



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

May 23, 2017

Weather Study

METEOROLOGY

ERA17FA123

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A. ACCIDENT

Location: Near Apex, North Carolina
Date: March 8, 2017
Time: 1537 Eastern Standard Time
2037 Coordinated Universal Time (UTC)
Airplane: Jordan Pitts S2E, N30BJ

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 traveled to the accident scene for this investigation and also gathered the weather data for this investigation from the NTSB's Washington D.C. office and 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 standard time (EST) on March 8, 2017, and are based upon the 24-hour clock, where local time is -5 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 accident site was located at latitude 35.7522° N, longitude 78.8644° W, at an approximate elevation of 370 feet.

D. WEATHER 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 Surface Analysis Chart

The NWS Surface Analysis Chart for 1600 EST is provided as figure 1 with the approximate location of the accident site marked within the red circle. The chart depicted a surface trough¹ located from central North Carolina (west of the accident site) northward through central Virginia and Maryland. Two surface low pressure systems were located east of the accident site with one surface low pressure system in eastern North Carolina with a pressure of 1020-hectopascals (hPa), and the other surface low pressure system located in eastern South Carolina with a pressure of 1021-hPa. A stationary frontal boundary connected the two surface low pressure systems along the eastern North Carolina and eastern South Carolina coasts. A cold frontal boundary was located in eastern South Carolina stretching southward into the western Atlantic Ocean. A warm front stretched eastward from the surface low pressure system in eastern North Carolina into the western Atlantic Ocean. The station models around the accident site depicted air temperatures in the upper 60's to lower 70's degrees Fahrenheit (°F), dew point temperatures in the upper teens to mid 20's °F, a west-northwest wind of 5 to 15 knots, and mostly clear skies. The surface trough could act as a lifting mechanism for clouds and precipitation if there was sufficient moisture in the atmosphere (section 4.0).

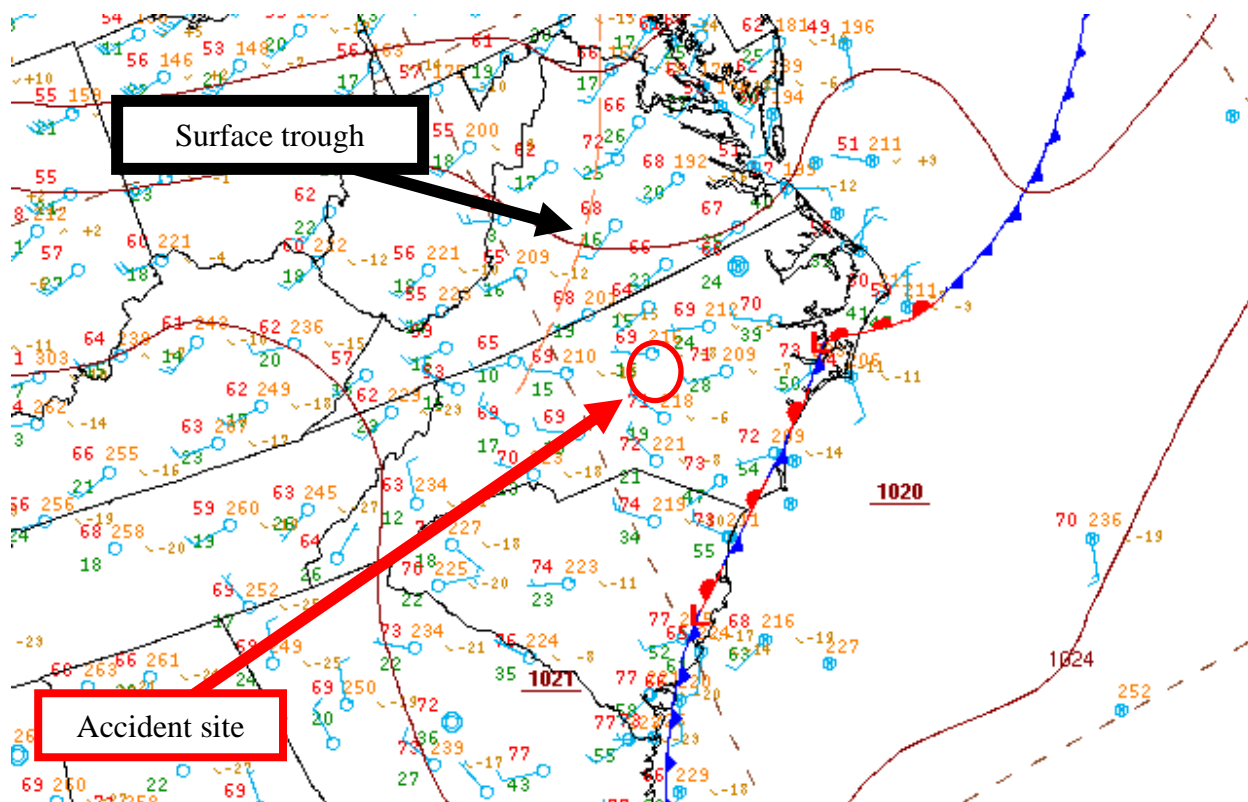


Figure 1 – NWS Surface Analysis Chart for 1600 EST

¹ Trough – An elongated area of relatively low atmospheric pressure or heights.

1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 1900 EST at 925-, 850-, 700-, 500-, and 300-hPa are presented in figures 2 through 6. The accident site was located east of a low-level trough at 925- and 850-hPa (figures 2 and 3). Areas near troughs are often favored locations for enhanced vertical motion, clouds, and precipitation. There was a west wind of 10 knots at 925-hPa (figure 2) with the wind remaining westerly through 700-hPa (figure 4). The wind speed increased to 35 knots by 700-hPa, with a further increase in wind speed to 90 knots by 300-hPa with the wind direction from the west-southwest (figure 6).

