



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

April 11, 2019

Weather Study Report

METEOROLOGY

ERA19FA071

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A. ACCIDENT

Location: Atlanta, Georgia
Date: December 20, 2018
Time: 1210 Eastern standard time
1710 Coordinated Universal Time (UTC)
Aircraft: Cessna 560, Registration: N188CW

B. METEOROLOGIST

Paul Suffern
Senior Meteorologist
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 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 20, 2018, 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 33.7906° N, longitude 84.4950° W, at an approximate elevation of 855 feet (ft).

D. 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 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

https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/1030

1.1 Surface Analysis Chart

The southeastern United States section of the NWS Surface Analysis Chart for 1300 EST is provided as figure 1 with the approximate location of the accident site marked with a red circle. The chart indicated a frontal system located over the southeastern United States. Low pressure centers were located in southwestern Georgia, central Alabama, and western Florida with pressures of 998-, 999-, and 997-hectopascals (hPa), respectively. A warm front stretched from southern Alabama northeastward into central North Carolina. A cold front stretched from southern Alabama into the Gulf of Mexico. A surface trough² stretched from southwestern Georgia northward over the accident site and into Tennessee and Kentucky.

The station models around the accident site depicted air temperatures in the upper 40's degrees Fahrenheit (°F), dew point temperatures in the upper 40's °F with a 2 degree temperature-dew point spread near the accident site, an east wind of 5 knots, overcast skies, and light to heavy rain.

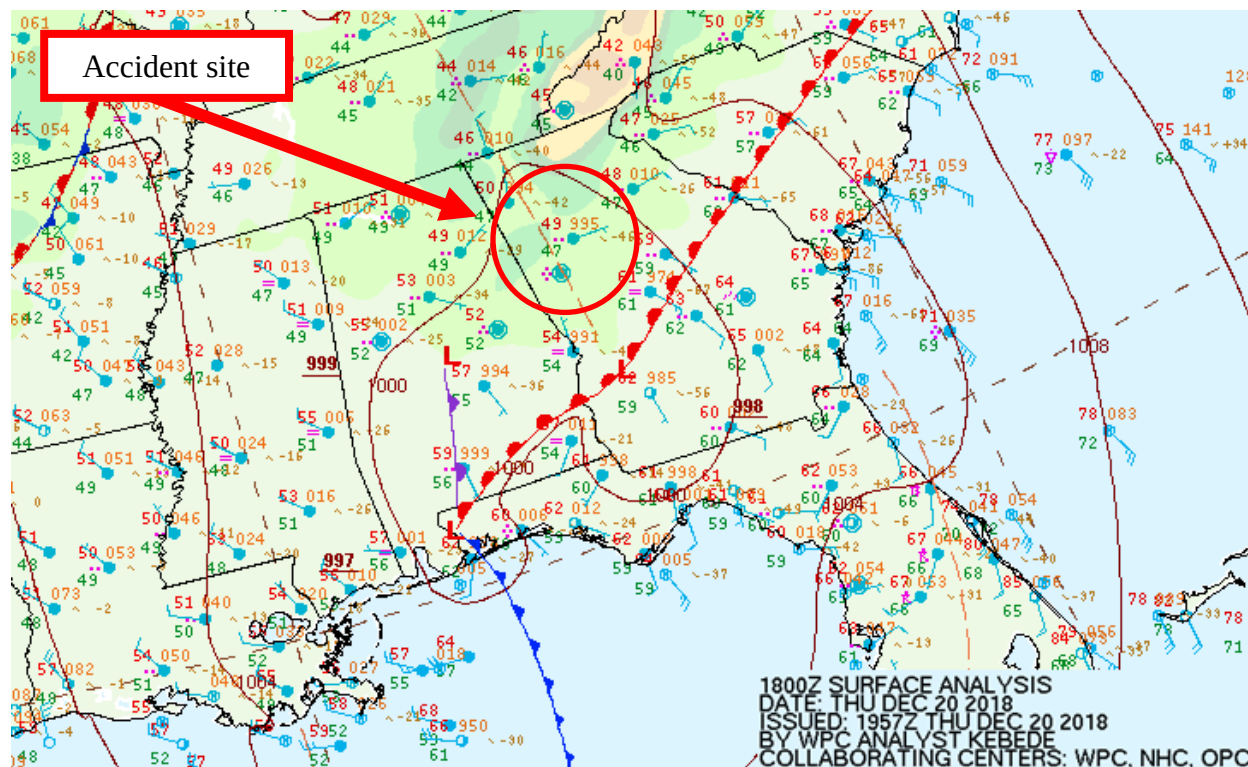


Figure 1 – NWS Surface Analysis Chart for 1300 EST

1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 0700 EST at 925-, 850-, 700-, 500-, and 300-hPa are presented in figures 2 through 6. There were low- and mid-level troughs southwest of the accident site at 925- through 500-hPa. Troughs can act as lifting mechanisms to help produce clouds and precipitation if sufficient moisture is present. The wind was from the east at 20 knots at 925-hPa with the wind becoming southerly at 30 knots by 850-hPa (figure 3). At 300-hPa, the wind was from the southwest at 105 knots (figure 6).

