



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

January 29, 2019

Weather Study

METEOROLOGY

ERA18FA197

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A. ACCIDENT

Location: Near Lincolnton, North Carolina
Date: July 24, 2018
Time: 0520 eastern daylight time
0920 Coordinated Universal Time (UTC)
Aircraft: Piper PA-32R-300, Registration: N38523

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 daylight time (EDT) on July 24, 2018, and are based upon the 24-hour clock, where local time is -4 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 final wreckage location was estimated to be at latitude 35.4847° N, longitude 81.1658° W, at an approximate elevation of 875 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 mid-Atlantic section of the NWS Surface Analysis Chart for 0500 EDT is provided as figure 1 with the approximate location of the accident site marked with the red circle. The chart indicated a stationary frontal boundary was located across northeastern South Carolina and stretched southwestward into southern Georgia.

The station models around the accident site depicted air temperatures in the low 70's degrees Fahrenheit (°F), dew point temperatures around 70 °F with temperature-dew point spreads of 1° F or less, a north-northeast wind of 5 knots or less, overcast sky cover, and mist.

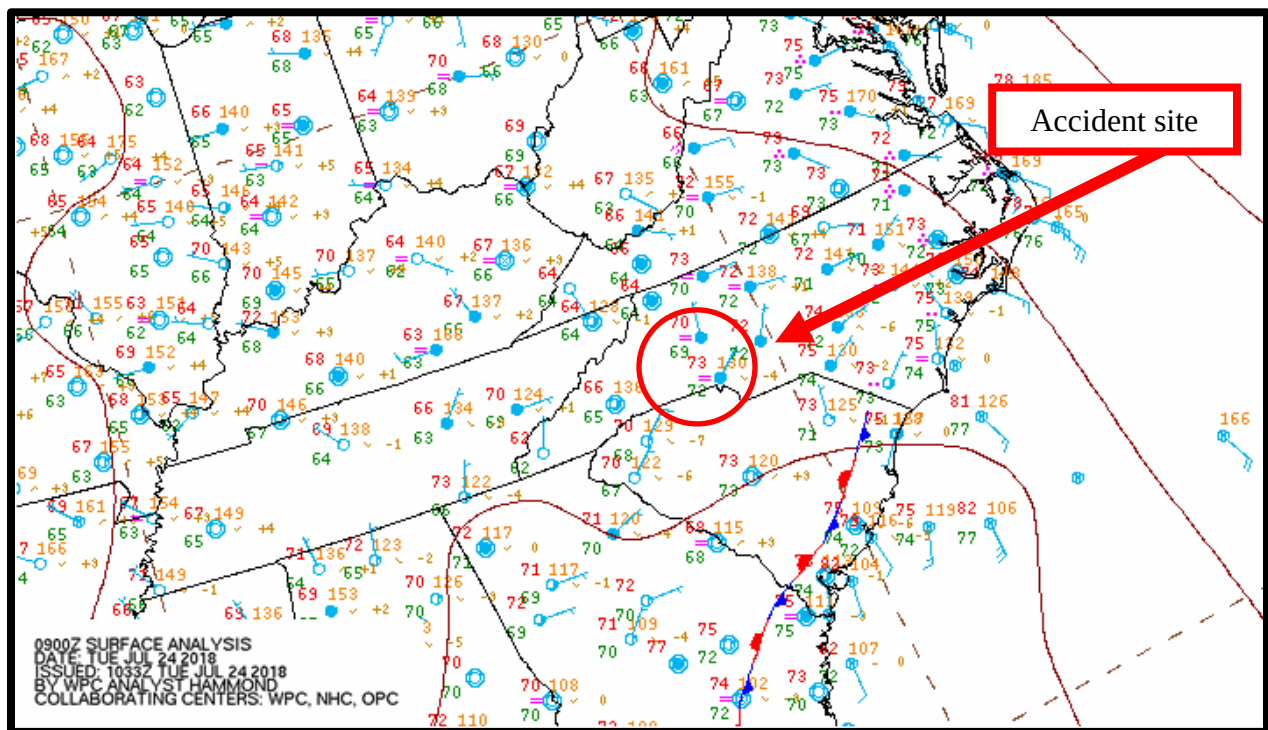


Figure 1 – NWS Surface Analysis Chart for 0500 EDT

1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 0800 EDT at 925-, 850-, 700-, 500-, and 300-hectopascals (hPa) are presented in figures 2 through 6. There was a low-level trough² located over the accident site (figure 3) at 850-hPa. There was a mid-level trough located over the accident at 700- and 500-hPa (figures 4 and 5) with an upper level trough located just west of the accident site (figure 6). Troughs can act as lifting mechanisms to help produce clouds and precipitation if sufficient moisture is present. The wind was relatively light and variable from 925-hPa through 700-hPa at or below 10 knots. By 500-hPa the wind increased to 30 knots and became southerly. At 300-hPa, the wind was from the southeast between 40 and 50 knots (figure 6).

