



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

November 2, 2022

Specialist's Factual Report

METEOROLOGY

CEN22FA406

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A. ACCIDENT

Location: Cleveland, Tennessee
Date: September 5, 2022
Time: 1711 eastern daylight time (2111 UTC¹)
Aircraft: Type – Cessna 182P; Registration – N58807

B. METEOROLOGIST

Mike Richards
Senior Meteorologist
Operational Factors Division (AS-30)
National Transportation Safety Board

C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board’s meteorological specialist did not travel in support of this accident investigation and gathered all weather data remotely. Unless otherwise noted, all times are in eastern daylight time for September 5, 2022 (based upon the 24-hour clock), directions are referenced to true north, distances are in nautical miles and heights are above mean sea level (msl). The accident site was located at about: 35.12614° north latitude; 84.72678° west longitude at an elevation of about 835 feet.

This report provides information on the weather conditions and forecasts applicable to the accident time and location.

D. WEATHER INFORMATION

1.0 Weather Radar

WSR-88D² Level-II base reflectivity weather radar imagery from near Huntsville, Alabama, (site KHTX) is presented in Figures 1 and 2. KHTX was located about 68 miles east-northeast of the accident location at an elevation of about 1,860 feet. Assuming standard refraction and considering the 0.95° beam width³ for the WSR-88D radar beam, the KHTX 0.483° tilt would have “seen” altitudes over the accident location of between about 11,800 and 5,000 feet.

¹ UTC – abbreviation for Coordinated Universal Time

² Weather Surveillance Radar 88 Doppler (WSR-88D)

³ Here we define the angular width of the radar beam as the region of transmitted energy that is bounded by one-half the maximum power. The maximum power lies along the beam centerline and decreases outward from the radar antenna.

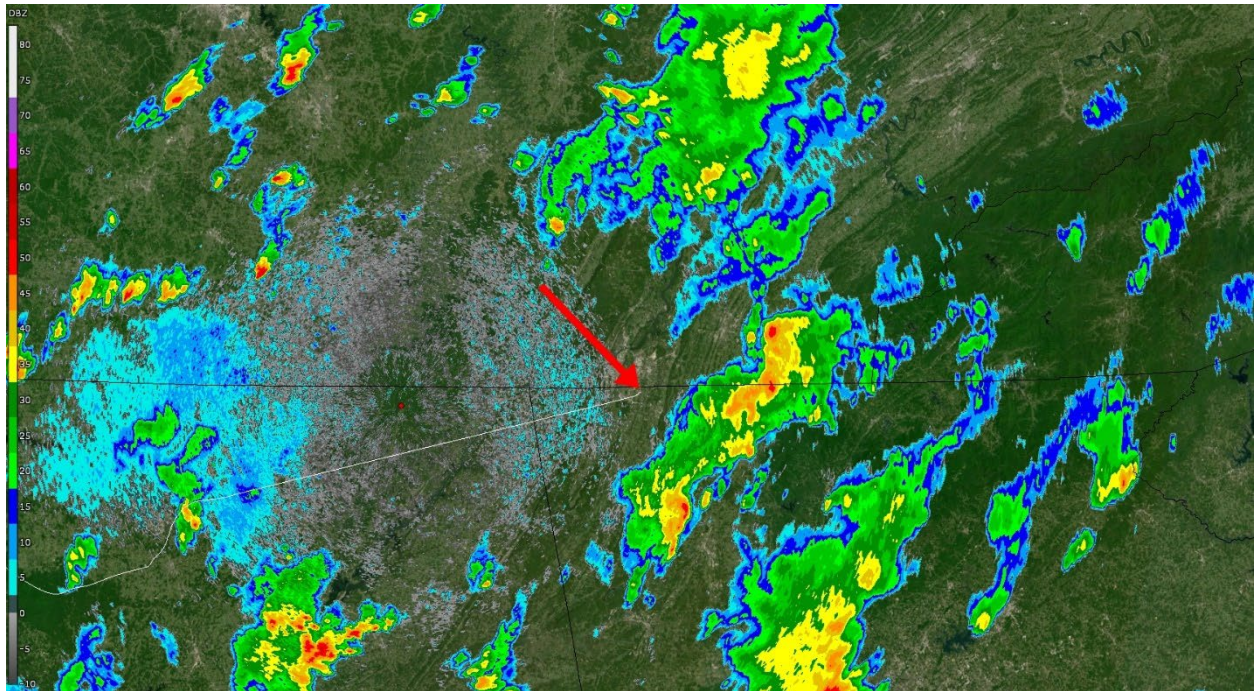


Figure 1 – KHTX 0.483° Level-II base reflectivity product from a sweep initiated at 1653:05. Accident aircraft's flight path denoted by the white line with its position at 1656:18, where the aircraft was at an altitude of about 9,275 feet, identified by the red arrow.

