



## **NATIONAL TRANSPORTATION SAFETY BOARD**

Office of Aviation Safety  
Washington, D.C. 20594

November 27, 2019

### **Weather Study**

# **METEOROLOGY**

ERA20FA021

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## **A. ACCIDENT**

Location: Atlanta, Georgia  
Date: October 30, 2019  
Time: 1021 eastern daylight time  
1421 Coordinated Universal Time (UTC)  
Aircraft: Piper PA28R; Registration: N56258

## **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) 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 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 location used was at latitude 33.8569° N, longitude 84.2906° W at an approximate elevation of 880 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.<sup>1</sup>

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<sup>1</sup>

[https://www.faa.gov/regulations\\_policies/advisory\\_circulars/index.cfm/go/document.information/documentID/1030](https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/1030)

## 1.1 Surface Analysis Chart

The southeastern section of the NWS Surface Analysis Chart for 1100 EDT is provided as figure 1 with the location of the accident site marked within the red circle. The chart indicated a low pressure system over northern Louisiana with a pressure of 1013-hectopascals (hPa) associated with a frontal wave, with a cold front extending southward and a stationary front extending east-northeastward from Louisiana into eastern Kentucky. A warm front stretched from western Mississippi eastward into southeastern Georgia. The accident site was located in between the stationary front and warm front boundaries.

The station models around the accident site depicted air temperatures near 70 degrees Fahrenheit (°F), dew point temperatures in the mid to upper 60's °F with a temperature-dew point spread of 4° or less, a southeast wind at 5 to 10 knots, overcast cloud cover, rain, and fog.

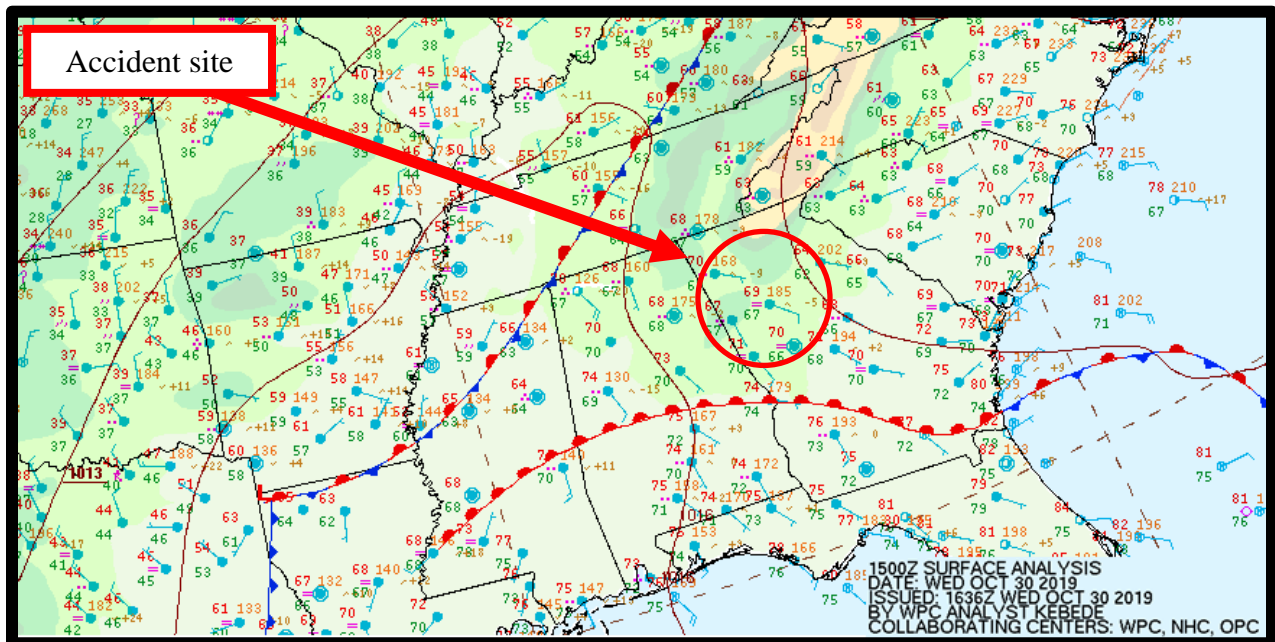


Figure 1 – NWS Surface Analysis Chart for 1100 EDT

## 1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 0800 EDT at 925-, 850-, 700-, 500-, and 300-hPa are presented in figures 2 through 6. There was a low- and mid-level trough<sup>2</sup> located near and above the accident site at 850-, 700-, and 500-hPa. Low- and mid-level troughs are the support for the surface pressure system and fronts aloft, and can act as lifting mechanisms to help produce clouds and precipitation if sufficient moisture is present. The wind was from the southeast at 25 knots at 925-hPa (figure 2) with the wind becoming southwesterly at 25 knots by 700-hPa (figure 4). At 300-hPa, the wind was from the southwest at 40 knots (figure 6).

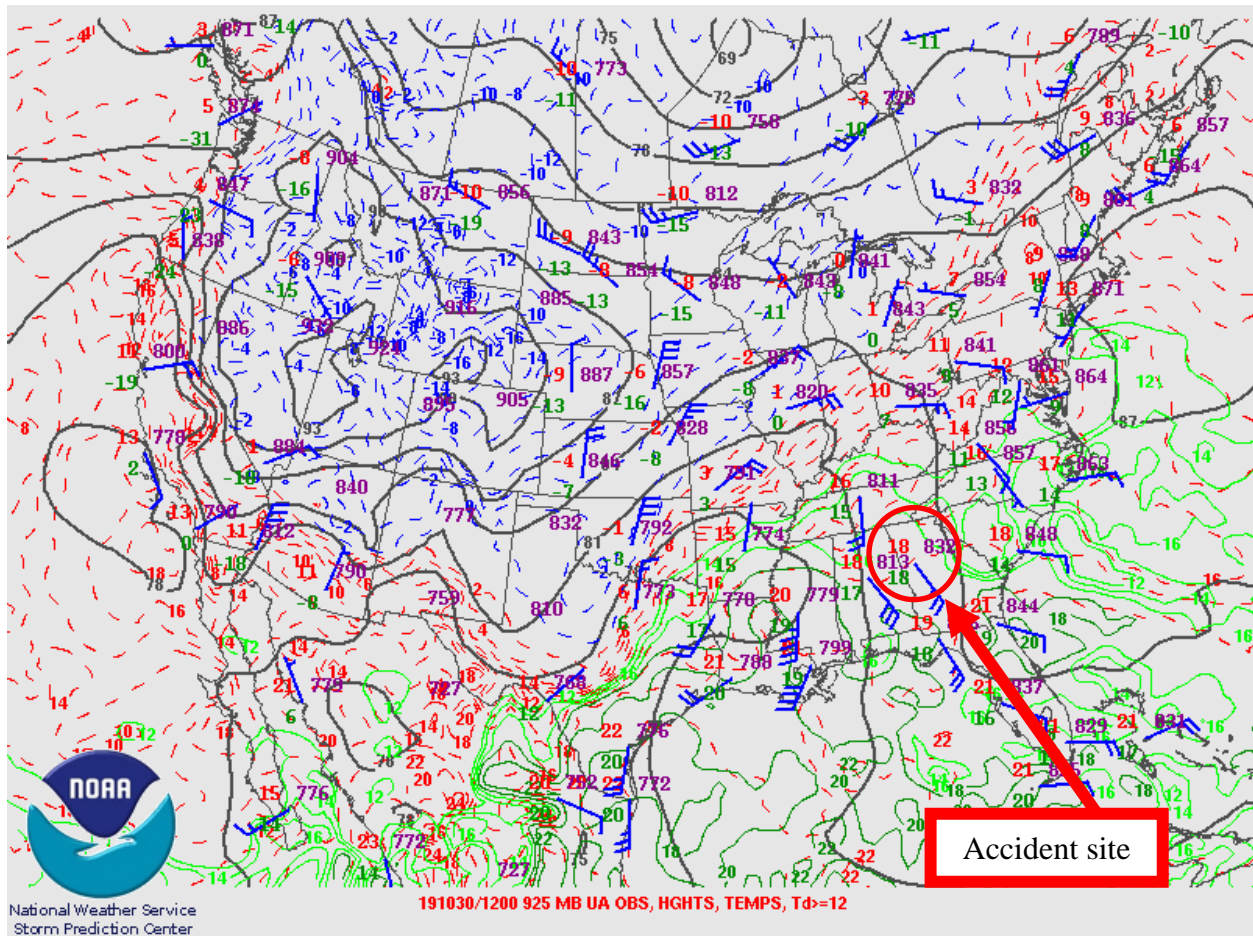


Figure 2 – 925-hPa Constant Pressure Chart for 0800 EDT

<sup>2</sup> Trough – An elongated area of relatively low atmospheric pressure or heights.