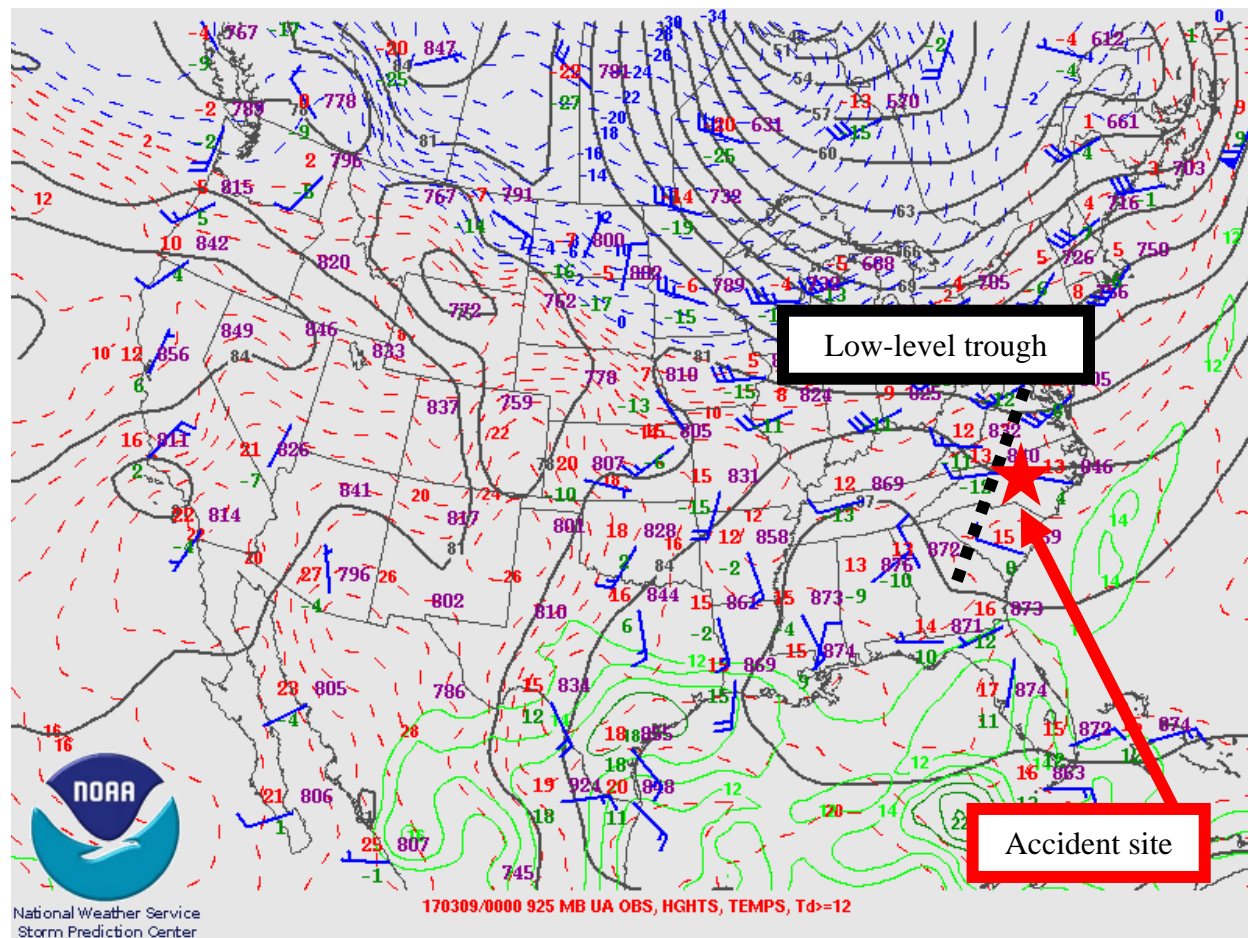


Figure 2 – 925-hPa Constant Pressure Chart for 1900 EST

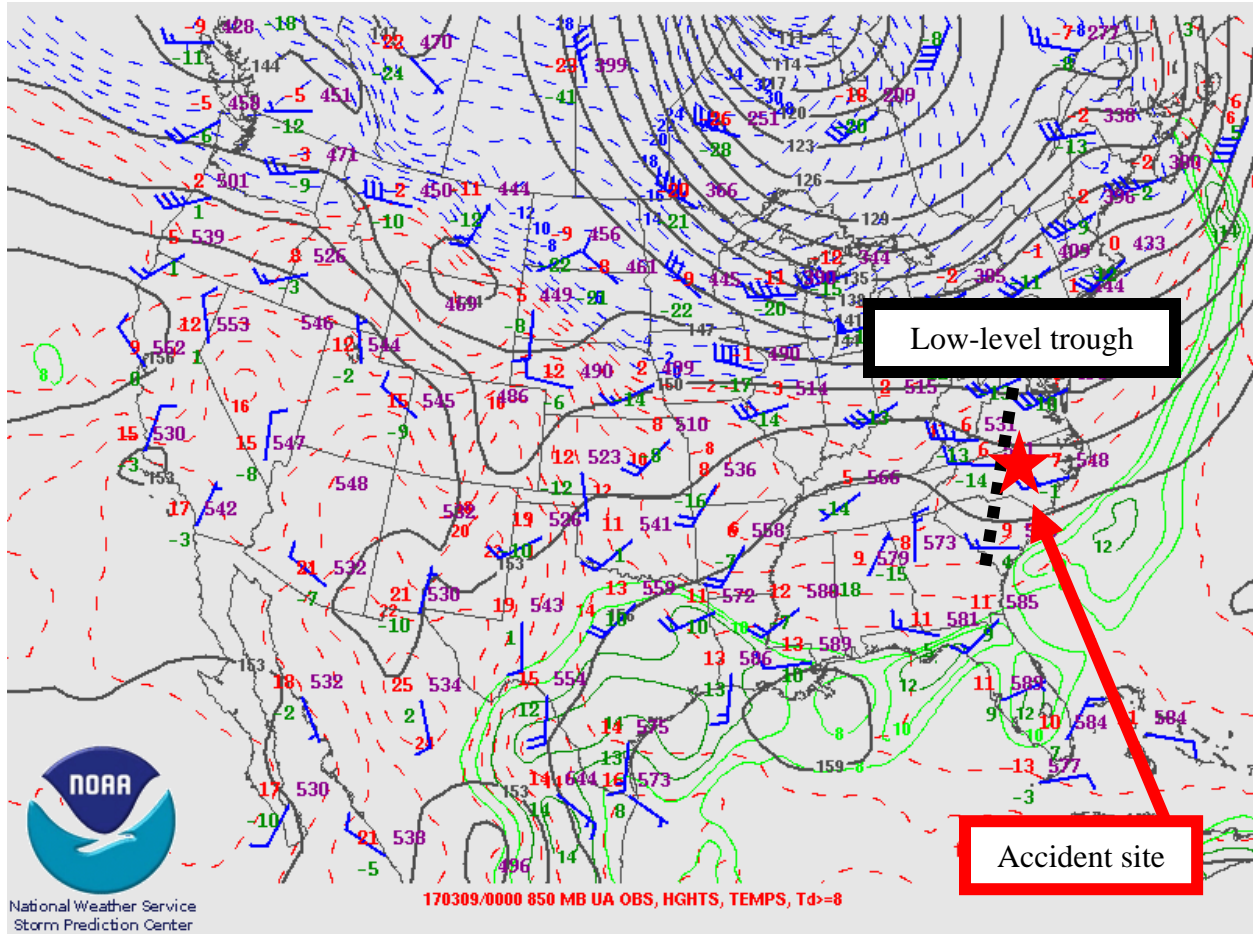


Figure 3 – 850-hPa Constant Pressure Chart for 1900 EST

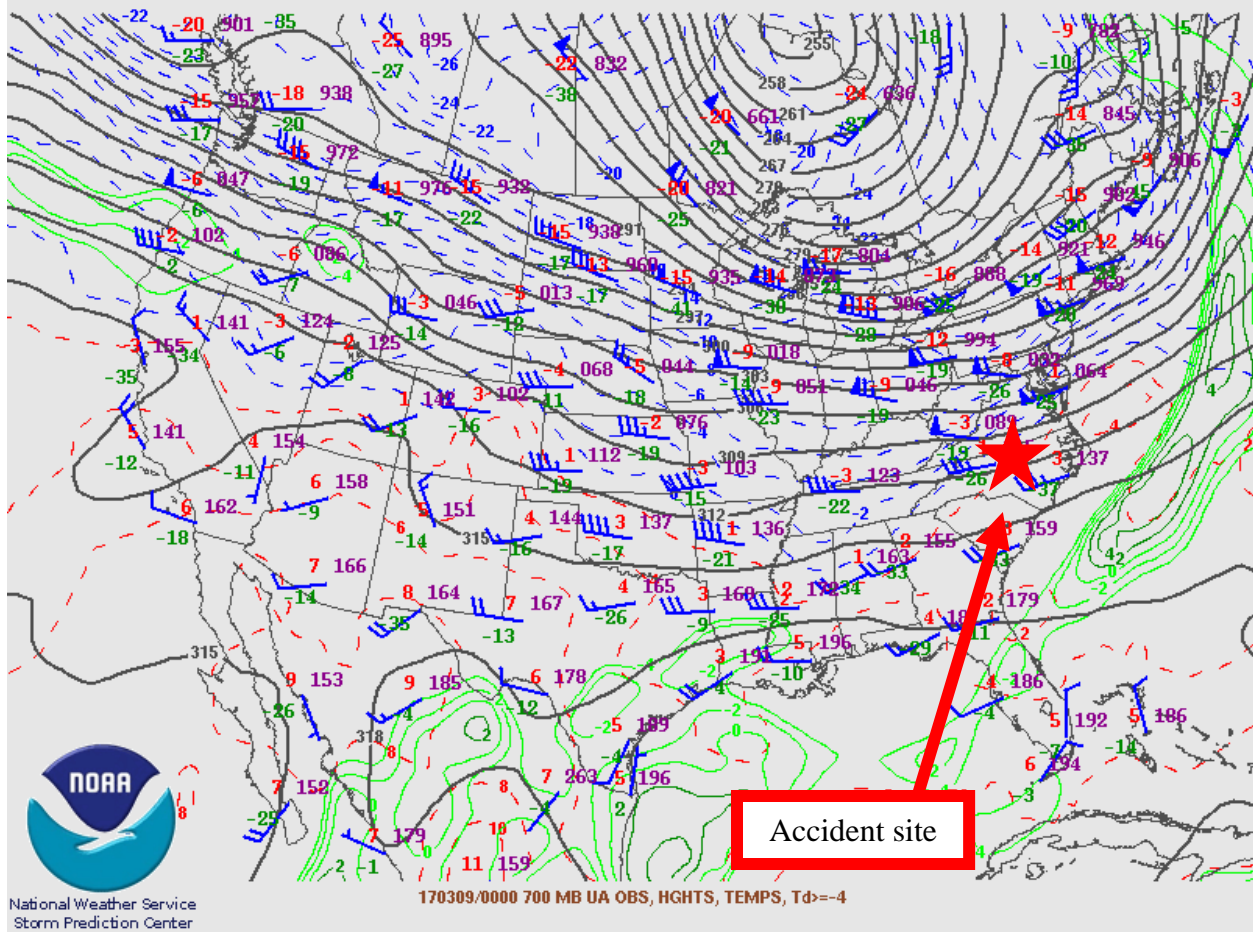


Figure 4 – 700-hPa Constant Pressure Chart for 1900 EST

