



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

September 13, 2017

Group Chairman's Factual Report

METEOROLOGY

ERA17FA222

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A. ACCIDENT

Location: Chatsworth, Georgia
Date: July 1, 2017
Time: about 1644 eastern daylight time (2044 UTC)¹
Airplane: Piper PA-23; N44HJ

B. METEOROLOGY GROUP

Mike Richards
Group Chairman
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 and gathered all weather data remotely. Unless otherwise noted, all times are in eastern daylight time (EDT) for July 1, 2017 (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).

Coordinates used for the accident location: 34.705133° north latitude, 84.724783° west longitude, at an elevation of about 825 feet. Details of the accident aircraft's flight track, which were used for imagery in this report, are found in Attachment 1.

D. WEATHER INFORMATION

1.0 Synoptic Conditions

A section of the National Weather Service (NWS) Surface Analysis Chart for 1700 EDT is presented in figure 1. The chart depicted a cold front stretching southwestward from Ohio into Arkansas. A low pressure system at 1011-hectopascals (hPa) was located over Virginia with a trough of low pressure extending northeast, as well as southwest from the low into western North Carolina. Further southwest of the trough was an outflow boundary² extending from western North Carolina into northern Georgia. Another outflow boundaries was identified over Alabama. The accident site was located near one of the outflow boundaries. The station models over northern

¹ UTC – abbreviation for Coordinated Universal Time

² An outflow boundary is a storm-scale or mesoscale boundary separating thunderstorm-cooled air or the outflow from the surrounding air; similar to a cold front with passage marked by a wind shift and usually a drop in temperature. Outflow boundaries may persist for 24 hours or more after the thunderstorms that generated them dissipate, and may travel hundreds of miles from their origin.

Georgia indicated southwesterly winds, with maximum temperatures of 90's degrees Fahrenheit (°F), and maximum dew point temperatures of 76° F.

A WSR-88D regional composite reflectivity radar mosaic obtained from the National Centers for Environmental Information (NCEI) for 1645 EDT (figure 2) identified a large area of light to extreme values of reflectivity coincident with or adjacent to the accident location.

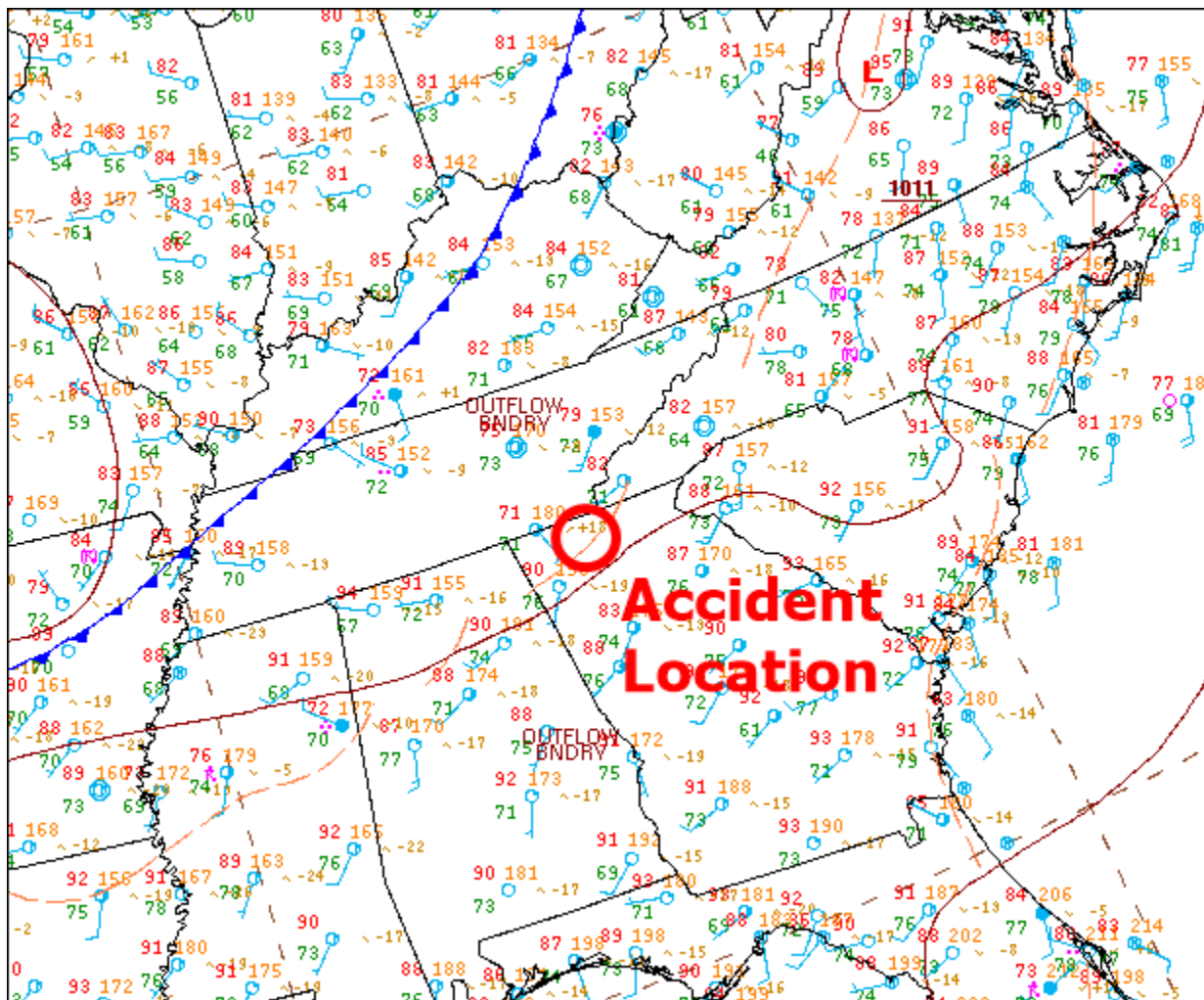


Figure 1 - NWS Surface Analysis Chart for 1700 EDT.

