NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

March 5, 2013

Group Chairman's Weather Study

METEOROLOGY

ERA13FA088

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A. ACCIDENT

Location: 4 miles east-southeast of Parkton, North Carolina
Date: December 16, 2012
Time: approximately 1532 eastern standard time (2032 UTC[1])
Aircraft: Piper PA-28-160, registration: N5714W

B. METEOROLOGY GROUP

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C. SUMMARY

For a summary of the accident, refer to the *Accident Summary* report, which is available in the docket for this investigation.

D. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's (NTSB) Meteorologist was not on scene for this investigation and gathered all 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 Climatic Data Center (NCDC). All times are eastern standard time (EST) on December 16, 2012, 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 location was located at latitude 34.87° N, longitude 78.95° W, elevation: 162 feet.

[1] UTC – is an abbreviation for Coordinated Universal Time.

E. 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 (NCEP), and the Hydrometeorological Prediction Center (HPC) 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-0045G CHG 1.

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. The chart depicted a stationary front located across the Mid-Atlantic region with an outflow boundary located across Alabama. The station models around the accident site depicted air temperatures in the mid 50's to low 60's Fahrenheit (F), with temperature-dew point spreads of 3° F or less, a light southwest to south wind around 5 knots, cloudy skies, and areas of light rain, drizzle, and mist. The low-level environment surrounding the accident site was relatively moist and given the mid-level environment with weak lifting mechanisms, clouds and light precipitation would be expected (further discussed in Section 1.2).

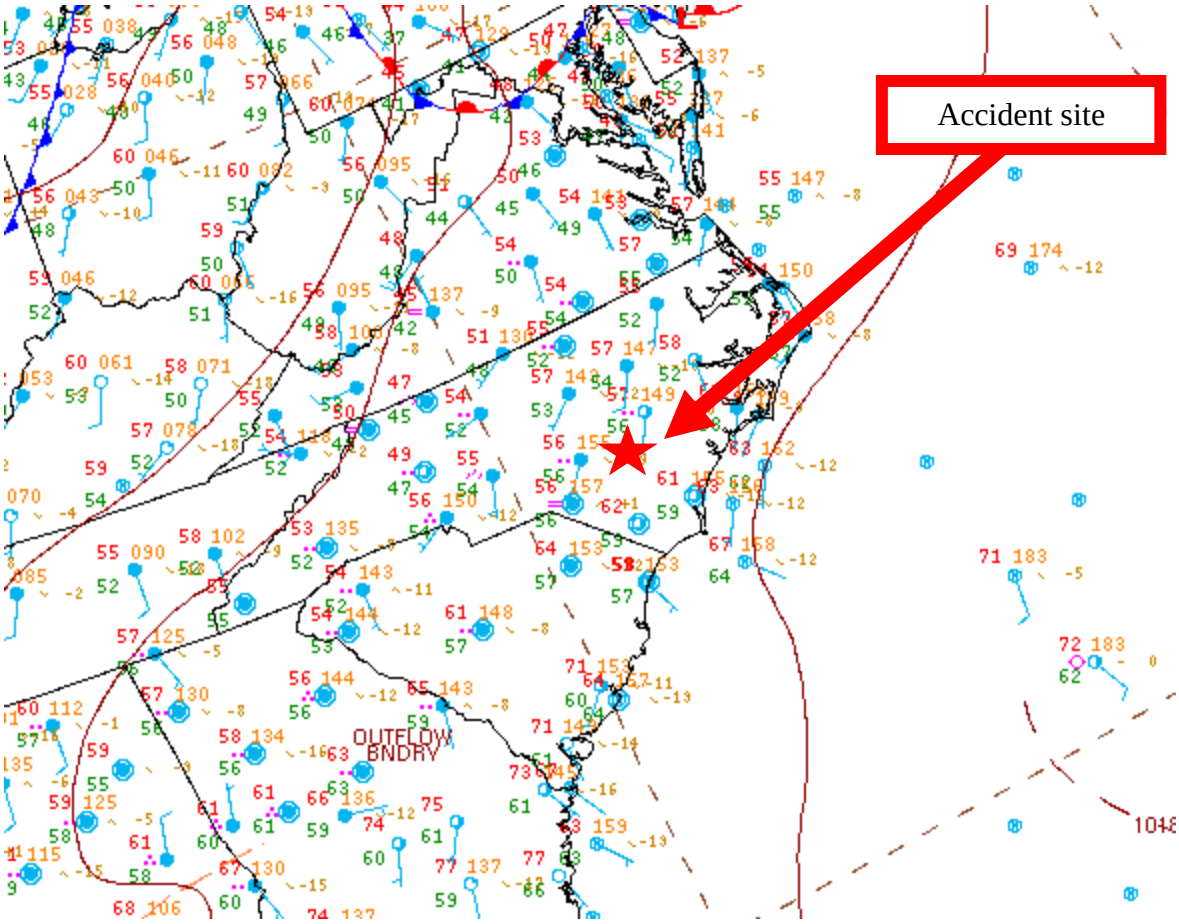

Figure 1 – NWS Surface Analysis Chart for 1600 EST

1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 1900 EST at 925-, 850-, 700-, 500-, and 250-hectopascals (hPa) are presented in figures 2 through 6. The 925- and 850-hPa charts depicted a relatively moist low-level environment given the dew point temperature values and with the south to southwest winds bringing up moisture from the Gulf of Mexico, the low-level environment was conducive for cloud and rain shower formation. The 500-hPa chart also depicted a weak mid-level trough above the relatively moist low-level environment, and this mid-level trough would act as a lifting mechanism for clouds and precipitation.