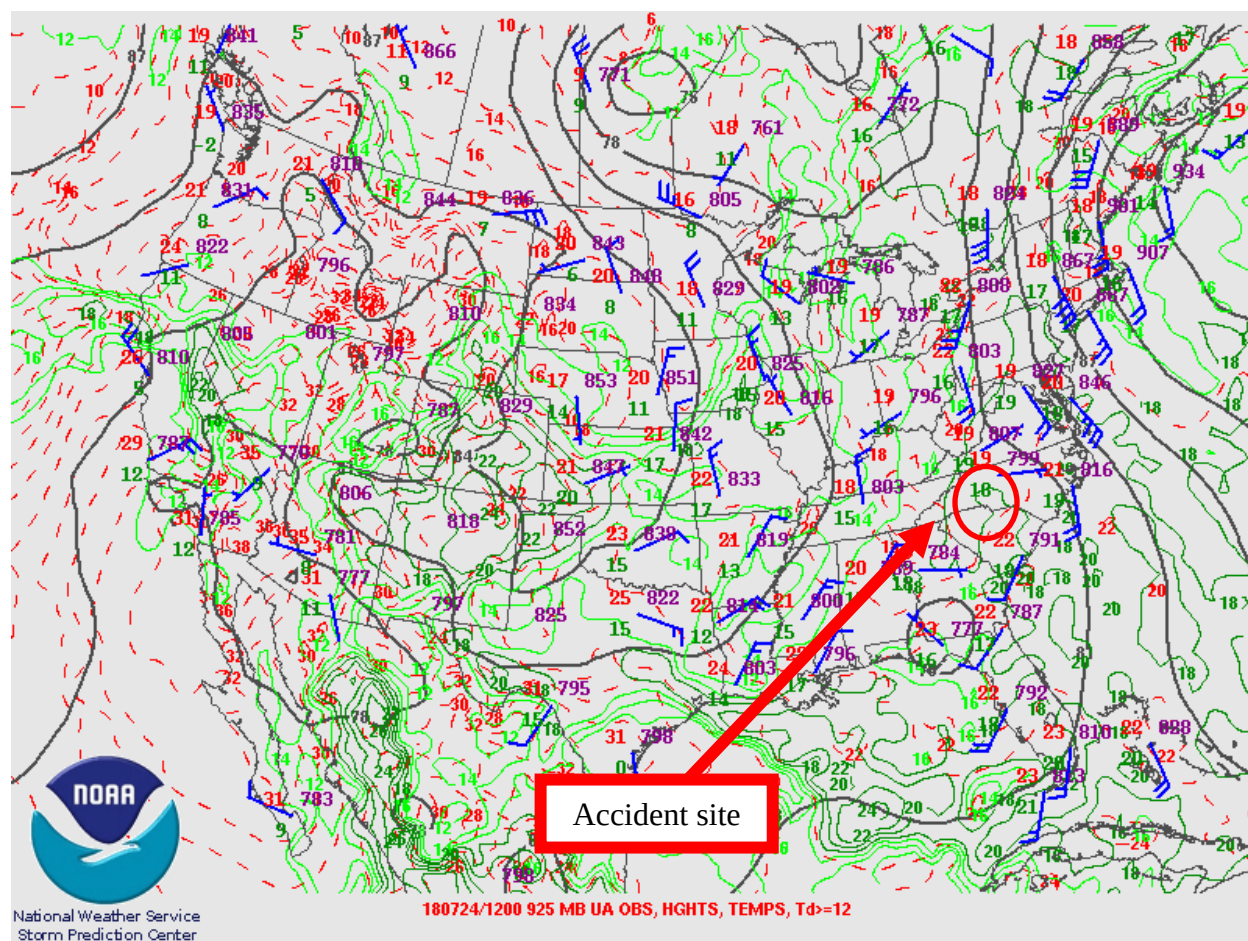


Figure 2 – 925-hPa Constant Pressure Chart for 0800 EDT

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

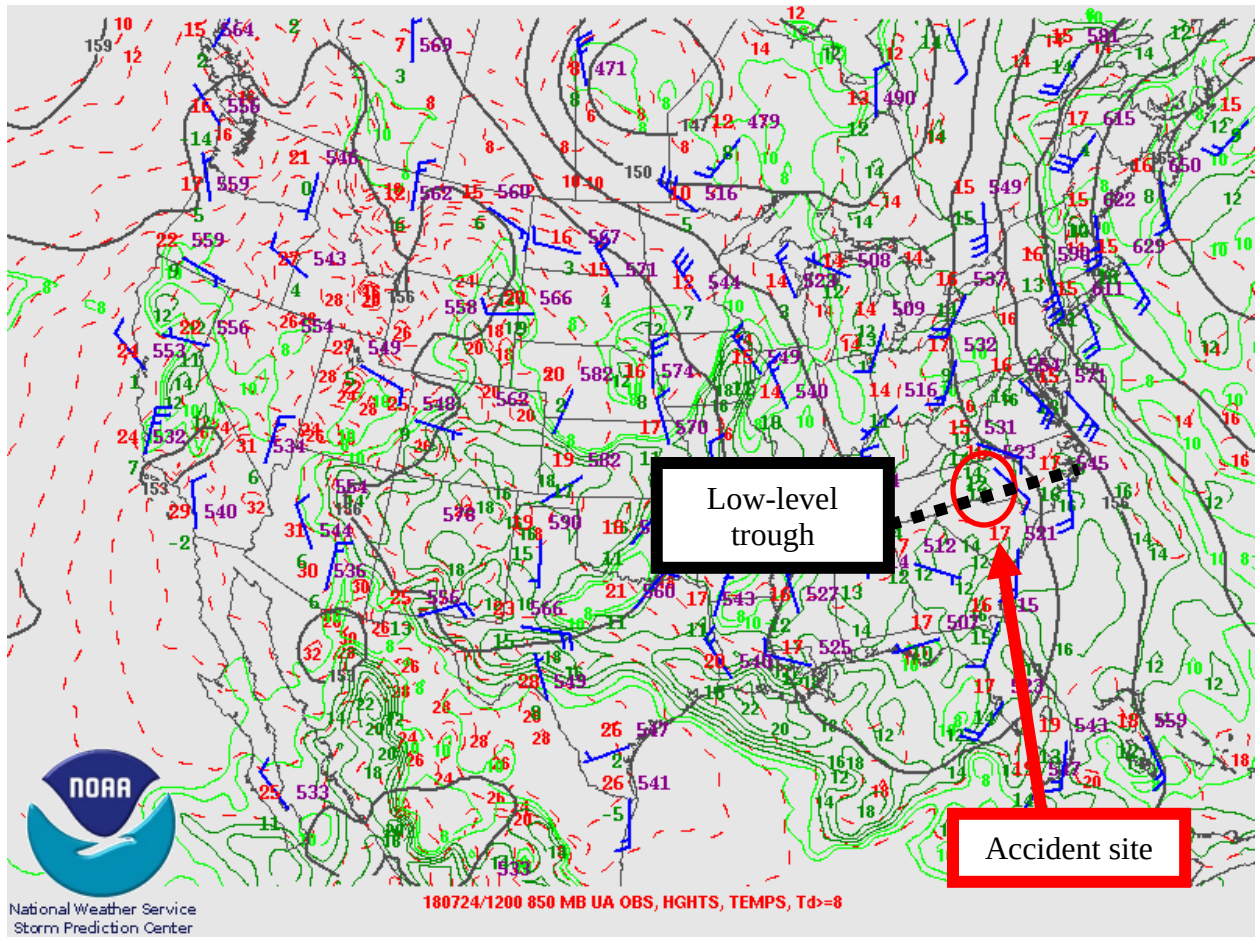


Figure 3 – 850-hPa Constant Pressure Chart for 0800 EDT

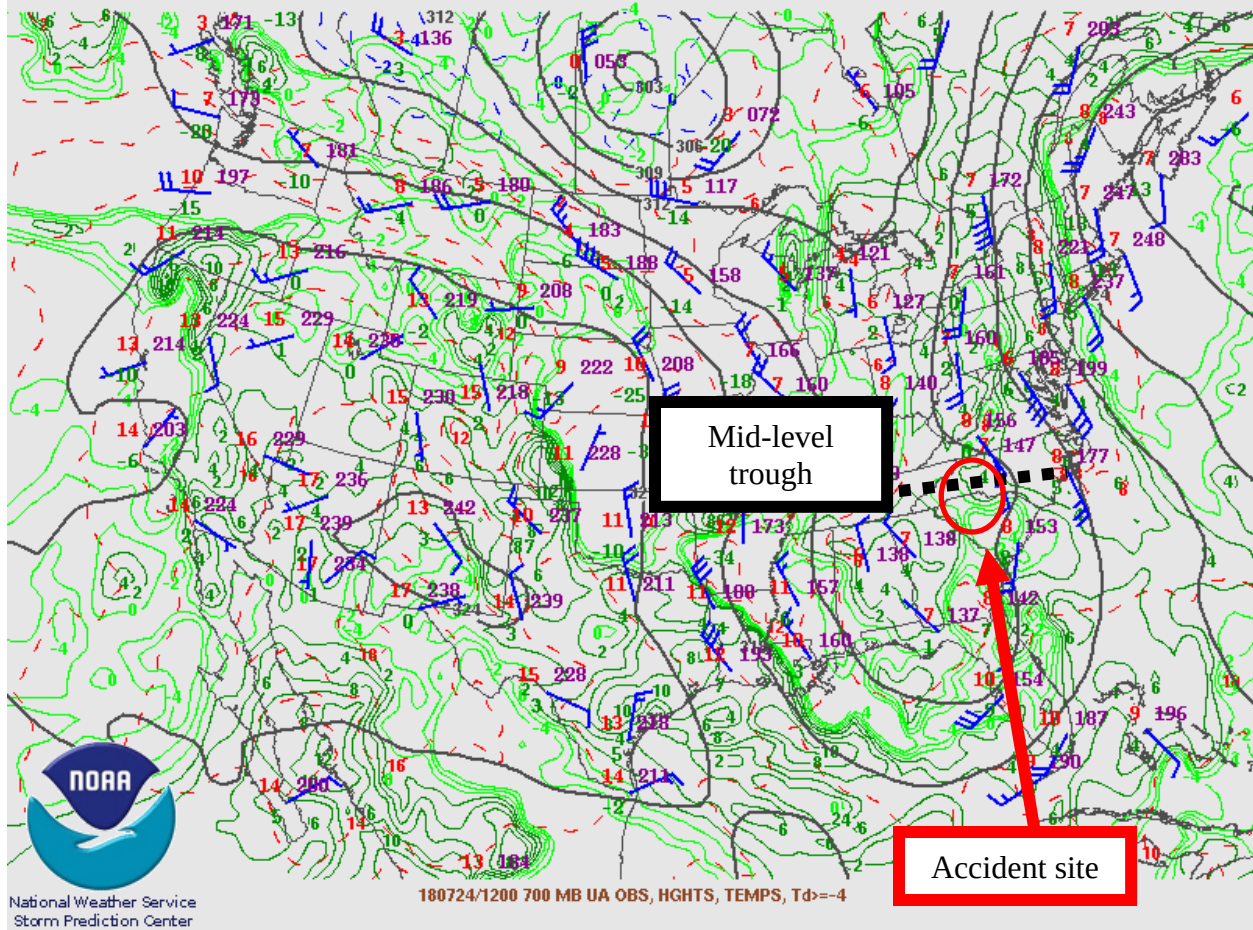


Figure 4 – 700-hPa Constant Pressure Chart for 0800 EDT

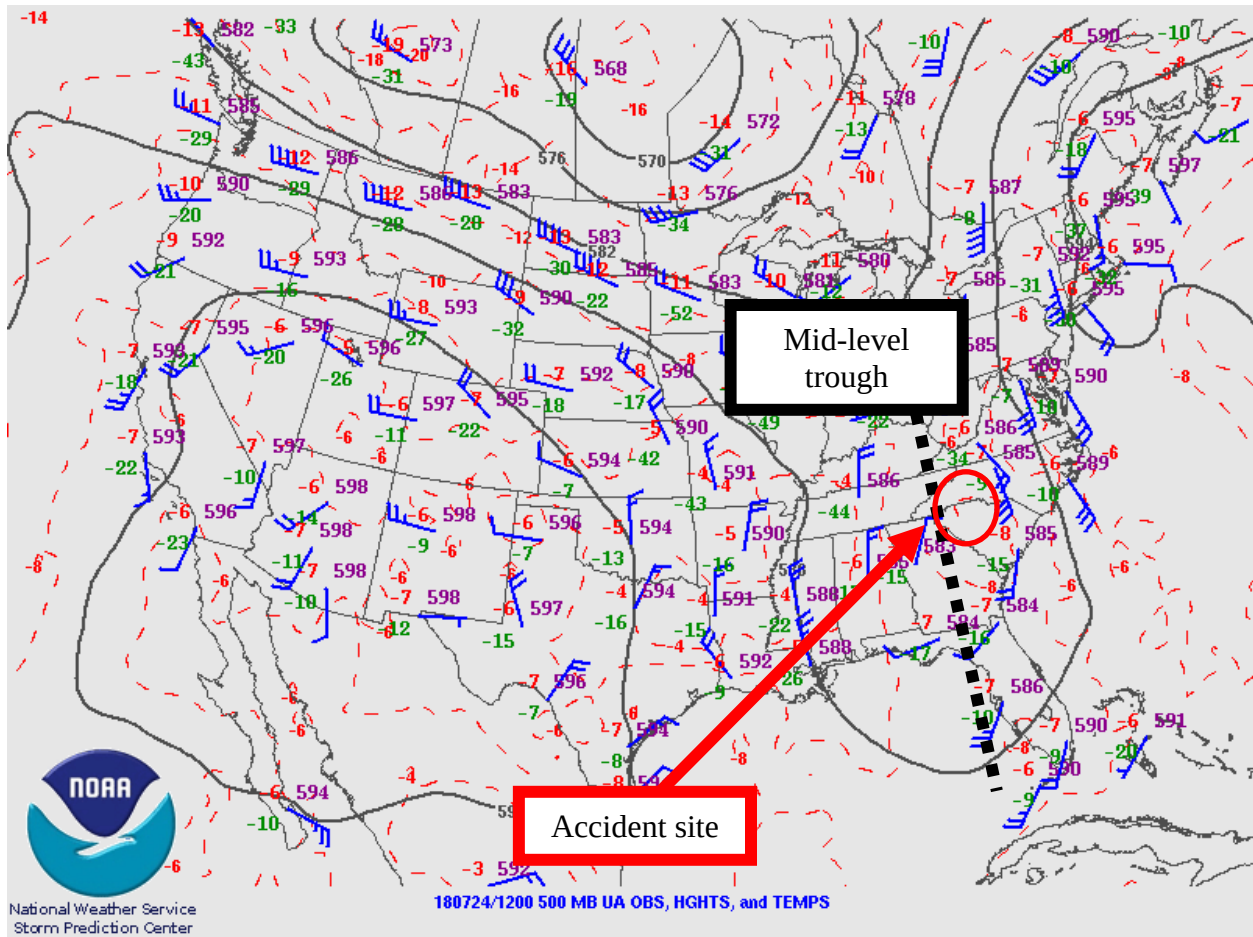


Figure 5 – 500-hPa Constant Pressure Chart for 0800 EDT

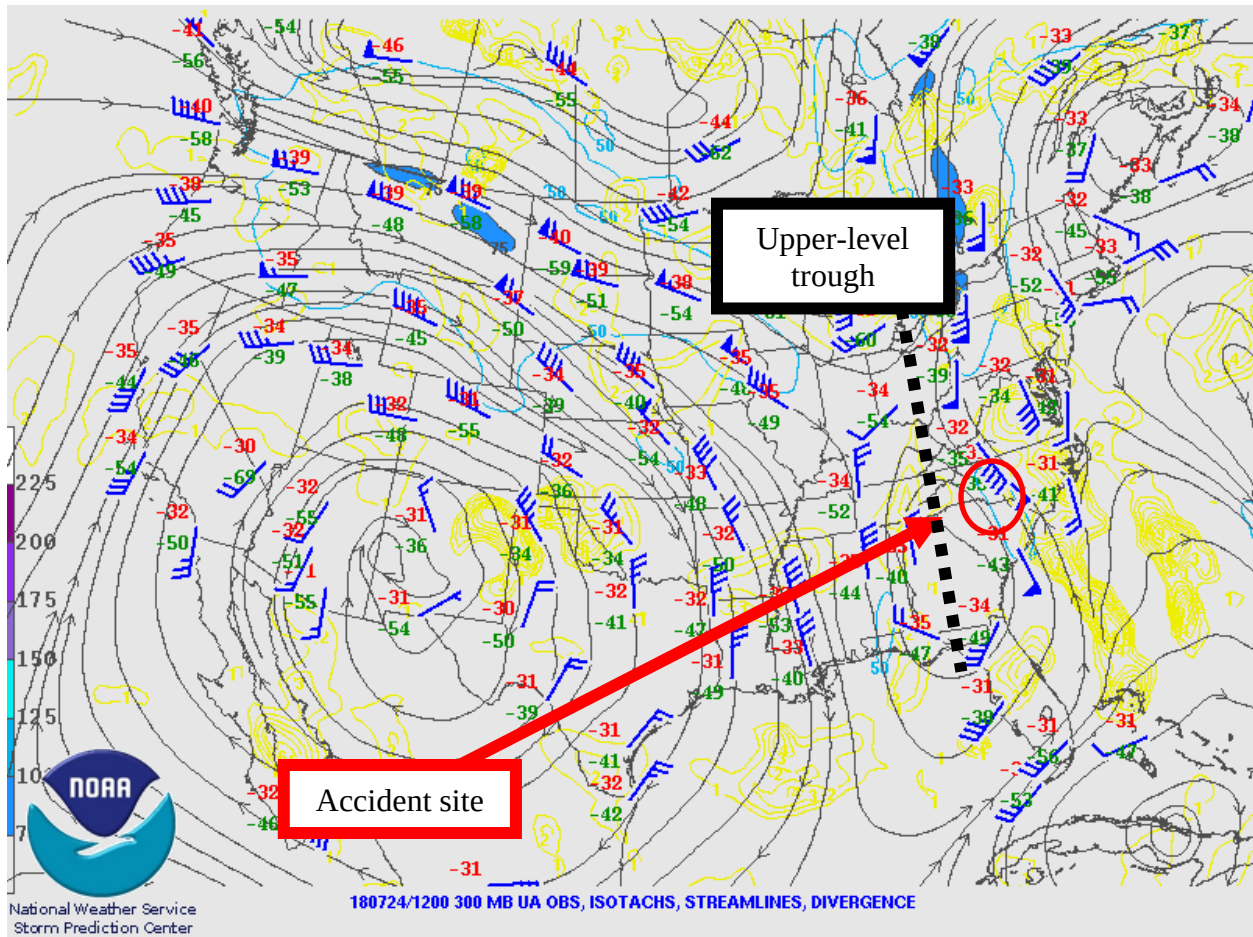


Figure 6 – 300-hPa Constant Pressure Chart for 0800 EDT

2.0 SPC Products

SPC issued the following Day 1 Convective Outlook at 2059 EDT on July 23, 2018, (figure 7) with areas of general thunderstorms forecast for the accident site. SPC defines the “TSTM” area as an area that encloses where a 10% or higher probability of thunderstorms is forecast during the valid period. This was the SPC Day 1 Convective Outlook valid at the accident time:

SPC AC 240059

Day 1 Convective Outlook
NWS Storm Prediction Center Norman OK
0759 PM CDT Mon Jul 23 2018

Valid 240100Z - 241200Z

...THERE IS A SLIGHT RISK OF SEVERE THUNDERSTORMS ACROSS PORTIONS OF EASTERN COLORADO AND INTO NORTHEAST NEW MEXICO AND VICINITY...

...SUMMARY...

A couple of severe storms may persist this evening across portions of southeast Colorado/northeast New Mexico and vicinity. Strong

storms -- and possibly a couple of briefly severe cells -- will also linger over coastal Louisiana for the next couple of hours.

...Eastern Colorado/northeast New Mexico and into adjacent portions of the Texas and Oklahoma Panhandles...

A moderately unstable environment persists across portions of the High Plains region of eastern Colorado and into northeast New Mexico, where ongoing storms have not yet overturned the airmass. With moderate mid-level westerly flow atop low-level easterlies, shear remains sufficient for a few stronger updrafts -- and attendant risk for locally damaging winds and possibly severe hail. With time, a cluster of storms may continue to evolve over the southeast Colorado vicinity, possibly spreading east-southeast toward western portions of the Texas and Oklahoma Panhandles this evening before weakening -- accompanied by some risk for locally gusty winds.