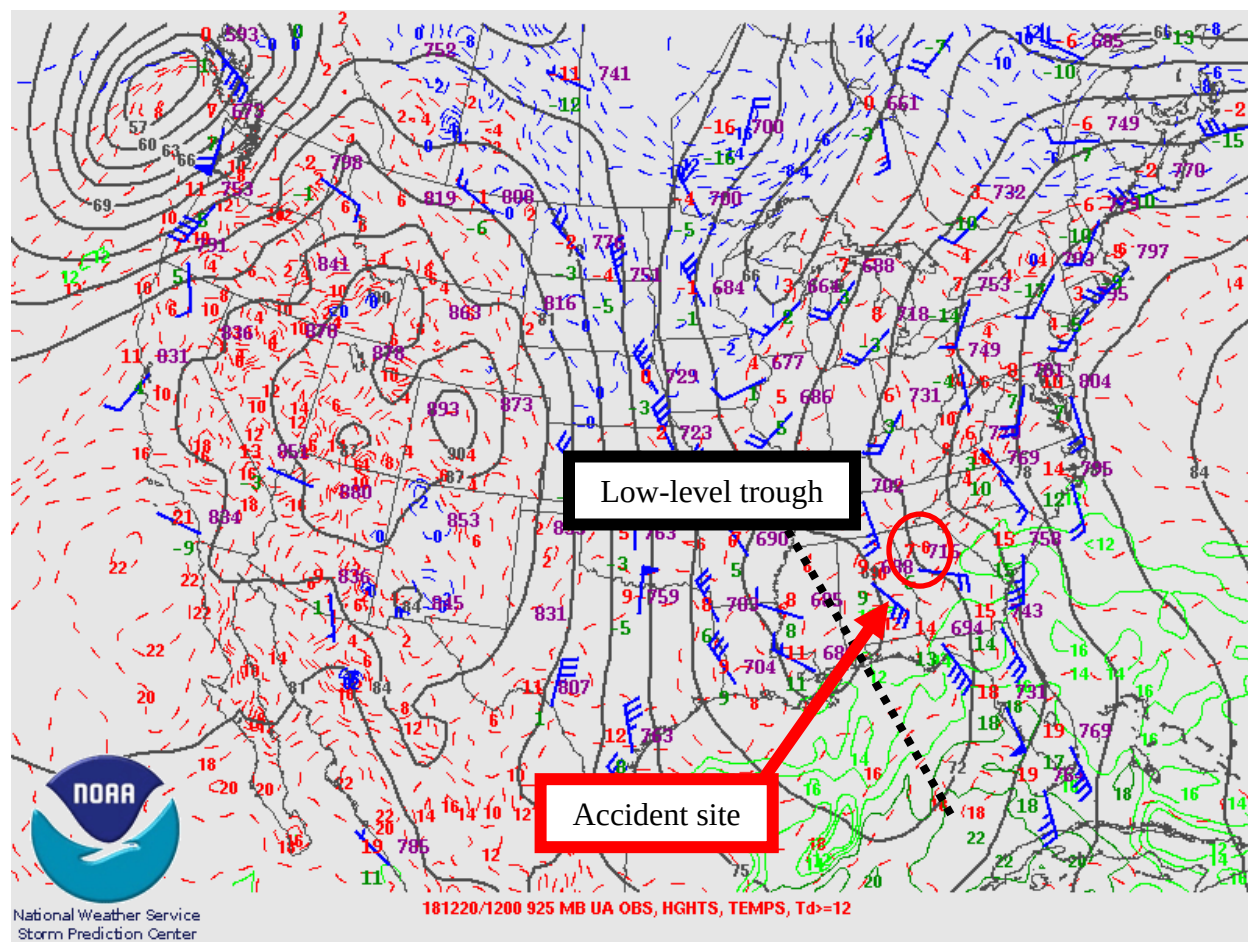


Figure 2 – 925-hPa Constant Pressure Chart for 0700 EST

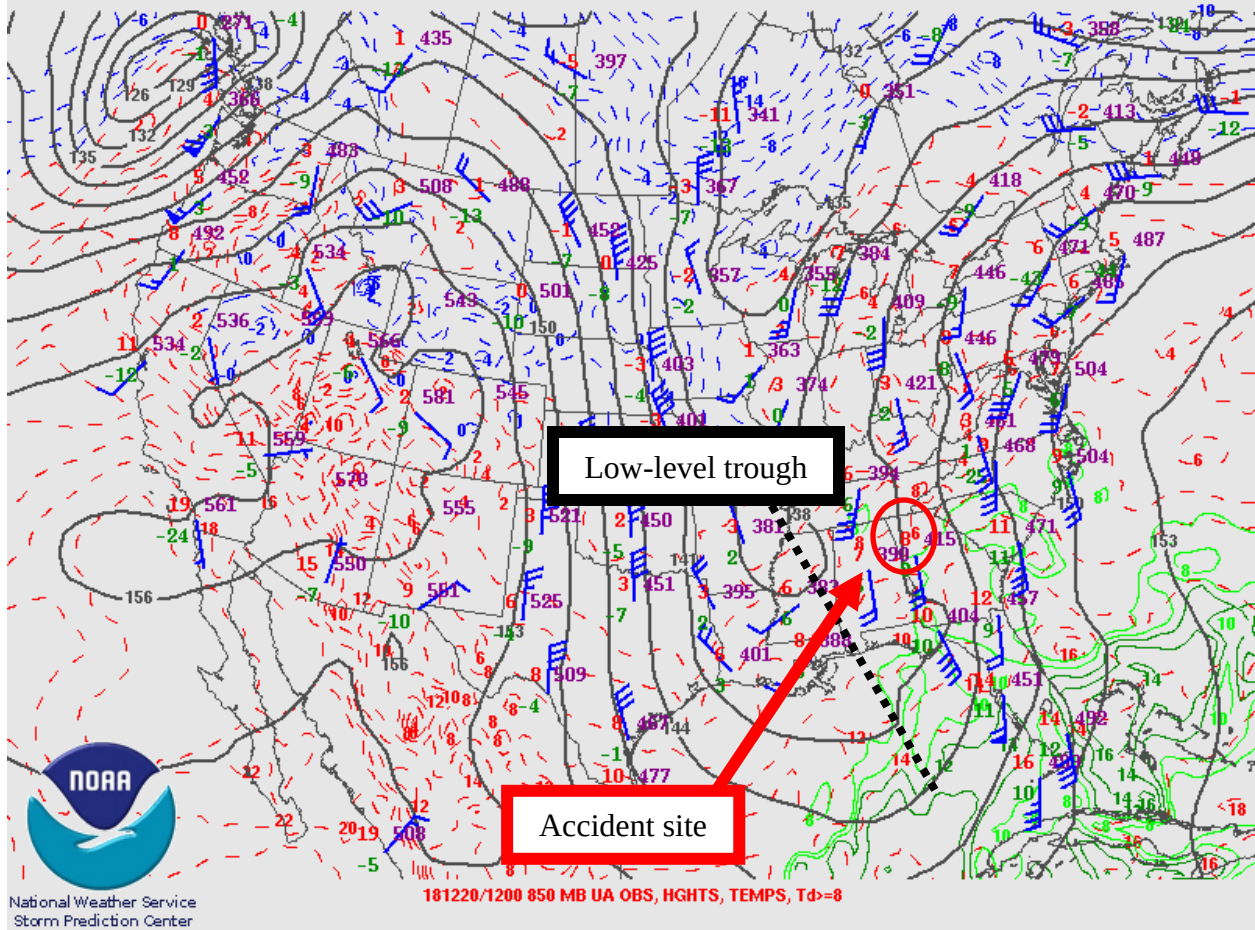


Figure 3 – 850-hPa Constant Pressure Chart for 0700 EST

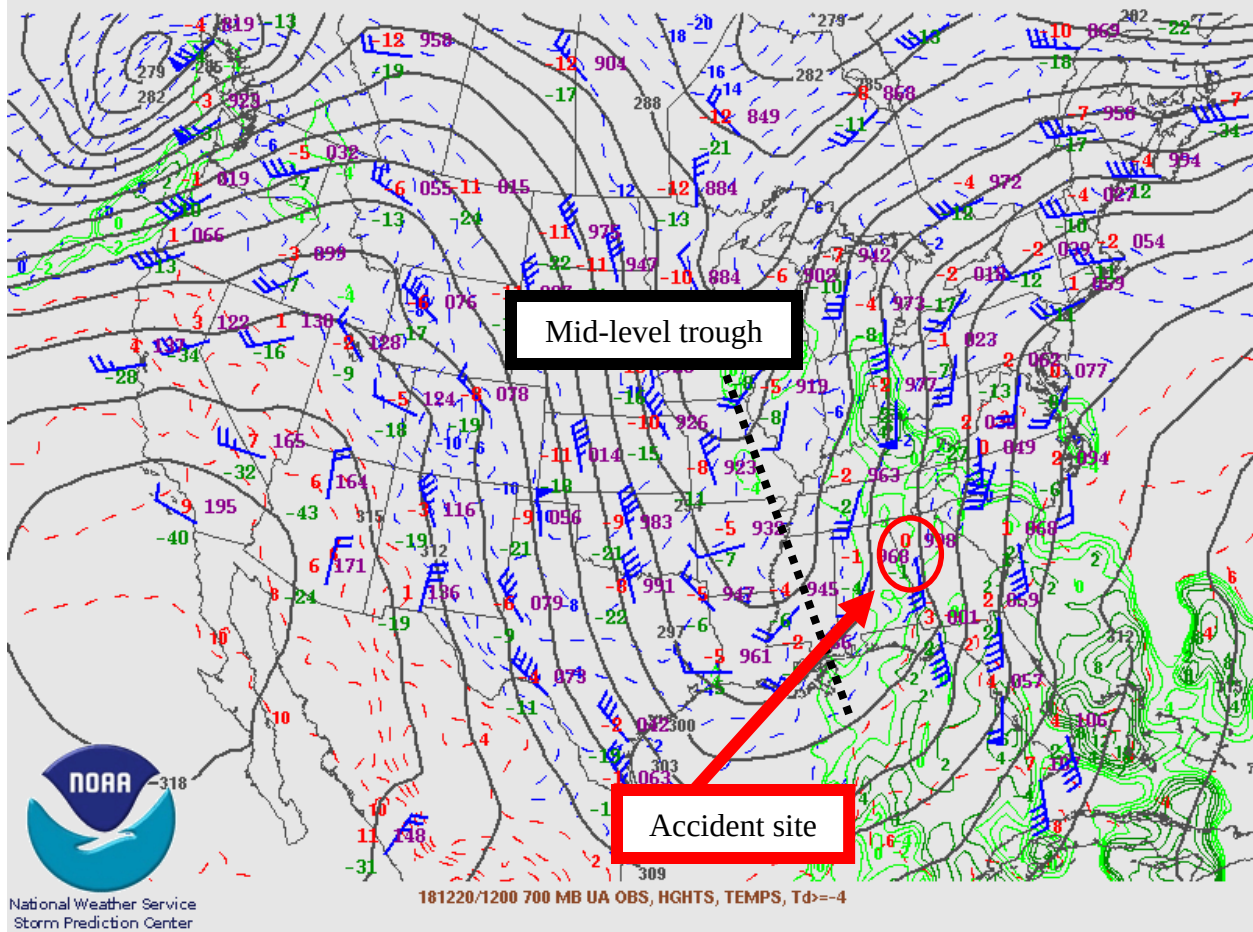


Figure 4 – 700-hPa Constant Pressure Chart for 0700 EST

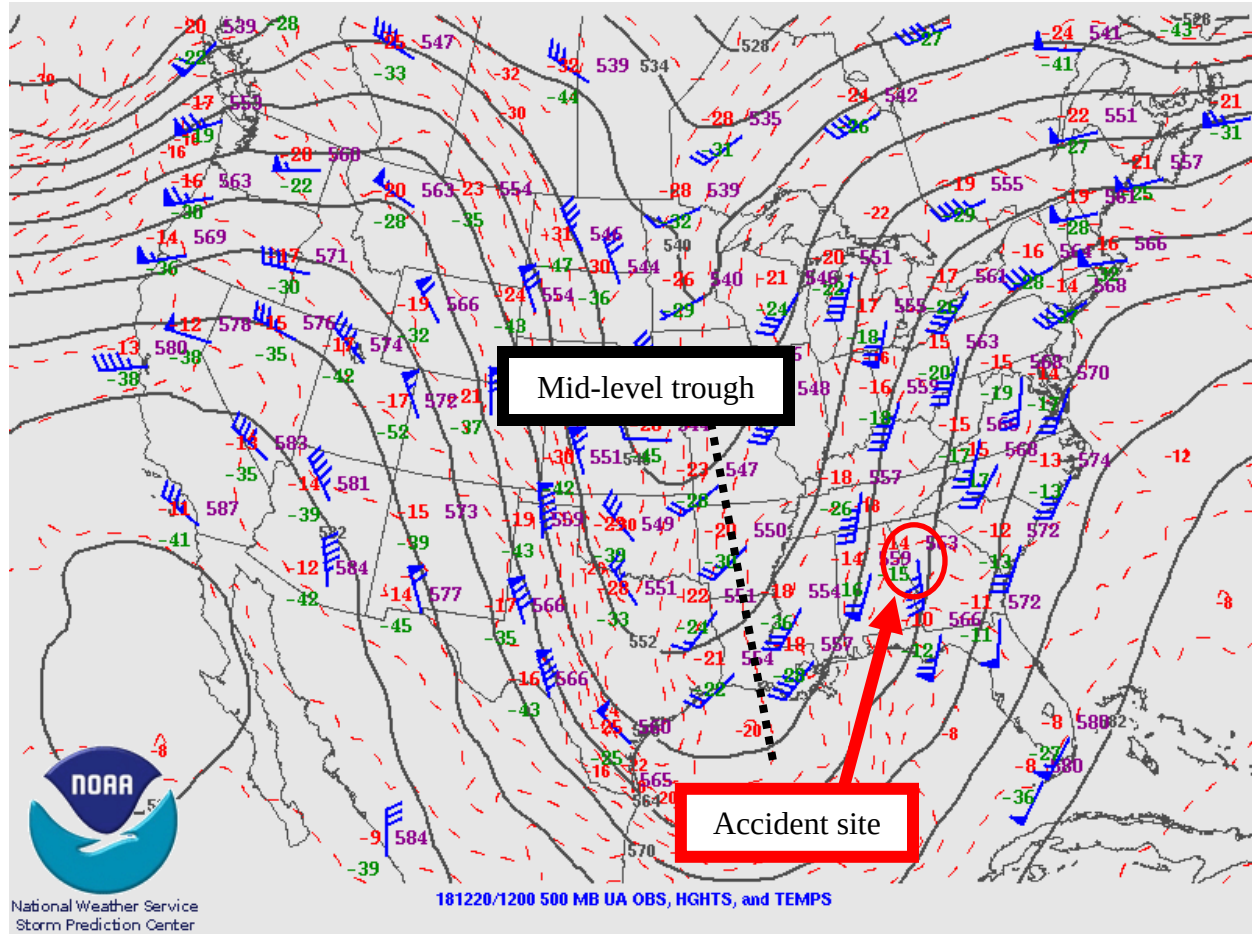


Figure 5 – 500-hPa Constant Pressure Chart for 0700 EST

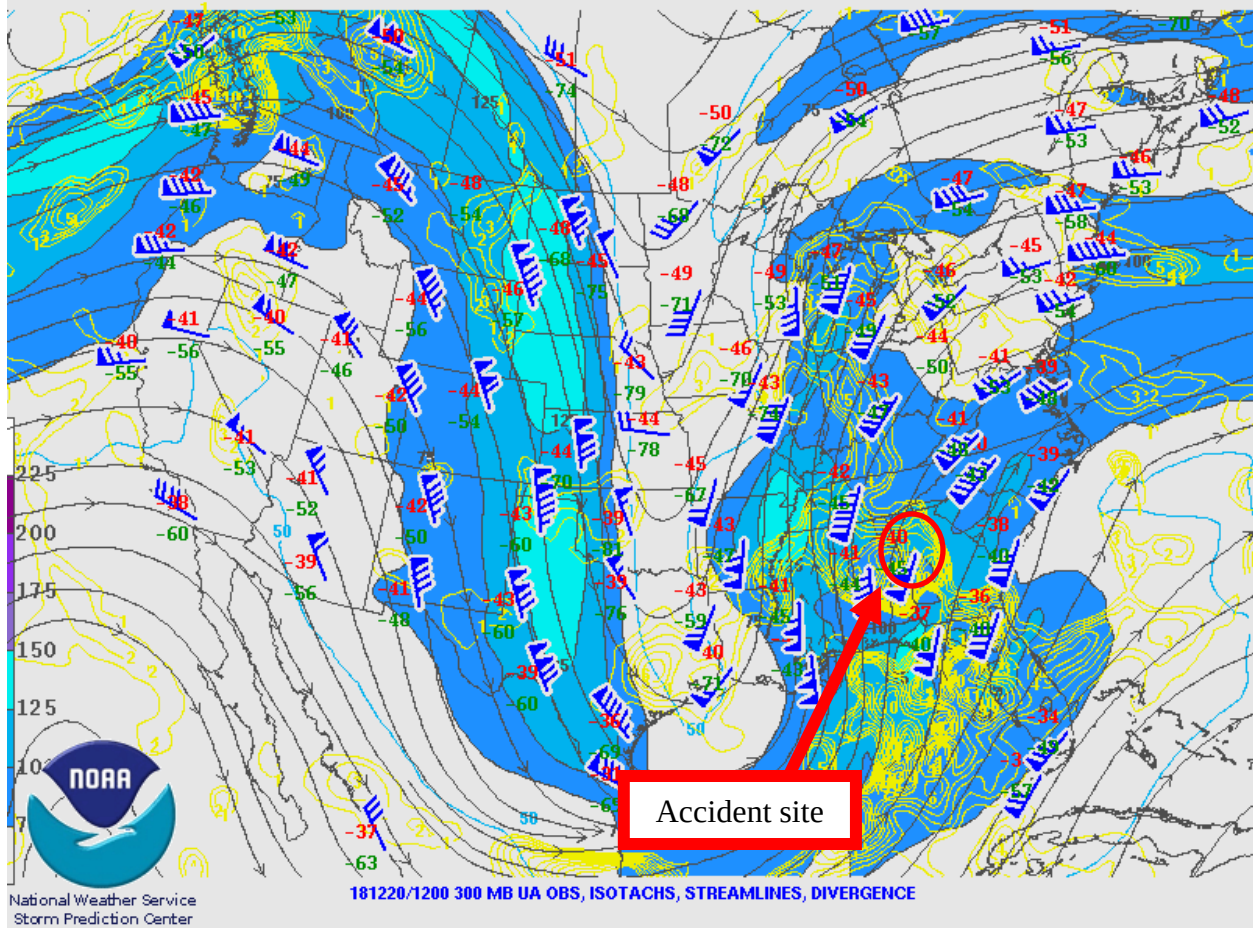


Figure 6 – 300-hPa Constant Pressure Chart for 0700 EST

2.0 SPC Products

No thunderstorms were forecast by SPC for the accident site at the accident time.

