

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



ERA22FA368

METEOROLOGY

Specialist's Factual Report

October 11, 2022

A. TABLE OF CONTENTS

A. TABLE OF CONTENTS.....	2
B. ACCIDENT.....	4
C. METEOROLOGY INVESTIGATOR	4
D. SUMMARY	4
E. DETAILS OF THE INVESTIGATION	4
F. FACTUAL INFORMATION.....	5
1.0 SYNOPTIC CONDITIONS	5
1.1 Surface Analysis Chart.....	5
1.2 Regional Radar Imagery.....	6
1.3 Convective Outlook.....	7
2.0 OBSERVATIONS.....	8
2.1 Morgantown, West Virginia	9
2.2 Clarksburg, West Virginia	11
3.0 MODEL SOUNDING	12
4.0 SATELLITE IMAGERY	14
5.0 WEATHER RADAR IMAGERY	17
5.1 Reflectivity Scales.....	17
5.2 Composite Reflectivity Imagery	19
5.3 Base Reflectivity Imagery	21
5.4 Lightning Data.....	25
5.5 Consolidated Storm Prediction for Aviation	26
6.0 PILOT REPORTS	29
7.0 NWS FORECASTS AND ADVISORIES.....	29
7.1 Terminal Aerodrome Forecast.....	29
7.2 Area Forecast Discussion.....	30
7.3 Graphic Forecast for Aviation.....	31
7.4 Traffic Flow Management (TFM) Convective Forecast (TCF)	33
7.5 Winds and Temperature Aloft Forecast.....	34
7.6 Inflight Weather Advisories	35
7.6.1 Center Weather Advisories	35

7.6.2	Convective SIGMETs	36
8.0	WEATHER BRIEFING INFORMATION	38
9.0	FIS-B WEATHER BROADCASTS	38
10.0	ASTRONOMICAL CONDITIONS	42
ATTACHMENTS		42
ATTACHMENT 1 - KMGW 1-MIN AND 5-MIN OBSERVATIONS		43
ATTACHMENT 2 - GOES-16 RGB MULTICHANNEL VISIBLE IMAGERY 1612-1902 EDT.....		43
ATTACHMENT 3 - KPBZ WSR-88D 1.36° BASE REFLECTIVITY IMAGERY 1735-1815 EDT		43
ATTACHMENT 4 - KZOB CWSU ATC MORNING PRE-DUTY WEATHER BRIEFING		43
ATTACHMENT 5 - KZOB CWSU ATC AFTERNOON PRE-DUTY WEATHER BRIEFING		43
ATTACHMENT 6 - KZOB CWSU ATC EVENING PRE-DUTY WEATHER BRIEFING		43

B. ACCIDENT

Location: Metz, West Virginia
Date: August 11, 2022
Time: 1805 eastern daylight time
2205 coordinated universal time (UTC)
Airplane: Piper PA32; Registration: N720RP

C. METEOROLOGY INVESTIGATOR

Donald Eick
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Washington, DC 20594

D. SUMMARY

On August 11, 2022, about 1805 eastern daylight time, a Piper PA32, N720RP, was destroyed when it was involved in an accident near Metz, West Virginia. The private pilot and two passengers were fatally injured. The airplane was operated as a Title 14 Code of Federal Regulations Part 91 personal flight. The accident airplane had departed from Daviess County Airport (DCY), Washington, Indiana, and was returning to Deck Airport (9D4), Myerstown, Pennsylvania.

E. 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 remotely, collecting data from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the Weather Prediction Center (WPC) and the National Center for Environmental Information (NCEI). This report documents the general weather products and forecasts over the region during the period and documents the pertinent meteorological parameters to the accident. All times are reported as eastern daylight time (EDT) based upon the 24-hour clock, local time is -4 hours from UTC, and UTC=Z. Airport and NWS 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 is based on the coordinates at latitude 39.62414° N and longitude 80.38504° W, at an elevation of about 1,200 ft.

F. FACTUAL 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) and the WPC 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 change 2¹.

1.1 Surface Analysis Chart

The NWS Surface Analysis Chart for 1700 EDT centered over the area is included as figure 1 with the approximate accident site marked by the red star. The chart depicted a low-pressure system at 1011-hectopascals (hPa)² just north of New York, with a cold front extending southward into Pennsylvania and then southwestward across northern West Virginia, into Ohio then west-northwestward into Indiana and Illinois. Another low-pressure system at 1014-hPa was located near the border of Kentucky, Tennessee, and Virginia, with a stationary front turning into a cold front extending eastward from the low across southern Virginia. The accident site was in the vicinity of the northern cold front and to the northeast of the second low-pressure system. The station models surrounding the accident site depicted scattered clouds south of the cold front and overcast clouds north of the cold front, with temperature near 78° Fahrenheit (F), dew point temperatures from 56° to 68° F, with calm to light northerly winds. One station immediately east-northeast of the accident site and in the vicinity of the cold front reported moderate rain at the time.