...Parts of coastal Louisiana...

A few vigorous storms are ongoing over the coastal Louisiana vicinity at this time, from roughly Terrebonne Parish westward toward Lake Charles. With a moist/moderately unstable airmass in place, and deep-layer flow sufficient for organized updrafts, a briefly severe storm or two may still occur over the next couple of hours, within the ongoing band of convection moving south-southeast toward the coast.

..Goss.. 07/24/2018

CLICK TO GET WUUS01 PTSDY1 PRODUCT

NOTE: THE NEXT DAY 1 OUTLOOK IS SCHEDULED BY 0600Z

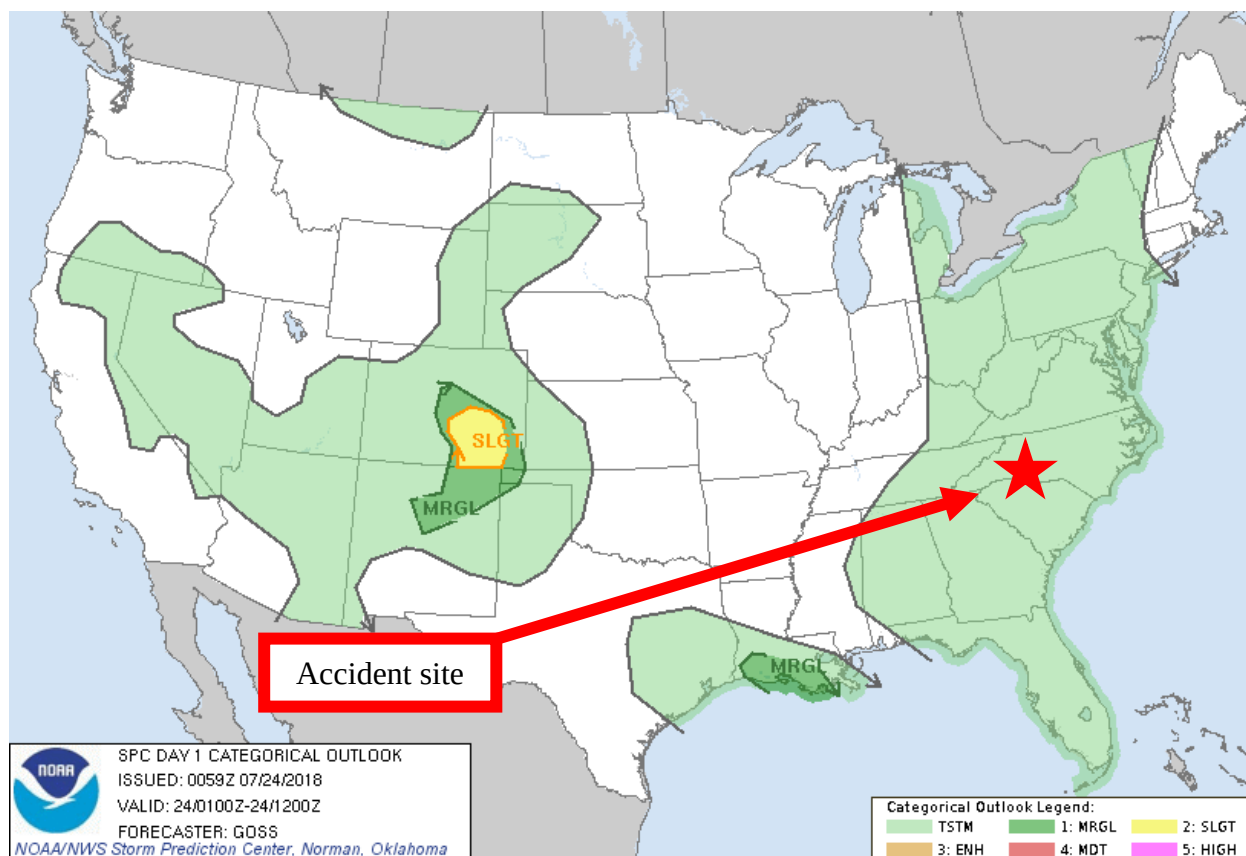


Figure 7 – SPC day 1 Convective Outlook valid at the time of the accident

3.0 Surface Observations

The area surrounding the accident site was documented using official Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). Figure 8 is a sectional chart with the accident site and the closest weather reporting locations to the accident site marked.



Figure 8 – Sectional chart of accident area with the location of the accident site and the closest surface observation sites

Lincolnton-Lincoln County Regional Airport (KIPJ) had the closest official weather observation point to the accident site, and was located 5 miles east of Lincolnton, North Carolina. KIPJ had an Automated Weather Observing System (AWOS³) whose reports were not supplemented. KIPJ was located within a mile of the accident site, at an elevation of 878 ft, and had a 7° westerly magnetic variation⁴ (figure 8). The following observations were taken and disseminated during the times surrounding the accident:⁵

[0325 EDT] METAR KIPJ 240725Z AUTO 02004KT 5SM BR OVC004 21/21 A2995
RMK AO2 T02060206=

[0345 EDT] METAR KIPJ 240745Z AUTO 01003KT 4SM BR OVC004 21/21 A2995
RMK AO2 T02060206=

³ AWOS – Automated Weather Observing System is equipped with meteorological instruments to observe and report temperature, dewpoint, wind speed and direction, visibility, cloud coverage and ceiling up to twelve thousand feet, and altimeter setting.

⁴ Magnetic variation – The angle (at a particular location) between magnetic north and true north. 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.

[0405 EDT] METAR KIPJ 240805Z AUTO 00000KT 4SM BR OVC002 21/21 A2994
RMK AO2 T02060206=

[0425 EDT] METAR KIPJ 240825Z AUTO 00000KT 4SM BR OVC002 21/21 A2995
RMK AO2 T02070207=

**[0445 EDT] METAR KIPJ 240845Z AUTO 00000KT 4SM BR OVC002 21/21 A2995
RMK AO2 T02080208=**

**[0505 EDT] METAR KIPJ 240905Z AUTO 00000KT 2SM BR OVC002 21/21 A2995
RMK AO2 T02080208=**

ACCIDENT TIME 0520 EDT

**[0525 EDT] METAR KIPJ 240925Z AUTO 00000KT 1 1/2SM BR OVC002 21/21 A2995
RMK AO2 T02080208=**

**[0545 EDT] METAR KIPJ 240945Z AUTO 00000KT 1 1/4SM BR OVC002 21/21 A2995
RMK AO2 T02090209=**

[0605 EDT] METAR KIPJ 241005Z AUTO 00000KT 1SM BR OVC002 21/21 A2995
RMK AO2 T02090209=

[0625 EDT] METAR KIPJ 241025Z AUTO 00000KT 1SM BR OVC002 21/21 A2995
RMK AO2 T02100210=

KIPJ weather at 0445 EDT, automated, wind calm, 4 miles visibility, mist, overcast ceiling at 200 ft above ground level (agl), temperature of 21° Celsius (C), dew point temperature of 21° C, and an altimeter setting of 29.95 inches of mercury. Remarks: automated station with a precipitation discriminator, temperature 20.8° C, dew point temperature 20.8° C.

KIPJ weather at 0505 EDT, automated, wind calm, 2 miles visibility, mist, overcast ceiling at 200 ft agl, temperature of 21° C, dew point temperature of 21° C, and an altimeter setting of 29.95 inches of mercury. Remarks: automated station with a precipitation discriminator, temperature 20.8° C, dew point temperature 20.8° C.

KIPJ weather at 0525 EDT, automated, wind calm, 1 and a half miles visibility, mist, overcast ceiling at 200 ft agl, temperature of 21° C, dew point temperature of 21° C, and an altimeter setting of 29.95 inches of mercury. Remarks: automated station with a precipitation discriminator, temperature 20.8° C, dew point temperature 20.8° C.

KIPJ weather at 0545 EDT, automated, wind calm, 1 and a quarter miles visibility, mist, overcast ceiling at 200 ft agl, temperature of 21° C, dew point temperature of 21° C, and an altimeter setting of 29.95 inches of mercury. Remarks: automated station with a precipitation discriminator, temperature 20.9° C, dew point temperature 20.9° C.

The observations from KIPJ surrounding the accident time indicated LIFR⁶ conditions with mist.