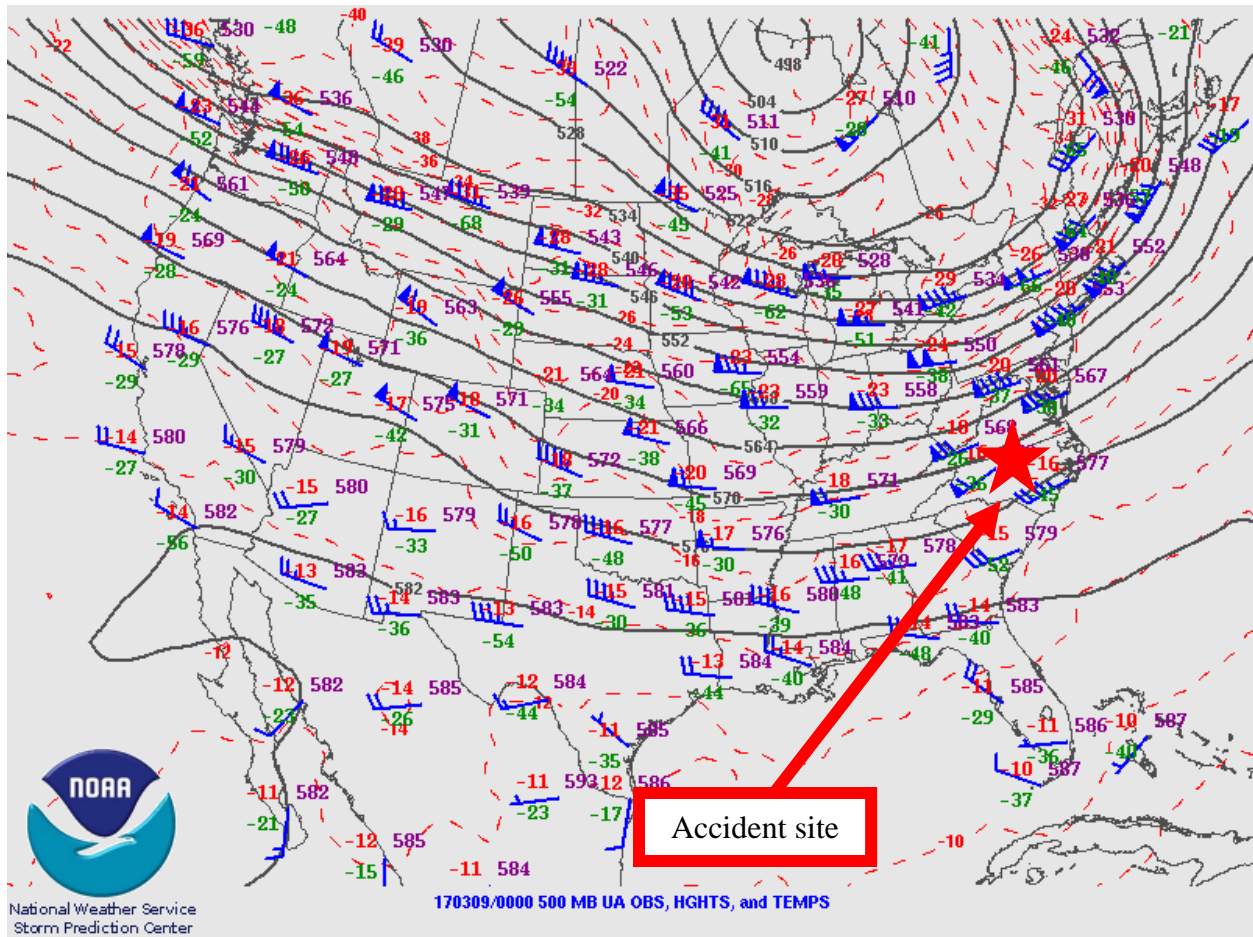


Figure 5 – 500-hPa Constant Pressure Chart for 1900 EST

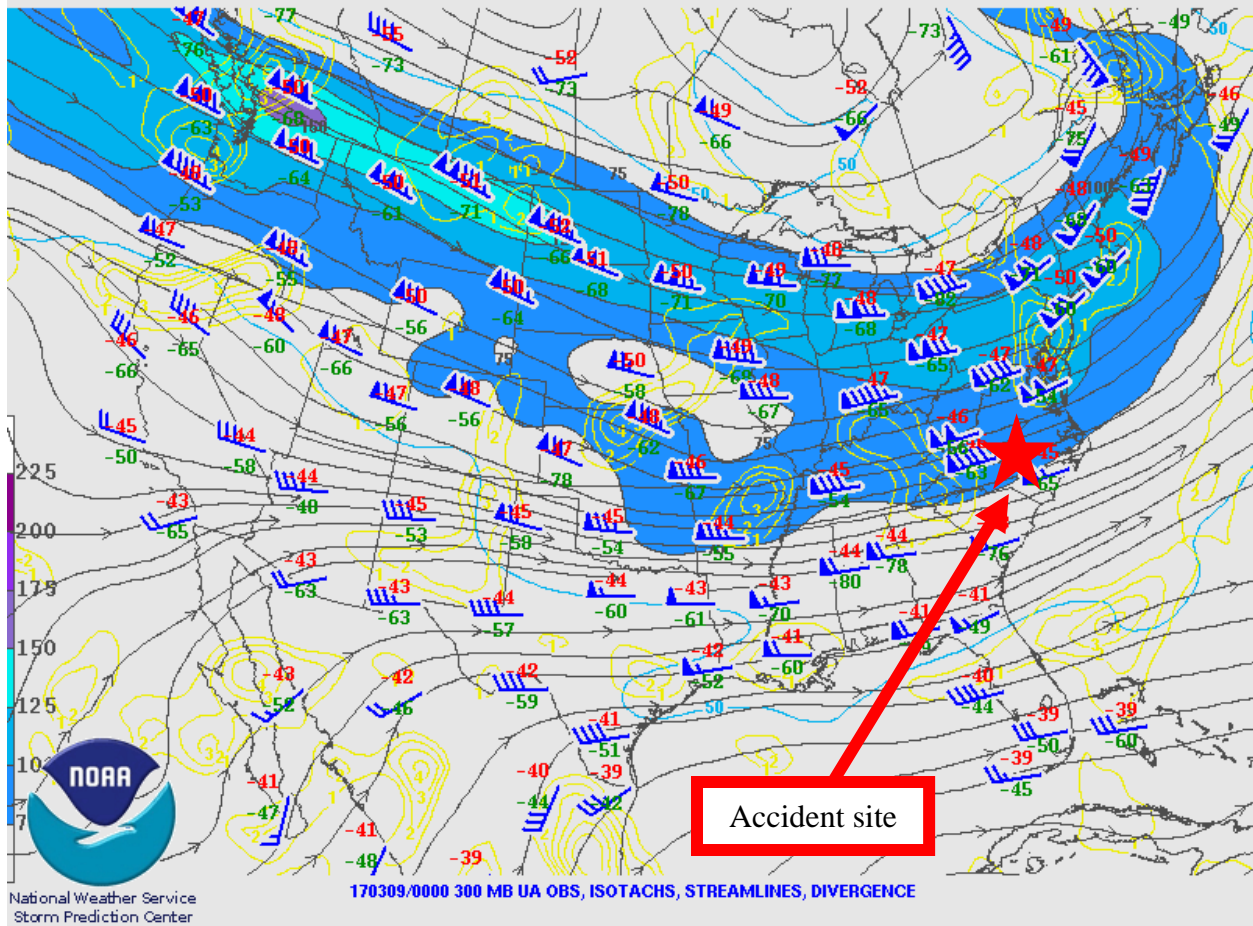


Figure 6 – 300-hPa Constant Pressure Chart for 1900 EST

2.0 SPC Products

There were no thunderstorms forecast for the accident site at the accident time.