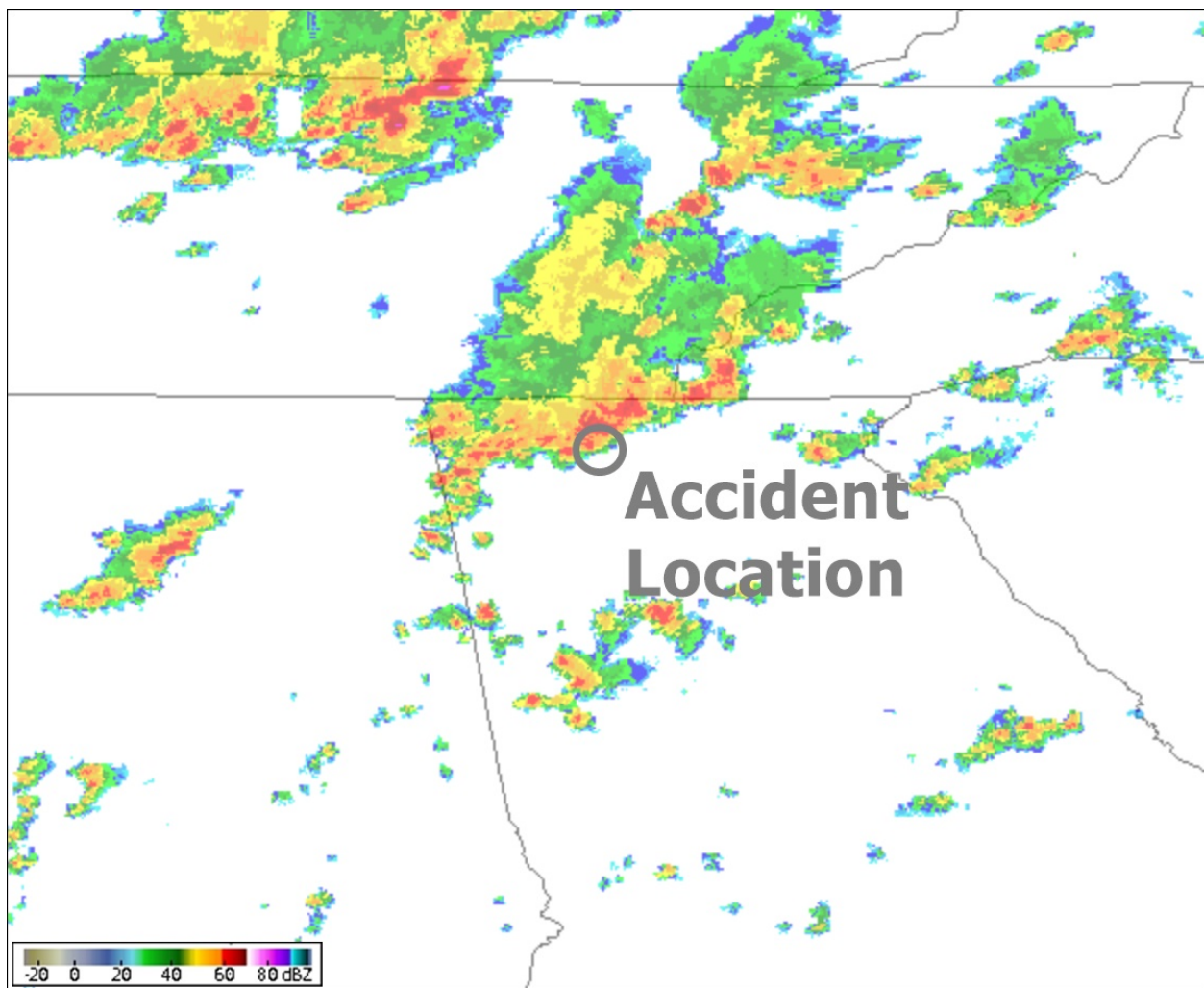


Figure 2 – NCEI WSR-88D mosaic from 1645 EDT.

2.0 Weather Radar

WSR-88D Level-II weather radar imagery from Huntsville, Alabama (KHTX), are presented in figures 3-6, with the accident aircraft's flight track overlaid. KHTX was located approximately 68 miles east of the accident site at an elevation of 1,760 feet. Assuming standard refraction and considering the 0.95° beam width for the WSR-88D radar beam, the KHTX 0.48° tilt would have "seen" altitudes above the accident location of between about 6,900 and 11,700 feet msl.

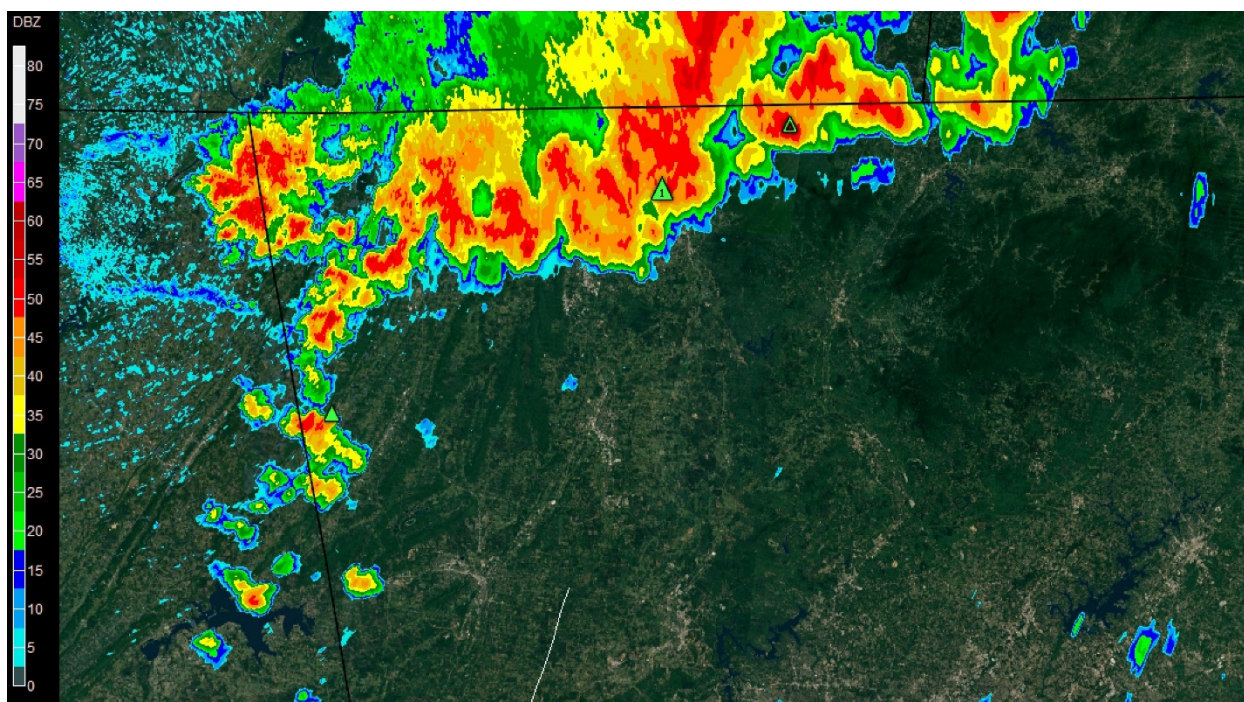


Figure 3 – KHTX 0.48° Level-II reflectivity product from a sweep initiated at 1629 EDT. Accident flight path at 1629 EDT denoted by white line. Green triangles identify regions of hail.