4.0 Upper Air Data

A High-Resolution Rapid Refresh (HRRR)⁷ model sounding was created for the accident site for 0500 EDT with a station elevation of 840 ft.⁸ The 0500 EDT HRRR sounding was plotted on a standard Skew-T Log P diagram⁹ with the derived stability parameters included in figure 9 (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 lifted condensation level (LCL)¹¹ at 211 ft agl (1,051 ft msl), the convective condensation level (CCL)¹² at 2,327 ft agl (3,167 ft msl), and the level of free convection (LFC)¹³ at 3,034 ft agl (3,874 ft msl). The sounding had a greater than 95% relative humidity from the surface through 5,000 ft. The freezing level was located at 14,089 ft msl and there were no icing concerns for this aircraft. The precipitable water value was 1.83 inches.

⁶ 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.

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

¹² 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.

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.

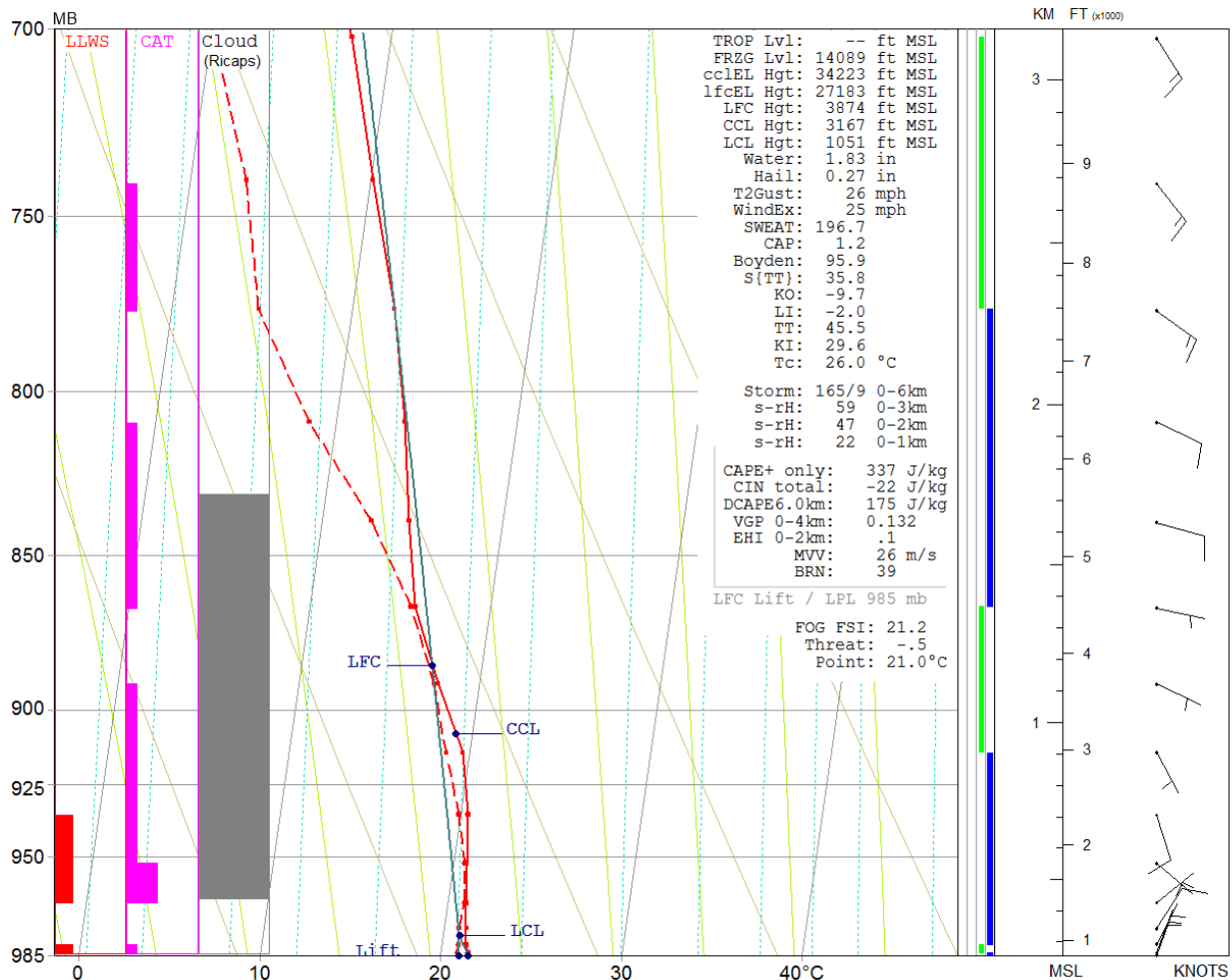


Figure 9 – 0500 EDT HRRR sounding

The 0500 EDT HRRR sounding indicated a stable environment from the surface through 3,000 ft, then alternating layers of conditionally unstable and stable environments from 3,000 ft through 10,000 ft. RAOB identified the possibility of clouds between 1,500 ft msl (~660 ft agl) through 5,500 ft msl. The HRRR sounding identified 337 Joules/kilogram (J/kg) of CAPE.¹⁴ The maximum vertical velocity (MVV) for this atmosphere was calculated as 26 meters/second (about 5,118 ft per minute).¹⁵ Downdraft CAPE (DCAPE; 6 kilometers agl)¹⁶ was measured at 175 J/kg

¹⁴ Convective Available Potential Energy (CAPE) – CAPE is a measure of the amount of energy available for convection and is directly related to the maximum potential vertical speed within an updraft.

¹⁵ 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.

¹⁶ 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.

The 0500 EDT HRRR sounding wind profile indicated a surface wind from 019° at 3 knots with the wind veering¹⁷ to the southeast by 2,500 ft. The wind speed remained at or below 10 knots through 7,000 ft. RAOB indicated a small chance of light low-level wind shear in two layers between the surface and 2,500 ft. RAOB indicated a small chance of clear-air turbulence existed in several layers between the surface and 9,000 ft.

5.0 Satellite Data

Infrared data from the Geostationary Operational Environmental Satellite number 16 (GOES-16) data was obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison in Madison, Wisconsin, and processed using the Man-computer Interactive Data Access System software. Infrared (band 13) imagery at a wavelength of 10.3 microns (μm) was retrieved for the period. Satellite imagery surrounding the time of the accident, from 0300 EDT through 0700 EDT at approximately 15-minute intervals were reviewed, and the closest images to the time of the accident are documented here.

Figures 10 and 11 present the GOES-16 infrared imagery from 0517 and 0522 EDT 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 (green colors; higher cloud tops) were located over and to the northwest of the accident site. The cloud cover was moving from southeast to northwest. Based on the brightness temperatures above the accident site (244° Kelvin) and the vertical temperature profile provided by the 0500 EDT HRRR sounding¹⁸, the approximate cloud-top heights over the accident site were 31,000 ft at 0522 EDT. It should be noted these figures have not been corrected for any parallax error.

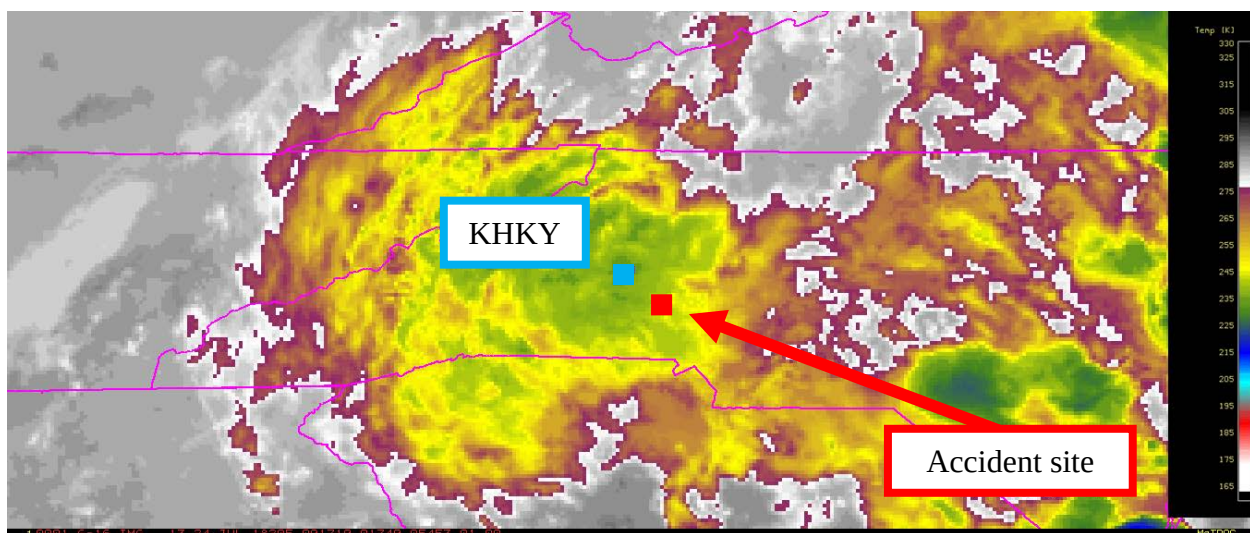


Figure 10 – GOES-16 infrared image at 0517 EDT

¹⁷ A change in wind direction with height in a clockwise sense in the Northern Hemisphere

¹⁸ The entire troposphere is not depicted in Figure 9.