3.0 Surface Observations

The area surrounding the accident site was documented using official Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). Figure 7 is a sectional chart with the accident site and the closest weather reporting location to the accident site marked.

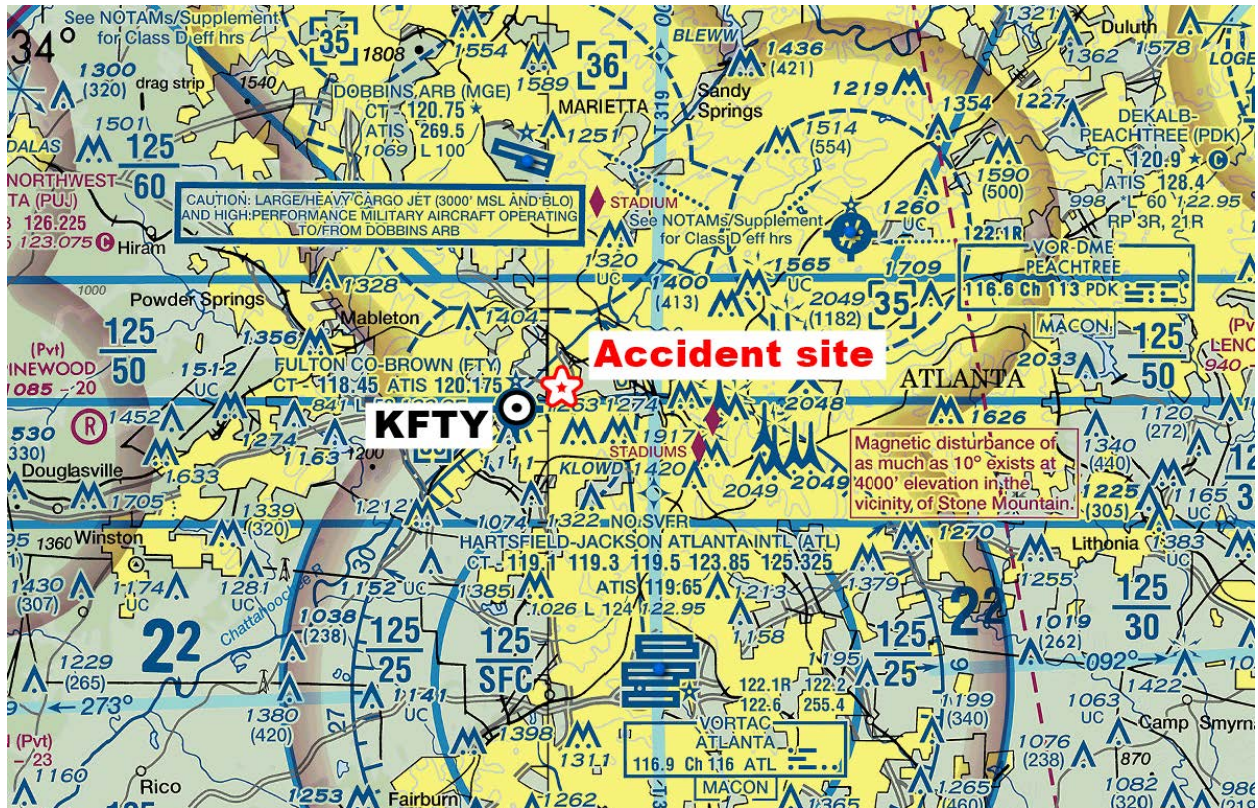


Figure 7 – Sectional chart of accident area with the location of the accident site and the closest surface observation site marked

Fulton County Airport-Brown Field (KFTY) had the closest official weather observation point to the accident site. KFTY had an Automated Surface Observing System (ASOS³) whose reports were supplemented by air traffic control (ATC). KFTY was located 2 miles west-southwest of the accident site, at an elevation of 841 ft, and had a 5° westerly magnetic variation⁴ (figure 7). The following observations were taken and disseminated during the times surrounding the accident:⁵

[0653 EST] METAR KFTY 201153Z 06010KT 6SM -RA BR BKN007 OVC012 08/08 A2977 RMK AO2 CIG 005V009 SLP080 P0005 60011 70011 T00830083 10100 20083 58021=

[0753 EST] METAR KFTY 201253Z 06010KT 4SM RA BR OVC007 08/08 A2975 RMK AO2 CIG 005V010 SLP072 P0010 T00780078=

[0853 EST] METAR KFTY 201353Z 06007KT 6SM -RA BR BKN006 BKN017 OVC024 08/08 A2972 RMK AO2 SLP064 P0008 T00830078=

³ ASOS – Automated Surface Observing System is equipped with meteorological instruments to observe and report wind, visibility, ceiling, temperature, dewpoint, altimeter, and barometric pressure.

⁴ Magnetic variation – The angle (at a particular location) between magnetic north and true north. Latest measurement taken from <https://skyvector.com/>

⁵ Bolded sections in this report highlight information that directly reference the weather conditions that affected the accident location around the accident time.

[0953 EST] METAR KFTY 201453Z 06008KT 3SM RA BR OVC007 08/08 A2971 RMK
AO2 SLP058 P0012 60030 T00830078 56021=

**[1053 EST] METAR KFTY 201553Z 05008KT 7SM -RA OVC008 08/08 A2965 RMK
AO2 CIG 006V011 SLP040 P0008 T00830083=**

**[1153 EST] METAR KFTY 201653Z 06010KT 4SM -RA BR BKN008 OVC014 08/08
A2957 RMK AO2 PRESFR SLP012 P0013 T00830083=**

ACCIDENT TIME 1210 EST

**[1216 EST] SPECI KFTY 201716Z 05010KT 7SM -RA OVC006 08/08 A2952 RMK
AO2 PRESFR P0002 T00830083=**

**[1253 EST] METAR KFTY 201753Z 05004KT 10SM -RA OVC006 09/09 A2951 RMK
AO2 SLP991 P0002 60053 T00890089 10089 20078 58065=**

[1305 EST] SPECI KFTY 201805Z 07004KT 1 3/4SM -RA BR OVC006 09/09 A2950
RMK AO2 P0001 T00890089=

KFTY weather at 1053 EST, wind from 050° at 8 knots, 7 miles visibility, light rain, overcast ceiling at 800 ft above ground level (agl), temperature of 8° Celsius (C), dew point temperature of 8° C, and an altimeter setting of 29.65 inches of mercury. Remarks: automated station with a precipitation discriminator, ceiling varying between 600 and 1,100 ft agl, sea level pressure 1004.0 hPa, 0.08 inches of precipitation since 0953 EST, temperature 8.3° C, dew point temperature 8.3° C.

KFTY weather at 1153 EST, wind from 060° at 10 knots, 4 miles visibility, light rain and mist, a broken ceiling at 800 ft agl, overcast skies at 1,400 ft agl, temperature of 8° C, dew point temperature of 8° C, and an altimeter setting of 29.57 inches of mercury. Remarks: automated station with a precipitation discriminator, pressure falling rapidly, sea level pressure 1001.2 hPa, 0.13 inches of precipitation since 1053 EST, temperature 8.3° C, dew point temperature 8.3° C.

KFTY weather at 1216 EST, wind from 050° at 10 knots, 7 miles visibility, light rain, overcast ceiling at 600 ft agl, temperature of 8° C, dew point temperature of 8° C, and an altimeter setting of 29.52 inches of mercury. Remarks: automated station with a precipitation discriminator, pressure falling rapidly, 0.02 inches of precipitation since 1153 EST, temperature 8.3° C, dew point temperature 8.3° C.

KFTY weather at 1253 EST, wind from 050° at 4 knots, 10 miles visibility, light rain, overcast ceiling at 600 ft agl, temperature of 9° C, dew point temperature of 9° C, and an altimeter setting of 29.51 inches of mercury. Remarks: automated station with a precipitation discriminator, sea level pressure 999.1 hPa, 0.03 inches of precipitation since 1153 EST, 6-hourly precipitation of 0.53 inches, temperature 8.9° C, dew point temperature 8.9° C, 6-hourly maximum temperature of 8.9° C, 6-hourly minimum temperature of 7.8° C, 3-hourly pressure decrease of 6.5 hPa.

The observations from KFTY surrounding the accident time indicated IFR⁶ conditions with a northeast wind around 10 knots. The surface pressure was also rapidly dropping during the 3 hours surrounding the accident timeframe causing large drops in the altimeter setting. The 1 and 5 minute KFTY ASOS data did not observe any large differences from the regular or SPECI METARs above (attachment 1).

4.0 Upper Air Data

A High-Resolution Rapid Refresh (HRRR)⁷ model sounding was created for the accident site for 1200 EST with station elevation of 837 ft.⁸ The 1200 EST HRRR sounding was plotted on a standard Skew-T Log P diagram⁹ with the derived stability parameters included in figure 8 (with data from the surface to 700-hPa (or approximately 10,000 ft msl). This data was analyzed using the RAOB¹⁰ software package. The sounding depicted the convective condensation level (CCL)¹¹ at 93 ft agl (930 ft msl), lifted condensation level (LCL)¹² at 198 ft agl (1,128 ft msl), and the level of free convection (LFC)¹³ at 213 ft agl (1,143 ft msl). The sounding had a greater than 90% relative humidity from the surface through 10,000 ft msl. The freezing level was located at 11,200 ft msl. The precipitable water value was 1.22 inches.

⁶ Instrument Flight Rules (IFR) – Refers to the general weather conditions pilots can expect at the surface. IFR criteria means a ceiling below 1,000 ft agl and/or less than 3 miles visibility.

⁷ 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.

⁸ HRRR sounding was created using NOAA Air Resource Laboratory: <https://ready.arl.noaa.gov/READYamet.php>

⁹ 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.

¹⁰ RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamoras, Pennsylvania.

¹¹ 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 LCL - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

¹³ 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.

