



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

June 1, 2021

Specialist's Factual Report

METEOROLOGY

ERA21LA068

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A. ACCIDENT

Location: Attalla, Alabama
Date: December 12, 2020
Time: 1249 central standard time
1849 Coordinated Universal Time (UTC)
Airplane: Beech V35A; Registration: N5470U

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 and also from the National Centers for Environmental Information (NCEI). This specialist factual contains the meteorological factors pertinent to the weather surrounding the accident time. All times are central standard time (CST) on December 12, 2020, and are based upon the 24-hour clock, where local time is -6 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. NWS airport and station identifiers use the standard International Civil Aviation Organization 4-letter station identifiers versus the International Air Transport Association 3-letter identifiers, which deletes the initial country code designator "K" for U.S. airports.

The accident site was located at latitude 34.093008° N, Longitude 86.086574° W, with an approximate elevation of 690 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

1.1 Surface Analysis Chart

A southeast section of the NWS Surface Analysis Chart for 1200 CST is provided as figure 1 with the approximate location of the accident site marked within the red circle. The chart identified a cold front that stretched from southern Louisiana northward through central Tennessee. A surface trough² was located from the northern Gulf of Mexico northward through central Alabama. The accident site was located east of the surface trough. Troughs can act as lifting mechanisms to help produce clouds and precipitation if sufficient moisture is present.

The station models around the accident site depicted air temperatures in the upper 50’s degrees Fahrenheit (°F), dew point temperatures in the upper 50’s °F with temperature-dew point spreads of 3°F or less, a calm wind, overcast sky cover, and light rain.

¹

https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/1030235

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

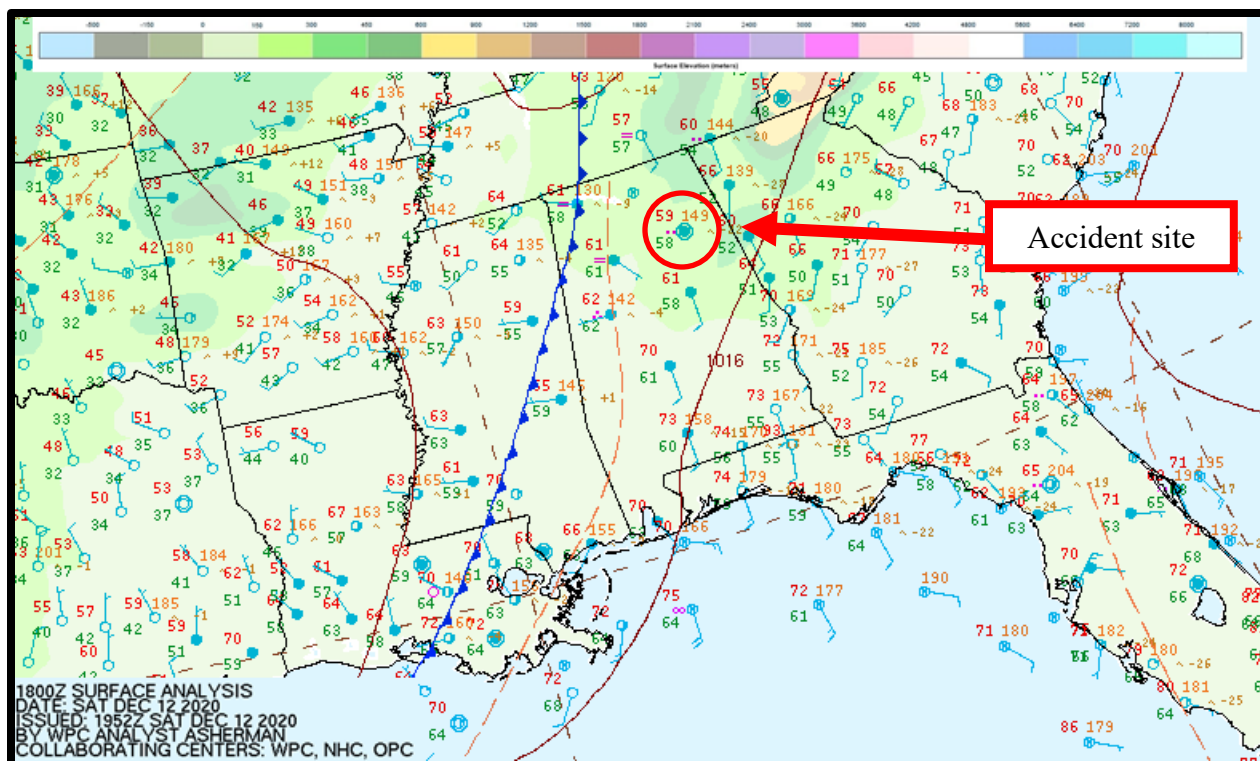


Figure 1 – NWS Surface Analysis Chart for 1200 CST.

1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 1800 CST at 925-, 850- and 700-hectopascals (hPa) are presented in figures 2 through 4. A low-level trough was located west of the accident site stretching from the Great Lakes southwestward through central Arkansas. There was a west wind at 15 knots at 925-hPa with the wind becoming southwesterly at 40 knots by 700-hPa.

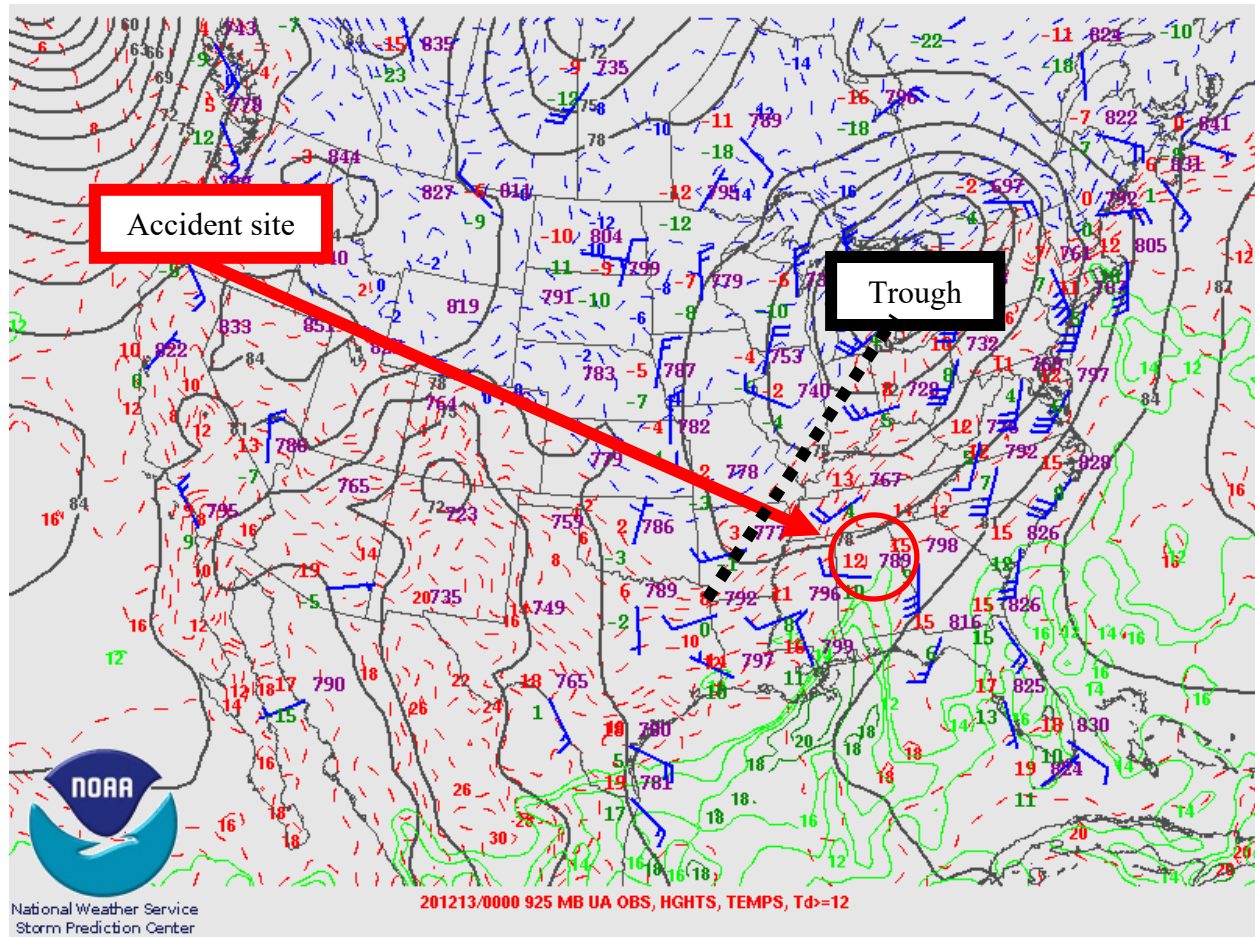


Figure 2 – 925-hPa Constant Pressure Chart for 1800 CST.