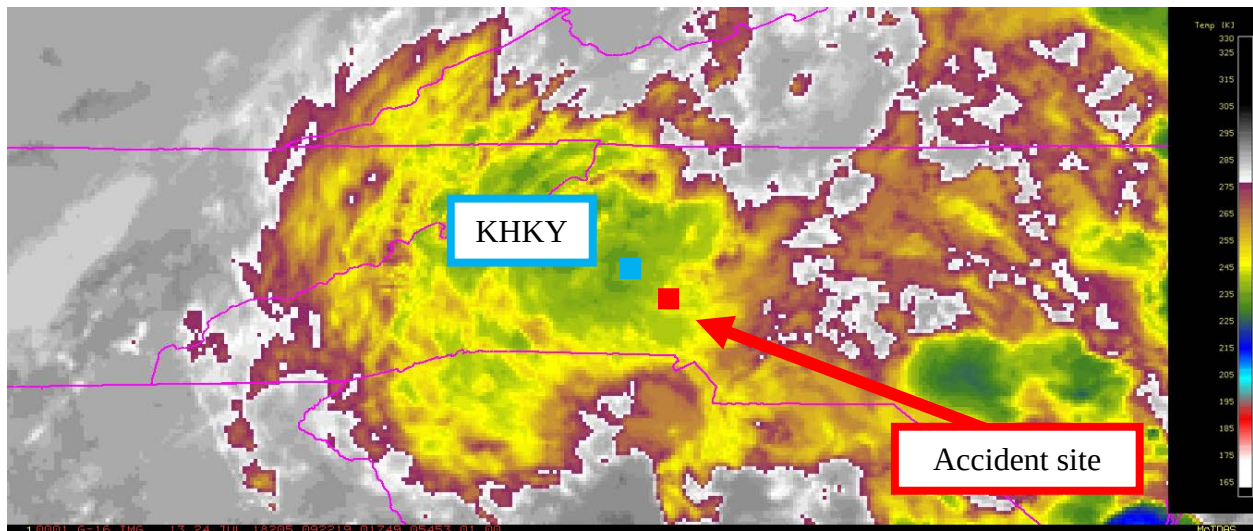


Figure 11 – GOES-16 infrared image at 0522 EDT

6.0 Radar Imagery Information

The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D)¹⁹ to the accident site was the Greer, South Carolina, radar (KGSP), which was located 62 miles southwest of the accident site. Level II archive radar data was obtained from the NCEI utilizing the NEXRAD Data Inventory Search and displayed using the NOAA's Weather and Climate Toolkit software. No precipitation targets were noted above the accident site around the accident time from KGSP. A regional view of the NWS national composite radar mosaic is included as figure 12 for 0520 EDT with the approximate accident site marked by a red circle. The image depicted no echoes above the accident site, but light to moderate intensity echoes were depicted southwest of Hickory, North Carolina, with additional light to moderate intensity echoes depicted east of Charlotte, North Carolina.

¹⁹ The WSR-88D is an S-band 10-centimeter wavelength radar with a power output of 750,000 watts, and with a 28-foot parabolic antenna that concentrates the energy between a 0.87° and 0.96° beam width. The radar produces three basic types of products: base reflectivity, base radial velocity, and base spectral width.

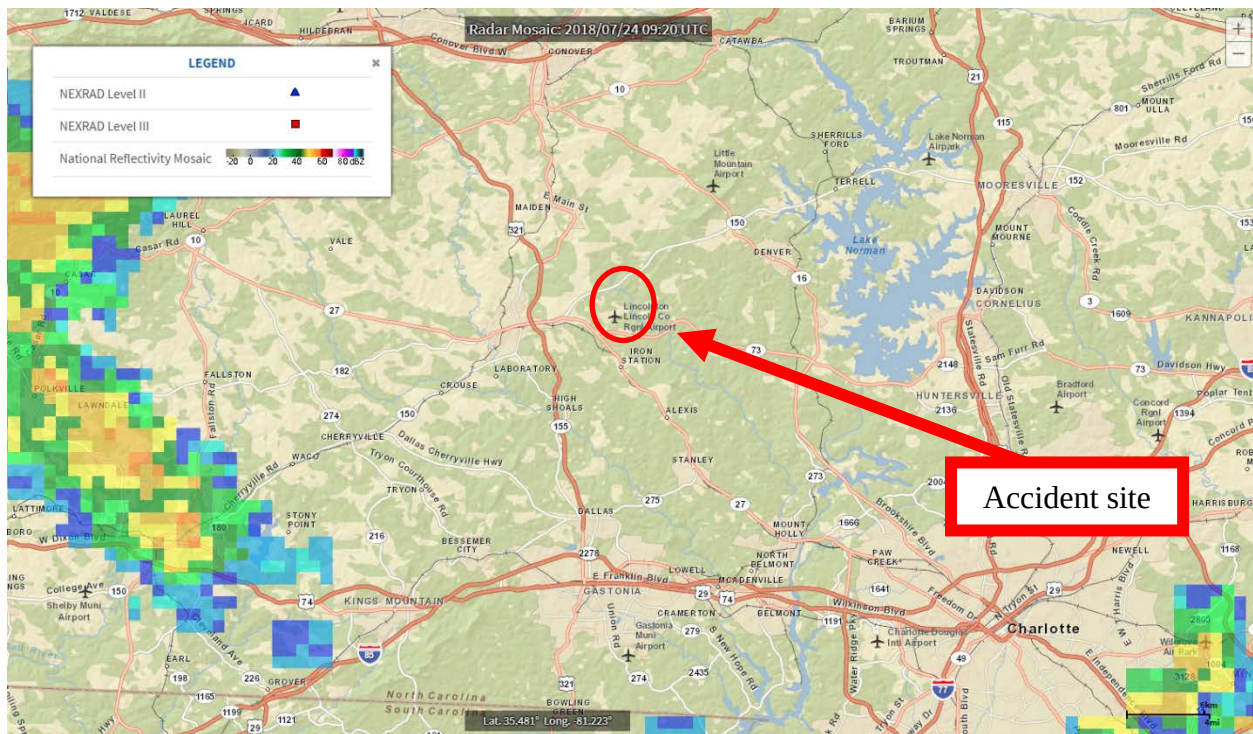


Figure 12 – Regional Composite Reflectivity image for 0520 EDT

7.0 Pilot Reports²⁰

All PIREPs within 200 miles of the accident site from about one hour prior to the accident time to about two hours after the accident time were reviewed. Only PIREPs for below FL200²¹ are provided below:

CLT UA /OV CLT240025/TM 1032/FL170/TP BE20/TA M05/IC LGT-MOD RIME/RM FL170-FL190 ZTLFD

AVL UA /OV RWY 35 FINAL/TM 1056/FL021/TP A320/SK OVC/RM BASES 023 TOPS 036

GSO UA /OV GSO270010/TM 1107/FL026/TP C68A/SK OVC014-TOP026/RM DURD ILS RWY 33 INT

CAE UA /OV CAE/TM 1117/FL005/TP SHD6/SK BKN/RM BASES 500/ TOPS 900/

Routine pilot report (UA), Charlotte/Douglas International Airport (CLT); Over – 25 miles from CLT on the 240° radial; Time – 0632 EDT (1032Z); Altitude – 17,000 ft; Type aircraft – Beech 200 Super King Air; Temperature – -5 C; Icing – Light to moderate rime; Remarks – Between FL170 and FL190 taken by Atlanta Air Route Traffic Control Center flight data position.

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

²¹ 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), Asheville Regional Airport (AVL); Over – Runway 35 on final; Time – 0656 EDT (1056Z); Altitude – 2,100 ft; Type aircraft – Airbus A320; Sky – Overcast; Remarks – Bases at 2,300 ft and cloud tops at 3,600 ft.