3.0 Surface Observations

The area surrounding the accident site was documented using official NWS Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). The following observations were taken from standard code and are provided in plain language with visibility reported in statute miles for this section. Figure 7 is a sectional chart with the accident site and the closest weather reporting locations marked.



Figure 7 – Sectional chart of accident area with the location of the accident site and surface observation sites

Raleigh-Durham International Airport (KRDU) was the closest official weather station to the accident site, located 9 miles northwest of Raleigh, North Carolina. KRDU had Automated Surface Observing System (ASOS²) whose reports were supplemented by an official human observer. KRDU was located 8 miles northeast of the accident site, at an elevation of 435 feet, and had a 7° westerly magnetic variation³ (figure 7). The following observations were taken and disseminated during the times surrounding the accident:⁴

[0851 EST] METAR KRDU 081351Z 31005KT 10SM FEW035 BKN045 BKN080 12/06
A3024 RMK AO2 SLP239 T01220056=

[0951 EST] METAR KRDU 081451Z 31007G14KT 270V350 10SM FEW045 FEW080
FEW250 14/01 A3024 RMK AO2 SLP239 60001 T01440006 51015=

[1051 EST] METAR KRDU 081551Z VRB06KT 10SM FEW080 FEW250 17/M02 A3024
RMK SLP236 T01671022=

[1151 EST] METAR KRDU 081651Z VRB06KT 10SM FEW250 18/M06 A3023 RMK AO2
SLP233 T01831056=

² ASOS – Automated Surface Observing System is equipped with meteorological instruments to observe and report wind, visibility, ceiling, temperature, dewpoint, altimeter, and barometric pressure.

³ Magnetic variation – The angle (at a particular location) between magnetic north and true north. 1985, latest measurement taken from <http://www.airnav.com/airport/KRDU>

⁴ The bold sections in this NWS product and the rest of products in this report are intended to highlight the sections that directly reference the weather conditions that affected the accident location around the accident time. The local times in section 3.0 next to the METARs are provided for quick reference between UTC and local times around the accident time.

[1251 EST] METAR KRDU 081751Z VRB06KT 10SM FEW250 19/M07 A3020 RMK AO2
SLP224 60001 T01941072 10194 20111 58015=

***[1351 EST] METAR KRDU 081851Z 30009KT 260V320 10SM FEW250 20/M07 A3018
RMK AO2 SLP218 T02001072=***

***[1451 EST] METAR KRDU 081951Z 33007G16KT 290V360 10SM FEW250 21/M11
A3018 RMK AO2 SLP217 T02061111=***

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***[1551 EST] METAR KRDU 082051Z 30007KT 10SM FEW250 21/M09 A3018 RMK AO2
SLP216 T02061089 56008=***

***[1651 EST] METAR KRDU 082151Z 24007KT 10SM FEW250 20/M08 A3016 RMK AO2
SLP211 T02001078=***

[1751 EST] METAR KRDU 082251Z 25004KT 10SM FEW250 18/M07 A3016 RMK AO2
SLP211 T01831067=

[1851 EST] METAR KRDU 082351Z 26003KT 10SM FEW250 15/M06 A3017 RMK AO2
SLP215 T01501056 10206 20144 55002=

KRDU weather at 1351 EST, wind from 300° at 9 knots with the wind direction varying between 260° and 320°, 10 miles visibility, few clouds at 25,000 feet above ground level (agl), temperature of 20° Celsius (C), dew point temperature of -7° C, and an altimeter setting of 30.18 inches of mercury. Remarks, station with a precipitation discriminator, sea level pressure 1021.8 hPa, temperature 20.0° C, dew point temperature -7.2° C.

KRDU weather at 1451 EST, wind from 330° at 7 knots with gusts to 16 knots, wind direction varying between 290° and 360°, 10 miles visibility, few clouds at 25,000 feet agl, temperature of 21° C, dew point temperature of -11° C, and an altimeter setting of 30.18 inches of mercury. Remarks, station with a precipitation discriminator, sea level pressure 1021.7 hPa, temperature 20.6° C, dew point temperature -11.1° C.

KRDU weather at 1551 EST, wind from 300° at 7 knots, 10 miles visibility, few clouds at 25,000 feet agl, temperature of 21° C, dew point temperature of -9° C, and an altimeter setting of 30.18 inches of mercury. Remarks, station with a precipitation discriminator, sea level pressure 1021.6 hPa, temperature 20.6° C, dew point temperature -8.9° C, 3-hourly pressure decrease of 0.8 hPa.

KRDU weather at 1651 EST, wind from 240° at 7 knots, 10 miles visibility, few clouds at 25,000 feet agl, temperature of 20° C, dew point temperature of -8° C, and an altimeter setting of 30.16 inches of mercury. Remarks, station with a precipitation discriminator, sea level pressure 1021.1 hPa, temperature 20.1° C, dew point temperature -7.8° C.

Sanford-Lee County Airport (KTTA) was located 7 miles northeast of Sanford, North Carolina. KTTA had Automated Weather Observing System (AWOS⁵) whose reports were not supplemented. KTTA was located 15 miles southwest of the accident site, at an elevation of 246 feet, and had a 8° westerly magnetic variation⁶ (figure 7). The following observations were taken and disseminated during the times surrounding the accident:

[1320 EST] METAR KTTA 081820Z AUTO 28012G18KT 10SM CLR 19/M07 A3019
RMK AO2 T01931070=

[1340 EST] METAR KTTA 081840Z AUTO 30010KT 10SM CLR 20/M08 A3019 RMK
AO2 T01951083=

[1400 EST] METAR KTTA 081900Z AUTO 29010G16KT 10SM CLR 20/M08 A3018
RMK AO2 T01981083=

[1420 EST] METAR KTTA 081920Z AUTO 31011G16KT 10SM CLR 20/M09 A3018
RMK AO2 T01961089=

[1440 EST] METAR KTTA 081940Z AUTO 30009G14KT 10SM CLR 20/M08 A3018
RMK AO2 T02001078=

***[1500 EST] METAR KTTA 082000Z AUTO 33007G16KT 10SM CLR 20/M08 A3018
RMK AO2 T02001080=***

***[1520 EST] METAR KTTA 082020Z AUTO 28003KT 10SM CLR 20/M08 A3018 RMK
AO2 T02001078=***

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***[1540 EST] METAR KTTA 082040Z AUTO 29007KT 10SM CLR 20/M06 A3018 RMK
AO2 T02001065=***

***[1600 EST] METAR KTTA 082100Z AUTO 28006G14KT 10SM CLR 20/M07 A3018
RMK AO2 T01981067=***

[1620 EST] METAR KTTA 082120Z AUTO 29006KT 10SM CLR 20/M07 A3018 RMK
AO2 T01981072=

[1640 EST] METAR KTTA 082140Z AUTO 29006G17KT 10SM CLR 20/M07 A3017
RMK AO2 T01981068=

⁵ 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.

⁶ Magnetic variation – The angle (at a particular location) between magnetic north and true north. 2000, latest measurement taken from <http://www.aimav.com/airport/KTTA>

KTTA weather at 1500 EST, automated, wind from 330° at 7 knots with gusts to 16 knots, 10 miles visibility, clear skies below 12,000 feet agl, temperature of 20° C, dew point temperature of -8° C, and an altimeter setting of 30.18 inches of mercury. Remarks, station with a precipitation discriminator, temperature 20.0° C, dew point temperature -8.0° C.

KTTA weather at 1520 EST, automated, wind from 280° at 3 knots, 10 miles visibility, clear skies below 12,000 feet agl, temperature of 20° C, dew point temperature of -8° C, and an altimeter setting of 30.18 inches of mercury. Remarks, station with a precipitation discriminator, temperature 20.0° C, dew point temperature -7.8° C.

