



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

August 14, 2018

Weather Study

METEOROLOGY

ERA18FA150

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A. ACCIDENT

Location: Chesapeake, Virginia
Date: May 22, 2018
Time: 0728 eastern daylight time
1128 Coordinated Universal Time (UTC)
Airplane: Piper PA-28-140 Cherokee; registration: N6177W

B. METEOROLOGIST

Don Eick
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Operational Factors Division (AS-30)
National Transportation Safety Board

C. SUMMARY

On May 22, 2018, at 0728 eastern daylight time, a Piper PA-28-140, N6177W, was destroyed when it impacted terrain near Chesapeake, Virginia. The commercial pilot was fatally injured. The privately-owned airplane was operated under the provisions of Title 14 *Code of Federal Regulations* Part 91 as a personal flight. Day instrument meteorological conditions prevailed, and an instrument flight rules flight plan was filed for the flight, which departed from Chesapeake Regional Airport (CPK), Chesapeake, Virginia, about 0726, and was destined for Republic Airport (FRG), Farmingdale, New York.

D. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's Senior Meteorologist was not on scene for this investigation and conducted the meteorology phase of the investigation from the Washington D.C. office, collecting data from official National Weather Service (NWS) sources including the Weather Prediction Center and the National Center for Environmental Information. All times are eastern daylight time (EDT) based upon the 24-hour clock, local time is -4 hours from UTC, and UTC=Z. NWS airport and station identifiers use the standard International Civil Aviation Organization 4-letter station identifiers versus the International Air Transport Association 3-letter identifiers, which deletes the initial country code designator "K" for U.S. airports. Directions are referenced to true north and distances in nautical miles. Heights are in feet (ft) 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 36.65750° N and longitude 76.336944° W, at an elevation of approximately 15 ft.

E. WEATHER INFORMATION

1.0 Synoptic Conditions

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) located in College Park, Maryland. These are the base products used in describing weather features and in the creation of forecasts and warnings. 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 mid-Atlantic Surface Analysis Chart for 0800 EDT is included as figure 1 with the approximate accident location marked by a red star. The chart depicted a low-pressure system at 1014-hectopascals (hPa)¹ just off the coast over Ontario, Canada with a warm front extending southeast across New York, Pennsylvania, Maryland, and into eastern Virginia, and then becoming stationary and extending eastward off the North Carolina. A trough of low-pressure was also identified south of the accident site over North Carolina and extended southwestward into South Carolina. A high-pressure system was located off the New England coast with a ridge extending southwestward into the mid-Atlantic region with another ridge of high pressure over West Virginia. The accident site was located in the vicinity of the warm front and near the northern location of the trough, and in a deformation zone or COL².

¹ Hectopascals (hPa) is the standard term for reporting sea level pressure and replaces the term millibar (mb) with the same units. Standard sea level pressure is 1013.25-hPa.

² COL is a saddle back or neutral point between two high's and two low pressure areas.

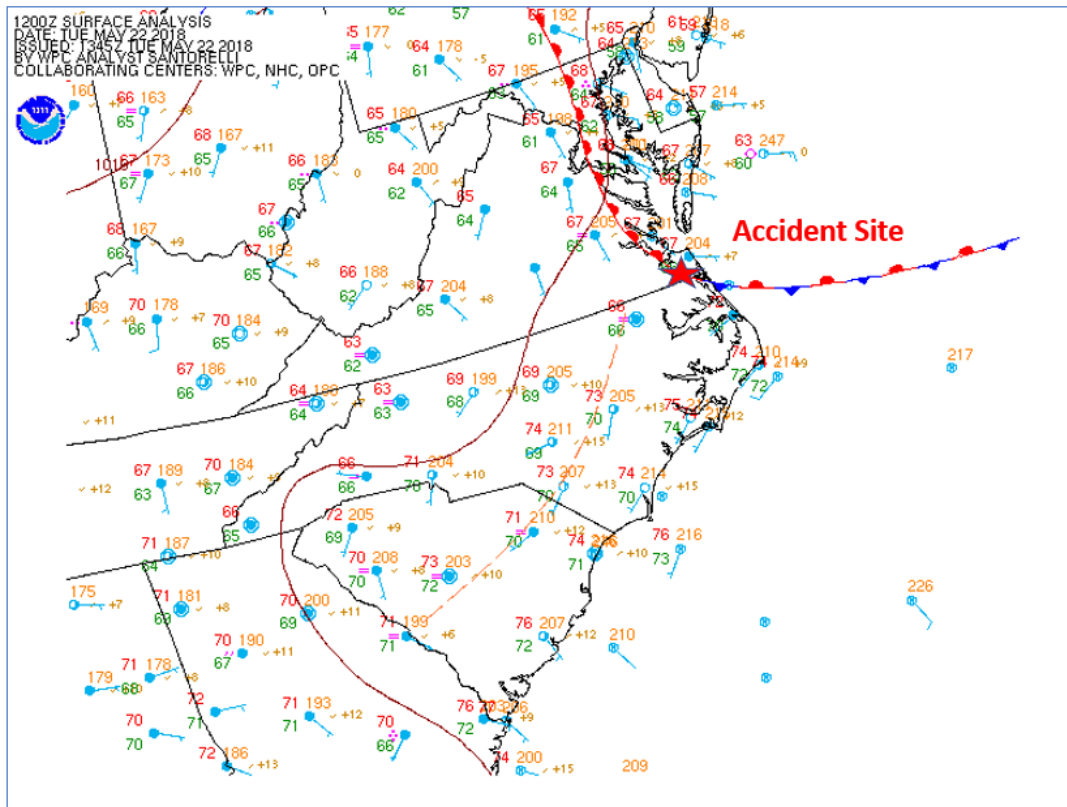


Figure 1 - NWS mid-Atlantic Surface Analysis Chart for 0800 EDT

The station model in the immediate vicinity of the accident site depicted light southerly wind, overcast clouds, with a temperature of 67° Fahrenheit (F), and a dew point temperature of 66° F. Other station models surrounding the area reported visibility restrictions in fog or mist.

1.2 Weather Depiction Chart

The eastern half of the NWS Weather Depiction Chart issued by NCEP for 0600 EDT is included as figure 2 depicting the frontal systems and the observed general flight categories³ conditions with the accident site. The accident location is within the red circle. The chart depicted Instrument Flight Rule (IFR) conditions by a shaded contour, Marginal Visual Flight Rule

³ As defined by the NWS and the FAA Aeronautical Information Manual (AIM) section 7-1-7 defines the following general flight categories:

- Low Instrument Flight Rules (LIFR*) – ceiling below 500 ft above ground level (agl) and/or visibility less than 1 statute mile.
- Instrument Flight Rules (IFR) – ceiling between 500 to below 1,000 feet agl and/or visibility 1 to less than 3 miles.
- Marginal Visual Flight Rules (MVFR**) – ceiling from 1,000 to 3,000 ft agl and/or visibility 3 to 5 miles.
- Visual Flight Rules (VFR) – ceiling greater 3,000 ft agl and visibility greater than 5 miles.

* By definition, IFR is a ceiling less than 1,000 ft agl and/or visibility less than 3 miles while LIFR is a sub-category of IFR.

**By definition, VFR is a ceiling greater than or equal to 3,000 ft agl and visibility greater than 5 miles while MVFR is a sub-category of VFR.

(MVFR) conditions with an unshaded contour, and Visual Flight Rule (VFR) conditions outside of the contours.