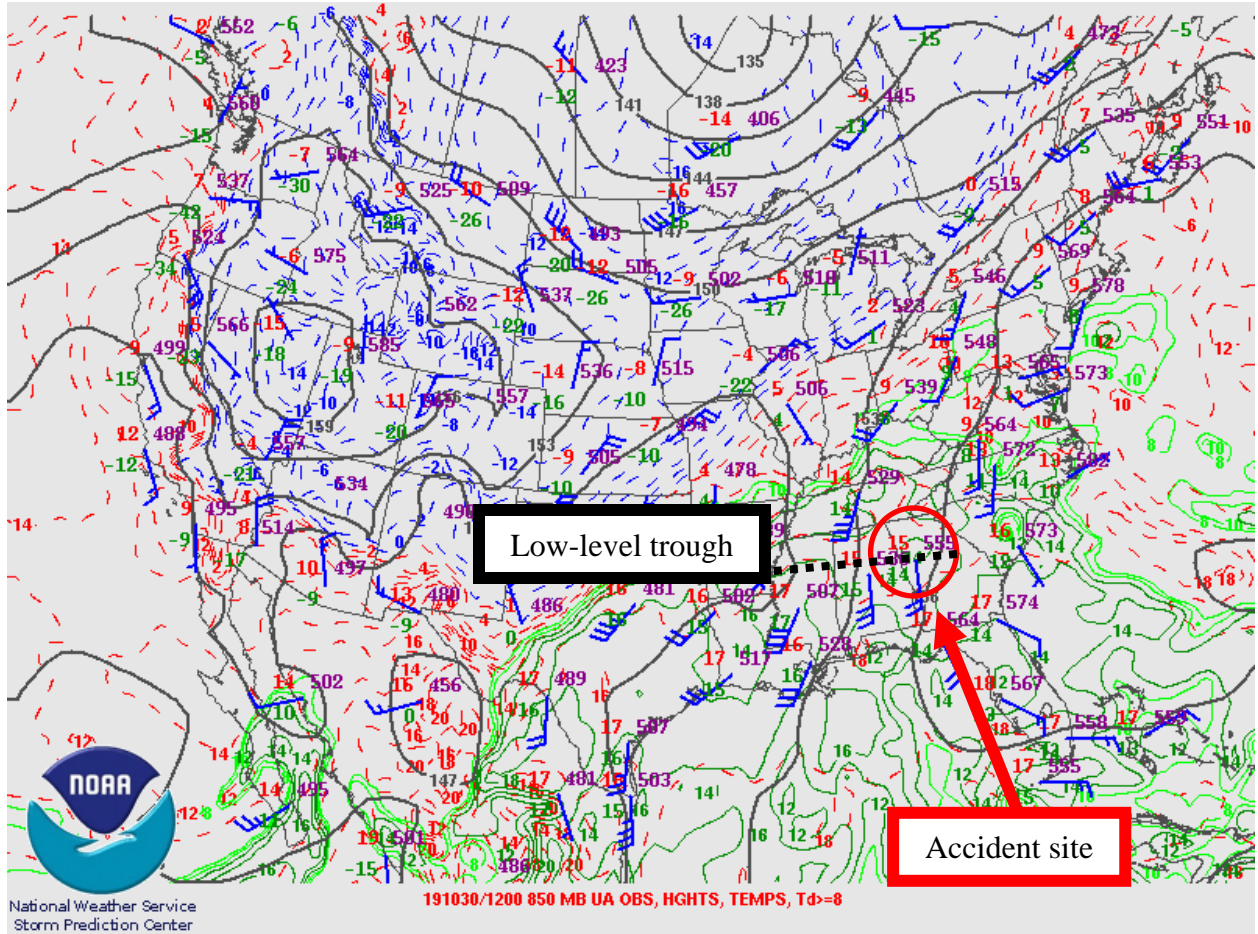


Figure 3 – 850-hPa Constant Pressure Chart for 0800 EDT

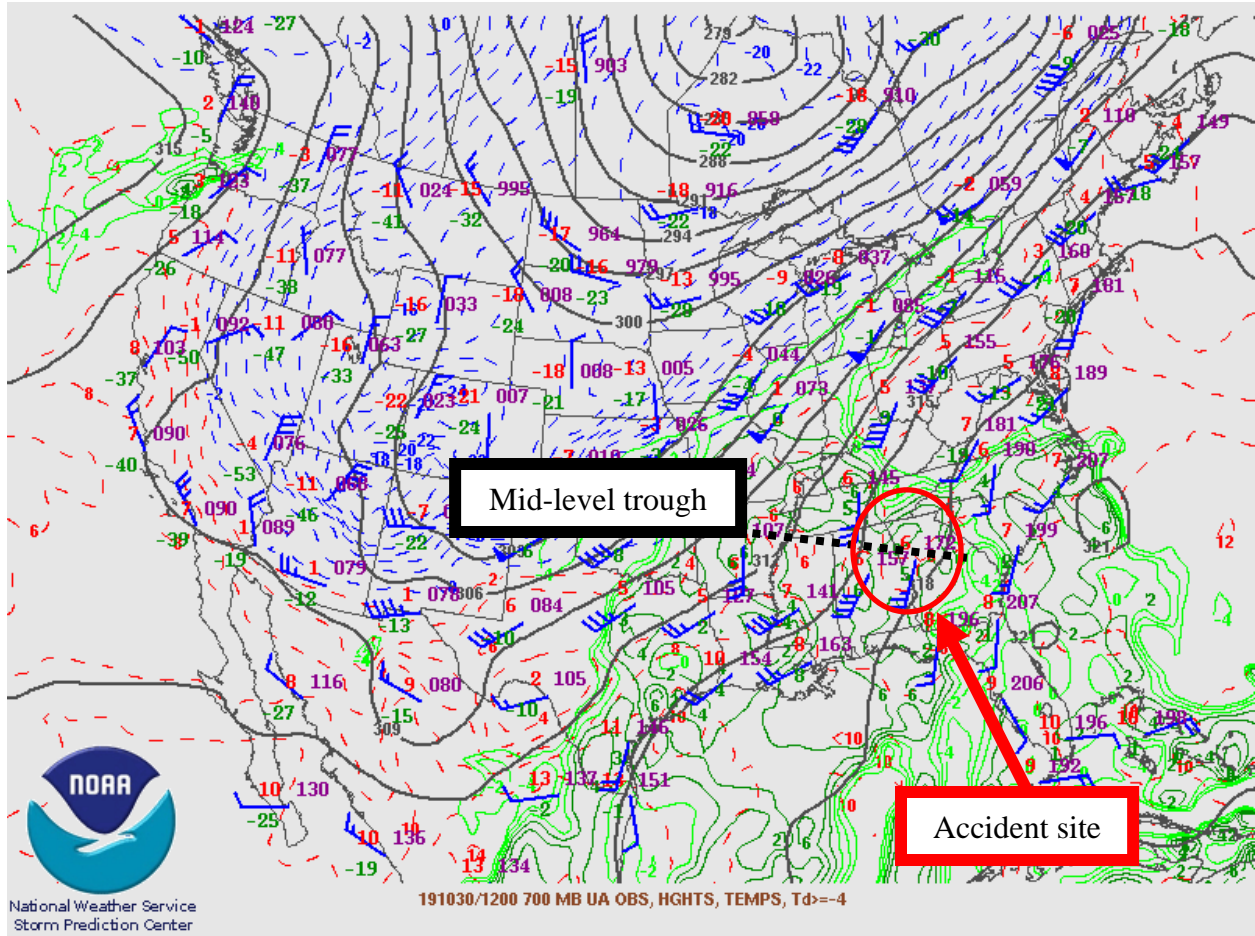


Figure 4 – 700-hPa Constant Pressure Chart for 0800 EDT

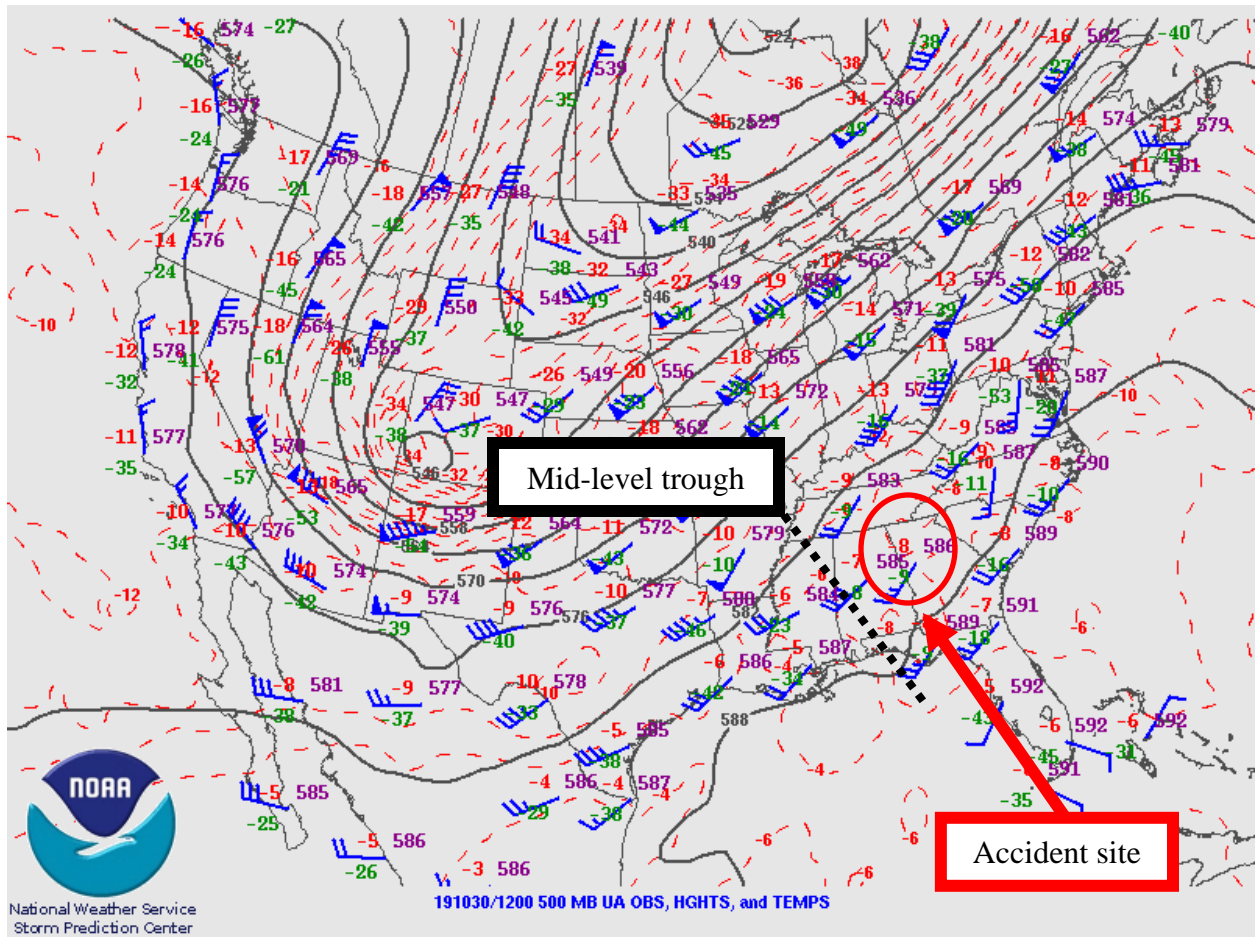


Figure 5 – 500-hPa Constant Pressure Chart for 0800 EDT



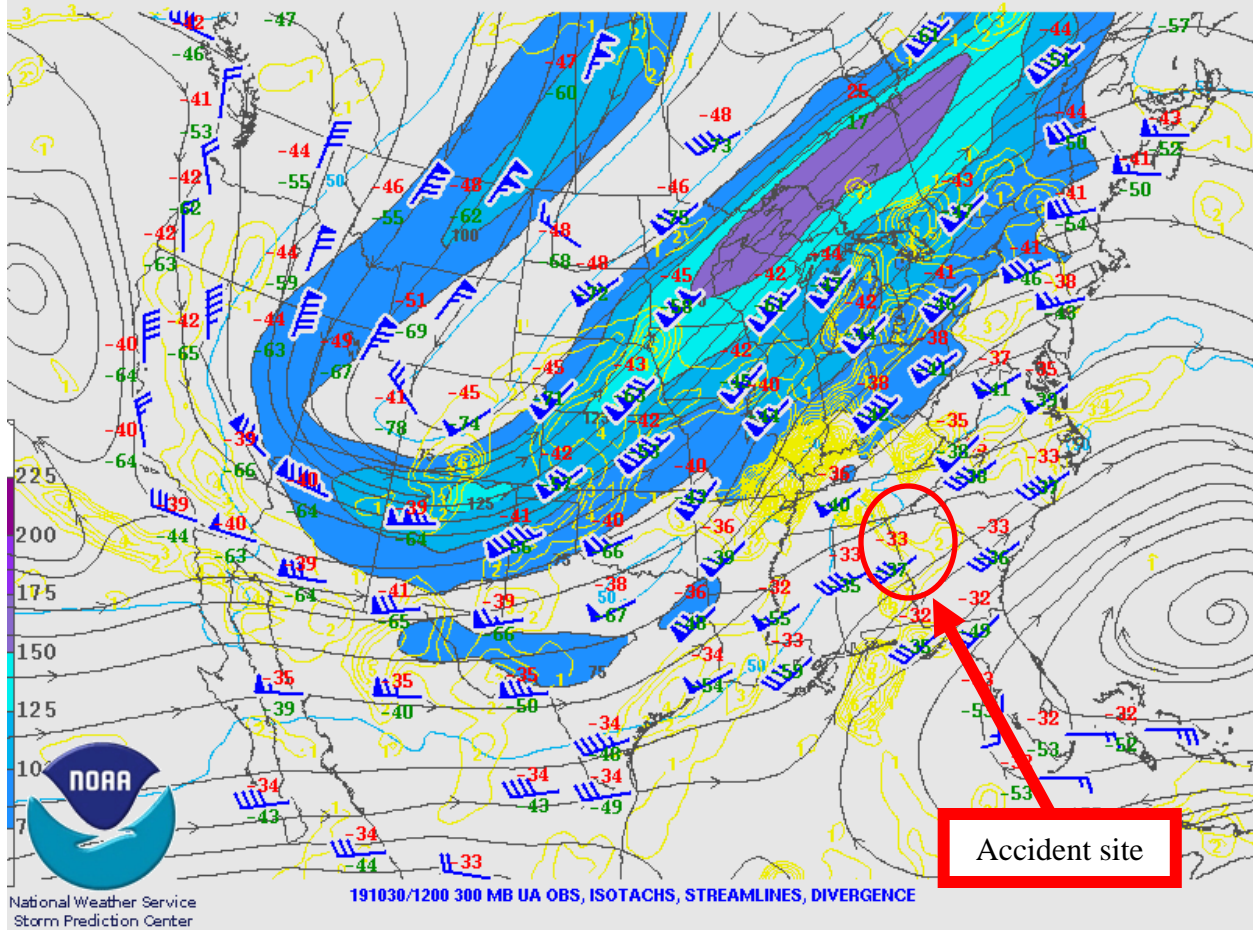
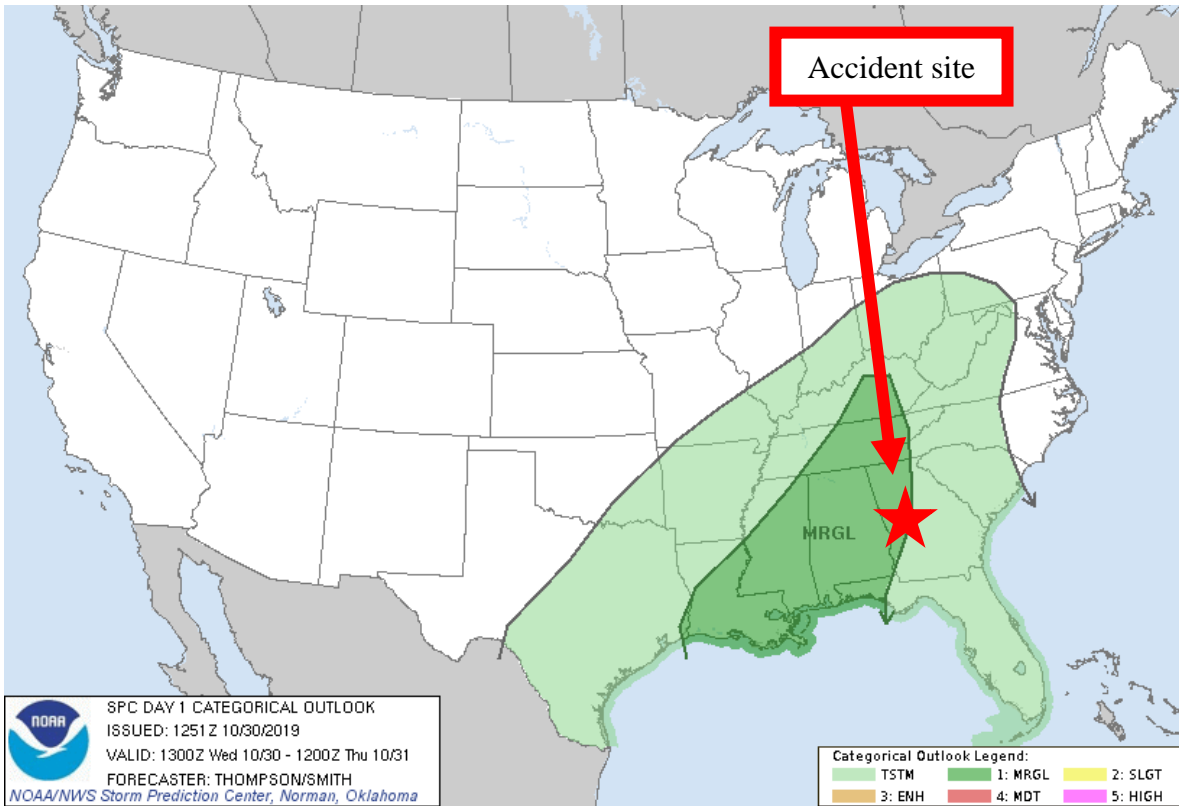


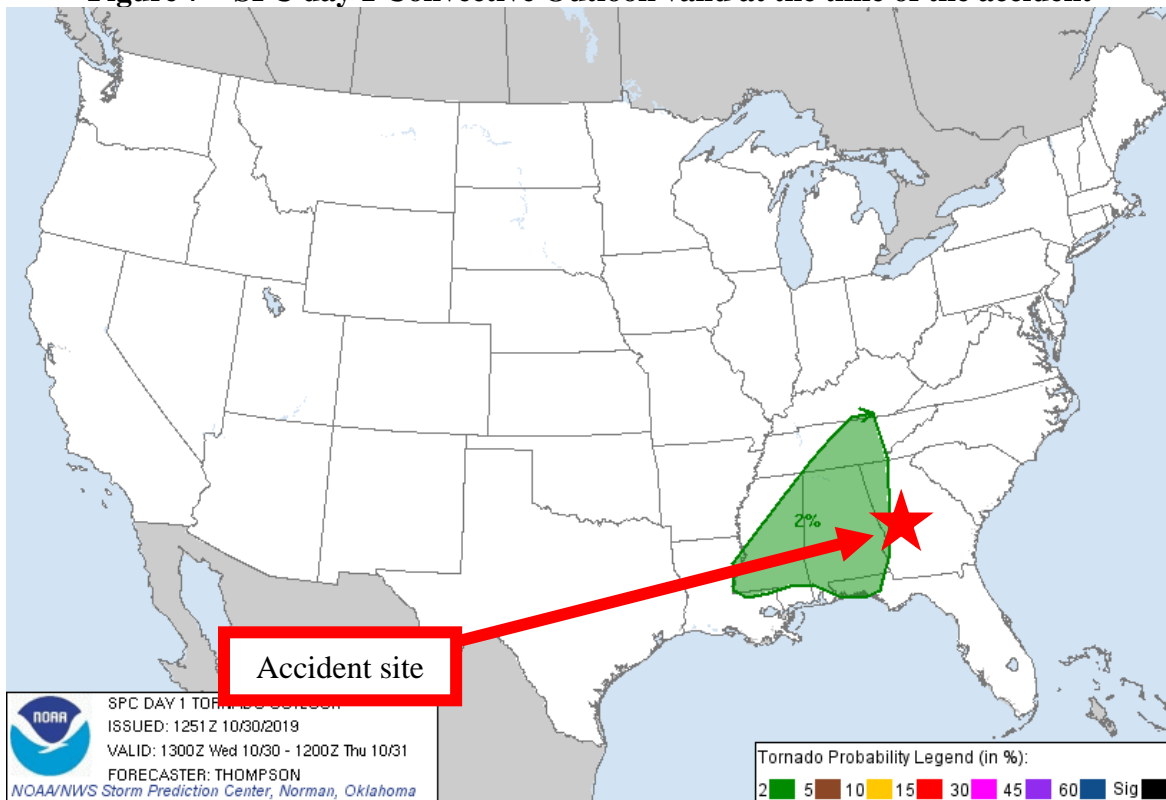
Figure 6 – 300-hPa Constant Pressure Chart for 0800 EDT

## 2.0 SPC Convective Outlook

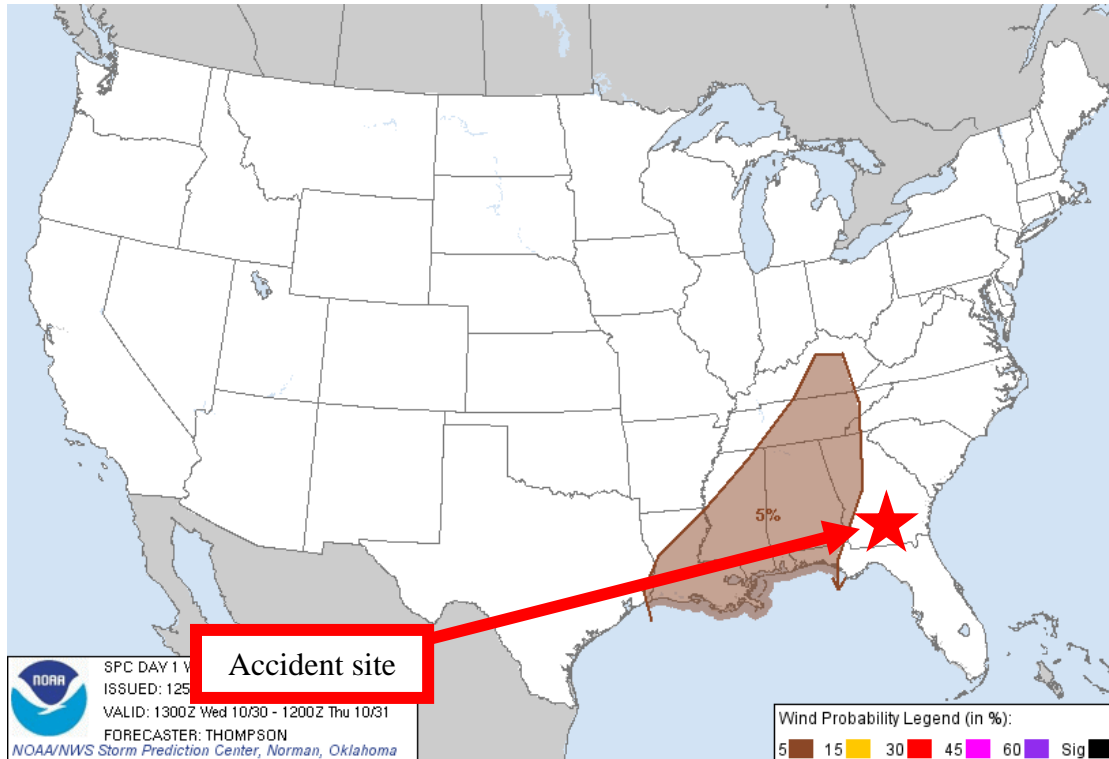
SPC issued the following Day 1 Convective Outlook at 0851 EDT (figure 7) with areas of thunderstorms and a marginal risk for severe thunderstorm forecast over Louisiana, Mississippi, Alabama, Tennessee, Kentucky, northwest Georgia, and the Florida Panhandle, and included the area over the accident site. The accident site was located in an area where SPC forecasted a 2 percent chance of a tornado within 25 miles of a point (figure 8) and a 5 percent chance of damaging thunderstorm winds or wind gusts 50 knots or greater within 25 miles of a point (figure 9). These chances for severe thunderstorms are well above normal climatology for this time of year in late October for Georgia. The SPC Day 1 Convective Outlook text follows figure 9:



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



**Figure 8 – SPC day 1 Tornado Outlook valid at the time of the accident**



**Figure 9 – SPC day 1 Wind Outlook valid at the time of the accident**

SPC AC 301251

Day 1 Convective Outlook  