¹https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/1030235

² Hectopascals (hPa) is the standard term for reporting sea-level pressure and is interchangeable with the former term millibar (mb) with the same units. The International Standard Atmosphere (ISA) is based on a standard sea-level pressure of 1013.25-hPa at 59° Fahrenheit (F) or 15° Celsius (C).

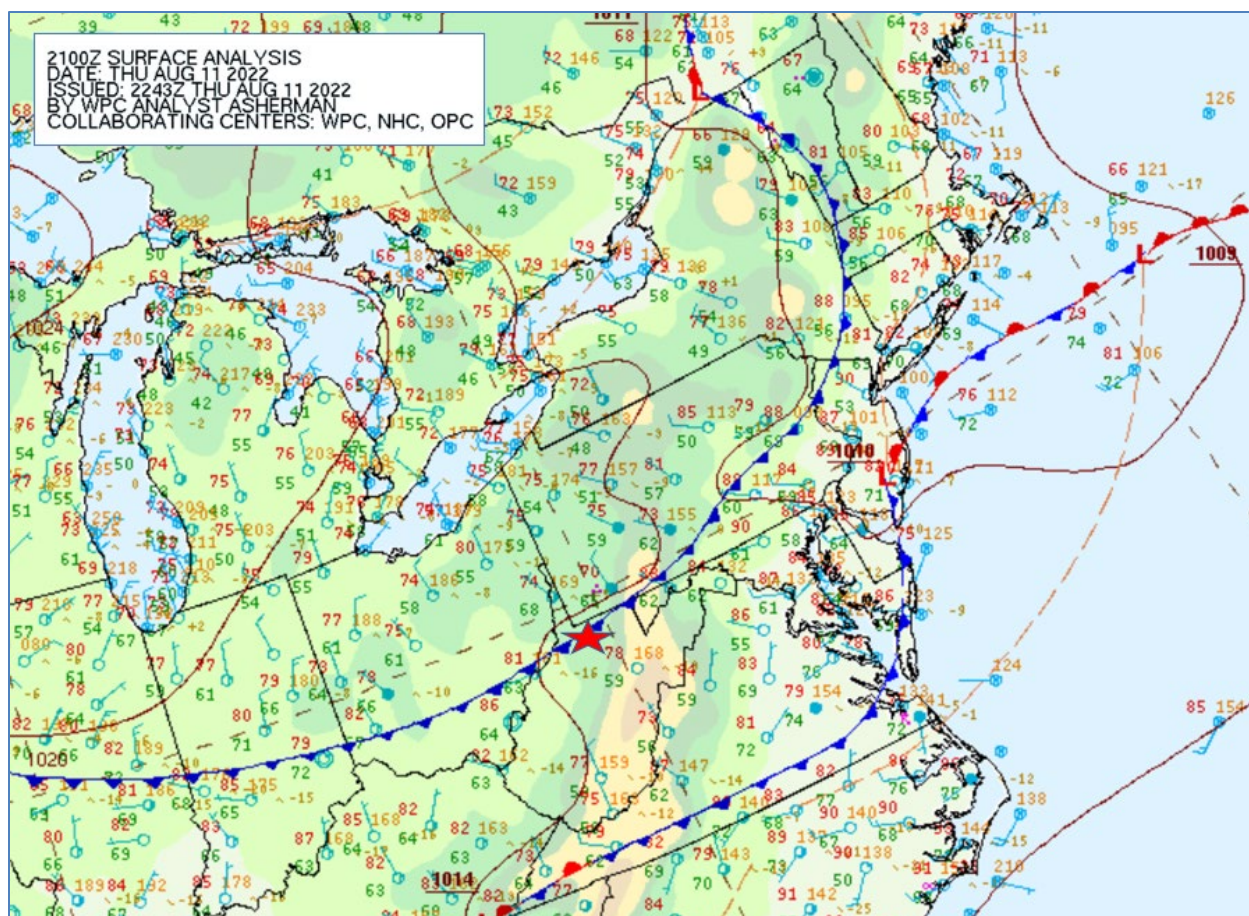


Figure 1 - NWS Surface Analysis Chart for 1700 EDT with accident site.