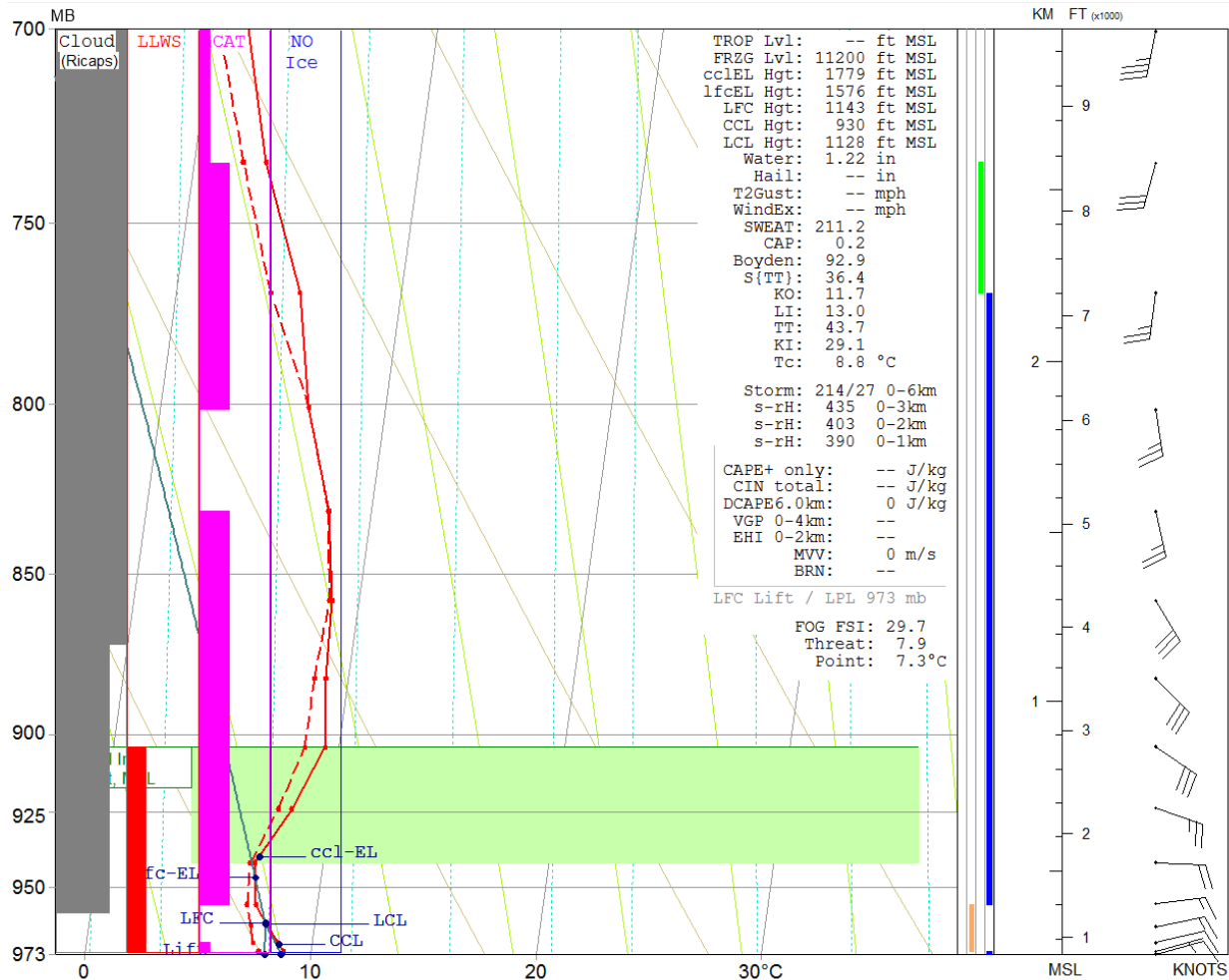


Figure 8 – 1200 EST HRRR sounding for the accident site

The 1200 EST HRRR sounding for the accident site indicated an unstable environment from the surface through 1,250 ft msl (~400 ft agl), then a stable environment from 1,250 ft msl through 7,000 ft msl. RAOB identified the possibility of clouds from 1,300 ft msl (~500 ft agl) through 10,000 ft msl. A frontal inversion¹⁴ was noted at 2,834 ft msl.

The 1200 EST HRRR sounding wind profile indicated a surface wind from 074° at 8 knots with the wind remaining out of the east through 3,000 ft msl with the wind magnitude increasing to 20 knots by 1,700 ft msl and 30 knots by 3,000 ft msl. The wind was southerly from 3,000 ft msl through 10,000 ft msl with the wind speed increasing to 35 knots by 10,000 ft msl. RAOB indicated the possibility of light low-level wind shear (LLWS) from the surface through 3,000 ft msl. RAOB indicated a chance of light to moderate clear-air turbulence existed in several layers between the surface and 10,000 ft msl.

¹⁴ Inversion – A departure from the usual decrease or increase with altitude of the value of an atmospheric property; also, the layer through which this departure occurs (the "inversion layer"), or the lowest altitude at which the departure is found (the "base of the inversion").

5.0 Satellite Data

The Geostationary Operational Environmental Satellite number 16 (GOES-16) visible and infrared data were 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-16 bands 2 and 13) at wavelengths of 0.64 microns (μm) and 10.3 μm , respectively, were retrieved for the period from 1000 EST through 1800 EST and reviewed, and the closest images to the time of the accident are documented here.

Figures 9 and 10 present the GOES-16 visible imagery at 1200 and 1215 EST at 2X magnification with the accident site highlighted with a red square. The visible imagery indicated an extensive layer of cloud cover over the accident site moving from southwest to northeast.

Figure 11 presents the GOES-16 infrared imagery from 1215 EST at 4X magnification with the accident site highlighted with a red square. Inspection of the infrared imagery indicated cloud cover over the accident site. The lower brightness temperatures (blue and green colors; higher cloud tops) were located above and to the north and east of the accident site. Based on the brightness temperatures above the accident site and the vertical temperature profile provided by the 1200 EST HRRR sounding, the approximate cloud-top heights over the accident site were 29,000 ft at 1215 EST (240° Kelvin). It should be noted these figures have not been corrected for any parallax error.

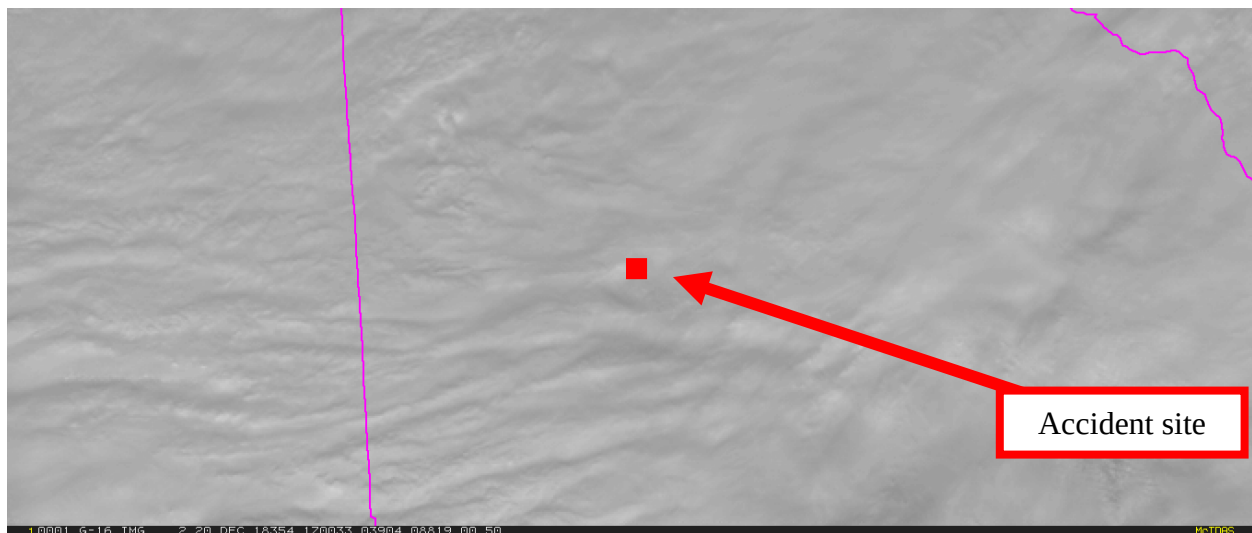


Figure 9 – GOES-16 visible image at 1200 EST

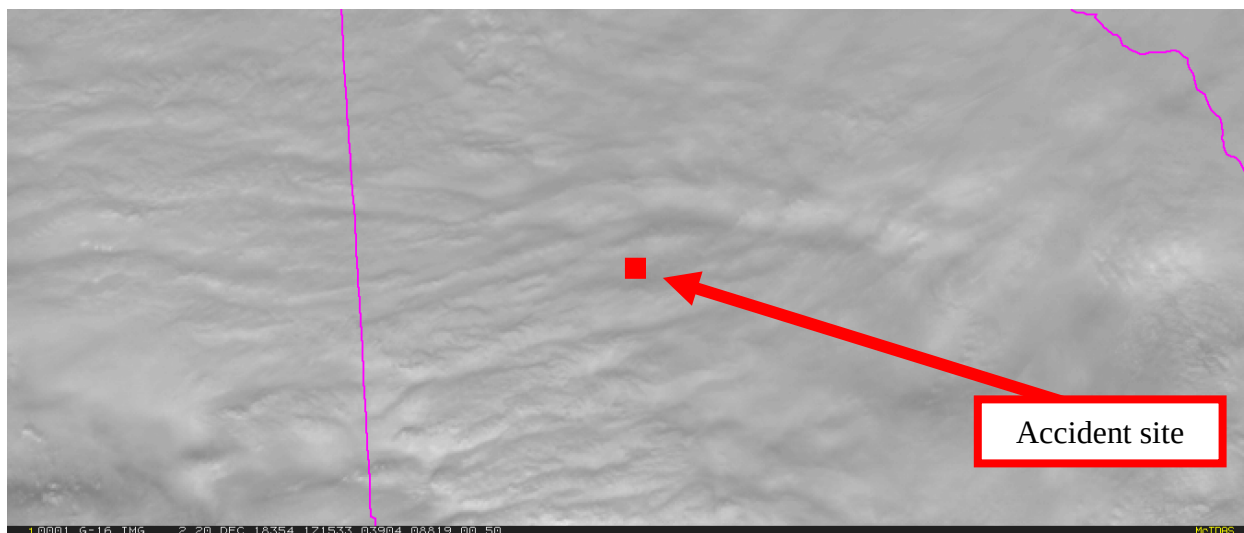


Figure 10 – GOES-16 visible image at 1215 EST

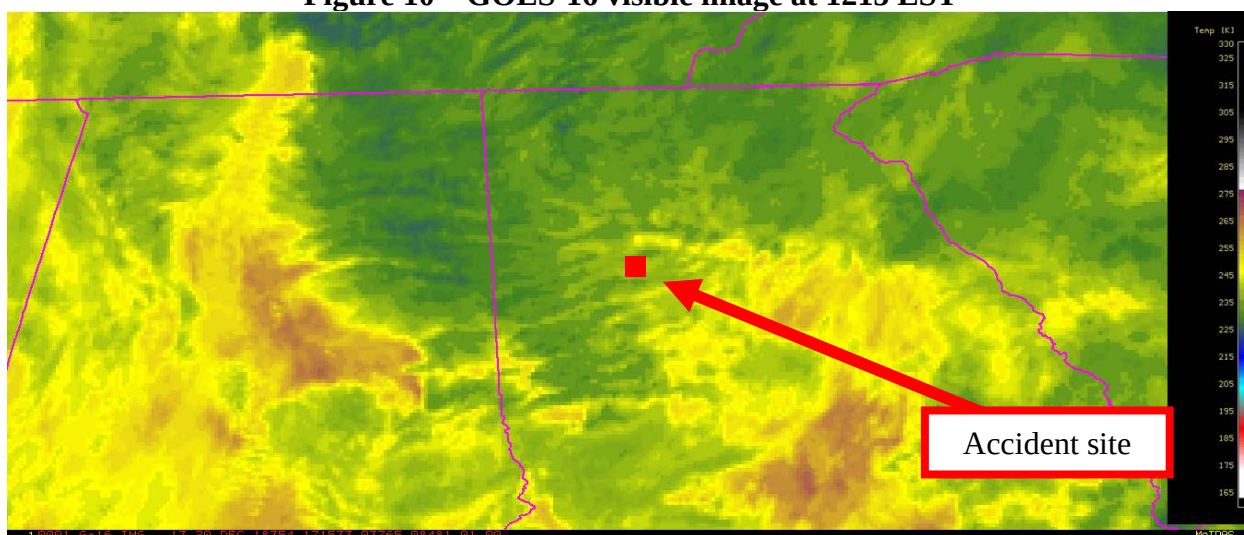


Figure 11 – GOES-16 infrared image at 1215 EST

6.0 Regional Radar Imagery Information

A regional view of the NWS national composite radar mosaic is included as figure 12 for 1210 EST with the approximate accident site marked by a red circle. The image depicted 20 to 35 decibels (dBZ¹⁵) echoes above the accident site.

¹⁵ 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.