Routine pilot report (UA), Piedmont Triad International Airport (GSO); Over – 10 miles from GSO on the 270° radial; Time – 0707 EDT (1107Z); Altitude – 2,600 ft; Type aircraft – Cessna Citation Latitude; Sky – Overcast at 1,400 ft with tops at 2,600 ft; Remarks – During descent ILS into runway 33 at Smith Reynolds Airport (INT).

Routine pilot report (UA), Columbia Metropolitan Airport (CAE); Over – CAE; Time – 0717 EDT (1117Z); Altitude – 500 ft; Type aircraft – Short Brothers SHD6; Sky – Broken; Remarks – Bases at 500 ft and tops at 900 ft.

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

No Center Weather Service Unit (CWSU) Center Weather Advisory (CWA) or Meteorological Impact Statement (MIS) were valid for the accident site at the accident time.

10.0 AIRMETs

There were Airmen's Meteorological Information (AIRMET) advisories Sierra that were valid for the accident site at the accident time. The AIRMETs warned of IFR²² conditions due to precipitation, mist, and fog, and mountains obscured by clouds, precipitation, and mist. The accident site had been advised for these conditions since the issuance of AIRMET Sierras at 0217 and 0031 EDT on July 24 and 2245 EDT on July 23:

WAUS42 KKCI 240845

WA2S

-MIAS WA 240845

AIRMET SIERRA UPDT 3 FOR IFR AND MTN OBSCN VALID UNTIL 241500

.

AIRMET IFR...NC SC GA FL WV MD VA

**FROM 40SSW JST TO 40NNE LYH TO 20S RDU TO 40ENE ILM TO 30NE FLO
TO 40SE IRQ TO SAV TO 30WNW CTY TO 30WNW TLH TO GQO TO HMV TO
20SSW BKW TO 40SSW JST**

CIG BLW 010/VIS BLW 3SM PCPN/BR/FG. CONDS CONTG BYD 15Z ENDG 15-18Z.

.

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

**FROM HAR TO 20N LYH TO CLT TO 40S ODF TO ATL TO GQO TO HMV TO
HNN TO EKN TO 30SSW JST TO HAR**

MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 15Z THRU 21Z.

²² 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.

....

WAUS42 KPCI 240617 AAB

WA2S

-MIAS WA 240617 AMD

AIRMET SIERRA UPDT 2 FOR IFR AND MTN OBSCN VALID UNTIL 240900

.

AIRMET IFR...GA FL...UPDT

FROM 40E PZD TO 20SSE AMG TO 30NW OMN TO 40SE CTY TO 20WNW CTY
TO 20ESE TLH TO 40E PZD

CIG BLW 010/VIS BLW 3SM BR/FG. CONDS DVLPG BY 09Z. CONDS CONTG
BYD 09Z ENDG 12-15Z.

...NEW AIRMET...

.

AIRMET IFR...NC SC GA WV VA AND CSTL WTRS...UPDT

FROM 50SSW EKN TO 40NE LYH TO 30E ORF TO 20ESE ECG TO RDU TO 70S
ECG TO 20ESE ILM TO 50SSE FLO TO 50W SAV TO 40WSW PZD TO 50E ATL
TO 50SSW VXV TO 20NNE HNV TO 20SSE BKW TO 50SSW EKN

CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 09Z THRU 15Z.

.

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

FROM 20ENE HAR TO 20SSW CLT TO ATL TO GQO TO HNV TO HNN TO 20SE
EKN TO 30SSW JST TO 20ENE HAR

MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 09Z THRU 15Z.

....

WAUS42 KPCI 240431 AAA

WA2S

-MIAS WA 240431 AMD

AIRMET SIERRA UPDT 1 FOR IFR AND MTN OBSCN VALID UNTIL 240900

.

AIRMET IFR...NC SC GA AND CSTL WTRS

FROM 40SW PSK TO 20NE ECG TO 50S ECG TO 40NNE ILM TO 30NNE CHS
TO 40S MCN TO 30S ATL TO ODF TO 30NW SPA TO 40SW PSK

CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS DVLPG 03-06Z. CONDS CONTG
BYD 09Z THRU 15Z.

.

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

FROM 20ENE HAR TO 20SSW CLT TO ATL TO GQO TO HNV TO HNN TO 20SE
EKN TO 30SSW JST TO 20ENE HAR

MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 09Z THRU 15Z.

....

WAUS42 KPCI 240245

WA2S

-MIAS WA 240245

AIRMET SIERRA FOR IFR AND MTN OBSCN VALID UNTIL 240900

.

AIRMET IFR...NC SC GA AND CSTL WTRS

FROM 40SW PSK TO 20NE ECG TO 50S ECG TO 40NNE ILM TO 30NNE CHS
TO 40S MCN TO 30S ATL TO ODF TO 30NW SPA TO 40SW PSK

CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS DVLPG 03-06Z. CONDS CONTG
BYD 09Z THRU 15Z.

.

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

FROM 20SSW HAR TO 20N GSO TO 20SSW CLT TO 20SSW ATL TO 20NE GQO

TO HNV TO HNN TO 20NW EKN TO 40SW JST TO 20SSW HAR
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 09Z THRU 15Z.
....

11.0 Graphical Forecasts for Aviation

The Graphical Forecasts for Aviation (GFA) products made available before the accident pilot checked the weather imagery on the ForeFlight app (around 1151 EDT on July 23, 2018) forecast MVFR²³ surface conditions with scattered thunderstorms possible, and ceilings between 2,500 and 3,000 ft msl for 0200 EDT on July 24 (attachments 1 and 3). No GFA products were available for 0500 and 0800 EDT on July 24, 2018, before the accident pilot checked the weather imagery on the ForeFlight app at 1151 EDT on July 23, 2018. The GFA products are only valid for an 18-hour period after the forecast issue time with the graphical AIRMETs only available on the GFA graphics through 9 to 12 hours after the forecast issue time. The latest GFA products available before the accident flight departed were issued between 0300 and 0305 EDT on July 24, 2018, and forecast VFR²⁴ to LIFR surface conditions, a chance of rain showers and scattered thunderstorms, AIRMET Sierra for IFR conditions and mountain obscuration conditions, and ceilings between 1,000 and 2,000 ft msl for 0500 and 0800 EDT on July 24, 2018 (attachment 1).

The reason for the differences between the GFA surface forecast and the GFA cloud forecast is the two are computed automatically by two different weather models. The Rapid Refresh (RAP) weather model is used for the cloud forecast and the Localized Aviation MOS²⁵ Program (LAMP) weather model is used for the surface forecast charts, and both forecasts are issued with no human intervention. The only human-generated information reflected in the two GFA products are the AIRMETs and the GFA is “human-over-the-loop.”

12.0 Terminal Aerodrome Forecast

Hickory Regional Airport (KHKY) was the closest site with a NWS Terminal Aerodrome Forecast (TAF) to the accident location and was located 19 miles northwest of the accident site (figure 8). The KHKY TAF valid at the accident time was an amended TAF issued at 0149 EDT and was valid for a 24-hour period beginning at 0200 EDT. The 0149 EDT TAF for KHKY was as follows:

KHKY 240549Z 2406/2506 **05003KT 6SM BR VCSH BKN015**
TEMPO 2406/2410 BKN003 OVC010
FM241000 04003KT 2SM BR OVC003
FM241400 06003KT P6SM BKN009
FM241500 07003KT P6SM BKN013
PROB30 2415/2420 4SM -TSRA BKN025CB
FM242000 09005KT P6SM -SHRA BKN040=

Between 0200 and 0600 EDT, the TAF expected a wind from 050° at 3 knots, 6 miles visibility,

²³ Marginal Visual Flight Rules – Refers to the general weather conditions pilots can expect at the surface. MVFR criteria means a ceiling between 1,000 and 3,000 ft agl (inclusive) and/or 3 to 5 miles visibility.

²⁴ Visual Flight Rules – Refers to the general weather conditions pilots can expect at the surface. VFR criteria means a ceiling greater than 3,000 feet agl and greater than 6 miles visibility.

²⁵ Model Output Statistics: https://www.weather.gov/mdl/mos_home

mist and vicinity showers²⁶, and a broken ceiling at 1,500 ft agl. During this time, temporary conditions²⁷ of a broken ceiling at 300 ft agl and overcast skies at 1,000 ft agl were forecast for between 0200 and 0600 EDT.

13.0 NWS Area Forecast Discussion

The NWS Office in Greenville-Spartanburg, South Carolina, issued the following Area Forecast Discussion (AFD) at 0328 EDT (closest AFD to the accident time with an aviation section). The aviation section of the AFD discussed the widespread LIFR conditions due to very moist east to southeasterly flow:

FXUS62 KGSP 240728
AFDGSP

Area Forecast Discussion
National Weather Service Greenville-Spartanburg SC
328 AM EDT Tue Jul 24 2018

.SYNOPSIS...