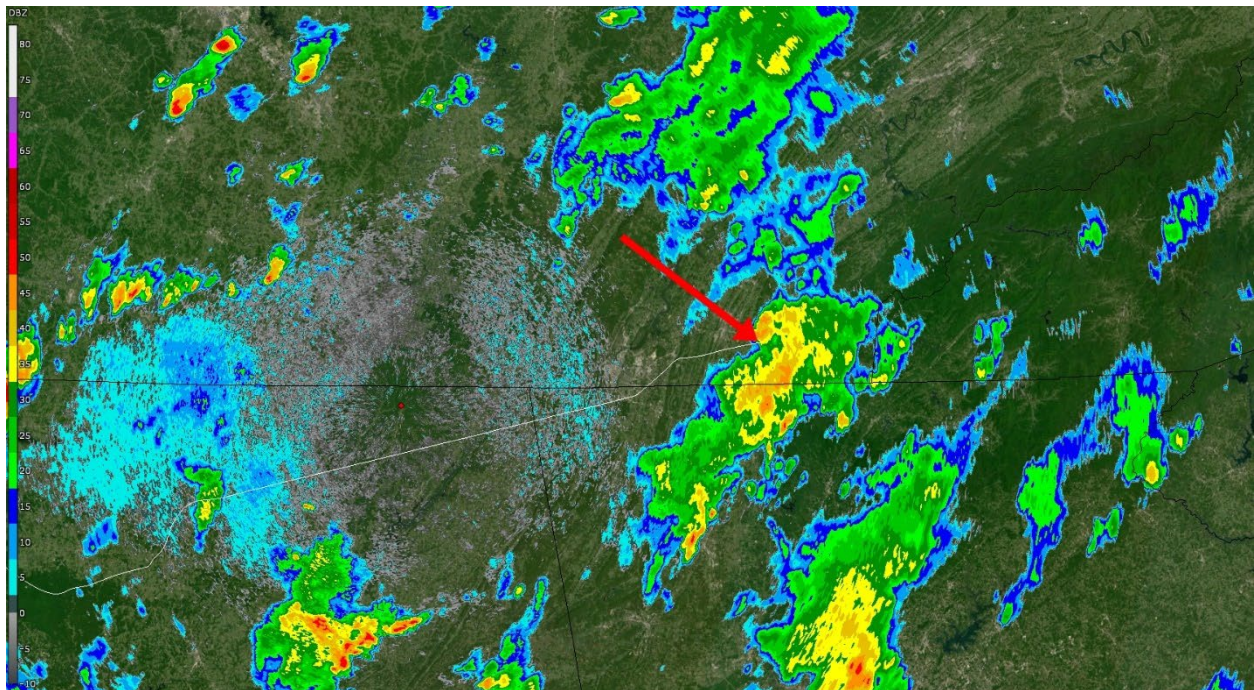


Figure 2 – KHTX 0.483° Level-II base reflectivity product from a sweep initiated at 1708:36. Accident aircraft's flight path denoted by the white line with its position at 1707:12, where the aircraft was at an altitude of about 9,175 feet, identified by the red arrow.

2.0 CIWS

Archive data from the FAA's Corridor Integrated Weather System (CIWS) for the accident region at 1710 and 1715 are presented in Figures 3 and 4. This image presents precipitation, convective growth and decay (orange and blue hatched areas, respectively) and echo top information.