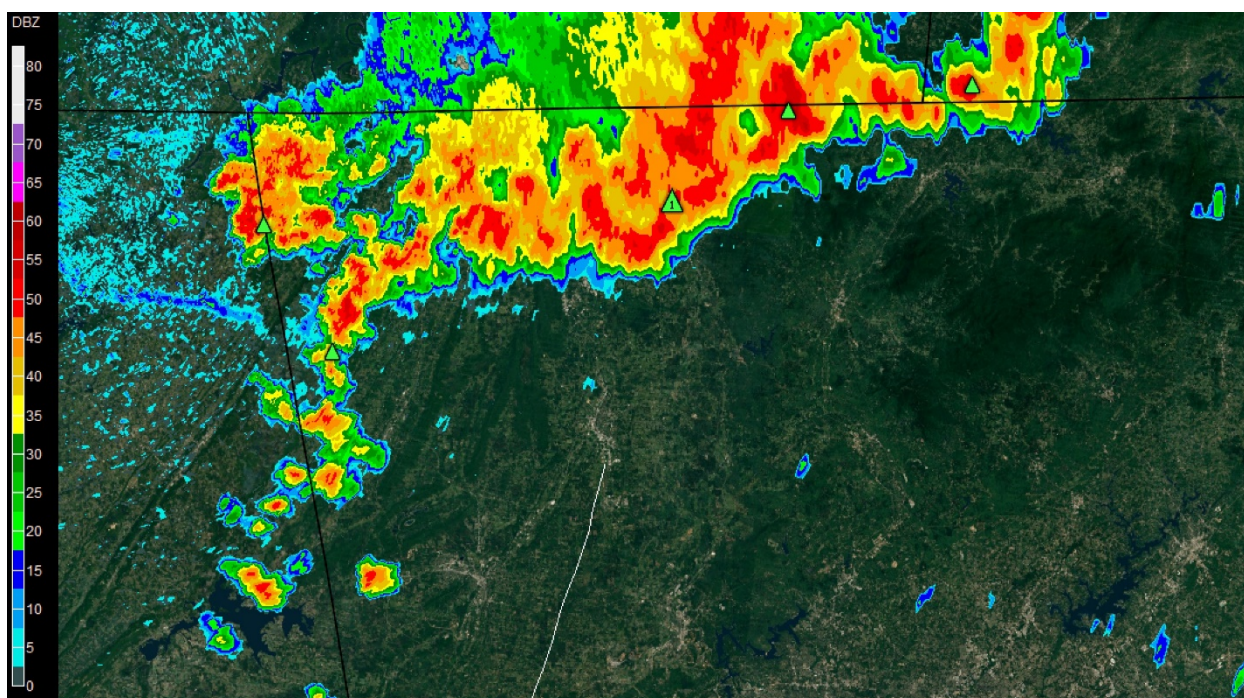


Figure 4 – KHTX 0.48° Level-II reflectivity product from a sweep initiated at 1634 EDT. Accident flight path at 1634 EDT denoted by white line. Green triangles identify regions of hail.

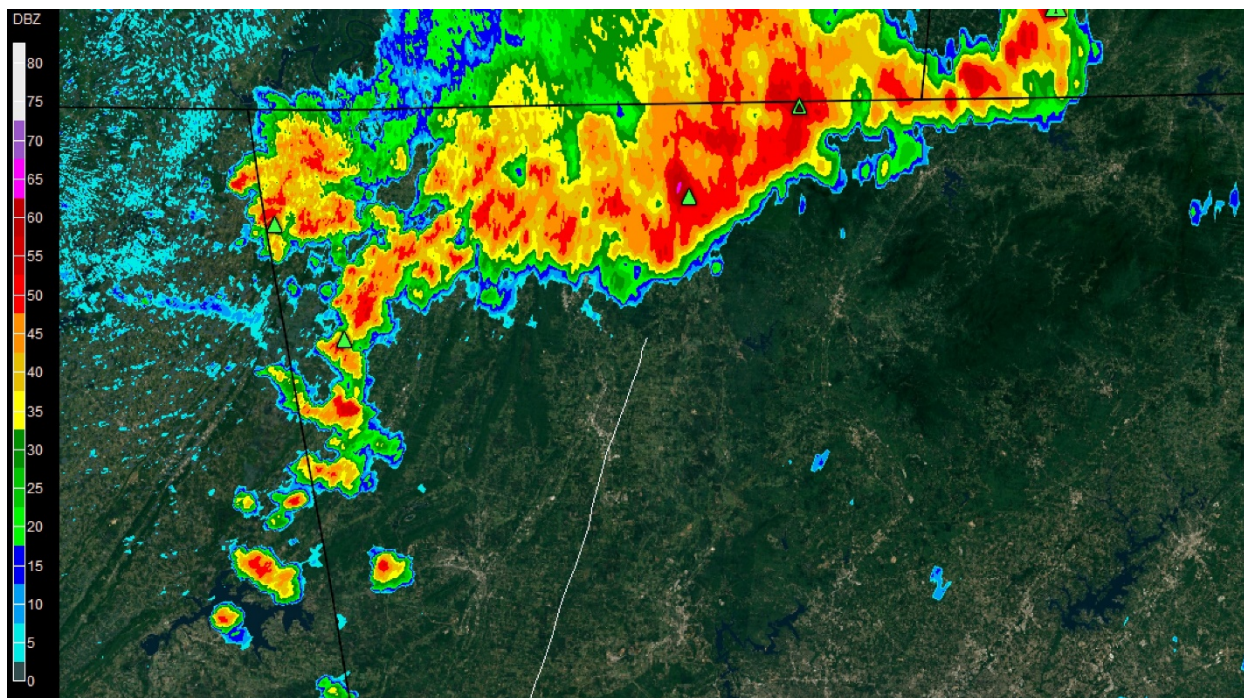


Figure 5 – KHTX 0.48° Level-II reflectivity product from a sweep initiated at 1638 EDT. Accident flight path at 1638 EDT denoted by white line. Green triangles identify regions of hail.

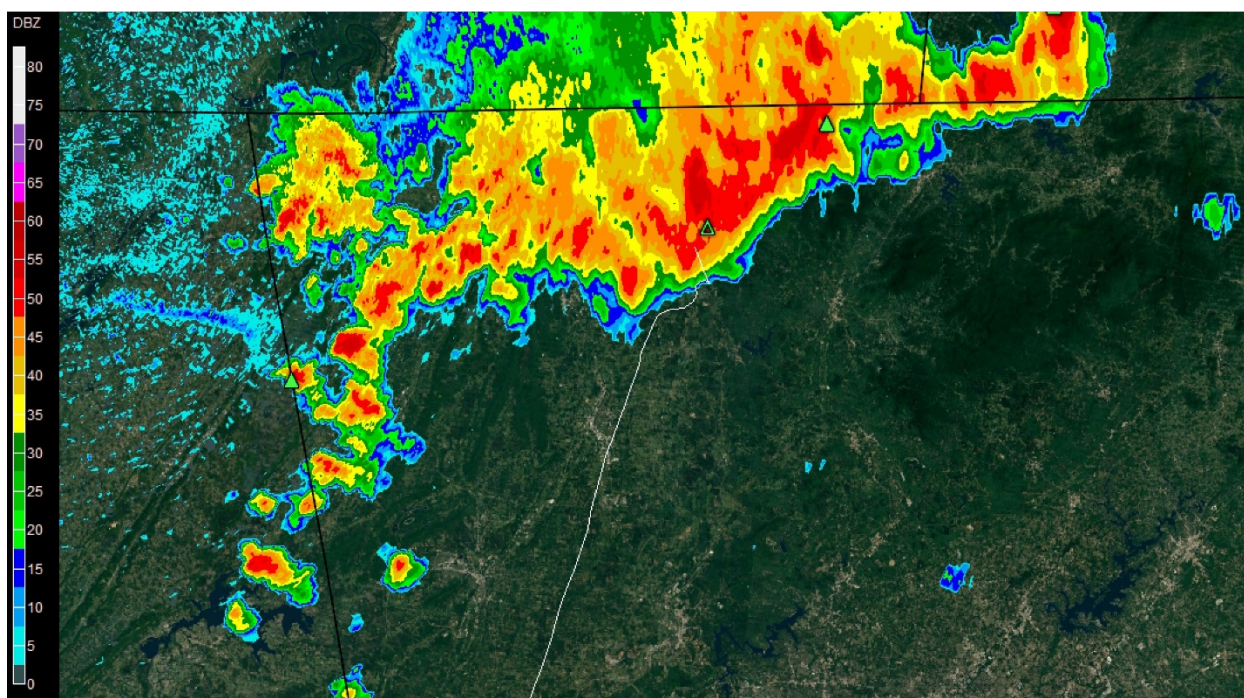


Figure 6 – KHTX 0.48° Level-II reflectivity product from a sweep initiated at 1642 EDT. Accident flight path through the accident time denoted by white line. Green triangles identify regions of hail.