KTTA weather at 1540 EST, automated, wind from 290° at 7 knots, 10 miles visibility, clear skies below 12,000 feet agl, temperature of 20° C, dew point temperature of -6° C, and an altimeter setting of 30.18 inches of mercury. Remarks, station with a precipitation discriminator, temperature 20.0° C, dew point temperature -6.5° C.

KTTA weather at 1600 EST, automated, wind from 280° at 6 knots with gusts to 14 knots, 10 miles visibility, clear skies below 12,000 feet agl, temperature of 20° C, dew point temperature of -7° C, and an altimeter setting of 30.18 inches of mercury. Remarks, station with a precipitation discriminator, temperature 19.8° C, dew point temperature -6.7° C.

Horace Williams Airport (KIGX) was located 1 mile north of Chapel Hill, North Carolina. KIGX had an ASOS whose reports were not supplemented. KIGX was located 15 miles northwest of the accident site, at an elevation of 511 feet, and had a 8° westerly magnetic variation⁷ (figure 7). The following observations were taken and disseminated during the times surrounding the accident:

[0856 EST] METAR KIGX 081356Z AUTO 30008KT 10SM SCT046 BKN060 OVC080
12/03 A3024 RMK AO2 SLP237 T01170033=

[0956 EST] METAR KIGX 081456Z AUTO 29011G16KT 10SM SCT065 14/M02 A3024
RMK AO2 SLP238 T01441022 51013=

[1056 EST] METAR KIGX 081556Z AUTO 28012G16KT 10SM CLR 16/M03 A3024
RMK AO2 SLP235 T01611028=

[1156 EST] METAR KIGX 081656Z AUTO VRB05KT 10SM CLR 18/M03 A3022 RMK
AO2 SLP230 T01781028=

[1256 EST] METAR KIGX 081756Z AUTO 30010KT 10SM CLR 19/M07 A3020 RMK
AO2 SLP223 T01941067 10194 20100 58014=

**[1356 EST] METAR KIGX 081856Z AUTO 30013G18KT 270V330 10SM CLR 19/M09
A3019 RMK AO2 SLP218 T01891089=**

⁷ Magnetic variation – The angle (at a particular location) between magnetic north and true north. 2000, latest measurement taken from <http://www.aimav.com/airport/KIGX>

***[1456 EST] METAR KIGX 081956Z AUTO 31008G16KT 10SM CLR 19/M06 A3019
RMK AO2 SLP217 T01941061=***

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***[1556 EST] METAR KIGX 082056Z AUTO 10SM CLR 19/M06 A3017 RMK AO2 SLP212
T01941056 58011=***

***[1656 EST] METAR KIGX 082156Z AUTO 28010G14KT 10SM CLR 19/M07 A3016
RMK AO2 SLP210 T01941072=***

***[1756 EST] METAR KIGX 082256Z AUTO 28006KT 10SM CLR 18/M08 A3016 RMK
AO2 SLP210 T01781083=***

***[1856 EST] METAR KIGX 082356Z AUTO 00000KT 10SM CLR 14/M05 A3017 RMK
AO2 SLP215 T01391050 10206 20139 53001=***

KIGX weather at 1356 EST, automated, wind from 300° at 13 knots with gusts to 18 knots, wind varying between 270° and 330°, 10 miles visibility, clear skies below 12,000 feet agl, temperature of 19° C, dew point temperature of -9° C, and an altimeter setting of 30.19 inches of mercury. Remarks, station with a precipitation discriminator, sea level pressure 1021.8 hPa, temperature 18.9° C, dew point temperature -8.9° C.

KIGX weather at 1456 EST, automated, wind from 310° at 8 knots with gusts to 16 knots, 10 miles visibility, clear skies below 12,000 feet agl, temperature of 19° C, dew point temperature of -6° C, and an altimeter setting of 30.19 inches of mercury. Remarks, station with a precipitation discriminator, sea level pressure 1021.7 hPa, temperature 19.4° C, dew point temperature -6.1° C.

KIGX weather at 1556 EST, automated, 10 miles visibility, clear skies below 12,000 feet agl, temperature of 19° C, dew point temperature of -6° C, and an altimeter setting of 30.17 inches of mercury. Remarks, station with a precipitation discriminator, sea level pressure 1021.2 hPa, temperature 19.4° C, dew point temperature -5.6° C, 3-hourly pressure decrease of 1.1 hPa.

KIGX weather at 1656 EST, automated, wind from 280° at 10 knots with gusts to 14 knots, 10 miles visibility, clear skies below 12,000 feet agl, temperature of 19° C, dew point temperature of -7° C, and an altimeter setting of 30.16 inches of mercury. Remarks, station with a precipitation discriminator, sea level pressure 1021.0 hPa, temperature 19.4° C, dew point temperature -7.2° C.

3.1 One Minute Wind Observations

The one-minute KRDU ASOS surface data was provided by the NWS for the time surrounding the accident. One-minute raw wind data was provided with two separate magnitudes and wind directions⁸. The first wind data in table 1 is the two-minute average wind speed, which was updated every 5 seconds and reported once a minute. The second source of one-minute wind data is the five-second maximum wind average, which was updated every five seconds and reported once every minute (table 1). The following table provides the meteorological data in UTC time.

⁸ The wind directions are in reference to true north.

Time UTC	Dir of 2 min avg wind	Speed of 2 min avg wind (knots)	Dir of max 5 sec avg wind	Speed of max 5 sec avg wind (knots)
2010	293	7	264	10
2011	279	9	270	13
2012	278	10	334	17
2013	300	14	307	21
2014	302	14	315	20
2015	298	12	313	16
2016	293	12	302	17
2017	301	10	298	13
2018	305	8	322	11
2019	280	9	261	16
2020	265	10	264	16
2021	289	9	331	12
2022	297	10	283	17
2023	281	10	279	15
2024	285	9	284	11
2025	287	10	287	20
2026	295	11	316	14
2027	291	8	269	14
2028	286	8	291	12
2029	284	9	269	16
2030	279	9	284	11
2031	285	9	291	15
2032	279	12	261	16
2033	279	12	290	13
2034	279	10	273	13
2035	272	9	269	12
2036	278	8	293	11
2037	292	9	297	15
2038	295	10	297	14
2039	309	9	317	15
2040	328	8	335	13
2041	326	7	332	9
2042	332	5	330	8
2043	354	6	348	12
2044	5	8	327	11
2045	351	8	341	10

Table 1 – One-minute KRDU ASOS data for the time surrounding the accident

At 1536 EST, KRDU reported the two-minute average wind from 278° at 8 knots, a five-second maximum average wind from 293° at 11 knots.

At 1537 EST, KRDU reported the two-minute average wind from 292° at 9 knots, a five-second maximum average wind from 297° at 15 knots.

At 1538 EST, KRDU reported the two-minute average wind from 295° at 10 knots, a five-second maximum average wind from 297° at 14 knots.

The observations from KRDU, KIGX, and, KTTA surrounding the accident time indicated VFR⁹ conditions around the accident site. Gusty surface wind conditions were also observed with the wind from the west through north and the wind direction was varying at times (section 3.0). Wind gusts as high as 20 knots from 287° were observed as close as 12 minutes before the accident time at KRDU (table 1). The accident flight likely experienced wind gusts as high as 20 knots around the accident time. For an unknown reason the wind information from KIGX was not reported or included in the 1556 EST METAR observation.

4.0 Upper Air Data

A High-Resolution Rapid Refresh (HRRR)¹⁰ model sounding was created for the accident site for 1500 EST. The 1500 EST sounding was plotted on a standard Skew-T log P diagram¹¹ with the derived stability parameters included in figure 8 (with data from the surface to 700-hPa, or 10,000 feet msl.) This data was analyzed utilizing the RAOB¹² software package. The sounding depicted the lifted condensation level (LCL)¹³ at 11,463 feet and a convective condensation level (CCL)¹⁴ of 19,928 feet. The freezing level was located at 11,576 feet. The precipitable water value was 0.17 inches.

⁹ 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 5 miles visibility.

¹⁰ 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.

¹¹ 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.

¹² RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamoras, Pennsylvania.