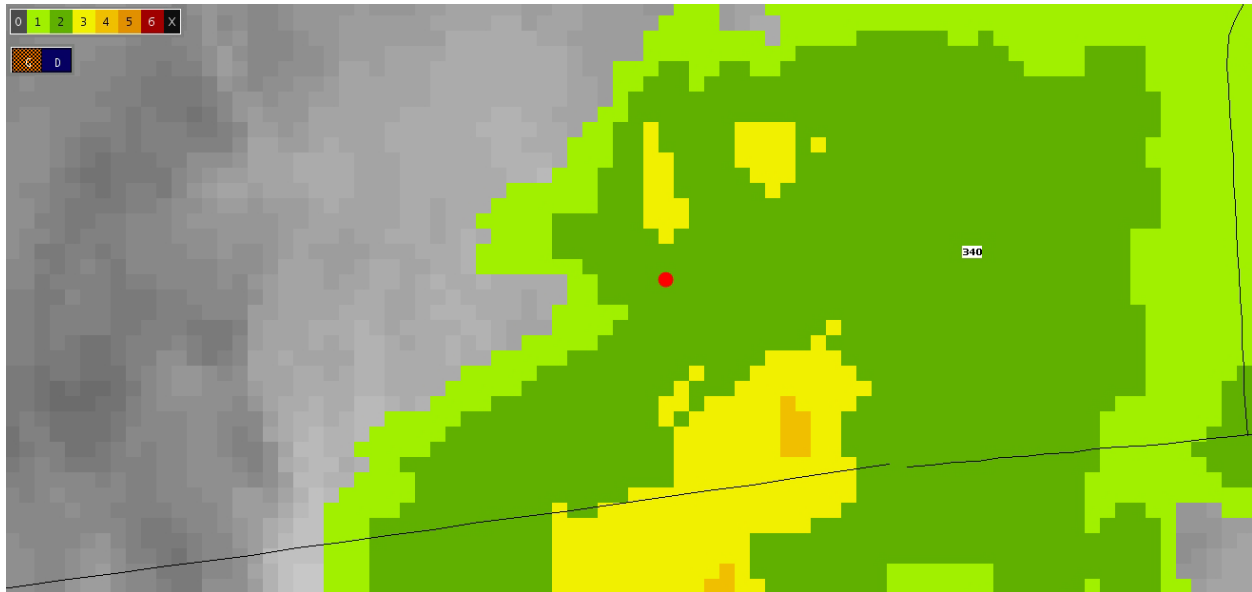


Figure 3 – Archive CIWS display from 1710. Areas of convective growth are identified by the orange hatched areas (there are none). Echo top heights are found in the white boxes in hundreds of feet. Accident location is denoted by the red dot.

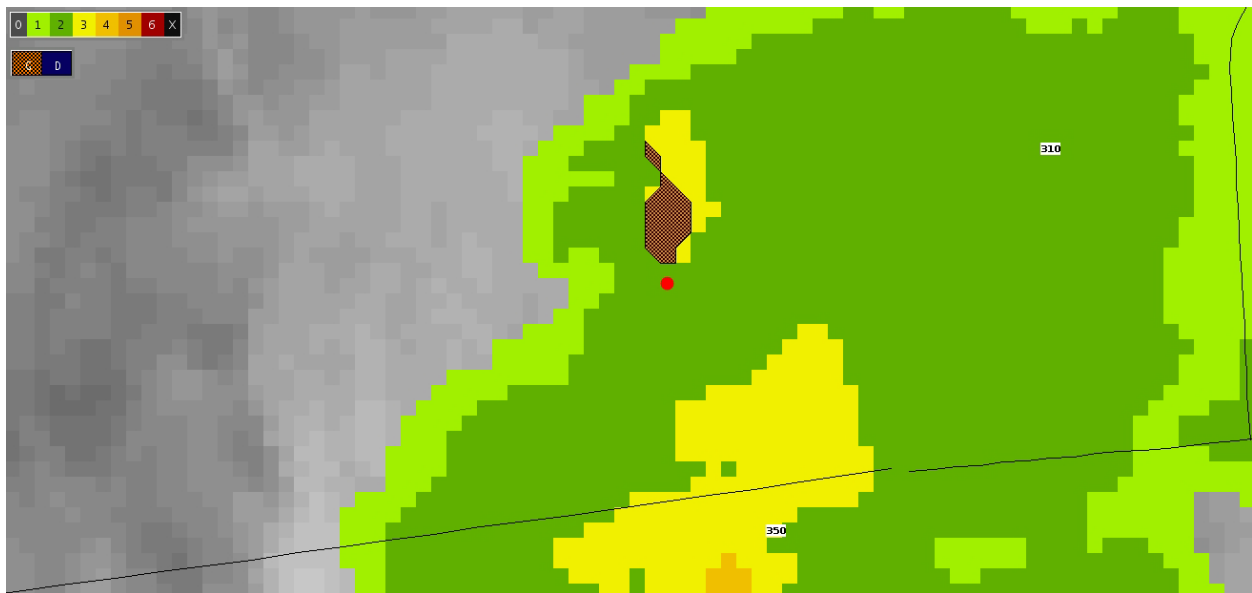


Figure 4 – Archive CIWS display from 1715. Areas of convective growth are identified by the orange hatched areas. Echo top heights are found in the white boxes in hundreds of feet. Accident location is denoted by the red dot.

