



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

February 23, 2017

Weather Study

METEOROLOGY

ERA17FA073

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A. ACCIDENT

Location: 5 miles southeast of Gatlinburg, Tennessee
Date: December 26, 2016
Time: 1602 eastern standard time
2102 Coordinated Universal Time (UTC)
Airplane: Cessna 182, N1839X

B. METEOROLOGIST

Paul Suffern
Group Chairman
Operational Factors Division (AS-30)
National Transportation Safety Board

C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's (NTSB) Meteorologist did not travel for this investigation and gathered 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 standard time (EST) on December 26, 2016, and are based upon the 24-hour clock, where local time is -5 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 35.6519° N, longitude 83.4583° W, at an approximate elevation of 5,520 feet.

D. WEATHER 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 and the Weather Prediction Center, 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 00-45H.

1.1 Surface Analysis Chart

The NWS Surface Analysis Chart for 1600 EST is provided as figure 1 with the approximate location of the accident site marked within the red circle. The chart depicted two frontal boundaries located west of the Ohio River Valley. There was a surface high pressure center located in central North Carolina with a pressure of 1032-hectopascals (hPa). This surface high pressure center was located in a location favored for cold air damming¹ east of the Appalachian Mountains. The station models around the accident site depicted air temperatures in the low 50’s to upper 60’s degrees Fahrenheit (°F), with temperature-dew point spreads of 14° F or more west of the Appalachian Mountains and temperature-dew point spreads of 4° F or less east of the Appalachian Mountains, a south to east wind of less than 10 knots, and partly cloudy skies west of the Appalachian Mountains and cloudy skies east of the Appalachian Mountains. Several stations in North Carolina reported fog or mist around 1600 EST.

¹ Damming – The piling up, or complete blocking, of cold air approaching the slopes of a mountain barrier. This produces high pressure along the windward slopes and, when it persists for more than several hours, can also produce a barrier jet.

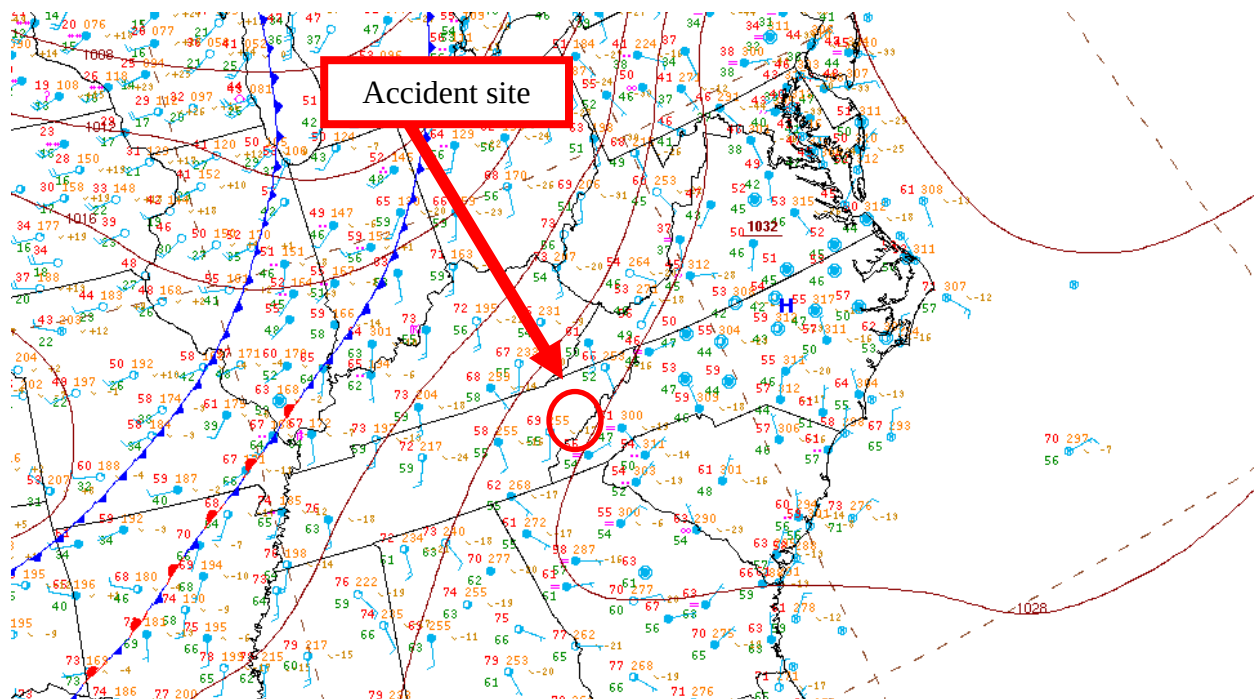


Figure 1 – NWS Surface Analysis Chart for 1600 EST

1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 1900 EST at 925-, 850-, 700-, 500-, and 300-hectopascals (hPa) are presented in figures 2 through 6. The accident site was not located near any low- or mid-level troughs². There was a south wind of 25 knots at 925-hPa (figure 2) with the wind becoming southwesterly by 850- and 700-hPa with the wind increasing in speed to between 30 and 40 knots (figures 3 and 4). The 40-knot southwesterly wind at 700-hPa became a 50-knot west-southwesterly wind by 300-hPa (figure 6).