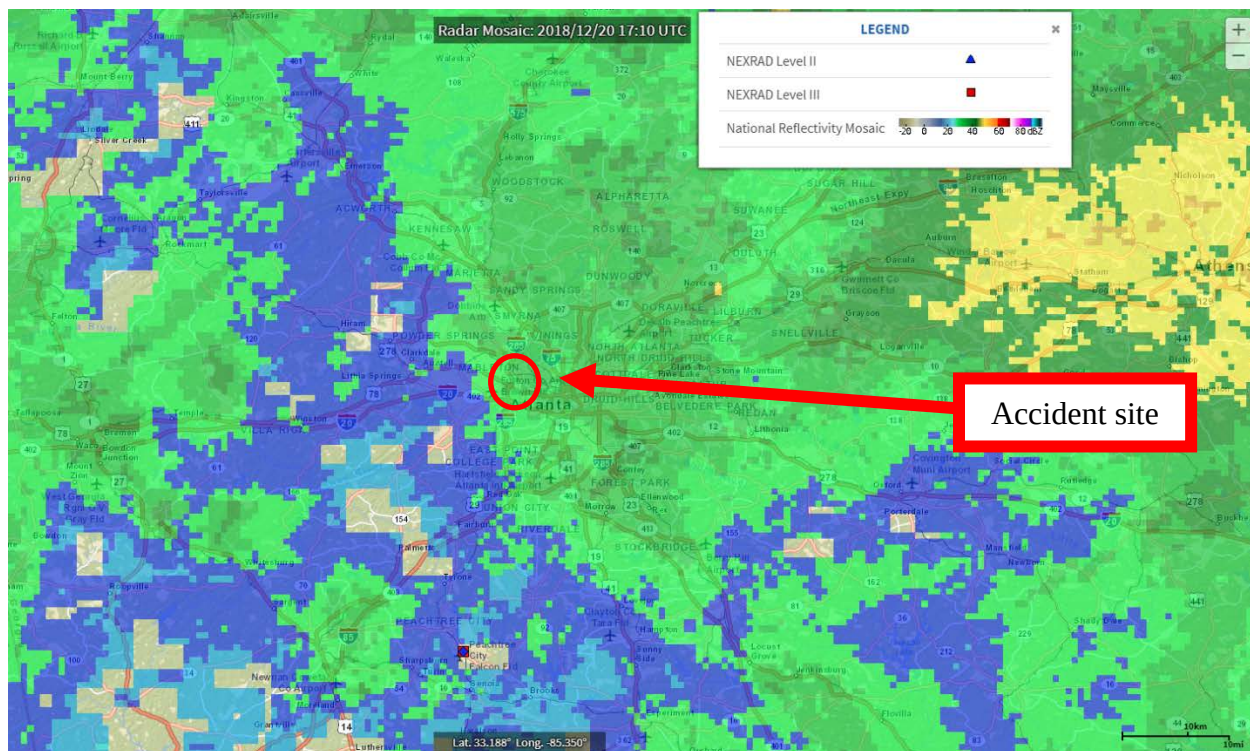


Figure 12 – Regional Composite Reflectivity image for 1210 EST

7.0 Radar Imagery Information

The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D)¹⁶ to the accident site was the Atlanta, Georgia, (Peachtree City, KFFC) WSR-88D , which had an antenna elevation of 972 ft and was located 26 miles south of the accident site. Level II and level III archive KFFC radar data was obtained from the NCEI utilizing the NEXRAD Data Inventory Search and displayed using the NOAA’s Weather and Climate Toolkit software.

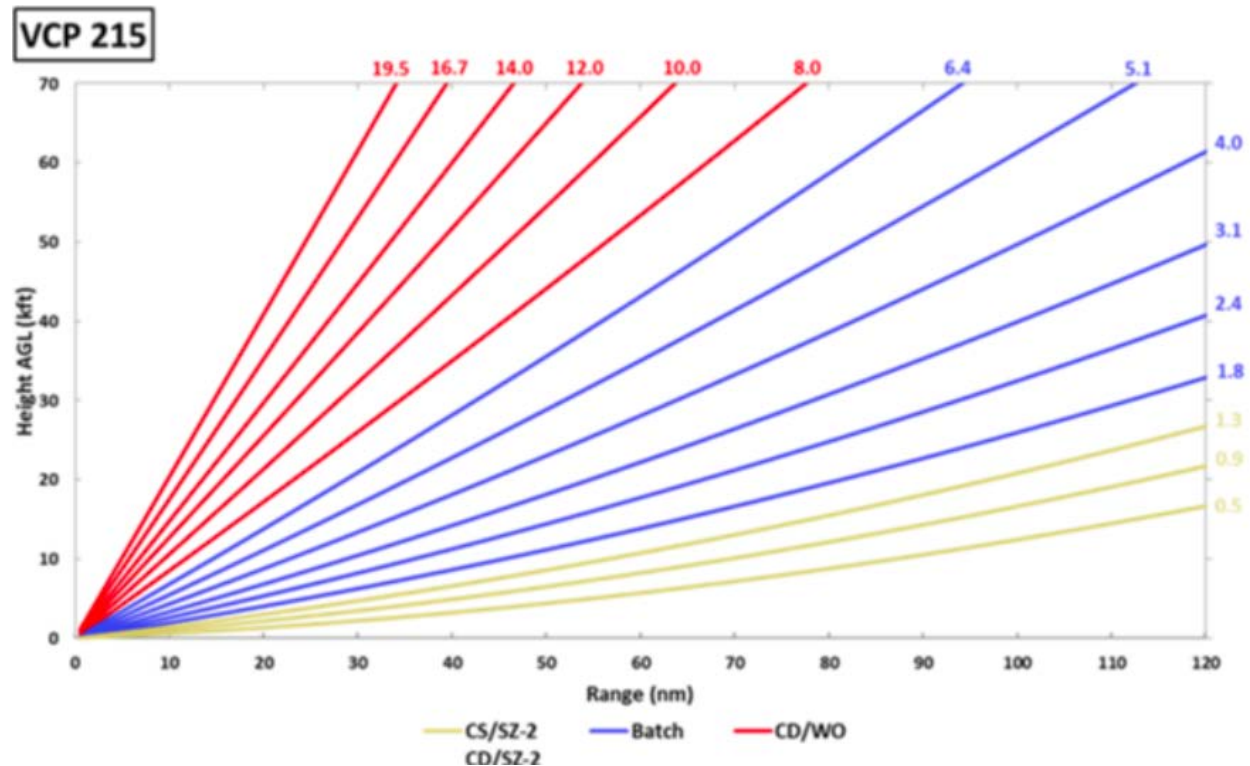
7.1 Volume Scan Strategy

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. 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 three common scanning strategies. The most common is where the radar makes 15 elevation scans from 0.5° to 19.5° every six minutes. This particular scanning strategy is documented as volume coverage pattern 215 (VCP-215). Mode B is the clear-air mode, where the radar makes 5 elevation scans during a ten-minute period. During the period surrounding the accident, the KFFC WSR-88D radar was operating in the precipitation mode VCP-

¹⁶ 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.

215. 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.



VCP-215 Precipitation Mode Scan Strategy¹⁷

¹⁷ Contiguous Surveillance (CS)--The low Pulse Repetition Frequency (PRF) scan of the split cut. Gives a high R_{max} value to determine proper target location and intensity, but a low V_{max} value limits the velocities that can be measured. Contiguous Doppler (CD)--The high PRF scan of the split cut. Gives a low R_{max} value causing more range folded (multiple trip) echoes, but a high V_{max} value to get higher, more accurate velocity values.

Batch Mode – Uses alternating low and high PRFs on each radial for one full rotation at each elevation angle. The two resulting data sets (low PRF and high PRF) are combined to resolve range ambiguity. Used in the middle elevation angles.

W – With range unfolding (W)

WO – Without range unfolding (WO)

7.2 Beam Height Calculation

Assuming standard refraction¹⁸ of the WSR-88D radar beam with the antenna elevation at 159 ft (KJAX), and considering a beamwidth¹⁹ of 0.95°, the following table shows the approximate heights for the radar beam center, top and base for antenna elevations over the accident site. These heights have been rounded to the nearest 10 ft.

ANTENNA ELEVATION	BEAM CENTER	BEAM BASE	BEAM TOP
KFFC 0.5°	2,840 ft	1,560 ft	4,120 ft

Based on the radar height calculations, the elevation scans listed in the above table depicted the conditions between 1,560 ft and 4,120 ft msl over the accident site and these scans “saw” the closest altitudes to the surface.

¹⁸ Standard Refraction in the atmosphere is when the temperature and humidity distributions are approximately average, and values set at the standard atmosphere.

¹⁹ Beamwidth - the angular separation between the half power points on the antenna radiation pattern, where the gain is one half the maximum value.

7.3 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 dBZ, and is a general measure of echo intensity. FAA Advisory Circular AC 00-24C²¹, “Thunderstorms,” dated February 19, 2013, also defines the echo intensity levels and weather radar echo intensity terminology associated with those levels. For dBZ values less than 30 the weather radar echo intensity terminology should be “light.” For dBZ values between 30 and 40, the terminology should be “moderate.” “Heavy” terminology is used for dBZ values greater than 40 dBZ but less than 50 dBZ, inclusive. Finally, any dBZ values above 50 dBZ shall be described as “extreme.” From the NWS, precipitation conditions at the surface can be inferred from VIP Levels described in the chart below:

- VIP 1 (Level 1, 18-30 dBZ) - Light precipitation
- VIP 2 (Level 2, 30-38 dBZ) - Light to moderate rain
- VIP 3 (Level 3, 38-44 dBZ) - Moderate to heavy rain
- VIP 4 (Level 4, 44-50 dBZ) - Heavy rain
- VIP 5 (Level 5, 50-57 dBZ) - Very heavy rain; hail possible
- VIP 6 (Level 6, >57 dBZ) - Very heavy rain and hail; large hail possible

7.4 Base Reflectivity and Lightning Data

Figures 13, 14, 15, and 16 present the KFFC WSR-88D base reflectivity images for the 0.5° elevation scans initiated at 1155:56, 1201:50, 1207:44, and 1213:38 EST, respectively, with a resolution of 0.5° X 250 m. Reflectivity values between 15 and 30 dBZ were located above the accident site at the accident time. The reflectivity bands were moving from south to north (attachment 2).

There were no lightning strikes around the accident site at the accident time.²²

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

https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/1020774

²² A review of Earth Networks Total Lightning network was done.

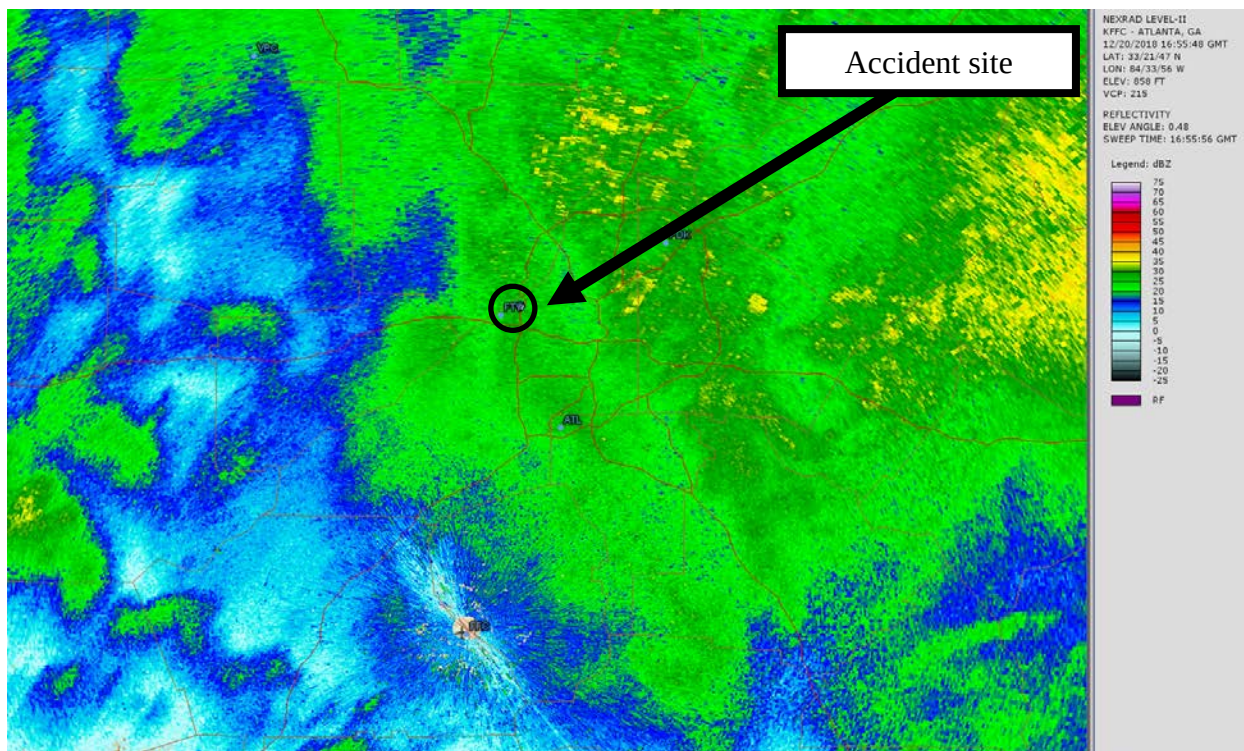


Figure 13 – KFFC WSR-88D reflectivity for the 0.5° elevation scan initiated at 1155:56 EST with the accident site marked with black circle