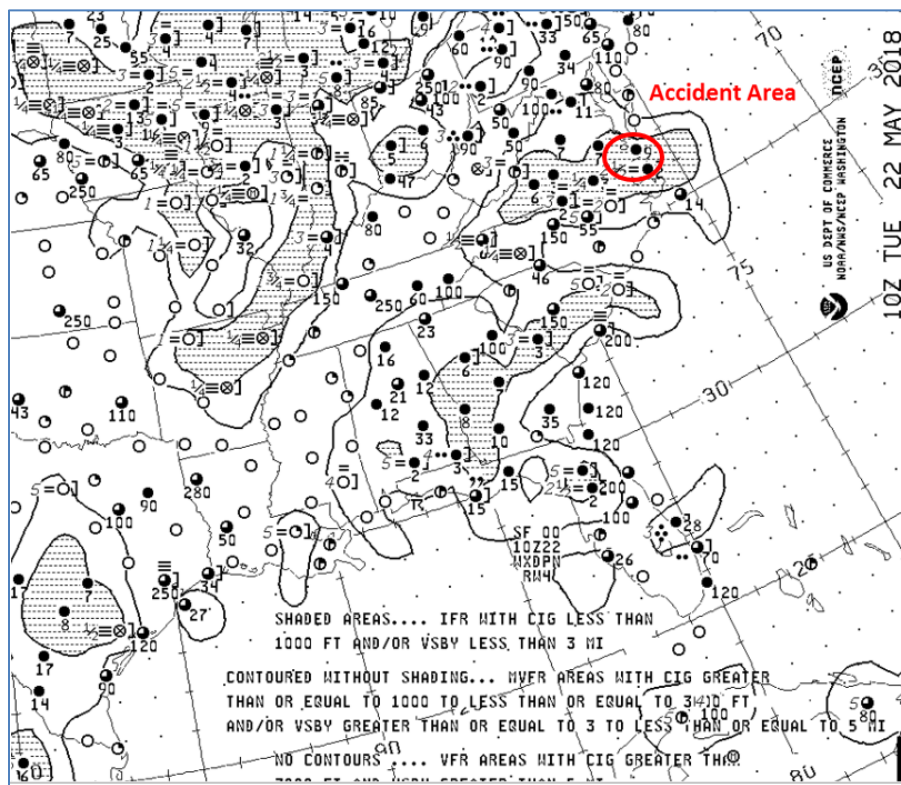


Figure 2 - Eastern half of Weather Depiction Chart for 0600 EDT

The chart depicted an area of IFR conditions over Virginia and the northern portions of North Carolina and extended over the accident site. Surrounding that area was a larger area of MVFR conditions over the region extending over Maryland. The station model near the accident site depicted visibility restrictions in fog with overcast clouds at 900 ft agl.

1.3 National Composite Radar Mosaic

The NWS National Composite Radar Mosaic over the mid-Atlantic region for 0730 EDT is included in figure 3, with the approximate accident site marked by the star. The image depicted several areas of light to moderate radar reflectivity associated with rain over Virginia, the District of Columbia, Maryland, Pennsylvania, and New Jersey, with no significant echoes in the Chesapeake, Virginia, area.



Figure 3 – NWS National Composite Radar Mosaic for 0730 EDT over the region

1.4 Low-level Significant Weather Prognostic Chart

The 12- and 24-hour Low-Level Significant Weather Prognostic Chart that was valid at the time of the accident is included as figure 4. The image on the left was the 12-hour forecast valid for 1400 EDT and the image on the right was the 24-hour forecast valid for 0200 EDT on May 23, 2018. The charts depicted the general flight categories expected during the period by colored lines; where a red solid line represented IFR conditions, a blue scalloped line MVFR conditions, and outside of the contours VFR conditions. In addition, the chart provided the location of the freezing level by a light blue dashed line.

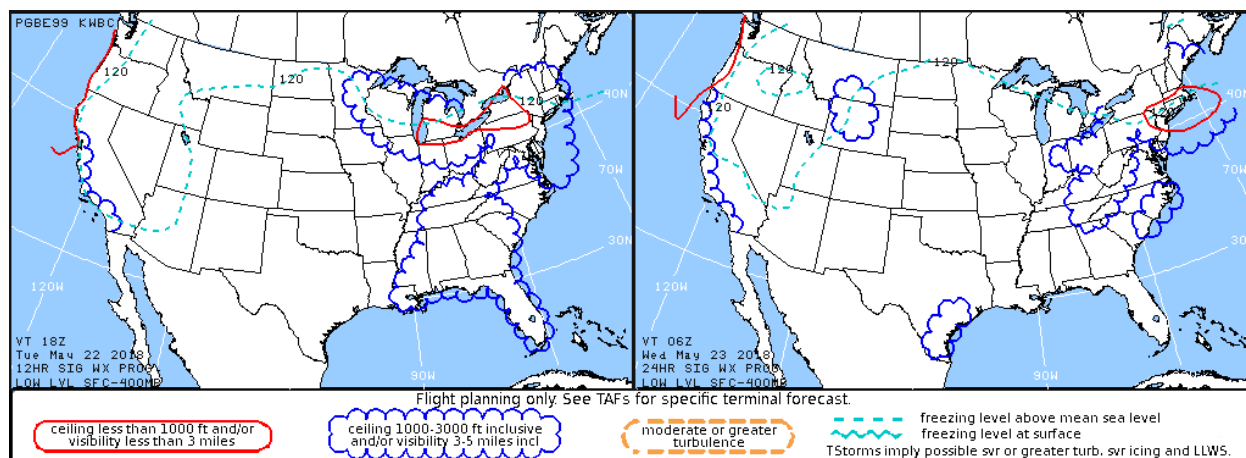


Figure 4 – NWS 12- and 24-hour Low-Level Significant Weather Prognostic Chart

The 12-hour forecast on the left valid for 1400 EDT depicted a large area of MVFR conditions over eastern Virginia northward into New England and extending over the accident site and route of flight. An area of IFR conditions extended over western New York and northern Pennsylvania. The freezing level was depicted above 12,000 ft.

2.0 Observations

The accident site was located less than a mile southwest of Chesapeake Regional Airport (KCPK), Chesapeake⁴, Virginia. The airport had an Automated Weather Observation System (AWOS) installed and listed an elevation of 19 feet and a magnetic variation of 11° W based on the latest aeronautical chart. The following conditions were reported at the approximate time of the accident:

KCPK weather observation at 0715 EDT, automated⁵, wind from 070° at 3 knots, visibility 1/4 statute mile in fog, ceiling overcast at 200 ft agl, temperature 19° Celsius (C), dew point temperature 18° C, altimeter 30.13 inches of mercury (Hg). Remarks; automated observation system with a precipitation discriminator, temperature 18.8° C, dew point 18.2° C.

The raw observations or Meteorological Aerodrome Reports (METARs) issued surrounding the period from about 0300 through 1200 EDT with the general flight categories color coded were as follows, with cloud heights reported in hundreds of feet agl:

IFR KCPK 220655Z AUTO 06003KT 7SM OVC006 18/18 A3012 RMK AO2 T01830175
IFR KCPK 220715Z AUTO 00000KT 7SM OVC006 18/18 A3012 RMK AO2 T01820175
IFR KCPK 220735Z AUTO 08003KT 5SM BR OVC006 18/18 A3012 RMK AO2 T01830176
LIFR KCPK 220755Z AUTO 00000KT 5SM BR OVC004 18/18 A3012 RMK AO2 T01820175
LIFR KCPK 220815Z AUTO 00000KT 5SM BR OVC004 18/18 A3012 RMK AO2 T01830176
LIFR KCPK 220835Z AUTO 00000KT 4SM BR OVC004 18/18 A3012 RMK AO2 T01830177
LIFR KCPK 220855Z AUTO 00000KT 1 1/4SM BR OVC002 18/18 A3012 RMK AO2 T01820176
LIFR KCPK 220915Z AUTO 00000KT 1/2SM FG OVC002 18/18 A3012 RMK AO2 T01820176
LIFR KCPK 220935Z AUTO 00000KT 1/4SM FG OVC002 18/18 A3012 RMK AO2 T01830177
LIFR KCPK 220955Z AUTO 00000KT 1/4SM FG OVC002 18/18 A3012 RMK AO2 T01830177
LIFR KCPK 221015Z AUTO 00000KT 1/4SM FG OVC002 19/18 A3012 RMK AO2 T01850178
LIFR KCPK 221035Z AUTO 00000KT 1/4SM FG OVC002 19/18 A3013 RMK AO2 T01860180
LIFR KCPK 221055Z AUTO 00000KT 1/4SM FG OVC002 19/18 A3013 RMK AO2 T01870181
LIFR **KCPK 221115Z AUTO 07003KT 1/4SM FG OVC002 19/18 A3013 RMK AO2 T01880182**
Accident 1128Z
LIFR KCPK 221135Z AUTO 07003KT 3/4SM BR OVC002 19/18 A3014 RMK AO2 T01890182
LIFR KCPK 221155Z AUTO 09003KT 1/2SM FG OVC002 19/18 A3013 RMK AO2 T01900184 10190 20182
LIFR KCPK 221215Z AUTO 06003KT 1/2SM FG OVC002 19/19 A3014 RMK AO2 T01900185
LIFR KCPK 221235Z AUTO 00000KT 1SM BR OVC002 19/19 A3014 RMK AO2 T01920186
LIFR KCPK 221255Z AUTO 00000KT 1 1/2SM BR OVC002 20/19 A3014 RMK AO2 T01950190
LIFR KCPK 221315Z AUTO 00000KT 1 1/2SM BR OVC002 20/19 A3014 RMK AO2 T01960190
LIFR KCPK 221335Z AUTO 00000KT 3SM BR OVC002 20/20 A3014 RMK AO2 T02010195

⁴ Airport Facility Directory (AFD) and AirNav database list the airport in the larger Norfolk, Virginia, area. The FAA airport page references the airport in Chesapeake County, Virginia.