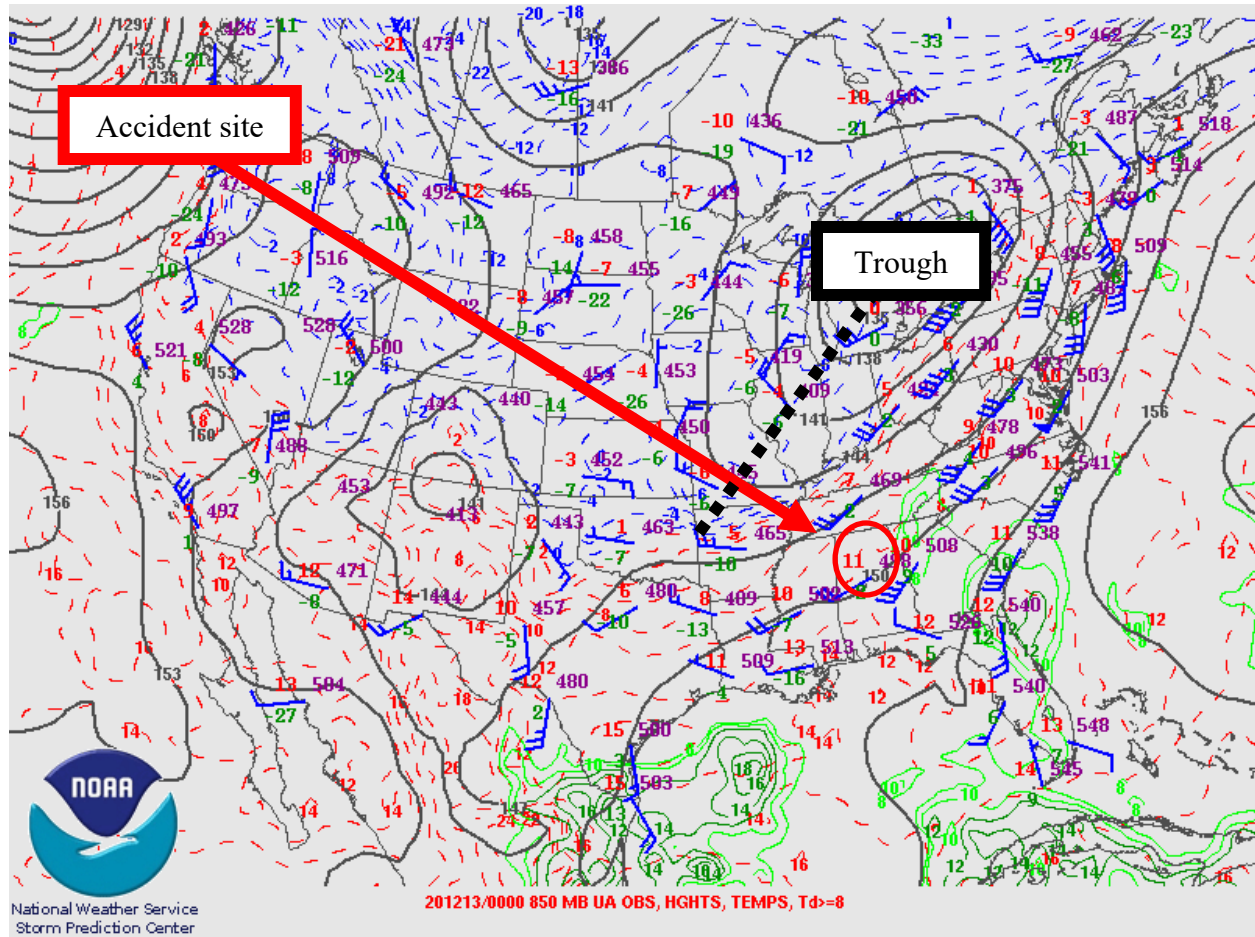


Figure 3 – 850-hPa Constant Pressure Chart for 1800 CST.

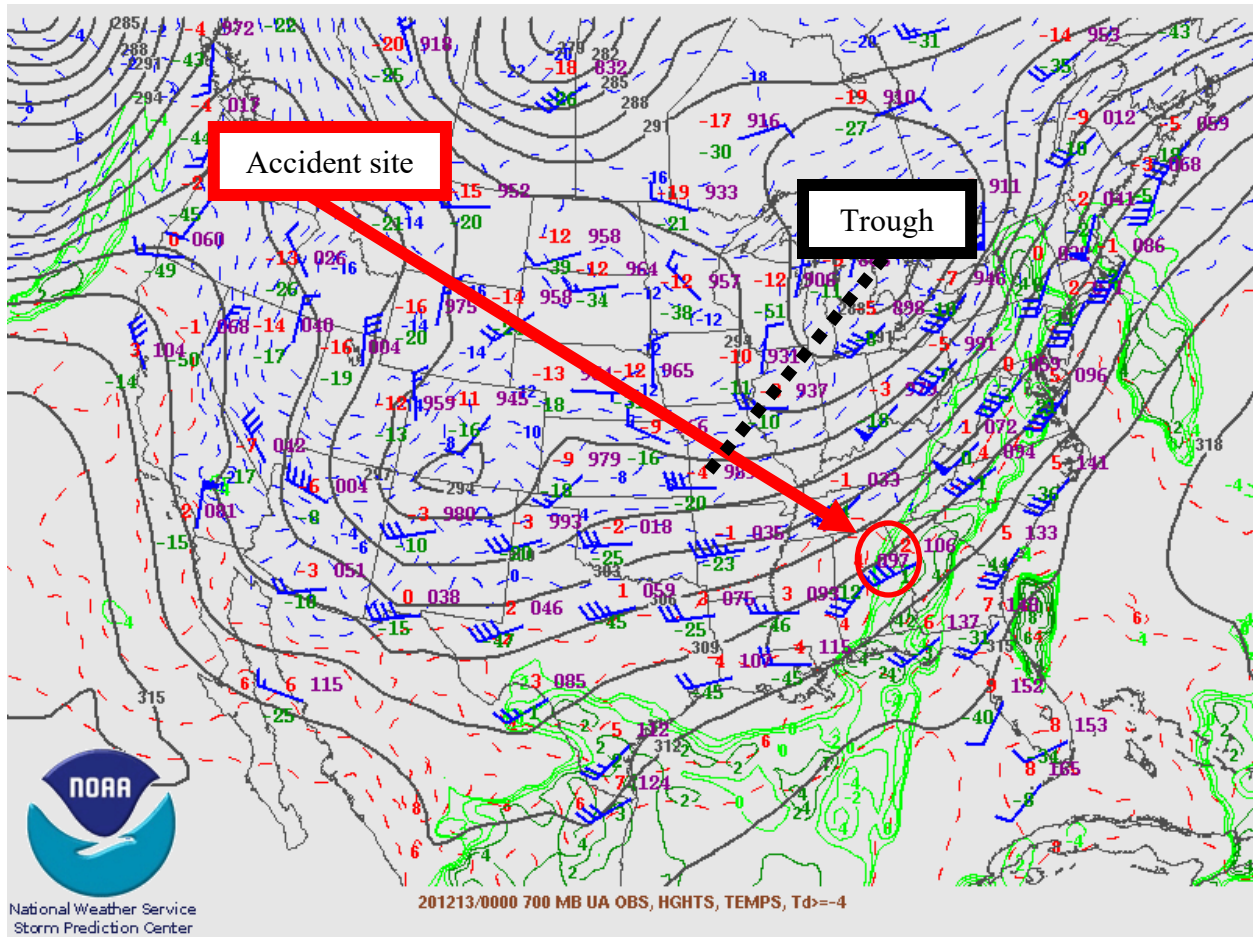


Figure 4 – 700-hPa Constant Pressure Chart for 1800 CST.

2.0 Surface Observations

The area surrounding the accident site was documented using official Aviation Routine Weather Reports (METARs) and Specials (SPECIs). The following observations were taken from standard code and are provided in plain language. Figure 5 is a local sectional chart with the accident site and the closest weather reporting location marked.



Figure 5 – Sectional map of the accident area with the location of the accident site and surface observation site.

Northeast Alabama Regional Airport (KGAD) had the closest official weather station to the accident site. KGAD had an Automated Weather Observing System (AWOS³) whose reports were not augmented. KGAD AWOS was located 7 miles south of the accident site, at an elevation of 569 ft, and had a 4° westerly magnetic variation⁴. The following automated longline⁵ observations were disseminated during the times surrounding the accident:⁶

[0956 CST] METAR KGAD 121556Z AUTO 18007KT 10SM BKN028 OVC036 16/13
A3002 RMK AO2 SLP169 T01610128=

[1056 CST] METAR KGAD 121656Z AUTO 20005KT 10SM -RA OVC019 16/13 A2999

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 12,000 feet, and altimeter setting. AWOS are maintained by the FAA.

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

⁵ “Longline” refers to the dissemination of weather observations with the intent that they are available in near-real time to national databases (effectively, the whole world) and accessible to the general global public from a large number of vendors. This does not include public accessibility to observations from a reporting station’s Very High Frequency (VHF; line-of-site) or telephone broadcast, where applicable. Longline-dissemination of weather observations is the primary vehicle through which the general global public has access to surface weather observations, particularly outside of the aviation community.

⁶ The bold sections in this NWS product and the rest of the 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 this section next to the METARs are provided for quick reference between UTC and local times around the accident time.