1.2 Regional Radar Imagery

The NWS National Composite Radar Mosaic image for 1805 EDT over the general route of flight is included as figure 2 with the approximate accident location within the red circle. The composite radar image depicted a broken line of echoes extending west-to-east across Indiana, central Ohio, northern West Virginia and into southern Pennsylvania, and coincided with the general position of the northern cold front. The echoes paralleled the general route of flight between the departure from Bloomfield, IN, to the planned destination of Myerstown, PA, which is estimated by the dashed blue line. Based on the existence of echoes near the accident site the closest NWS weather radar and actual flight track will be further documented in section 5.0 of this report.

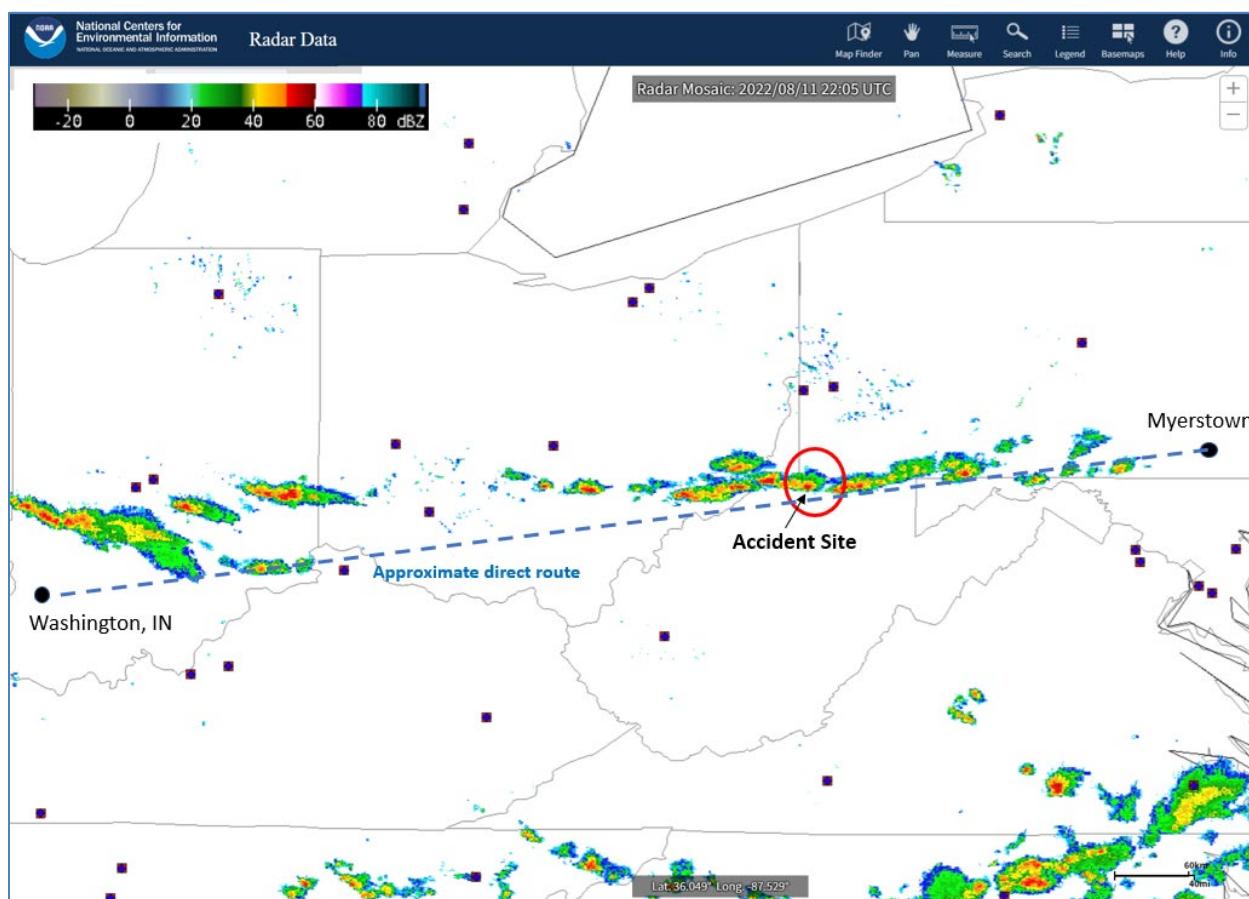


Figure 2 - NWS National Composite Radar Mosaic for 1805 EDT with estimated route of flight.

1.3 Convective Outlook

The NWS Storm Prediction Center's (SPC) Convective Outlook issued at 1230 EDT is included as figure 3 with the approximate accident site and destination indicated. The chart depicted a general risk of thunderstorms by the green shaded area over West Virginia and Pennsylvania, with no areas of organized severe thunderstorms³ expected over the planned route of flight.