3.0 Lightning

Archive total lightning data was obtained from the Earth Networks Total Lightning Network (ENTLN). Figure 7 presents total lightning registered by the ENTLN in the accident region between 1630 and 1645 EDT (inclusive).

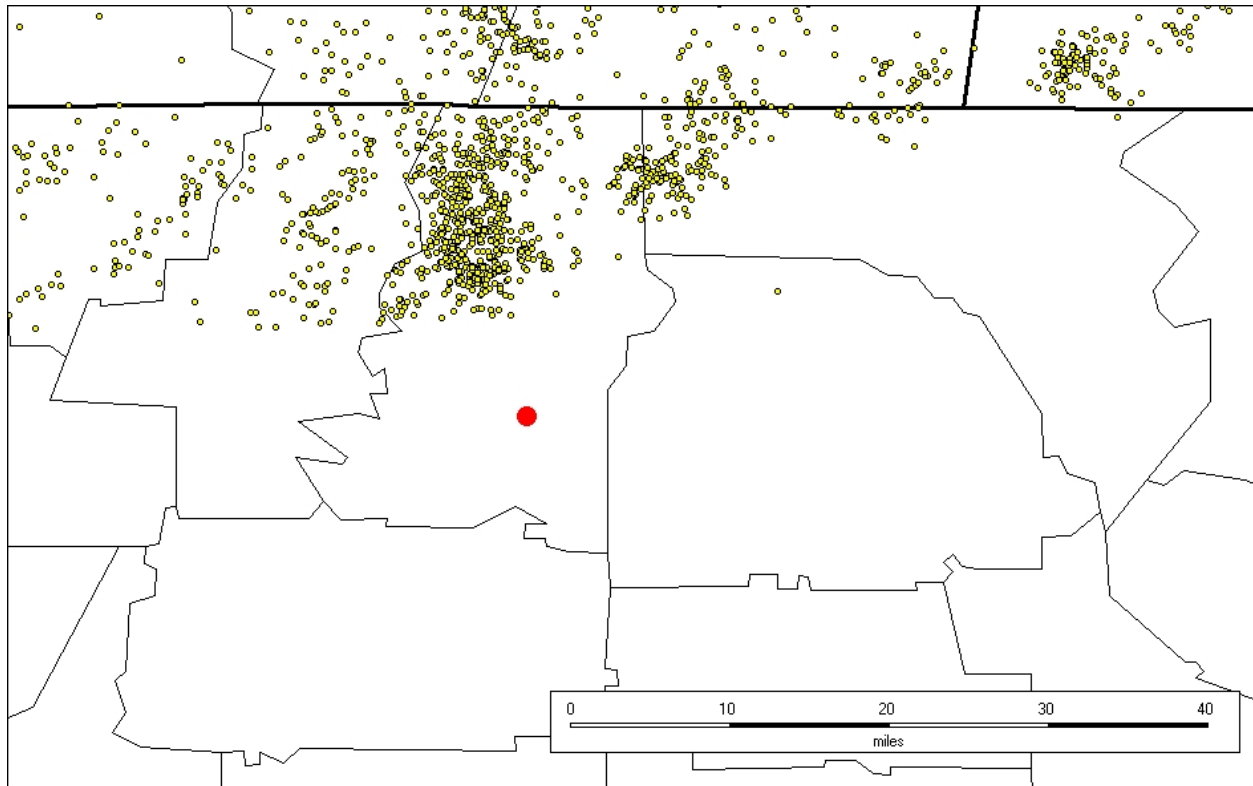


Figure 7 – Total lightning from the ENTLN between 1630 and 1645 EDT (inclusive). Red dot denotes the accident location.

4.0 CIWS

Archive data from the Federal Aviation Administration’s Corridor Integrated Weather System (CIWS) for the accident region at 1645 EDT is presented in figure 8. This CIWS image presents precipitation levels (0-6), echo top heights and cloud-to-ground lightning flash detections from the National Lightning Detection Network for the previous 6 minutes (1639-1644 EDT).

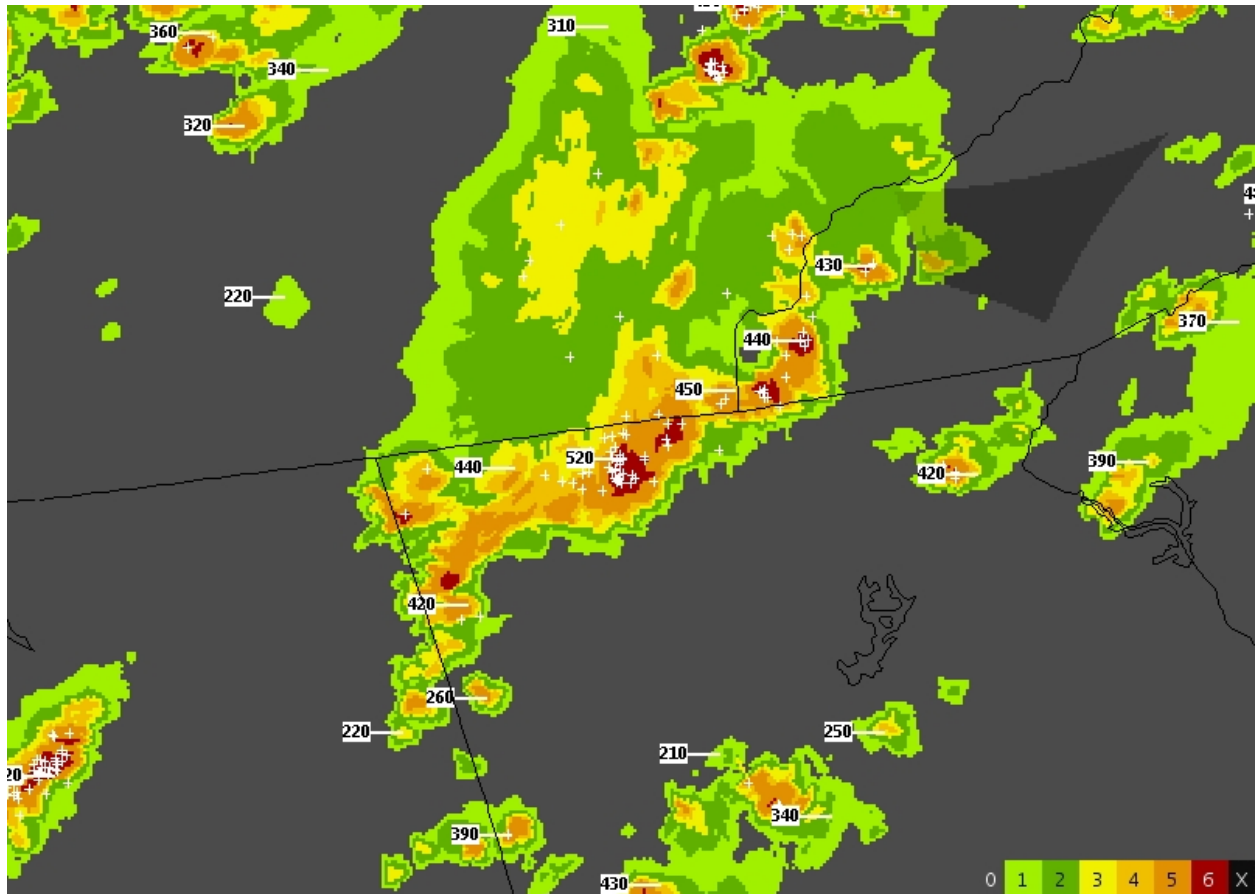


Figure 8 – Archive CIWS display from 1645 EDT. White “+” symbols denote lightning activity. Numbers indicate echo top heights (hundreds of feet).