¹³ Lifting Condensation Level (LCL) - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

¹⁴ Convective Condensation Level (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.

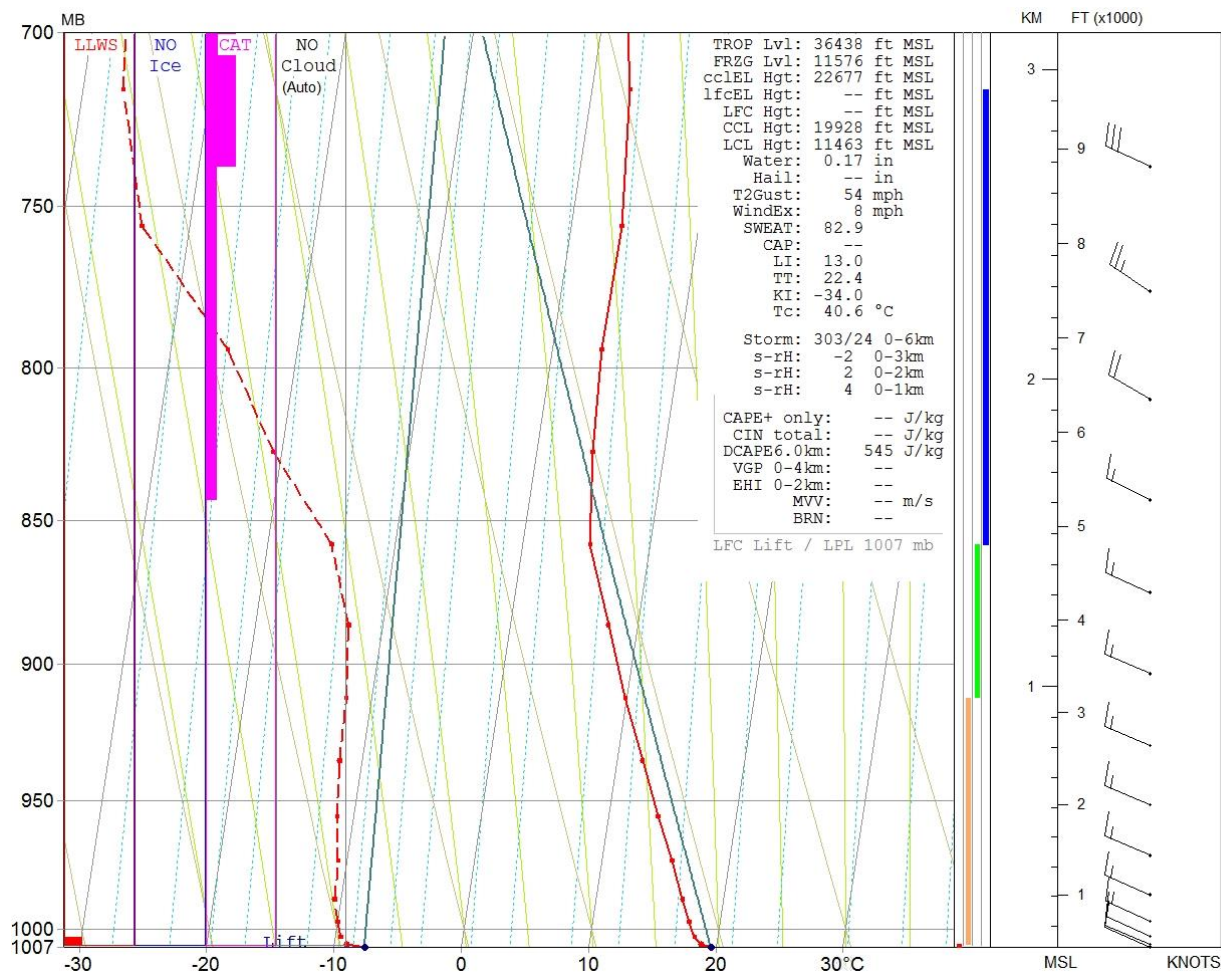


Figure 8 – 1500 EST HRRR sounding for the accident site

The 1500 EST HRRR sounding indicated an absolutely unstable to conditionally unstable atmosphere between the surface and 5,000 feet. This would have allowed for the mixing of the wind direction and speeds from the surface through 5,000 feet. The lifting mechanisms (sections 1.1 and 1.2) in the area of the accident site at the accident time would have promoted vertical motion as well, but given the relatively dry vertical environment, clouds and precipitation would not have been likely nor were they indicated by RAOB. No icing was indicated by RAOB below 10,000 feet.

The 1500 EST HRRR sounding wind profile indicated a surface wind from 295° at 10 knots with the wind remaining northwesterly through 10,000 feet. The wind increased in speed to 15 knots by 2,500 feet and increased again to 30 knots by 9,000 feet. RAOB indicated the possibility of light low-level wind shear between the surface and 700 feet, with light to moderate clear-air turbulence possible above 5,000 feet.

5.0 Satellite Data

Visible data from the Geostationary Operational Environmental Satellite number 13 (GOES-13) 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 imagery (GOES-13 band 1) at wavelength of 0.65 microns was retrieved for the period. Satellite imagery surrounding the time of the accident, from 1300 EST through 1700 EST at approximately 15-minute intervals were reviewed, and the closest image to the time of the accident is documented here.

Figure 9 presents the GOES-13 visible imagery from 1545 EST at 3X magnification with the accident site highlighted with a red square. Inspection of the visible imagery indicated no visible cloud cover above the accident site around the accident time. It should be noted these figures have not been corrected for any parallax error.

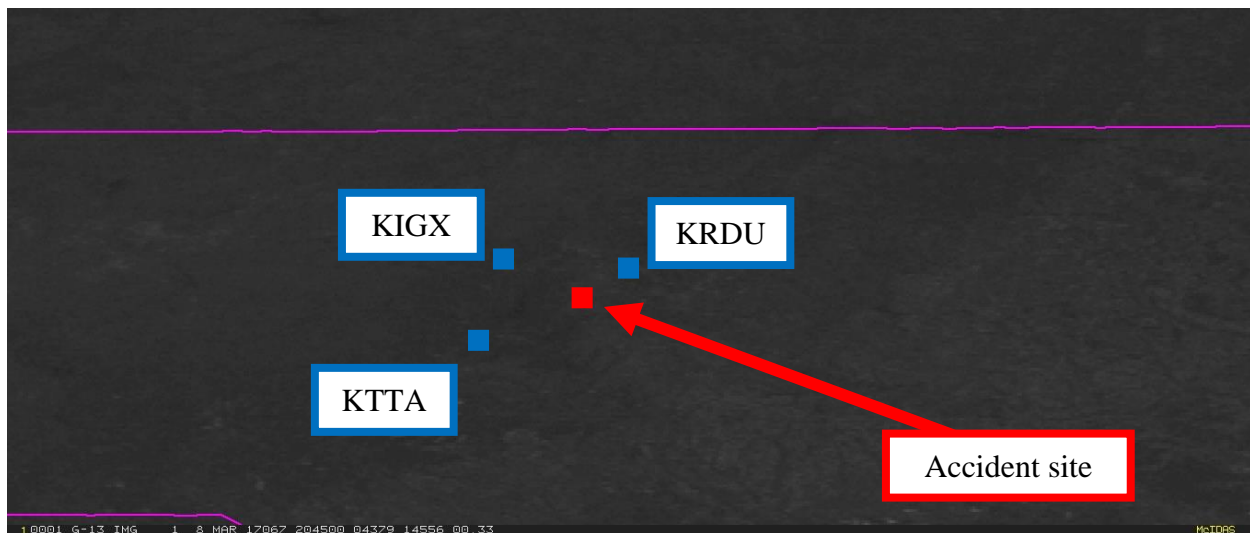


Figure 9 – GOES-13 visible image at 1545 EST

6.0 Radar Imagery Information

The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D)¹⁵ to the accident site was the Clayton/Raleigh, North Carolina, (KRAX) site located 19 miles east-southeast of the accident site with an elevation of 348 feet. Level II and III archive radar data were obtained from the NCEI utilizing the NEXRAD Data Inventory Search and displayed using the NOAA's Weather and Climate Toolkit software. No reflectivity targets were located above the accident site at the accident time.

¹⁵ 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.