NWS Storm Prediction Center Norman OK  
0751 AM CDT Wed Oct 30 2019

Valid 301300Z - 311200Z

...THERE IS A MARGINAL RISK OF SEVERE THUNDERSTORMS THROUGH TONIGHT FROM THE NORTHERN GULF COAST TO THE TN VALLEY...

...SUMMARY...

A few strong to severe thunderstorms are possible during the day across the northern Gulf Coast states, with a threat evolving overnight into parts of Tennessee. Localized wind damage or a brief tornado will be possible.

...Northern Gulf coast to TN Valley through tonight...

A pronounced midlevel shortwave trough over CO will progress eastward toward MO tonight, while strengthening and taking on a more neutral tilt. Surface cyclogenesis is expected downstream from the midlevel trough, across the lower OH Valley overnight along a pre-existing baroclinic zone. South of the developing cyclone, the cold front will begin to surge eastward tonight across the lower MS and TN Valleys.

Low-level moisture is spreading north-northeastward this morning across southern MS/AL, and the warm sector should expand northward into the TN Valley by tonight. Some surface heating will occur

today across central/southern MS/AL where cloud breaks occur in the warm sector. However, the warm-advection pattern observed this morning, and related low-level shear, will tend to weaken through the afternoon. The net result will be a low-end threat for rotating storms this morning near the coast and within the expanding warm sector inland later today, with the possibility for isolated strong gusts and/or a brief tornado.

