELY BRING SOME MVFR CIGS AND -SHRA BACK INTO THE AREA THU...MOVING OUT FRI WITH VFR CONDITIONS RETURNING FRI-SAT.

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.RNK WATCHES/WARNINGS/ADVISORIES...
VA...NONE.

NC...NONE.
WV...NONE.

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14.0 Pilot Weather Briefing

The accident pilot received two official weather briefings from Direct User Access Terminal Service (DUATS) and one briefing text via ForeFlight Mobile prior to flight. The DUATS weather briefings were obtained at 0734:59 EDT and the second briefing at 0738:48 EDT (attachments 6 and 7), with the briefing text via ForeFlight Mobile obtained at 0720 EDT (attachment 8). The weather briefing information contained the closest departure and destination METAR observations, the TAF for the destination, KMFD, which mentioned thunderstorm activity possible by 1400 EDT, AIRMETs valid for IFR²⁶ and mountain obscuration, CWAs valid for LIFR²⁷ conditions, TAF and METAR information for surface stations along the route of flight, and wind aloft information. The accident pilot did review the Area Forecast information for North Carolina and points southward, but did not review the Area Forecast information for points north of the North Carolina border. The 0445 EDT Area Forecast for points north of the North Carolina border forecasted scattered to a broken ceiling around 5,000 feet msl, with scattered rain shower and thunderstorm activity as early as 1500 EDT in southwestern Virginia, as early as 1100 EDT in northern West Virginia, as early as 1400 EDT in southern West Virginia, and as early as 1100 EDT in southern Ohio. There is no record of the accident pilot receiving or retrieving any other weather information before the accident flight.

15.0 Astronomical Data

The astronomical data obtained from the United States Naval Observatory for the accident site on May 18, 2015, indicated the following:

SUN	
Begin civil twilight	0548 EDT
Sunrise	0617 EDT
Sun transit	1323 EDT
Sunset	2030 EDT
End civil twilight	2100 EDT

²⁶ Instrument Flight Rules – Refers to the general weather conditions pilots can expect at the surface. IFR criteria means a ceiling below 1,000 feet agl and/or less than 3 miles visibility.

²⁷ Low Instrument Flight Rules – Refers to the general weather conditions pilots can expect at the surface. LIFR criteria means a ceiling below 500 feet agl and/or less than 1 miles visibility.

16.0 FIS-B Regional NEXRAD with Flight Path

Figures 24 through 27 are the regional NEXRAD weather radar data available to the pilot in the cockpit from Flight Information Services–Broadcast (FIS-B), if the accident pilot had the regional NEXRAD weather radar screen selected (at this horizontal scale) on his ForeFlight Mobile application. In addition, the Traffic Information Service–Broadcast (TIS-B) radar track is provided for the 10 minutes before the NEXRAD weather radar data was valid in each figure. The TIS-B data indicated that the accident flight was heading regularly north to northeastward from 1210 through 1230 EDT. There appeared to be a slight jog westward in the 1215 to 1225 EDT flight to avoid some possible weather conditions (figure 25). The flight track ends before it would have passed through an area of light green on the regional NEXRAD plot (figure 27). These are similar conditions as noted in sections 6.4 and 6.5 of a building rain shower near the accident site at the accident time. For additional information regarding the regional NEXRAD weather radar data please see attachment 9.

Regional NEXRAD Mosaic Creation Time 16:20 UTC N5816S Flight Path 16:10 to 16:20 UTC