⁵ The “automated” notation indicated that there was no human augmentation of the system.

LIFR KCPK 221355Z AUTO 17003KT 3SM BR OVC002 21/20 A3014 RMK AO2 T02050199
LIFR KCPK 221415Z AUTO 18005KT 3SM BR OVC004 21/20 A3014 RMK AO2 T02080200
LIFR KCPK 221435Z AUTO 19005KT 3SM -RA OVC004 21/20 A3014 RMK AO2 T02080201
LIFR KCPK 221455Z AUTO 19005KT 4SM RA OVC004 21/20 A3013 RMK AO2 T02130203
IFR KCPK 221515Z AUTO 18006KT 5SM BR OVC006 22/21 A3013 RMK AO2 T02240208
IFR KCPK 221535Z AUTO 21004KT 5SM BR OVC008 22/21 A3013 RMK AO2 T02220205
MVFR KCPK 221555Z AUTO 18004KT 7SM BKN012 BKN050 24/20 A3012 RMK AO2 T02380203

A review of the observations indicated that IFR conditions were reported during the early morning, with LIFR conditions due to low overcast clouds and dense fog prevailing from 0355 EDT through 1055 EDT, with gradual improvement to IFR and MVFR conditions by 1155 EDT.

2.1 Display of METARs

The NWS Aviation Weather Center's website METAR display⁶ of observations provides user's a quick view of the current conditions in a graphic format, with the observation available with a toggle or hover. Figure 5 is the station model decoding key for the chart, and figures 6 and 7 are the 0700 and 0800 EDT METAR displays, respectively, with the stations color coded as above. The images depicted IFR to LIFR conditions prevailing in the neighboring stations over eastern Virginia, with MVFR conditions being reported at Langley Air Force Base (KLFJ), Hampton, Virginia, and at Norfolk International Airport (KORF), Norfolk, Virginia, at 0800 EDT immediately north of the accident site. The station model for KCPK at 0700 EDT reported calm wind, visibility 0.3 miles (or 1/4 mile) in fog, ceiling overcast at 200 ft agl, temperature of 66° F, dew point of 65° F, and an altimeter of 30.13 inches of Hg. At 0800 EDT KCPK indicated a wind from the east at 5 knots, visibility 0.5 mile in fog, with a ceiling overcast at 200 ft agl, with no change in temperature, dew point, or altimeter setting.

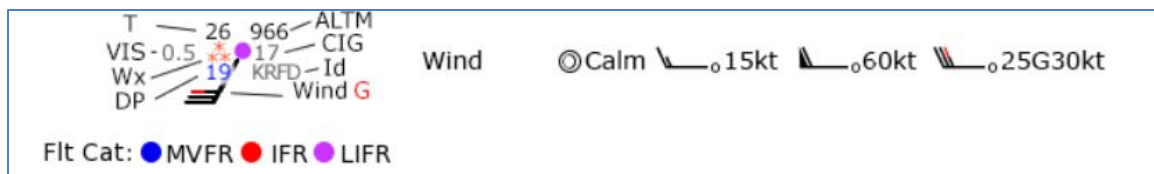


Figure 5 - Station Model Decode

⁶ <https://aviationweather.gov/metar>

METAR Display valid at 1100 UTC 22 May 2018

[permalink](#)

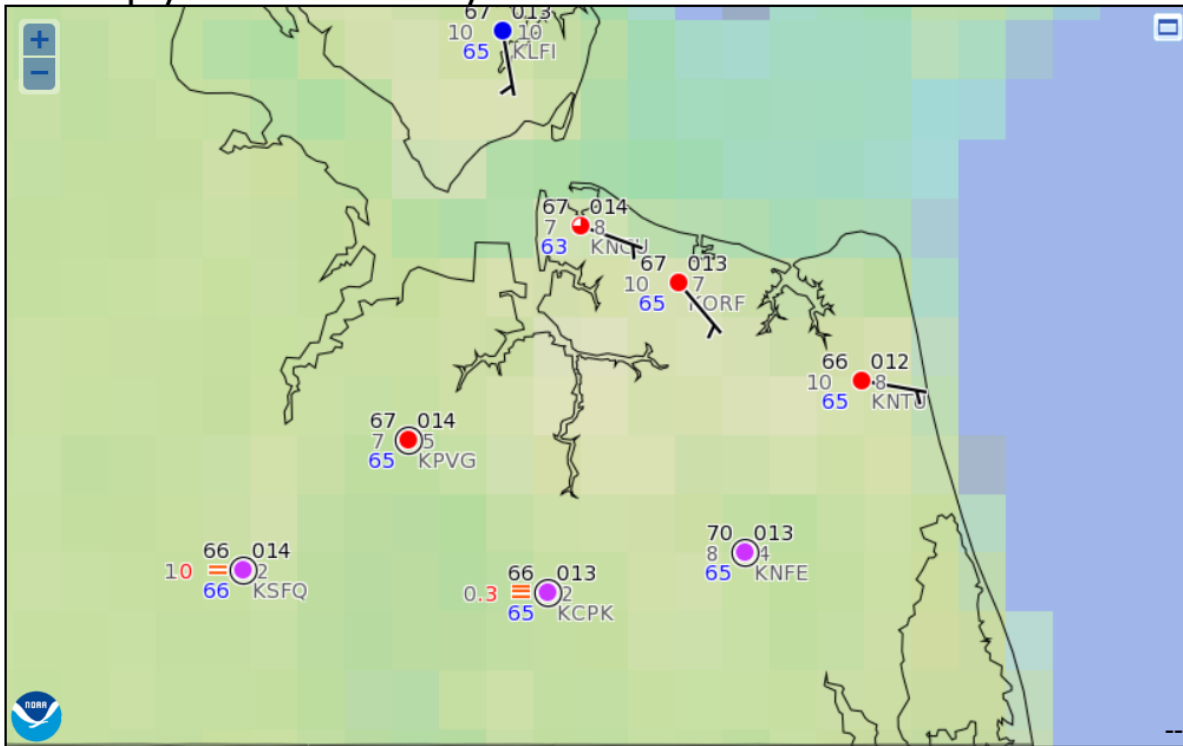


Figure 6 – NWS AWC METAR display at 0700 EDT over the region

METAR Display valid at 1200 UTC 22 May 2018

[permalink](#)