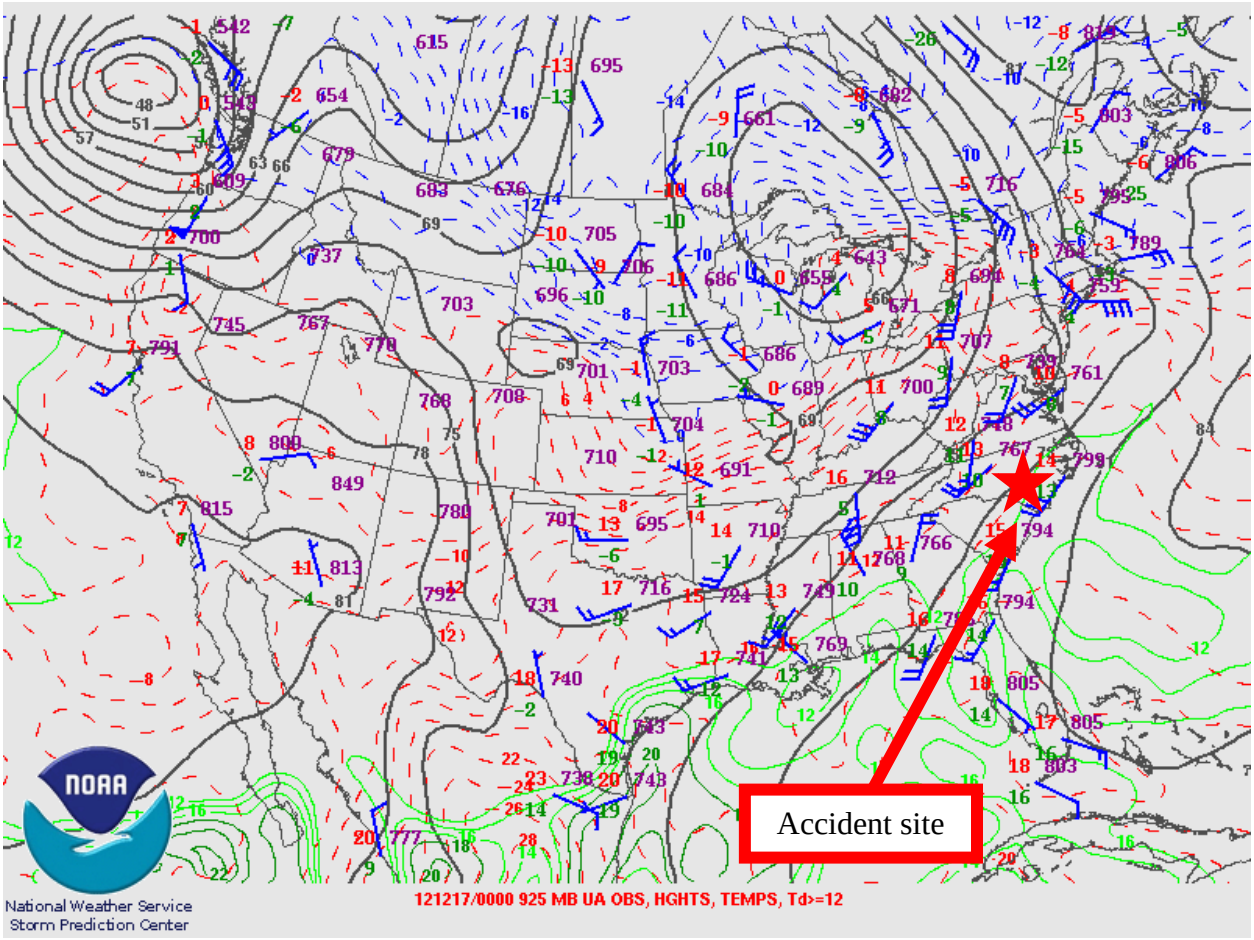

Figure 2 – 925-hPa Constant Pressure Chart for 1900 EST

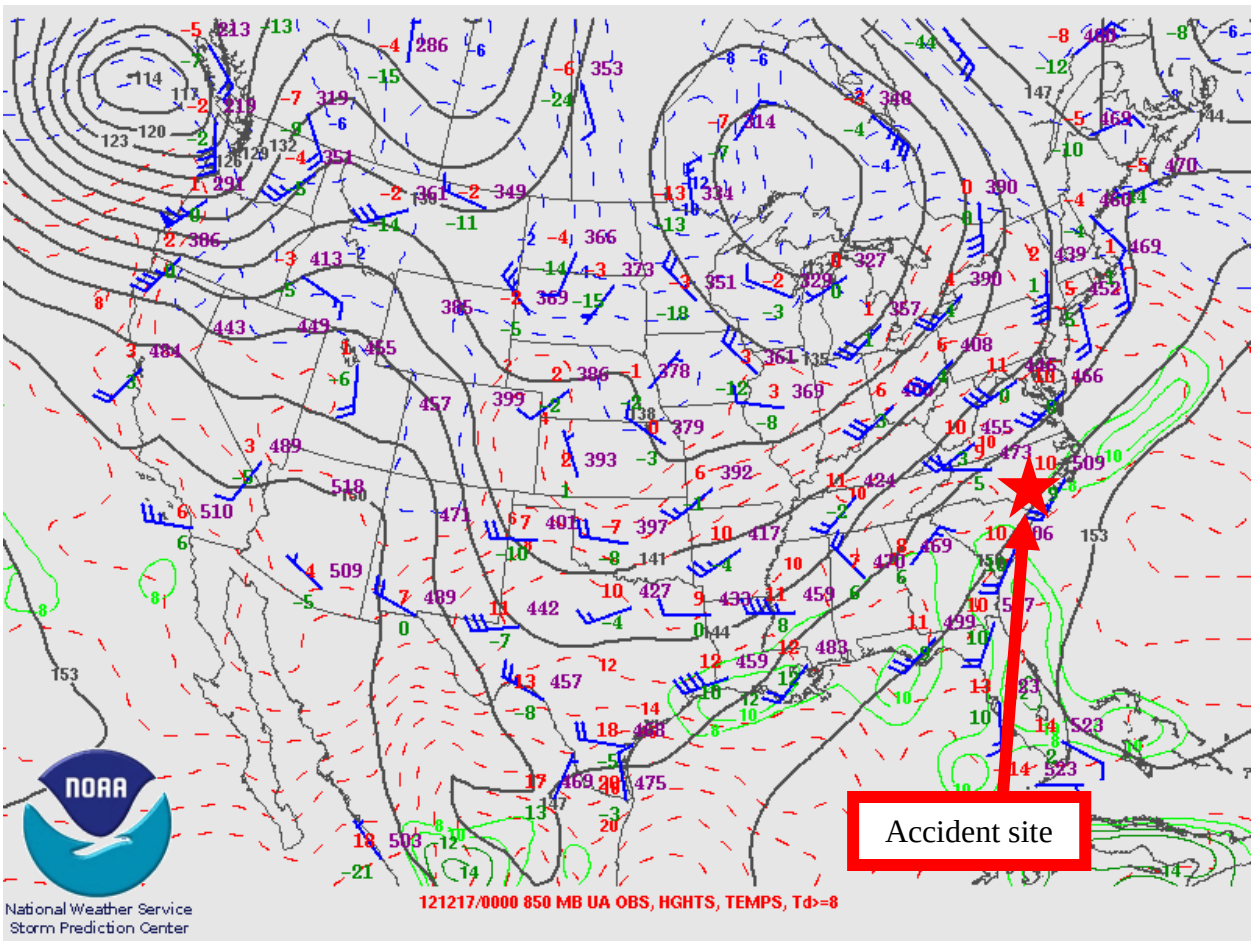

Figure 3 – 850-hPa Constant Pressure Chart for 1900 EST

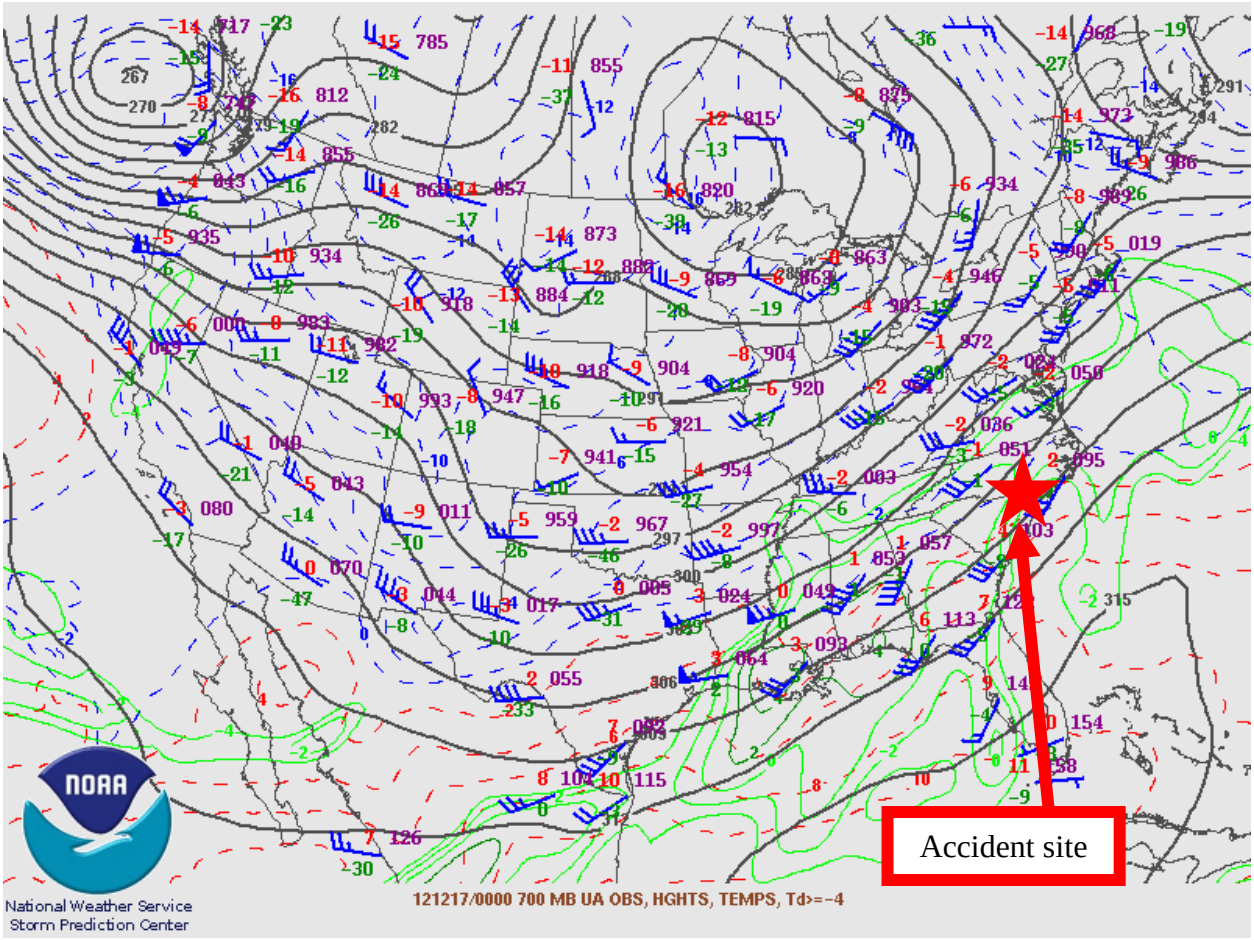

Figure 4 – 700-hPa Constant Pressure Chart for 1900 EST

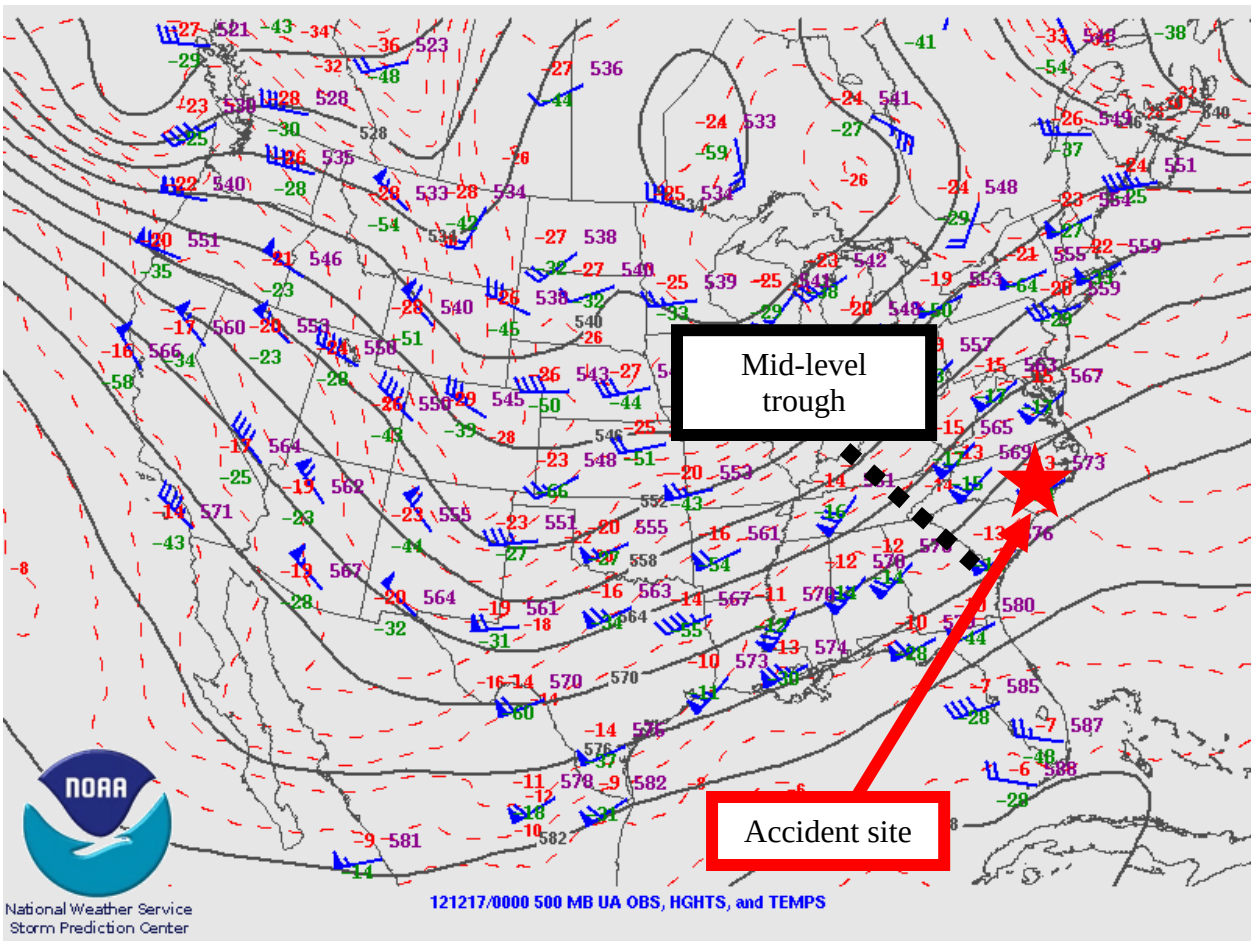

Figure 5 – 500-hPa Constant Pressure Chart for 1900 EST

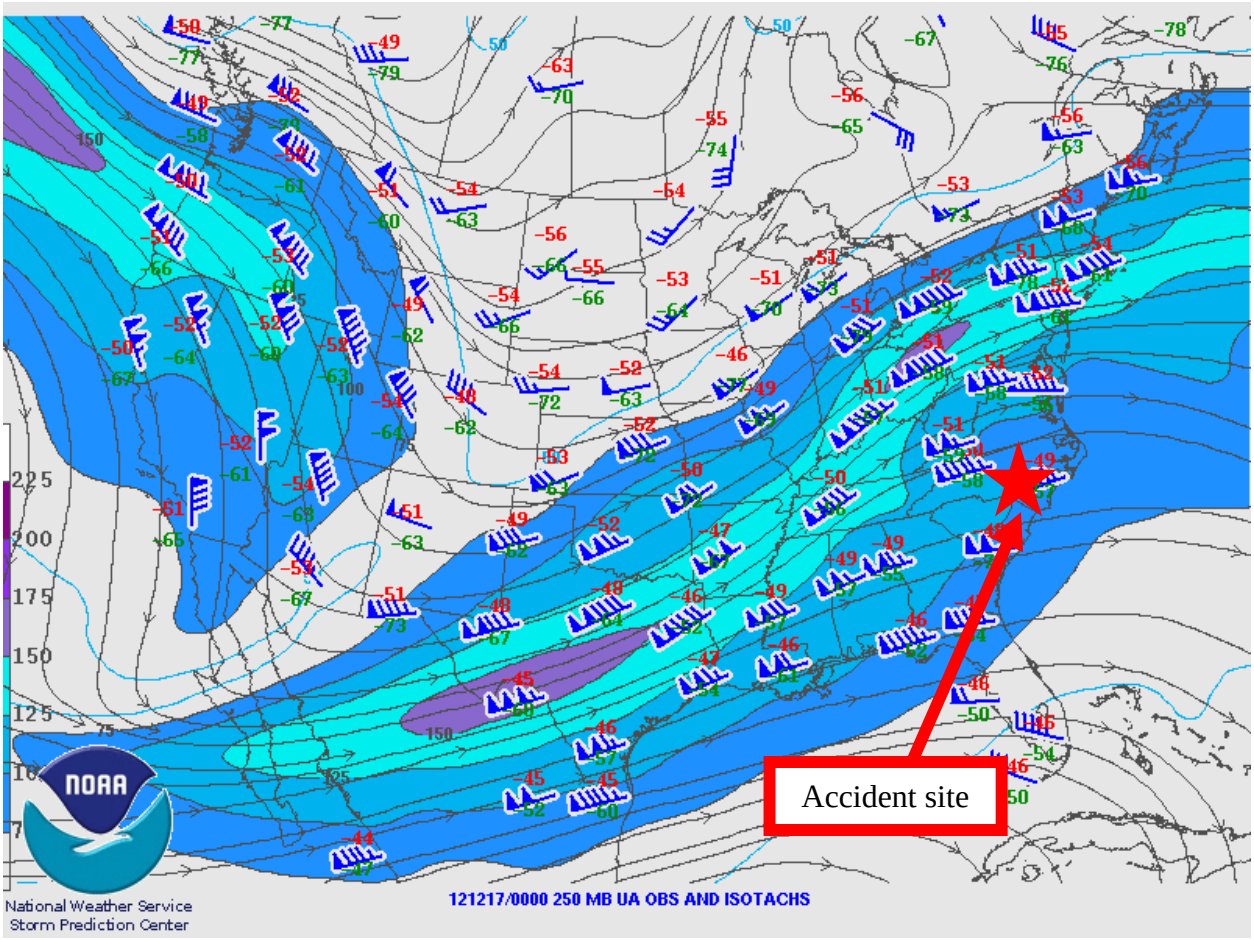

Figure 6 – 250-hPa Constant Pressure Chart for 1900 EST

2.0 Storm Prediction Center Products

No thunderstorm products or convective outlooks were valid for the accident site at the accident time.

3.0 Surface Observations

The area surrounding the accident site was documented utilizing official NWS Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). The following observations were taken from standard code and are provided in plain language.

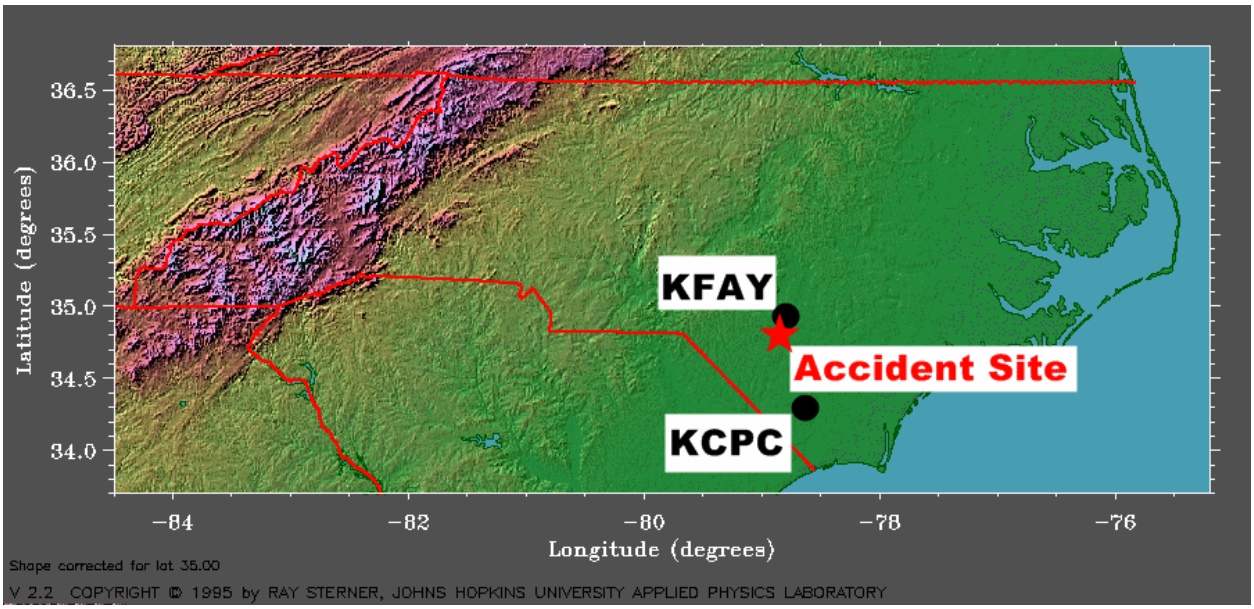

Figure 7 – Map of North Carolina with the location of the accident site and surface observation sites

Fayetteville Regional Airport/Grannis Field (KFAY) was the closest official weather station to the accident site located 3 miles south of Fayetteville, North Carolina, and had an Automated Surface Observing System (ASOS[2]) whose reports were supplemented by the air traffic control tower. KFAY was located 7 miles north-northeast of the accident site, at an elevation of 189 feet, and had a 7° westerly magnetic variation[3] (figure 7). The following observations were taken and disseminated during the times surrounding the accident[4]:

[1053 EST] METAR KFAY 161553Z AUTO 00000KT 2SM -RA BR OVC003 12/11 A3007 RMK AO2 RAE1456B34 SLP177 P0002 T01170111=

[1105 EST] SPECI KFAY 161605Z AUTO 19004KT 4SM -RA BR OVC003 12/12 A3006 RMK AO2 P0000=

[1153 EST] METAR KFAY 161653Z AUTO 20005KT 3SM BR OVC003 13/12 A3004 RMK AO2 RAE06B34E45 SLP166 P0001 T01280122=

[1253 EST] METAR KFAY 161753Z AUTO 23004KT 7SM OVC003 13/13 A3001 RMK AO2 SLP159 60004 T01330128 10133 20100 58018=

[1319 EST] SPECI KFAY 161819Z AUTO 21003KT 5SM -RA BR OVC005 14/13 A3000 RMK AO2 RAB1759 P0001=

[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.
[4] The bold sections in this NWS product and the rest of products in the weather study report are to highlight the individual sections that directly reference the weather conditions that are or will affect the accident location around the accident time.

[1353 EST] METAR KFAY 161853Z AUTO 19004KT 6SM BR OVC005 14/13 A2998 RMK AO2 RAB1759E21B39E49 SLP149 P0001 T01440133=

[1453 EST] METAR KFAY 161953Z AUTO 22004KT 7SM OVC005 14/13 A2999 RMK AO2 CIG 004V007 SLP151 T01440133=

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[1543 EST] SPECI KFAY 162043Z AUTO 21003KT 3SM BR SCT007 OVC013 14/14 A2999 RMK AO2=

[1553 EST] METAR KFAY 162053Z AUTO 20003KT 3SM BR FEW007 OVC013 14/14 A2998 RMK AO2 SLP149 60001 T01440139 56010=

[1603 EST] SPECI KFAY 162103Z AUTO 20004KT 2 1/2SM BR OVC013 14/13 A2998 RMK AO2=

[1623 EST] SPECI KFAY 162123Z AUTO 00000KT 1 3/4SM BR FEW006 OVC015 14/13 A2999 RMK AO2=

[1638 EST] SPECI KFAY 162138Z AUTO 19005KT 1 3/4SM BR BKN004 OVC015 14/13 A2999 RMK AO2 CIG 003V007=

KFAY weather at 1353 EST, wind from 190° at 4 knots, 6 miles visibility and mist, an overcast ceiling at 500 feet above ground level (agl), temperature of 14° Celsius (C), dew point temperature of 13° C, and an altimeter setting of 29.98 inches of mercury. Remarks: automated station with a precipitation discriminator, rain began at 1259 EST and ended at 1321 EST, rain began again at 1339 EST and ended at 1349 EST, sea-level pressure 1014.9 hPa, one-hourly precipitation of 0.01 inches, temperature 14.4° C, dew point temperature 13.3° C.

KFAY weather at 1453 EST, wind from 220° at 4 knots, 7 miles visibility, an overcast ceiling at 500 feet agl, temperature of 14° C, dew point temperature of 13° C, and an altimeter setting of 29.99 inches of mercury. Remarks: automated station with a precipitation discriminator, ceiling variable between 400 and 700 feet agl, sea-level pressure 1015.1 hPa, temperature 14.4° C, dew point temperature 13.3° C.