A review of the NWS storm reports during the period noted no reports of any tornadoes, hail, or damaging winds over the region.

³ The NWS identifies a severe thunderstorm as a cumulonimbus cloud that produces a tornado, large hail of 1-inch in diameter or larger at the surface, or strong gusting winds of 50 knots or more.

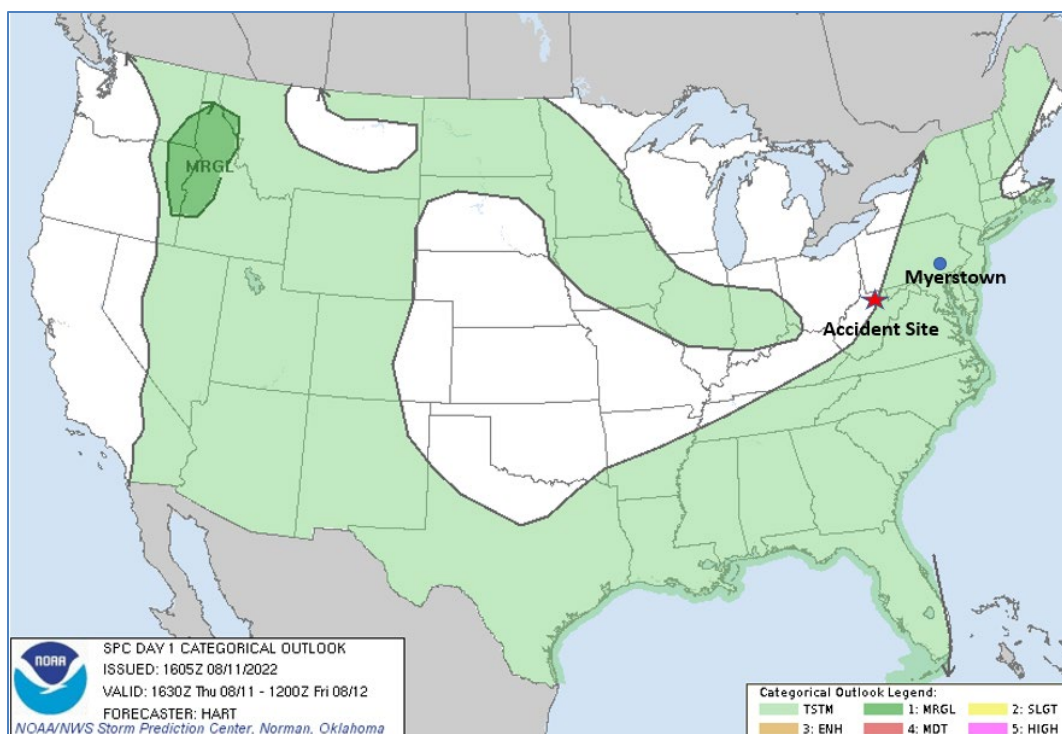


Figure 3 - NWS Convective Outlook issued at 1230 EDT for thunderstorm.

2.0 Observations

The area was documented using official Aviation Routine Weather Reports (METAR⁴) and Aviation Selected Special Weather Reports (SPECI). Cloud heights are reported above ground level (agl) in the following section, and the magnetic variation was estimated at 8° west based on the latest sectional chart for the area. A depiction of the observations from the NWS Aviation Weather Center's (AWC) METAR display⁵ at 1810 EDT with the radar overlay is included as figure 4 with the accident site marked within the red circle and the two closest weather reporting locations documented below.

⁴ Abbreviation for METeorological Aerodrome Report (METAR).