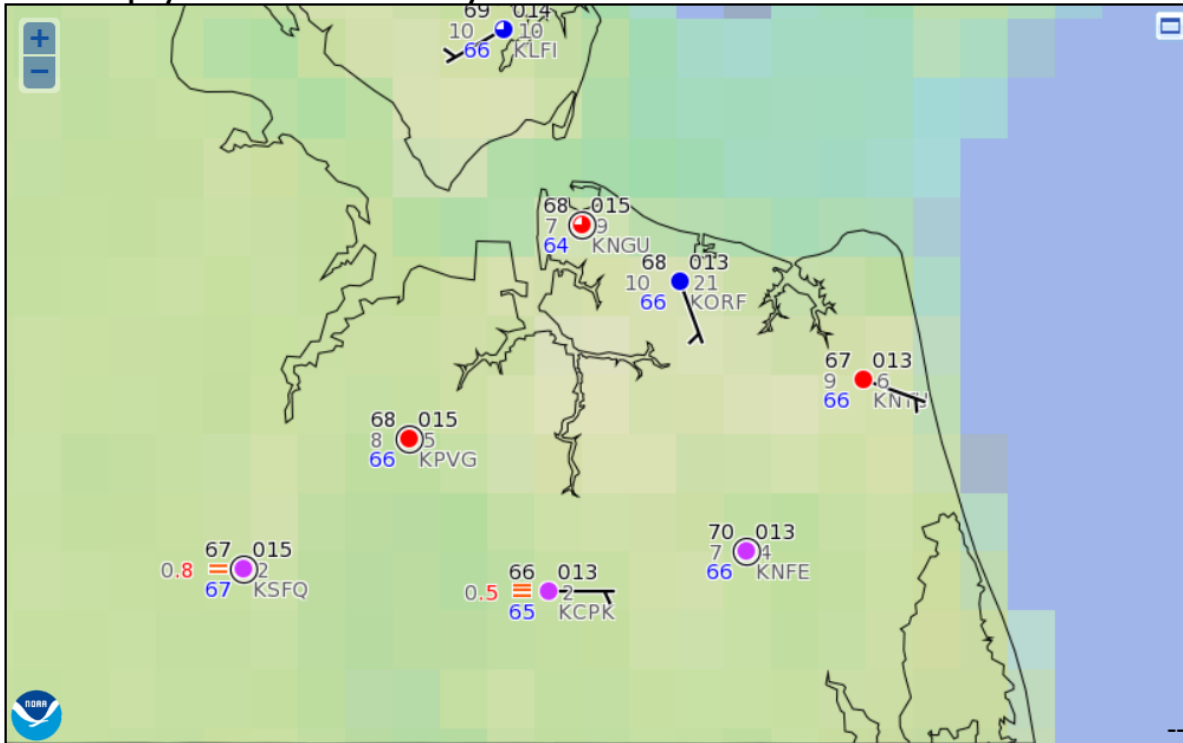


Figure 7 – NWS AWC METAR display at 0800 EDT over the region

3.0 Sounding

The closest NWS upper air observation was taken from the NWS Wallops Island (KWAL), Virginia, site number 72402, located about 85 miles north-northeast of the accident site at the National Aeronautics and Space Administration (NASA) Wallops Flight Facility at an elevation of 10 ft. The KWAL observed data were plotted on a standard skew T log P diagram⁷ using the complete Rawinsonde Observation program software⁸ from the surface to 500-hPa or approximately 18,000 ft and is included as figure 8.

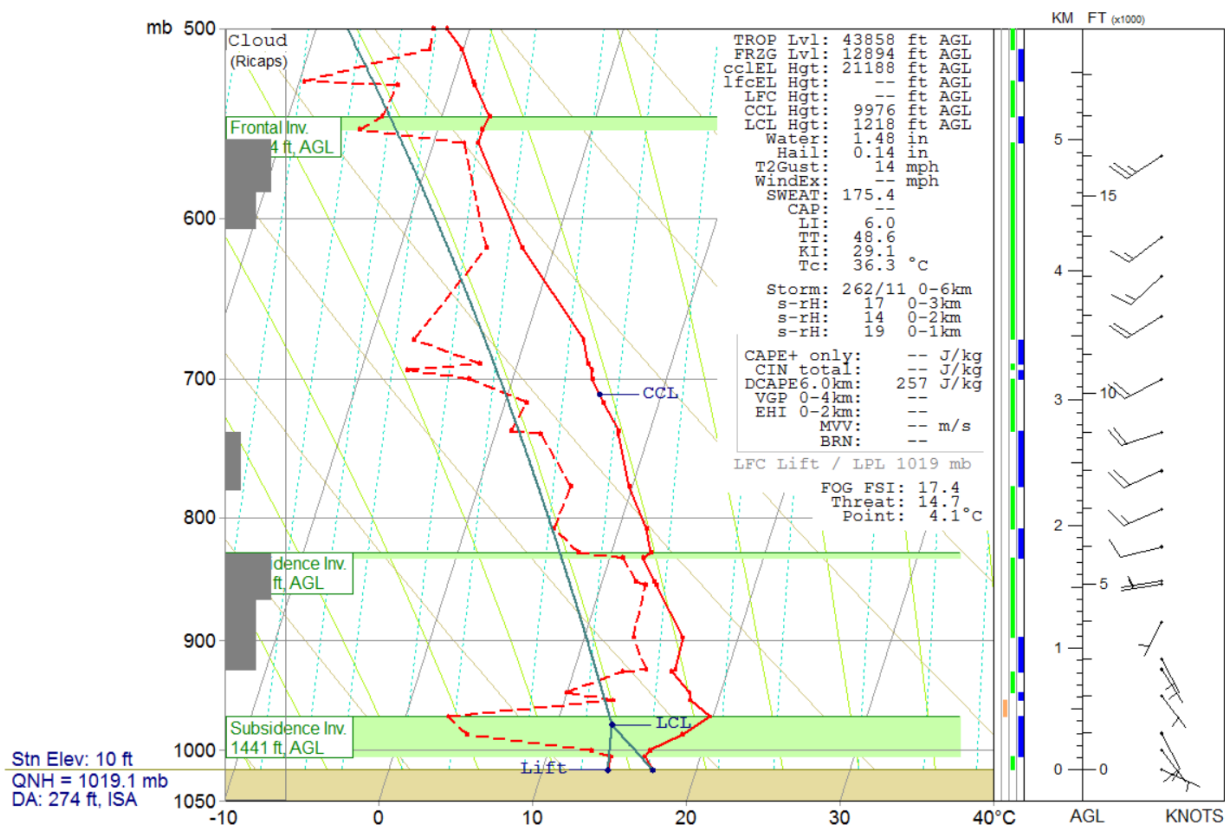


Figure 8 - KWAL sounding for 0800 EDT

The KWAL 0800 EDT sounding indicated a surface wind from 115° at 3 knots, a temperature of 17° C, a dew point temperature of 14° C, with a relative humidity of 83%. A low-level temperature inversion was noted immediately above the surface from 300 to 1,475 ft agl, with the lifted condensation level (LCL)⁹ just below the top of the inversion at 1,218 ft agl. The sounding supported multiple layers of clouds, with the lowest layer from 2,700 ft agl (where the sounding

⁷ Skew T log P diagram – is a standard meteorological plot or thermodynamic diagram 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.

⁸ RAOB software – The complete RAWinsonde OBservation program is an interactive sounding analysis program developed by Environmental Research Services, Matamoras, Pennsylvania, for plotting and analyzing upper air data.

⁹ Lifting Condensation Level (LCL) - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

had a relative humidity greater than 80%) with tops near 5,800 ft. The freezing level was identified at approximately 12,900 ft. The wind profile indicated light southerly winds of 10 knots or less through 5,000 ft, with winds veering to the west and slowly increasing in speed with height. The mean 0 to 6 kilometer (km) or 18,000 ft wind was from 230° at 14 knots. The sounding did not indicate any significant low-level wind shear (LLWS) or any potential for moderate or greater turbulence below 5,000 ft.

A table of the KVAL observed heights, pressure, temperature (T), dew point (Td), relative humidity (RH%), wind direction and speed, and derived clear air turbulence (CAT), and LLWS potential is included below in figure 9.

Height (ft-MSL)	Pres (mb)	T (C)	Td (C)	RH (%)	DD / FF (deg / kts)	CAT (FAA)	LLWS
10	1019	17.2	14.3	83	115 / 3		
370	1006	16.4	14.2	87		LGT	
537	1000	16.6	12.8	78	145 / 6	LGT	
961	985	18.4	4.4	40	155 / 10		
1451	968	19.8	2.8	32			
1891	953	18.2	13.2	73		LGT	
2098	946	18.0	10.0	59	145 / 7		
2667	927	16.4	13.2	81			
2728	925	16.6	14.7	89	150 / 7		
3000	916				155 / 7		
3589	897	16.4	13.2	81		LGT	
4000	884				205 / 4	LGT	
4991	853	13.6	12.9	96	260 / 4		
5089	850	13.4	12.2	92	260 / 4		
5714	831	12.2	10.9	92			
5847	827	12.6	7.9	73		LGT	
6000	822				255 / 8		
6487	808	11.8	5.8	67		MDT	
7000	793				245 / 16		
7595	776	9.8	6.0	77		LGT	
8000	765				245 / 19	LGT	
8962	738	8.0	3.0	71	250 / 22		
9036	736	8.0	1.0	61			
9781	716	6.4	1.4	70		LGT	
10389	700	5.2	-2.8	56	240 / 19		
10620	694	5.0	-7.0	41			
10775	690	4.6	-2.4	60			
11402	674	3.8	-7.2	44			

Figure 9 - KVAL 0800 EDT observed sounding

To better represent the conditions over the accident site a High-Resolution Rapid Refresh (HRRR) numerical model¹⁰ data was retrieved from the NOAA Air Resources Laboratory and plotted on a Skew T log P diagram. Figure 10 is the HRRR model sounding for 0700 EDT which depicted a surface temperature of 20° C and a dew point of 19° C, with a 98% relative humidity.

¹⁰ The HRRR is a National Oceanic and Atmospheric Administration (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.

The HRRR model sounding wind profile indicated a near surface wind from 100° at 3 knots with winds veering to the west through 1,500 ft. The mean 0 to 6 km wind was from 240° at 10 knots. A shallow layer of potential moderate turbulence was identified near 1,000 ft, where the wind direction veered rapidly in direction from the southeast to the west.