RMK AO2 RAB37 SLP158 P0000 T01610133=

[1142 CST] SPECI KGAD 121742Z AUTO 23003KT 9SM -RA OVC013 16/14 A2997
RMK AO2 P0000=

***[1156 CST] METAR KGAD 121756Z AUTO 00000KT 8SM -RA OVC013 15/14 A2996
RMK AO2 SLP149 P0000 60000 T01500144 10167 20133 58022=***

ACCIDENT TIME 1249 CST

***[1256 CST] METAR KGAD 121856Z AUTO 21005KT 5SM -RA BR OVC011 16/15 A2994
RMK AO2 RAE28B47 SLP141 P0000 T01610150=***

[1311 CST] SPECI KGAD 121911Z AUTO 23006KT 4SM -RA BR OVC009 16/15 A2994
RMK AO2 P0001=

KGAD weather at 1156 CST, automated, wind calm, visibility 8 miles, light rain, overcast ceiling at 1,300 ft above ground level (agl), temperature of 15°Celsius (C), dew point temperature of 14°C, and an altimeter setting of 29.96 inches of mercury (inHg). Remarks: automated station with a precipitation discriminator, sea level pressure 1014.9 hPa, a trace of precipitation since 1056 CST, 6-hourly precipitation of a trace, temperature 15.0°C, dew point temperature 14.4°C, 6-hourly maximum temperature of 16.7°C, 6-hourly minimum temperature of 13.3°C, 3-hourly pressure decrease of 2.2 hPa.

KGAD weather at 1256 CST, automated, wind from 210° at 5 knots, visibility 5 miles, light rain and mist, overcast ceiling at 1,100 ft agl, temperature of 16°C, dew point temperature of 15°C, and an altimeter setting of 29.94 inHg. Remarks: automated station with a precipitation discriminator, rain ended at 1228 CST, rain began at 1247 CST, sea level pressure 1014.1 hPa, a trace of precipitation since 1156 CST, temperature 16.1°C, dew point temperature 15.0°C.

The observations from KGAD surrounding the accident time indicated MVFR⁷ conditions prevailing with light rain.

⁷ As defined by the NWS and the FAA Aeronautical Information Manual (AIM) section 7-1-7 defines the following general flight categories:

- Low Instrument Flight Rules (LIFR*) – ceiling below 500 ft above ground level (agl) and/or visibility less than 1 statute mile.
- Instrument Flight Rules (IFR) – ceiling between 500 to below 1,000 feet agl and/or visibility 1 to less than 3 miles.
- Marginal Visual Flight Rules (MVFR**) – ceiling from 1,000 to 3,000 ft agl and/or visibility 3 to 5 miles.
- Visual Flight Rules (VFR) – ceiling greater 3,000 ft agl and visibility greater than 5 miles.

* By definition, IFR is a ceiling less than 1,000 ft agl and/or visibility less than 3 miles while LIFR is a sub-category of IFR.

**By definition, VFR is a ceiling greater than or equal to 3,000 ft agl and visibility greater than 5 miles while MVFR is a sub-category of VFR.

3.0 Upper Air Data

A High-Resolution Rapid Refresh (HRRR)⁸ model sounding was created for the accident site for 1300 CST using a surface elevation of 761 ft.⁹ The 1300 CST HRRR sounding was plotted on a standard Skew-T Log P diagram¹⁰ with the derived stability parameters included in figure 6 with data from the surface to 600-hPa (or approximately 14,000 ft msl). These data were analyzed using the RAOB¹¹ software package. The sounding depicted the lifted condensation level (LCL)¹² at 586 ft agl (1,347 ft msl) and the convective condensation level (CCL)¹³ at 2,445 ft agl (3,206 ft msl). The freezing level was located at 11,777 ft above msl. The precipitable water value was 1.11 inches.

⁸ 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.

⁹ HRRR sounding was created using NOAA Air Resource Laboratory: <https://ready.arl.noaa.gov/READYamet.php>

¹⁰ 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.

¹¹ RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Eosonde Research Services, The Villages, Florida.

¹² LCL - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

¹³ 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.

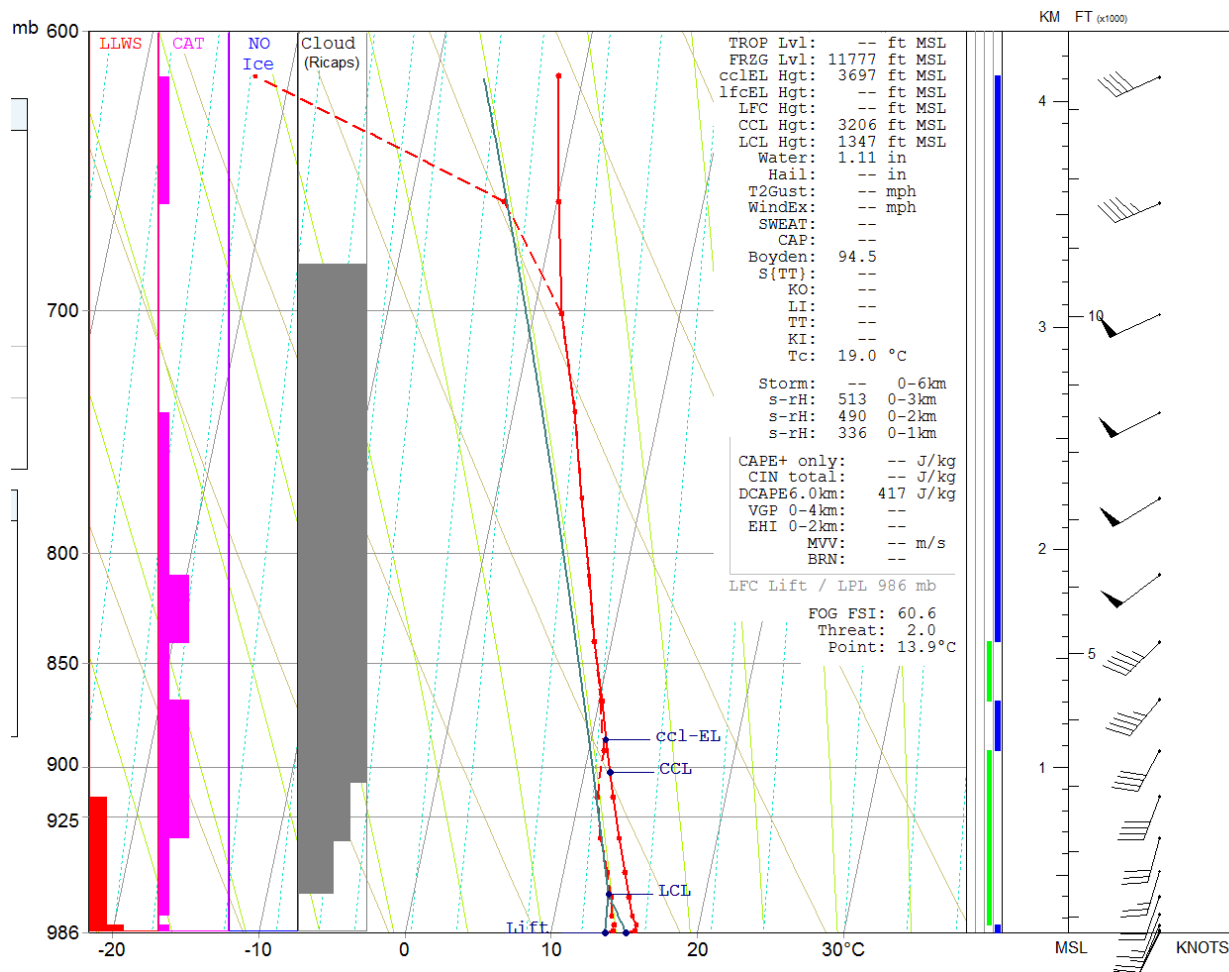


Figure 6 – 1300 CST HRRR sounding.

The 1300 CST HRRR sounding indicated a conditionally unstable environment from the surface through 5,000 ft msl (except for a small stable layer between 3,500 and 4,250 ft msl) and a stable layer above 5,000 ft msl. RAOB indicated cloud cover between 1,500 and 11,000 ft msl. No icing was indicated by RAOB for below 11,000 ft msl.

The 1300 CST HRRR sounding wind profile indicated a near surface wind from 204° at 8 knots with the wind veering¹⁴ to the west-southwest through 14,000 ft. The wind speed increased to 20 knots by 1,500 ft msl and 40 knots by 3,500 ft. RAOB indicated the possibility of low-level wind shear (LLWS) between the surface and 3,000 ft msl. RAOB did indicate the possibility of light to moderate clear air turbulence in several layers between the surface and 14,000 ft msl. At the aircraft's altitude¹⁵ near 9,000 ft msl around 1248 CST, the wind was from 243° at 50 knots, temperature of 4.2°C and a dew point temperature of 4.2°C with a relative humidity of 100%.

¹⁴ A clockwise turning of the wind with height in the northern hemisphere.

¹⁵ For more information, please see air traffic control (ATC) data located in the docket of this accident.

4.0 Satellite Data

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 CST through 1500 CST and reviewed, and the closest images to the time of the accident were documented.

Figures 7 and 8 present the GOES-16 visible imagery from 1250 and 1300 CST at 2X magnification with the accident site highlighted with a red square. The cloud cover was moving from west to east. Figure 9 presents the GOES-16 infrared imagery from 1250 CST at 6X magnification with the accident site highlighted with a red square. The lower brightness temperatures (yellow colors; higher cloud tops) were located east of the accident site. Based on the brightness temperatures (about 272 Kelvin) above the accident site and the vertical temperature profile provided by the 1300 CST HRRR sounding, the approximate cloud-top heights over the accident site were 13,000 ft above msl at 1250 CST. It should be noted these figures have not been corrected for any parallax error.