⁵ <https://www.aviationweather.gov/metar>

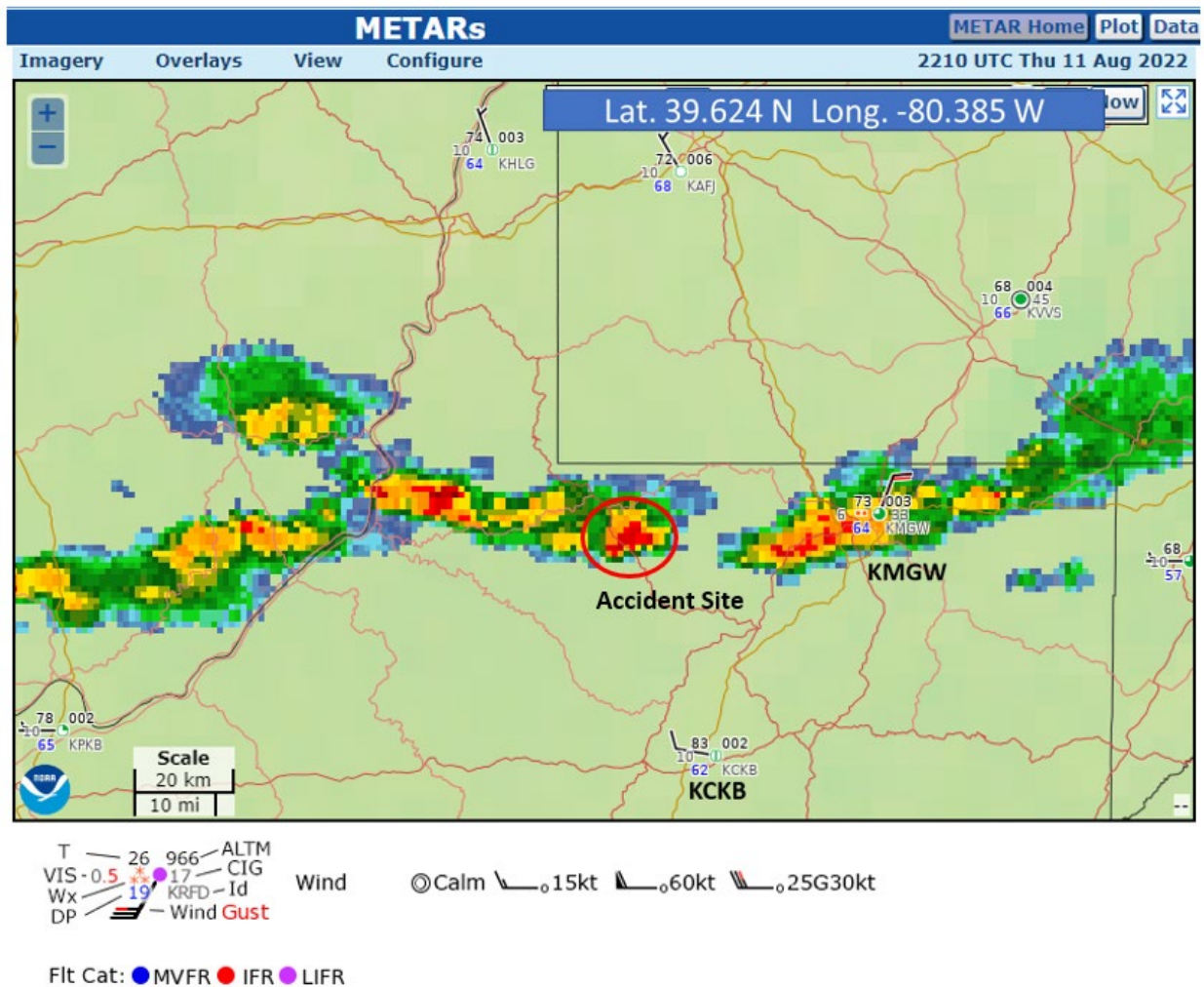


Figure 4 - NWS AWC's METAR display for 1810 EDT with radar overlaid and accident site.

2.1 Morgantown, West Virginia

The closest weather reporting facility was from Morgantown Municipal Airport-Walter L. Bill Hart Field (KMGW), Morgantown, WV, which was located about 21 miles east of the accident site at an elevation of 1,244 ft. The airport had an Automated Surface Observation System (ASOS) whose reports were augmented by air traffic controllers during normal operating hours between 0500 and 2400 EDT. The following conditions were reported surrounding the time of the accident:

Weather observation for KMGW at 1753 EDT, wind from 020° at 9 knots gusting to 21 knots, visibility 6 miles, light rain and mist, ceiling⁶ broken at 3,300 ft agl, broken at 6,000 ft, temperature 23° C, dew point temperature 18° C,

⁶ Ceiling is the lowest layer of clouds reported as broken or overcast, or the vertical visibility into a surface based obscuration.

altimeter 30.03 inches of mercury (inHg). Remarks: automated station with a precipitation discriminator, lightning distant⁷ west, rain began at 1751 EDT, sea level pressure of 1016.1-hPa, hourly precipitation 0.01 inches or a trace (since 1653 EDT), temperature 22.8° C, dew point temperature 17.8° C.

Weather observation for KMGW at 1853 EDT, wind from 210° at 5 knots, visibility 6 miles in mist, scattered clouds at 1,300 ft, ceiling broken at 3,700 ft, temperature 21° C, dew point temperature 19° C, altimeter 30.04 inHg. Remarks: automated station with a precipitation discriminator, lightning distant east and west, rain ended at 1852 EDT, thunderstorm began at 1804 and ended at 1805 EDT⁸, sea level pressure 1016.5-hPa, hourly precipitation 0.19 inches (since 1753 EDT), temperature 20.6° C, dew point temperature 19.4° C.