3.0 HRRR Model Sounding

A High-Resolution Rapid Refresh (HRRR) model⁴ sounding (Figure 5) for near the accident site⁵ at 1700 using an elevation of 784 feet was retrieved from the National Oceanic and Atmospheric Administration's Air Resources Laboratory and analyzed by the RAwinsonde OBservation (RAOB) program. Cloudy conditions were identified by RAOB from about 6,000 feet up through 18,000 feet. The freezing level was noted at about 15,000 feet. The wind at about 10,000 feet was about 15 knots from the west-southwest. RAOB did not identify any areas of turbulence below 15,000 feet. The Convective Available Potential Energy (CAPE) parameter was 1,411 Joules/kilogram (from 986 hectopascals [hPa]). Maximum vertical velocity⁶ for the most-unstable atmosphere was calculated as 53 meters/second (about 10,400 feet per minute).

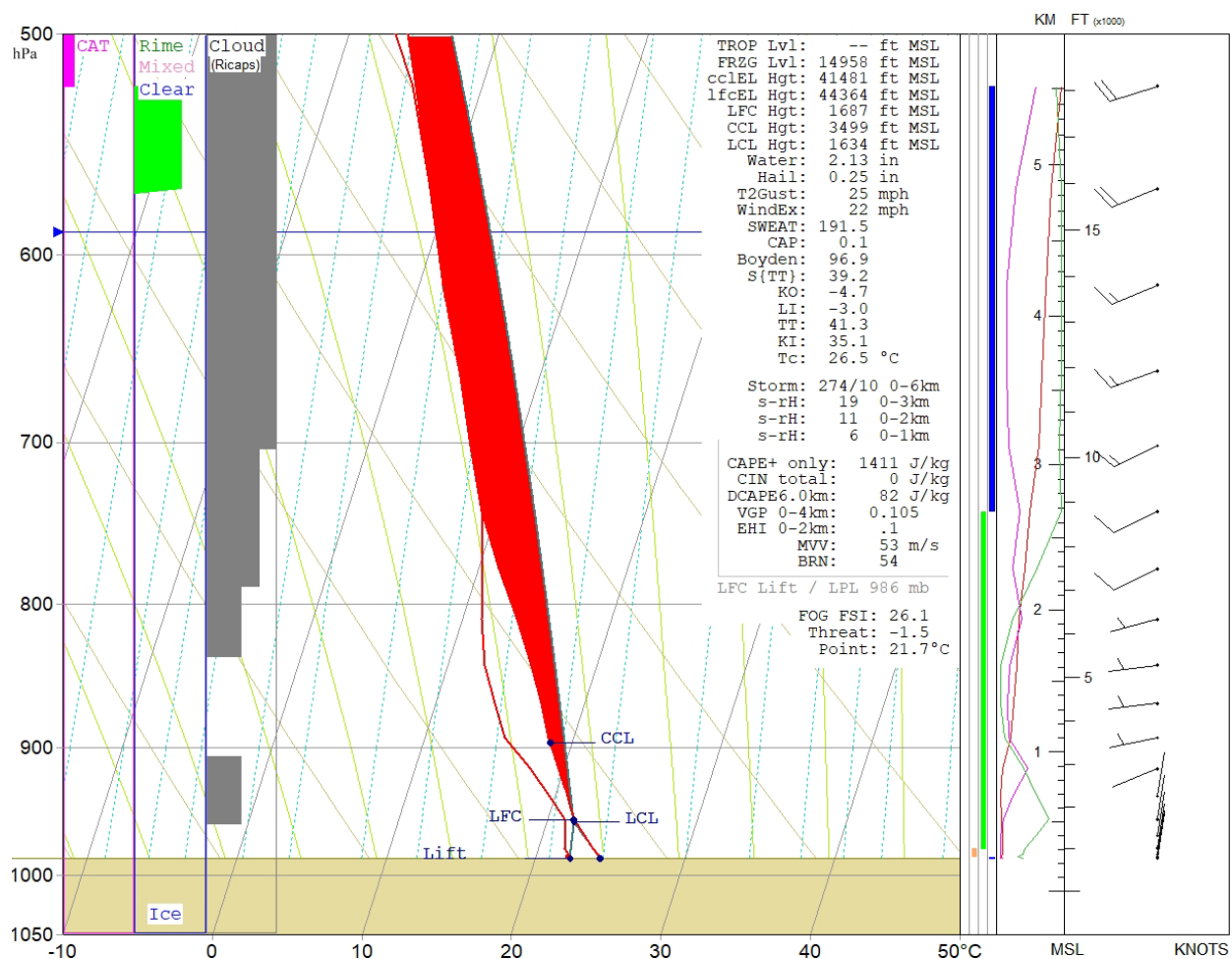


Figure 5 – HRRR model sounding data in SkewT/LogP format for 1700 near the accident site, surface to 500 hPa.

⁴ 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.

⁵ Coordinates used for the model were 35.13, -84.73.