5.0 Upper Air Data

A High-Resolution Rapid Refresh (HRRR) model³ sounding (figure 9) for the accident location at 1600 EDT was retrieved from the National Oceanic and Atmospheric Administration's (NOAA) Air Resources Laboratory. Near the surface, the wind was from the south at 8 knots. Above this level the wind veered with height and increased in magnitude to a southwest wind of about 20 knots near 5,000 feet, and a west wind of about 10 knots near 10,000 feet. Above 10,000 feet, the wind remained generally westerly and with magnitudes between approximately 25 and 35 knots through 30,000 feet. Calculations made by the Rawinsonde OBServation Program did not yield any significant areas of non-convective turbulence for this atmosphere. The freezing level was at about 15,000 feet.

The most-unstable Convective Available Potential Energy (CAPE)⁴ parameter was 2,838 Joules/kilogram (from 979 hPa). The Lifting Condensation Level⁵ (LCL) and Level of Free Convection⁶ (LFC) were calculated to be 2,233 feet. Maximum vertical velocity (MVV) for this atmosphere was calculated as 75 meters/second (about 14,764 feet per minute).⁷ Downdraft CAPE (DCAPE; 6 kilometers agl)⁸ was measured at 681 Joules/kilogram.

³ 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.

⁴ Convective Available Potential Energy - A measure of the amount of energy available for convection. CAPE is directly related to the maximum potential vertical speed within an updraft; thus, higher values indicate greater potential for severe weather. A CAPE of 2,838 Joules/kilogram would be considered a strong value.

⁵ Lifting Condensation Level - The level at which a parcel of moist air lifted dry-adiabatically would become saturated.

⁶ Level of Free Convection - The level at which a parcel of air lifted dry-adiabatically until saturated and saturation-adiabatically thereafter would first become warmer than its surroundings in a conditionally unstable atmosphere. On a thermodynamic diagram the level of free convection is given by the point of intersection of the process curve, representing the process followed by the ascending parcel, and the sounding curve, representing the lapse rate of temperature in the environment.

⁷ 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.

⁸ The DCAPE can be used to estimate the potential strength of rain-cooled downdrafts within thunderstorm convection, and is similar to CAPE. Larger DCAPE values are associated with stronger downdrafts. 681 Joules/kilogram would be considered a moderate value.

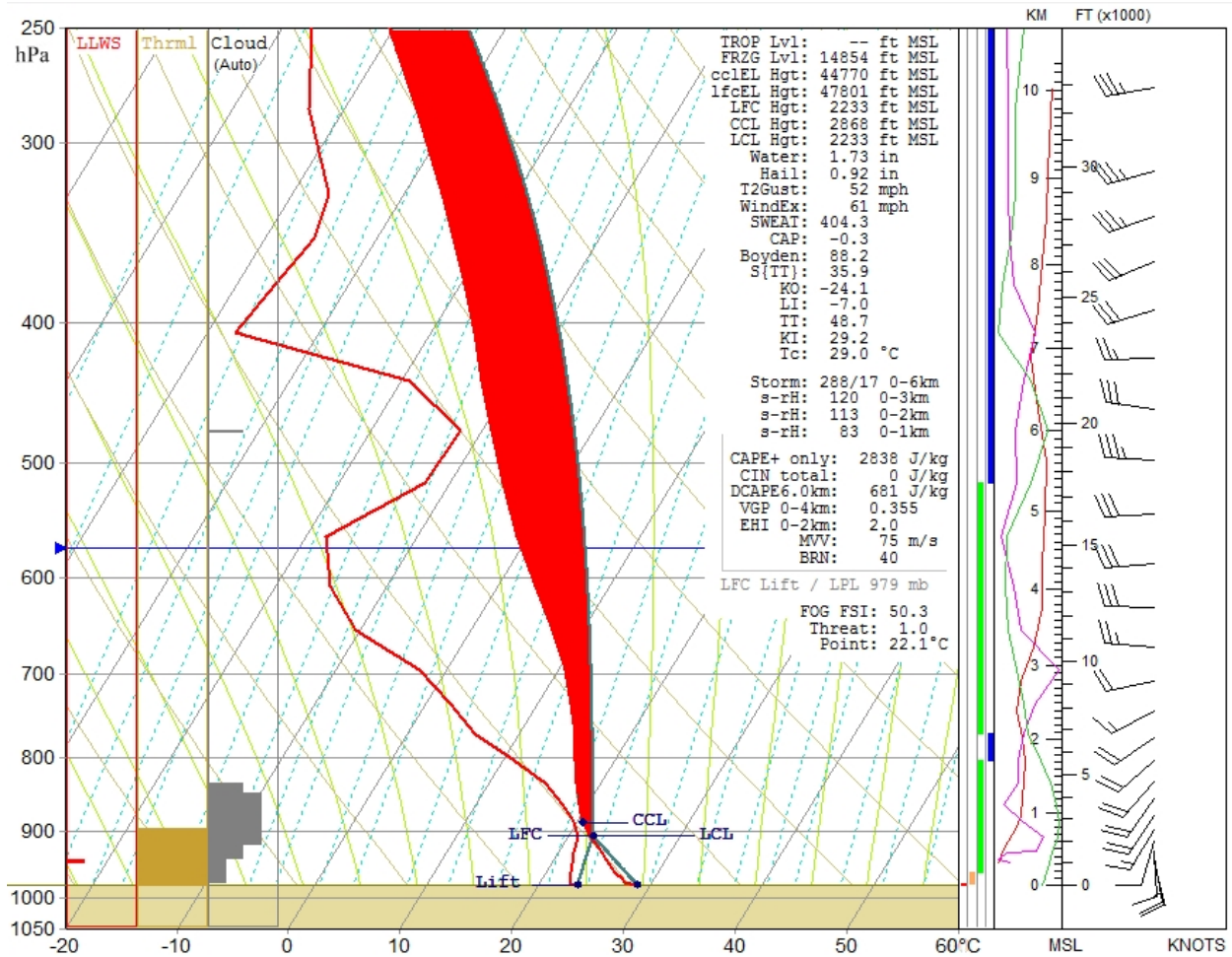


Figure 9 – HRRR model sounding data in SkewT/LogP format for 1600 EDT at the accident site, surface to 250 hPa.

6.0 Satellite Imagery

Geostationary Operational Environmental Satellite (GOES)-13 visible ($0.63\mu\text{m}$) and infrared ($10.7\mu\text{m}$) data were obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison. Imagery from 1645 EDT is presented in figures 10 and 11. The figures depict the accident site on the southern edge of a large cumulonimbus cloud system. There was a steep infrared cloud-top temperature gradient around the accident location, with a minimum cloud top temperature (to the north of the accident location) of -67°C . When considering the HRRR model sounding, -67°C corresponded to a cloud top height of about 47,000 feet (not plotted in figure 11). It should be noted that these figures have not been corrected for any parallax error.