The general flight categories⁹ and raw METAR observations for KMGW surrounding the period were as follows.

VFR METAR KMGW 111853Z VRB03KT 10SM FEW050 28/15 A3005 RMK AO2 SLP166 T02780150=

VFR METAR KMGW 111953Z 10SM SCT050 SCT060 28/16 A3003 RMK AO2 SLP157 T02780156=

VFR METAR KMGW 112053Z 28006KT 10SM SCT050 BKN060 27/15 A3002 RMK AO2 SLP156 T02720150 56016=

VFR METAR KMGW 112153Z 02009G21KT 6SM -RA BR BKN033 BKN060 23/18 A3003 RMK AO2 LTG DSNT W RAB51 SLP161 P0000 T02280178=

Accident 2206Z

VFR METAR KMGW 112253Z 21005KT 6SM BR SCT013 BKN037 21/19 A3004 RMK AO2 LTG DSNT E AND W RAE52 TSB04E05 SLP165 P0019 T02060194=

MVFR METAR KMGW 112353Z 24003KT 5SM BR SCT032 BKN055 21/19 A3006 RMK AO2 LTG DSNT

⁷ Distant refers to cloud-to-ground lightning strike between 10 and 30 miles from the ASOS location.

⁸ According to the Federal Meteorological Handbook number 1 (FMH-1) section 2.5.2, criteria for SPECI, a SPECI shall be made as soon as possible after the beginning and end of a thunderstorm. This requirement is also reflected in FAA JO 7900.5E CHG 1, Surface Weather Observing. A review of the 5-minute observations indicated no significant changes in the reported conditions from the 2153Z observation were noted when the thunderstorm was reported.

⁹ 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 or the lowest layer of clouds reported as broken or overcast, or the vertical visibility into a surface based obscuration 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.

SE AND SW SLP172 60019 T02060189 10289 20200 53012=

A review of the observations indicated that the hourly precipitation reported at 1853 EDT was 0.19 inches, which indicated that moderate or heavy rain had also occurred within that hour. According to the NWS Federal Meteorological Handbook (FMH-1) light rain is defined as up to 0.10 inch per hour, or a maximum of 0.01 inch in 6 minutes, while moderate rain is from 0.11 inch to 0.30 inch per hour, or more than 0.01 to 0.03 inch in 6 minutes. Heavy rain is defined as more than 0.30 inch per hour, or more than 0.03 inch in 6 minutes. A SPECI is required if a wind shift of more than 45° occurs in less than 15 minutes and the wind speed is 10 knots or more, visibility decreased to 3 miles or less, thunderstorm begins or ends, hail begins or ends, a tornado, or a squall occurs. Other than the start and end of a thunderstorm, no other criteria for a SPECI were met.

A review of the KMGW 5-minute and 1-minute ASOS data (attachment 1) indicated that light rain began at 1751 EDT. Moderate rain was recorded between 1802 and 1823 EDT with a period of heavy rain between 1809 and 1818 EDT.

2.2 Clarksburg, West Virginia

The next closest weather reporting system was from North Central West Virginia Airport (KCKB), Clarksburg, WV, located 21 miles south of the accident site at an elevation of 1,224 ft. KCKB also had an ASOS whose reports were augmented by air traffic control during operating hours. At the time of the accident KCKB reported the following conditions:

Weather observation for KCKB at 1753 EDT, wind from 280° at 8, visibility 10 miles or more, a few clouds at 6,000 ft agl, temperature 28° C, dew point temperature 17° C, altimeter 30.02 inHg. Remarks: automated station with a precipitation discriminator, lightning distant northwest, sea-level pressure 1014.8-hPa, temperature 28.3° C, dew point temperature 16.7° C.

The general flight categories and raw observation surrounding the period for KCKB were as follows.

VFR METAR KCKB 111853Z 00000KT 10SM SCT048 27/16 A3006 RMK AO2 SLP161 T02720156=

VFR METAR KCKB 111953Z 02006KT 10SM SCT050 28/16 A3003 RMK AO2 SLP153 T02830161=

VFR METAR KCKB 112053Z 28007KT 10SM SCT049 29/16 A3002 RMK AO2 SLP149 T0289016158014=

VFR METAR KCKB 112153Z 28008KT 10SM FEW060 28/17 A3002 RMK AO2 LTG DSNT NW SLP148 T02830167=

Accident 2206Z

VFR METAR KCKB 112253Z 32005KT 10SM SCT060 26/17 A3001 RMK AO2 LTG DSNT NW SLP146 T02610172=

VFR SPECI KCKB 112335Z 02013KT 10SM SCT055 BKN070 OVC110 23/17 A3003 RMK AO2 WSHFT 2315 LTG DSNT W-NE T02330172=

VFR METAR KCKB 112353Z 02010KT 10SM VCTS SCT046 BKN055 OVC090 22/17 A3003 RMK AO2 WSHFT 2315 LTG DSNT E AND W AND NW SLP154 T02220172 10289 20222 53002=