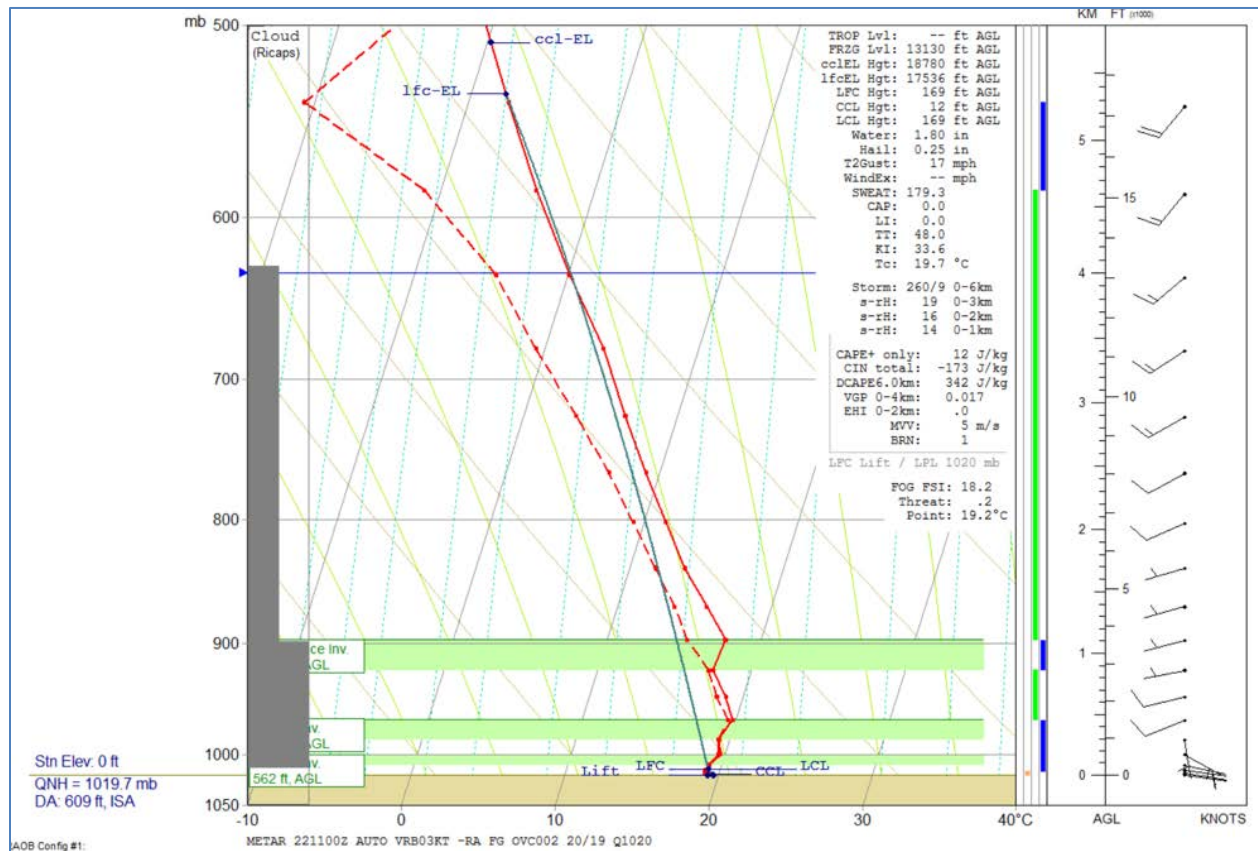


Figure 10 - HRRR numerical model sounding over the accident site for 0700 EDT

A table of the HRRR model heights, pressure, temperature, dew point, relative humidity, and wind direction and speed, CAT and LLWS potential is included below in figure 11.

¹¹ **Lifting Condensation Level (LCL)** - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

¹² Level of Free Convection (LFC) -The level at which a parcel of saturated air becomes warmer than the surrounding air and begins to rise freely. This occurs most readily in a conditionally unstable atmosphere.

Height (ft-MSL)	Pres (mb)	T (C)	Td (C)	RH (%)	DD / FF (deg / kts)	CAT (FAA)	LLWS
0	1020	19.7	19.3	98	99 / 3		
28	1019	19.5	19.1	98	99 / 3		LIGHT
112	1016	19.2	19.0	99	98 / 4		
280	1010	19.2	19.2	100	103 / 5		
562	1000	19.7	19.6	99	121 / 5	LGT	
962	986	19.3	19.3	100	172 / 3	MDT	LIGHT
1485	968	19.8	19.5	98	247 / 9		
2107	947	18.9	18.3	96	255 / 9	LGT	
2832	923	17.5	17.2	98	257 / 6		
3636	897	17.7	15.2	85	255 / 5		
4526	869	15.8	13.7	87	254 / 7		
5537	838	13.6	11.7	88	253 / 7		
6749	802	11.4	9.3	87	244 / 9		
8042	765	9.1	6.7	85	239 / 12		
9499	725	6.6	3.4	80	238 / 14		
11219	680	3.8	-0.6	73	235 / 14		

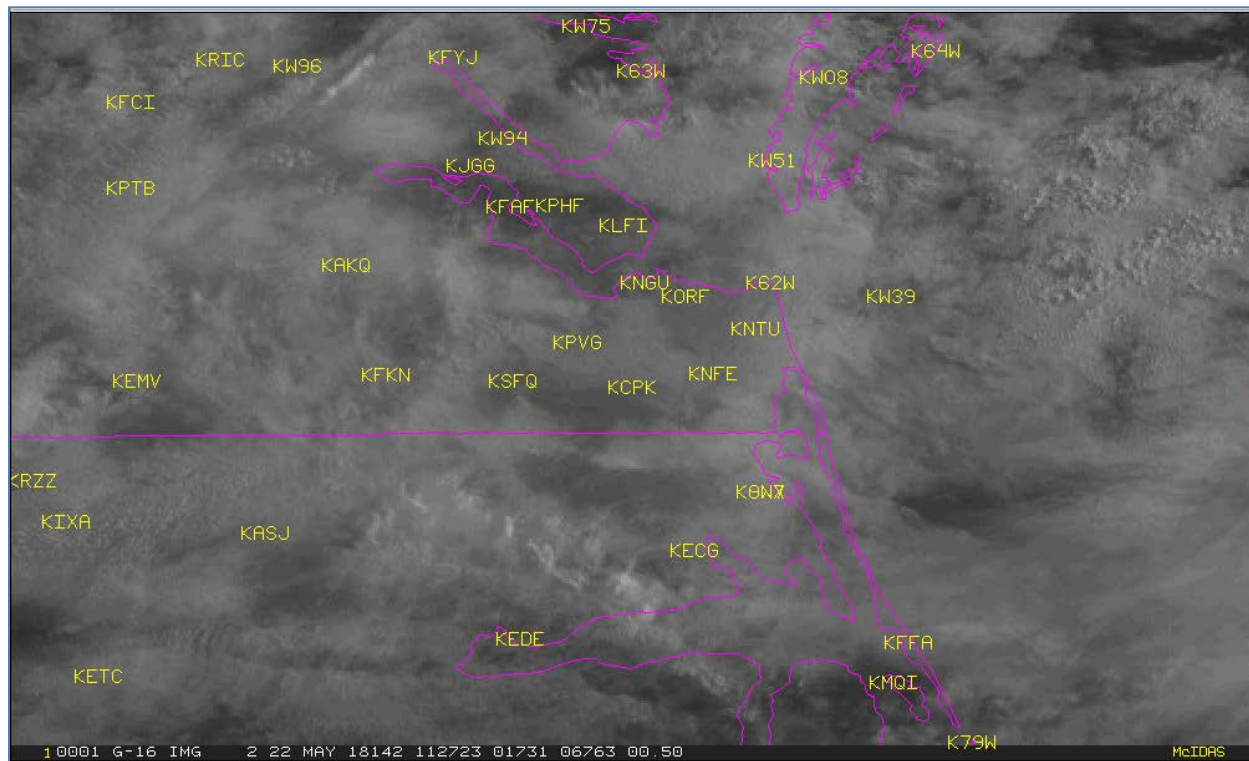
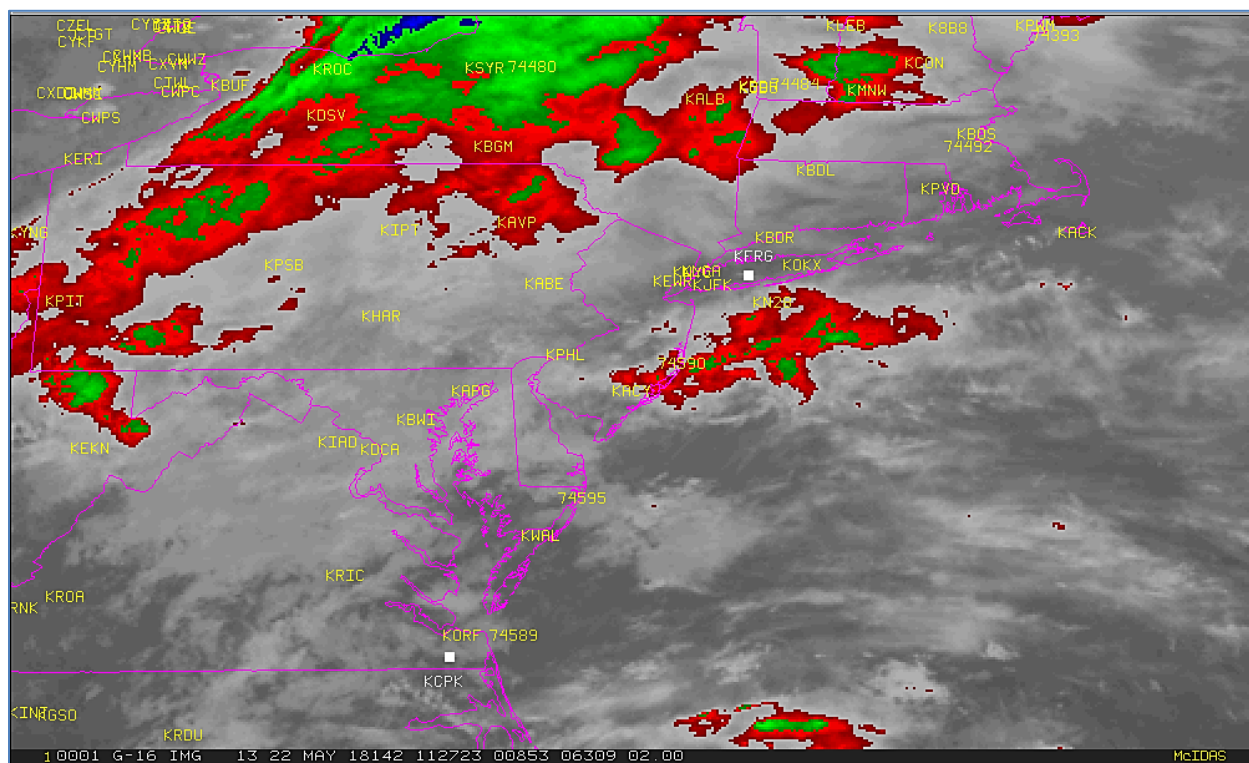
Figure 11 - HRRR numerical model derived parameters through 11,000 ft.