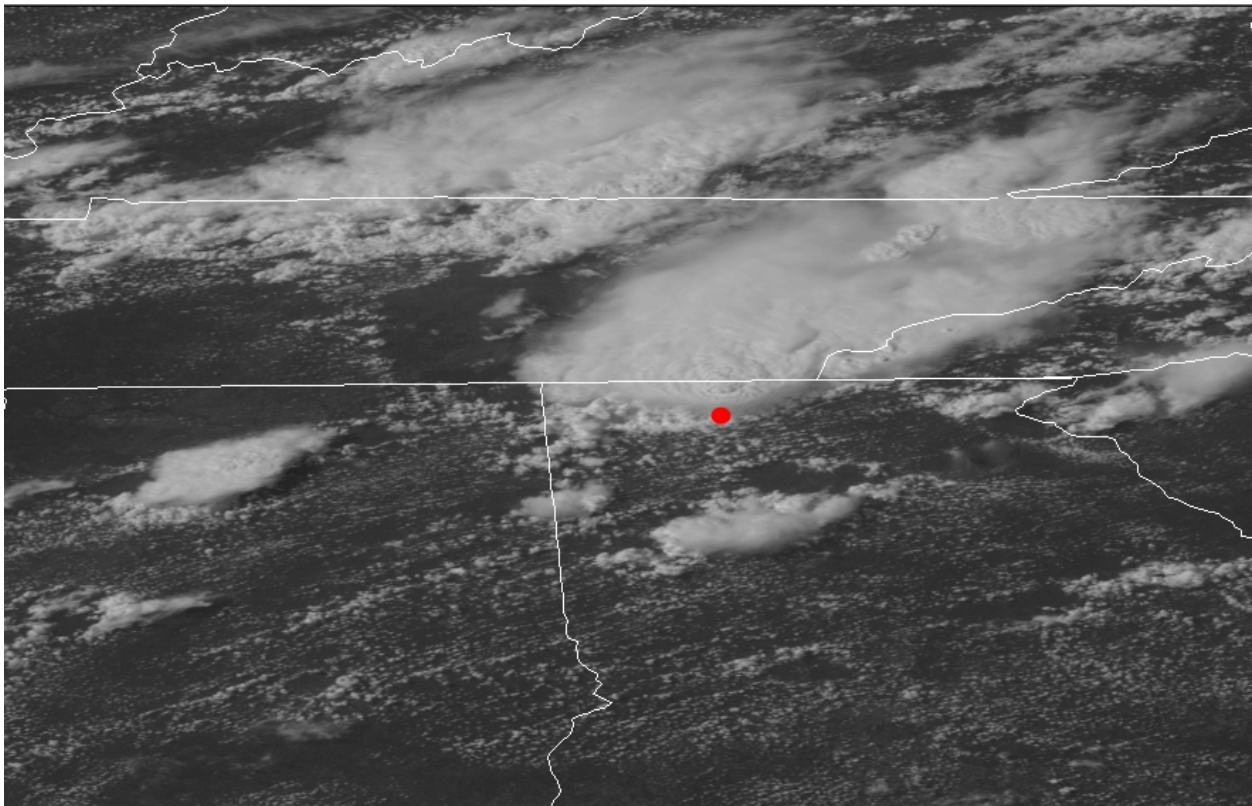


Figure 10 – GOES-13 visible imagery from 1645 EDT. Accident location denoted by red dot.

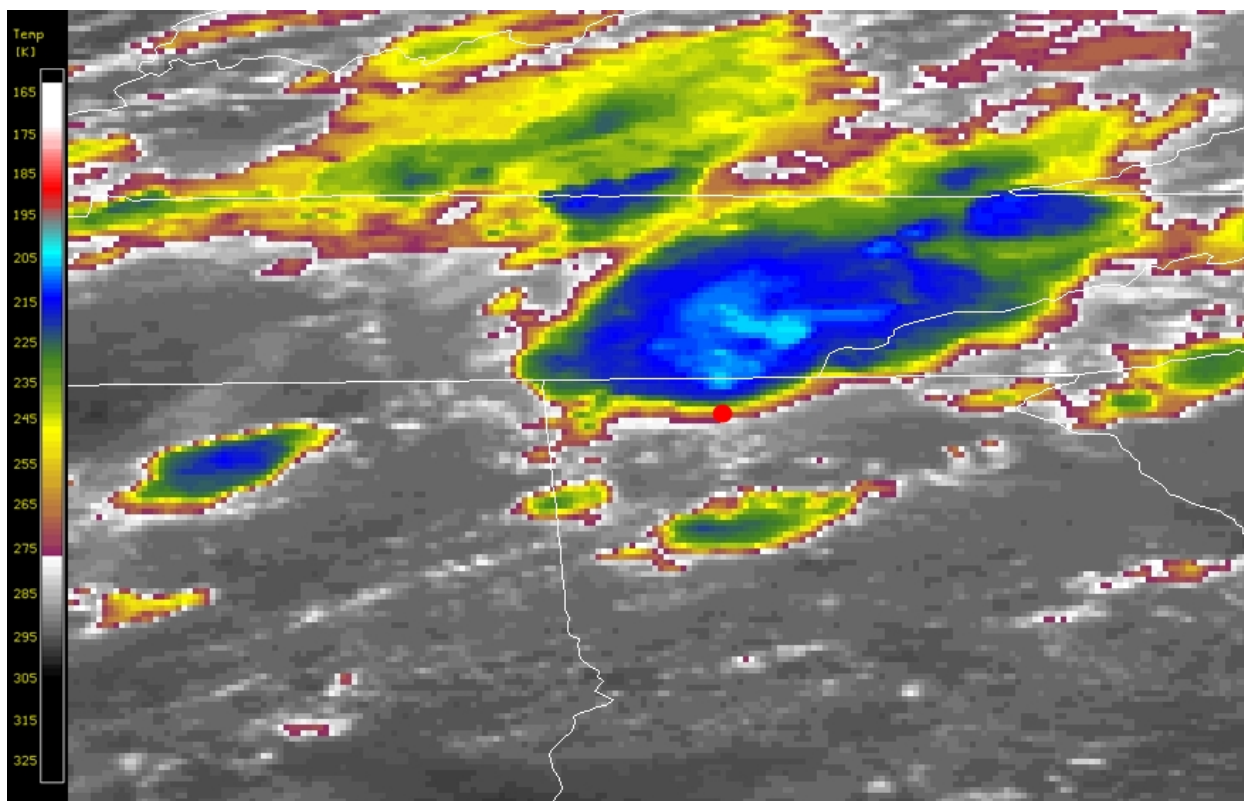


Figure 11 – GOES-13 infrared imagery from 1645 EDT. Accident location denoted by red dot.

7.0 Surface Observations

An Automated Weather Observing System (AWOS) was located at Dalton Municipal Airport (DNN)⁹ in Dalton, Georgia, which was located about 7 miles west of the accident location at an elevation of 708 feet. Automated reports from DNN during the times surrounding the accident time are presented here:

[1555 EDT] METAR KDNN 011955Z AUTO 20005KT 10SM SCT031 SCT041 30/23
A3005 RMK AO2 LTG DSNT NW THRU NE=

[1615 EDT] METAR KDNN 012015Z AUTO 17007KT 10SM VCTS SCT033 SCT041
30/23 A3004 RMK AO2 LTG DSNT N AND NW=

[1635 EDT] METAR KDNN 012035Z AUTO 35019G35KT 4SM +VCTSRA SCT010
SCT030 BKN036 26/22 A3009 RMK AO2 LTG DSNT W THRU NE=

⁹ The National Weather Service (NWS) uses the 4-digit International Civil Aviation Organization (ICAO) format for station identifiers (as seen in the body of some formatted weather observations). This report uses the 3-digit International Air Transport Association format for station identification, which does not use the geographic designating digit (“K” for stations in the continental U.S. and “P” for U.S. stations in Alaska and the Pacific region) as found in the ICAO format.