VFR SPECI KCKB 120002Z 36011KT 8SM TSRA BKN046 BKN055 OVC070 22/18 A3005 RMK AO2 LTG DSNT W RAB2355 TSB2356 PRESRR P0001 T02220183=

IFR SPECI KCKB 120021Z 29005KT 2 1/2SM TSRA OVC047 21/18 A3006 RMK AO2 LTG DSNT E RAB2355 TSB2356 P0010 T02110183=

MVFR SPECI KCKB 120028Z 28004KT 3SM VCTS RA BR BKN047 BKN075 OVC100 21/18 A3006 RMK AO2 LTG DSNT SE RAB2355 TSB2356E28 P0012 T02060183=

3.0 Model Sounding

A High-Resolution Rapid Refresh (HRRR)¹⁰ numerical model data was obtained from the NOAA Air Resource Laboratory archive using the closest grid point¹¹ to the accident site coordinates. The HRRR model data was then plotted on a standard skew T log P diagram¹² using the RAOB Analysis software¹³ for 1800 EDT from the surface to 450-hPa (approximately 22,000 ft) and is included as figure 5.

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 The grid point coordinates were latitude 39.62° N and 80.39° W.

¹² 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.

¹³ RAOB -The Universal RAOBwinsonde OBServation program is an interactive sounding analysis program developed by Eosonde Research Services (ERS) previously known as Environmental Research Services, The Villages, Florida.