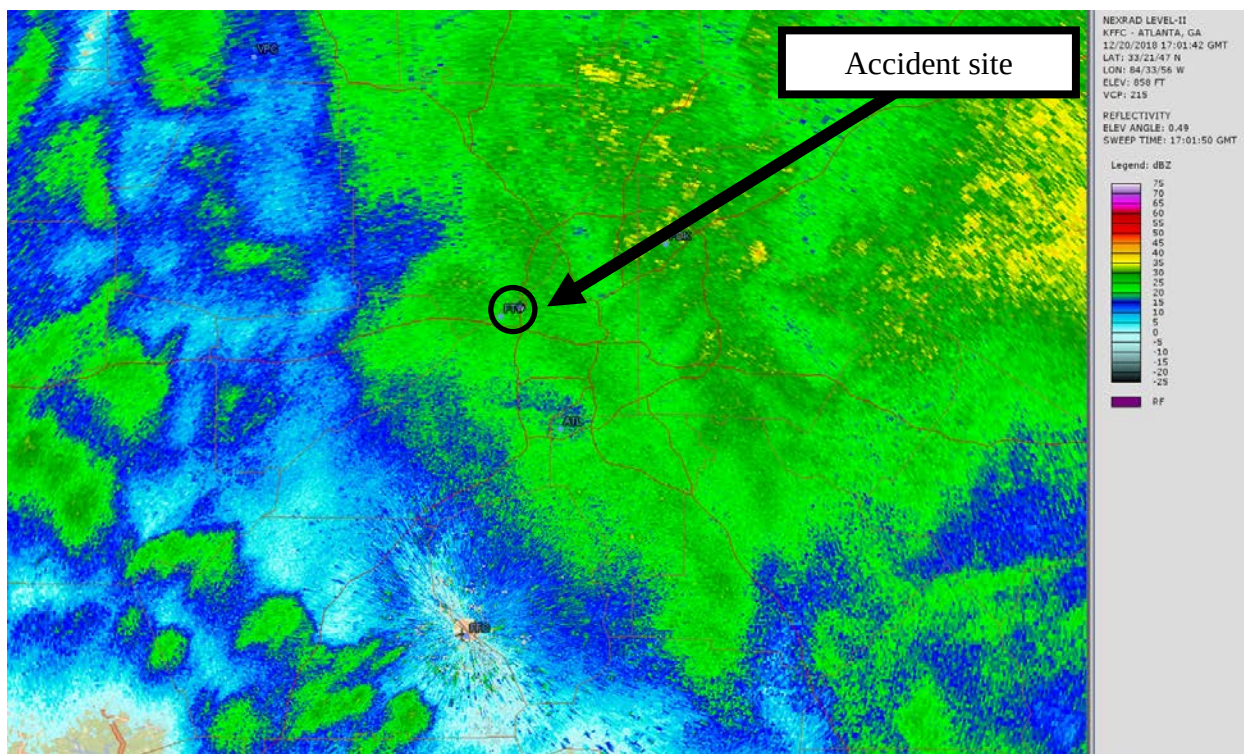


Figure 14 – KFFC WSR-88D reflectivity for the 0.5° elevation scan initiated at 1201:50 EST with the accident site marked with black circle

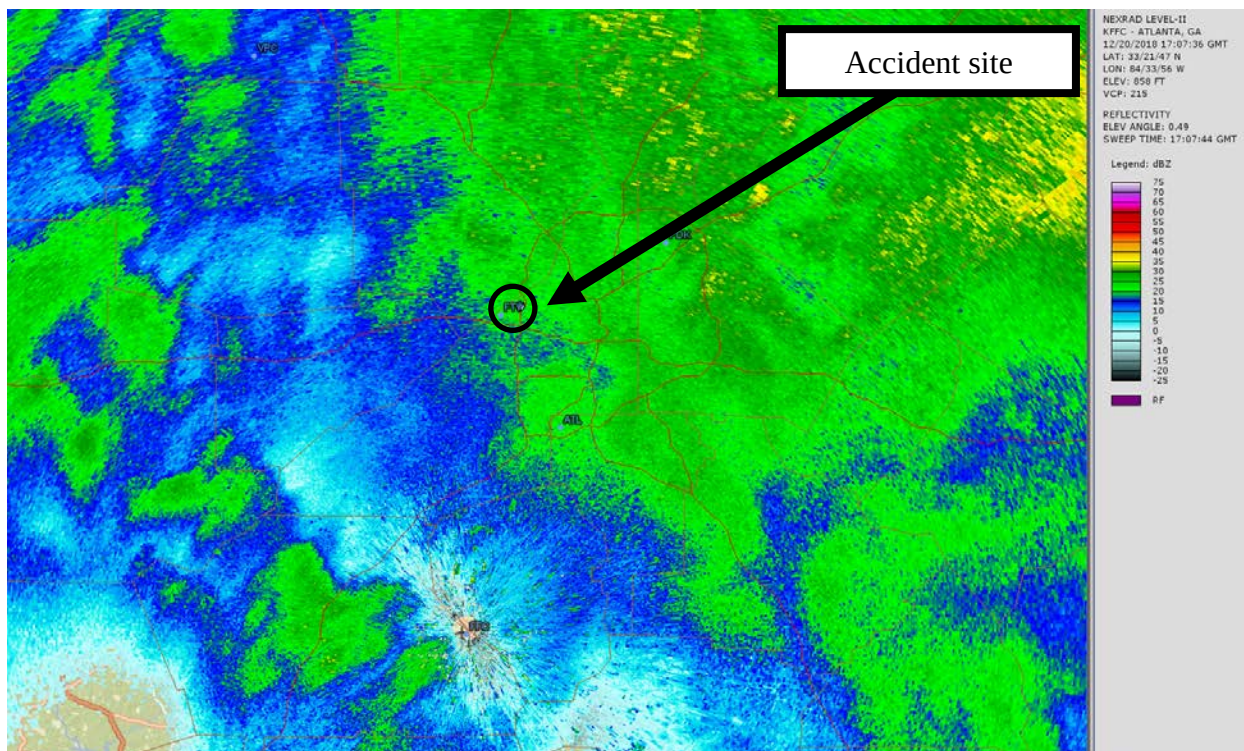


Figure 15 – KFFC WSR-88D reflectivity for the 0.5° elevation scan initiated at 1207:44 EST with the accident site marked with black circle

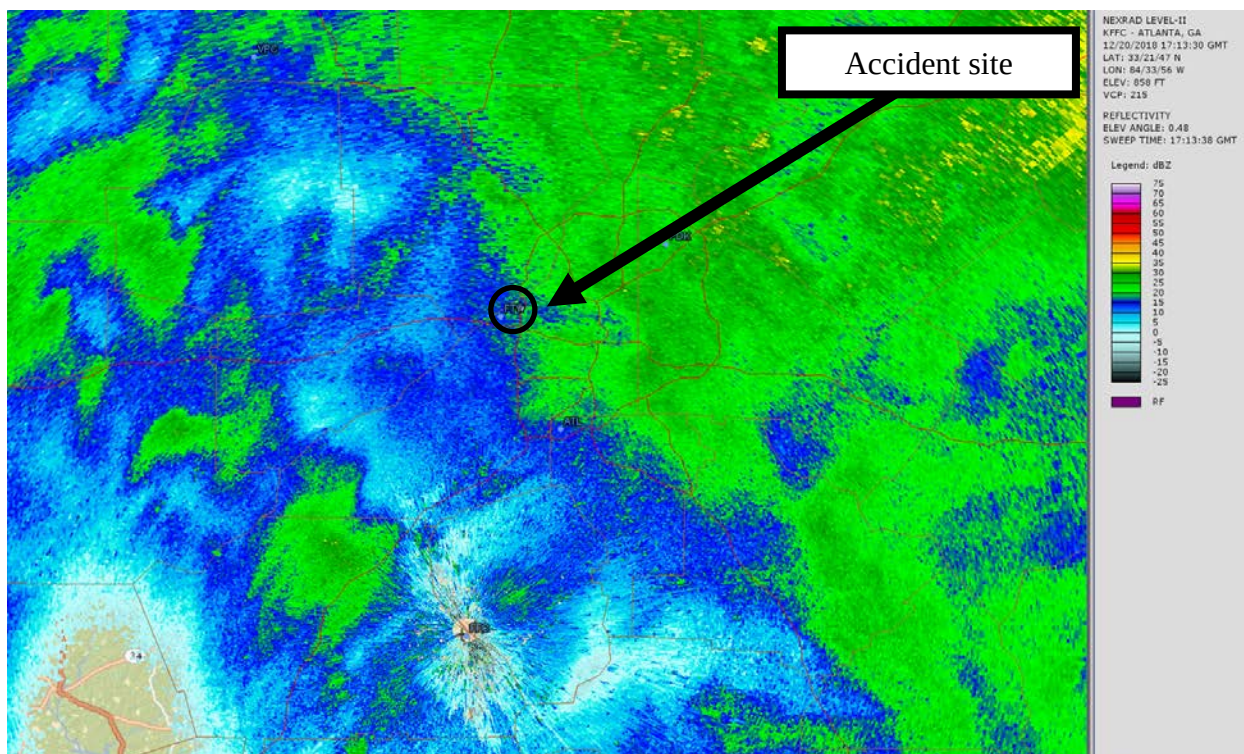


Figure 16 – KFFC WSR-88D reflectivity for the 0.5° elevation scan initiated at 1213:38 EST with the accident site marked with black circle

8.0 Pilot Reports²³

All pilot reports (PIREPs) within 80 miles of the accident site from about one hour prior to the accident time to about one hour after the accident time for below FL200²⁴ are provided below:

LZU UA /OV LANDING RWY 25/TM 1608/FL014/TP PC12/RM PILOT REPORTS BASE OF THE CLOUDS AT 014 MSL / 003 AGL

WRB UA /OV MCN/TM 1613/FL200/TP MD80/TA M11/IC LGT-MOD RIME/RM ZTLFD

ATL UA /OV RWY 10/TM 1619/FLDURD/TP B737/SK BASES OVC 004

MCN UA /OV MCN/TM 1635/FLDURGD/TP E135/SK BASES 250 AGL T 030/TB MOD TURB

CSG UA /OV CSG/TM 1702/FLDURGD/TP CRJ2/SK OVC010

ATL UA /OV RWY 10/TM 1724/FLDURD/TP B737/SK BKN BASES 004

ATL UA /OV ATL270030/TM 1736/FL150/TP B757/TB CONS MOD CHOP/RM ZTLFD

AHN UA /OV AHN180004/TM 1738/FL170/TP MD88/TB OCNL LGT CHOP/RM ZTLFD

LGC UA /OV LGC/TM 1740/FL040/TP E75/TA M05/IC RIME

LGC UA /OV LGC/TM 1743/FL120/TP E75L/TA M05/IC LGT RIME/RM ZTLFD

CSG UA /OV CSG/TM 1746/FL040/TP CRJ2/SK OVC005-TOP038

LGC UA /OV LGC/TM 1752/FL170/TP A320/TB CONS MOD CAT CHOP 170-130/RM ZTLFD

ATL UA /OV PDK/TM 1752/FLDURGD/TP BE9L/SK BASE 016 OVC

The reports in plain language taken from standard code and abbreviations, with time converted to local were as follows:

Routine pilot report (UA) Gwinnett County Airport, Georgia (LZU); Over landing runway 25; Time – 1108 EST (1608Z); Altitude – 1,400 ft; Type aircraft – Pilatus PC-12; Remarks – Pilot reports base of the clouds at 1,400 ft msl, 300 ft agl.

Routine pilot report (UA) Robins Air Force Base, Georgia (WRB); Over Macon, Georgia (MCN) VORTAC; Time – 1113 EST (1613Z); Altitude – FL200; Type aircraft – McDonnell Douglas MD-80; Temperature – -11° C; Icing – Light to moderate rime; Remarks – PIREP reported by Atlanta Air Route Traffic Control Center (ZTL ARTCC) Flight Data (FD) position.