Overnight, convection should begin to organize in a band along the surging cold front from northeast MS into northern AL and middle TN. Low-midlevel lapse rates will be poor, but weak surface-based buoyancy will be driven largely by boundary-layer dewpoints in the upper 60s north to lower 70s south. Strengthening deep-layer flow/vertical shear in conjunction with the OH Valley cyclogenesis, and the weakly unstable warm sector (MLCAPE near 500 J/kg) will favor some threat for damaging gusts with the frontal convection, mainly after 06z.

..Thompson/Smith.. 10/30/2019

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NOTE: THE NEXT DAY 1 OUTLOOK IS SCHEDULED BY 1630Z

### **3.0 Surface Observations**

The area surrounding the accident site was documented using official Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). Figure 10 is a sectional chart with the accident site and the closest weather reporting location to the accident site marked.

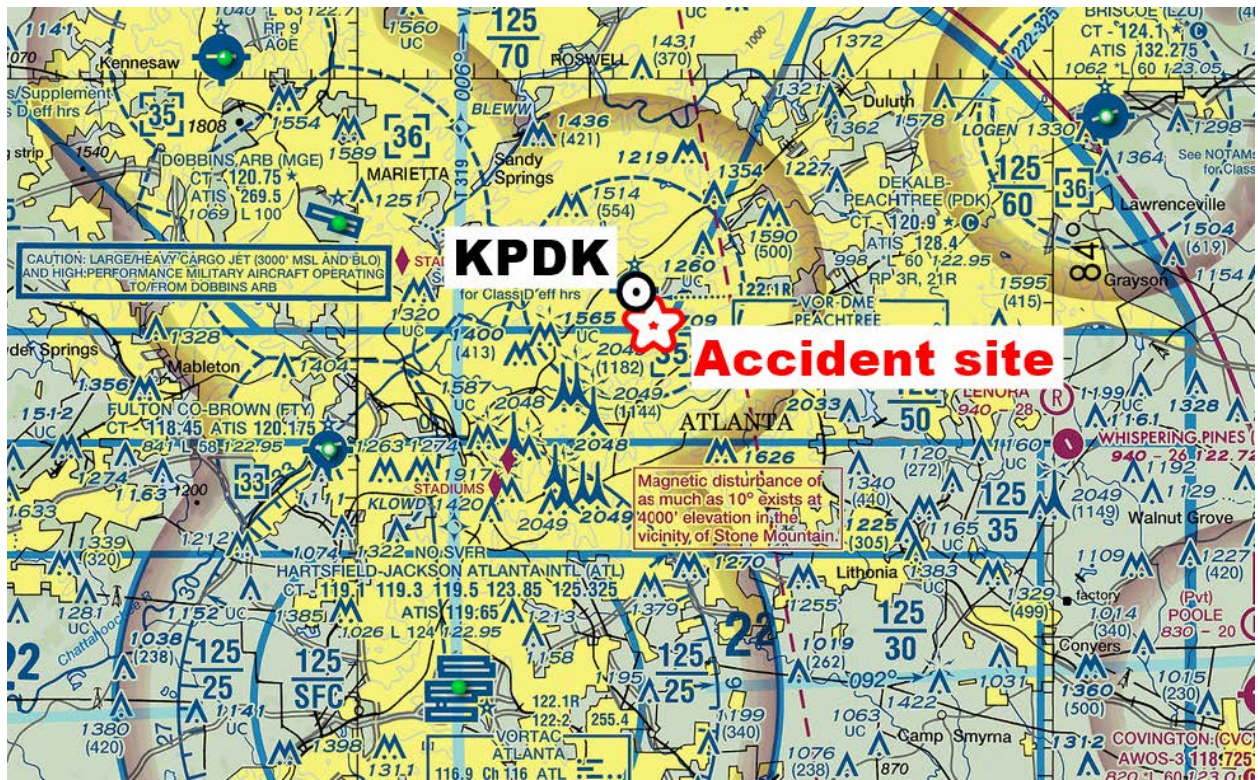


Figure 10 – Sectional chart of accident area with the location of the accident site and the closest surface observation site

The closest official weather reporting facility to the accident site was from Dekalb-Peachtree Airport (KPKK), Atlanta, Georgia, at an elevation of 998 ft, located 1 mile northwest of the accident site (figure 10). KPKK had an Automated Surface Observing System (ASOS)<sup>3</sup> whose reports were supplemented by air traffic control (ATC) when the tower was in operation<sup>4</sup>. KPKK had a 5° westerly magnetic variation<sup>5</sup>. The following observations were taken and disseminated during the times surrounding the accident:<sup>6</sup>

[0720 EDT] SPECI KPKK 301120Z VRB04KT 4SM BR OVC002 19/19 A3011 RMK  
AO2 T01890189=

[0753 EDT] METAR KPKK 301153Z 10003KT 4SM BR OVC003 19/19 A3011 RMK  
AO2 SLP189 60008 70011 T01890189 10189 20178 50001=

[0853 EDT] METAR KPKK 301253Z VRB03KT 8SM -RA OVC006 19/19 A3011 RMK  
AO2 RAB1159 CIG 003V009 SLP186 P0002 T01940189=

<sup>3</sup> ASOS – Automated Surface Observing System is equipped with meteorological instruments to observe and report wind, visibility, present weather, cloud cover, temperature, dewpoint, altimeter, and barometric pressure, and other supplementary information.

<sup>4</sup> ATC hours from 0600 to 2300 local.

<sup>5</sup> Magnetic variation – The angle (at a particular location) between magnetic north and true north. Latest measurement taken from <https://skyvector.com/>

<sup>6</sup> Bolded sections in this report highlight information that directly reference the weather conditions that affected the accident location around the accident time.

[0905 EDT] SPECI KPDK 301305Z 13006KT 10SM -RA OVC004 19/19 A3011 RMK AO2 P0001 T01940189=

[0953 EDT] METAR KPDK 301353Z VRB06KT 6SM BR OVC004 19/19 A3011 RMK AO2 RAE15B31E47 SLP188 P0001 T01940194=

**[1014 EDT] SPECI KPDK 301414Z 14006KT 1 3/4SM -RA BR OVC004 19/19 A3011 RMK AO2 RAB03 P0002 T01940194=**

**ACCIDENT TIME 1021 EDT**

**[1027 EDT] SPECI KPDK 301427Z VRB05KT 3SM -RA BR OVC004 19/19 A3011 RMK AO2 RAB03 CIG 003V010 P0005 T01940194=**

[1044 EDT] SPECI KPDK 301444Z 15005KT 5SM -RA BR OVC005 19/19 A3011 RMK AO2 RAB03 CIG 003V008 P0006 T01940194=

[1053 EDT] METAR KPDK 301453Z 15004KT 8SM -RA BKN006 OVC009 19/19 A3011 RMK AO2 RAB03 SLP186 P0006 60009 T01940194 56003=

KPDK weather at 1014 EDT, wind from 140° at 6 knots, 1 3/4 miles visibility, light rain, mist, an overcast ceiling at 400 ft above ground level (agl), temperature of 19°Celsius (C), dew point temperature of 19°C, and an altimeter setting of 30.11 inches of mercury (inHg). Remarks: automated station with a precipitation discriminator, rain began 1003 EDT, 0.02 inches of precipitation since 0953 EDT, temperature 19.4°C, dew point temperature 19.4°C.

KPDK weather at 1027 EDT, variable wind 5 knots, 3 miles visibility, light rain, mist, an overcast ceiling at 400 ft agl, temperature of 19°C, dew point temperature of 19°C, and an altimeter setting of 30.11 inHg. Remarks: automated station with a precipitation discriminator, rain began 1003 EDT, ceiling varying between 300 to 1,000 ft agl, 0.05 inches of precipitation since 0953 EDT, temperature 19.4°C, dew point temperature 19.4°C.

The observations for KPDK surrounding the period indicated LIFR<sup>7</sup> ceiling conditions with a southeast wind to 6 knots and light rain.

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<sup>7</sup> 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.

#### 4.0 Upper Air Data

The NWS Atlanta/Peachtree City, Georgia, (KFFC) was the closest site with an upper air sounding and was 33 miles south-southwest of the accident site at 866 ft, and had a station ID of 72215. The 0800 EDT KFFC sounding was plotted on a standard Skew-T Log P diagram<sup>8</sup> with the derived stability parameters included in figure 11 with data from the surface to 700-hPa (or approximately 10,000 ft msl). This data was analyzed using the RAOB<sup>9</sup> software package. The sounding depicted the lifted condensation level (LCL)<sup>10</sup> at 210 ft agl (1,076 ft msl) and the convective condensation level (CCL)<sup>11</sup> at 2,750 ft agl (3,616 ft msl). The sounding had a greater than 90% relative humidity from the surface through 7,000 ft msl. The freezing level was located at 14,476 ft msl. The precipitable water value was 1.93 inches.

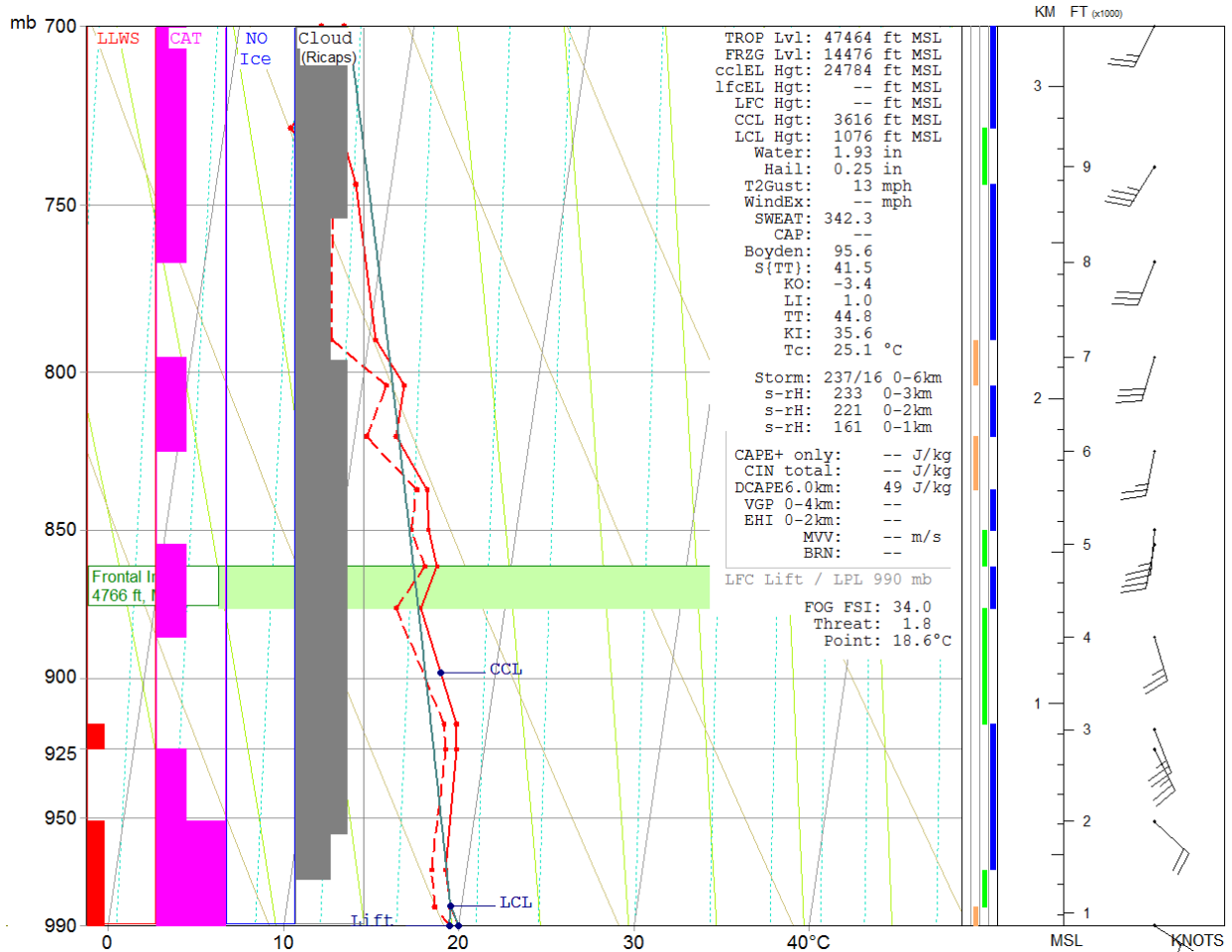
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<sup>8</sup> Skew T log P diagram – is a standard meteorological plot using temperature and the logarithmic of pressure as coordinates, used to display winds, temperature, dew point, and various indices used to define the vertical structure of the atmosphere.