KFAY weather at 1543 EST, wind from 210° at 3 knots, 3 miles visibility and mist, scattered clouds at 700 feet agl, an overcast ceiling at 1,300 feet agl, temperature of 14° C, dew point temperature of 14° C, and an altimeter setting of 29.99 inches of mercury. Remarks: automated station with a precipitation discriminator.

Columbus County Municipal Airport (KCPC) was the accident pilot's alternate airport located 3 miles south of Whiteville, North Carolina, and had an Automated Weather Observing System (AWOS[5]) whose reports were not supplemented by a human observer. KCPC is at an elevation of 99 feet, had a 7° westerly magnetic variation, and was located 38 miles southeast of the accident site (figure 7). The following observations were taken and disseminated during the times surrounding the accident:

[1315 EST] METAR KCPC 161815Z AUTO 00000KT 10SM OVC005 15/15 A3001 RMK AO2 T01460145=

[1335 EST] METAR KCPC 161835Z AUTO 00000KT 10SM OVC007 15/14 A3001 RMK AO2 T01470144=

[1355 EST] METAR KCPC 161855Z AUTO 00000KT 10SM OVC007 15/15 A2999 RMK AO2 T01470145=

[1415 EST] METAR KCPC 161915Z AUTO 00000KT 10SM OVC007 15/15 A2998 RMK AO2 T01510147=

[1435 EST] METAR KCPC 161935Z AUTO 00000KT 7SM SCT007 SCT070 16/15 A2998 RMK AO2 T01570150=

[1455 EST] METAR KCPC 161955Z AUTO 00000KT 10SM SCT046 SCT060 16/15 A2998 RMK AO2 T01620150=

[1515 EST] METAR KCPC 162015Z AUTO 00000KT 10SM SCT031 SCT046 SCT060 16/15 A2999 RMK AO2 T01620150=

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[1535 EST] METAR KCPC 162035Z AUTO 00000KT 10SM SCT029 BKN055 16/15 A2999 RMK AO2 T01630150=

[1555 EST] METAR KCPC 162055Z AUTO 00000KT 10SM SCT029 BKN048 BKN050 17/15 A2998 RMK AO2 T01650151=

[1615 EST] METAR KCPC 162115Z AUTO 00000KT 10SM SCT048 SCT060 17/15 A2999 RMK AO2 T01650152=

[1635 EST] METAR KCPC 162135Z AUTO 00000KT 10SM BKN048 BKN060 BKN080 16/15 A2999 RMK AO2 T01610151=

[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.

[1655 EST] METAR KCPC 162155Z AUTO 00000KT 7SM BKN046 BKN060 16/15 A2999 RMK AO2 T01570150=

KCPC weather at 1455 EST, wind calm, 10 miles visibility, scattered clouds at 4,600 feet agl, scattered clouds at 6,000 feet agl, temperature of 16° C, dew point temperature of 15° C, and an altimeter setting of 29.98 inches of mercury. Remarks: automated station with a precipitation discriminator, temperature 16.2° C, dew point temperature 15.0° C.

KCPC weather at 1515 EST, wind calm, 10 miles visibility, scattered clouds at 3,100 feet agl, scattered clouds at 4,600 feet agl, scattered clouds at 6,000 feet agl, temperature of 16° C, dew point temperature of 15° C, and an altimeter setting of 29.99 inches of mercury. Remarks: automated station with a precipitation discriminator, temperature 16.2° C, dew point temperature 15.0° C.

KCPC weather at 1535 EST, wind calm, 10 miles visibility, scattered clouds at 2,900 feet agl, a broken ceiling at 5,500 feet agl, temperature of 16° C, dew point temperature of 15° C, and an altimeter setting of 29.99 inches of mercury. Remarks: automated station with a precipitation discriminator, temperature 16.3° C, dew point temperature 15.0° C.

The observation from KFAY indicated IFR[6] conditions at and around the time of the accident near the accident site with VFR[7] conditions at the accident pilot's alternate airport. In addition to the IFR ceilings at and around the accident site, mist and light rainfall where reported around the accident site at the accident time.

4.0 Upper Air Data

The closest official upper air sounding to the accident site was from Greensboro, North Carolina (KGSO), which was approximately 88 miles northwest of the accident site, with a site number 72317, and a station elevation of 926 feet. The 1900 EST sounding from KGSO was plotted on a standard Skew-T log P diagram[8], which is presented along with the derived stability parameters in figure 8 (with data from the surface to 300-hPa, or approximately 30,000 feet msl). This data was analyzed utilizing the RAOB[9] software package. The sounding depicted a moist vertical environment with the Lifted Condensation Level (LCL)[10] at 1,302 feet msl and a Convective Condensation Level (CCL)[11] of 4,967 feet. The freezing level was identified at 9,580 feet. The precipitable water value was 1.17 inches.

[6] Instrument Flight Rules – Refers to the general weather conditions pilots can expect at the surface. IFR criteria means a ceiling below 1,000 feet agl and/or less than 3 miles visibility.
[7] 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.
[8] 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.
[9] RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamopras, Pennsylvania.
[10] Lifting Condensation Level (LCL) - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.
[11] 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.

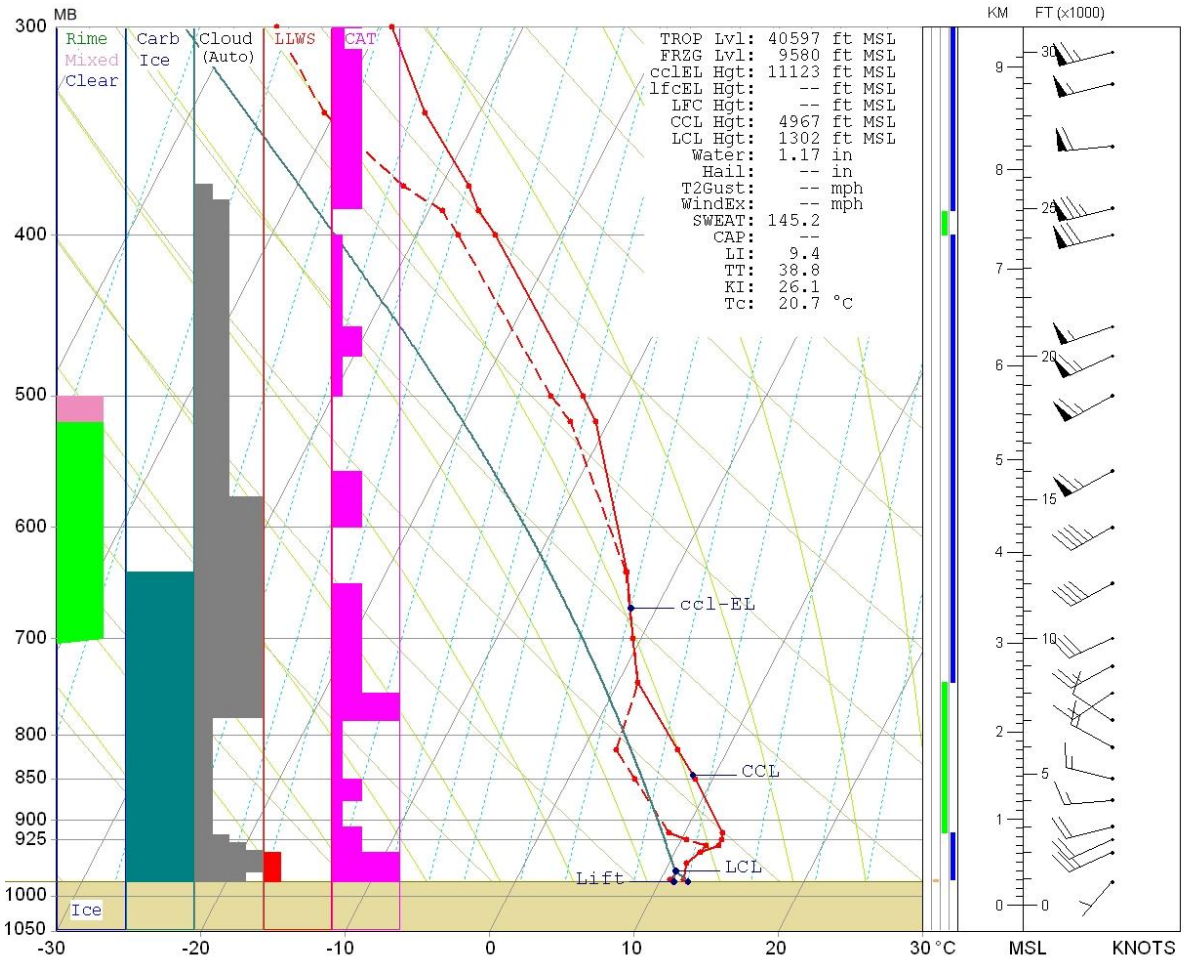


Figure 8 – 1900 EST KGSO upper air sounding

The 1900 EST KGSO sounding indicated a moist stable vertical environment, with the exception of a 5,000 foot conditionally unstable layer between 3,000 and 8,000 feet msl. The vertical environment was relatively moist through 25,000 feet with the relatively humidity at or above 75%. This vertical environment would have been supportive of clouds, light rain, and drizzle. RAOB identified the high probability of clouds between the surface and 2,500 feet, then another cloud layer from 8,000 feet through 25,000 feet. Icing was likely in a layer between 10,000 and 18,000 feet.

The sounding wind profile indicated there was a surface wind from 220° at 7 knots and the wind increased in speed through 2,000 feet to around 25 knots. Low-level wind shear (LLWS) was indicated by RAOB, with several layers of possible clear-air turbulence from the surface through 30,000 feet.

5.0 Satellite Data

Visible and infrared data from the Geostationary Operational Environmental Satellite number 13 (GOES-13) data was obtained from the NCDC and processed with the NTSB's Man-computer Interactive Data Access System (McIDAS) workstation. Visible and infrared imagery (GOES-13 band 1 and 4) at a wavelength of 0.65 microns (μm) and 10.7 μm retrieved brightness temperatures for the scene. Satellite imagery surrounding the time of the accident, from 1300 EST through 1700 EST at approximately 15-minute intervals, were reviewed and the closest images to the time of the accident are documented here.

Figures 9 and 10 present the GOES-13 visible imagery from 1515 and 1532 EST, at 3X magnification with the accident site highlighted with a red square. The visible imagery indicated a large amount of cloud cover at and around the accident site at the accident time. Figure 11 presents the GOES-13 infrared imagery from 1532 EST at 9X magnification. Inspection of the infrared imagery indicated a fairly uniform layer of clouds with a brightness temperature near 250 Kelvin at and around the accident site at the accident time. Based on the brightness temperatures above the accident site and the vertical temperature profile provided by the 1900 EST KGSO sounding (figure 8), the approximate cloud-top heights over the accident site were 25,000 feet at 1532 EST.