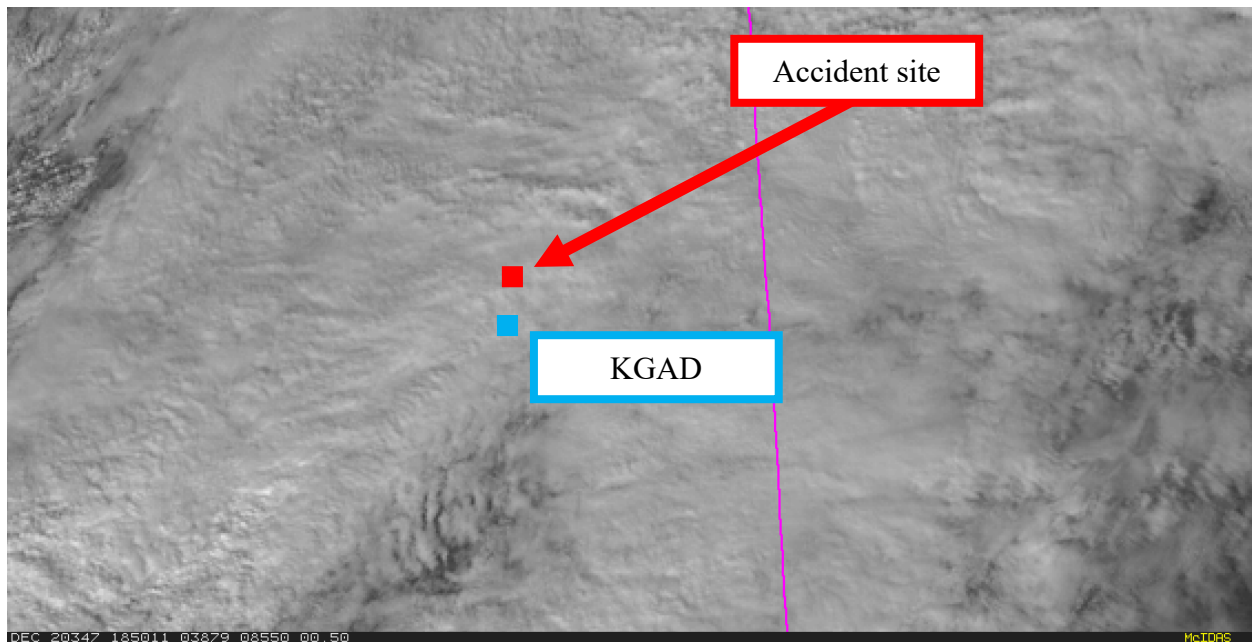


Figure 7 – GOES-16 visible image at 1250 CST.

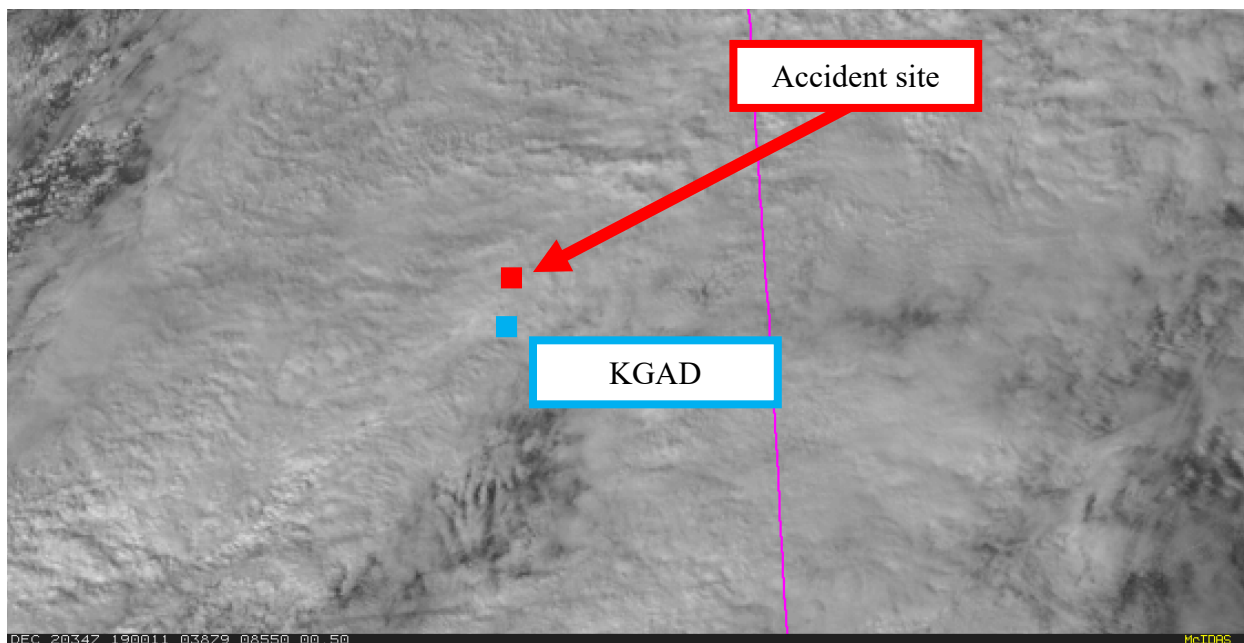


Figure 8 – GOES-16 visible image at 1300 CST.

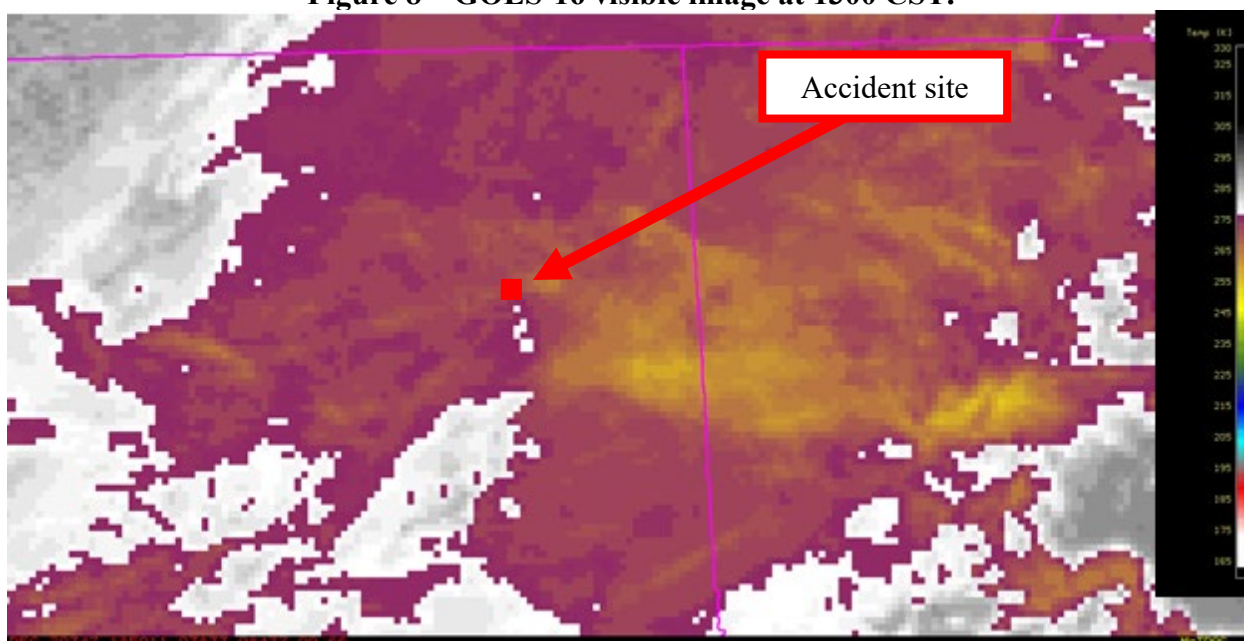


Figure 9 – GOES-16 infrared image at 1250 CST.

5.0 Regional Radar Imagery Information

A regional view of the NWS national composite radar mosaic is included as figure 10 for 1250 CST with the approximate location of the accident site marked within a red circle. The image depicted scattered echoes from 15 to 30 decibels (dBZ)¹⁶ from central Alabama stretching northeastward into southern Tennessee.

¹⁶ 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.