<sup>9</sup> RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamoras, Pennsylvania.

<sup>10</sup> LCL - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

<sup>11</sup> 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 11 – 0800 EDT KFFC sounding**

The 0800 EDT KFFC sounding for the accident site indicated alternating layers of conditional instability and stability from the surface through ~9,500 ft msl. RAOB identified the possibility of clouds from ~650 ft agl through ~10,000 ft msl. RAOB did not indicate the possibility of icing conditions below 10,000 ft msl. RAOB indicated a frontal inversion<sup>12</sup> was in place above the accident site at 4,766 ft msl with clouds indicated below those inversion layers (figure 11).

The 0800 EDT KFFC sounding wind profile indicated a surface wind from 125° at 3 knots with the wind veering<sup>13</sup> to the south by 5,000 ft msl. The wind speed increased to 20 knots by 2,000 ft. RAOB indicated the possibility of light low-level wind shear (LLWS) between the surface and ~2,000 ft agl (~2,900 ft msl). RAOB indicated moderate or greater clear-air turbulence (CAT) existed in several layers between the surface and 10,000 ft msl.

<sup>12</sup> Inversion – A departure from the usual decrease of the value of an atmospheric property with increasing altitude; also, the layer through which this departure occurs (the "inversion layer"), or the lowest altitude at which the departure is found (the "base of the inversion").

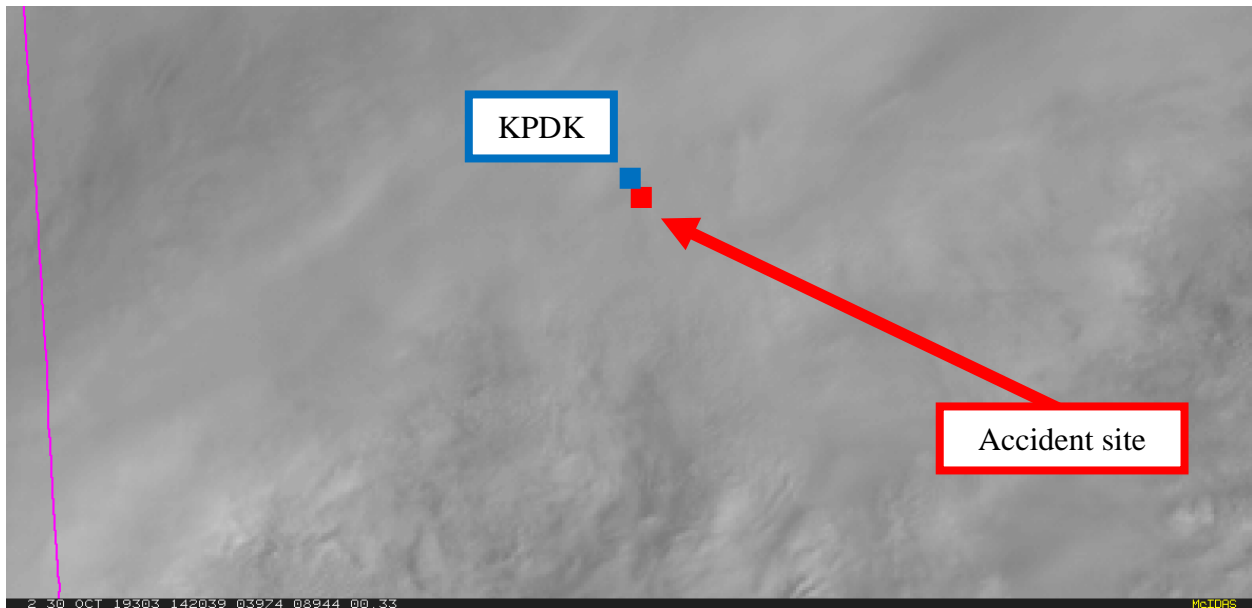
<sup>13</sup> A clockwise turning of the wind with height in the northern hemisphere.



## 5.0 Satellite Data

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. Visible (band 2) and infrared (bands 13) imagery at wavelengths of 0.64 microns ( $\mu\text{m}$ ) and 10.3  $\mu\text{m}$ , respectively, were retrieved for the period. Satellite imagery surrounding the time of the accident, from 0800 EDT through 1400 EDT at approximately 5-minute intervals were reviewed, and the closest images to the time of the accident are documented here.

Figure 12 is the GOES-16 visible imagery from 1020 EDT at 3X magnification with the accident site highlighted with a red square. Inspection of the visible imagery indicated cloud cover over the accident site at the accident time with the cloud cover moving from southwest to northeast (attachment 1). Figure 13 is the GOES-16 infrared imagery from 1020 EDT at 6X magnification and with a temperature enhancement curve applied with the accident site highlighted with a red square. Inspection of the infrared imagery indicated cloud cover over the accident site at the accident time with the lowest brightness temperatures (blue and green colors, higher clouds) located to the west through north of the accident site. Based on the brightness temperatures above the accident site (231 Kelvin) and the vertical temperature profile provided by the 0800 EDT KFFC sounding, the approximate cloud-top heights over the accident site were 34,000 ft at 1020 EDT. It should be noted these figures have not been corrected for any parallax error.



**Figure 12 – GOES-16 visible image at 1020 EDT**

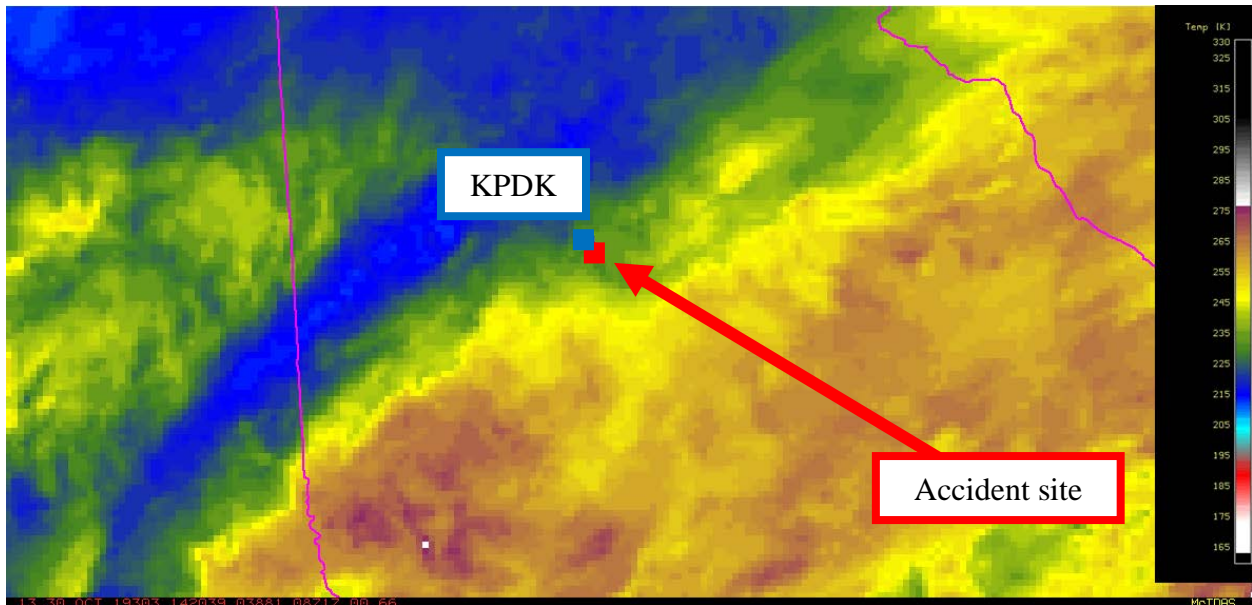
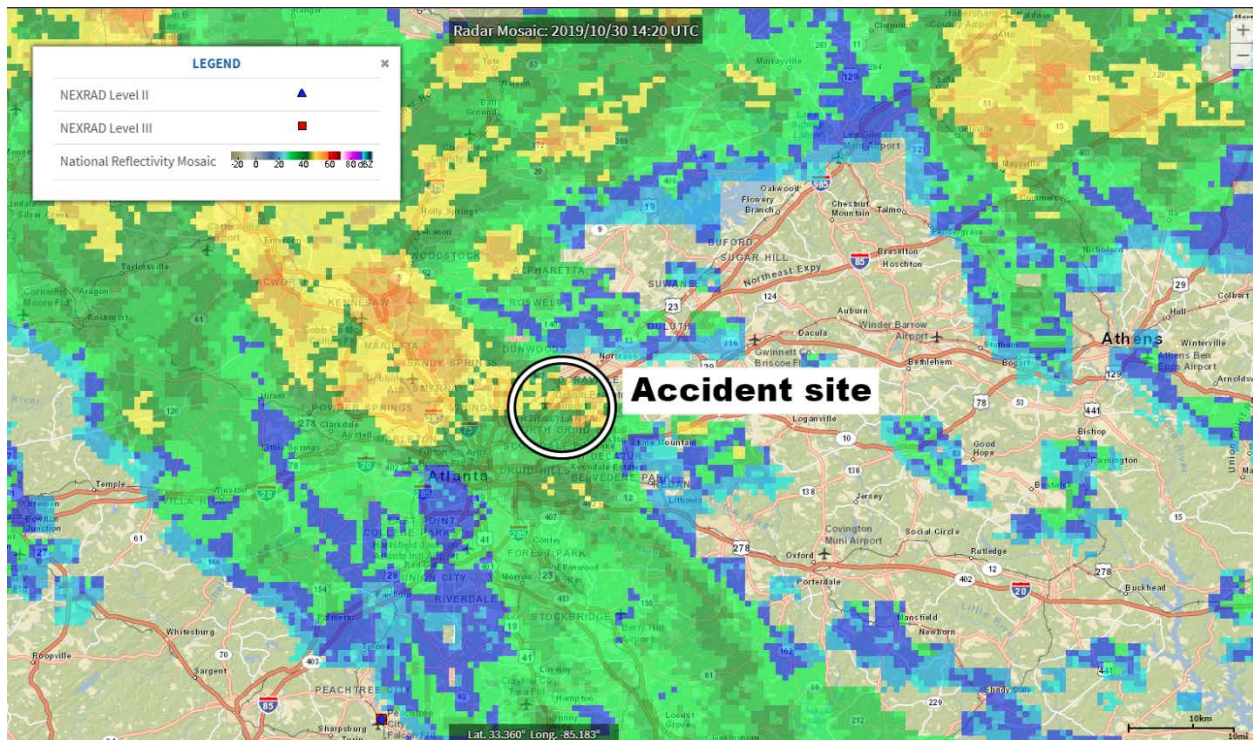


Figure 13 – GOES-16 infrared image at 1020 EDT

## 6.0 Regional Radar Imagery Information

A regional view of the NWS national composite radar mosaic is included as figure 14 for 1020 EDT with the approximate location of the accident site marked within a white circle. The image depicted an area of echoes extending northwest to southeast across the accident site with echoes of 30 to 50 decibels (dBZ<sup>14</sup>) in the vicinity of the accident site.