4.0 Satellite Imagery

The Geostationary Operational Environmental Satellite number 16 (GOES-16) data was obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison in Madison, Wisconsin, and processed using the Man-computer Interactive Data Access System (McIDAS) software. Both the infrared long wave and visible band imagery were obtained surrounding the time of the accident. The infrared long wave imagery (band 13) at a wavelength of 10.3 microns (μm) provided radiative cloud top temperatures with a nominal resolution of 2 km. The visible imagery (band 2) at a wavelength of 0.64 μm provided a nominal spatial resolution of 0.5 km.

Figure 12 is the GOES-16 infrared image at 0727 EDT at 2 X magnification and with a standard MB temperature enhancement curve applied. The departure airport of KCPT and the planned destination of Farmingdale (KFRG), New York, are indicated by the white squares. The images depicted low clouds extending over the accident site and a large portion of northern and eastern Virginia, Maryland, Delaware, and New Jersey along the proposed route of flight with clearing over southeast New York. The radiative cloud top temperature over the accident site was 250° Kelvin or 6.8° C, which corresponded to cloud tops near 6,800 ft.

Figure 13 is the GOES-16 visible image for the same period at 2X magnification and depicted multiple layers of low clouds over the region with the accident site in the immediate vicinity of KCPK in the center of the image.



5.0 Pilot Reports

The following pilot reports (PIREPs) were noted between 0500 and 1000 EDT within 100 miles over eastern Virginia. The reports are in standard code as received and time is referenced to UTC, and were as follows:

RIC UA /OV RIC/TM 1002/FL120/TP B738/SK BASES OVC007 TOPS OVC015
RIC UA /OV RIC020007/TM 1140/FL005/TP MU2/SK BASES 005OVC
RIC UA /OV RIC/TM 1230/FL005/TP CRJ9/SK BASES 005 OVC
RIC UA /OV KRIC/TM 1305/FL004/TP MD88/SK BASES OVC004/WV 21005/RM DURC

All the reports came from aircraft in the vicinity of Richmond International Airport (KRIC) located approximately 70 miles northwest of the accident site. The pilots reported overcast clouds with bases between 400 to 700 ft, and one aircraft provided cloud tops at 1,500 ft. A review of the RIC observations during the period also reported visibility ranged from 1 ½ to 2 ½ miles in mist and ceilings overcast from 700 ft agl down to 300 ft agl during the period.

6.0 Terminal Aerodrome Forecast

The closest Terminal Aerodrome Forecast (TAF) to the accident site was for KORF located about 15 miles northeast of KCPK and was issued by the NWS Wakefield Weather Forecast Office (WFO). While a TAF is only valid for a 5-mile radius of the airport's center point, it provides a time specific breakdown of wind, visibility, potential weather conditions, and clouds than other broader forecasts. The forecast current at the time of departure was as follows:

TAF KORF 220540Z 2206/2306 10003KT P6SM OVC012
FM220630 09003KT 5SM BR OVC008
FM220900 10003KT 2SM BR OVC004
FM221200 15004KT 5SM BR VCSH OVC007
FM221400 20006KT P6SM VCSH OVC020
FM221800 21011KT P6SM BKN050=

The forecast valid for 0500 through 0800 EDT expected a wind from 100° at 3 knots, visibility of 2 miles in mist, with ceiling overcast at 400 ft agl.

The next scheduled TAF was issued immediately prior to departure at 0742 EDT and was as follows:

TAF KORF 221142Z 2212/2312 15004KT 6SM BR OVC006
FM221500 18005KT P6SM VCSH OVC015
FM221800 20010KT P6SM BKN040
FM222100 21009KT P6SM VCSH BKN050
FM230400 22008KT P6SM BKN070=

The forecast from 0800 through 1100 EDT expected the wind from 150° at 4 knots, visibility of 6 miles in mist, with ceiling overcast at 600 ft agl. MVFR conditions were expected after 1100 EDT, with VFR conditions after 1400 EDT.

7.0 Graphic Aviation Forecast

The NWS AWC Graphic Aviation Forecast (GFA) of enroute clouds and expected mountain obscuration and icing conditions issued at 0600 EDT and valid for 0800 and 1100 EDT, respectively, are included in figure 14 and 15 respectively. The GFA valid for 0800 EDT expected overcast clouds with bases at 500 ft with tops to 3,000 ft, with an AIRMET Zulu for icing conditions extending from Virginia, Maryland, Delaware, New Jersey, and into southern New York immediately west of the accident aircraft's planned destination. The forecast for 1100 EDT continued to expect overcast clouds with bases at 500 ft with tops to 2,000 ft in the vicinity of the accident site, with an AIRMET Zulu for icing conditions extending over most of Maryland, Delaware, New Jersey, and into southeastern New York now extending over the planned destination.