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

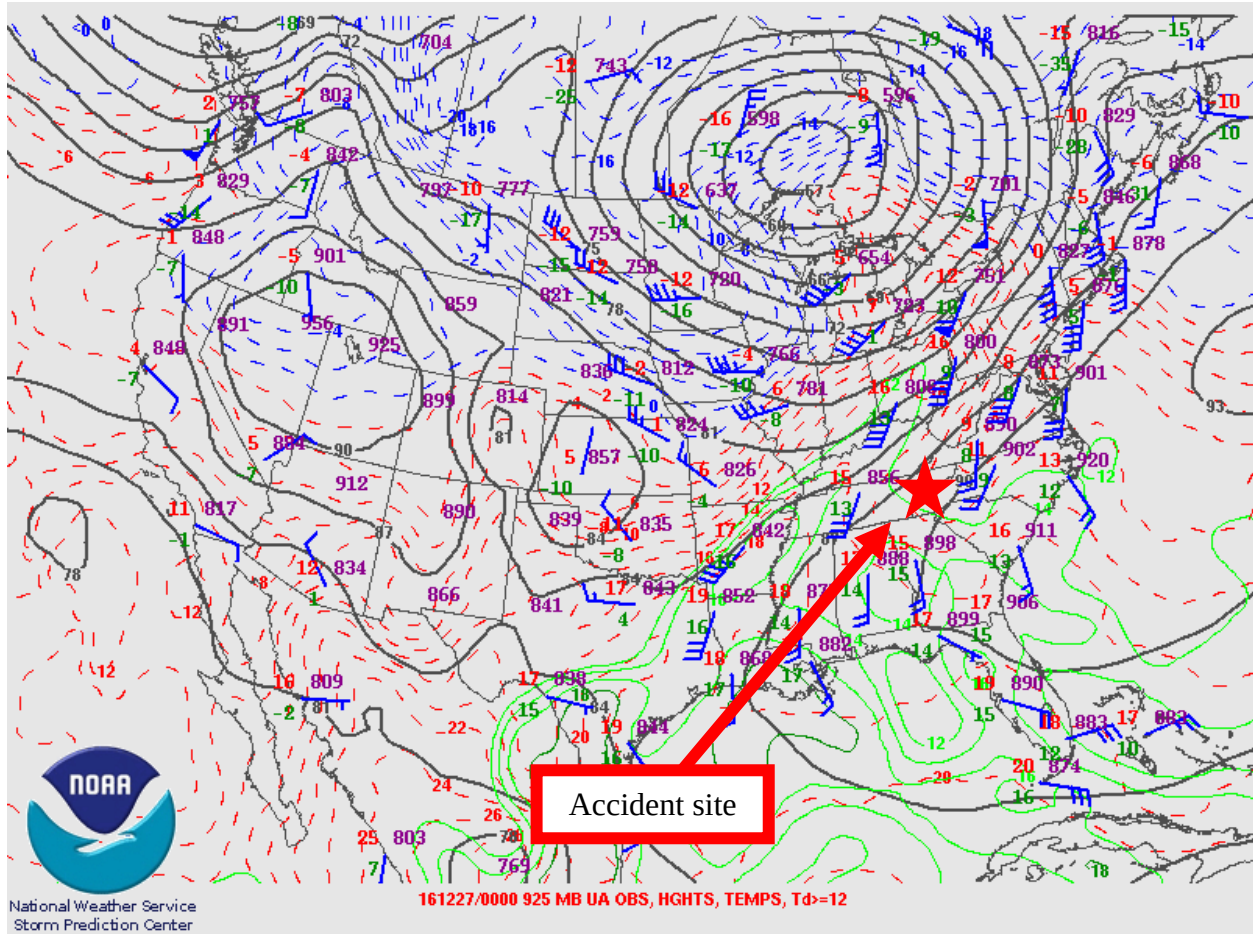


Figure 2 – 925-hPa Constant Pressure Chart for 1900 EST

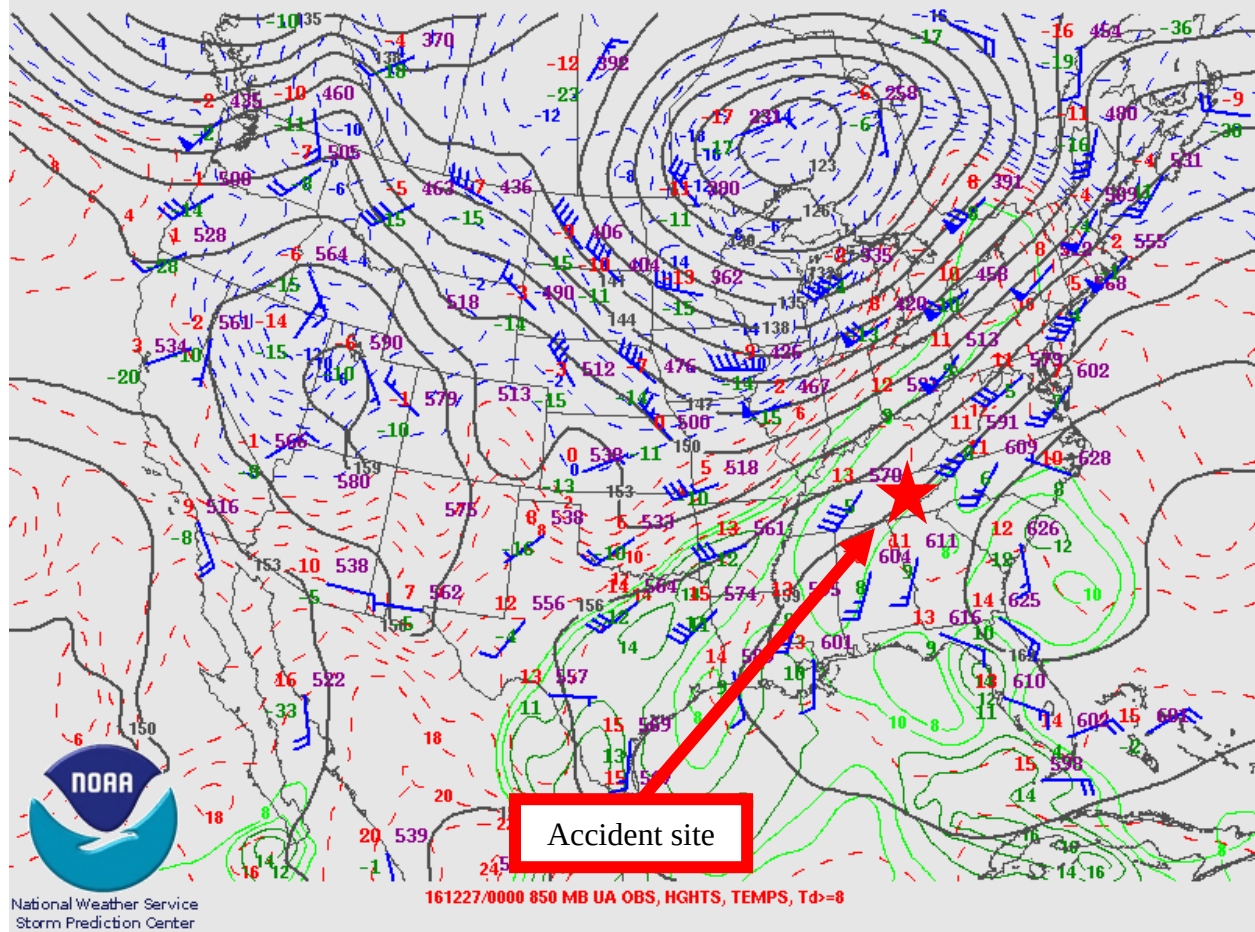


Figure 3 – 850-hPa Constant Pressure Chart for 1900 EST

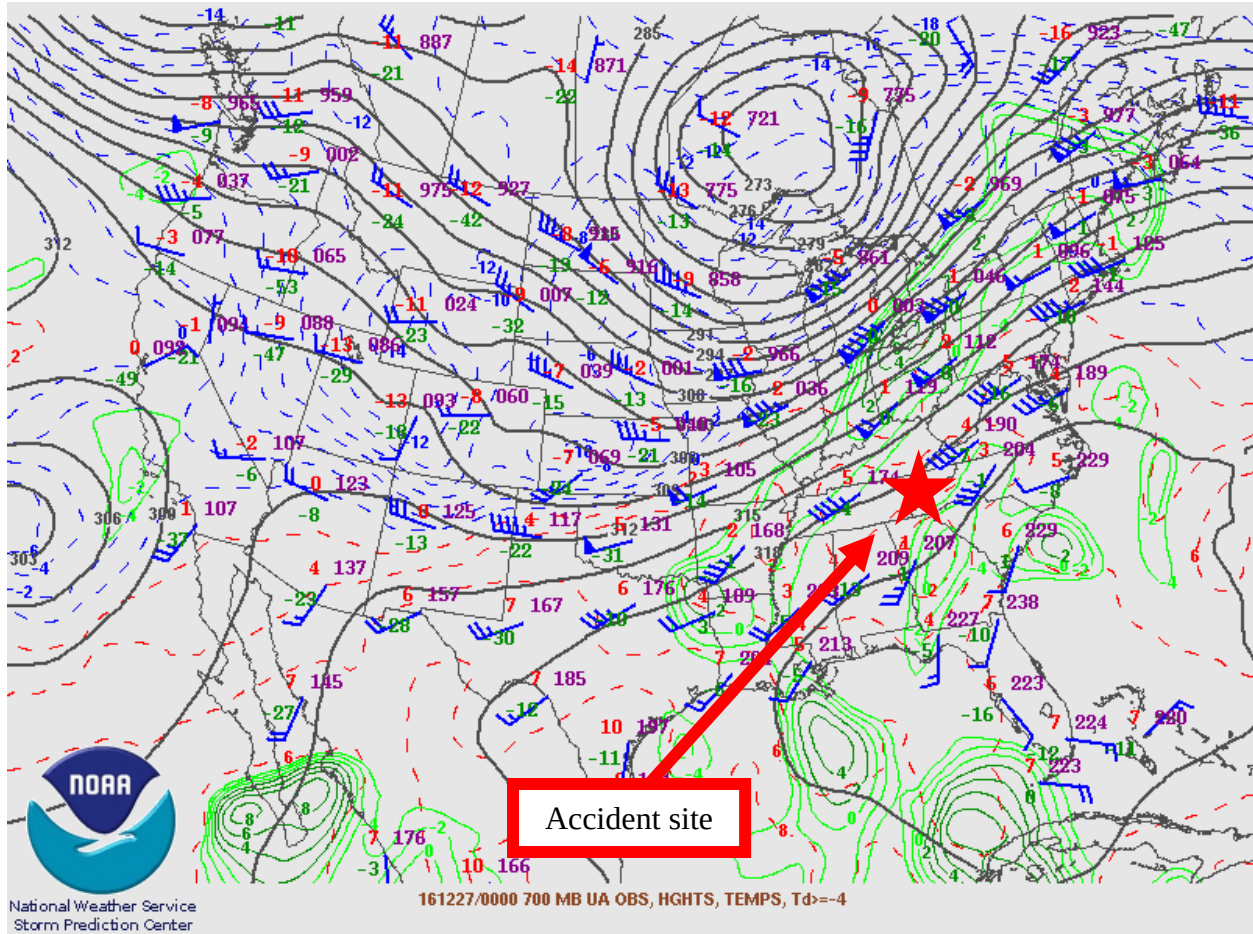


Figure 4 – 700-hPa Constant Pressure Chart for 1900 EST

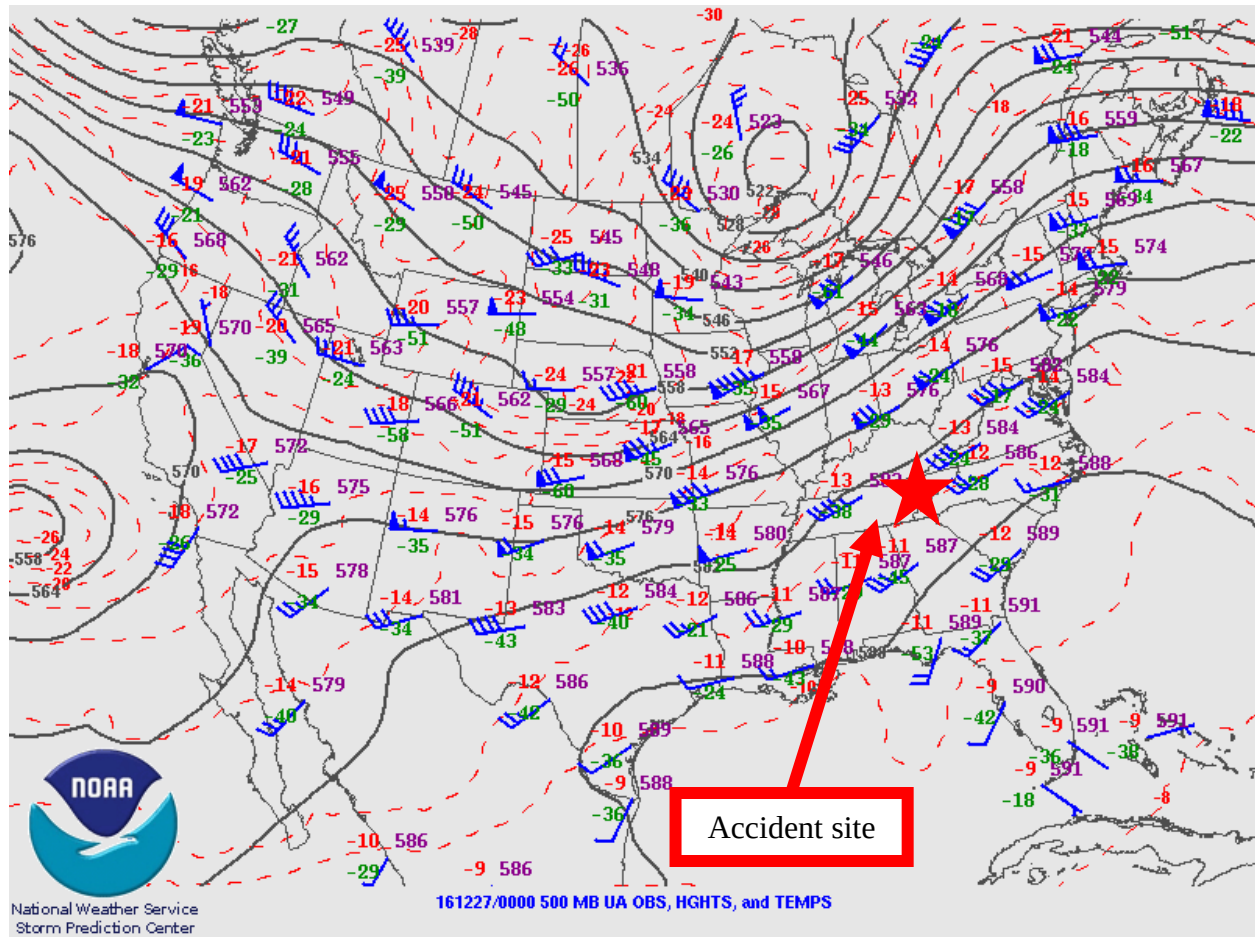


Figure 5 – 500-hPa Constant Pressure Chart for 1900 EST

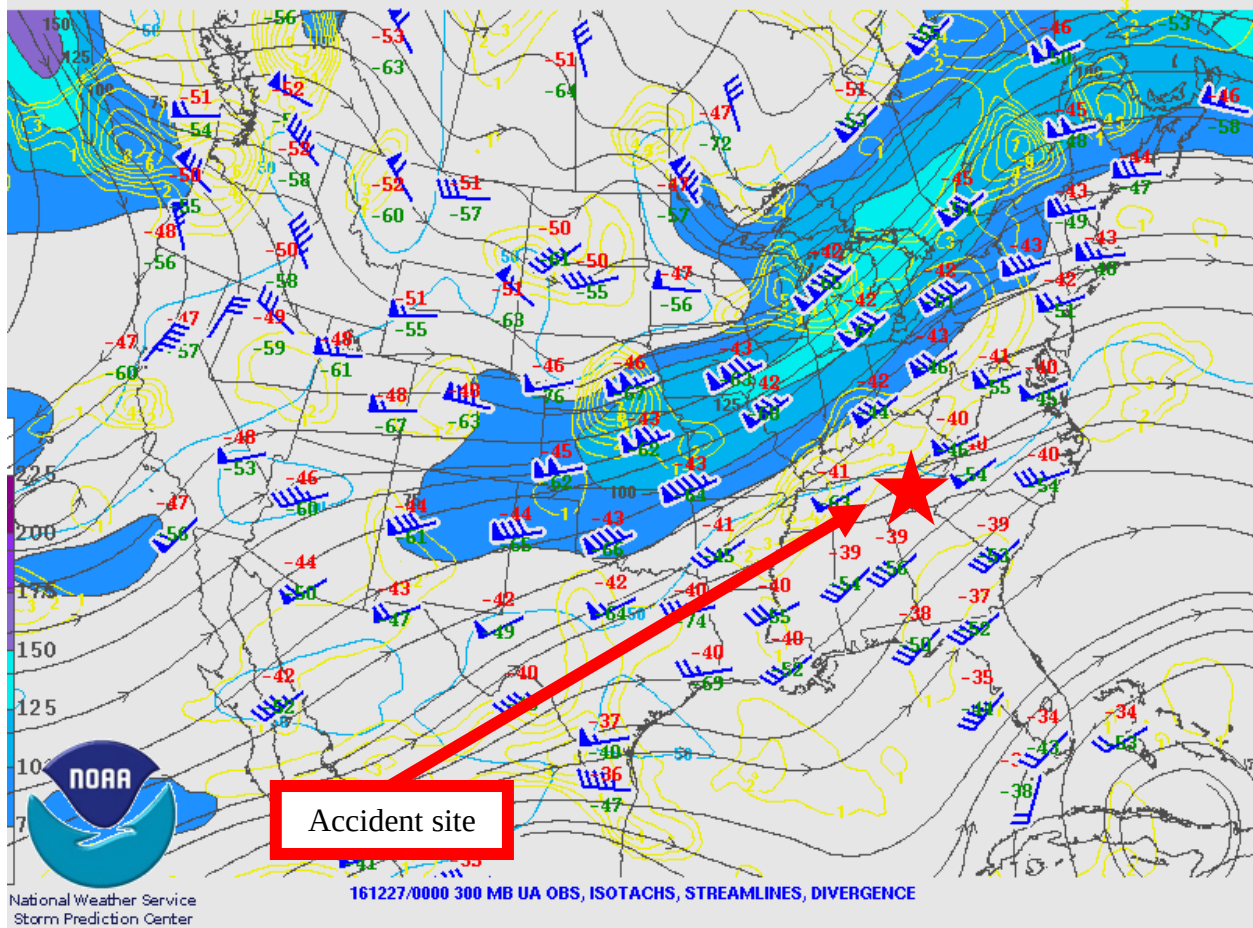


Figure 6 – 300-hPa Constant Pressure Chart for 1900 EST

2.0 SPC Products

There were no thunderstorms forecast for the accident site at the accident time.

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 7 is a sectional chart with the accident site and the closest weather reporting locations marked.



Figure 7 – Sectional chart of accident area with the location of the accident site and surface observation sites

Gatlinburg-Pigeon Forge Airport (KGKT) was the closest official weather station to the accident site, located 2 miles southeast of Sevierville, Tennessee. KGKT had an Automated Weather Observing System (AWOS³) whose reports were not supplemented. KGKT was located 13 miles north-northwest of the accident site, at an elevation of 1,014 feet, and had a 3° westerly magnetic variation⁴ (figure 7). The following observations were taken and disseminated during the times surrounding the accident:⁵

- [1355 EST] METAR KGKT 261855Z AUTO 30003KT 10SM FEW043 BKN049 OVC050 18/13 A3032 RMK=
- [1415 EST] METAR KGKT 261915Z AUTO 03003KT 10SM FEW045 BKN049 BKN085 18/13 A3031 RMK=
- [1435 EST] METAR KGKT 261935Z AUTO 00000KT 10SM FEW037 BKN047 BKN055 18/13 A3032 RMK=
- [1455 EST] METAR KGKT 261955Z AUTO 00000KT 10SM FEW037 OVC046 18/13 A3032 RMK=

³ 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.

⁴ Magnetic variation – The angle (at a particular location) between magnetic north and true north. 1985, latest measurement taken from <http://www.airnav.com/airport/KGKT>

⁵ The bold sections in this NWS product and the rest of products in this report are intended to highlight the sections that directly reference the weather conditions that affected the accident location around the accident time. The local times in section 3.0 next to the METARs are provided for quick reference between UTC and local times around the accident time.

[1515 EST] METAR KGKT 262015Z AUTO 29004KT 10SM FEW043 BKN050 OVC065
18/13 A3031 RMK=

**[1535 EST] METAR KGKT 262035Z AUTO 00000KT 10SM BKN050 OVC060 18/13
A3031 RMK=**

[1555 EST] METAR KGKT 262055Z AUTO 00000KT 10SM 19/13 A3031 RMK=

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[1615 EST] METAR KGKT 262115Z AUTO 00000KT 10SM FEW046 18/13 A3030 RMK=

[1635 EST] METAR KGKT 262135Z AUTO 00000KT 10SM CLR 18/13 A3030 RMK=

[1655 EST] METAR KGKT 262155Z AUTO 22007KT 10SM CLR 18/12 A3029 RMK=

[1715 EST] METAR KGKT 262215Z AUTO 22004KT 10SM CLR 19/12 A3029 RMK=

KGKT weather at 1535 EST, automated, wind calm, 10 miles visibility, broken ceiling at 5,000 feet above ground level (agl), overcast skies at 6,000 feet agl, temperature of 18° Celsius (C), dew point temperature of 13° C, and an altimeter setting of 30.31 inches of mercury.

KGKT weather at 1555 EST, automated, wind calm, 10 miles visibility, cloud group missing, temperature of 19° C, dew point temperature of 13° C, and an altimeter setting of 30.31 inches of mercury.

KGKT weather at 1615 EST, automated, wind calm, 10 miles visibility, few clouds at 4,600 feet agl, temperature of 18° C, dew point temperature of 13° C, and an altimeter setting of 30.30 inches of mercury.