<sup>14</sup> 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 14 – Regional Composite Reflectivity image for 1020 EDT**

## 7.0 Weather Radar Imagery

The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D)<sup>15</sup> to the accident site was KFFC. 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.

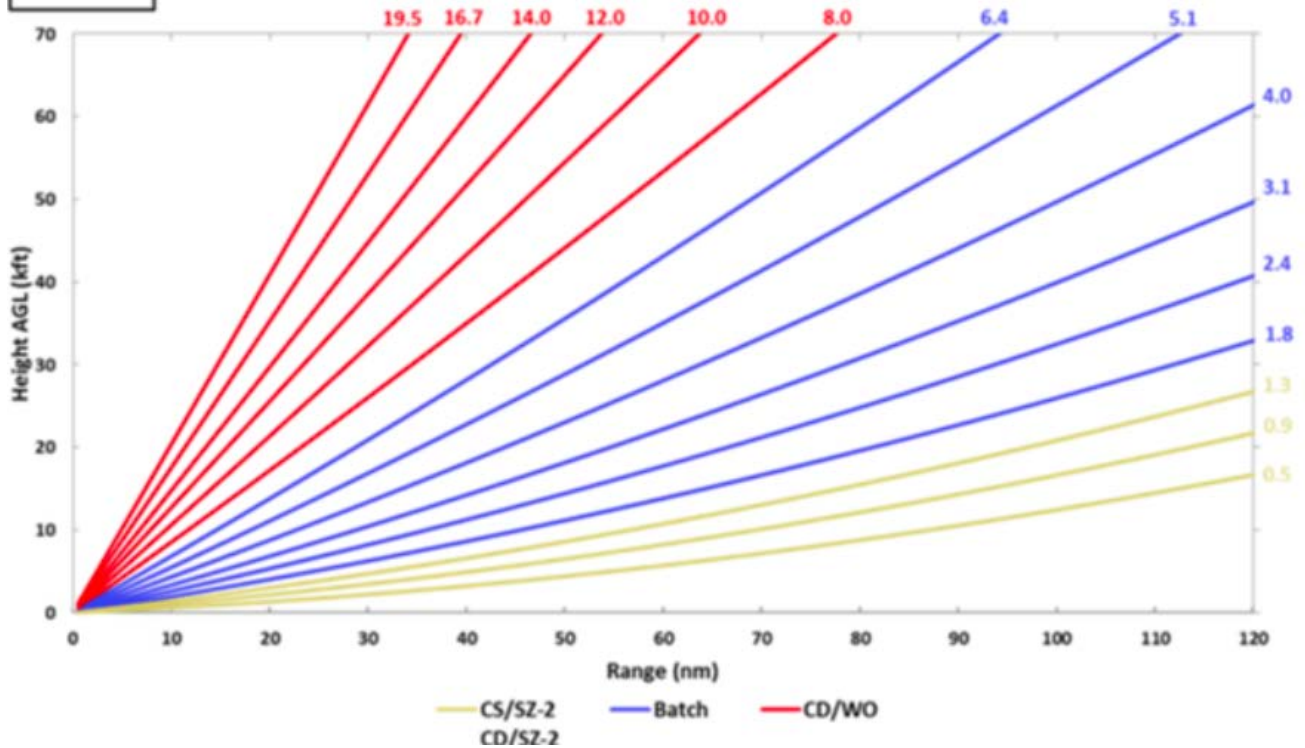
### 7.1 Volume Scan Strategy

The WSR-88D is a computer-controlled radar system, which automatically creates a complete series of specific scans in a specific sequence known as a volume scan. Individual elevation scans are immediately available. Products that require data from multiple elevation scans are not available until the end of the five to ten-minute volume scan.

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

<sup>15</sup> 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.

## VCP 215



**VCP-215 Precipitation Mode Scan Strategy<sup>16</sup>**

### 7.2 Beam Height Calculation

Assuming standard refraction<sup>17</sup> of the WSR-88D radar beam with the antenna elevation at 972 ft (KFFC), and considering a beamwidth<sup>18</sup> of 0.95°, the following table shows the approximate heights for the radar beam center, top and base for antenna elevations over the accident site. These heights have been rounded to the nearest 10 ft.

ANTENNA ELEVATION	BEAM CENTER	BEAM BASE	BEAM TOP
KFFC 0.5°	3,510 ft	1,880 ft	5,140 ft

<sup>16</sup> 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)

<sup>17</sup> Standard Refraction in the atmosphere is when the temperature and humidity distributions are approximately average, and values set at the standard atmosphere.

<sup>18</sup> Beamwidth - the angular separation between the half power points on the antenna radiation pattern, where the gain is one half the maximum value.

Based on the radar height calculations, the elevation scans from KFFC listed in the above table depicted the conditions between 1,880 ft and 5,140 ft msl over the accident site and these scans “saw” the closest altitudes to the surface at the accident time.

### 7.3 Reflectivity

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors<sup>19</sup> 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 00-24C<sup>20</sup>, “Thunderstorms,” dated February 19, 2013, also defines the echo intensity levels and weather radar echo intensity terminology associated with those levels. For dBZ values less than 30 the weather radar echo intensity terminology should be “light.” For dBZ values between 30 and 40, the terminology should be “moderate.” “Heavy” terminology is used for dBZ values greater than 40 dBZ but less than 50 dBZ, inclusive. Finally, any dBZ values above 50 dBZ shall be described as “extreme.” From the NWS, precipitation conditions at the surface can be inferred from VIP Levels described in the list below:

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

### 7.4 Base Reflectivity and Lightning Data

Figures 15, 16, and 17 present the KFFC WSR-88D base reflectivity images for the 0.5° elevation scans initiated at 1016:37, 1022:04, and 1027:30 EDT, respectively, with the flight track of N56258 overlaid in pink. The images had a resolution of 0.5° X 250 m. Reflectivity values between 20 and 35 dBZ or light to moderate intensity echoes (section 7.3) were located above the accident site at the accident time. The reflectivity bands were moving from southwest to northeast near the accident site (attachment 2).

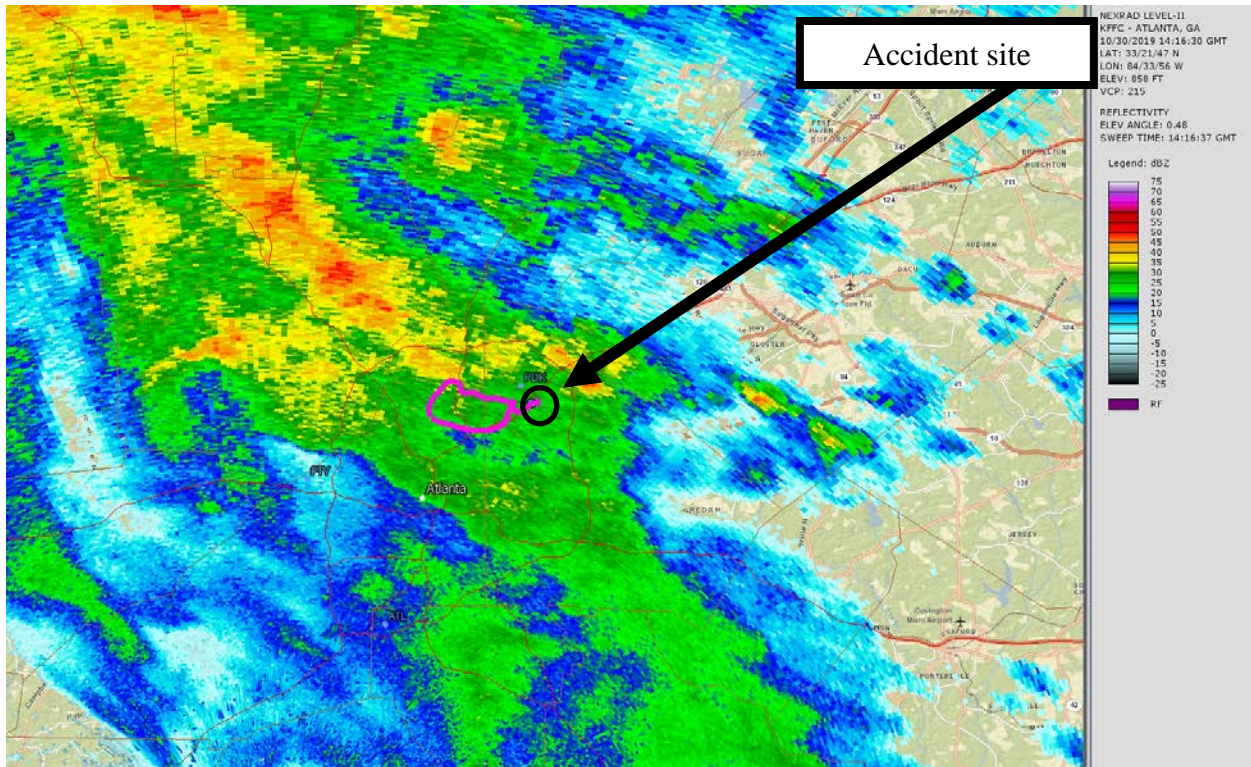
There were no lightning strikes around the accident site at the accident time.<sup>21</sup>

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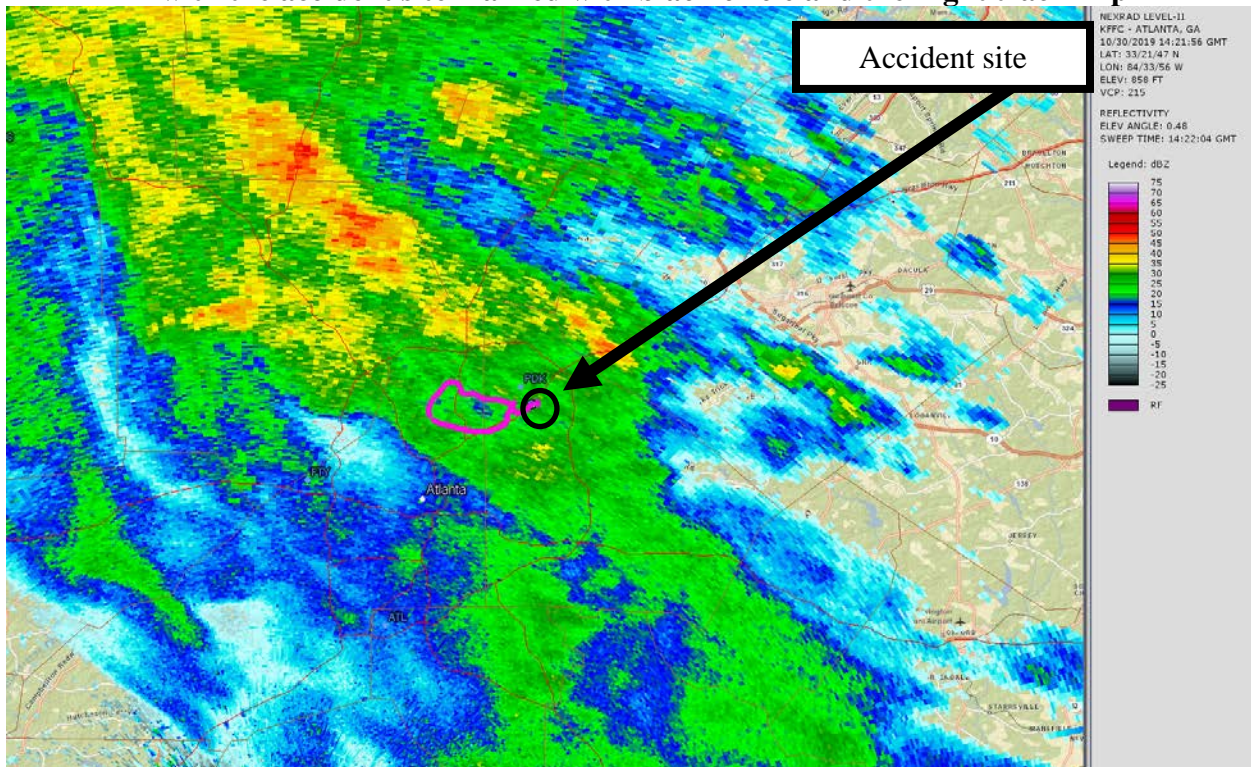
<sup>19</sup> Hydrometeors are any product of condensation or sublimation of atmospheric water vapor, whether formed in the free atmosphere or at the earth’s surface; also, any water particles blown by the wind from the earth’s surface. Hydrometeors are classified as; (a) Liquid or solid water particles 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.