⁶ MVV is not usually considered a realistic estimate for maximum vertical velocity in a storm. Anecdotes suggest considering a value of MVV/2, however it is not well understood when or where such a half-value should be applied.

4.0 Lightning

A review of the Earth Networks Total Lightning Network (ENTLN) lightning database did not yield any flash total lightning activity between 1700 and 1715 in the accident region.⁷

5.0 Satellite Imagery

Geostationary Operational Environmental Satellite (GOES)-16 visible ($0.64\mu\text{m}$) and infrared ($10.3\mu\text{m}$) data were obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison. Images from 1711 are presented in Figures 6 and 7. The GOES-16 visible imagery depicted cloudy conditions over the accident region. Infrared cloud-top temperatures over the accident site were about -58°C , which, when considering the 1700 HRRR sounding, corresponded to cloud top heights of over 40,000 feet (-58°C is not depicted in Figure 5).

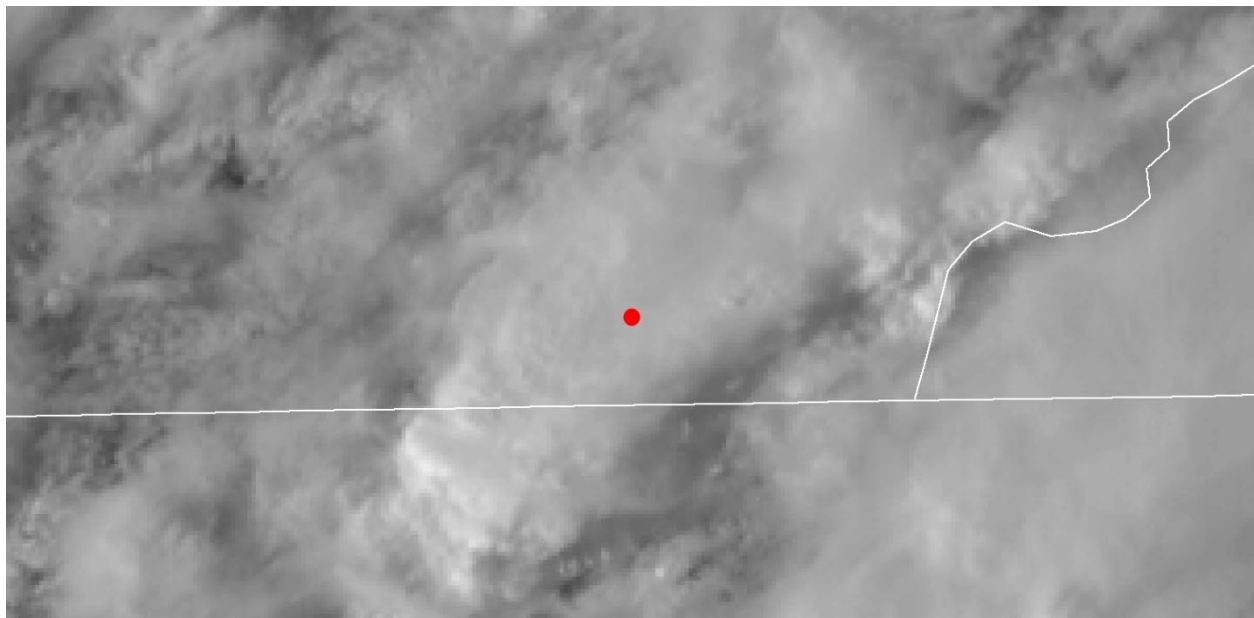


Figure 6 – GOES-16 visible imagery from 1711. Accident location denoted by the red dot. Image is not corrected for parallax error.