KGKT weather at 1635 EST, automated, wind calm, 10 miles visibility, clear skies below 12,000 feet agl, temperature of 18° C, dew point temperature of 13° C, and an altimeter setting of 30.30 inches of mercury.

Macon County Airport (K1A5) was the next closest official weather station to the accident site, located 3 miles northwest of Franklin, North Carolina. K1A5 had an AWOS whose reports were not supplemented. K1A5 was located 26 miles south-southeast of the accident site, at an elevation of 2,034 feet, and had a 5° westerly magnetic variation⁶ (figure 7). The following observations were taken and disseminated during the times surrounding the accident:

[1340 EST] METAR K1A5 261840Z AUTO 17003KT 4SM DZ SCT021 BKN028 OVC043
14/12 A3042 RMK AO2 T01400117=

⁶ Magnetic variation – The angle (at a particular location) between magnetic north and true north. 2010, latest measurement taken from <http://www.aimav.com/airport/1A5>

[1405 EST] METAR K1A5 261905Z AUTO 00000KT 5SM BR SCT009 OVC017 14/12
A3042 RMK AO2 T01360115=

[1425 EST] METAR K1A5 261925Z AUTO 00000KT 5SM RA SCT014 OVC023 14/12
A3041 RMK AO2 T01370115=

[1445 EST] METAR K1A5 261945Z AUTO 00000KT 3SM +RA SCT007 SCT012 OVC021
14/12 A3041 RMK AO2 P0001 T01370121=

[1505 EST] METAR K1A5 262005Z AUTO 08003KT 2 1/2SM -DZ SCT007 OVC019
13/12 A3041 RMK AO2 T01320120=

***[1525 EST] METAR K1A5 262025Z AUTO 00000KT 3SM -RA SCT005 BKN010 OVC017
13/12 A3042 RMK AO2 T01320121=***

***[1545 EST] METAR K1A5 262045Z AUTO 08003KT 4SM BR SCT007 BKN012 OVC024
13/12 A3041 RMK AO2 T01320121=***

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***[1605 EST] METAR K1A5 262105Z AUTO 00000KT 4SM DZ BKN010 OVC024 13/12
A3041 RMK AO2 T01320121=***

***[1625 EST] METAR K1A5 262125Z AUTO 04004KT 10SM SCT008 BKN015 OVC022
14/12 A3041 RMK AO2 P0001 T01350120=***

[1645 EST] METAR K1A5 262145Z AUTO 03004KT 10SM SCT008 OVC015 14/12
A3041 RMK AO2 P0001 T01350120=

[1705 EST] METAR K1A5 262205Z AUTO 00000KT 10SM BKN013 BKN022 OVC030
14/12 A3040 RMK AO2 T01350120=

K1A5 weather at 1525 EST, automated, wind calm, 3 miles visibility, light rain, scattered clouds at 500 feet agl, broken ceiling at 1,000 feet agl, overcast skies at 1,700 feet agl, temperature of 13° C, dew point temperature of 12° C, and an altimeter setting of 30.42 inches of mercury. Remarks, station with a precipitation discriminator, temperature 13.2° C, dew point temperature 12.1° C.

K1A5 weather at 1545 EST, automated, wind from 080° at 3 knots, 4 miles visibility, mist, scattered clouds at 700 feet agl, broken ceiling at 1,200 feet agl, overcast skies at 2,400 feet agl, temperature of 13° C, dew point temperature of 12° C, and an altimeter setting of 30.41 inches of mercury. Remarks, station with a precipitation discriminator, temperature 13.2° C, dew point temperature 12.1° C.

K1A5 weather at 1605 EST, automated, wind calm, 4 miles visibility, drizzle, broken ceiling at 1,000 feet agl, overcast skies at 2,400 feet agl, temperature of 13° C, dew point temperature of 12° C, and an altimeter setting of 30.41 inches of mercury. Remarks, station with a precipitation discriminator, temperature 13.2° C, dew point temperature 12.1° C.

K1A5 weather at 1625 EST, automated, wind from 040° at 4 knots, 10 miles visibility, scattered clouds at 800 feet agl, broken ceiling at 1,500 feet agl, overcast skies at 2,200 feet agl, temperature of 14° C, dew point temperature of 12° C, and an altimeter setting of 30.41 inches of mercury. Remarks, station with a precipitation discriminator, one-hourly precipitation of 0.01 inches, temperature 13.5° C, dew point temperature 12.0° C.