<sup>20</sup> Terminology used primary by ATC for broadcast of precipitation intensity: [https://www.faa.gov/regulations\\_policies/advisory\\_circulars/index.cfm/go/document/information/documentID/1020774](https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document/information/documentID/1020774)

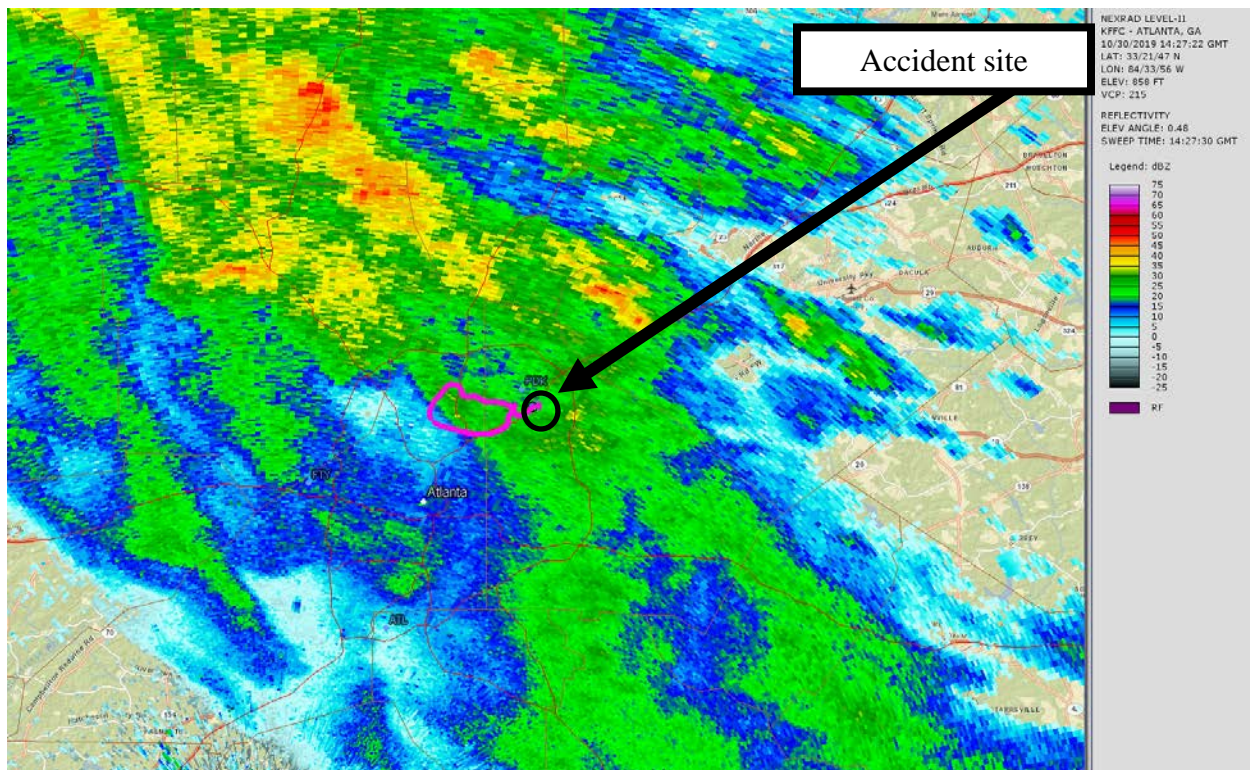
<sup>21</sup> A review of Earth Networks Total Lightning network was done.



**Figure 15 – KFFC WSR-88D reflectivity for the 0.5° elevation scan initiated at 1016:37 EDT with the accident site marked with black circle and the flight track in pink**



**Figure 16 – KFFC WSR-88D reflectivity for the 0.5° elevation scan initiated at 1022:04 EDT with the accident site marked with black circle and the flight track in pink**



**Figure 17 – KFFC WSR-88D reflectivity for the 0.5° elevation scan initiated at 1027:30 EDT with the accident site marked with black circle and the flight track in pink**

## 8.0 Pilot Reports<sup>22</sup>

All pilot reports (PIREPs) within 75 miles of the accident site from about one hour prior to the accident time to about one hour after the accident time for below 18,000 ft are provided below:

PDK UA /OV PDK/TM 1328/FLDURGC/TP C68A/RM BASES BELOW 400 AGL ON DEPARTURE

TOC UA /OV ODF190030/TM 1330/FL171/TP MD80/TB MOD/RM ZTLFD

PDK UA /OV PDK/TM 1330/FLDURGD/TP PC12/SK BASES 1450 MSL

PDK UA /OV PDK/TM 1331/FLDURD/TP C525/SK BASES 1450 MSL

ATL UA /OV WDR/TM 1332/FLCLMB/TP MU2/G/SK BASES OVC004 TOPS OVC032

TOC UA /OV ODF190030/TM 1340/FL150/TP B738/TB LGT/RM ZTLFD

ATL UA /OV FLANC/TM 1353/FL003/TP C550/SK OVC003/RM DURA

RMG UA /OV RMG045010/TM 1413/FL120/TP CRJ2/TB MOD 120/RM ZTLFD

CHA UA /OV GQO100045/TM 1414/FL135/TP CRJ7/TB MOD/RM ZTLFD

<sup>22</sup> Only pilot reports with the World Meteorological Organization (WMO) header UBGA\*\*, UBTN\*\*, UBSC\*\*, UBNC\*\*, and UBAL\*\* identifier were considered.

RMG UA /OV RMG240010/TM 1420/FLDURGD/TP MD88/TA M10/IC LGT RIME 220-170/RM ZTLFD

LZU UA /OV LZU07001/TM 1426/FL014/TP PRM1/RM BASE REPORT 003AGL

ATL UA /OV RWY 10 FINAL/TM 1432/FLDURD/TP MD88/SK BASES003

RMG UA /OV RMG/TM 1441/FL070/TP COL3/SK TOP090/RM ZTLFD

AHN UA /OV GVL135010/TM 1443/FL070/TP BE36/SK TOPS OVC 080

FTY UA /OV FTY/TM 1445/FL1400/TP BE-20

ATL UA /OV FTY/TM 1449/FLDURGC/TP F900/SK OVC 003 OVC 023 TOPS UNKNOWN

LGC UA /OV LGC275045/TM 1453/FL150/TP MD88/TB CONS LGT CHOP 150/RM ZTLFD

PDK UA /OV PDK/TM 1455/FLDURD/TP E545/SK BASES 1300 MSL

PDK UA /OV PDK/TM 1502/FLDURGC/TP C680/SK BASES 1400 MSL

AHN UA /OV 5 W 3J7/TM 1510/FL022/TP LJ75/SK B OVC022/WX IMC

The reports from PDK are provided in plain language taken from standard code and abbreviations, with cloud heights in msl were as follows:

PDK, routine pilot report (UA); Over – Peachtree VORTAC (PDK); Time – 0928 EDT (1328Z); Altitude – During climb; Type aircraft – Cessna Citation Latitude; Remarks – Cloud bases below 400 ft agl on departure.

PDK, routine pilot report (UA); Over – PDK; Time – 0930 EDT (1330Z); Altitude – During descent; Type aircraft – Pilatus PC-12; Sky – Cloud bases at 1,450 ft msl.

PDK, routine pilot report (UA); Over – PDK; Time – 0931 EDT (1331Z); Altitude – During descent; Type aircraft – Cessna 525 Citation Jet; Sky – Cloud bases at 1,450 ft msl.

PDK, routine pilot report (UA); Over – PDK; Time – 1055 EDT (1455Z); Altitude – During descent; Type aircraft – Embraer EMB-545; Sky – Cloud bases at 1,300 ft msl.

PDK, routine pilot report (UA); Over – PDK; Time – 1102 EDT (1502Z); Altitude – During climb; Type aircraft – Cessna Citation Sovereign; Sky – Cloud bases at 1,400 ft msl.

Additional PIREP print out information from ATC is provided in attachment 3. All additional PIREPs from attachment 3 that were distributed into the national airspace.