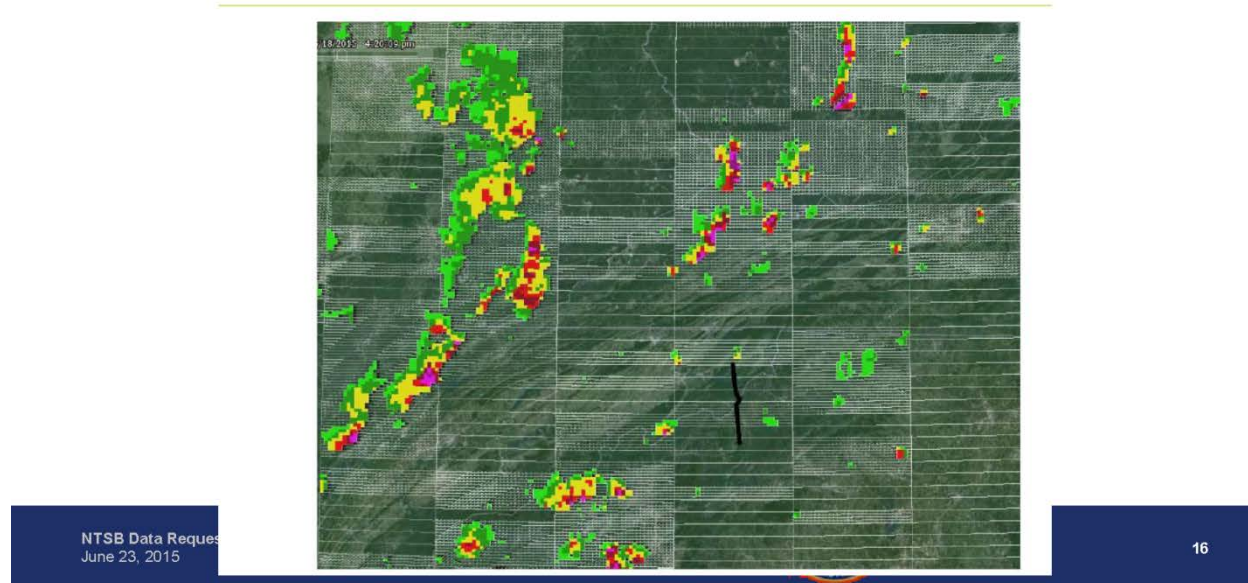


Figure 24 –FIS-B regional NEXRAD plot valid at 1220 EDT with TIS-B radar track from 1210 to 1220 EDT