Mc Ghee Tyson Airport (KTYN) was the next closest official weather station to the accident site, located 10 miles south of Knoxville, Tennessee. KTYN had Automated Surface Observing System (ASOS⁷) whose reports were supplemented by an official weather observer. KTYN was located 28 miles west-northwest of the accident site, at an elevation of 979 feet, and had a 6° westerly magnetic variation⁸ (figure 7). The following observations were taken and disseminated during the times surrounding the accident:

[0953 EST] METAR KTYN 261453Z 00000KT 7SM FEW049 BKN065 BKN250 13/12
A3040 RMK AO2 SLP293 T01330117 53008 \$=

[1053 EST] METAR KTYN 261553Z 31003KT 10SM BKN070 OVC250 16/12 A3040
RMK AO2 SLP291 T01610122 \$=

[1153 EST] METAR KTYN 261653Z 00000KT 10SM SCT048 BKN060 OVC075 17/12
A3037 RMK AO2 SLP282 T01720122 \$=

[1253 EST] METAR KTYN 261753Z 00000KT 10SM FEW034 BKN041 OVC080 18/12
A3035 RMK AO2 SLP272 T01780122 10178 20094 58019 \$=

[1353 EST] METAR KTYN 261853Z 20007KT 10SM BKN037 OVC047 18/13 A3032
RMK AO2 SLP264 T01830133 \$=

**[1453 EST] METAR KTYN 261953Z 22008KT 10SM FEW039 BKN049 OVC055 19/13
A3031 RMK AO2 SLP260 T01890133 \$=**

**[1553 EST] METAR KTYN 262053Z 20010KT 10SM FEW039 BKN250 21/13 A3030
RMK AO2 SLP255 60000 T02060128 56017 \$=**

ACCIDENT TIME 1602 EST

⁷ ASOS – Automated Surface Observing System is equipped with meteorological instruments to observe and report wind, visibility, ceiling, temperature, dewpoint, altimeter, and barometric pressure.

⁸ Magnetic variation – The angle (at a particular location) between magnetic north and true north. 2015, latest measurement taken from <http://www.aimav.com/airport/KTYN>

**[1653 EST] METAR KTYS 262153Z 21007KT 10SM SCT034 SCT070 19/13 A3030
RMK AO2 SLP255 T01890128 \$=**

**[1753 EST] METAR KTYS 262253Z 23008KT 10SM BKN070 17/12 A3029 RMK AO2
SLP253 T01670122 \$=**

**[1853 EST] METAR KTYS 262353Z 24009KT 10SM BKN038 BKN250 17/13 A3029
RMK AO2 SLP252 60000 T01670128 10206 20150 58003 \$=**

**[1953 EST] METAR KTYS 270053Z 22010KT 10SM SCT034 BKN050 BKN060 17/13
A3027 RMK AO2 SLP248 T01670133 \$=**

KTYS weather at 1453 EST, wind from 220° at 8 knots, 10 miles visibility, few clouds at 3,900 feet agl, broken ceiling at 4,900 feet agl, overcast skies at 5,500 feet agl, temperature of 19° C, dew point temperature of 13° C, and an altimeter setting of 30.31 inches of mercury. Remarks, station with a precipitation discriminator, sea level pressure 1026.0 hPa, temperature 18.9° C, dew point temperature 13.3° C, maintenance is needed on the system.

KTYS weather at 1553 EST, wind from 200° at 10 knots, 10 miles visibility, few clouds at 3,900 feet agl, broken ceiling at 25,000 feet agl, temperature of 21° C, dew point temperature of 13° C, and an altimeter setting of 30.30 inches of mercury. Remarks, station with a precipitation discriminator, sea level pressure 1025.5 hPa, 6-hourly precipitation of a trace, temperature 20.6° C, dew point temperature 12.8° C, 3-hourly pressure drop of 1.7 hPa, maintenance is needed on the system.

KTYS weather at 1653 EST, wind from 210° at 7 knots, 10 miles visibility, scattered clouds at 3,400 feet agl, scattered clouds at 7,000 feet agl, temperature of 19° C, dew point temperature of 13° C, and an altimeter setting of 30.30 inches of mercury. Remarks, station with a precipitation discriminator, sea level pressure 1025.5 hPa, temperature 18.9° C, dew point temperature 12.8° C, maintenance is needed on the system.

KTYS weather at 1753 EST, wind from 230° at 8 knots, 10 miles visibility, broken ceiling at 7,000 feet agl, temperature of 17° C, dew point temperature of 12° C, and an altimeter setting of 30.29 inches of mercury. Remarks, station with a precipitation discriminator, sea level pressure 1025.3 hPa, temperature 16.7° C, dew point temperature 12.2° C, maintenance is needed on the system.

The observations from KGKT and KTYL surrounding the accident time indicated VFR⁹ conditions around the accident site at the accident time with the lowest cloud cover around 6,000 to 7,000 feet msl in the 2 hours surrounding the accident time. South of the Appalachian Mountains the cloud cover was extensive (section 5.0) with cloud ceilings around 3,000 feet msl and IFR¹⁰ to MVFR¹¹ visibility and ceiling conditions at K1A5. Precipitation was also reported at K1A5 at the accident time. With the relatively cool surface temperatures and warmer air from the southwest coming over top of the colder surface air (sections 1.1, 1.2, and 4.0), mid- and low-level clouds and light precipitation would have been favored east of the Appalachian Mountains, with only scattered high or mid-level clouds favored west of the Appalachian Mountains.

4.0 Upper Air Data

A High-Resolution Rapid Refresh (HRRR)¹² model sounding was created for the accident site for 1600 EST. The 1600 EST sounding was plotted on a standard Skew-T log P diagram¹³ with the derived stability parameters included in figure 8 (with data from the surface to 500-hPa, or 19,000 feet msl.) This data was analyzed utilizing the RAOB¹⁴ software package. The sounding depicted the lifted condensation level (LCL)¹⁵ at 5,221 feet msl, a convective condensation level (CCL)¹⁶ of 10,352 feet, and a level of free convection (LFC)¹⁷ at 5,221 feet. The freezing level was 12,633 feet. The precipitable water value was 0.62 inches.

⁹ 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.

¹⁰ 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.

¹¹ 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 (inclusive) and/or 3 to 5 miles visibility.

¹² The HRRR is a NOAA real-time three-kilometer resolution, hourly-updated, cloud-resolving, convection-allowing atmospheric model, initialized by three kilometer grids with three kilometer radar assimilation. Radar data is assimilated in the HRRR every 15 minutes over a one hour period.

¹³ 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.

¹⁴ RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamoras, Pennsylvania.

¹⁵ Lifting Condensation Level (LCL) - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

¹⁶ 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.

¹⁷ 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.



The 1600 EST HRRR sounding wind profile indicated a surface wind from 162° at 17 knots with the wind remaining primarily southerly through 7,000 feet. Above 7,000 feet the wind became southwesterly and remained southwesterly through 19,000 feet. The wind speed increased to 37 knots by 7,000 feet, and then remained between 20 and 40 knots through 19,000 feet. RAOB indicated the possibility of light to moderate low-level wind shear between the surface and 6,000 feet with light clear-air turbulence possible between the surface and 11,000 feet.

5.0 Satellite Data

Visible and infrared data from the Geostationary Operational Environmental Satellite number 13 (GOES-13) data was obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison in Madison, Wisconsin, and processed using the Man-computer Interactive Data Access System software. Visible and infrared imagery (GOES-13 bands 1 and 4) at wavelengths of 0.65 microns (μm) and 10.7 μm , respectively, were retrieved for the period. Satellite imagery surrounding the time of the accident, from 1400 EST through 1800 EST at approximately 15-minute intervals were reviewed, and the closest images to the time of the accident are documented here.

Figures 9 and 10 present the GOES-13 visible imagery from 1545 and 1615 EST at 3X magnification with the accident site highlighted with a red square. The visible imagery indicated extensive cloud cover from the accident site southward. North and west of the Appalachian Mountains and the accident site it remained partly cloudy to mostly clear near KGKT and KTYS at 1545 and 1615 EST. Both of the closest official weather sites south of the Appalachian Mountains to the accident site K1A5 and Western Carolina Regional Airport (KRHP, figure 7) had extensive cloud cover, with the cloud cover from the Appalachian Mountains eastward remaining stagnant between 1545 and 1615 EST.

Figures 11 and 12 present the GOES-13 infrared imagery from 1545 and 1615 EST at 7X magnification with the accident site highlighted with a red square. Inspection of the infrared imagery indicated abundant clouds over the accident site at the accident time. The lower brightness temperatures (yellows and reds, higher cloud tops) were over and to east of the accident site around the accident time, with another band of higher cloud tops located in northeastern Tennessee, eastern Kentucky, and southwestern Virginia. Based on the brightness temperatures above the accident site and the vertical temperature profile provided by the 1600 EST HRRR sounding, the approximate cloud-top heights over the accident site were estimated at 13,000 feet at 1615 EST (figure 12). It should be noted these figures have not been corrected for any parallax error.

Based on the 1600 EST HRRR sounding data (section 4.0) and the infrared satellite imagery, a flight profile was created¹⁸ and included as figure 13 to indicate the likely cloud cover encountered by the accident flight while travelling to its intended destination. The accident flight likely encountered instrument meteorological conditions (IMC) shortly after crossing the Georgia/North Carolina border and descending towards the intended destination airport.

¹⁸ For more information, please see the air traffic control (ATC) data located in the docket for this accident.