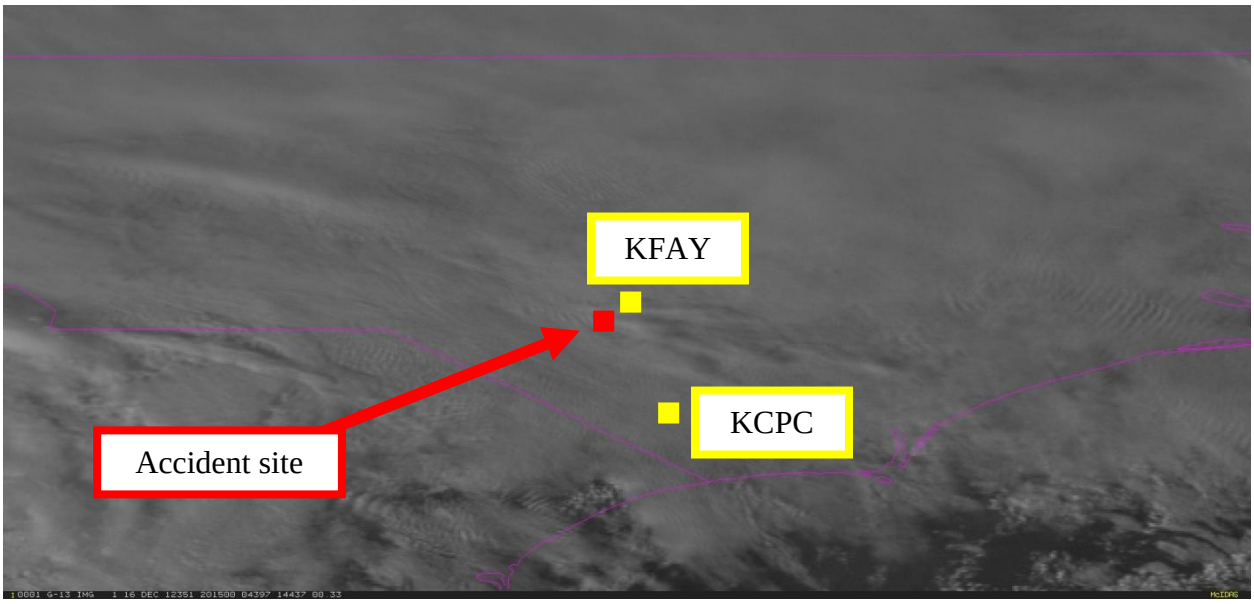


Figure 9 – GOES-13 visible image at 1515 EST

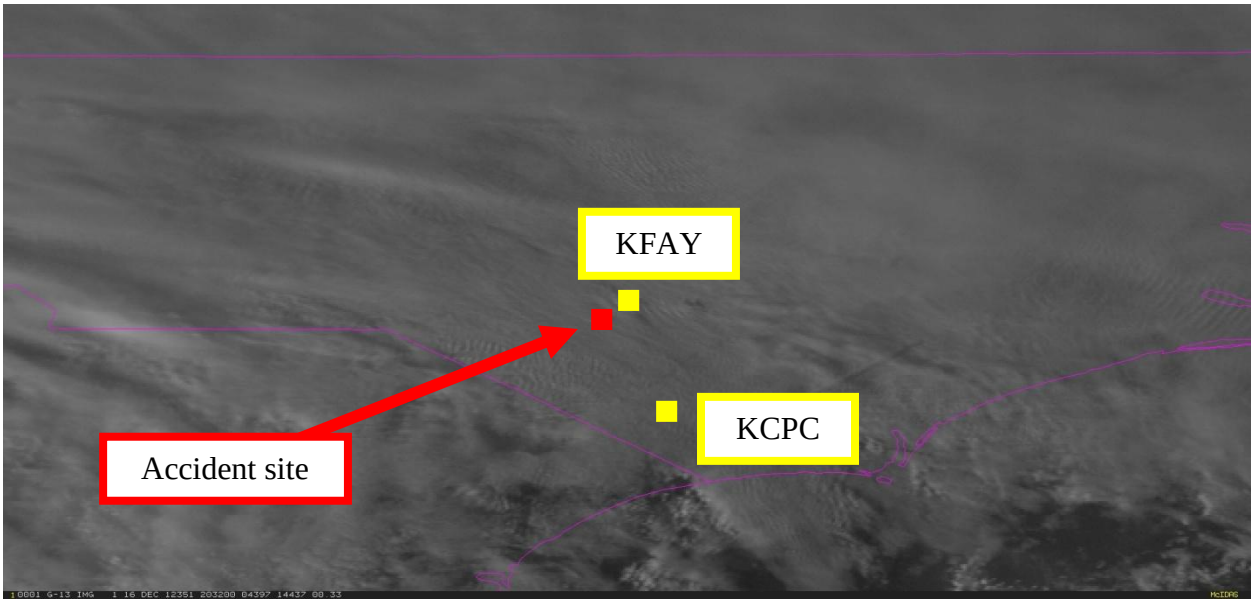


Figure 10 – GOES-13 visible image at 1532 EST

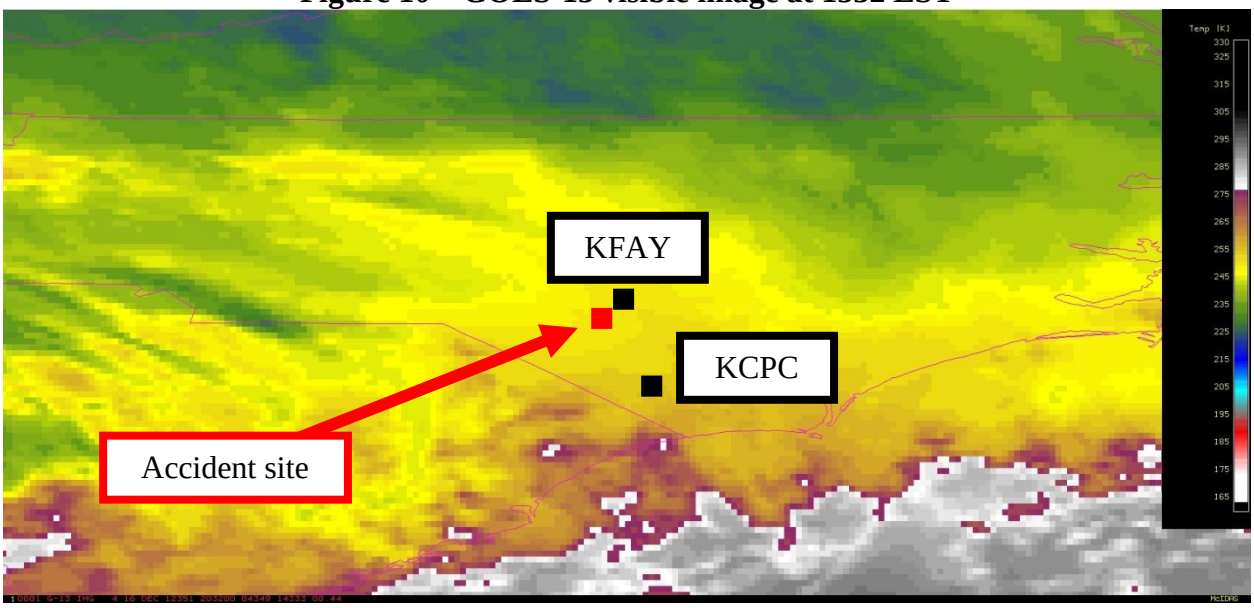


Figure 11 – GOES-13 infrared image at 1532 EST

6.0 Radar Imagery Information

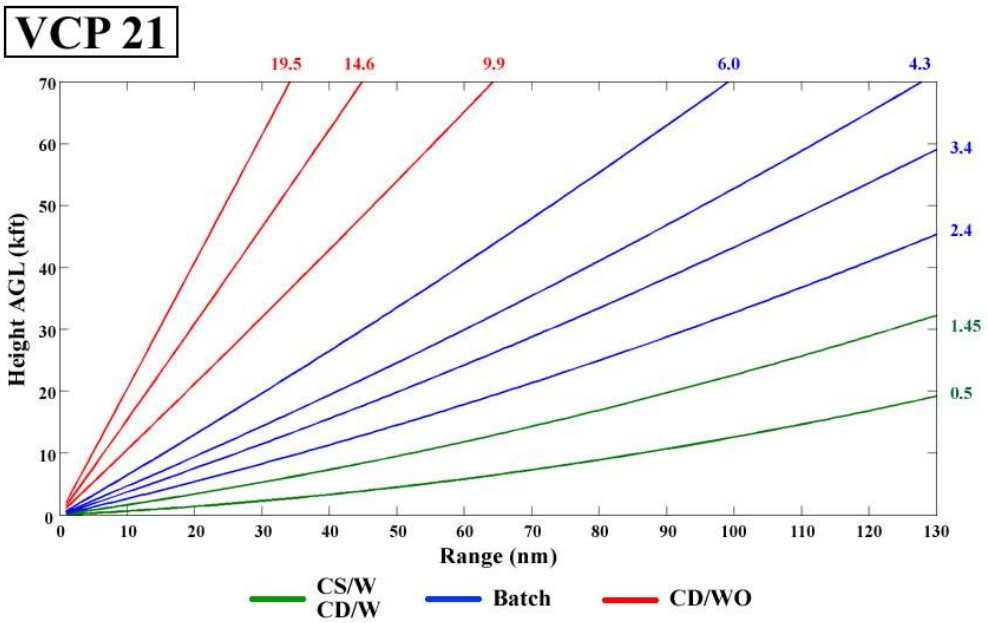
The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D) was KRAX located near Raleigh/Durham, North Carolina, approximately 53 miles south-southwest of the accident site at an elevation of 348 feet. Level II archive radar data was obtained from the NCDC utilizing the NEXRAD Data Inventory Search and displayed using the NOAA's Weather and Climate Toolkit software.

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[12]. The radar produces three basic types of products: base reflectivity, base radial velocity, and base spectral width.

6.1 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 on the WSR-88D's Principle Users Processor (PUP). 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 two common scanning strategies. The most common is where the radar makes 9 elevation scans from 0.5° to 19.5° every six minutes. This particular scanning strategy is documented as volume coverage pattern 21 (VCP-21). 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 KRAX WSR-88D radar was operating in the normal precipitation mode (Mode A, VCP-21). 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.



VCP-21 Precipitation Mode Scan Strategy

[12] Beam width – A measure of the angular width of a radar beam.

6.2 Beam Height Calculation

Assuming standard refraction[13] of the WSR-88D 0.95° wide radar beam, the following table shows the approximate beam height and width information[14] of the radar display over the site of the accident. The heights have been rounded to the nearest 10 feet.

ANTENNA ELEVATION	BEAM CENTER	BEAM BASE	BEAM TOP	BEAM WIDTH
0.5°	5,190 feet	2,570 feet	8,800 feet	5,230 feet

Based on the radar height calculations, the 0.5° elevation scan depicted the conditions between 2,570 feet and 8,800 feet msl over the accident site, and this antenna elevation is the closest to accident aircraft's altitude[15] before the accident descent.

6.3 Reflectivity

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors[16] 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 decibels (dBZ[17]), and is a general measure of echo intensity. The chart below relates the NWS video integrator and processor (VIP) intensity levels versus the WSR-88D's display levels, precipitation mode reflectivity in decibels, and rainfall rates.

[13] Standard Refraction in the atmosphere is when the temperature and humidity distributions are approximately average, and values set at the standard atmosphere.

[14] Beamwidth values are shown for legacy resolution products. Super resolution products would an effective beamwidth that would be approximately half these values.

[15] For more information see the ATC Factual Report.

[16] 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.

[17] 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.

NWS VIP/DBZ CONVERSION TABLE

NWS VIP	WSR-88D LEVEL	PREC MODE DBZ	RAINFALL
0	0	< 5	
	1	5 to 9	
	2	10 to 14	
1	3	15 to 19	.01 in/hr
Very Light	4	20 to 24	.02 in/hr
	5	25 to 29	.04 in/hr
2	6	30 to 34	.09 in/hr
Light to	7	35 to 39	.21 in/hr
Moderate			
3	8	40 to 44	.48 in/hr
Strong			
4	9	45 to 49	1.10 in/hr
Very Strong			
5	10	50 to 54	2.49 in/hr
Intense			
6	11	55 to 59	>5.67 in/hr
Extreme	12	60 to 64	
	13	65 to 69	
	14	70 to 74	
	15	> 75	

The Federal Aviation Administration (FAA) Advisory Circular AC 00-24B titled "Thunderstorms" dated January 2, 1983, also defines the echo intensity levels and potential weather phenomena associated with those levels. If the maximum VIP Level is 1 "weak" and 2 "moderate", then light to moderate turbulence is possible with lightning. VIP Level 3 is "strong" and severe turbulence is possible with lightning. VIP Level 4 is "very heavy" and severe turbulence is likely with lightning. VIP Level 5 is "intense" with severe turbulence, lightning, hail likely, and organized surface wind gusts. VIP Level 6 is "extreme" with severe turbulence, lightning, large hail, extensive surface wind gusts and turbulence.

6.4 Radar Summary

Figure 12 provides a radar summary image from 1545 EST with reflectivity values over the southeastern United States, with the accident site located near an area with 20 to 30 dBZ values. These reflectivity values indicate very light to light echoes near the accident site around the accident time.

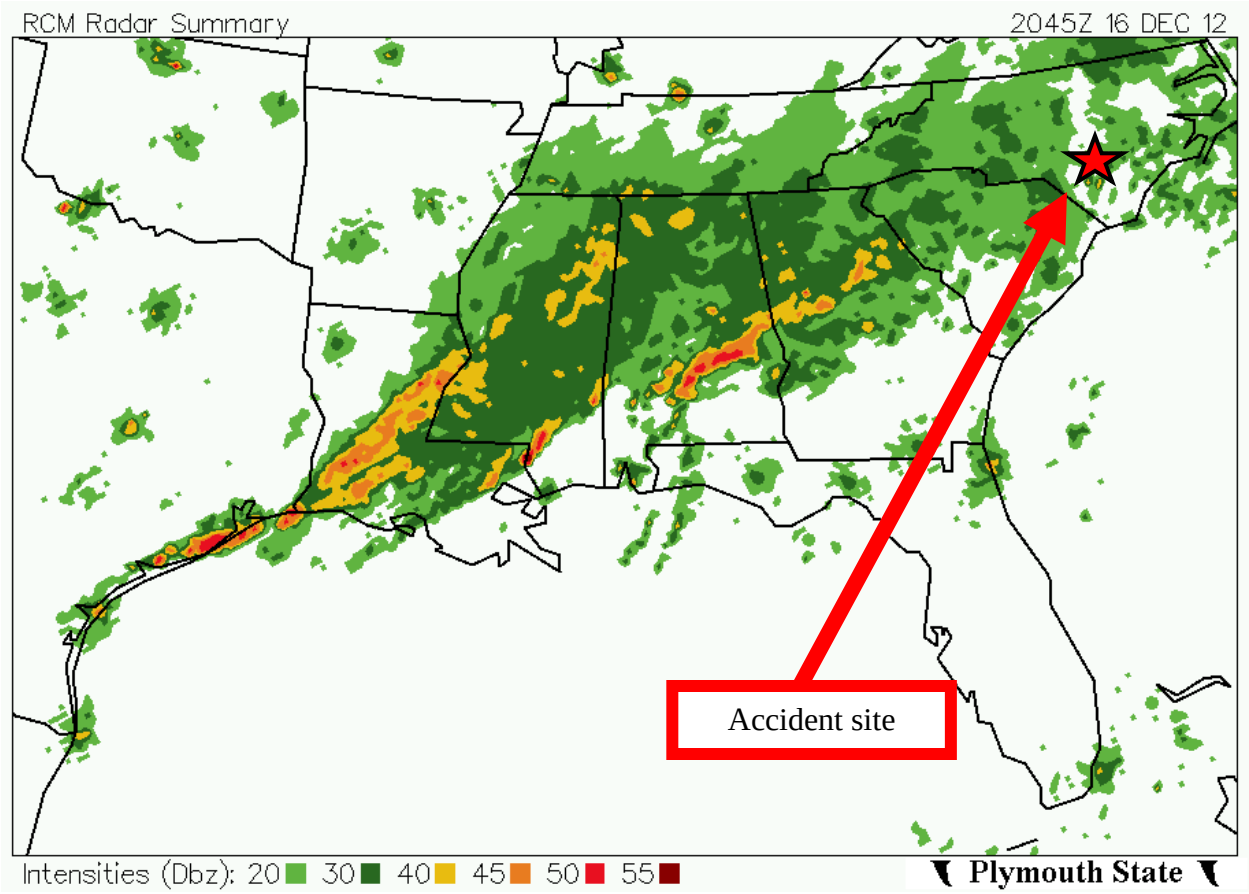


Figure 12 – Radar summary image for 1545 EST with the accident site

6.5 Base Reflectivity and Lightning Data

Figures 13 and 14 present the KRAX WSR-88D base reflectivity image for the 0.5° elevation scans initiated at 1528 and 1533 EST with a resolution of 0.5° X 250 m. The ATC flight track is also provided from 1517 to 1532 EST with the accident aircraft's location at 1528 EST marked. The aircraft flew through 20 to 30 dBZ reflectivity values around the accident time and given these values the accident aircraft likely encountered precipitation around the time of the accident while located within a cloud layer (see Section 4.0 and ATC Factual Report). No lightning was reported or detected near the accident site at the accident time.

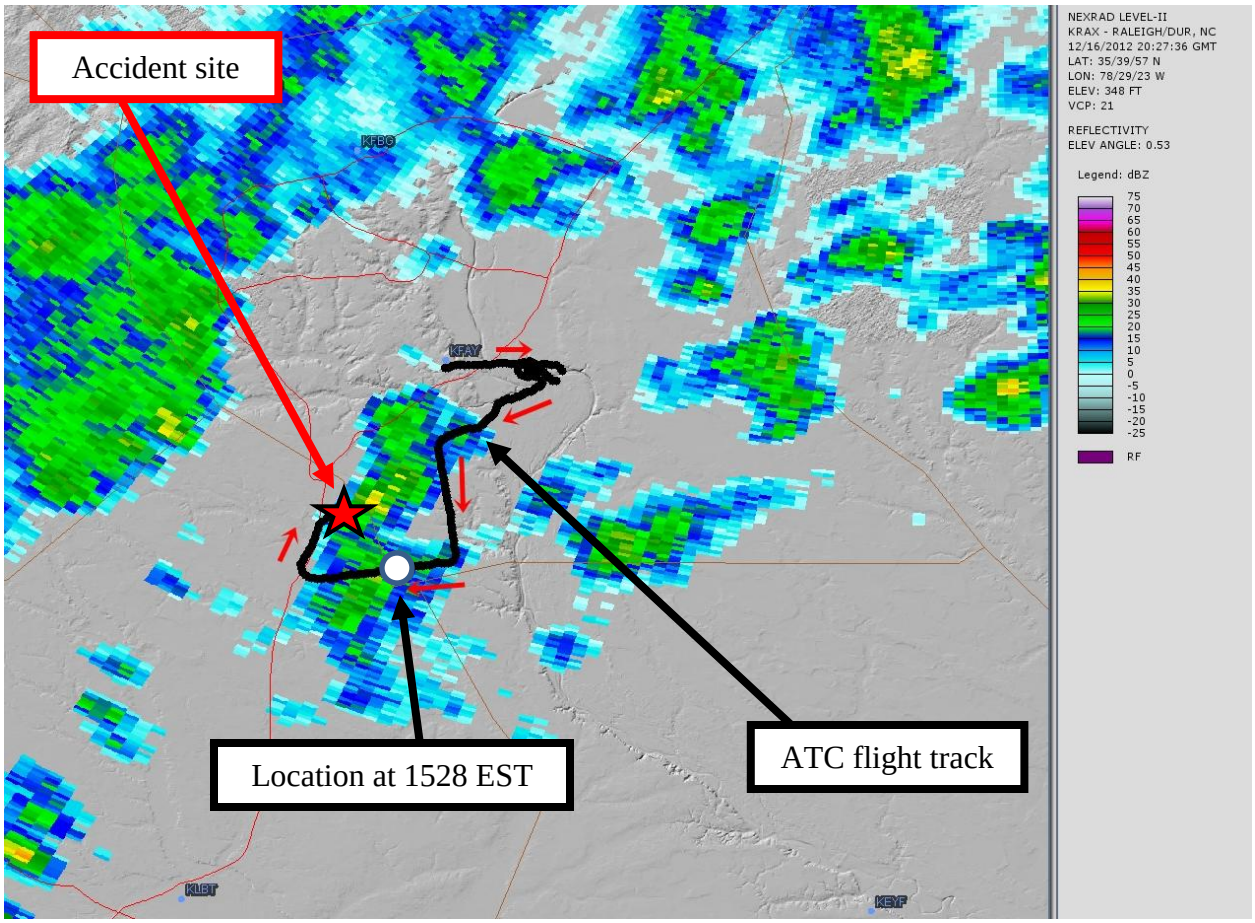


Figure 13 – KRAX WSR-88D reflectivity for the 0.5° elevation scan initiated at 1528 EST with the ATC flight track from 1517 to 1532 EST