²³ Only pilot reports with the World Meteorological Organization (WMO) header UBGA**, UBAL**, UBTN**, and UBNC** identifier were considered.

²⁴ Flight Level – A Flight Level (FL) is a standard nominal altitude of an aircraft, in hundreds of ft. 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.

Routine pilot report (UA) Hartsfield – Jackson Atlanta International Airport, Georgia (ATL); Over Runway 10; Time – 1119 EST (1619Z); Altitude – During descent; Type aircraft – Boeing 737-700; Sky – Bases overcast at 400 ft (agl).

Routine pilot report (UA) MCN; Over MCN; Time – 1135 EST (1635Z); Altitude – During descent; Type aircraft – Embraer ERJ-135; Sky – Bases 250 ft agl, with tops at 3,000 ft; Turbulence – Moderate turbulence.

Routine pilot report (UA) Columbus Airport, Georgia (CSG); Over CSG; Time – 1202 EST (1702Z); Altitude – During descent; Type aircraft – Bombardier CRJ-200; Sky – overcast skies at 1,000 ft.

Routine pilot report (UA) ATL; Over Runway 10; Time – 1224 EST (1724Z); Altitude – During descent; Type aircraft – Boeing 737-700; Sky – Broken bases at 400 ft.

Routine pilot report (UA) ATL; Over 30 miles from ATL on the 270° radial; Time – 1236 EST (1736Z); Altitude – 15,000 ft; Type aircraft – Boeing 757; Turbulence – Continuous moderate chop; Remarks – PIREP reported by ZTL FD.

Routine pilot report (UA) Athens/Ben Epps Airport, Georgia (AHN); Over 4 miles from AHN on the 180° radial; Time – 1238 EST (1738Z); Altitude – 17,000 ft; Type aircraft – McDonnell Douglas MD-88; Turbulence – Occasional light chop; Remarks – PIREP reported by ZTL FD.

Routine pilot report (UA) LaGrange-Callaway Airport, Georgia (LGC); Over LGC; Time – 1240 EST (1740Z); Altitude – 4,000 ft; Type aircraft – Embraer 175; Temperature – -5° C; Icing – Rime.

Routine pilot report (UA) LGC; Over LGC; Time – 1243 EST (1743Z); Altitude – 12,000 ft; Type aircraft – Embraer 175L; Temperature – -5° C; Icing – Light rime; Remarks – PIREP reported by ZTL FD.

Routine pilot report (UA) CSG; Over CSG; Time – 1246 EST (1746Z); Altitude – 4,000 ft; Type aircraft – Bombardier CRJ-200; Sky – overcast skies at 500 ft with tops at 3,800 ft.

Routine pilot report (UA) LGC; Over LGC; Time – 1252 EST (1752Z); Altitude – 17,000 ft; Type aircraft – Airbus A320; Turbulence – Continuous moderate clear-air turbulence chop between 17,000 and 13,000 ft; Remarks – PIREP reported by ZTL FD.

Routine pilot report (UA) ATL; Over Peachtree, Georgia (PDK) VORTAC; Time – 1252 EST (1752Z); Altitude – During descent; Type aircraft – Beechcraft King Air; Sky – Bases at 1,600 ft overcast.

9.0 SIGMET

There were no convective or non-convective Significant Meteorological Information (SIGMET) advisories valid for the accident site at the accident time.

10.0 CWSU Advisories

The Center Weather Service Unit (CWSU) at ZTL was responsible for the region. The ZTL CWSU did not issue any Meteorological Impact Statements (MIS) for the area prior to the accident. The ZTL CWSU issued Center Weather Advisory (CWA) 103 at 1056 EST, which was valid until 1255 EST for the accident area at the time of the accident. The CWA warned of areas of occasional LIFR²⁵ ceilings below 500 ft agl and occasional visibilities below 2 miles in rain and fog with conditions expected to continue beyond the end of the period (figures 17 and 18):

FAUS21 KZTL 201556
ZTL1 CWA 201556
ZTL CWA 103 VALID UNTIL 201755
FROM GSO-FLO-AMG-40N SJI-40W VUZ-GSO
**AREA OCNL LIFR CIGS BLW 005 AND OCNL VIS BLW 2SM IN RA/FG. EXP CONDS
TO CONT BYD END OF PD.**
=

²⁵ Low Instrument Flight Rules (LIFR) – Refers to the general weather conditions pilots can expect at the surface. LIFR criteria means a ceiling below 500 ft agl and/or less than 1-mile visibility.

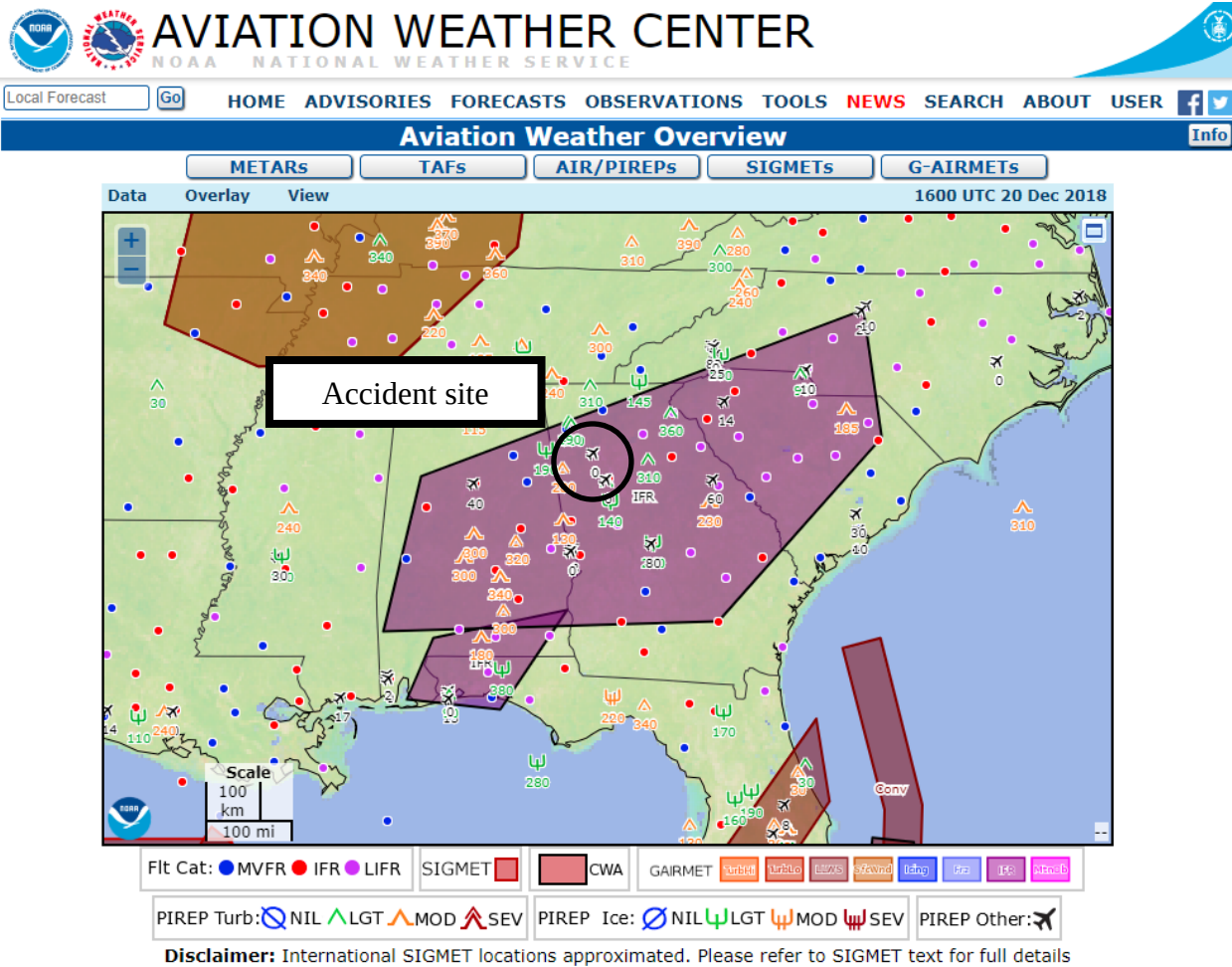


Figure 17 – SIGMETs and CWAs valid at 1100 EST

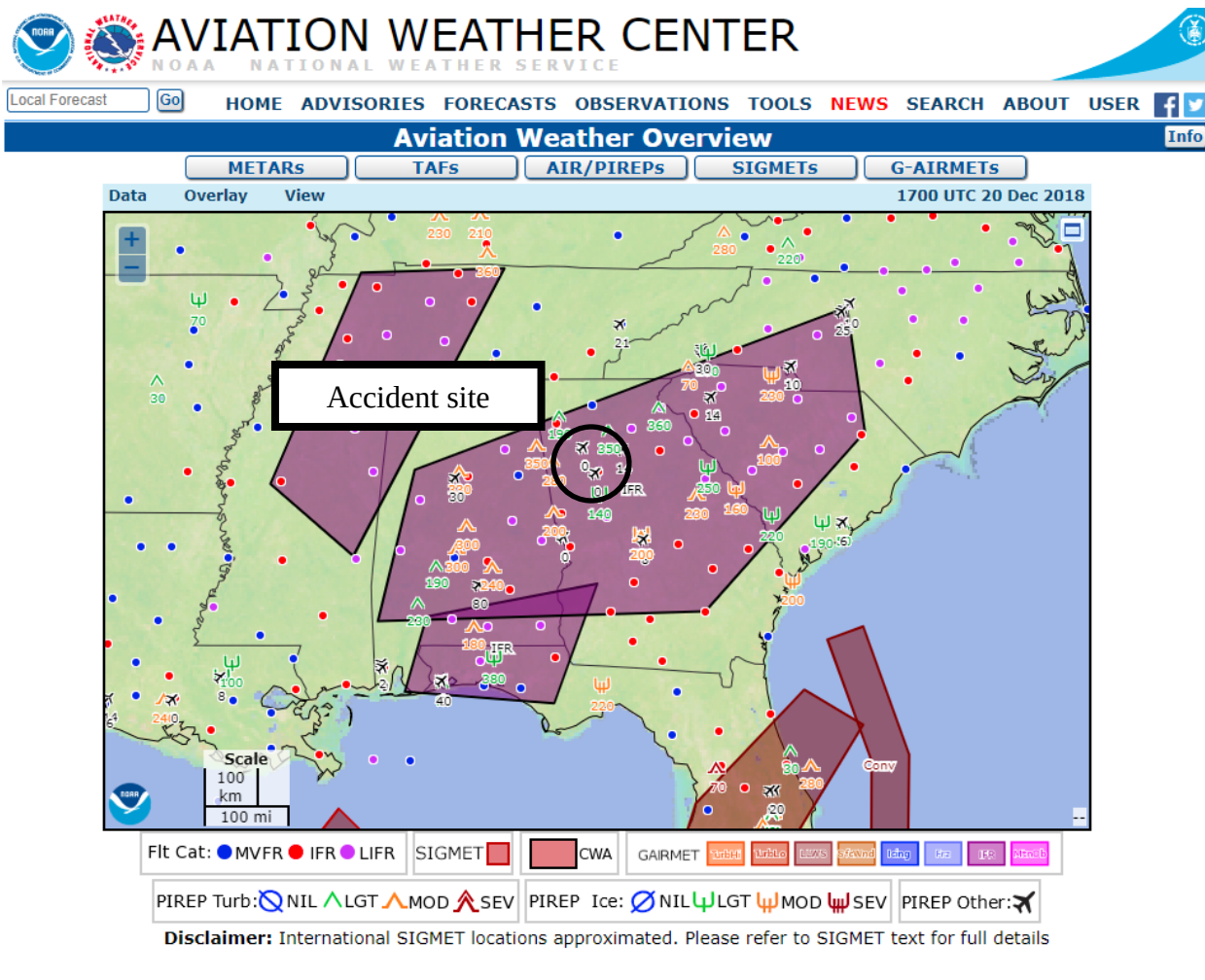


Figure 18 – SIGMETs and CWAs valid at 1200 EST

11.0 AIRMETs

Airmen's Meteorological Information (AIRMET) advisories Sierra and Tango were valid for the accident site at the accident time for below 10,000 ft. The AIRMETs warned of moderate turbulence below FL180 and IFR and mountain obscuration conditions due to clouds, precipitation, and mist:

WAUS42 KNCI 201445

WA2S

-MIAS WA 201445

AIRMET SIERRA UPDT 2 FOR IFR AND MTN OBSCN VALID UNTIL 202100

AIRMET IFR...NC SC GA FL NY NJ PA OH WV MD DC DE VA AND CSTL WTRS
FROM SLT TO 40WNW ETX TO 20ENE JFK TO 40SSE SBY TO 70E ECG TO
60E CRG TO TRV TO 20SW SRQ TO 100SSW TLH TO 50SE SJI TO 40W CEW
TO 50SW PZD TO GQO TO HNV TO HNN TO SLT
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 21Z THRU 03Z.