**[1655 EDT] METAR KDNN 012055Z AUTO 02008G18KT 346V056 2SM +VCTSRA
SCT009 BKN014 OVC023 20/20 A3011 RMK AO2 LTG DSNT W
THRU E=**

**[1715 EDT] METAR KDNN 012115Z AUTO 04008G14KT 3SM +VCTSRA BKN013
20/20 A3010 RMK AO2 LTG DSNT ALQS=**

At 1635 EDT, DNN reported a wind from 350° at 19 knots with gusts to 35 knots, visibility of 4 statute miles, heavy rain at the airport and a thunderstorm between 5 and 10 miles from the airport, scattered clouds at 1,000 feet above ground level (agl), scattered clouds at 3,000 feet agl, ceiling broken at 3,600 feet agl, temperature of 26°C and a dew point temperature of 22°C, altimeter setting of 30.09 inches of mercury; remarks: station with a precipitation discriminator, lightning more than 10 miles away to the west through northeast.

At 1655 EDT, DNN reported a wind from 020° at 8 knots with gusts to 18 knots, wind direction variable between 346° and 056°, visibility of 2 statute miles, heavy rain at the airport and a thunderstorm between 5 and 10 miles from the airport, scattered clouds at 900 feet agl, ceiling broken at 1,400 feet agl, overcast cloud base at 2,300 feet agl, temperature of 20°C and a dew point temperature of 20°C, altimeter setting of 30.11 inches of mercury; remarks: station with a precipitation discriminator, lightning more than 10 miles away to the west through east.

8.0 SIGMETs

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

At 1555 EDT, the Aviation Weather Center (AWC) in Kansas City, Missouri, issued the following Convective SIGMETs applicable to Georgia, which were valid for two hours (see figure 12).

WSUS31 KNCI 011955

SIGE

_MKCE WST 011955

CONVECTIVE SIGMET 60E

VALID UNTIL 2155Z

VA NC GA TN KY IN AL

FROM 20NE PXV-20SSW HNV-40SSW GQO-50ENE DYR-20NE PXV

AREA SEV TS MOV FROM 27025KT. TOPS ABV FL450.

HAIL TO 1 IN...WIND GUSTS TO 50KT POSS.

CONVECTIVE SIGMET 61E

VALID UNTIL 2155Z

VA NC SC GA

FROM 30E LYH-20SW GSO-30NNE LGC

LINE SEV TS 30 NM WIDE MOV FROM 26025KT. TOPS ABV FL450.

HAIL TO 1 IN...WIND GUSTS TO 50KT POSS.

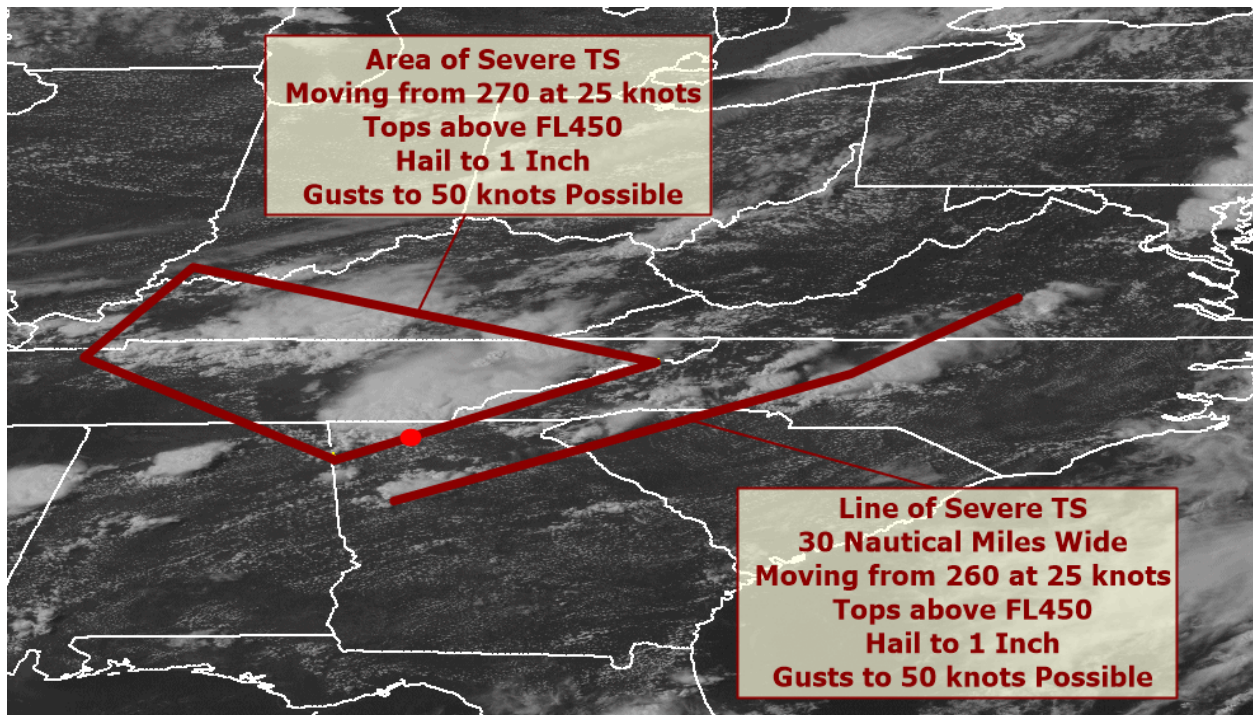


Figure 12 – Boundaries of convective SIGMETs 60E and 61E issued at 1555 EDT. Red dot denotes accident location.

One hour earlier at 1455 EDT, the AWC issued the following convective SIGMET, which was valid for two hours (see figure 13).

WSUS31 KKCI 011855
 SIGE
 _MKCE WST 011855
 CONVECTIVE SIGMET 54E
 VALID UNTIL 2055Z
 VA NC GA TN KY AL IL
 FROM 70NNE DYR-50WNW HMY-30SE GQO-50E MSL-70NNE DYR
 AREA SEV TS MOV FROM 27025KT. TOPS ABV FL450.
 HAIL TO 1 IN...WIND GUSTS TO 50KT POSS.