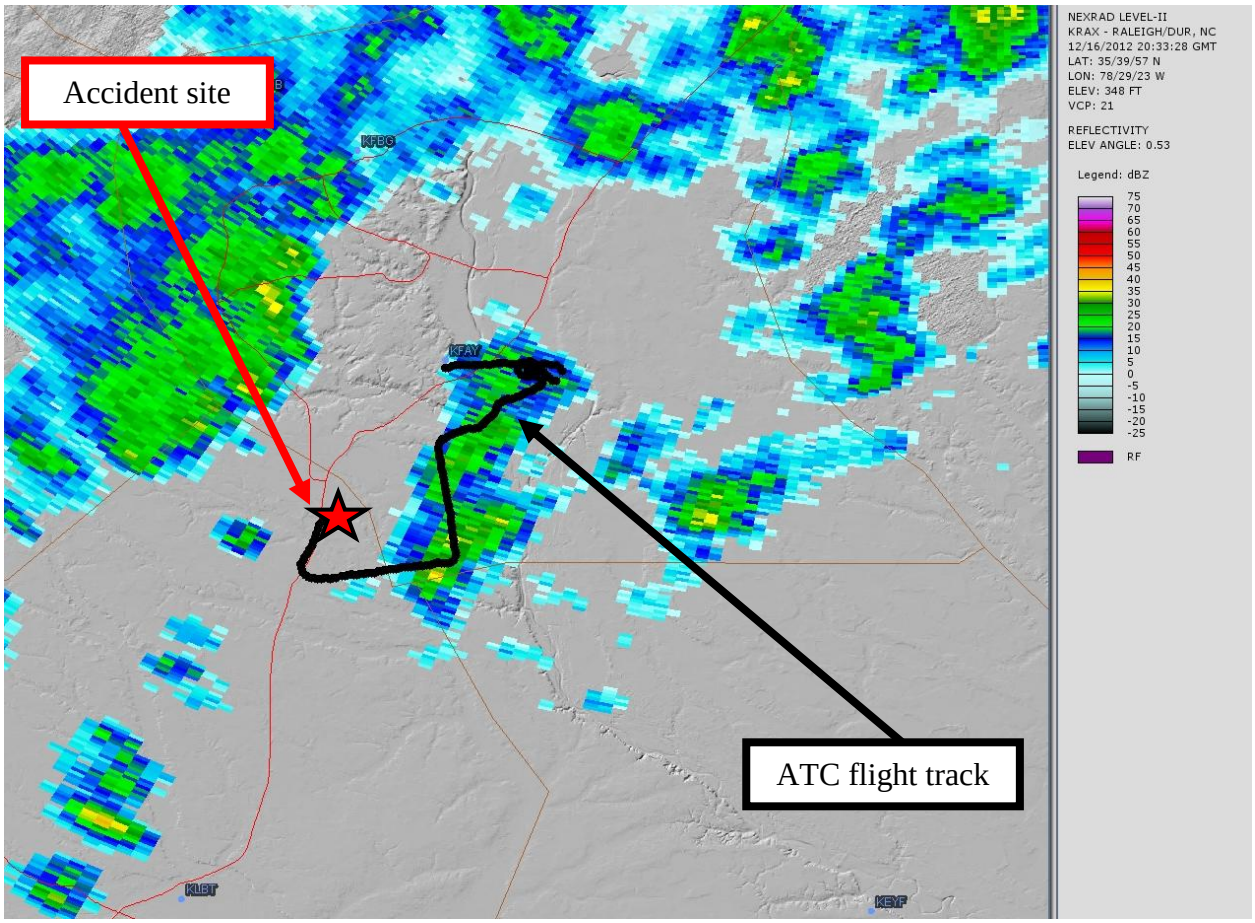


Figure 14 – KRAX WSR-88D reflectivity for the 0.5° elevation scan initiated at 1533 EST with the ATC flight track from 1517 to 1532 EST

6.6 3-Dimensional Radar Reflectivity Data

Figures 15 through 17 present a 3-dimensional view of the KRAX WSR-88D base reflectivity for the elevation scan initiated at 1528 EST. The accident aircraft's flight track obtained from ATC[18] was also plotted on the Google Earth image for a time comparison with the base reflectivity image. Figures 15 through 17 show the accident flight encountering a rain shower while turning westward, which matches figure 13 and the base reflectivity data. As discussed in the previous section, it is likely the accident aircraft encountered precipitation while located within a cloud layer near the accident time.

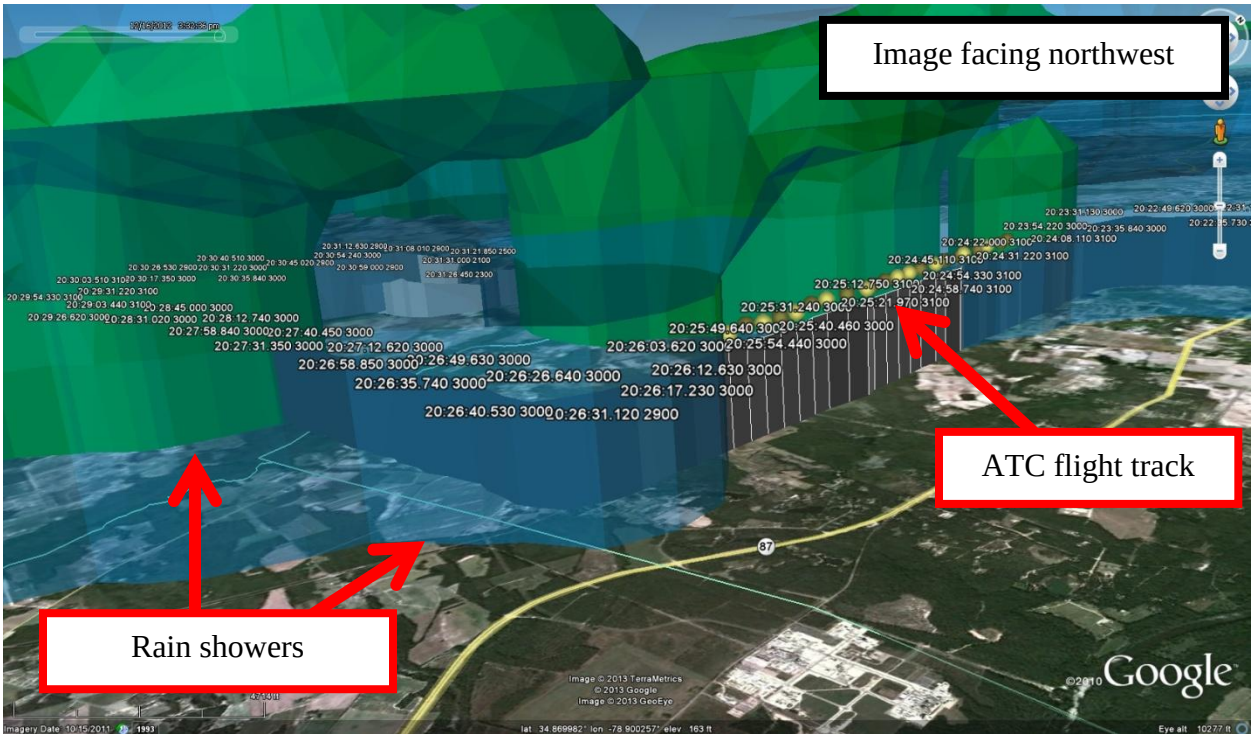


Figure 15 – 3-dimensional KRAX WSR-88D base reflectivity from the scan initiated at 1528 EST and the ATC Flight Track

[18] For more information see the ATC Factual Report.

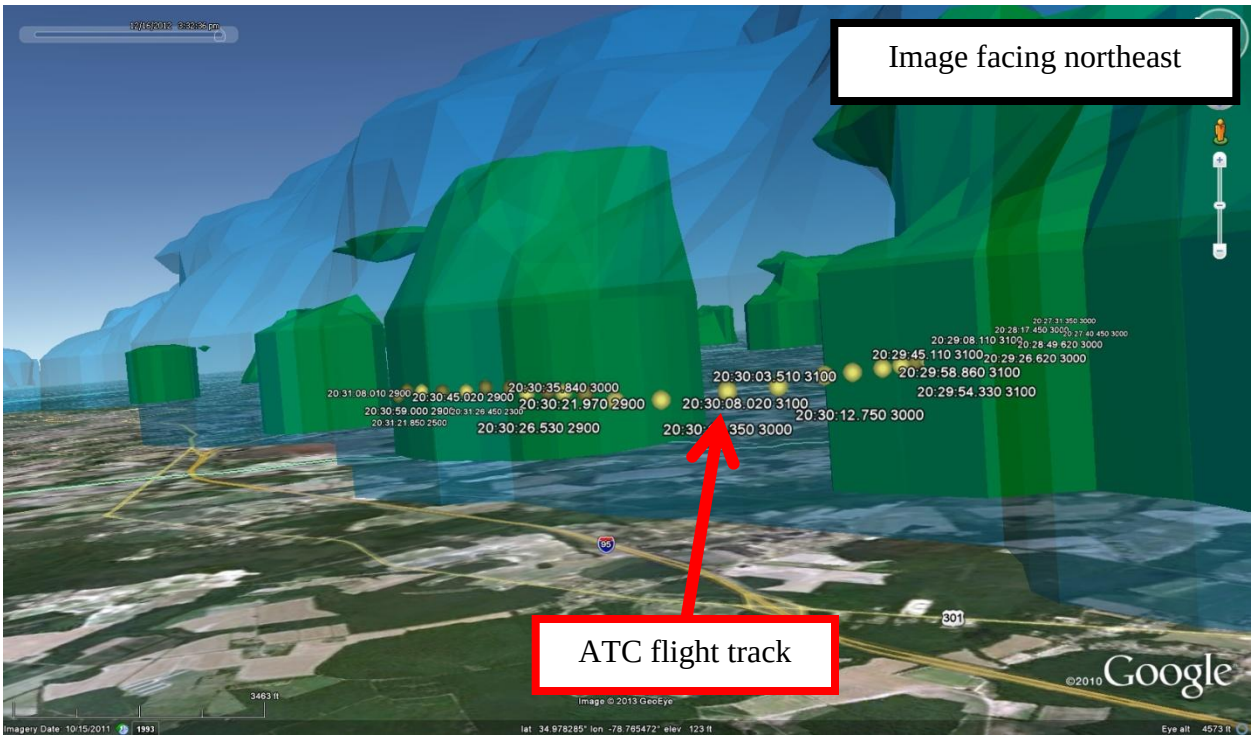


Figure 16 – 3-dimensional KRAX WSR-88D base reflectivity from the scan initiated at 1528 EST and the ATC Flight Track

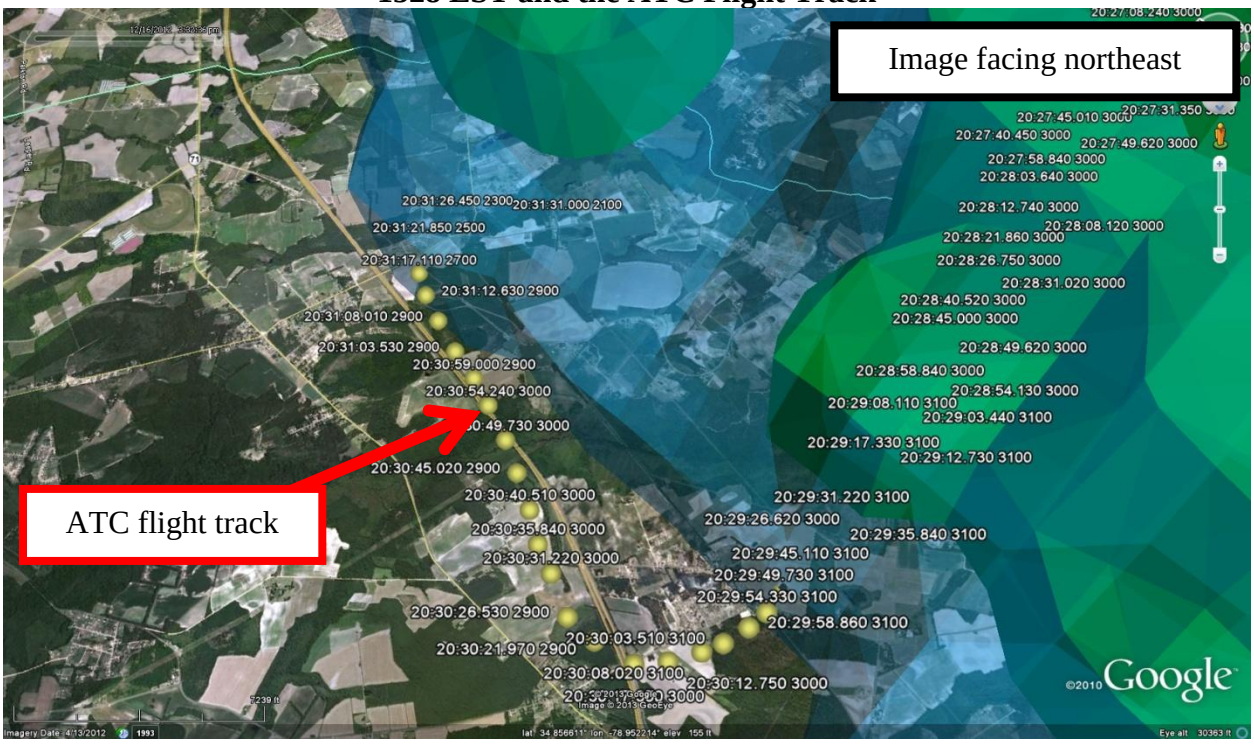


Figure 17 – 3-dimensional KRAX WSR-88D base reflectivity from the scan initiated at 1528 EST and the ATC Flight Track

7.0 Pilot Reports

Pilot reports (PIREPs) were reviewed close to the accident site from around three hours prior to the accident time to around three hours after the accident time and these PIREPs were disseminated near the accident flight's altitude:

PGV UA /OV PGV /TM 2009 /FLUNKN /TP LJ45 /SK OVC005 /RM OVC-BKN=

GSO UA /OV GSO /TM 2012 /FL015 /TP BE35 /SK OVC015 /RM ON FINAL APCH 23L GSO=

RDU UA /OV RDU050002 /TM 2144 /FLUNKN /TP E190 /SK BKN011 /RM DURD FINAL RY23R=

RDU UA /OV RDU /TM 2310 /FL009 /TP C750 /SK BKN /RM RAGGED BASES=

GSO UA /OV GSO /TM 2347 /FLUNKN /TP E145 /SK OVC007-TOP022 /RM DPTG RWY 23L DURC=

Routine pilot report (UA); Over Greenville, North Carolina; Time – 1509 EST (2009Z); Altitude – unknown; Type aircraft – Learjet 45; Sky – Overcast skies at 500 feet agl; Remarks – Sky overcast to broken.