AIRMET MTN OBSCN...NC SC GA NY PA WV MD VA

**FROM 60ESE BUF TO 20NNW ETX TO HAR TO CLT TO ATL TO GQO TO HMV
TO HNN TO EWC TO 60ESE BUF
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 21Z THRU 03Z.**

.
OTLK VALID 2100-0300Z

AREA 1...IFR NC SC GA FL MA CT NY NJ PA OH WV MD DC DE VA AND
CSTL WTRS

BOUNDED BY SYR-ALB-20NNE HTO-30ENE ECG-40ESE ILM-OMN-20SW SRQ-
60SSW CEW-130ESE LEV-40W CEW-50SW PZD-GQO-HMV-HNN-20NE SLT-SYR
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG THRU 03Z.

.
AREA 2...MTN OBSCN NC SC GA NH VT MA NY PA WV MD VA
BOUNDED BY MSS-MPV-CON-HAR-CLT-ATL-GQO-HMV-HNN-JHW-SYR-MSS
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG THRU 03Z.

....

WAUS42 KPCI 201445

WA2T

-MIAT WA 201445

AIRMET TANGO UPDT 2 FOR TURB STG WNDZ AND LLWS VALID UNTIL 202100

.
AIRMET TURB...NC SC GA FL AND CSTL WTRS

FROM 160SE SIE TO 190ESE ECG TO 130SSE ILM TO 200ENE PBI TO 20W
RSW TO 90W EYW TO 90WSW PIE TO 170SE LEV TO 130ESE LEV TO 40W
CEW TO 50SW PZD TO GQO TO HMV TO 20NE ECG TO 160SE SIE
MOD TURB BTN FL220 AND FL390. CONDS CONTG BYD 21Z THRU 03Z.

.
**AIRMET TURB...NC SC GA FL WV MD VA AND CSTL WTRS
FROM HNN TO 30W SBY TO 160SE SIE TO 50ESE ECG TO 100SSE CHS TO
50ENE CRG TO 40S ORL TO 80WSW EYW TO 90WSW PIE TO 170SE LEV TO
130ESE LEV TO 40W CEW TO 50SW PZD TO GQO TO HMV TO HNN
MOD TURB BLW FL180. CONDS CONTG BYD 21Z THRU 03Z.**

.
AIRMET STG SFC WNDZ...SC GA FL CSTL WTRS
FROM 50ENE CHS TO 100S ILM TO 170ENE OMN TO 140E OMN TO 80ENE
TRV TO 40SE OMN TO 20SE CRG TO 50ENE CHS
SUSTAINED SURFACE WINDS GTR THAN 30KT EXP. CONDS DVLPG 15-18Z.
CONDS CONTG BYD 21Z THRU 03Z.

.
LLWS POTENTIAL...NC SC GA FL WV VA AND CSTL WTRS
BOUNDED BY 30NNE EKN-60SW CSN-50NE FLO-30SSW ILM-50NE OMN-CRG-
20NNW AMG-50S ODF-HMV-50S HNN-30NNE EKN
LLWS EXP. CONDS CONTG BYD 21Z THRU 03Z.

.
LLWS POTENTIAL...FL AND CSTL WTRS
BOUNDED BY CRG-50NE OMN-20ENE ORL-30W TRV-50SW SRQ-80W PIE-CRG
LLWS EXP. CONDS CONTG BYD 21Z ENDG 21-00Z.

.
OTLK VALID 2100-0300Z

AREA 1...TURB NC SC GA FL NJ PA OH LE WV MD DC DE VA AND CSTL
WTRS

BOUNDED BY 30E ECK-30SE JST-110S HTO-120E ORF-20SSW ILM-100ESE
EYW-80WSW EYW-90WSW PIE-170SE LEV-130ESE LEV-40W CEW-50SW PZD-
GQO-HMV-HNN-CVG-FWA-30E ECK
MOD TURB BLW FL180. CONDS CONTG THRU 03Z.

.

AREA 2...STG SFC WND S FL CSTL WTRS
BOUNDED BY 120SSE SJI-170S CEW-60W PIE-80WSW RSW-100WNW EYW-
90WSW PIE-170SE LEV-120SSE SJI
SUSTAINED SURFACE WINDS GTR THAN 30KT EXP. CONDS DVLPG 00-03Z.
CONDS CONTG THRU 03Z.
....

12.0 Graphical Forecasts for Aviation

The Graphical Forecasts for Aviation (GFA) products made available before the accident flight are shown in attachment 3. The GFA surface forecast products indicated IFR to MVFR²⁶ conditions for 1300 EST with likely (greater than 60 percent chance) rain showers and an east wind between 5 and 10 knots. The GFA cloud forecast products indicated overcast cloud ceilings between 800 and 1,100 ft msl with layered clouds through FL320. For more information please see attachment 3.

13.0 Terminal Aerodrome Forecast

KFTY was the closest site with a NWS Terminal Aerodrome Forecast (TAF). The KFTY TAF valid at the accident time was issued at 0630 EST and was valid for a 24-hour period beginning at 0700 EST. The 0630 EST TAF for KFTY was as follows:

TAF KFTY 201130Z 2012/2112 06006KT 6SM -RA BR BKN007 OVC012
FM201500 07010KT 3SM SHRA OVC008
FM201600 07010KT 3SM SHRA OVC007
FM210300 00000KT 1 1/2SM SHRA OVC004
FM210800 29004KT 3SM SHRA OVC008
FM211000 30006KT 4SM SHRA OVC010=

The TAF expected a wind from 070° at 10 knots, 3 miles visibility, moderate rain showers and an overcast ceiling at 700 ft agl between 1100 EST and 2200 EST.

14.0 NWS Area Forecast Discussion

The NWS Weather Forecast Office in Peachtree City, Georgia, issued the following Area Forecast Discussion (AFD) at 0633 EST (closest AFD to the accident time with an aviation section). The aviation section of the AFD discussed MVFR conditions deteriorating to IFR conditions for much of the day with an east wind to 10 knots and isolated gusts and visibilities in rain showers between 2 to 5 miles:

FXUS62 KFFC 201133
AFDFFC

Area Forecast Discussion
National Weather Service Peachtree City GA
633 AM EST Thu Dec 20 2018

²⁶ Marginal Visual Flight Rules – Refers to the general weather conditions pilots can expect at the surface. MVFR criteria means a ceiling 1,000 to 3,000 ft agl and/or 3 to 5 miles visibility.

.PREV DISCUSSION... /Issued 343 AM EST Thu Dec 20 2018/

SHORT TERM /Today through Friday/...

Rain will punctuate the short term period. A long wave trough will move across the Gulf coast states through tomorrow, pushing a surface low/front through the forecast area. HI-RES models show increasing coverage of showers across the area through midday associated with the surface low pushing into the forecast area. There may be a brief break this afternoon with increased coverage once again as several upper level waves move across the area late this afternoon into the overnight hours. Models are in agreement that much of the better energy will remain south of the area, MUCAPE values are anemic at best with 200 J/kg at best across the area and have continued lack of thunderstorms. Periods of light rain will continue tomorrow. Updated QPF for storm total through tomorrow continues to show 1.5 to 2 inches across the area. While locally heavy rainfall at times can be expected, a Flood Watch is not expected at this time. Guidance temperatures shows warmer than normal temperatures through the period. Clouds and rain will keep temperatures nearly steady or falling slowly through the period.

Atwell

LONG TERM /Friday Night through Wednesday/...

Cold front will continue to move south of the CWFA Friday night. There is still some potential for wintry precip, especially in the highest terrain of northern GA. Moisture will decrease rapidly behind the front, but do think there will be enough for a chance of RW/SW especially in the far north where NW flow will help fuel upslope precip.

High pressure will build in briefly for Saturday. However, with fast flow aloft, several systems are progged to move through during the first half of next week. The first system is expected Sunday night into early Monday. Models are producing a bit more precip with this frontal boundary than in previous runs. Some light wintry precip is possible Sunday night, but the potential is still low. Precip chances for Monday still remain in the chance category.

Christmas day looks to be mostly dry, but chances for precip increase again on Wednesday and Thursday as the next system impacts the CWFA.

NListemaa

&&

.AVIATION...

12Z Update...

MVFR CIGs will deteriorate to IFR and remain there for much of the TAF period. East winds near 10kts with isolated gusts possible, before shifting to the southwest between 04-06Z at 5-10kts. Periods of rain and showers will reduce visibilities to 2-5SM.

//ATL Confidence...12Z Update...

Medium confidence all elements.

Atwell

&&

.PRELIMINARY POINT TEMPS/POPS...

Athens	54	47	51	35	/	100	80	70	10
Atlanta	53	45	47	34	/	100	80	80	10
Blairsville	50	41	45	30	/	100	80	90	40
Cartersville	52	43	46	32	/	100	80	80	20
Columbus	60	46	50	35	/	90	80	70	10
Gainesville	50	45	48	34	/	100	80	80	10
Macon	61	49	53	35	/	100	80	70	10
Rome	53	43	46	32	/	100	80	80	10
Peachtree City	55	45	49	33	/	90	80	80	10
Vidalia	66	52	57	38	/	100	70	60	10

&&

.FFC WATCHES/WARNINGS/ADVISORIES...

NONE.

&&

\$\$

15.0 Winds and Temperature Aloft Forecast

The NWS 0857 EST Winds and Temperature Aloft forecast valid for the closest point to the accident site is included below:

FBUS31 KWN0 201357

FD1US1

DATA BASED ON 201200Z

VALID 201800Z FOR USE 1400-2100Z. TEMPS NEG ABV 24000

FT	3000	6000	9000	12000	18000	24000	30000	34000	39000
----	------	------	------	-------	-------	-------	-------	-------	-------

ATL 1728 2027+07 2027+02 2030-02 1848-12 2072-25 690739 701046 721453

The accident site was closest to the ATL forecast point. The 0857 EST ATL forecast for use between 0900 EST and 1600 EST indicated a wind from 170° at 28 knots at 3,000 ft, a wind from 200° at 27 knots at 6,000 ft with a temperature of 7° C, and a wind from 200° at 27 knots at 9,000 ft with a temperature of 2° C.

16.0 Pilot Weather Briefing

The accident pilot did not request a weather briefing through Leidos.

A search of archived ForeFlight information indicated that the accident pilot did not review or request any weather information from ForeFlight on the day of the accident. The accident pilot did check weather information on the day before the accident for other flight routes flown on December 19 (attachment 4). It is unknown if the accident pilot checked or received additional weather information before or during the accident flight.

17.0 Astronomical Data

The astronomical data obtained from the United States Naval Observatory for the accident site on December 20, 2018, indicated the following:

SUN	
Begin civil twilight	0711 EST
Sunrise	0738 EST
Accident	1210 EST²⁷
Sun transit	1236 EST
Sunset	1733 EST
End civil twilight	1801 EST

E. LIST OF ATTACHMENTS

Attachment 1 – KFTY ASOS 1 and 5 minute dataset surrounding accident time

Attachment 2 – KFFC 0.5° elevation scan base reflectivity animation from 1138 to 1225 EST

Attachment 3 – GFA products available before the accident flight for around the accident time

Attachment 4 – ForeFlight correspondence weather information

Submitted by:

Paul Suffern
Senior Meteorologist

²⁷ Inserted accident time for reference and context.

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