7.0 Pilot Reports¹⁶

All pilot reports (PIREPs) close to the accident site from three hours prior to the accident time to three hours after the accident time were reviewed. Only PIREPs for below FL200¹⁷ are provided below:

TTA UA /OV TTA270007 /TM 1829 /FL030 /TP P28A /SK SKC /WX FV99SM /TA 10 /TB CONS LGT CHOP

KVUJ UA /OV VUJ/TM 2002/FL500/TP C172/RM WIND SHEAR 5 KNOT LOSE

Routine pilot report (UA); 7 miles from Sanford, North Carolina, on the 270° radial; Time – 1329 EST (1829Z); Altitude – 3,000 feet; Type aircraft – Piper PA-28 Cherokee; Sky – Clear skies; Visibility – Unlimited; Temperature – 10° C; Turbulence – Constant light chop.

Routine pilot report (UA); Over Albemarle, North Carolina; Time – 1502 EST (2002Z); Altitude – 500 feet agl; Type aircraft – Cessna 172; Remarks – Wind shear 5 knot loss.

8.0 SIGMET and CWSU Advisory

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

No Center Weather Service Unit (CWSU) Center Weather Advisories (CWA)s were valid for the accident site at the accident time. No CWSU Meteorological Impact Statements (MIS)s were valid for the accident site at the accident time. However, a CWSU MIS was issued at 0802 EST and valid through 1500 EST and forecasted areas of moderate turbulence below FL350:

FAUS20 KZDC 081302
ZDC MIS 01 VALID 081305-082000
...FOR ATC PLANNING PURPOSES ONLY...
OCNL MOD TURB ABV FL350; **AREAS OF MOD TURB BLW FL350.**
LLWS/OCNL SEV TURB BLW 120 OVR/E OF N ZDC MTNS...SPCLY
FOR LIGHT ACFT...INCLUDING DC METRO AREA. LLWS/ISOL SEV
TURB BLW 120 SE ZDC THIS MORN AS A COLD FRONT MOVES SE.
=

9.0 AIRMETs

An updated Airmen's Meteorological Information (AIRMET) advisory Tango was issued at 1159 EST and valid at the accident time. This updated AIRMET Tango forecasted moderate turbulence below 12,000 feet for areas east of the accident site, from eastern Wake County eastward through eastern North Carolina and Virginia. There were no AIRMETs valid for the accident site at the accident time:

¹⁶ Only pilot reports with the WMO header UBNC** identifier were considered.

¹⁷ Flight Level – A Flight Level (FL) is 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 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.

862

WAUS42 KPCI 081659 AAA

WA2T

-MIAT WA 081659 AMD

AIRMET TANGO UPDT 4 FOR TURB AND STG SFC WNDZ VALID UNTIL 082100

.
AIRMET TURB...NC SC ME NH VT MA RI CT NY LO NJ PA OH LE WV MD DC
DE VA AND CSTL WTRS

FROM 70NW PQI TO 60NE PQI TO 150ENE ACK TO 50NE RDU TO 20S CLT
TO HMV TO HNN TO CVG TO FWA TO 30SSE ECK TO YOW TO YSC TO 70NW
PQI

MOD TURB BTN 160 AND FL390. CONDS CONTG BYD 21Z THRU 03Z.

.
AIRMET TURB...NC SC GA FL ME NH MA RI CT NY NJ MD DE VA AND CSTL
WTRS

FROM 140ENE ACK TO 200SE ACK TO 160SE SIE TO 190ESE ECG TO 80SSE
ILM TO 60SSE SAV TO 20SSE TLH TO 50SW PZD TO 40SSE LGC TO 30NE
RDU TO 80ESE CYN TO 140ENE ACK

MOD TURB BTN FL180 AND FL410. CONDS CONTG BYD 21Z THRU 03Z.

.
**AIRMET TURB...NC ME NH VT MA RI CT NY LO NJ PA WV MD DC DE VA
AND CSTL WTRS**

**FROM 70NW PQI TO 60NE PQI TO 200SE ACK TO 160SE SIE TO 190ESE
ECG TO 30ENE ILM TO 40S LYH TO 40SSE RIC TO 20S BDL TO YSC TO
70NW PQI**

MOD TURB BLW 120. CONDS CONTG BYD 21Z ENDG 21-00Z.

.
AIRMET TURB...NC SC GA NH VT MA CT NY LO NJ PA OH LE WV MD DC DE
VA AND CSTL WTRS...UPDT

FROM YSC TO 20S BDL TO 20WNW SIE TO 30SSE RIC TO 40S LYH TO
20WSW CLT TO GQO TO HMV TO HNN TO CVG TO FWA TO 30SE ECK TO YOW
TO YSC

MOD TURB BLW 150. CONDS DVLPG BY 17Z. CONDS CONTG BYD 21Z THRU
03Z.

.
AIRMET STG SFC WNDZ...NC CSTL WTRS

FROM 150SE SIE TO 180E ECG TO 190ESE ECG TO 170SE ECG TO 100SE
ECG TO 120E ORF TO 150SE SIE

SUSTAINED SURFACE WINDS GTR THAN 30KT EXP. CONDS ENDG 15-18Z.

....

10.0 Area Forecast

The Area Forecast issued at 1345 EST, valid at the accident time, forecasted clear skies for the accident site:

133

FAUS42 KPCI 081845

FA2W

-MIAC FA 081845

SYNOPSIS AND VFR CLDS/WX

SYNOPSIS VALID UNTIL 091300

CLDS/WX VALID UNTIL 090700...OTLK VALID 090700-091300

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...HI PRES BUILDING IN BEHIND CDFNT THAT PUSHED THRU THE
AREA YESTERDAY. CDFNT IS CURRENTLY JUST EAST OF THE CAROLINA
COAST AND EXTDG ACROSS NRN FL AND INTO NRN GULF WTRS. BY 13Z HI
PRES REMAINS IN PLACE OVER GA AND WRN CAROLINAS. STNR FRONT
DRAPED ACROSS CNTRL FL AND EXTDG INTO CNTRL GULF WATERS.

.
NC
MTNS...SKC. OTLK...VFR.
PIEDMONT...SKC. 05Z SCT-BKN CI. OTLK...VFR.
ERN...SCT100. BECMG 2200 SKC. OTLK...VFR.

.
SC
MTNS-PIEDMONT...SKC. OTLK...VFR.
ERN...SCT080. BECMG 2200 SKC. OTLK...VFR.

.
GA
N-CNTRL-SW...SKC. TIL 00Z WND NW G25KT. BECMG 0406 SCT-BKN CI.
OTLK...VFR.
ELSW...BKN050 TOP 100. BECMG 0002 SCT-BKN CI. OTLK...VFR.

.
FL
PNHDL-N CNTRL...BKN050 TOP 080. BECMG 2301Z SCT-BKN CI. 06Z SKC.
OTLK...VFR.
RMNDR N...SCT060 BKN080 TOP 100. TIL 00Z ISOL -SHRA. 01Z BKN040
TOP 100. OTLK...VFR.
CNTRL...BKN050 TOP 100. OTLK...VFR.
KEYS-SRN...SCT040 BKN060 TOP 100. OTLK...VFR.

.
CSTL WTRS
ATLC WTRS...
NC/SC...BKN030 TOP 100. VIS 4SM ISOL -SHRA/-TSRA. CB TOP FL450.
06Z SCT100. OTLK...VFR.
GA/FL...SCT-BKN050 TOP 120. ISOL -SHRA/TSRA. CB TOP FL450.
OTLK...VFR.
GULF WTRS E OF 85W...
N HLF...SCT030 SCT070 BKN CI. ISOL -SHRA. 21Z SCT030
SCT CI. OTLK...VFR.
S HLF...SCT030 SCT060. OTLK...VFR.

....

11.0 Terminal Aerodrome Forecast

KRDU was the closest site to the accident site with a NWS Terminal Aerodrome Forecast (TAF). The TAF valid at the time of the accident was issued at 1235 EST, and was valid for a 24-hour period beginning at 1300 EST. The TAF for KRDU was as follows:

TAF KRDU 081735Z 0818/0918 **30007KT P6SM FEW250**
FM082300 VRB03KT P6SM SKC
FM091600 23009KT P6SM SKC=

The forecast expected a wind from 300° at 7 knots, greater than 6 miles visibility, and few clouds at 25,000 feet agl.