## 9.0 SIGMET

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

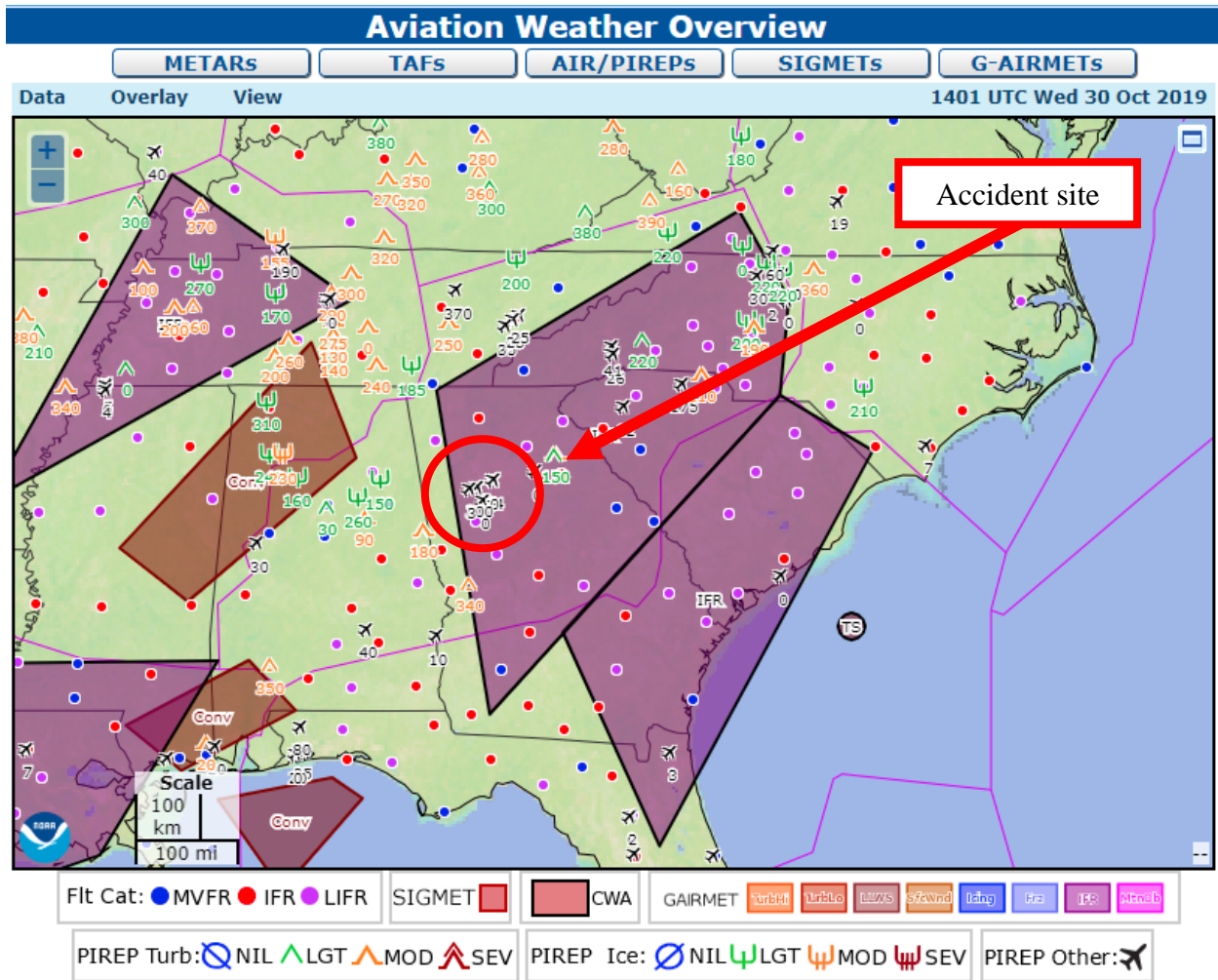


## 10.0 CWSU Advisories

The Atlanta Air Route Traffic Control Center (ARTCC ZTL) Center Weather Service Unit (CWSU) was responsible for the region. There were no Center Weather Service Unit (CWSU) Meteorological Impact Statements (MIS) valid for the accident site at the accident time. Center Weather Advisory (CWA) 103 was valid for the accident site issued at 1000 EDT (figure 18) and warned of areas of patchy LIFR ceilings in fog and rain with conditions expected to continue beyond 1200 EDT. CWA 102 was valid for similar weather conditions for the accident site between 0800 and 1000 EDT. CWA 103 text follows:

FAUS21 KZTL 301400  
 ZTL1 CWA 301400  
 ZTL CWA 103 VALID UNTIL 301600  
 FROM PSK-GSO-45ESE CLT-25N SZW-GQO-PSK  
**AREA PATCHY LIFR CIGS BLW 005 AND VIS BLW 1/2SM IN FG/RA. EXP CONDS TO CONT BYD END OF PD.**

=



**Figure 18 – SIGMETs and CWAs valid at 1001 EDT through the accident time**

## 11.0 AIRMETS

Airmen's Meteorological Information (AIRMET) advisory Sierra was issued at 0729 EDT and was the only AIRMET valid for the accident site at the accident time for below 10,000 ft msl. AIRMET Sierra warned of IFR conditions due to precipitation and mist:

WAUS42 KPCI 301129 AAA  
WA2S  
-MIAS WA 301129 AMD  
AIRMET SIERRA UPDT 2 FOR IFR AND MTN OBSCN VALID UNTIL 301500

.  
**AIRMET IFR...NC SC GA FL AND CSTL WTRS...UPDT  
FROM 20SSW ORF TO 70SSE ECG TO 20SE ILM TO 70ESE CHS TO 50SSE  
SAV TO 20SW ORL TO 20NNW PIE TO 70SSW TLH TO 70SSE SJI TO 40W  
CEW TO 50SW PZD TO GQO TO HMV TO 20SSW ORF  
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 15Z THRU 21Z.**

.  
AIRMET MTN OBSCN...NC SC GA  
FROM HMV TO 20N GSO TO CLT TO ATL TO GQO TO HMV  
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 15Z THRU 21Z.

.  
OTLK VALID 1500-2100Z...MTN OBSCN NC SC GA NY PA WV MD VA  
BOUNDED BY JHW-20NNW SAX-HAR-40SE PSK-CLT-ATL-GQO-HMV-HNN-JHW  
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG THRU 21Z.

....

## 12.0 Graphical Forecasts for Aviation

The Graphical Forecasts for Aviation (GFA) products made available before the accident flight are shown in attachment 4. The GFA surface forecast products indicated IFR to LIFR conditions would be likely for 1100 EDT with likely rain showers (greater than 60 percent chance) with a surface wind from the southeast at 5 to 10 knots. The GFA cloud forecast products indicated an overcast cloud ceiling at 1,100 to 1,600 ft msl with layered clouds through FL260. For more information please see attachment 4.

## 13.0 Terminal Aerodrome Forecast

KPDK was the closest site with a NWS Terminal Aerodrome Forecast (TAF) and the KPDK TAF valid at the accident time was issued at 0732 EDT and was valid for a 24-hour period beginning at 0800 EDT. The 0732 EDT TAF for KPDK was as follows:

TAF KPDK 301132Z 3012/3112 **11004KT 4SM -RA BR OVC004**  
TEMPO 3012/3013 1SM -SHRA BR OVC003  
FM301500 12007KT 3SM -RA BR OVC005  
FM302300 15006KT 2SM -RA BR OVC004  
PROB30 3101/3105 3SM -TSRA BKN006CB  
FM310600 17007KT 4SM -SHRA BR OVC007=

The TAF expected a wind from 110° at 4 knots, 4 miles visibility, light rain, mist, and an overcast ceiling at 400 ft agl.

## 14.0 NWS Area Forecast Discussion

The NWS Office in Peachtree City, Georgia, issued the following Area Forecast Discussion (AFD) at 0735 EDT (closest AFD to the accident time with an aviation section). The aviation section of the AFD discussed continued IFR to LIFR conditions in showers and fog through the day with little improvement expected:

FXUS62 KFFC 301138  
AFDFFC

Area Forecast Discussion...Updated for Aviation  
National Weather Service Peachtree City GA  
735 AM EDT Wed Oct 30 2019

...Morning Area Forecast Discussion...

.SHORT TERM /Today through Thursday/...

Deep moisture will continue to stream into the forecast area ahead of a strong upper trough now deepening in the Plains. This trough will gradually swing eastward through Thursday. North and central GA can expect several rounds of showers during this time. CAPE increases over the area mainly this afternoon and into the overnight. Thunder still looks reasonable area wide for 18z today through the end of the period. An isolated severe thunderstorm is possible mainly this evening and overnight as the surface cold front approaches the state. By late morning or early afternoon Thursday the front should be moving into northwest GA. Have tapered pops off starting in the far northwest Thursday afternoon.

Clouds and periods of rain should limit the diurnal spread through the period. At this time...not confident enough to issue a Flash Flood Watch for any of the area. The next shift can monitor accumulations and how the rainfall evolves over north and central GA.

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.LONG TERM /Thursday Night through Tuesday/...

By Thursday Night, the main line of showers and thunderstorms out ahead of the cold front are expected to have moved out of the forecast area with a weak line of residual light showers accompanying the frontal boundary which will also move through and out of the forecast area by Thursday night.

After the FROPA, a surface high pressure will spread across the southeastern CONUS and cool, dry air will move into Georgia through the weekend with PWATS expected to fall below a quarter of an inch. Areas of far northern Georgia are also forecast to reach

freezing for the first time during the cool season on Friday morning. An additional cold front, associated by a secondary shortwave moving across the Midwest, is expected Saturday afternoon, but given the dry air in place it should result in nothing more than a wind shift with another stout, surface high pressure moving across the state Saturday night through Sunday night. Highs will be consistent Friday through Sunday and are forecast to be in the mid- to upper- 50s, around 60, and in the mid- to upper- 60s, to the northwest, along, and to the southwest of the I-20 corridor, respectfully. Skies will be mostly clear with seasonal winds generally out of the north.

By Monday, the region will transition back to an upper-level southwesterly flow pattern ahead of a broader longwave trough over the CONUS, returning Gulf moisture to the region and increasing PWATS to near an inch by Tuesday with surface dewpoints also rising back into the 50s. The surface high pressure will also shift eastward, resulting in cold air damming against the southern Appalachians with a wedge front shifting into the area. As moist, air overrides the wedge, overcast skies and scatter rain showers are expected to return by early Tuesday morning.

Thiem

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**.AVIATION...  
12Z UPDATE...**

**IFR/LIFR conditions in showers and fog should continue for the day and into tonight. Little improvement is expected during the day today as rain will continue develop and spread across the taf sites.**

Isolated thunder is possible mainly late this afternoon and evening and have included a prob30 for all taf sites after 00z Thursday. Winds will remain east to southeast for the entire period.

//ATL CONFIDENCE  
12Z UPDATE...

Medium on timing of thunder.  
High on remaining elements.

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.PRELIMINARY POINT TEMPS/POPS...  
Athens 72 66 76 38 / 70 70 80 40  
Atlanta 73 68 73 36 / 80 80 90 20  
Blairsville 66 63 69 32 / 90 90 90 20  
Cartersville 73 66 73 35 / 80 80 90 10  
Columbus 78 69 77 39 / 70 70 80 20  
Gainesville 69 66 74 38 / 90 80 90 20  
Macon 78 68 81 40 / 60 50 70 40

Rome 73 65 72 34 / 90 90 90 10  
Peachtree City 74 68 75 36 / 70 80 80 20  
Vidalia 82 71 86 48 / 50 30 50 50

&&

.FFC WATCHES/WARNINGS/ADVISORIES...

NONE.

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## 15.0 Winds and Temperature Aloft Forecast

The NWS 0952 EDT Winds and Temperature Aloft forecast valid for 1400 EDT for the closest point to the accident site is included below:

FBUS31 KWN0 301352

FD1US1

DATA BASED ON 301200Z

VALID 301800Z FOR USE 1400-2100Z. TEMPS NEG ABV 24000

FT	3000	6000	9000	12000	18000	24000	30000	34000	39000
ATL	1931	2039+14	2240+09	2334+04	2436-08	2639-18	254233	245243	236656

The accident site was closest to the Atlanta, Georgia (ATL) forecast point. The ATL forecast for use between 1000 and 1700 EDT indicated a wind at 3,000 ft from 190° at 31 knots and at 6,000 ft a wind from 200° at 39 knots with a temperature of 14°C.

## 16.0 Pilot Weather Briefing

The accident pilot did not request nor receive a weather briefing through The FAA contract Automated Flight Service Station provider Leidos or filed any flight plan.

A check of ForeFlight was done and revealed that the accident pilot did not request a weather briefing through ForeFlight. It is unknown if the accident pilot checked or received any additional weather information before or during the accident flight.

## 17.0 Integrated Terminal Weather System Data

The Integrated Terminal Weather System (ITWS)<sup>23</sup> data valid at the accident time was retrieved for the accident region and it is provided in attachment 5.

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<sup>23</sup> [https://www.faa.gov/air\\_traffic/technology/itws/](https://www.faa.gov/air_traffic/technology/itws/)

## 18.0 Astronomical Data

The astronomical data obtained for the accident site on October 30, 2019, indicated the following conditions:

<b>SUN</b>	
Begin civil twilight	0729 EDT
Sunrise	0754 EDT
<b><i>Accident</i></b>	<b><i>1021 EDT<sup>24</sup></i></b>
Sun transit	1321 EDT
Sunset	1847 EDT
End civil twilight	1912 EDT

## E. LIST OF ATTACHMENTS

Attachment 1 – GOES-16 visible imagery animation from 0931 to 1106 EDT

Attachment 2 – KFFC WSR-88D animation from 1004 EDT to 1044 EDT

Attachment 3 – ATC printed PIREPs surrounding accident time

Attachment 4 – GFA products available before the accident flight for around the accident time

Attachment 5 – ITWS data for the accident time

Submitted by:

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Paul Suffern  
Senior Meteorologist

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<sup>24</sup> Inserted accident time for reference and context.

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