Routine pilot report (UA); Over Greensboro, North Carolina; Time – 1512 EST (2012Z); Altitude – 1,500 feet msl; Type aircraft – Beechcraft 35 Bonanza; Sky – Overcast skies at 1,500 feet agl; Remarks – On final approach to runway 23L in Greensboro.

Routine pilot report (UA); 2 miles from Raleigh/Durham, North Carolina, on the 050° radial; Time – 1644 EST (2144Z); Altitude – unknown; Type aircraft – Embraer E190; Sky – Broken skies at 1,100 feet agl; Remarks – During final into runway 23R.

Routine pilot report (UA); Over Raleigh/Durham, North Carolina; Time – 1810 EST (2310Z); Altitude – 900 feet msl; Type aircraft – Cessna C750; Sky – Broken; Remarks – Ragged bases.

Routine pilot report (UA); Over Greensboro, North Carolina; Time – 1847 EST (2347Z); Altitude – Unknown; Type aircraft – Embraer E145; Sky – Overcast skies at 700 feet agl with tops at 2,200 feet agl; Remarks – Departing runway 23L during climb.

8.0 SIGMET and CWSU Advisory

No SIGMETs were valid for the accident site at the accident time.

A CWSU Advisory (CWA) was valid for the accident flight in South Carolina and was issued at 1354 EST. The CWA advised of IFR conditions with areas of ceilings below 500 feet and/or visibility below 3 miles in mist, fog, and low clouds. Little change in these conditions was expected for the next 2 hours.

FAUS21 KZJX 161854
ZJX1 CWA 161855
ZJX CWA 104 VALID UNTIL 162055
FROM 50ESE CLT-45SW ILM-60SW ILM-30NNW CAE-50ESE CLT
AREA OF CIGS BLW 005 AND/OR VSBY BLW 3SM IN BR/FG/LOW CLDS.
LTL CHANGE EXPD NXT 2 HRS.
VC
=

A Meteorological Impact Statement (MIS) was issued at 0740 EST for the area of the accident site and this MIS was valid through 1500 EST. The MIS advised of IFR conditions with rain from central Virginia through central North Carolina. Conditions were expected to slowly after 1200 EST to VFR:

FAUS20 KZDC 161240
ZDC MIS 02 VALID 161235-162000
...FOR ATC PLANNING PURPOSES ONLY...
IFR/MVFR CIG 005-025 SHRA CENTRAL VA NC TRACK E 35 KT...SLOWLY
IMPROVE TO VFR CIG 040 AFT 17Z. ISOL TS POSS E NC WITH TOPS TO NEAR
FL300. VFR CIG 050-100 N VA MD DE NJ. LGT-MOD ICE 090-FL250 WITH
SHRA. LGT-MOD TURB FL240-FL400 MOST OF ZDC.
=

Another (MIS) was issued at 1530 EST and valid for the accident site at the accident time. This MIS advised IFR conditions continuing with rain showers and mist from central Virginia to central North Carolina:

FAUS20 KZDC 162030
ZDC MIS 02 VALID 162030-170300
...FOR ATC PLANNING PURPOSES ONLY...
IFR/MVFR CIG 005-030 SHRA BR CENTRAL VA / NC TRACK E-NE 30 KT. VFR
CIGS ACROSS DC METRO'S AND NORTH WILL LOWER TO MVFR CIG BR 23Z-01Z
AND EVENTUALLY IFR CIG BR AFT 03Z. LGT-MOD ICE 090-FL250 AND LGT-MOD
TURB FL240-FL400...POSS SEV SOUTHWEST ZDC..
=

9.0 AIRMETs

AIRMET Sierra issued at 1126 EST, and valid at the accident time, forecasted IFR conditions for the accident site with ceilings below 1,000 feet and visibilities below 3 miles with precipitation, mist, and fog:

WAUS42 KKCI 161626 AAA
WA2S
_MIAS WA 161626 AMD
AIRMET SIERRA UPDT 3 FOR IFR AND MTN OBSCN VALID UNTIL 162100
.
AIRMET IFR...NC SC GA FL WV MD DE VA AND CSTL WTRS
FROM 30WSW EMI TO 20WSW SIE TO 160SE SIE TO 180E ECG TO 20NNW
CRG TO 50SW PZD TO GQO TO HMV TO 50WSW BKW TO 40SSW EKN TO 30WSW
EMI
CIG BLW 010/VIS BLW 3SM PCPN/BR/FG. CONDS ENDG 18-21Z.

.
AIRMET IFR...FL AND CSTL WTRS...UPDT
FROM 20NE CEW TO 50SW PZD TO 30SSW TLH TO 80SSW TLH TO 50SE SJI
TO 40W CEW TO 20NE CEW
CIG BLW 010/VIS BLW 3SM PCPN/BR/FG. CONDS ENDG 18-21Z.
...NEW AIRMET...
.
AIRMET MTN OBSCN...NC SC GA ME NH VT NY PA WV MD VA
FROM 40E YSC TO CON TO HNK TO 30NNE GSO TO CLT TO ATL TO GQO TO
HMV TO HNN TO JHW TO SYR TO 30ESE YOW TO 40E YSC
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 21Z THRU 03Z.
.
OTLK VALID 2100-0300Z...IFR NC SC GA WV MD DC VA AND CSTL WTRS
BOUNDED BY EMI-20NE ECG-20S ILM-20SE IRQ-GQO-HMV-60SSW HNN-EKN-
EMI
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS DVLPG 21-00Z. CONDS CONTG
THRU 03Z.
....
WAUS42 KKCI 161445
WA2T
_MIAT WA 161445
AIRMET TANGO UPDT 2 FOR TURB VALID UNTIL 162100
.
AIRMET TURB...NC CT NY NJ PA OH WV MD DC DE VA AND CSTL WTRS
FROM 40SSE BUF TO 40SW BDL TO 170S ACK TO 160SE SIE TO 180E ECG
TO 80S ECG TO HMV TO HNN TO CVG TO FWA TO 40SSE BUF
MOD TURB BTN FL240 AND FL410. CONDS CONTG BYD 21Z THRU 03Z.
....
WAUS42 KKCI 161445
WA2Z
_MIAZ WA 161445
AIRMET ZULU UPDT 2 FOR ICE AND FRZLVL VALID UNTIL 162100
.
AIRMET ICE...NC SC GA WV MD DE VA AND CSTL WTRS
FROM 130E ACK TO 200SE ACK TO 160SE SIE TO 200ESE ECG TO 20SW CHS
TO 50WSW PZD TO GQO TO HMV TO 50WSW BKW TO 40WSW EKN TO 60ESE CYN
TO 30ESE HTO TO 130E ACK
MOD ICE BTN FRZLVL AND FL240. FRZLVL 060-120. CONDS CONTG BYD 21Z
THRU 03Z.
.
OTLK VALID 2100-0300Z...ICE NC SC GA FL MA RI CT NY NJ PA WV MD
DC DE VA AND CSTL WTRS
BOUNDED BY 130ENE ACK-200SE ACK-160SE SIE-190ESE ECG-130SE
ILM-50SW PZD-GQO-HMV-40W BKW-40WSW EKN-30ESE EKN-40SSE
JST-SAX-20NW HTO-20W PVD-130ENE ACK
MOD ICE BTN FRZLVL AND FL240. FRZLVL 060-120. CONDS CONTG THRU
03Z.
.
FRZLVL...RANGING FROM 090-165 ACRS AREA
  120 ALG 40WNW PZD-SAV-170SSE ILM
  160 ALG 110WNW EYW-80SW RSW-60SSE MIA-130SE MIA
....

10.0 Terminal Aerodrome Forecast

KFAY (figure 7) was the closest site with a NWS TAF. The TAF valid at the time of the accident was issued at 1241 EST and was valid for a 24-hour period beginning at 1300 EST. The TAF forecast for KFAY was as follows:

KFAY 161741Z 1618/1718 **18005KT P6SM VCSH OVC003**
TEMPO 1618/1622 BKN010
FM162200 20007KT P6SM BKN015 OVC090
FM170300 22005KT 5SM -SHRA BKN005 OVC015
TEMPO 1708/1712 2SM BR OVC002=

The forecast expected wind from 180° at 5 knots, visibility greater than 6 miles, an overcast ceiling at 300 feet agl. Temporary conditions of a broken ceiling at 1,000 feet agl were forecast between 1300 and 1700 EST.

The previous KFAY TAF was issued at 1049 EST and was valid for a 20-hour period beginning at 1100 EST. The 1100 EST TAF forecast for KFAY was as follows:

KFAY 161549Z 1616/1712 22003KT 2SM -RA BR OVC003
TEMPO 1616/1619 6SM BR BKN012
FM161900 22008KT P6SM BKN015 OVC080
FM162300 22006KT P6SM BKN008 OVC080
FM170300 22005KT 4SM -SHRA BR OVC004=

The forecast valid at the accident time expected wind from 220° at 8 knots, visibility greater than 6 miles, a broken ceiling at 1,500 feet agl, and overcast skies at 8,000 feet agl.

11.0 Area Forecast

The Area Forecast issued at 1345 EST, and valid at the accident time, forecasted a broken ceiling between 1,500 and 2,500 feet msl, and an overcast layer between 8,000 and 10,000 feet msl with layered clouds through FL240[19]. Occasional visibilities between 3 and 5 miles and mist was forecast with widely scattered light rain showers:

FAUS42 KKCI 161845
FA2W
-MIAC FA 161845
SYNOPSIS AND VFR CLDS/WX
SYNOPSIS VALID UNTIL 171300
CLDS/WX VALID UNTIL 170700...OTLK VALID 170700-171300
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.

[19] 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.

.
SYNOPSIS...SERIES OF MID/UPR LVL IMPULSES WILL CONT ACRS OH VLY
AND CNTRL/SRN APPALACHIANS THRU OTLK. WSW FLOW THRUT. WRM FNT WRN
PA-MD-DE WILL APCH CNTRL PA-NJ THRU 00Z AND BECM STNR SRN PA NJ
DURG OTLK. CDFNT WRN OH WILL MV LTL THRU PD AND APCH SRN OH LATE
DURG OTLK.
.
NC
MTNS...BKN020-025 BKN100 LYRD FL220. OCNL VIS 3-5SM BR. WDLY SCT
-SHRA/ISOL -TSRA. CB TOP FL270. OTLK...IFR CIG SHRA BR.
**PIEDMONT...BKN015-025 OVC080-100 LYRD FL240. OCNL VIS 3-5SM BR.
WDLY SCT -SHRA. BECMG 0103 BKN-OVC010-020 OVC080. WDLY SCT
-SHRA. OTLK...IFR CIG SHRA.**
CSTL PLAINS...BKN015-025 OVC100 LYRD FL240. OCNL VIS 3-5SM BR.
WDLY SCT -SHRA. OTLK...MVFR CIG SHRA BR.
.
SC
MTNS...BKN025 OVC080-100 LYRD FL220. OCNL VIS 3-5SM BR. WDLY SCT
-SHRA/ISOL -TSRA. CB TOP FL250. BECMG 2200 BKN-OVC015-025
OVC040 LYRD FL250. OCNL VIS 3-5SM BR. WDLY SCT -SHRA/ISOL
-TSRA. CB TOP FL260. OTLK...IFR CIG SHRA BR.
PIEDMONT...BKN025 OVC100 LYRD FL240. OCNL VIS 3-5SM BR. ISOL
-SHRA. BECMG 2301 BKN-OVC010-020 OVC040. OCNL VIS 3-5SM BR.
WDLY SCT -SHRA. OTLK...IFR CIG SHRA.
CSTL PLAINS...BKN020-025 BKN100-120 LYRD FL220. ISOL -SHRA.
BECMG 0305 BKN010-020 OVC100. OCNL VIS 3-5SM BR. WDLY SCT
-SHRA. OTLK...MVFR CIG SHRA BR.
.
GA
NRN-CNTRL PTN...BKN-OVC015-025 LYRD FL240. OCNL VIS 3-5SM BR.
WDLY SCT -SHRA/ISOL -TSRA. CB TOP FL270. OTLK...IFR CIG SHRA
BR.
SRN PTN...SCT-BKN035 BKN100 TOPS 160. OCNL -RA. BECMG 0103
BKN020-025 BKN100. OCNL VIS 3-5SM ISOL -RA BR. OTLK...IFR CIG
RA BR.
.
FL
PNHDL...BKN015-025 BKN100 TOPS 160 BKN CI. OCNL VIS 3-5SM BR.
ISOL -SHRA/-TSRA. CB TOP FL300. BECMG 0104 BKN-OVC010 TOPS
050. OCNL VIS 3-5SM BR. ISOL -SHRA. OTLK...IFR CIG BR.
NRN PEN...SCT-BKN035 TOPS 060. BECMG 0204 SCT025-030 BKN CI.
OCNL VIS 3-5SM BR. OTLK...IFR CIG BR.
CNTRL-SRN PEN...SCT040-060 SCT-BKN CI. BECMG 2200 BKN035 TOPS
070. OTLK...VFR.
.
CSTL WTRS
ATLC WTRS...
N CHS...BKN020 BKN-OVC080-100 LYRD FL270. WDLY SCT -SHRA.
OTLK...IFR CIG SHRA.
CHS-SWD...SCT025 BKN CI. BECMG 2301 BKN025 TOPS 080 BKN CI.
ISOL -SHRA. OTLK...MVFR CIG SHRA.
GULF WTRS E OF 85W...SCT025-030 SCT-BKN CI. OTLK...MVFR CIG NRN
PTN VFR SRN PTN.
....