**Regional NEXRAD Mosaic Creation Time 16:25 UTC
N5816S Flight Path 16:15 to 16:25 UTC**

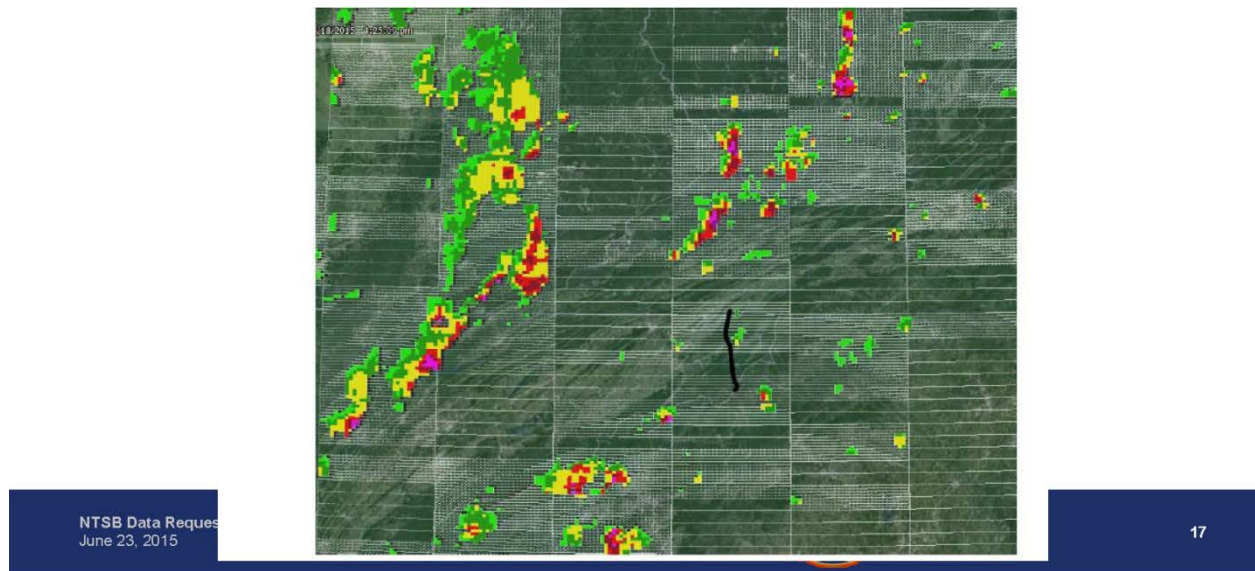


Figure 25 – FIS-B regional NEXRAD plot valid at 1225 EDT with TIS-B radar track from 1215 to 1225 EDT

**Regional NEXRAD Mosaic Creation Time 16:30 UTC
N5816S Flight Path 16:20 to 16:30 UTC**

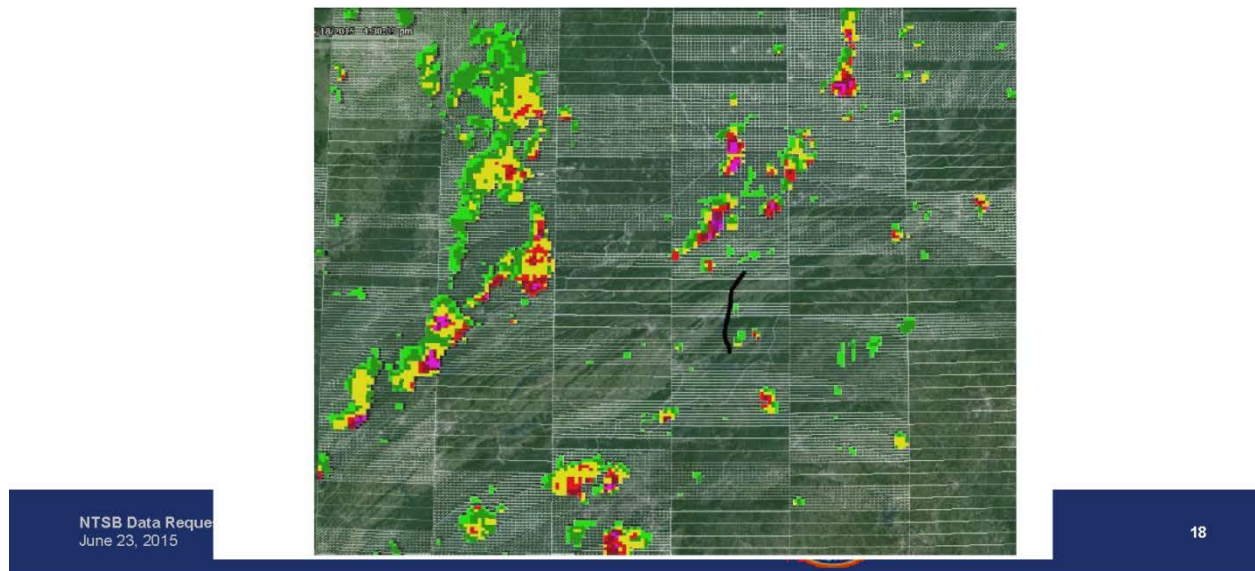


Figure 26 –FIS-B regional NEXRAD plot valid at 1230 EDT with TIS-B radar track from 1220 to 1230 EDT