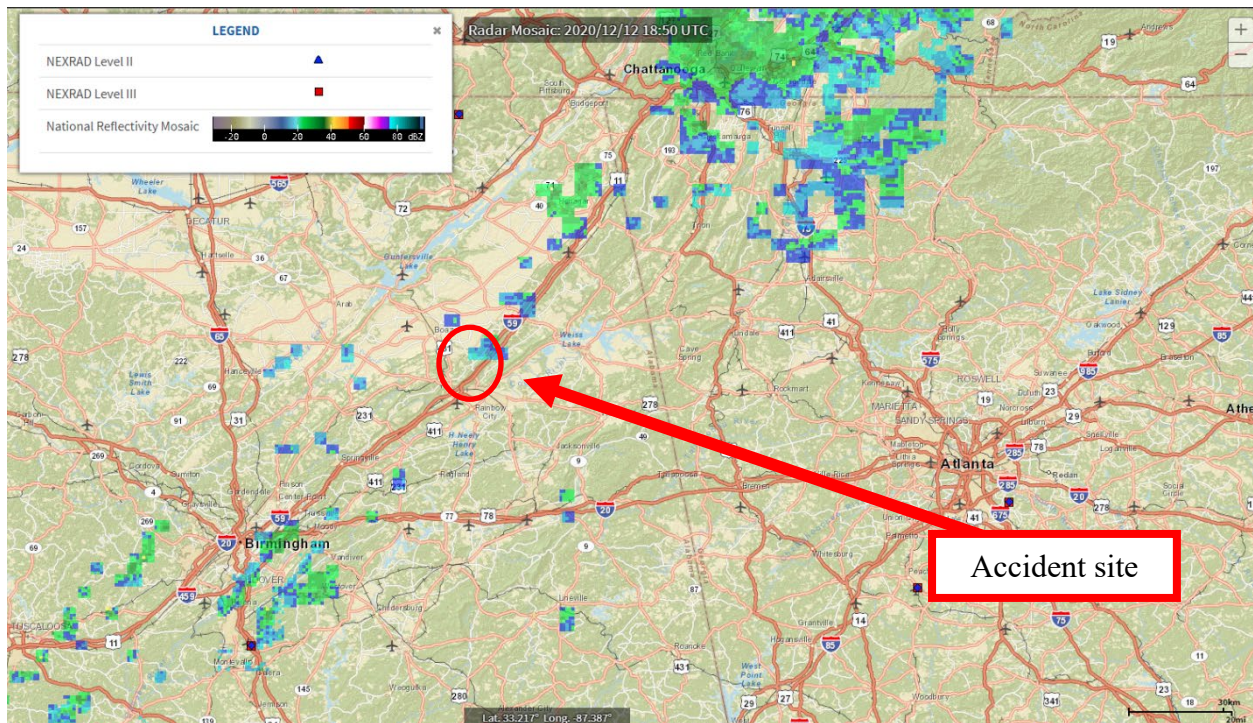


Figure 10 – Regional Composite Reflectivity image for 1250 CST.

6.0 Radar Imagery Information

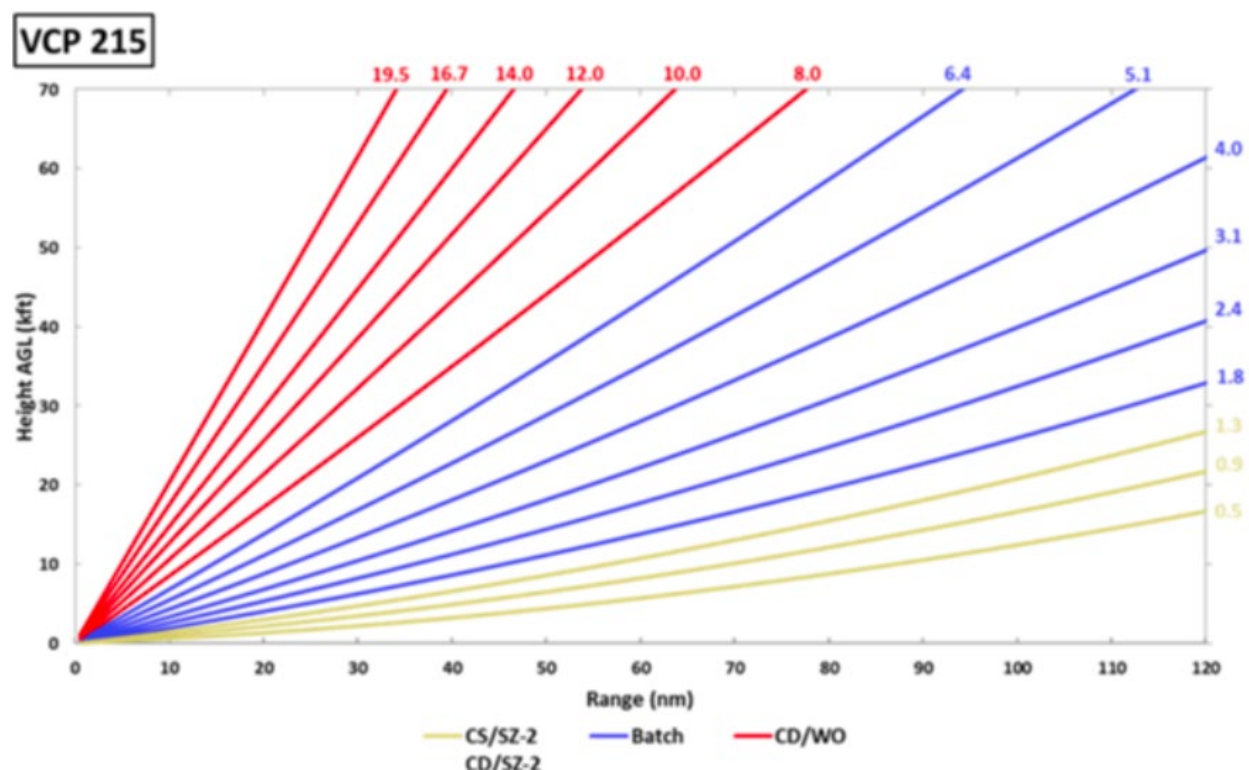
The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D)¹⁷ to the accident site was Huntsville, Alabama (KHTX) located 50 miles north of the accident site. Level II archive radar data were obtained from the NCEI utilizing the NEXRAD Data Inventory Search and displayed using the NOAA's Weather and Climate Toolkit software.

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. Products that require data from multiple elevation scans are not available until the end of the five-to-ten-minute volume scan.

¹⁷ 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.

The WSR-88D operates in two main scanning modes, identified as Mode A and Mode B. Mode A is the precipitation scan and has three common scanning strategies¹⁸. 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 9 elevation scans during a ten-minute period. During the period surrounding the accident, the KHTX WSR-88D radar was operating in the precipitation mode VCP-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 Strategy.

¹⁸ 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)

6.2 Beam Height Calculation

Assuming standard refraction¹⁹ of the KHTX WSR-88D radar beam with the antenna elevation at 1,859 ft, and considering a beamwidth²⁰ of 0.95°, the following table shows the approximate heights for the radar beam center, base, and top 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
KHTX 0.5°	6,320 ft	3,850 ft	8,790 ft
KHTX 0.9°	8,430 ft	5,960 ft	10,900 ft

Based on the radar height calculations, the elevation scans from KHTX listed in the above table depicted the conditions between 3,850 ft and 10,900 ft above msl over the accident site and these scans “saw” the closest altitudes to the aircraft’s altitude before descent between 1248 and 1249 CST.

6.3 Reflectivity

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors²¹ 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 00-24C²², “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.”

6.4 Base Reflectivity and Lightning Data

Figures 11 through 15 present the KHTX WSR-88D base reflectivity images for the 0.9° elevation scans initiated at 1228:49, 1238:01, 1247:14, and 1251:50 CST, with a resolution of 0.5°

¹⁹ Standard Refraction in the atmosphere is when the temperature and humidity distributions are approximately average, and values set at the standard atmosphere.

²⁰ Beamwidth - the angular separation between the half power points on the antenna radiation pattern, where the gain is one half the maximum value.

²¹ 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.

²²

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

X 250 m. Discussions between ATC and the accident flight were transcribed and portions of the transcription²³ wording have been added for context in figures 11 through 13. Reflectivity values between 5 and 15 dBZ were located above the accident site at the accident time with the precipitation near the accident site expanding in spatial coverage (attachments 1 and 2). The precipitation was moving from west to east over the accident site at the accident time (attachments 1 and 2) with the accident site located near the eastern edge of the banded precipitation (figure 14).

There were no lightning flashes²⁴ near the accident site at the accident time.²⁵

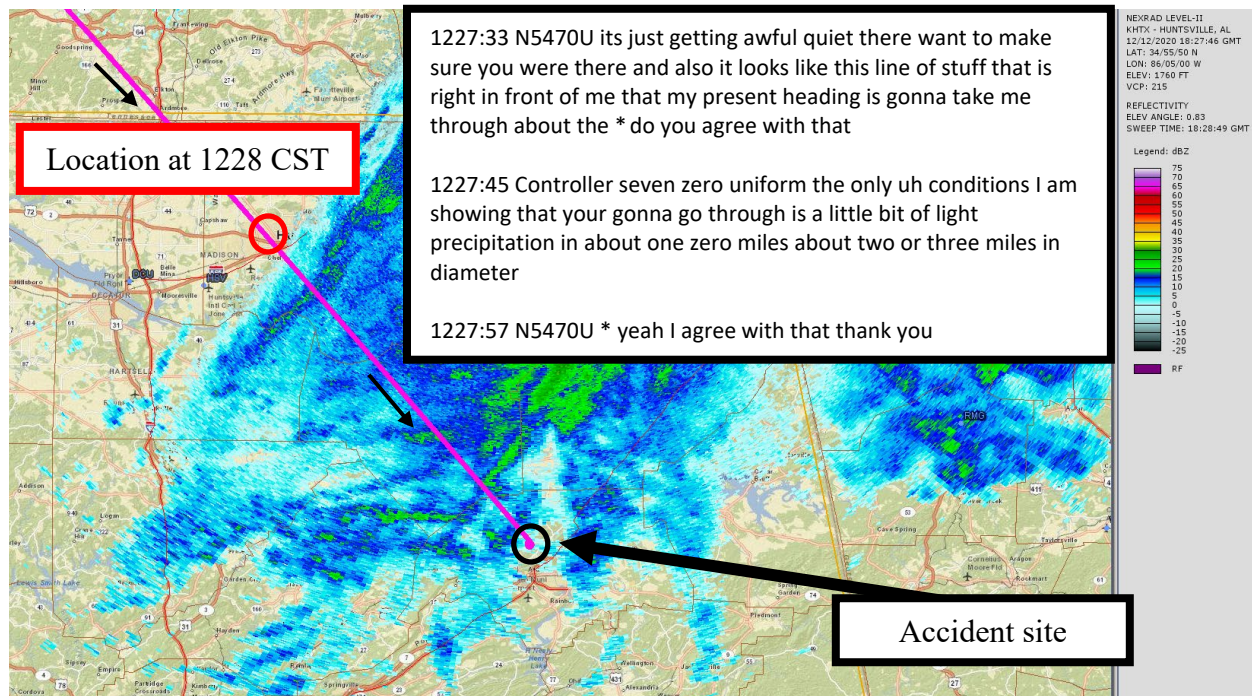


Figure 11 – KHTX WSR-88D reflectivity for the 0.9° elevation scan initiated at 1228:49 CST with the accident site marked with a black circle and the accident flight track in pink with arrows pointing in the direction of travel.