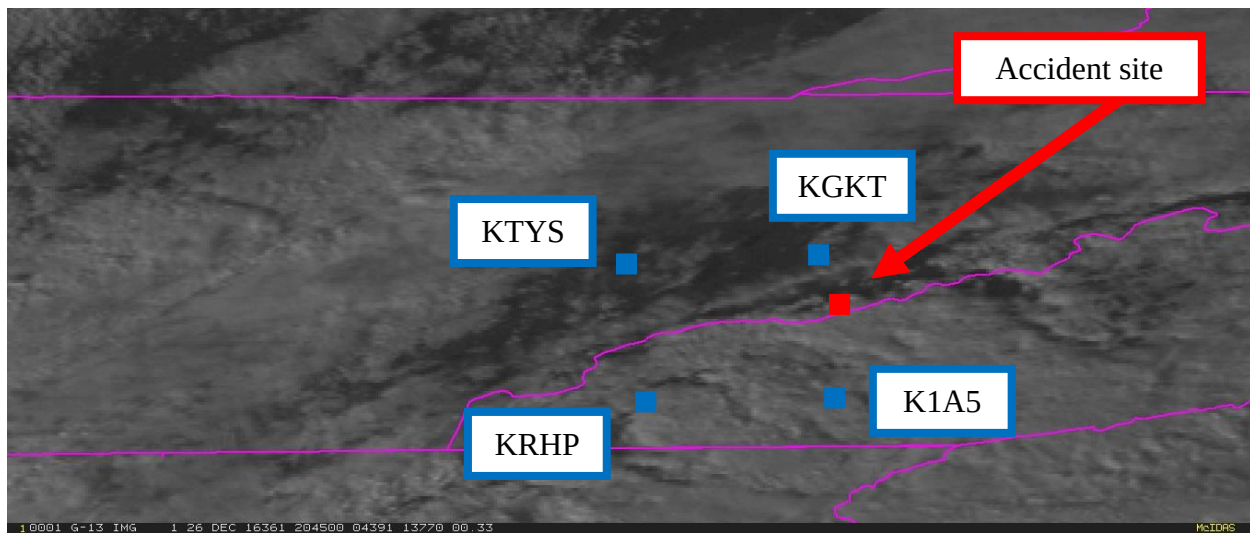


Figure 9 – GOES-13 visible image at 1545 EST

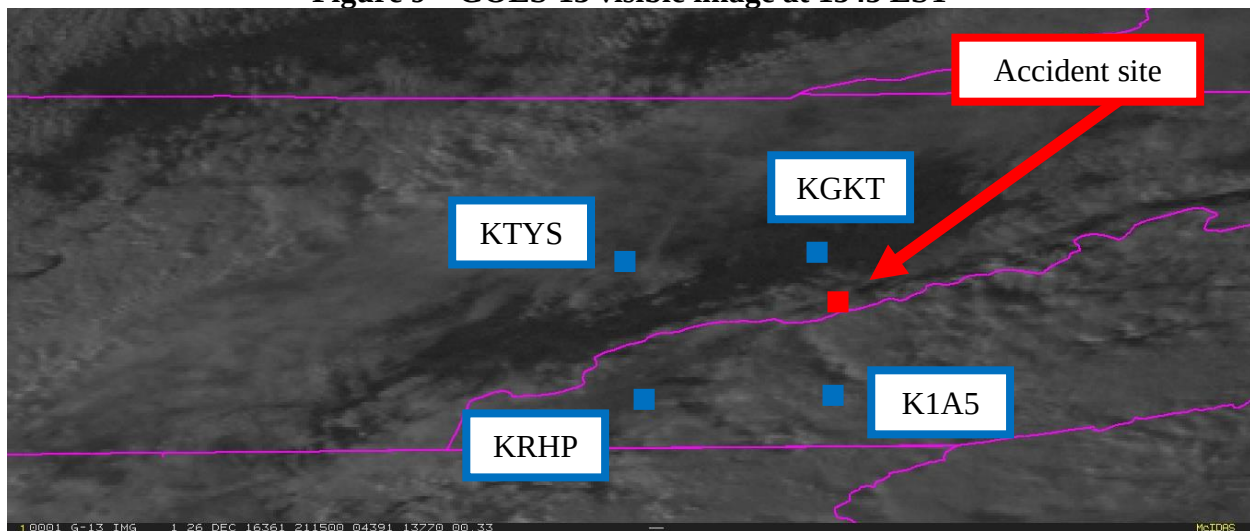


Figure 10 – GOES-13 visible image at 1615 EST

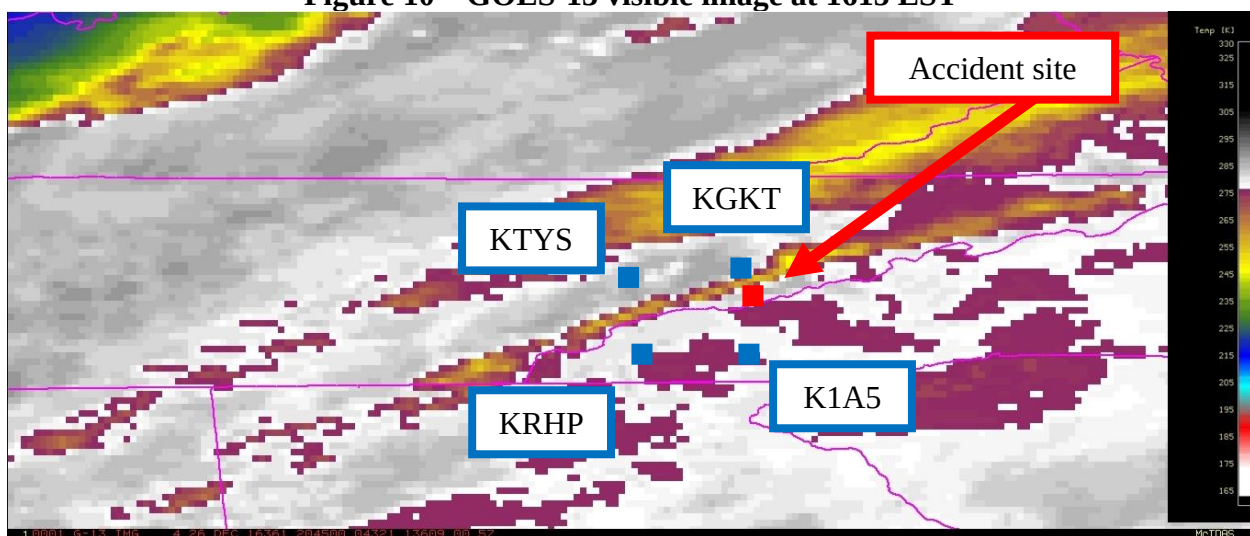


Figure 11 – GOES-13 infrared image at 1545 EST

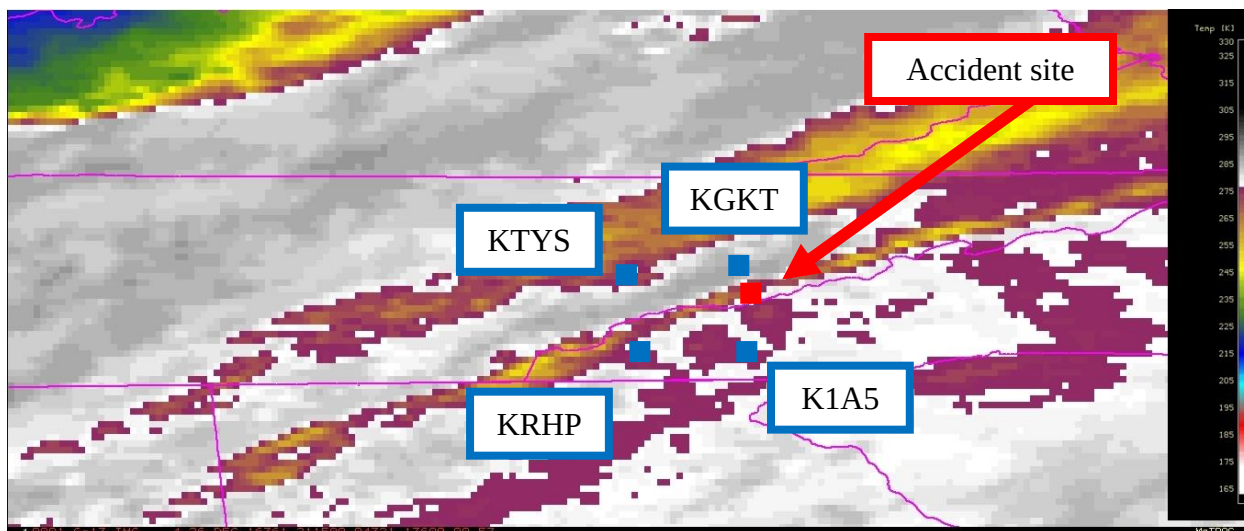


Figure 12 – GOES-13 infrared image at 1615 EST

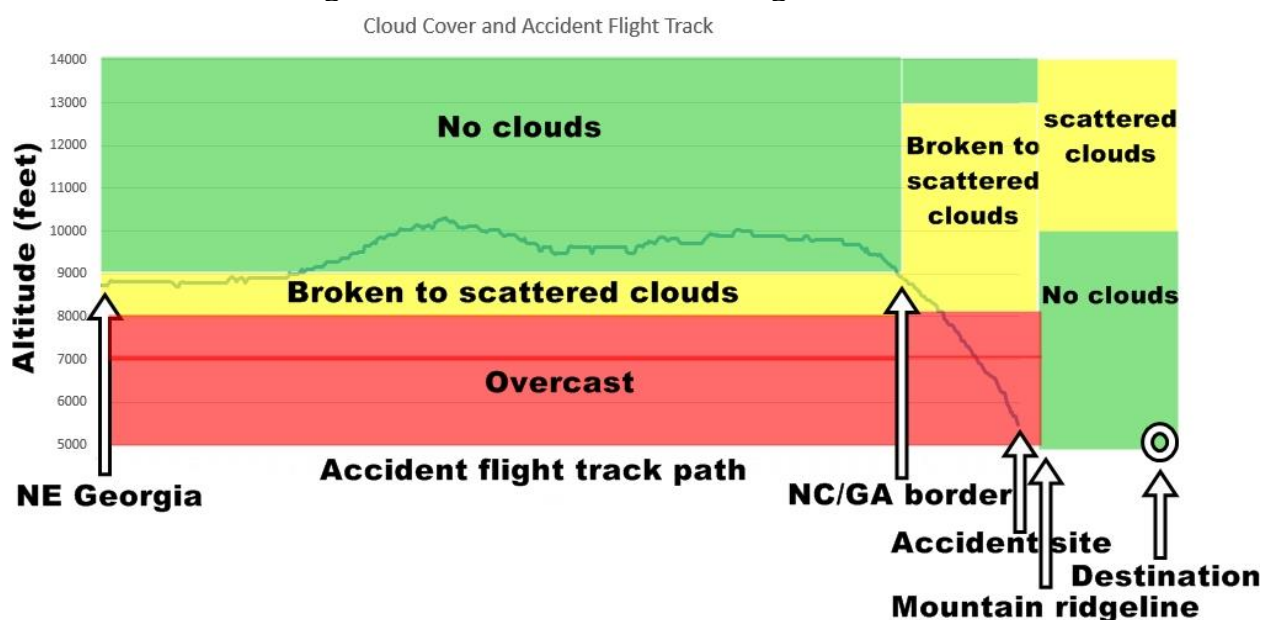


Figure 13 – Cloud cover with height (color fill) and accident flight track (line)

6.0 Radar Imagery Information

The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D)¹⁹ to the accident site was the Knoxville, Tennessee, radar (KMRX), which was located 31 miles north-northeast of the accident site at an elevation of 1,337 feet. Level II and III archive radar data were obtained from the NCEI utilizing the NEXRAD Data Inventory Search and displayed using the NOAA's Weather and Climate Toolkit software. No reflectivity targets were located above the accident site at the accident time.

¹⁹ 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.

7.0 Pilot Reports²⁰

All pilot reports (PIREPs) close to the accident site from about two hours prior to the accident time to about two hours after the accident time were reviewed. Only PIREPs for below 15,000 feet are provided below:

AVL UA /OV AVL/TM 1910/FL026/TP CRJ7/SK OVC026

AVL UA /OV AVL190025/TM 2107/FL100/TP BE58/WX -RA/TA 02/RM IMC / SMOOTH RIDE

Routine pilot report (UA); Over Asheville, North Carolina; Time – 1410 EST (1910Z); Altitude – 2,600 feet; Type aircraft – Bombardier CRJ 700; Sky – Overcast ceiling at 2,600 feet.