**Regional NEXRAD Mosaic Creation Time 16:35 UTC
N5816S Flight Path 16:25 to 16:35 UTC**

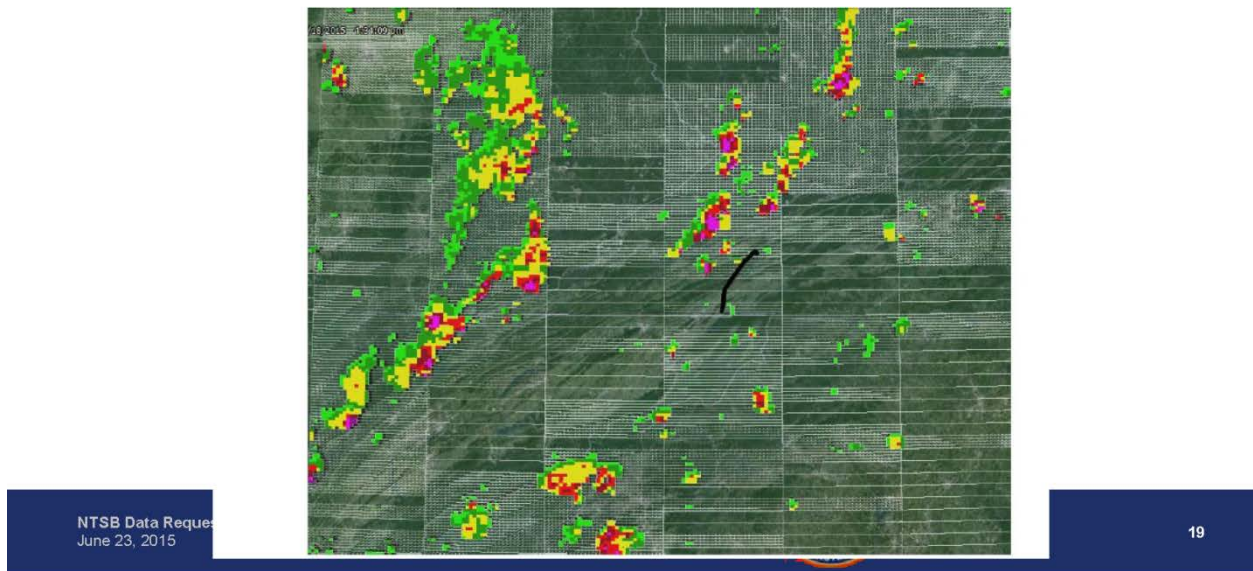


Figure 27 – FIS-B regional NEXRAD plot valid at 1235 EDT with TIS-B radar track from 1225 to 1235 EDT

17.0 XM Weather Data

The airplane was equipped with an EWR50 Weather Receiver which is capable of displaying XM Weather information. If the accident pilot had been viewing XM Weather radar information he would have had a chance to view something similar to figures 28 through 31, which was XM Weather radar information available around and before the accident time. The scale used in the XM Weather radar images is located in figure 32. The XM Weather radar images from 1220 through 1235 EDT displayed light echoes to the west and north of the accident site with only very light echoes approaching the southwest corner of the accident site region by 1235 EDT. These XM Weather radar images are consistent with the weather radar from sections 6.4 and 6.5 with the majority of the moderate to heavy rain showers and thunderstorms north and west of the accident flight track. Given that the rain shower development right near the accident site occurred right at the accident time it would be very difficult for either XM Weather or FIS-B regional NEXRAD data to pick up the newest rain shower development, especially given the FIS-B regional NEXRAD and XM Weather were using composite weather radar data. For additional information regarding the XM Weather radar data please see attachment 10.