12.0 NWS Area Forecast Discussion

The NWS office in Raleigh, North Carolina, issued the following Area Forecast Discussion (AFD) at 1447 EST (closest AFD to the accident time with an aviation section). The aviation section of the AFD discussed a high confidence in VFR conditions continuing through the following day. A surface northwest wind was gusting to 15 to 20 knots and the winds were expected to diminish during the evening to overnight hours:

211
FXUS62 KRAH 081947
AFDRAH

Area Forecast Discussion
National Weather Service Raleigh NC
247 PM EST Wed Mar 8 2017

.SYNOPSIS...

A cold front will push off the coast this afternoon. Mild high pressure will build over the Southeast states tonight through Friday. A stronger but dry cold front will drop southward through North Carolina Friday night.

&&

.NEAR TERM /THROUGH TONIGHT/...

As of 1035 AM Wednesday...

The earlier forecast is generally on track, with the cold frontal rain band having exited the CWA to the east and more aggressive clearing is underway across the Piedmont. The main change is to lower temps slightly in the east, where early cloud cover, cold advection and shallower mixing suggest MAV guidance may be best; 67-71. We have also issued an Increased Fire Danger statement per coordination with the NCFS given low RH, little rain last night and wind gusts to around 20kt in the Piedmont this afternoon. -Smith

Skies will be generally clear tonight, although western and northern sections have a good chance of seeing orographically enhanced mid and high clouds as a batch of mid/high level moisture and weak vorticity now over the Four Corners/CO area swings through our region, where the thermal and kinematic structure of the column will support such development. Expect lows to be near or slightly above normal, in the upper 30s to lower 40s, although if there is a trend to thicker or longer-lived mid/high clouds tonight, these lows may be too low across the west and north. -GIH

&&

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

As of 325 AM Wednesday...

Weak but mild high pressure over the Southeast states early Thu will shift off the coast later in the day. Forecast soundings show very dry air through the column, with light W/NW surface breezes backing and increasing from the SW by afternoon. Under plentiful sunshine with good mixing and warm air advection, expect highs of 70-75. A frontal zone will strengthen from the Central Plains across the Ohio Valley late Thu, before extending across the Mid Atlantic region Thu night and evolving into a backdoor front that will be poised to drop southward through NC on Friday. Expect mild temps but increasing clouds Thu night, especially over the north and west CWA. Lows 45-50. -GIH

&&

.LONG TERM /FRIDAY THROUGH WEDNESDAY/...

As of 245 PM Wednesday...

Split flow will prevail through the period, with a couple of potential precipitation events late Sat night-early Sun and again late Mon-Tue, with the former likely to be a nrm stream-dominated quick-hitting system and the latter a potentially more wound up/phased one.

A lead cold front, propelled by a strong shortwave trough forecast to migrate across the Great Lakes and Northeast, will cross central NC during the day Fri - late morning to midday NW Piedmont to mid-afternoon over the Sandhills and srn Coastal Plain. A preceding mid level moist axis accompanying the aforementioned shortwave trough, and associated weakening band of showers with time and Ewd extent as it moves into an increasingly dry and stable regime E of the Appalachians, may support a few sprinkles or light showers over the Piedmont early Fri. Then, very weak instability on the order of a couple of hundred J/kg or less, but with weak moisture convergence along the surface front, may prove sufficient for a couple of shallow/light showers along the passing frontal zone as it settles through the Coastal Plain and Sandhills coincident with (near) peak diurnal heating. It will otherwise be warm --mid 60s to mid 70s with NW downslope flow likely to help offset CAA-- and breezy both ahead of and behind the front. The noticeably colder air will arrive Fri night, with temperatures expected to fall into the 30s by Fri morning.

This lead front will settle to the Gulf coast through Sat night, while a separate frontal zone --along the leading edge of arctic high pressure initially centered over the nrm Plains and Upper Midwest-- develops NEwd along/west of the srn Appalachians. As is often times the case, the models are likely too aggressive to bring that air mass Swd, in backdoor/damming fashion, through central NC Sat night. However, the sub-cloud and boundary layer will have already dried appreciably behind the lead front, such that surface dewpoints will likely be in the teens at the time precipitation streams E into the Piedmont early Sat night. As such, diabatic cooling should prove sufficient to cool the thermal profiles to ones supportive of mostly snow north of 64, with a rain/snow mix

along the srn tier, ****if**** sufficiently heavy precipitation falls to fully wet-bulb the sub-cloud layer. Given that the models have trended drier with the 12Z run, such a solution is at least somewhat in doubt. Given the fast progression of the precipitation shield, in any one area for 3-6 hours, precipitation amounts should be relatively light, less than a quarter inch expected at this time. While a light snow accumulation may result, preceding warmth and ground temperatures would favor most accumulation on elevated surfaces.

It will clear from W to E, during the day Sun, while the next nrm stream trough digs south and possibly phases with the srn stream and results in coastal cyclone developing along the srn Middle Atlantic coast late Mon-Tue. Only marginally cool temperatures in central NC during that time would favor mostly or all liquid with that system, but with much colder air to follow through mid week.

&&

.AVIATION /18Z WEDNESDAY THROUGH MONDAY/...
As of 1245 PM Wednesday...

High confidence in VFR conditions through Thursday afternoon.

Northwest winds, gusty at times to 15-20kt, will continue this afternoon and then diminish tonight as high pressure settles into the region. An 8-12kt southwest wind will develop on Thursday, under continued clear skies.

Outlook: VFR conditions will continue through Friday night, with a dry cold front to move through the area Friday afternoon and southwest winds becoming northwest. A low pressure system will cross the region Saturday night and Sunday, bringing the next chance of sub-VFR conditions and precipitation.

&&

.RAH WATCHES/WARNINGS/ADVISORIES...
None.

&&

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SYNOPSIS...HARTFIELD
NEAR TERM...SMITH/HARTFIELD
SHORT TERM...HARTFIELD
LONG TERM...MWS
AVIATION...SMITH

13.0 Winds and Temperature Aloft Forecast

The NWS 1501 EST Winds and Temperature Aloft forecast valid for the accident flight are included below:

766
 FBUS31 KWN0 082001
 FD1US1
 DATA BASED ON 081800Z
 VALID 090000Z FOR USE 2000-0300Z. TEMPS NEG ABV 24000

FT	3000	6000	9000	12000	18000	24000	30000	34000	39000
RDU	2716	3128+04	3040+02	2744-02	2553-18	2769-30	278645	278755	279160

The accident site was closest to the RDU/KRDU forecast point. The 1501 EST RDU forecast indicated a wind at 3,000 feet from 270° at 16 knots and a wind at 6,000 feet from 310° at 28 knots with a temperature of 4° C.

The NWS 0901 EST Winds and Temperature Aloft forecast was issued before the accident flight took off and was also valid for the accident flight and accident site:

378
 FBUS31 KWN0 081401
 FD1US1
 DATA BASED ON 081200Z
 VALID 081800Z FOR USE 1400-2100Z. TEMPS NEG ABV 24000

FT	3000	6000	9000	12000	18000	24000	30000	34000	39000
RDU	3111	2730+05	2734+03	2741-01	2752-17	2761-30	278146	279154	269459

The 0901 EST RDU forecast indicated a wind at 3,000 feet from 310° at 11 knots and a wind at 6,000 feet from 270° at 30 knots with a temperature of 5° C.

14.0 Pilot Weather Briefing

A search of official weather briefing sources, such as Lockheed Martin Flight Service and Direct User Access Terminal Service was done and the accident pilot did not receive an official weather briefing from those sources. A search of ForeFlight weather information revealed that the accident pilot did not request a weather briefing using ForeFlight Mobile prior to his flight. It is unknown if the accident pilot checked or received any other weather information before or during the accident flight.

15.0 Astronomical Data

The astronomical data obtained from the United States Naval Observatory for the accident site on March 8, 2017, indicated the following:

SUN

Begin civil twilight	0610 EST
Sunrise	0636 EST
Sun transit	1226 EST
Sunset	1817 EST
End civil twilight	1843 EST

E. LIST OF ATTACHMENTS

None.

Submitted by:

Paul Suffern
Senior Meteorologist

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