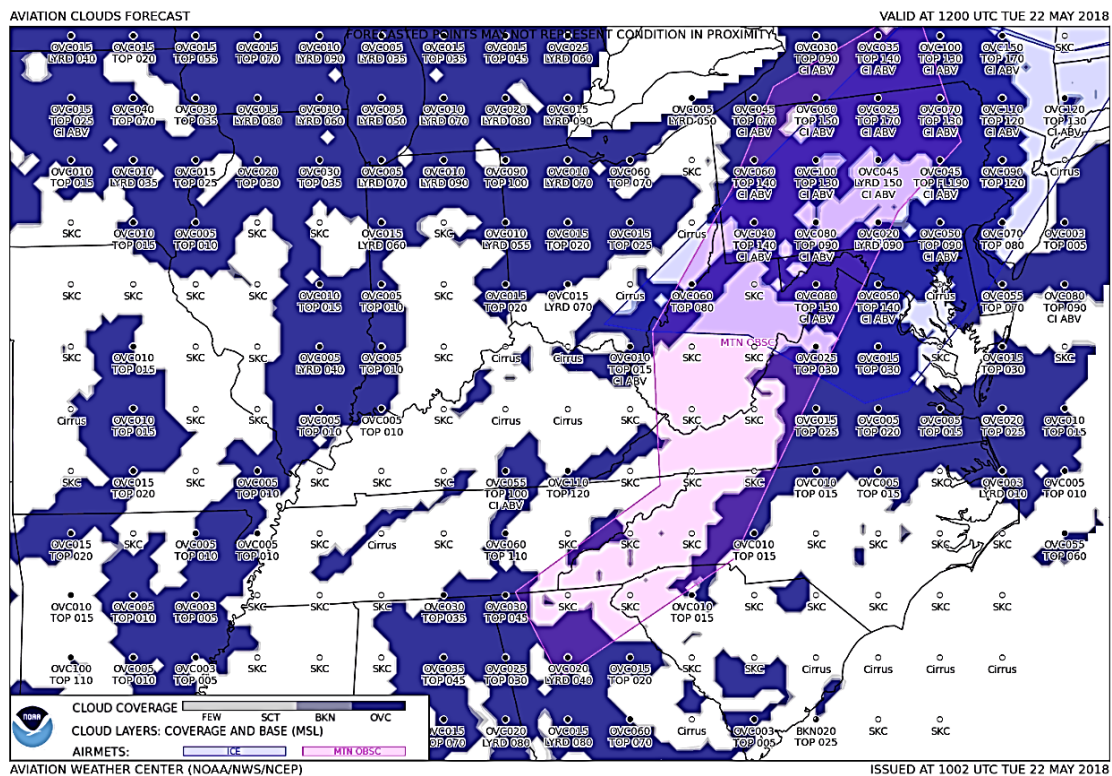


Figure 14 - GFA clouds and AIRMET Sierra valid for 0800 EDT

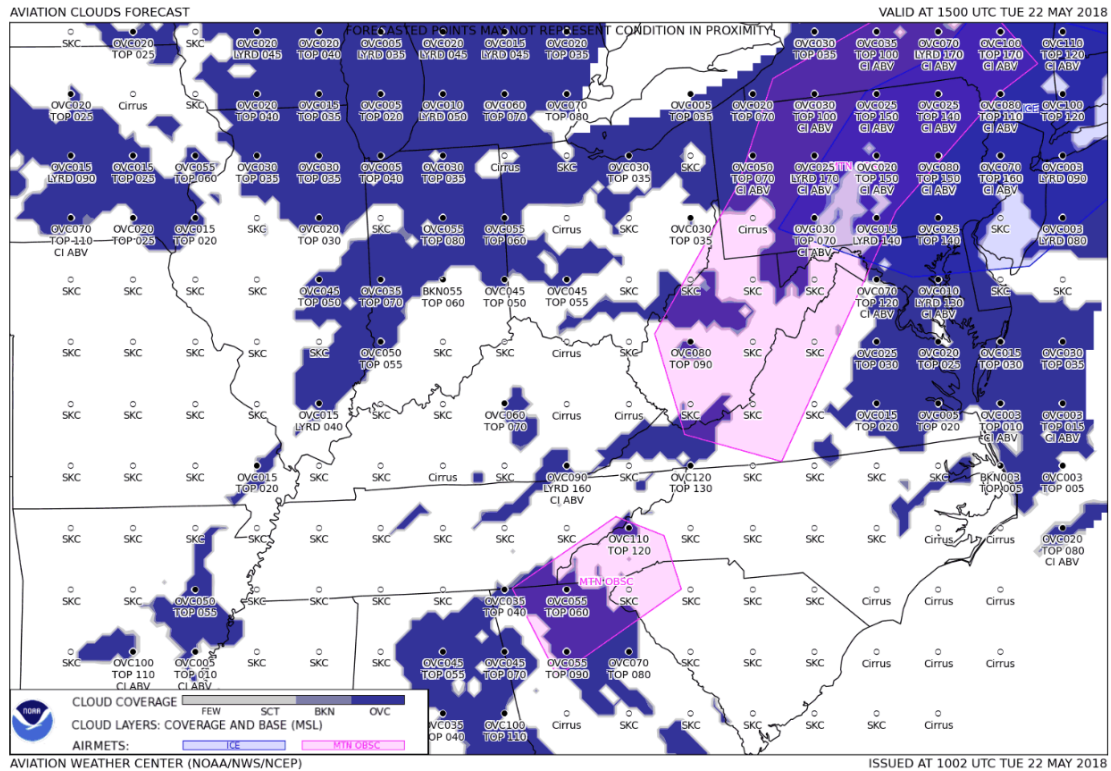


Figure 15 - GFA clouds and AIRMET Sierra valid for 1100 EDT

The GFA winds and expected visibility and weather for 0800 and 1100 EDT are included as figures 16 and 17 respectively. The forecasts expected southerly winds of 5 to 10 knots, with a change of thunderstorms over the region. The 0800 EDT GFA depicted the current extent of LIFR and IFR conditions, with the AIRMET Sierra for IFR conditions extending over Virginia, and VFR conditions prevailing over Maryland and along the route of flight.

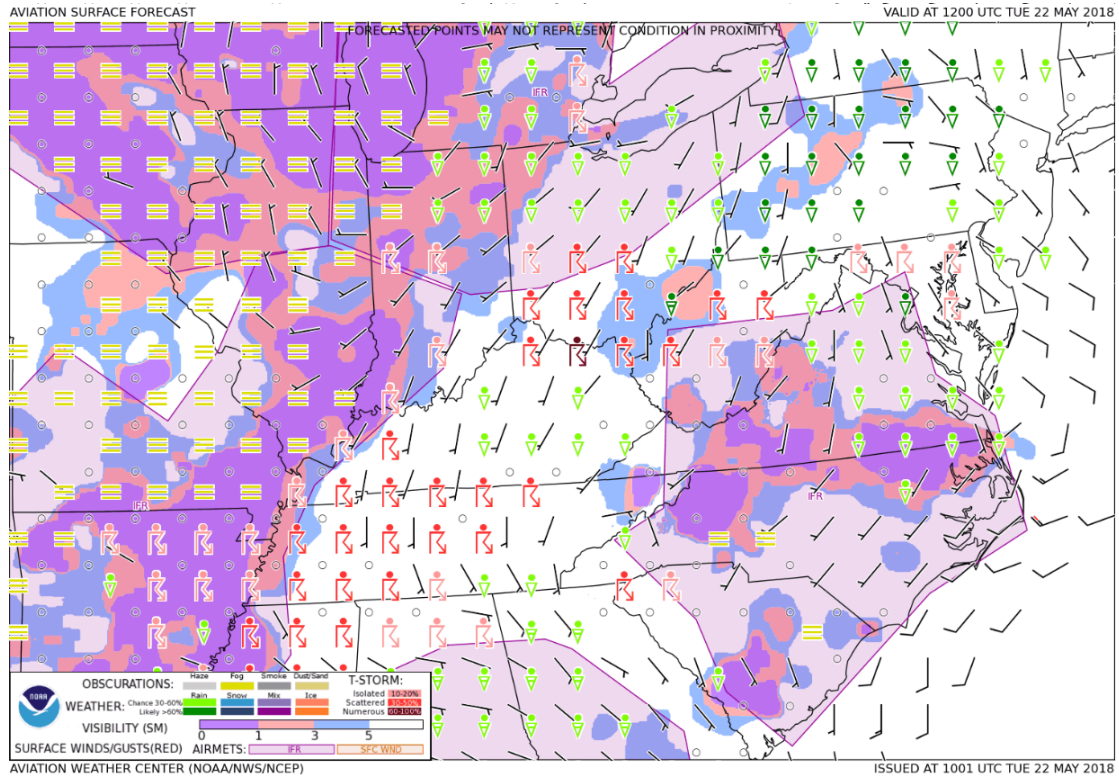


Figure 16 - GFA winds, visibility and weather with AIRMET Sierra for IFR conditions valid for 0800 EDT