Routine pilot report (UA); 25 miles from Asheville, North Carolina, on the 190° radial; Time – 1607 EST (2107Z); Altitude – 10,000 feet; Type aircraft – Beechcraft Baron; Weather – Light rain; Temperature – 2° C; Remarks – IMC with a smooth ride.

Given the area of responsibility described at Knoxville ATCT/TRACON²¹ and the information provided in the interviews, it would likely be beneficial for Knoxville ATCT/TRACON to review or be aware of weather information south of the Appalachian Mountains (such as K1A5 and KRHP, figure 7) when soliciting for PIREPs in their airspace.

8.0 SIGMET and CWSU Advisory

There were no SIGMETs valid for the accident site at the accident time.

No Center Weather Service Unit (CWSU) Center Weather Advisories (CWA)s were valid for the accident site at the accident time. No CWSU Meteorological Impact Statements (MIS)s were valid for the accident site at the accident time.

9.0 AIRMETs

AIRMET Sierra was issued at 1545 EST and valid at the accident time for the accident site (figures 14 through 17). The AIRMET forecasted mountain obscuration conditions due to clouds, precipitation, and mist. In addition, AIRMET Sierra forecasted the same mountain obscuration conditions along the route of flight before the accident flight took off with the 1213 EST AIRMET Sierra:

WAUS42 KKCI 262045

WA2S

_MIAS WA 262045

AIRMET SIERRA UPDT 5 FOR IFR AND MTN OBSCN VALID UNTIL 270300

.

AIRMET IFR...FL AND CSTL WTRS

FROM 30ENE CEW TO 50S TLH TO 100SSW TLH TO 60SE SJI TO 40W CEW
TO 30ENE CEW

²⁰ Only pilot reports with the WMO header UBTN** and those UBNC** identifier were considered.

²¹ See ATC Factual report and information located in the docket for this accident.

CIG BLW 010/VIS BLW 3SM BR. CONDS DVLPG 21-00Z. CONDS CONTG BYD 03Z THRU 09Z.

.
AIRMET IFR...NC SC GA FL AND CSTL WTRS
FROM 20NE CLT TO 30SW ILM TO 40S SAV TO 20NNE OMN TO 20ESE CTY
TO 60S AMG TO 30W AMG TO 40WSW PZD TO GQO TO 30NNE ODF TO 20NE
CLT
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 03Z THRU 09Z.

.
AIRMET IFR...NC WV VA
FROM 40W CSN TO 20SSE CSN TO 30SE LYH TO 20NE CLT TO 30NNE ODF
TO HMY TO 20ESE BKW TO 40W CSN
CIG BLW 010/VIS BLW 3SM BR. CONDS CONTG BYD 03Z THRU 09Z.

.
AIRMET MTN OBSCN...NC SC GA
FROM 40SE PSK TO CLT TO ATL TO GQO TO HMY TO 40SE PSK
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 03Z THRU 09Z.

.
OTLK VALID 0300-0900Z
AREA 1...IFR NC SC GA WV VA AND CSTL WTRS
BOUNDED BY 30ENE BKW-40S SBY-40ESE ORF-30N RDU-40S GSO-CLT-ODF-
GQO-HMY-30ENE BKW
CIG BLW 010/VIS BLW 3SM BR. CONDS CONTG THRU 09Z.

.
AREA 2...IFR NC SC GA FL AND CSTL WTRS
BOUNDED BY 30N RDU-20SSE ECG-90S ECG-20ESE SAV-20NE OMN-20ESE
CTY-60SSW TLH-30ENE CEW-50SW PZD-GQO-ODF-40S GSO-30N RDU
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG THRU 09Z.

....

WAUS42 KKCI 261713 AAA
WA2S
_MIAS WA 261713 AMD
AIRMET SIERRA UPDT 4 FOR IFR AND MTN OBSCN VALID UNTIL 262100

.
AIRMET IFR...NC SC GA
FROM 20NE ODF TO 30S SPA TO 40NNW SAV TO 20NE AMG TO 40WNW PZD
TO 40S GQO TO 20NE ODF
CIG BLW 010/VIS BLW 3SM BR. CONDS CONTG BYD 21Z THRU 03Z.

.
AIRMET IFR...SC GA FL AND CSTL WTRS...UPDT
FROM 30S SPA TO 30WNW FLO TO 20ESE CHS TO 50SSE SAV TO 20S CRG
TO 100SSE CEW TO 60SE SJJ TO 40W CEW TO 30ENE CEW TO 50SSW TLH
TO 50ESE TLH TO 30ENE PZD TO 20NE AMG TO 40NNW SAV TO 30S SPA
CIG BLW 010/VIS BLW 3SM BR. CONDS ENDG 18-21Z.

.
AIRMET IFR...NC WV VA...UPDT
FROM 30S CSN TO 40WSW RIC TO 20W GSO TO 30W SPA TO 40ESE VXV TO
20ENE HMY TO 40SW BKW TO 30S CSN
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS ENDG 18-21Z.

.
AIRMET MTN OBSCN...NC SC GA
FROM HMY TO 20NNW GSO TO CLT TO 20ESE ATL TO GQO TO HMY
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 21Z THRU 03Z.

.
OTLK VALID 2100-0300Z...IFR NC SC GA AND CSTL WTRS

BOUNDED BY 30SSW PSK-40S LYH-40ESE CLT-30WSW ILM-60ENE CHS-
 100SSE CHS-50SSE SAV-40WSW PZD-40S LGC-GQO-30SSW PSK
 CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG THRU 03Z.

....

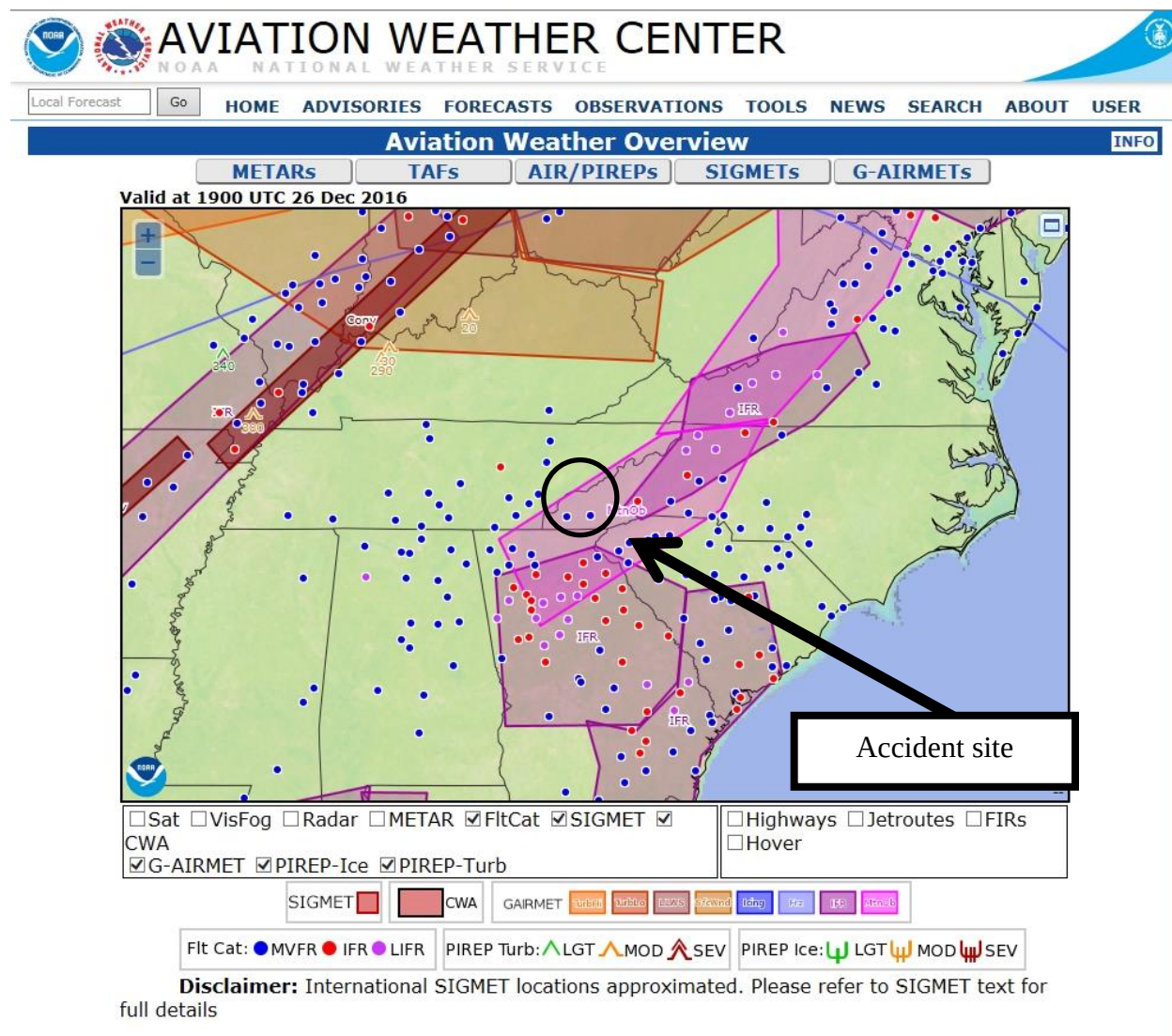
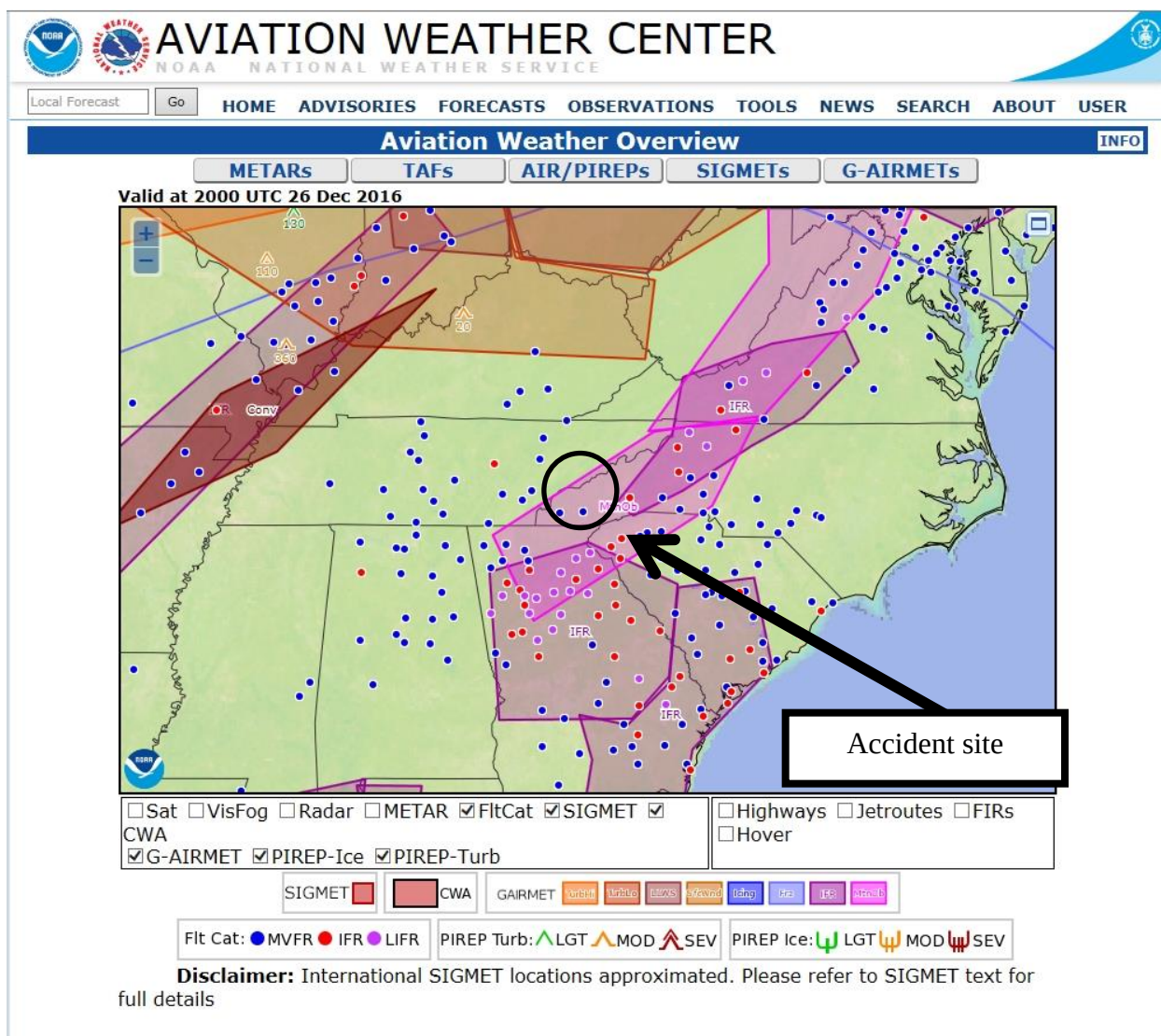