⁷ The ENTLN was queried for a geographic area bounded by latitudes 35.3342°N and 34.9828°N , and longitudes 85.1454°W and 84.537°W .

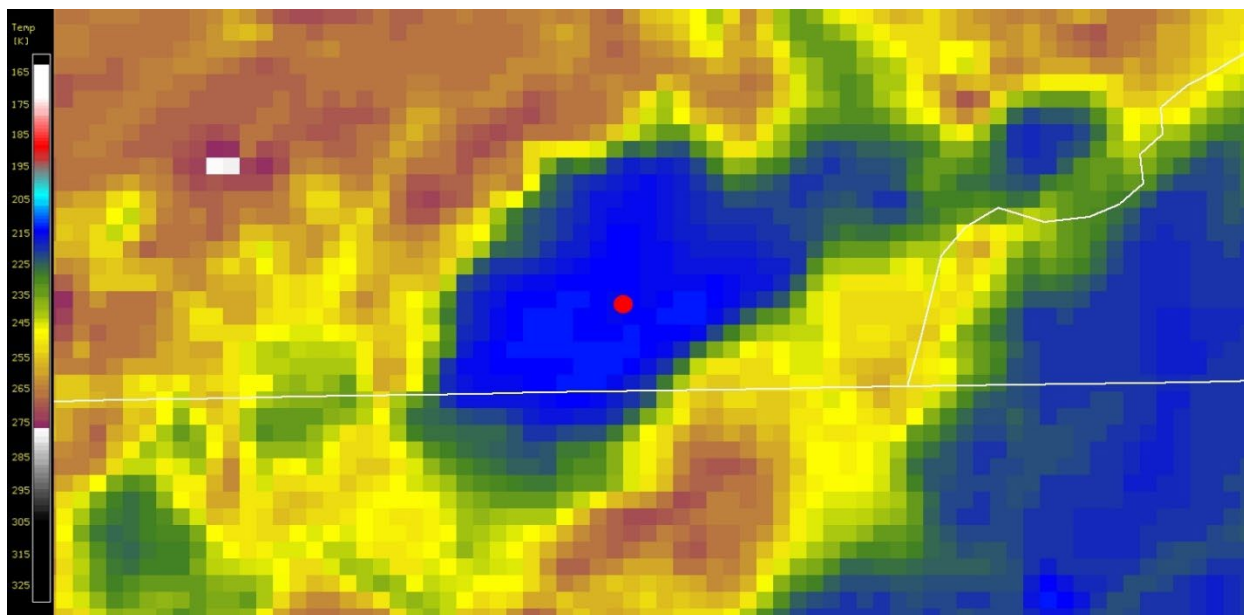


Figure 7 – GOES-16 infrared brightness temperature imagery from 1711. Accident location is denoted by the red dot. This image has not been corrected for any parallax error.

6.0 Pilot Reports

There were no longline-disseminated pilot reports⁸ (PIREPs) made between 1500 and 1900 within 50 miles of the accident location.

7.0 Surface Observations

An Automated Weather Observing Station (AWOS) was located at McMinn County Airport (MMI) in Athens, Tennessee, and was located about 18 miles northeast of the accident location at an elevation of about 875 feet and had a magnetic variation of about 5° west. Automated longline⁹ reports from the MMI AWOS during the times surrounding the accident time are presented here, and the observation closest in time to the accident time is highlighted by bold text.

[1635] METAR KMMI 052035Z AUTO 00000KT 10SM SCT016 BKN060 OVC075
26/22 A3000 RMK A01=

⁸ These do not include pilot reports only broadcast via radio.

⁹ “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.

[1655] METAR KMMI 052055Z AUTO 00000KT 10SM SCT016 BKN075 OVC085
26/22 A3000 RMK A01=
[1715] **METAR KMMI 052115Z AUTO 00000KT 9SM SCT018 BKN028 BKN055
25/23 A3001 RMK A01=**
[1735] METAR KMMI 052135Z AUTO 26004KT 5SM BR FEW018 FEW025 SCT039
25/23 A3001 RMK A01=

At 1715, the MMI AWOS reported a calm wind, visibility of 9 statute miles, scattered clouds at 1,800 feet above ground level (agl), ceiling broken at 2,800 feet agl, broken clouds at 5,500 feet agl, temperature of 25° Celsius (C) and dew point temperature of 23°C, altimeter setting of 30.01 inches of mercury; Remarks: automated station without a precipitation discriminator.