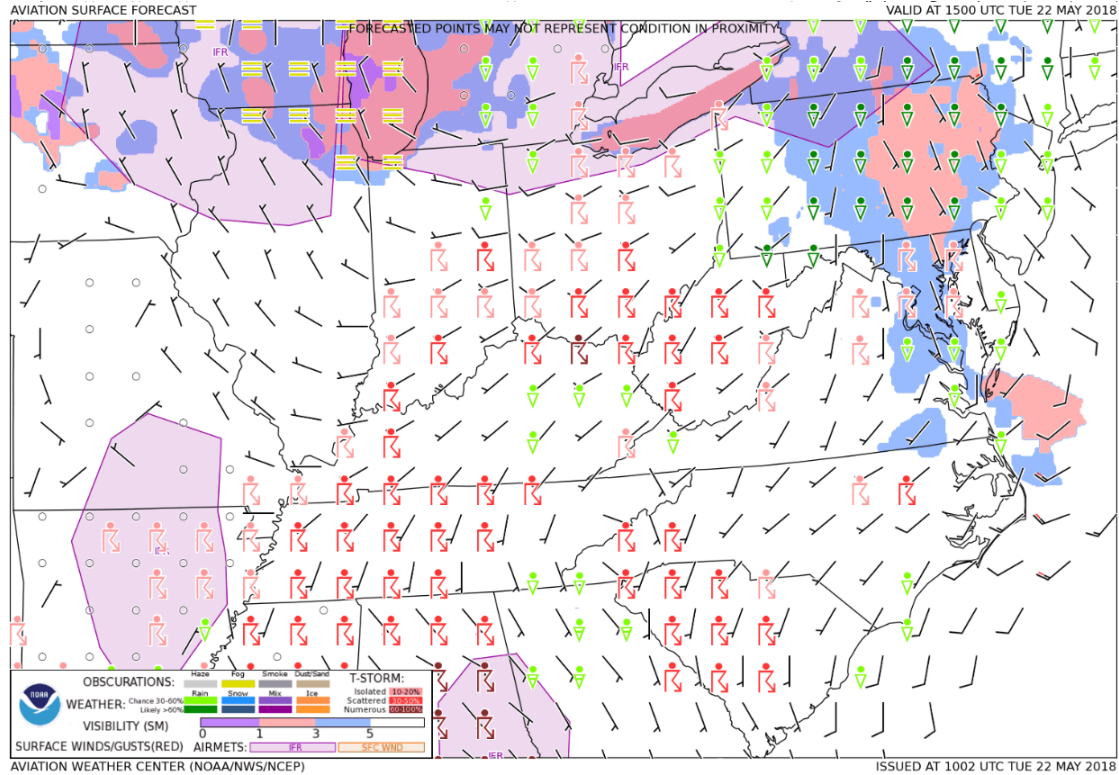


Figure 17 - GFA winds, visibility and weather with AIRMET Sierra for IFR conditions valid for 1100 EDT

8.0 Inflight weather Advisories

A review of the NWS inflight weather advisories indicated that there were no Significant Meteorological Advisories or SIGMETs, Convective SIGMETs, or Center Weather Advisories (CWA) for the area. The NWS AWC had an AIRMET Sierra current for IFR conditions over the area, which was issued at 0649 EDT and valid through 1100 EDT. The advisory warned of IFR conditions with ceilings below 1,000 ft agl and/or visibility below 3 miles in mist or fog, with conditions ending between 0800 and 1100 EDT. An AIRMET Zulu for icing conditions was also current over the general route of flight above 12,000 ft. The advisories were as follows:

WAUS41 KKCI 221049 AAA

WA1S

BOSS WA 221049 AMD

AIRMET SIERRA UPDT 2 FOR IFR AND MTN OBSCN VALID UNTIL 221500

. AIRMET IFR...NY LO PA OH LE WV...UPDT

FROM 30NE YYZ TO 30W SYR TO 30WNW HNK TO 30E PSB TO 40SSE PSB TO

30SW JST TO CVG TO FWA TO 30SE ECK TO 50W YYZ TO 30NE YYZ

CIG BLW 010/VIS BLW 3SM PCPN/BR/FG. CONDS CONTG BYD 15Z ENDG 18-21Z.

. AIRMET IFR...OH WV MD DC VA NC SC GA AND CSTL WTRS

FROM EMI TO 30ENE RIC TO 30ENE ORF TO 100SSE ECG TO 40ESE SAV TO

50SSW CAE TO 30ESE VXV TO HNV TO HNN TO EMI

CIG BLW 010/VIS BLW 3SM BR/FG. CONDS ENDG 12-15Z.

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

FROM 60SW MSS TO 30W BDL TO 20ENE HAR TO 30ENE EMI TO CLT TO ATL

TO GQO TO HNV TO HNN TO 20N EWC TO 30SSW BUF TO SYR TO 60SW MSS

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

WAUS41 KKCI 220845

WA1Z

-BOSZ WA 220845

AIRMET ZULU UPDT 1 FOR ICE AND FRZLVL VALID UNTIL 221500

. AIRMET ICE...VT MA RI CT NY LO NJ PA OH WV MD DC DE VA AND CSTL WTRS

FROM 50ENE BUF TO 40NW ALB TO 20SW BOS TO 60SE ENE TO 20E ACK TO

20E RIC TO 40E LYH TO 40SSE EKN TO CVG TO 50ENE BUF

MOD ICE BTN FRZLVL AND FL240. FRZLVL 100-140. CONDS CONTG BYD 15Z THRU 21Z.

. AIRMET ICE...ME NH VT MA RI NY LO AND CSTL WTRS

FROM YSC TO 60S BGR TO 60SE ENE TO 20SW BOS TO 40NW ALB TO 50ENE

BUF TO 30ENE YYZ TO YOW TO YSC

MOD ICE BTN FRZLVL AND FL180. FRZLVL 090-110. CONDS CONTG BYD 15Z THRU 21Z.

. OTLK VALID 1500-2100Z

AREA 1...ICE NH VT MA RI CT NY NJ PA WV MD DC DE VA AND CSTL WTRS

BOUNDED BY 30SSW MPV-30N CON-20ENE BOS-50ESE ENE-70E ACK-90SE ACK-110SSE HTO-

20SE SBY-40WSW JST-40NE SLT-30NW HNK-50NW ALB-30SSW MPV

MOD ICE BTN FRZLVL AND FL240. FRZLVL 100-140. CONDS CONTG THRU 21Z.

. AREA 2...ICE ME NH VT MA NY LO AND CSTL WTRS

BOUNDED BY 70NW PQI-60NE PQI-140E ACK-70E ACK-50ESE ENE-20ENE

BOS-30N CON-30SSW MPV-50NW ALB-70W YOW-YSC-70NW PQI

MOD ICE BTN FRZLVL AND FL200. FRZLVL 090-110. CONDS CONTG THRU 21Z.

FRZLVL...RANGING FROM 055-135 ACRS AREA

MULT FRZLVL 080-110 BOUNDED BY YOW-70S MSS-30ESE SYR-30SSW SYR-60NE YYZ-YOW
080 ALG 60E YQB-50SE HUL

120 ALG 30SE ECK-40NNW ERI-40NW ETX-50SSW ACK-120ESE ACK-160ESE ACK

9.0 Winds and Temperature Aloft Forecast

The NWS Winds and Temperature Aloft Forecast valid for the period and the route is included below:

WINDS ALOFT FORECASTS

DATA BASED ON 220600Z

VALID 221200Z FOR USE 0800-1500Z. TEMPS NEG ABV 24000

FT	3000	6000	9000	12000	18000	24000	30000	34000	39000
ORF	2310	2411+13	2413+08	2317+02	2317-10	2519-20	252636	262947	253258
RIC	2012	2415+13	2417+07	2316+02	2417-10	2521-21	262336	262347	252358
HAT	2320	2516+13	2513+08	2013+02	2121-11	2422-19	252635	253846	254158
ACY	1511	2510+11	2716+06	2520+02	2526-10	2628-21	263737	263948	253859
JFK	1613	1809+10	2516+05	2622+01	2638-11	2739-22	274938	265348	265859
BDL	1512	1511+08	2310+03	2523-01	2743-11	2748-23	276039	276749	267659

The forecast wind from Norfolk (ORF) for 3,000 ft was from 230° at 10 knots, at 6,000 ft from 240° at 11 knots with a temperature of +13 C.

10.0 Astronomical Data

The United States Naval Observatory's website provided the following astronomical conditions on May 22, 2018 for the Chesapeake and Norfolk, Virginia area. The accident time is added for reference:

Beginning civil twilight	0523 EDT
Sunrise	0552 EDT
Sun transit	1302 EDT
Sunset	2012 EDT
End civil twilight	2041 EDT

At the time of the accident the Sun was 17° above the horizon at an azimuth of 77°.

11.0 Preflight Weather Briefing

The pilot filed an IFR flight plan with the FAA contract Automated Flight Service Station provider Leidos prior to departure; however, he declined a weather briefing at that time. It is therefore unknown what time and what specific weather products the pilot had reviewed regarding the reports, forecast, and inflight weather advisories over the route of flight.

Submitted by:

Don Eick
Senior Meteorologist