A broad upper low will settle across the Deep South through Wednesday. This low will remain nearly stationary and support moist unsettled weather across the region through mid-week, before weakening ahead of an approaching cold front.

&&

.NEAR TERM /THROUGH TONIGHT/...

As of 330 AM: An upper low will begin to fill and open up into a sharp trough today, with its axis remaining nearly stationary along the western edge of the forecast area. Overall, conditions shouldn't change much from yesterday. Guidance shows weak, though persistent deep-layer Q-vector convergence across the eastern half of the forecast area. Moist southeasterly flow will continue, and PWATs may increase a tad from yesterday, at least across the I-77 corridor. Looking at MRMS QPE and 24 rain gauge totals, there are about half a dozen spots within the Flash Flood WAtch area that received heavy rainfall. So FFG values have come down, with much of Charlotte only needing a little over 2" in 3 hours to exceed FFG. The operational model QPF and the CAMs reflectivity suggest similar convective trend to yesterday. So with all that said, I will extend the FFA to midnight tonight. The western half of the area will also have a heavy rain threat, but more localized with higher average FFG values. SBCAPE looks similar to yesterday with weak shear, but with a little higher sfc delta theta-e values. So a non-zero severe threat will exist today, with downburst winds being the main threat. Highs will be a couple categories below normal again today under mostly cloudy skies.

²⁶ In the vicinity of the airport is defined as a weather phenomenon within 5-10 miles of the airfield, but not over the airfield.

²⁷ Temporarily 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.

Convection may linger well into the overnight, as the sharp upper trough begins to drift east. Flow is expected to start veering from SE to SW, so we should lose most of the upslope forcing. Min temps will be near normal under mostly cloudy to cloudy skies.

&&

.SHORT TERM /WEDNESDAY THROUGH THURSDAY NIGHT/...

As of 200 am Tuesday: Upper trough axis will be in the process of slowly crossing the forecast area at the start of the period, essentially bisecting the area at 12Z Wed, likely pushing east by 00Z Thu. One more day of high pops therefore appears warranted across eastern zones. Even across the mtns, there's a strong enough signal supporting a combination of NW low level upslope flow and moderate instability that will allow plenty of convection to initiate across the high terrain during the afternoon and move E/SE during late afternoon/evening to warrant 50-60 pops across much of the western half of the area. Depending upon the status of antecedent hydro conditions, a threat for at least localized flash flooding may extend through the day Wed along and near the I-77 corridor.

The remainder of the work week will see significantly drier conditions develop, as the upper trough shifts east and drier air overspreads the area in the wake of associated weak frontal zone. Forecast soundings Thu afternoon exhibit a decent amount of low level inhibition, esp the farther NW one moves across the CWA. The highest pops (only 30-40%) are advertised along a small section of the far southern Piedmont, nearer the frontal zone Thu afternoon, with slight chances generally from the southern escarpment/I-85 south, but even that may prove to be a bit high. Maxes remain below climo to begin the period, but should warm to near normal within the drier regime Thu afternoon. Min temps should remain near normal through the period.

&&

.LONG TERM /FRIDAY THROUGH MONDAY/...

As of 215 am Tuesday: Upper troughing will remain in place from the Great Lakes through the Mid-South through the medium range, although a gradual amplification of the pattern is advertised by the major global models and their ensemble systems. Meanwhile, mid-summer insolation and strengthening Bermuda high across the western Atlantic will ensure that the relatively dry and stable air mass over our area during late week modifies quickly through the weekend, such that Saturday should see rather typical coverage of diurnal showers and storms. Convective activity will only increase Sunday and especially Monday as the atmosphere becomes increasingly moist and unstable, and the synoptic pattern becomes more conducive to UVV in light of the amplifying upper trough. Max temps will begin the period near normal before returning to below-normal levels early next week with the increase in diurnal convection. Min temps will be near to slightly-above climo through the period.

&&

.AVIATION /08Z TUESDAY THROUGH SATURDAY/...

At KCLT and Elsewhere: **With an upper low still over the region and a very moist easterly to southeasterly flow providing upslope lift, expect widespread MVFR to LIFR cigs as stratus expands. A few showers are also popping up within the flow, enough so, that VCSH has been added to most of the sites starting around 9z.** Later today looks very similar to yesterday, with numerous SHRA and TSRA developing across the region by early aftn, especially across the KCLT and KHKY areas. Will go with prevailing TSRA at KCLT, where guidance is in good agreement around 19-23z. Cigs should gradually lift from IFR to VFR by early aftn. Convection will begin to wane later this evening, and stratus will likely develop again tonight. Winds will favor a light NE direction overnight thru about midday, then shift to ESE at KCLT and KAVL, and ENE or E at the other sites.

Outlook: The active/wet period will continue through at least Wednesday as a slow moving low pressure system impacts much of the East. Numerous showers and thunderstorms are expected again Wednesday. Drier air begins to work in Thursday and Friday, resulting in more typical late July diurnal convection coverage.

Confidence Table...

	07-13Z	13-19Z	19-01Z	01-06Z
KCLT	Low 54%	Med 76%	High 100%	High 94%
KGSP	Med 73%	Med 75%	High 100%	High 98%
KAVL	High 86%	High 84%	High 100%	High 93%
KHKY	Low 53%	Med 78%	High 100%	High 86%
KGMU	Low 59%	Med 75%	High 100%	High 100%
KAND	High 82%	Med 77%	High 100%	High 100%

The percentage reflects the number of guidance members agreeing with the scheduled TAF issuance flight rule category. Complete hourly experimental aviation forecast consistency tables and ensemble forecasts are available at the following link:

www.weather.gov/gsp/aviation

&&

.GSP WATCHES/WARNINGS/ADVISORIES...

GA...None.

NC...Flash Flood Watch until 6 AM EDT early this morning for NCZ033-035>037-049-050-056-057-068>072-082-501>510.

SC...Flash Flood Watch until 6 AM EDT early this morning for SCZ008-009-014.

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14.0 Winds and Temperature Aloft Forecast

The NWS 0400 EDT Winds and Temperature Aloft forecast valid for the closest point to the accident site is included below:

FBUS31 KWN0 240800
 FD1US1
 DATA BASED ON 240600Z
 VALID 241200Z FOR USE 0800-1500Z. TEMPS NEG ABV 24000

FT 3000 6000 9000 12000 18000 24000 30000 34000 39000

GSP 9900 1307+14 1810+09 1808+04 1511-09 1516-20 141134 151943 152450

The accident site was closest to the Greer, South Carolina, (GSP) forecast point. The 0400 EDT GSP forecast for use between 0400 and 1100 EDT indicated a calm wind at 3,000 ft and a wind at 6,000 ft from 130° at 7 knots with a temperature of 14° C.

15.0 Pilot Weather Briefing

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

A search of archived ForeFlight information indicated that ForeFlight did not have any record of the accident pilot requesting a weather briefing before or during the accident flight. ForeFlight did record that the accident pilot’s account entered a proposed flight route into the ForeFlight app at 1151:13 EDT on July 23, 2018, with the proposed flight route from KIPJ to Sheboygan County Memorial Airport (KSBM, attachment 3). In addition, the accident pilot’s account accessed the “12 HR Prob of Precipitation: DAY 3 Ending at 00Z” weather imagery at 1159:07 EDT on July 23, 2018, and accessed the “GFS MOS Visibility Forecast 15 HR” weather imagery at 1157:59 EDT on July 23, 2018. The weather imagery accessed on July 23, 2018, was accessed by the accident pilot’s account on the ForeFlight app. With no internet access while in flight, the mobile ForeFlight application is still able to access weather information directly from the FAA but leaves no record of such access. It is unknown if the accident pilot checked or received additional weather information before or during the accident flight.

16.0 Astronomical Data

The astronomical data obtained from the United States Naval Observatory for the accident site on July 24, 2018, indicated the following:

SUN	
Accident	0520 EDT²⁸
Begin civil twilight	0559 EDT
Sunrise	0627 EDT
Sun transit	1331 EDT
Sunset	2035 EDT
End civil twilight	2103 EDT

²⁸ Inserted accident time for reference and context.

E. LIST OF ATTACHMENTS

Attachment 1 – GFA products available before the accident flight for around the accident time

Attachment 2 – Correspondence with the Aviation Weather Center regarding GFA products

Attachment 3 – Correspondence with ForeFlight

Submitted by:

Paul Suffern
Senior Meteorologist

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