8.0 Terminal Aerodrome Forecasts

The National Weather Service (NWS) produced Terminal Aerodrome Forecasts (TAF) for Lovell Field Airport (CHA) in Chattanooga, Tennessee, which was located about 24 miles west-southwest of the accident location at an elevation of about 680 feet. 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.”¹⁰

At 1609 a TAF was issued by the NWS for CHA that forecasted for the accident time: variable wind at 6 knots, visibility greater than 6 statute miles, light rain showers, scattered clouds at 1,500 feet agl, ceiling broken at 5,000 feet agl; temporary conditions¹¹ of visibility of 5 statute miles, light rain, mist, scattered clouds at 1,000 feet agl, ceiling broken at 1,500 feet agl.

KCHA 052009Z 0520/0618 VRB06KT P6SM -SHRA SCT015 BKN050
TEMPO 0520/0524 5SM -RA BR SCT010 BKN015
FM060000 00000KT P6SM VCSH BKN035
FM060500 00000KT 3SM BR OVC025
FM060900 00000KT 1/2SM FG OVC003
FM061300 24003KT P6SM OVC015=

9.0 Area Forecast Discussion

The NWS Weather Forecast Office in Morristown, Tennessee, issued the following Aviation section of an Area Forecast Discussion at 1557.

FXUS64 KMRX 051957

¹⁰ www.nws.noaa.gov/directives/sym/pd01008013curr.pdf

¹¹ Temporary conditions - fluctuations to forecast conditions which are expected to last less than one hour in each instance and, in the aggregate, to cover less than half of the indicated period.

*AFDMRX
Area Forecast Discussion
National Weather Service Morristown TN
357 PM EDT Mon Sep 5 2022*

*.AVIATION...
(18Z TAFS)
Issued at 134 PM EDT Mon Sep 5 2022*

MVFR CIGs and VIS most likely at all sites through at least the early evening. Maybe a really short IFR under a heavy shower. Showers will continue, but will decrease in coverage this evening. Brief period of VFR at TYS and CHA tonight before all sites will see decreasing CIGs and VSBY. All sites have a line for half a mile fog. Though the fog will burn off after sunrise, CIGs may only improve to MVFR.

10.0 SIGMETs

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

At 1555, the NWS Aviation Weather Center issued the following Convective SIGMET (#42E) that was active for the accident location and was valid until 1755 that advised of an area of thunderstorms.

*WSUS31 KKC1 051955
SIGE
-MKCE WST 051955

CONVECTIVE SIGMET 42E
VALID UNTIL 2155Z
NC SC GA TN AL MS
FROM 20NNW BNA-30NNW SPA-30ESE MGM-40NE MHZ-20NNW BNA
AREA TS MOV FROM 24010KT. TOPS ABV FL450.*

At 1655, the NWS Aviation Weather Center issued the following Convective SIGMET (#53E) that advised of an area of thunderstorms and superseded the Convective SIGMET #42E and was active for the accident location at the accident time.

*WSUS31 KKC1 052055
SIGE
-MKCE WST 052055

CONVECTIVE SIGMET 53E
VALID UNTIL 2255Z
VA NC SC GA TN KY AL MS
FROM 10NNE HNV-30SSE SPA-20S MGM-30SE SQS-30SW BWG-10NNE HNV
AREA TS MOV FROM 25010KT. TOPS ABV FL450.*

11.0 CWSU Products

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

12.0 Graphical Forecasts for Aviation

The Graphical Forecasts for Aviation (GFA) are intended to provide the necessary aviation weather information to give users a complete picture of the weather that might impact flight in the continental United States. Hourly model data and forecasts, including information on clouds, flight category, precipitation, icing, turbulence, wind, and other output from the NWS are available, however only certain imagery are archived by the NWS.