²³ See docket of this accident for more information. The “*” wording in figure 11 indicates an unintelligible comment.

²⁴ 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.

²⁵ A review of Earth Networks Total Lightning network was done.

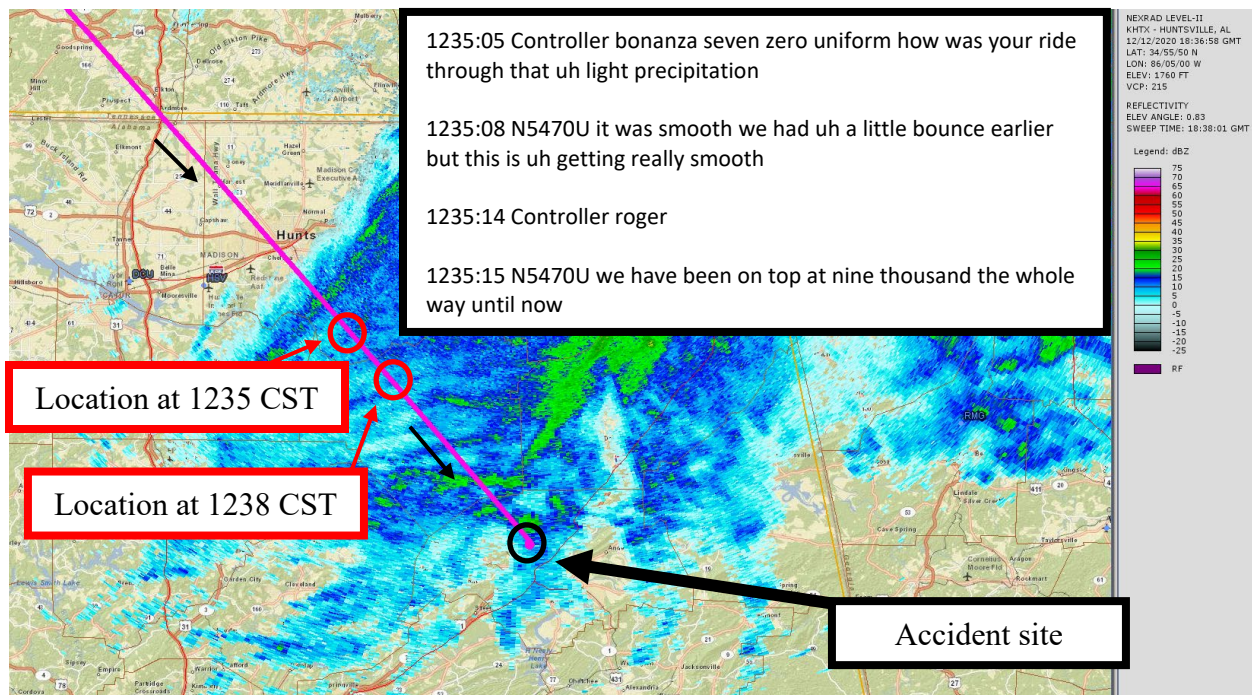


Figure 12 – KHTX WSR-88D reflectivity for the 0.9° elevation scan initiated at 1238:01 CST with the accident site marked with a black circle and the accident flight track in pink with arrows pointing in the direction of travel.

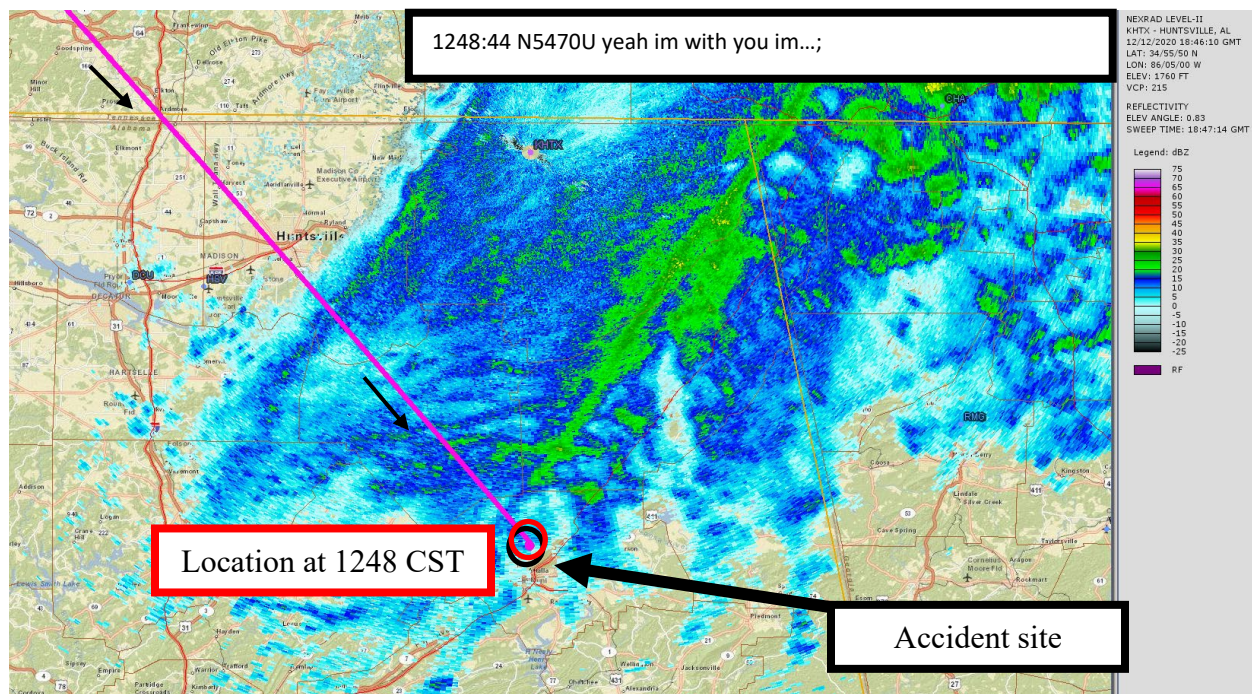


Figure 13 – KHTX WSR-88D reflectivity for the 0.9° elevation scan initiated at 1247:14 CST with the accident site marked with a black circle and the accident flight track in pink with arrows pointing in the direction of travel.²⁶

²⁶ The remainder of the comment from 1248:44 CST was unintelligible.

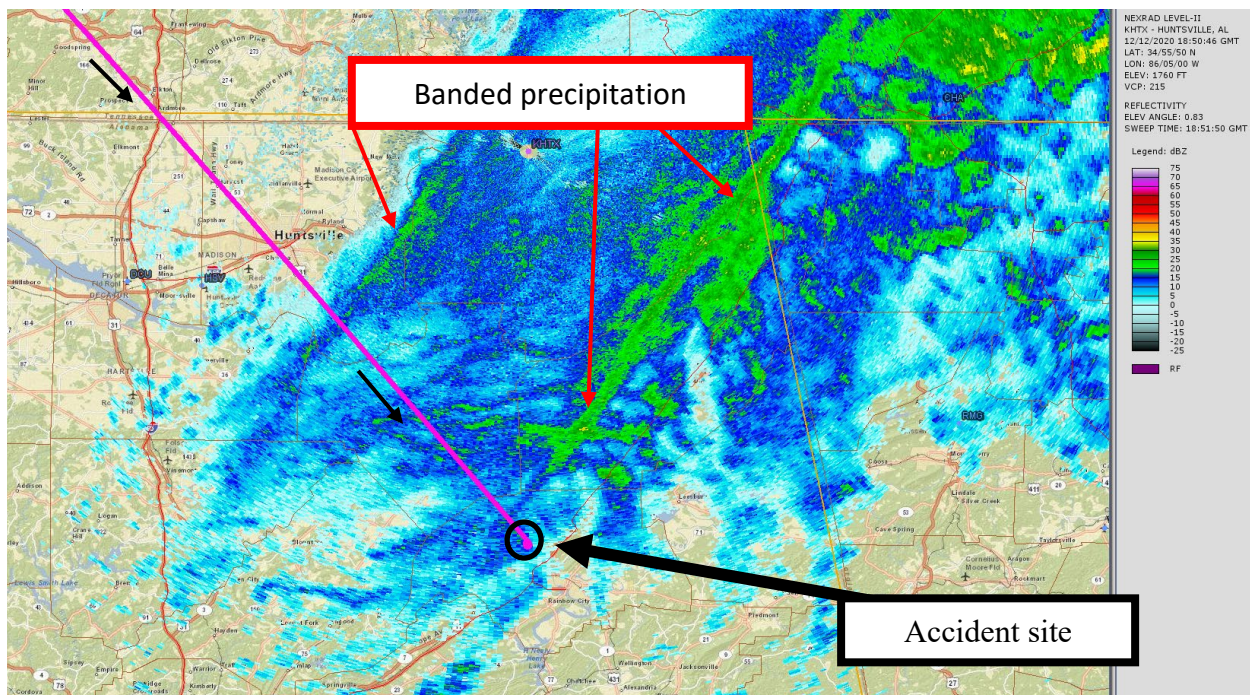


Figure 14 – KHTX WSR-88D reflectivity for the 0.9° elevation scan initiated at 1251:50 CST with the accident site marked with a black circle and the accident flight track in pink with arrows pointing in the direction of travel.