12.0 National Weather Service Area Forecast Discussion

The National Weather Service Office in Raleigh, North Carolina, issued the following Area Forecast Discussion at 1547 EST which discussed areas of IFR conditions near KFAY continuing through the day with more rain shower activity expected:

FXUS62 KRAH 162047
AFDRAH
AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE RALEIGH NC
347 PM EST SUN DEC 16 2012
.SYNOPSIS...
A LOW PRESSURE SYSTEM WILL DEVELOP ALONG A STATIONARY FRONT WEST OF THE MOUNTAINS TONIGHT...THEN TRACK NORTHEAST THROUGH THE OHIO VALLEY AND MID-ATLANTIC MONDAY INTO MONDAY NIGHT...PROPELLING A COLD FRONT EASTWARD THROUGH THE CAROLINAS EARLY TUESDAY MORNING.
&&
.NEAR TERM /THROUGH MONDAY NIGHT/...
AS OF 130 PM SUNDAY...
TONIGHT:
EXPECT PRECIP CHANCES TO INCREASE EVERYWHERE FROM SW-NE AS MULTIPLE SMALL AMPLITUDE DISTURBANCES ALOFT TRACK INTO CENTRAL/WESTERN NC THIS AFT/EVE INTO TONIGHT...AND WILL INDICATE PRECIP CHANCES OF 60-80% OVERNIGHT...HIGHEST IN THE SW PIEDMONT AND SANDHILLS BETWEEN ROUGHLY 03-09Z. EXPECT OVERNIGHT LOWS IN THE LOWER/MID 50S GIVEN PERVASIVE CLOUD COVER AND AN ATYPICALLY MOIST AIRMASS IN PLACE...COOLEST IN THE NW PIEDMONT.
MONDAY AND MONDAY NIGHT:
ABOVE NORMAL UNCERTAINTY. SHORTWAVE ENERGY OVER THE ROCKIES THIS AFTERNOON WILL DIG INTO THE CENTRAL PLAINS BY 12Z MONDAY... INITIATING CYCLOGENESIS ALONG A STALLED FRONTAL ZONE EXTENDING SW-NE FROM THE LOWER MS RIVER INTO THE OH VALLEY. THE AFOREMENTIONED SHORTWAVE ENERGY WILL PROGRESS EAST INTO THE MID-ATLANTIC BY 12Z TUE MORNING...WHILE THE ATTENDANT SFC LOW TRACKS NORTHEAST THROUGH THE OH VALLEY INTO THE NORTHERN MID-ATLANTIC AND AN ASSOCIATED COLD FRONT PROGRESSES THROUGH THE CAROLINAS. THE BEST OVERALL FORCING ASSOC/W THIS SYSTEM IS EXPECTED TO OCCUR BETWEEN 00-12Z TUE WHEN LOW-LEVEL CONVERGENCE ASSOCIATED WITH THE SFC-H85 TROUGH /COLD FRONT/ WILL BE COINCIDENT WITH THE RELATIVE STRONGEST UPPER LEVEL FORCING AS THE SHORTWAVE MAKES ITS CLOSEST APPROACH TO THE REGION. FCST SOUNDINGS INDICATE WHAT MAY BE A COLD FRONT ALOFT PROGRESSING THROUGH THE AREA BETWEEN 00-06Z TUE...CHARACTERIZED BY COOLING/ DRYING ALOFT IN ADVANCE OF THE SURFACE COLD FRONT. FURTHER COMPLICATING MATTERS...SMALL AMPLITUDE DISTURBANCES WILL BE POSSIBLE THROUGHOUT THE DAY MONDAY IN SW FLOW ALOFT DOWNSTREAM OF THE APPROACHING SHORTWAVE...IN THE PRESENCE OF AN UNSEASONABLY MOIST AIRMASS. EXPECT SHOWER ACTIVITY WILL BE POSSIBLE THROUGHOUT THE DAY...DRIVEN PRIMARILY BY SMALL AMPLITUDE DISTURBANCES ALOFT AND PERHAPS A BRIEF SURGE OF WARM ADVECTION IN ASSOC/W A WEAK WARM FRONTAL PASSAGE DURING THE AFTERNOON. THEREAFTER...IF A COLD FRONT ALOFT DOES INDEED PROGRESS INTO THE AREA...THE BEST CHANCE OF CONVECTION MAY ACTUALLY OCCUR MONDAY EVENING PRIOR TO THE SURFACE FROPA...WITH ISOLD CONVECTION POSSIBLE ALONG THE SURFACE FRONT IF DEEP-LAYER FORCING IS SUFFICIENT TO CAPITALIZE ON POTENTIAL INSTABILITY PRESENT AFTER THE CFA PASSAGE. WILL INDICATE THE BEST

CHANCE FOR SHOWER ACTIVITY BETWEEN 21-06Z. GIVEN THAT HIGHS DID NOT
EXCEED THE MID/UPPER 50S IN MOST AREAS TODAY...AND THAT RATHER
SIMILAR CONDITIONS ARE EXPECTED TOMORROW...HAVE OPTED TO LOWER HIGHS
A FEW DEGREES...RANGING FROM THE MID/UPPER 50S NW TO LOWER 60S SE...
DEPENDING PRIMARILY ON CLOUDS AND SHOWER ACTIVITY. LOWS MON NIGHT
WILL HIGHLY DEPEND ON THE TIMING OF THE COLD FRONTAL PASSAGE. AT
THIS TIME WILL INDICATE LOWS IN THE UPPER 40S NW TO MID 50S SE.
SEVERE THREAT:
THE THREAT FOR ISOLD SEVERE STORMS REMAINS VERY UNCERTAIN GIVEN THE
COMPLICATED NATURE OF THE PATTERN MENTIONED ABOVE...IN ADDITION TO
THE UNCERTAINTY NORMALLY PRESENT IN ASSOC/W A HIGH SHEAR/LOW CAPE
SETUP. IF DEEP CONVECTION DOES DEVELOP...ORGANIZATION OF SOME SORT
WOULD BE LIKELY...ALONG WITH A THREAT FOR DAMAGING WINDS GIVEN ~50
KT MID-LEVEL FLOW. AN ISOLD TORNADO COULD NOT BE ENTIRELY RULED OUT
GIVEN THE PRESENCE OF SUFFICIENT DEEP-LAYER SHEAR AND 0-1 KM SRH...
ESP DURING THE AFTERNOON AND EARLY EVENING WHEN A WEAK WARM FRONTAL
PASSAGE IS EXPECTED AND A SECONDARY LOW COULD DEVELOP ALONG THE
FRONT AS IT LIFTS N/NE INTO VA AND THE DELMARVA. -VINCENT
&&
.SHORT TERM /TUESDAY THROUGH WEDNESDAY NIGHT/...
AS OF 300 PM SUNDAY...
A BRISK NW WIND WILL FOLLOW THE DEPARTING STORM AS IT MOVES THROUGH
NEW ENGLAND TUESDAY. STRONG SUBSIDENCE IN THE REAR OF THE DEPARTING
UPPER TROUGH WILL BRING RAPID CLEARING EARLY TUESDAY. THE PRESSURE
GRADIENT WILL BE TIGHT BUT THE SURFACE HIGH APPROACHING FROM THE
SOUTHWEST IS OF PACIFIC ORIGIN. THIS WILL BRING A MILD TO WARM BUT
WINDY DAY. WNW WINDS AT 10-20 MPH WITH GUSTS TO 25 MPH CAN BE
EXPECTED. THE TEMPERATURES MAY ACTUALLY START THE DAY AROUND 60 IN
THE EAST... AND HIGHS SHOULD EASILY REACH INTO THE 60S IN MOST
AREAS. THE RIDGE AXIS IS EXPECTED TO MOVE OVERHEAD WEDNESDAY AND
WEDNESDAY NIGHT. CLEAR SKIES WITH DIMINISHING WINDS ARE EXPECTED TUE
NIGHT WITH LOWS IN THE 30S. WEDNESDAY AND WEDNESDAY NIGHT ARE
EXPECTED TO BE FAIR. HIGHS IN THE UPPER 50S TO MID 60S AND LOWS IN
THE 30S.
&&
.LONG TERM /THURSDAY THROUGH SUNDAY/...
AS OF 300 PM SUNDAY...
A VERY ACTIVE PATTERN IS EXPECTED MID TO LATE WEEK INTO THE
WEEKEND... TURNING COLDER AS WELL. MODERATE CONFIDENCE.
MODELS FAVOR THE DEVELOPMENT OF A POWERFUL STORM THAT IS FORECAST TO
TRACK FROM THE MID-MISSISSIPPI VALLEY NE NEAR CHICAGO THEN ACROSS
THE GREAT LAKES THURSDAY INTO FRIDAY. THE TRAILING COLD FRONT IS
EXPECTED TO BE ACCOMPANIED BY A SHARP TEMPERATURE GRADIENT AS IT
SURGES EAST THROUGH OUR REGION LATE THURSDAY AND THURSDAY NIGHT. THE
FORECAST HEIGHT FALLS COMBINED WITH THE POTENTIAL FOR A SECONDARY
TRIPLE POINT LOW DEVELOPMENT THAT MAY TRACK ACROSS A PORTION OF OUR
REGION MEAN A BRIEF (6-9 HOURS) BUT SIGNIFICANT (HEAVY RAIN AND
POTENTIAL FOR STRONG TO ISOLATED SEVERE THUNDERSTORMS) WEATHER
EVENT. THE MOISTURE SOURCES APPEAR TO BE OPEN FOR BUSINESS WITH THE
SURFACE HIGH OVER THE WESTERN ATLANTIC EXPECTED TO TAP THE GULF OF
MEXICO AND WESTERN ATLANTIC AHEAD OF THE SHARP COLD FRONT. QPF OF
0.75 TO 1.25 MAY FALL FAIRLY QUICKLY WITH THE EXPECTED FRONTAL BAND.
FORECAST DEW POINTS MAY BE TOO LOW GIVEN THE CLIMATOLOGY OF THIS
EVENT... AND THEY MAY SURGE INTO THE LOWER 60S PRIOR TO THE BAND
THURSDAY. IF SO... THIS MAY CREATE A MORE SPRING-LIKE SEVERE WEATHER
THREAT GIVEN THE EXPECTED STRONG DYNAMICS AND WINDS WITH THE TROUGH

AS IT PUNCHES EAST ACROSS THE MOUNTAINS. THE POP WILL BE UPGRADED TO LIKELY WITH A CHANCE OF THUNDERSTORMS. STRONG GUSTY WINDS WOULD BE THE MAIN SEVERE WEATHER HAZARD.
THE POP WILL REDUCE QUICKLY BEHIND THE LINE OF CONVECTION WITH THE FRONT THURSDAY NIGHT. IT WILL TURN WINDY AND SHARPLY COLDER BEHIND THE FRONT LATE THURSDAY NIGHT AND FRIDAY. LOWS THURSDAY NIGHT SHOULD FALL TO BETWEEN 30-38 NW TO SE. HIGHS FRIDAY WITH VARIABLY CLOUDY SKIES AND A BRISK NW WIND WILL ONLY REACH THE MID 40S WEST AND MID 50S SE.
FRIDAY NIGHT THROUGH SATURDAY... A CONTINUED CHILLY PATTERN IS EXPECTED WITH CONTINUED BRISK NW BREEZE FRIDAY NIGHT INTO SATURDAY AS THE LARGE UPPER CYCLONE WILL BE SLOW TO DEPART NEW ENGLAND. LOWS 25-30 AND HIGHS SATURDAY EXPECTED IN THE 47-52 RANGE.
LATE WEEKEND... EXPECT A LARGE ARCTIC HIGH OVER CENTRAL CANADA TO BEGIN TO EXPAND SOUTH AND EAST INTO THE MIDWEST AND GREAT LAKES. THE FAVORED EC AND GEFS ENSEMBLE MEANS SUGGEST THAT THE COLDEST AIR WILL REMAIN OVER THE MIDWEST. HOWEVER... ENSEMBLES SUGGEST THAT AT LEAST A PORTION OF THIS ARCTIC HIGH MAY EXTEND INTO THE OHIO VALLEY AND GREAT LAKES... THEN DOWN THE EASTERN SEABOARD INTO THE CAROLINAS BY TUESDAY. THE NEXT POTENT UPPER TROUGH THAT IS FORECAST TO COME EAST FROM THE WESTERN STATES MAY HAVE A MORE WINTRY FACE FOR OUR REGION (IF)... COLD AIR CAN BECOME ESTABLISHED DOWN THE EASTERN SEABOARD BY THE 25TH/26TH. A CAD PATTERN IS PRESENT WITH SOME MODEL SOLUTIONS INCLUDING THE 234-240 HOUR OPERATIONAL EC... WITH THE HIGH IN A FAVORABLE POSITION... AND A POTENTIAL MILLER B STORM (MAIN STORM TRACK THROUGH THE LOWER MIDWEST... WITH SECONDARY DEVELOPMENT OVER THE SE US). INTERESTINGLY... THAT FAR OUT... THE CAD ADVERTISED BY THE MODELS WOULD COME WITH WARMING ALOFT (WITH THE APPROACHING DIGGING UPPER TROUGH FROM THE WEST) STRONGLY SUGGESTING EITHER A COLD RAIN OR SOME FREEZING RAIN IN THE TYPICAL PIEDMONT DAMMING REGION AROUND DEC 26-27.
SUNDAY... EXPECT MOSTLY SUNNY AND CHILLY WEATHER. LOWS IN THE MID TO UPPER 20S. HIGHS 45-52.
THE BOTTOM LINE HERE... A TREND TOWARD STORMY AND PROGRESSIVELY COLDER WEATHER FOR OUR REGION CAN BE EXPECTED FRIDAY (DAY 5 AND BEYOND).
&&
.AVIATION /18Z SUNDAY THROUGH THURSDAY/...
AS OF 130 PM SUNDAY...
A WIDE RANGE OF CONDITIONS WERE PRESENT ACROSS CENTRAL NC EARLY THIS AFTERNOON...RANGING FROM IFR/LIFR AT THE FAY TERMINAL TO MVFR VISBYS AT INT/GSO AND VFR CONDITIONS AT RDU. AS A RESULT...THE AVIATION FORECAST REMAINS RATHER UNCERTAIN THIS EVENING INTO TONIGHT. AT THIS TIME...EXPECT DETERIORATING CONDITIONS AND AN INCREASING CHANCE FOR SHOWERS BETWEEN 21-06Z AT ALL TERMINALS...FURTHER DETERIORATING BETWEEN 06-12Z. IMPROVEMENT MAY BE SLOW TO OCCUR AFTER SUNRISE MONDAY...AND IT IS POSSIBLE THAT CEILINGS MAY REMAIN IN THE IFR CATEGORY IN ASSOC/W A MOIST AIRMASS IN ADVANCE OF A COLD FRONT APPROACHING THE MOUNTAINS FROM THE WEST...WITH A CHANCE OF PERIODIC SHOWER ACTIVITY THROUGHOUT THE DAY.
LOOKING AHEAD:
EXPECT A CHANCE FOR SHOWER ACTIVITY MONDAY EVENING/NIGHT IN ADVANCE OF THE APPROACHING COLD FRONT...WITH SHOWER CHANCES ENDING BY 06-12Z TUE MORNING WHEN THE COLD FRONTAL PASSAGE IS EXPECTED TO OCCUR. VFR CONDITIONS WILL PREVAIL IN THE WAKE OF THE FRONT TUE/WED. THE NEXT CHANCE FOR ADVERSE AVIATION CONDITIONS WILL BE THURSDAY AS A STRONG

COLD FRONT APPROACHES FROM THE WEST. -VINCENT
&&
.RAH WATCHES/WARNINGS/ADVISORIES...
NONE.
&&
$$&&
$$

The National Weather Service Office in Raleigh, North Carolina, also, issued the following Area Forecast Discussion at 1223 EST which discussed the IFR conditions near KFAY and the low ceilings were expected to lift into the afternoon. IFR conditions were expected to return after sunset:

FXUS62 KRAH 161723
AFDRAH
AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE RALEIGH NC
1222 PM EST SUN DEC 16 2012
.SYNOPSIS...
A LOW PRESSURE SYSTEM WILL DEVELOP ALONG A STATIONARY FRONT WEST OF THE MOUNTAINS TONIGHT...THEN TRACK NORTHEAST THROUGH THE OHIO VALLEY AND MID-ATLANTIC MONDAY INTO MONDAY NIGHT...PROPELLING A COLD FRONT EASTWARD THROUGH THE CAROLINAS EARLY TUESDAY MORNING.
&&
.NEAR TERM /THROUGH MONDAY/...
AS OF 1200 PM SUNDAY...
TODAY/TONIGHT:
ASIDE FROM A FEW BREAKS IN CLOUD COVER IN VICINITY OF HIGHWAY 1 THIS AFTERNOON...EXPECT OVERCAST CONDITIONS TO PREDOMINATE OVER CENTRAL NC THROUGH SUNSET IN ASSOC/W SMALL AMPLITUDE DISTURBANCES IN SW FLOW ALOFT IN THE PRESENCE OF AN UNSEASONABLY MOIST AIRMASS (CHARACTERIZED BY PWAT VALUES 1.00-1.25"). PER LATEST WV IMAGERY AND RAP DATA WHICH INDICATES SMALL AMPLITUDE DISTURBANCES EMBEDDED IN SW FLOW ALOFT OVER WESTERN NC AND UPSTREAM OVER CENTRAL MS/AL AND NORTHERN GA...EXPECT THE BEST (AND MORE FREQUENT) CHANCE FOR SHOWER ACTIVITY OVER THE WESTERN PIEDMONT TODAY. ALTHOUGH LITTLE TO NO MUCAPE HAS RECENTLY BEEN ANALYZED OVER CENTRAL NC IN THE PAST SEVERAL HRS...A FEW LIGHTNING STRIKES HAVE BEEN OBSERVED UPSTREAM IN THE FOOTHILLS SINCE 16Z...AND IT IS POSSIBLE THAT CONDITIONAL SYMMETRIC INSTABILITY IS PRESENT AND BEING RELEASED IN THE MOIST/LOW-LEVEL WARM ADVECTION REGIME ON THE EQUATOR-WARD SIDE OF A STRONG UPPER LEVEL JET EXTENDING NORTHEAST INTO THE MID-ATLANTIC... OR THAT WEAK ELEVATED INSTABILITY IS PRESENT BUT NOT ANALYZED PROPERLY...OR A COMBINATION THEREOF. EXPECT PRECIP CHANCES TO INCREASE EVERYWHERE FROM SW-NE AS THE MORE ROBUST SMALL AMPLITUDE DISTURBANCES ALOFT (PROGRESSING INTO CENTRAL AL AT 17Z) BEGIN TO TRACK INTO CENTRAL NC AFTER ~00Z...AND WILL INDICATE PRECIP CHANCES OF 60-80% OVERNIGHT...HIGHEST IN THE SW PIEDMONT AND SANDHILLS BETWEEN ROUGHLY 03-09Z. WILL DECREASE HIGH TEMPS BY A FEW DEGREES TODAY GIVEN CURRENT TRENDS...ESP. IN THE FAR NW PIEDMONT WHERE OVERCAST CONDITIONS AND PERIODIC RAIN WILL PREVENT TEMPS FROM EXCEEDING THE LOWER/MID 50S. ELSEWHERE...EXPECT HIGHS RANGING FROM THE MID/UPPER 50S TO LOWER 60S...WARMEST S/SE AND WHERE BREAKS IN CLOUD COVER ARE PRESENT. EXPECT OVERNIGHT LOWS IN THE LOWER/MID 50S GIVEN PERVASIVE CLOUD COVER AND AN ATYPICALLY MOIST AIRMASS IN

PLACE...COOLEST IN THE NW PIEDMONT. -VINCENT
FOR MONDAY: ANOTHER ROUND OF HEAVIER SHOWERS AND A FEW STORMS APPEARS IMMINENT. WITH ATYPICALLY HIGH PRECIP WATER STILL IN PLACE... FORCING FOR ASCENT RAMPS UP BY MONDAY AFTERNOON. MODELS AGREE ON STACKED STRONG LIFT AT MULTIPLE LEVELS... INCLUDING THAT FORCED BY INTENSIFYING MOIST UPGLIDE AT 295K-310K... HEIGHT FALLS OF 70-100 METERS OVER VA/NC AS THE MID LEVEL TROUGH APPROACHES... AND STRENGTHENING UPPER DIVERGENCE AS THE SUBTROPICAL JET SPEEDS UP OVER 150 KTS AND SHIFTS EAST TO THE DEEP SOUTH AND APPALACHIANS. HAVE RAISED POPS UP TO CATEGORICAL FOR MONDAY AFTERNOON INTO THE VERY EARLY EVENING. THE STRONG LIFT AND DEEP WARM LAYER SHOULD PROMPT HIGHER RAINFALL TOTALS OVER A HALF INCH. A 35-45 KT LOW LEVEL JET WILL NOSE UP THROUGH THE CENTRAL/ERN CAROLINAS MONDAY AFTERNOON... JUST AHEAD OF A MID LEVEL DRY PUNCH NOTED ON THE GFS... AND THIS COUPLED WITH STILL-WARM AND MOIST BUOYANT LOW LEVELS... SUBZERO LIFTED INDICES... MID LEVEL LAPSE RATES ABOVE 6.5 C/KM... AND STRONG DYNAMIC LIFT SHOULD EASILY FOSTER DEVELOPMENT OF SCATTERED STORMS... SOME OF WHICH COULD BE STRONG AS THE MARGINAL INSTABILITY (PROJECTED TO BE JUST 300-400 J/KG OF MUCAPE) IS OFFSET SOMEWHAT BY THE DYNAMIC LIFT CONCURRENT WITH 40 KTS OF 0-3 KM SHEAR. HIGHS 60-67 WITH A STOUT SOUTHWESTERLY BREEZE. -GIH
&&
.SHORT TERM /MONDAY NIGHT THROUGH TUESDAY NIGHT/...
AS OF 305 AM SUNDAY...
THE MID-LEVEL TROUGH AXIS MOVES THROUGH CENTRAL NORTH CAROLINA OVERNIGHT MONDAY INTO TUESDAY...WITH A 125KT JET AT 300MB AND 80KT AT 500MB MOVING THROUGH THE AREA MONDAY NIGHT. PRECIPITABLE WATER VALUES AHEAD OF THE SURFACE AND 850MB FRONTS REMAIN BETWEEN 1 AND 1.5 INCHES EARLY MONDAY EVENING...DRYING FAST OVERNIGHT MONDAY AND FALLING MOSTLY BELOW A HALF-INCH BY 12Z TUESDAY. WHILE WILL HAVE CHANCES FOR PRECIPITATION THROUGHOUT CENTRAL NORTH CAROLINA MONDAY EVENING...THE HIGHEST CHANCES WILL BE TOWARD THE COASTAL PLAIN... LIKELY AT THE TIME...WHERE THE STRONGEST DIVERGENCE ALOFT IS FORECAST AHEAD OF AT LEAST MODERATELY STRONG POTENTIAL VORTICITY ON THE 1.5PVU SURFACE AS FORECAST BY THE GFS. CONVERGENCE ALOFT IS FORECAST ESSENTIALLY BEYOND 06Z TUESDAY...AND WHILE THE GRIDDED FORECAST WILL HAVE CHANCES FOR PRECIPITATION DIMINISHING A LITTLE MORE GRADUALLY...BASED ON BUFR SOUNDINGS FORECAST BY BOTH THE NAM AND THE GFS AND PLAN-VIEW SUBSIDENCE AND MOISTURE AT VARIOUS LEVELS...EVEN TOWARD THE COASTAL PLAIN CHANCES FOR PRECIPITATION SHOULD FALL FAST BY AROUND MIDNIGHT. SOME CLOUDS COULD LINGER UNTIL THE 850MB FRONT PASSES THROUGH...AS BUFR SOUNDINGS SHOW RESIDUAL LOW-LEVEL MOISTURE HANGING ON AND THE GFS FORECASTS A SLENDER 850MB THETA-E RIDGE NOT PASSING EAST OF CENTRAL NORTH CAROLINA UNTIL ABOUT 12Z TUESDAY.
THE NAM BUFR SOUNDINGS ARE MORE UNSTABLE THAN THE GFS BUFR SOUNDINGS FOR MONDAY EVENING...BUT EVEN THE GFS FORECASTS ABOUT 300J/KG OF MIXED-LAYER CAPE ALONG AND EAST OF ABOUT U.S. 1...WITH LIFTED INDICES AS LOW AS AROUND -3C. THIS INSTABILITY SWEEPS EAST FAIRLY QUICKLY BY 06Z TUESDAY AS MID-LEVEL DRYING TAKES PLACE. FOR THIS FORECAST WILL MAINTAIN A CHANCE OF THUNDER ESSENTIALLY ALONG AND EAST OF ABOUT U.S. 1 DURING MONDAY EVENING. 0-3KM SHEAR INCREASES TO JUST BELOW 50KT ON THE GFS TOWARD INTERSTATE 95 MONDAY EVENING. WOULD BE MORE CONCERNED ABOUT ISOLATED SEVERE WEATHER IF THE NAM PROFILES VERIFY...LESS SO WITH THE GFS BUT WILL ACKNOWLEDGE THE SPC OUTLOOK FOR DAY TWO. WILL CONTINUE THE MENTION OF STRONG

THUNDERSTORMS INTO EASTERN PARTS OF THE AREA MONDAY EVENING IN THE HWO.
BREEZY CONDITIONS SHOULD TAKE PLACE TUESDAY AS 925MB WINDS ARE FORECAST BETWEEN 20 AND 25KT AND BUFR SOUNDINGS SHOW THE POTENTIAL FOR ENOUGH MIXING THAT GUSTS AROUND THESE VALUES SHOULD BE REALIZED IN THE RELATIVELY TIGHT GRADIENT BEHIND THE COLD FRONT AND LOW PRESSURE SYSTEM. THE GRADIENT QUICKLY RELAXES UNDER SURFACE RIDGING FOR TUESDAY NIGHT. AFTER OVERNIGHT LOWS IN THE MID 40S TO LOWER 50S MONDAY NIGHT...HIGHS SHOULD BE MOSTLY IN THE LOWER TO MID 60S TUESDAY...WITH LOWS MAINLY IN THE 30S TUESDAY NIGHT.
&&
.LONG TERM /WEDNESDAY THROUGH SATURDAY/...
AS OF 305 AM SUNDAY...
RIDGE AXIS ALOFT MOVES IN WEDNESDAY...PASSING QUICKLY OFF TO THE EAST WEDNESDAY NIGHT...IN A FAIRLY PROGRESSIVE FLOW ALOFT WITH THE JET STREAM DIVING SOUTH OVER THE MIDSECTION OF THE COUNTRY. SURFACE HIGH PRESSURE SHOULD HELP KEEP CONDITIONS DRY THROUGH WEDNESDAY... UNTIL A DEEP UPPER TROUGH MOVES QUICKLY THROUGH THE GREAT LAKES AND HELPS TO PUSH A COLD FRONT ACROSS THE MID-ATLANTIC AND THE CAROLINAS SOMETIME THURSDAY. GIVEN THE CURRENTLY EXPECTED STRENGTH OF BOTH LOW PRESSURE AND THE FRONT...MOISTURE RETURN SHOULD BE DECENT ALONG THE FRONT WITH AMPLE LIFT IN GOOD DIFFLUENCE ALOFT TO PROVIDE FOR SHOWERS. FOR NOW...OUT FIVE DAYS...WILL FORECAST ONLY A CHANCE OF SHOWERS MAINLY THURSDAY AND THURSDAY NIGHT...EXTENDING A SLIGHT CHANCE INTO THE DAY FRIDAY EAST OF U.S. 1 MAINLY DUE TO THE SLIGHTLY SLOWER TIMING OF THE ECMWF WITH DRYING AND SUBSIDENCE COMPARED TO THE GFS. COARSE MODEL SOUNDINGS FROM THE ECMWF AND EVEN THE GFS BUFR SOUNDINGS ON THURSDAY SHOW THAT THE BEST TEMPERATURE LAPSE RATE ALOFT IS MOIST ADIABATIC. WILL KEEP OUT THE MENTION OF THUNDER FOR NOW...ALTHOUGH THE PATTERN ITSELF...ALONG WITH THE AVAILABLE LOW-LEVEL SHEAR WITH WINDS NOT FAR OFF OF THE SURFACE INCREASING QUICKLY TO NEAR 45KT ON THE WEAKEST GUIDANCE...SUGGEST THUNDER IS POSSIBLE. SIMILARITIES IN THE UPPER PATTERN BETWEEN THE ECMWF AND GFS END BY SATURDAY...HOWEVER...DESPITE THEIR DIFFERENCES BOTH SETS OF GUIDANCE ARE DRY AND WILL FEATURE A DRY FORECAST FOR NOW ON SATURDAY...ALTHOUGH MUCH COLDER AND BREEZY TO ROUND OUT THE WEEK AND BEGIN THE NEXT WEEKEND FOLLOWING WARMER THAN NORMAL CONDITIONS EARLY IN THIS LONG-TERM PERIOD. RECORD HIGHS ARE IN THE MID 70S OR HIGHER...AT LEAST A COUPLE OF CATEGORIES HIGHER THAN THE HIGHEST MAXES FOR THIS FORECAST PACKAGE.

&&
.AVIATION /12Z SUNDAY THROUGH THURSDAY/...
AS OF 630 AM SUNDAY...
HIGH CONFIDENCE IN ADVERSE AVIATION CONDITIONS FOR THE NEXT 24 HOURS. IFR/LIFR CONDITIONS AT FAY ARE LIKELY TO HOLD THROUGH 14Z BEFORE CIGS RISE TO MVFR AND HOLD THERE THROUGH THE AFTERNOON. MVFR CIGS ARE EXPECTED TO DOMINATE AT RDU/RWI THROUGH THE AFTERNOON... WHILE AT INT/GSO... CURRENT VFR CIGS SHOULD DROP TO MVFR BY 16Z. ANY MVFR OR BRIEF VFR CONDITIONS THIS AFTERNOON WILL DROP TO IFR TOWARD SUNSET AND REMAIN IFR/LIFR THROUGH THE END OF THE FORECAST PERIOD... WITH NUMEROUS SHOWERS OVERSPREADING THE AREA FROM SW TO NE LATE AFTERNOON THROUGH THIS EVENING. SOUTHWEST SURFACE WINDS WILL HOLD UNDER 10 KTS... BUT WINDS WILL INCREASE QUICKLY WITH HEIGHT... FROM THE SW AT 20-25 KTS JUST ABOVE AT 1 KFT AGL... WHICH MAY INDUCE MECHANICAL TURBULENCE ESPECIALLY THROUGH THIS MORNING.

LOOKING BEYOND 12Z MONDAY MORNING... HIGH CONFIDENCE IN IFR/LIFR CONDITIONS DOMINATING THROUGH MONDAY... AHEAD OF A SLOWLY APPROACHING FRONT... WITH SHOWERS LIKELY ALONG WITH A FEW STRONG STORMS. CONDITIONS WILL IMPROVE DRASTICALLY MONDAY NIGHT... WITH VFR CONDITIONS RETURNING FOR TUESDAY THROUGH WEDNESDAY NIGHT. MVFR CIGS AND SHOWERS EXPECTED TO RETURN THURSDAY AHEAD OF ANOTHER COLD FRONT.
-GIH
&&
.RAH WATCHES/WARNINGS/ADVISORIES...
NONE.
&&
$$

13.0 Pilot Weather Briefing

Before the accident flight, the accident pilot filed an IFR flight plan with Lockheed Martin Flight Services. The pilot declined receiving the latest adverse conditions along the route of flight. The accident pilot also received services from IAD DUATS before the flight, however, the data and services received from IAD DUATS is not available.

14.0 Astronomical Data

The astronomical data obtained from the United States Naval Observatory for the accident site on December 16, 2012, indicated the following:

SUN	
Begin civil twilight	0649 EST
Sunrise	0717 EST
Sun transit	1212 EST
Sunset	1706 EST
End civil twilight	1735 EST

F. LIST OF ATTACHMENTS

None

Paul Suffern
NTSB, AS-30