Figures 8 and 9 depict GFA forecast information on sky condition, icing, mountain obscuration, instrument flight rule (IFR)¹² condition and surface wind Graphical Airmen's Meteorological Information (G-AIRMET) advisories, surface visibility, surface wind, precipitation, and other obscurations and hazards, valid for a time near the accident time. The GFA forecast imagery (Figure 8) depicted scattered to overcast sky conditions near the accident site with a point to the southwest of the accident site identifying scattered clouds at 3,000 feet and an overcast ceiling at 10,000 feet with cloud tops to 14,000 feet. A G-AIRMET for mountain obscuration was active over the accident site. The GFA surface forecast (Figure 9) depicted a westerly surface wind of 5 knots near the accident location, a surface visibility of greater than 5 statute miles at the accident location and scattered to numerous thunderstorms with rain across the region.

¹² IFR conditions - Ceilings less than 1,000 feet agl and/or visibility less than three statute miles.

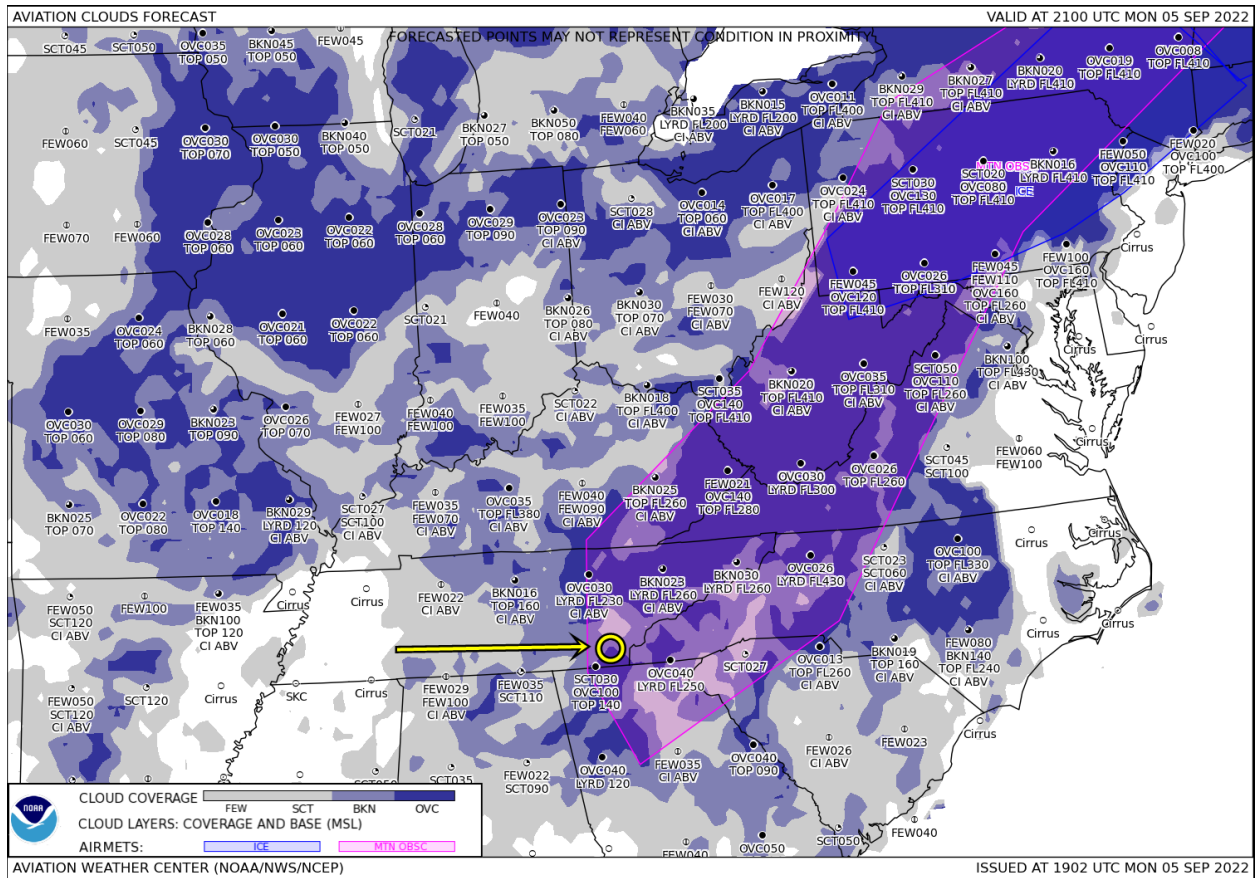


Figure 8 – GFA forecast imagery depicting sky condition and icing and mountain obscuration G-AIRMETs issued about 1500 and valid for 1700. The accident location is located within the yellow circle.