Figure 14 – SIGMETs, AIRMETs, CWAs, and PIREPs valid for the accident area at 1400 EST



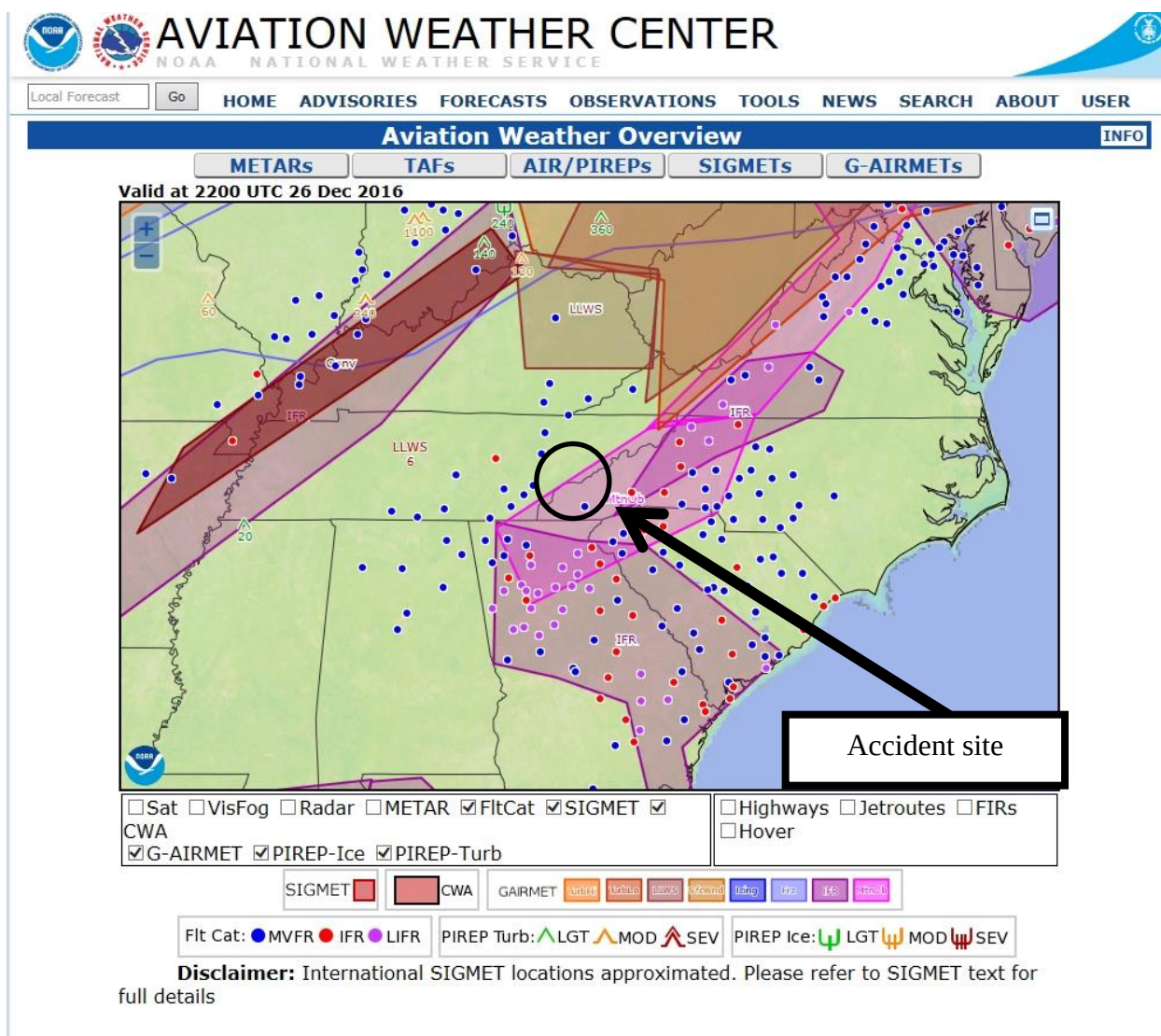


Figure 17 – SIGMETs, AIRMETs, CWAs, and PIREPs valid for the accident area at 1700 EST

10.0 Area Forecast

The Area Forecast issued at 1445 EST, valid at the accident time, forecasted a broken ceiling at 3,000 feet with broken clouds at 6,000 feet with clouds tops at 8,000 feet for the accident site. The 0545 EST Area Forecast valid before the accident flight departed mentioned scattered clouds to a broken ceiling at 5,000 feet with cloud tops at 8,000 feet for the accident site:

FAUS44 KPCI 261945
FA4W
_DFWC FA 261945
SYNOPSIS AND VFR CLDS/WX
SYNOPSIS VALID UNTIL 271400
CLDS/WX VALID UNTIL 270800...OTLK VALID 270800-271400
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...20Z CDFNT ALG AN IND-20W ARG-60W TXK LN...CONTG AS A
STNR FNT ALG A 60W TXK-DLF LN. CDFNT ALG A DEC-RZC-OKC-TBE LN.
14Z CDFNT ALG A TRI-GQO-JAN-50SE GGG-SAT-DLF LN.

.
OK
SE QTR...OVC045 TOPS 110. 22Z SCT045 SCT-BKN100. OTLK...VFR.
RMNDR...SKC. OCNL SCT CI. OTLK...VFR.

.
NWRN TX
SCT-BKN CI. OTLK...VFR.

.
SWRN TX
MTNS WWD...SCT-BKN CI. OTLK...VFR.
W HLF TRANSPCOS RGN...SCT CI. OTLK...VFR.
E HLF TRANSPCOS RGN...SCT030 BKN045 TOPS 060. OTLK...VFR THRUT
EXC MVFR CIG SERN SXNS.

.
N CNTRL TX
SCT030 SCT-BKN050 TOPS 080. TIL 00Z WDLY SCT -SHRA SERN SXNS.
OTLK...VFR.

.
NERN TX
OVC015-025 TOPS 090. SCT -SHRA. WDLY SCT -TSRA SERN SXNS. CB TOPS
FL380. OTLK...IFR CIG SHRA BR.

.
SERN TX
SCT015 BKN040 TOPS 090. WDLY SCT -SHRA. ISOL -TSRA. CB TOPS
FL350. BECMG 0204 OVC010. VIS 4SM BR. OTLK...IFR CIG BR FG.

.
S CNTRL TX
BKN015-025 BKN040 TOPS 070. WDLY SCT -SHRA. ISOL -TSRA. CB TOPS
FL350. BECMG 0205 BKN010-015. VIS 3-5SM BR. ISOL -SHRA.
OTLK...IFR CIG BR.

.
AR
NW HLF...SCT030 BKN050 TOPS 080. TIL 06Z WDLY SCT -SHRA.
OTLK...VFR THRUT EXC MVFR CIG SERN SXNS.
SE HLF...BKN025 TOPS 110. WDLY SCT -TSRA...POSS SEV. CB TOPS
FL450. BECMG 0104 OVC025. SCT -SHRA. ISOL -TSRA. OTLK...MVFR CIG
SHRA BR.

.
LA
N THIRD...SCT030 BKN050 TOPS 110. WDLY SCT -TSRA. CB TOPS FL350.
WDLY SCT -SHRA. ISOL -TSRA. CB TOPS FL350. BECMG 2302 OVC015. SCT
-TSRA. OTLK...IFR CIG SHRA.
SE THIRD...BKN015-025 TOPS 070. 01Z OVC010. VIS 3SM BR.
OTLK...IFR CIG BR FG.
RMNDR...BKN020 BKN040 TOPS 070. WDLY SCT -SHRA. ISOL -TSRA. CB
TOPS FL350. BECMG 0003 OVC010. VIS 4SM BR. OTLK...IFR CIG BR FG.

.
TN
W TN...BKN030 BKN050 TOPS 100. 23Z WDLY SCT -TSRA...POSS SEV. CB

TOPS FL450. OTLK...IFR CIG SHRA BR.
MIDDLE TN...BKN040 TOPS 060. BECMG 0104 OVC015-020. SCT -SHRA.
WDLY SCT -TSRA. CB TOPS FL380. OTLK...IFR CIG SHRA.
E TN...BKN030 BKN060 TOPS 080. OTLK...MVFR CIG SHRA 11Z MVFR CIG SHRA BR.