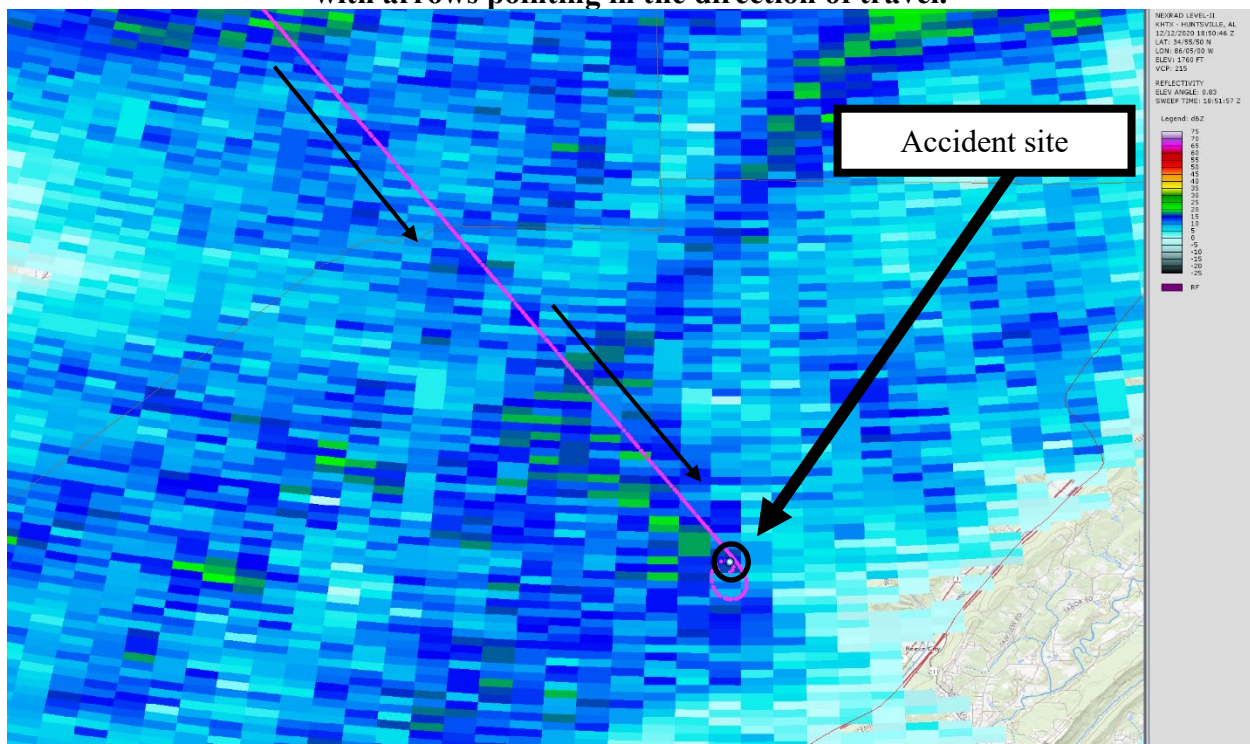


Figure 15 – KHTX WSR-88D reflectivity for the 0.9° elevation scan initiated at 1251:50 CST with the accident site marked with a black circle and the accident flight track in pink with arrows pointing in the direction of travel. Figure zoomed in for clarity.

7.0 Pilot Reports²⁷

The following are the publicly longline-disseminated pilot reports²⁸ (PIREPs) distributed into the national airspace (NAS) within 75 miles of the accident site from about two and half hours prior to the accident time to two hours after the accident time for below 18,000 ft above msl.

GAD UA /OV GAD360030/TM 1631/FL170/TP BE9L/SK BKN170/TA M06/IC LGT-MOD RIME 170/RM ZTLFD

BHM UA /OV EET045005/TM 1700/FLDURGD/TP M20P/SK B010

HSV UA /OV HSV/TM 1710/FLDURD/TP C500/SK BASE BKN010 TOPS 110

BHM UA /OV BHM135020/TM 1719/FL040/TP PA30/RM TB /PRETTY BUMPY/

BHM UA /OV BHM/TM 1724/FLDURGC/TP PC12/SK B005-006

HSV UA /OV /OV HSV018002/TM 1739/FLDURC/TP E170/SK BASES BKN005 AND MULTIPLE LAYERS UP TO BKN085

HSV UA /OV /OV HSV 36001/TM 1750/FLDURD/TP E170/SK BASES BKN004

HSV UA /OV /OV HSV36001/TM 1820/FLDURD/TP CRJ/SK BASES BKN005

BHM UA /OV BHM/TM 1825/FLDURD/TP CL30/SK BASES010OVC/RM LANDING RWY 24

BHM UA /OV 20A360006/TM 1839/FL040/TP S22T/WX -RA/TB LGT

BHM UA /OV BHM/TM 1943/FL010/TP B737/SK B011

BHM UA /OV BHM060003/TM 1945/FLDURGD/TP BE33/SK BASES010OVC/RM LANDING RY 24

BHM UA /OV BHM/TM 1945/FL010/TP BE33/SK B010

BHM UA /OV 8A0/TM 1947/FL070/TP SR22/WX -RA

HSV UA /OV /OV HSV36003/TM 2020/FLDURD/TP KC135/SK TOPS BKN018

BHM UA /OV RWY 24 FINAL/TM 2032/FL011/TP B712/SK OVC/RM AIRPORT INSIGHT AT 013 BASES 011

8.0 SIGMET

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

9.0 CWSU Advisories

The Atlanta (ZTL) Air Route Traffic Control Center (ARTCC) Center Weather Service Unit (CWSU) was responsible for the accident region. The ZTL CWSU did not issue a Meteorological

²⁷ Only pilot reports with the World Meteorological Organization headers UBAL**, UBTN**, and UBGA** were considered.

²⁸ These do not include pilot reports only broadcast via radio.

Impact Statement (MIS) or a Center Weather Advisory (CWA) for the accident site at the accident time.

10.0 AIRMETS

There were Airmen's Meteorological Information (AIRMET) advisories Zulu and Sierra that had been issued and were valid for the accident site at the accident time. The AIRMETS warned of moderate icing between the freezing level²⁹ and FL240 and IFR conditions due to precipitation and mist:

WAUS44 KKCI 121445
WA4Z
-DFWZ WA 121445
AIRMET ZULU UPDT 2 FOR ICE AND FRZLVL VALID UNTIL 122100

AIRMET ICE...TN AL
FROM 20SSW BWG TO HMY TO GQO TO LGC TO 20ENE IGB TO 20SSW BWG
MOD ICE BTN FRZLVL AND FL240. FRZLVL 080-130. CONDS ENDG BY 21Z.

OTLK VALID 2100-0300Z
AREA 1...ICE OK AR NE KS IA MO WI LM MI IL IN KY
BOUNDED BY 40SW FNT-30E DXO-FWA-CVG-60E CVG-40SSE PXV-40ENE
ARG-20NNW ARG-20NW FSM-40S ICT-30SW OBH-40SW OVR-60SW IRK-40W
AXC-40SW FNT
MOD ICE BLW 100. CONDS DVLPG 21-00Z. CONDS CONTG THRU 03Z.

AREA 2...ICE OK TX ND SD NE KS
BOUNDED BY 50N ISN-50SW MOT-40E DPR-50WNW LBF-50E HLC-20SW
END-50NNE TCC-30ESE TBE-50W LBL-GLD-BFF-70SW RAP-50N ISN
MOD ICE BLW 160. CONDS CONTG THRU 03Z.

AREA 3...ICE TN AL
BOUNDED BY 50WSW BKW-HMY-GQO-50WSW PZD-20S LGC-30WSW GQO-50WSW
BKW
MOD ICE BTN FRZLVL AND FL240. FRZLVL 080-120. CONDS DVLPG AFT
03Z. CONDS ENDG BY 03Z.