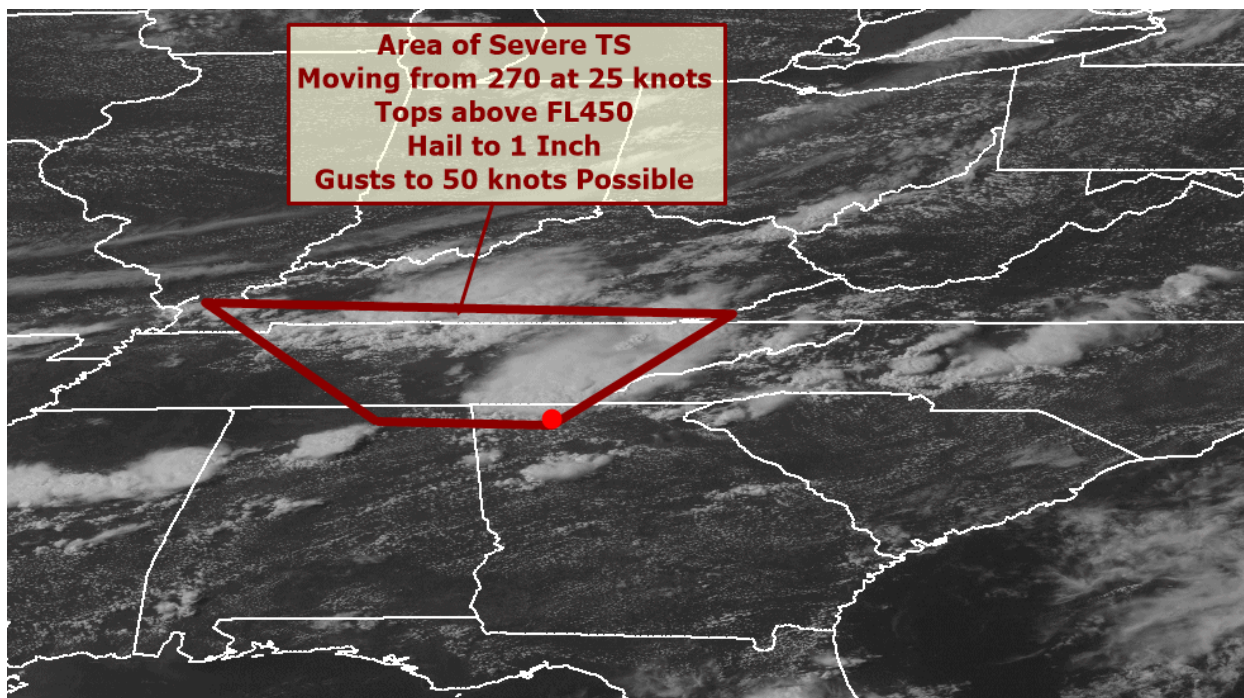


Figure 13 – Boundaries of convective SIGMETs 54E issued at 1455 EDT. Red dot denotes accident location.

9.0 Center Weather Service Unit Products

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

10.0 AIRMETs

There was an Airmen's Meteorological Information (AIRMET) advisory for mountain obscuration active for the accident location at the accident time.

11.0 Area Forecast

An Area Forecast that included the state of Georgia was issued at 1345 EDT by the AWC. Cloud heights are above msl. The portion of the Area Forecast directed toward Georgia forecasted for the accident time: scattered clouds at 3,500 feet, scattered clouds at 5,000 feet, isolated rain showers and thunderstorms with moderate rain, possibly severe storms, cumulonimbus clouds with tops to FL450¹⁰.

¹⁰ Flight Level (FL) - a standard nominal altitude of an aircraft, in hundreds of feet. This altitude is calculated from the International standard pressure datum of 1013.25 hPa (29.92 in Hg), the average sea-level pressure, and therefore is not necessarily the same as the aircraft's true altitude either above msl or agl.

FAUS42 KKCI 011745

FA2W

-MIAC FA 011745

SYNOPSIS AND VFR CLDS/WX

SYNOPSIS VALID UNTIL 021200

CLDS/WX VALID UNTIL 020600...OTLK VALID 020600-021200

NC SC GA FL AND CSTL WTRS E OF 85W

.

SEE AIRMET SIERRA FOR IFR CONDS AND MTN OBSCN.

TS IMPLY SEV OR GTR TURB SEV ICE LLWS AND IFR CONDS.

NON MSL HGTS DENOTED BY AGL OR CIG.

.

SYNOPSIS...SEVERAL MID/UPR LVL IMPULSES WILL CONT ACRS THE DEEP S THRU OTLK. OTRW..UPR LVL TROF ERN GREAT LAKES-OH VLY-CNTRL MID S WILL CONT NEWD THRU PD AND APCH NE US-NEW ENGLAND 04-06Z AND CONT NE THRU OTLK. WRM MOIST AMS THRUT. WK ANTICYCLONIC FLOW THRUT. TROF LEE APPALACHIANS THRU CNTRL FL THRU OTLK. OTRW..CDFNT WRN OH-WRN MID S WILL APCH CNTRL ME-ERN NEW ENGLAND-E CNTRL US CSTL WTRS-SE VA-NRN NC 09-12Z.

.

GA

SCT035 SCT050. ISOL SHRA/TSRA POSS SEV. CB TOP FL450. BECMG 2122 SCT-BKN045 TOPS 080. WDLY SCT SHRA/TSRA POSS SEV. 05Z SCT025 SCT040. ISOL -SHRA/-TSRA. OTLK...VFR.

12.0 Area Forecast Discussion

An Area Forecast Discussion (AFD) was issued at 1454 EDT by the NWS Weather Forecast Office in Peachtree City, Georgia. The "short term" and aviation portions of the AFD are presented here.

FXUS62 KFFC 011854

AFDFFC

Area Forecast Discussion

National Weather Service Peachtree City GA

254 PM EDT Sat Jul 1 2017

.SHORT TERM /Tonight through Sunday Night/...

Convection has initiated across north and central Georgia this afternoon, and main concern continues to be potential for strong, damaging storms and heavy rain, generally in northwest Georgia through late evening.

Hi-Res models still showing MCV will tap into destabilized, tropical air mass to promote storm development over the Tennessee Valley. Clusters of these storms are expected to move into northwest Georgia with the potential to produce very heavy rainfall and damaging winds. Already seeing some of this development between Nashville and Chattanooga, and have kept likely pops across northwest Georgia region through the

afternoon. SPC has portions of north Georgia outlooked in a Slight Risk for severe storms. A Flash Flood Watch remains in effect through 10 PM due to the current wet soil conditions and the potential for storms to dump 1-2 inches of rainfall in a short period. The 3-hr FFG values continue to range in the 1.5-2 inch range for northwest Georgia, which could easily be achieved with slow moving or training storms, particularly in this tropical environment. PW on the morning sounding was 1.5 inches, but expect PWs to increase and approach 2 inches by this evening. Have continued with a slightly higher QPF than WPC's latest forecast for the 18-00z and 00-06z period.

Broad upper trough axis remains over the eastern U.S. through the short term, and with a moisture-rich atmosphere fueled by flow around the surface high, expect slightly above normal diurnal precip chances into early week. Temperatures will remain warm, with highs in the upper 80s to low 90s. The combination of high relative humidity and warm temperatures will produce heat index values of 100-103 degrees in portions of central Georgia. Those out enjoying the holiday weekend should stay hydrated and take breaks from the outdoors in cool or shady spaces.

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.AVIATION...

18Z Update...

MVFR to VFR cigs remain over the area, and just now starting to see shower development over the area. Expect best -TSRA potential to be 21-01z, and have generally gone VCSH with TEMPO -TSRA. Winds should be west at 9kt or less through the period. Clearing skies overnight could result in patchy fog, particularly over north Georgia. PROB30 in again tomorrow from 19-23 for KATL.

//ATL Confidence...18Z Update...

Medium confidence on timing of TEMPO.

High confidence on all other elements.

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13.0 Preflight Weather Briefing

Contents of a "Route Outlook Briefing" provided to the accident aircraft at 2033 EDT the day before the accident was provided to the NTSB by Leidos Flight Service and is contained in Attachment 2.

14.0 Astronomical Data

The astronomical data obtained from the United States Naval Observatory for 34° 42' north latitude and 84° 43' west longitude, indicated the following:

SUN

Sunrise	0630 EDT
Sunset	2056 EDT

MOON

Moonrise	1423 EDT
Moonset	0219 EDT (on July 2, 2017)

E. LIST OF ATTACHMENTS

Attachment 1 - Details of the accident aircraft's flight track.

Attachment 2 - Contents of a Route Outlook Briefing provided to the accident aircraft at 2033 EDT the day before the accident.

Submitted by:

Mike Richards
Senior Meteorologist

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