.
MS
N THIRD...BKN030 OVC045 TOPS 110. BECMG 0103 OVC030. ISOL -SHRA.
07Z OVC020. WDLY SCT -TSRA. CB TOPS FL400. OTLK...MVFR CIG TSRA.
CNTRL THIRD...SCT020 BKN035 TOPS 050. BECMG 0003 OVC020.
OTLK...MVFR CIG 11Z SHRA NRN SXNS.
S THIRD...BKN015-025 TOPS 040. OTLK...IFR CIG BR FG.

.
AL
N HLF...BKN-OVC020-030 TOPS 070. 04Z WDLY SCT -SHRA. OTLK...IFR CIG SHRA BR.
S HLF...SCT020 BKN060 TOPS 080. 06Z VIS 3SM BR CSTL SXNS.
OTLK...MVFR CIG NRN SXNS...IFR CIG BR SRN SXNS.

....
FAUS44 KPCI 261045
FA4W
_DFWC FA 261045
SYNOPSIS AND VFR CLDS/WX
SYNOPSIS VALID UNTIL 270500
CLDS/WX VALID UNTIL 262300...OTLK VALID 262300-270500
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 EXTDS FM SRN IL-W CNTRL AR-SE OK BECMG STNR TO S CNTRL TX. MOIST SLY FLOW WL CONT AHD OF THE FNT. FNT WL DRFT SLOLY EWD AND EXTD FM SW KY BECMG STNR CNTRL AR-S CNTRL TX BY 00Z.

.
OK
PNHDL/WRN...SKC. OTLK...VFR.
CNTRL...BKN080 TOPS 110. 18Z SKC. OTLK...VFR.
NERN...BKN080 TOPS 110. 19Z SKC. OTLK...VFR.
SERN...BKN030 BKN070 TOPS 100. 16Z BKN080. 21Z SCT080.
OTLK...VFR.

.
NWRN TX
SKC. OTLK...VFR.

.
SWRN TX
FAR W/BIG BEND AREA...SKC. OTLK...VFR.
TRANSPECOS RGN...
WRN PTNS...SCT060. 15Z SKC. OTLK...VFR.
ERN PTNS...BKN050 TOPS 080. 20Z SCT050-060. OTLK...VFR.

.
N CNTRL TX
WRN PTNS...OVC050-060 TOPS 080. 21Z SCT060. OTLK...VFR.
ERN PTNS...BKN030 OVC060 TOPS 090. 15Z BKN050-060. OTLK...VFR.

NERN TX
 BKN020-030 OVC050 TOPS 090. 19Z BKN030 BKN070. ISOL -SHRA/-TSRA.
 CB TOPS FL350. OTLK...MVFR CIG.

.

SERN TX
 CSTLN SXNS...OVC010-020 TOPS 080. OCNL VIS 3-5SM BR. 16Z
 BKN015-025. OTLK...MVFR CIG..03Z IFR CIG.
 INLAND SXNS...OVC015-020 TOPS 080. OCNL VIS 4-5SM BR. BECMG 1518
 BKN025-030. 19Z BKN030-040. ISOL -SHRA. OTLK...MVFR CIG.

.

S CNTRL TX
 NRN SXNS...OVC015-020 TOPS 070. 19Z BKN030. OTLK...VFR..03Z MVFR
 CIG.
 SRN SXNS...BKN-OVC010-020 TOPS 050. OCNL VIS 4-5SM BR. 16Z
 BKN025-030. 19Z BKN040. OTLK...VFR..02Z IFR CIG ERN SXNS.

.

AR
 NWRN...BKN040 BKN080 TOPS 120. WDLY SCT -SHRA. 18Z BKN060-070
 TOPS 090. OTLK...VFR.
 RMNDR...BKN020-030 BKN060 TOPS 090. TIL 16Z OCNL VIS 4-5SM BR.
 BECMG 1720 BKN030-040. WDLY SCT -SHRA/-TSRA. CB TOPS FL370.
 OTLK...VFR NERN...MVFR CIG ELSW.

.

LA
 NRN...BKN020-030 TOPS 070. 19Z BKN040. ISOL -SHRA.
 OTLK...VFR..03Z MVFR CIG.
 SRN...OVC010-020 TOPS 070. OCNL VIS 3-5SM BR. BECMG 1820
 BKN020-025. OTLK...MVFR CIG..02Z IFR CIG.

.

TN
 WRN...SCT-BKN020-030 BKN050 TOPS 090. ISOL -SHRA. BECMG 1821
 BKN030-040 TOPS 100. ISOL TO WDLY SCT -SHRA/-TSRA. CB TOPS FL370.
 OTLK...MVFR CIG.
**ERN...SCT040-050 BKN CI. OCNL VIS 3-5SM BR. 15Z SCT-BKN050 TOPS
 080. OTLK...VFR.**

.

MS
 NRN...BKN020-030 BKN060 TOPS 090. 19Z BKN050. ISOL -SHRA.
 OTLK...VFR.
 SRN...OVC010-020 TOPS 050. OCNL VIS 3-5SM BR. 16Z BKN015-025. 19Z
 BKN025-030. OTLK...MVFR CIG..03Z IFR CIG BR.

.

AL
 NWRN...SCT-BKN040-050 TOPS 070. OTLK...VFR.
 NERN...BKN020-030 TOPS 060. 20Z BKN040. OTLK...VFR.
 SWRN...OVC010-015 TOPS 040. OCNL VIS 3-5SM BR. 18Z BKN020.
 OTLK...MVFR CIG..01Z IFR CIG.
 SERN...SCT-BKN020-030 TOPS 040. OCNL VIS 3-5SM BR. 15Z SCT-BKN040
 TOPS 070. OTLK...VFR.

....

11.0 Terminal Aerodrome Forecast

KTYS was the closest site to the accident site with a NWS Terminal Aerodrome Forecast (TAF). The TAF valid at the time of the accident was issued at 1228 EST and was valid for a 24-hour period beginning at 1300 EST. The TAF for KTYS was as follows:

TAF KTYS 261728Z 2618/2718 **22009KT P6SM SCT050 BKN060 OVC080**
FM270000 22006KT P6SM OVC050
FM270500 22008KT P6SM OVC020
FM271000 22009KT 5SM -SHRA BR OVC015
FM271300 24009KT 2SM -SHRA BR OVC007=

The forecast expected a wind from 220° at 9 knots, greater than 6 miles visibility, scattered clouds at 5,000 feet agl, a broken ceiling at 6,000 feet agl, and overcast skies at 8,000 feet agl.

12.0 NWS Area Forecast Discussion

The NWS Office in Morristown, Tennessee, issued the following Area Forecast Discussion (AFD) at 1258 EST (closest AFD to the accident time with an aviation section). The aviation section of the AFD discussed that VFR conditions persisted at KTYS with MVFR conditions not expected until the overnight hours as a weather front approached the area:

FXUS64 KMRX 261758
AFDMRX
Area Forecast Discussion
National Weather Service Morristown TN
1258 PM EST Mon Dec 26 2016
.AVIATION...Lower clouds have moved in to CHA today and then
will spread further north to TYS and TRI tonight. MVFR conditions
at CHA becoming IFR tonight. At TYS and TRI conditions will be
VFR...then MVFR overnight as front approaches. Light rain or
showers will keep ceilings low either MVFR or IFR through Tuesday
morning.
&&
.MRX WATCHES/WARNINGS/ADVISORIES...
NC...None.
TN...None.
VA...None.
&&
\$\$

13.0 Winds and Temperature Aloft Forecast

The NWS 1459 EST and 0859 EST Winds and Temperature Aloft forecasts valid for the accident flight are included below:

FBUS31 KWNO 261959

FD1US1

_DATA BASED ON 261800Z

VALID 270000Z FOR USE 2000-0300Z. TEMPS NEG ABV 24000

FT 3000 6000 9000 12000 18000 24000 30000 34000 39000

_TYS **2136 2337+10 2435+06** 2332+01 2630-12 2541-25 254840 255750 256357

FBUS31 KWNO 261359

FD1US1

_DATA BASED ON 261200Z

VALID 261800Z FOR USE 1400-2100Z. TEMPS NEG ABV 24000

FT 3000 6000 9000 12000 18000 24000 30000 34000 39000

_TYS **1922 2234+10 2329+05** 2329+02 2335-13 2441-25 244840 235550 246857

The accident site was closest to the TYS forecast point. The 1459 EST TYS forecast indicated a wind at 3,000 feet from 210° at 36 knots, a wind at 6,000 feet from 230° at 37 knots with a temperature of 10° C, and a wind at 9,000 feet from 240° at 35 knots with a temperature of 6° C. The 0859 EST TYS forecast indicated a wind at 3,000 feet from 190° at 22 knots, a wind at 6,000 feet from 220° at 34 knots with a temperature of 10° C, and a wind at 9,000 feet from 230° at 29 knots with a temperature of 5° C.

14.0 Pilot Weather Briefing

A search of official weather briefing sources, such as Lockheed Martin Flight Service and Direct User Access Terminal Service was done and the accident pilot did not receive an official weather briefing from those sources. A search of ForeFlight weather information revealed that the accident pilot did not request a weather briefing using ForeFlight Mobile prior to his flight (attachment 1). However, while the accident pilot did not file a flight plan with ForeFlight Mobile, the accident pilot did enter route information at 1449 EST with the route from 42J to KGKT. The accident pilot did not look at any weather imagery (e.g.: Prog Charts, G-AIRMETs, Icing information, etc...) prior to the entering of the route at 1449 EST (attachment 2). The accident pilot could have accessed other “live” weather information such as METARs/TAFs, etc... (attachment 2), because that information is not logged by ForeFlight. It is unknown if the accident pilot checked or received any more weather information before or during the accident flight.

15.0 Witness Information

A pilot traveling from Rogersville (KRVN), Tennessee, southwestward to Winchester (KBGF), Tennessee, around the accident time captured images and weather information near the accident site. The pilot described entering a cloud layer around 5,000 feet msl with the tops at 7,000 feet msl shortly after departing KRVN. The pilot remained above the clouds at 8,000 feet msl and took a few pictures (attachments 3 and 4), with the images from around 1620 EST revealing a relatively flat stratus cloud top stretching in all directions. The pilot described the cloud top layer around 7,000 feet msl remaining consistent throughout the flight to KBGF and the pilot descending through that cloud layer when landing at KBGF.

16.0 Astronomical Data

The astronomical data obtained from the United States Naval Observatory for the accident site on December 26, 2016, indicated the following:

SUN

Begin civil twilight	0714 EST
Sunrise	0742 EST
Sun transit	1235 EST
Sunset	1727 EST
End civil twilight	1756 EST

E. LIST OF ATTACHMENTS

Attachment 1 – ForeFlight weather information request

Attachment 2 – ForeFlight weather information request

Attachment 3 – Witness information

Attachment 4 – Witness information

Submitted by:

Paul Suffern
Senior Meteorologist

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