FRZLVL...RANGING FROM SFC-135 ACRS AREA
MULT FRZLVL BLW 080 BOUNDED BY 20SW OSW-RZC-30N DYR-20W LIT-
60WSW LIT-50NNW TXK-30NW SPS-40WNW ABI-30NNE INK-40ESE LBB-
20NNE CDS-40WSW MMB-50ENE END-20SW OSW
MULT FRZLVL BLW 090 BOUNDED BY 70SSE TBE-40WSW MMB-20NNE CDS-
40ESE LBB-30NNE INK-70SSE TBE
MULT FRZLVL 080-110 BOUNDED BY 50NNW MSL-30NNE IGB-40NNE MLU-
20NNW TXK-20W MEM-50NNW MSL
SFC ALG 60N INK-40SE LBB-50SW ICT
040 ALG 50SSW TXO-30ENE CDS-20WNW MLC-FSM-70SSE SGF
080 ALG 20N INK-30ENE MAF-50SSW SPS-40WSW LIT-40ENE DYR
120 ALG 30WNW LRD-40WSW PSX-30SE AEX-20WNW MHZ-30WNW MGM-20NE
LGC

....

²⁹ Freezing level between 8,000 and 13,000 ft msl.

WAUS44 KPCI 121445
WA4S
-DFWS WA 121445
AIRMET SIERRA UPDT 4 FOR IFR AND MTN OBSCN VALID UNTIL 122100

.
AIRMET IFR...TX AR LA MS AND CSTL WTRS
FROM 40SSW MEM TO 30WSW HRV TO 60SE LCH TO 100SE PSX TO 20E BRO
TO 70W BRO TO 40S LRD TO 30SE CWK TO 50SSE EIC TO 40SSW MEM
CIG BLW 010/VIS BLW 3SM BR. CONDS ENDG 18-21Z.

.
AIRMET IFR...TN LA MS AL
FROM 40W LOZ TO 40WSW HMV TO GQO TO 50S GQO TO 30WSW HRV TO
50SSW MEM TO 50ESE MEM TO 30WSW BWG TO 30SE BWG TO 40W LOZ
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 21Z THRU 03Z.

.
AIRMET MTN OBSCN...TN KY
FROM HNN TO HMV TO GQO TO 50W LOZ TO 50NNE LOZ TO HNN
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 21Z THRU 03Z.

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11.0 Graphical Forecasts for Aviation

The Graphical Forecasts for Aviation (GFA) products valid before departure for around the accident time at 1500 CST are shown in attachment 3. The GFA surface forecast products indicated IFR surface visibilities with likely (greater than 60 percent chance) rain shower activity and a surface wind from the southwest at 5 knots. The GFA cloud forecast valid before departure for around the accident time indicated overcast ceilings at 1,600 to 2,200 ft msl with cloud top altitudes of 14,000 to 16,000 ft msl. The Graphical AIRMET³⁰ (G-AIRMET) Sierra valid for the accident site was overlaid on the GFA surface forecast graphics. For more information, please see attachment 3.

12.0 Terminal Aerodrome Forecast

There were no NWS³¹ Terminal Aerodrome Forecast (TAF) sites located within 30 miles of the accident site.

13.0 NWS Area Forecast Discussion

The NWS office in Birmingham, Alabama, (WFO BMX) issued the following Area Forecast Discussion (AFD) at 1050 CST (closest AFD to the accident time with an aviation section). The aviation section of the AFD discussed MVFR to IFR ceilings and light rain moving from west to east across the region:

FXUS64 KBMX 121650
AFDBMX

³⁰ <https://aviationweather.gov/gairmet>

³¹ According to NWS Instruction 10-813: "A NWS TAF consists of the expected meteorological conditions significant to aviation at an airport for a specified time period. For the U.S., this is the area within five (5) statute miles (SM) of the center of an airport's runway complex." www.nws.noaa.gov/directives/sym/pd01008013curr.pdf

Area Forecast Discussion
National Weather Service Birmingham AL
1050 AM CST Sat Dec 12 2020

.UPDATE...
Midday Update and 18Z Aviation.

&&

.SHORT TERM...
/Updated at 1030 AM CST Sat Dec 12 2020/

Cold front continues to advance slowly across the state giving most everyone a chance of measurable precip through this evening, albeit light. The showers will exit east by around midnight tonight. Meanwhile the next, much faster and stronger disturbance will be getting more organized just upstream through the day tomorrow. While much of the morning and early afternoon will remain dry, rain showers and some isolated thunder will be near the MS state line by late afternoon tomorrow.

17/KLAWS

.LONG TERM...
/Updated at 0225 AM CST Sat Dec 12 2020/
Sunday night through Monday morning:

The next shortwave within the progressive wave train across the CONUS will move through Sunday night. An associated surface low will ride along the stalled frontal boundary, moving near/just south of the I-20 corridor and causing the front to drift northward as a warm front before pushing back southward as a cold front. Strong forcing for ascent associated with the shortwave, upper level divergence, deep layer frontogenesis and isentropic lift within a saturated air mass will result in widespread rainfall north of I-85 Sunday evening, reaching areas south of I-85 after midnight. Rainfall amounts of 1 to 1.5 inches are expected, with totals near 2 inches in a few locations. The surface low has trended a little further north, and will have to monitor instability trends given strongly curved hodographs in the warm sector. However, at this time surface-based instability appears minimal to non-existent with 65F dew points lagging behind the surface low, so at this time severe storms are not expected. Did add in a mention of isolated thunder across the southern half of the area. Precipitation should rapidly end from west to east early Monday morning before the cooler air arrives.

Monday afternoon through Friday:

Cool northerly winds are expected behind the front on Monday, with high temperatures dependent on how long a post-frontal stratus deck persists, with a cool night expected Monday night. Winds become easterly by Tuesday morning as a cold air damming wedge develops along the East coast. Another strong shortwave moves through Tuesday night and Wednesday. Ensembles have all trended much wetter for this period though there are still some timing differences, with a surface low expected to develop over the northern Gulf with an

inverted trough extending northward across Alabama. Have raised PoPs and suspect further increases will be needed. Thermal profiles remain supportive of only liquid precip at this time. More cold air is expected Wednesday night through Thursday night, with flow becoming southwesterly Friday ahead of another shortwave that moves through the area next weekend.

32/Davis

&&

.AVIATION...

18Z TAF Discussion.

Aviation weather forecast will include mainly MVFR and IFR cigs through most of the time period as a slow-moving cold front works across the state from west to east. Generally speaking, the rainfall associated with this front will remain light and moisture starved. During the overnight hours, any shower activity will begin to diminish as the front moves further east leaving IFR cigs at most sites in its wake.

17/KLAWS

&&

.FIRE WEATHER...

A cold front will move into the area and stall, resulting in periods of rainfall through early Monday morning. Rain-free conditions are expected thereafter through Tuesday, with more rain arriving Tuesday night. Relative humidity values remain well above critical values through the period.

&&

.PRELIMINARY POINT TEMPS/POPS...

Gadsden	63	44	63	40	50	/	100	60	20	100	10
Anniston	66	51	67	46	52	/	80	70	30	100	20
Birmingham	64	46	65	43	49	/	100	50	30	100	10
Tuscaloosa	67	44	65	42	51	/	100	20	40	100	0
Calera	65	48	65	45	50	/	100	60	30	100	10
Auburn	68	54	67	50	56	/	50	70	30	90	30
Montgomery	72	53	70	50	57	/	70	70	40	90	10
Troy	72	57	70	52	59	/	50	70	30	80	20

&&

.BMX WATCHES/WARNINGS/ADVISORIES/...

None.

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14.0 Winds and Temperature Aloft Forecast

The NWS 0755 CST Winds and Temperature Aloft forecast valid for the closest point to the accident site is included below:

```
FBUS31 KWNO 121355
FD1US1
DATA BASED ON 121200Z
VALID 121800Z    FOR USE 1400-2100Z. TEMPS NEG ABV 24000

FT  3000    6000    9000    12000    18000    24000    30000    34000    39000
BHM 2043 2442+10 2433+04 2438+00 2549-12 2558-25 257639 259048 750757
```

The closest forecast point above accident location was the Birmingham, Alabama, (BHM) forecast point. The 0755 CST BHM forecast for use between 0800 CST and 1500 CST indicated a wind at 3,000 ft from 200° at 43 knots, a wind at 6,000 ft from 240° at 42 knots with a temperature of 10°C, and a wind at 9,000 ft from 240° at 33 knots with a temperature of 4°C.

15.0 Pilot Weather Briefing

The accident pilot did not request a weather briefing from Leidos Flight Service.

A search of archived ForeFlight information indicated that the accident pilot did request and receive weather information from ForeFlight at 1049 CST. The 1049 CST weather information contained all the official NWS aviation forecast information for the route of flight. In addition, the accident pilot requested and viewed other weather imagery at 0809 to 0811 CST on December 12 and viewed additional weather imagery on December 10 and 11. For more information please see attachment 4. There is no record of the accident pilot receiving or retrieving any other weather information before or during the accident flight.

16.0 Astronomical Data

The astronomical data obtained for the accident site on December 12, 2020, indicated the following:

SUN	
Begin civil twilight	0613 CST
Sunrise	0641 CST
Sun transit	1138 CST
Accident time	1249 CST³²
Sunset	1636 CST
End civil twilight	1703 CST

E. LIST OF ATTACHMENTS

³² Inserted accident time for reference and context.

Attachment 1 – KHTX base reflectivity 0.5° animation from 1228 to 1255 CST

Attachment 2 – KHTX base reflectivity 0.9° animation from 1228 to 1255 CST

Attachment 3 – GFA valid for the accident site at accident time

Attachment 4 – ForeFlight weather information

Submitted by:

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