XM Weather Radar

12:20 pm EDT

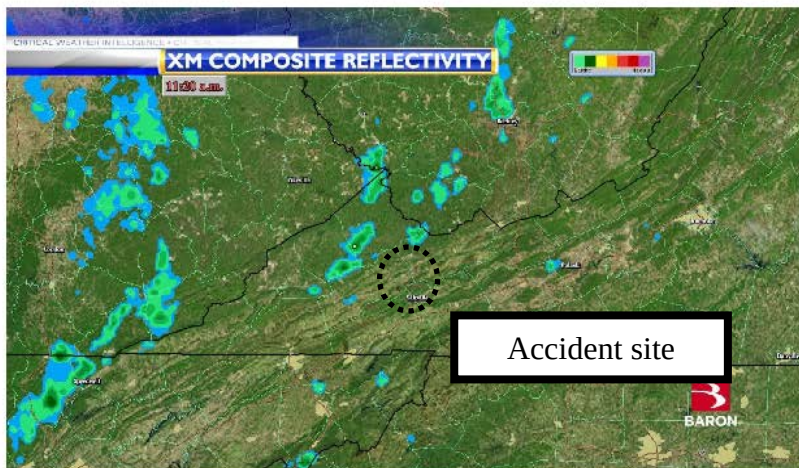


Figure 28 –XM Weather Radar from 1220 EDT

XM Weather Radar

12:25 pm EDT



Figure 29 – XM Weather Radar from 1225 EDT

XM Weather Radar

12:30 pm EDT



Figure 30 – XM Weather Radar from 1230 EDT

XM Weather Radar

12:35 pm EDT

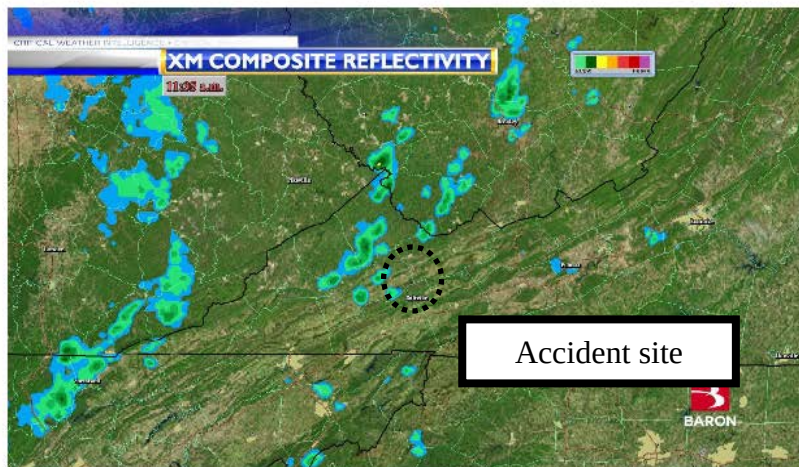


Figure 31 – XM Weather Radar from 1235 EDT

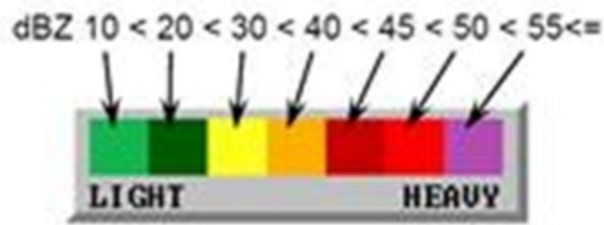


Figure 32 – XM Weather Radar scale for figures 28 through 31

F. LIST OF ATTACHMENTS

Attachment 1 – Visible satellite animation from 1208 to 1300 EDT zoomed over the accident site

Attachment 2 – ZTL Weather Bulletin produced at 0628 EDT

Attachment 3 – ZTL Weather Bulletin produced at 1235 EDT

Attachment 4 – ZID internal graphical weather charts produced at 0700 EDT

Attachment 5 – ZID internal graphical weather charts produced at 0750 EDT (icing chart), 0909 EDT (Terminal Aerodrome Forecast “TAF” chart), 0942 EDT (thunderstorm chart), and 1138 EDT (turbulence chart)

Attachment 6 – IAD DUATS weather briefing from 0734 EDT

Attachment 7 – IAD DUATS weather briefing from 0738 EDT

Attachment 8 – Text weather briefing information received by accident pilot from ForeFlight Mobile

Attachment 9 – NTSB request to FAA for the FIS-B regional NEXRAD weather radar plots and information

Attachment 10 – XM Weather radar information around and before the accident time

Paul Suffern
NTSB, AS-30