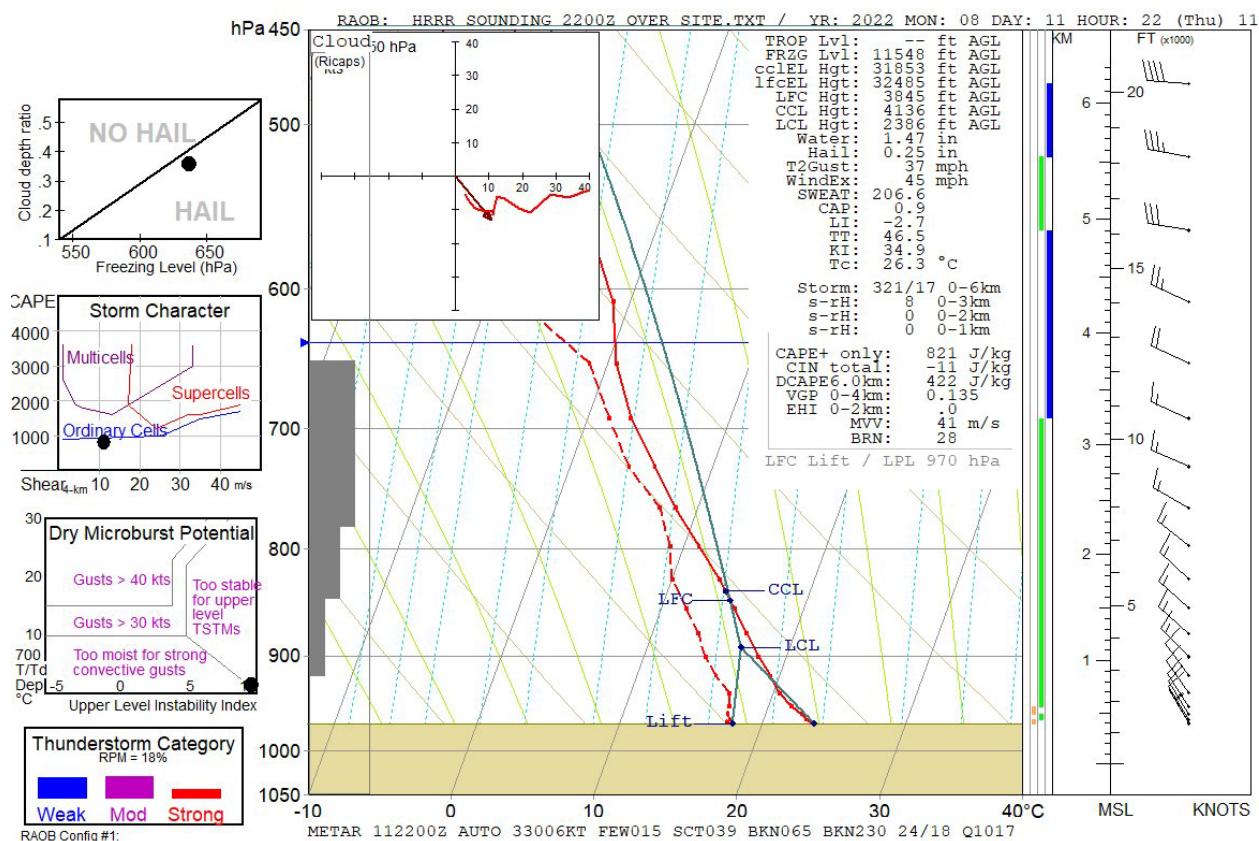


Figure 5 - HRRR Numerical sounding over the accident site for 1800 EDT.

The HRRR 1800 EDT sounding indicated an elevation of 1,306 ft over the grid point with a near surface temperature of 23.6° C (75° F), a dew point temperature of 17.9° C (64° F), a relative humidity of 70%, which indicated a density altitude of 2,744 ft. The freezing level was identified at 12,800 ft, which was above the accident airplanes cruising altitude of 9,500 ft. The lifted condensation level (LCL)¹⁴ was identified at 2,386 ft agl, the level of free convection (LFC)¹⁵ at 3,845 ft agl, and the convective condensation level (CCL)¹⁶ at 4,136 ft agl. The atmosphere was characterized as conditionally unstable with a Lifted Index¹⁷ of -2.7, a K-index¹⁸ of 34.9, a Convective

¹⁴ Lifted Condensation Level (LCL) - the level at which a lifted parcel becomes saturated. The LCL height corresponds to cloud base height for forced ascent.

¹⁵ Level of Free Convection (LFC) - the level where a parcel becomes buoyant, or "warmer" than the environmental temperature at the same level. The LFC represents the bottom of the layer containing CAPE.

¹⁶ Convective Condensation Level (CCL) - is the height at which a parcel of air, when heated sufficiently from below, rises and becomes saturated. It is where newly forming convective clouds should form bases.

¹⁷ Lifted Index (LI) - A common measure of atmospheric instability. Its value is obtained by computing the temperature that air near the ground would have if it were lifted to 500-hPa or approximately 18,000 feet and comparing that temperature to the actual temperature at that level.

¹⁸ K-Index - The measure of thunderstorm potential based on the vertical temperature lapse rate, the moisture content of the lower atmosphere and the vertical extent of the moist layer. The higher the K-Index value the greater the probability of air mass type thunderstorm development across the region.

Available Potential Energy (CAPE) of 821 J/kg, with a precipitable water content of 1.47 inches. The RAOB Analysis program supported the development of general thunderstorms in this environment, with the potential for outflow winds of 35 knots (based on the T2 Gust), with tops near 34,000 ft¹⁹. The maximum vertical velocity of the potential updrafts was calculated at 41 m/s (or 80 knots), or at 8,070 fpm. The storm motion was estimated from 320° at 17 knots and is depicted by the wind vector in the top left side of the diagram.

The HRRR wind profile indicated a surface wind from 330° at 6 knots with winds backing to the west with height with increasing wind speeds. The mean 0 to 6 km (or 18,000 ft) wind was from 290° at 22 knots. At the accident airplane's cruising altitude of 9,500 ft the HRRR sounding indicated a wind from 295° at 15 knots with a temperature of 5° C.

A table of the HRRR parameters below 12,000 ft of height, pressure, temperature (T), dew point temperature (Td), relative humidity (RH), wind, potential Clear Air Turbulence (CAT) intensity, and Low-Level Wind Shear (LLWS) based on the vertical wind shear is included below.

Height (ft-msl)	Pres (hPa)	T (°C)	Td (°C)	RH (%)	Wind (deg/kts)	CAT (FAA)	LLWS (FAA)
1,306	970	23.6	17.9	70	332/ 6		
1,336	969	23.4	17.5	69	331/ 6	LGT	LIGHT
1,425	966	23.0	17.6	72	331/ 9		
1,604	960	22.5	17.3	72	330/ 10		
1,843	952	21.6	17.2	76	329/ 11		
2,265	938	20.4	16.9	80	328/ 11		
2,815	920	19.3	15.5	79	326/ 12		
3,404	901	18.0	14.3	79	318/ 14		
4,131	878	16.6	13.2	80	314/ 15		
4,906	854	15.1	11.7	80	315/ 16		
5,798	827	13.3	10.0	80	316/ 16		
6,817	797	11.0	9.0	87	311/ 15		
7,972	764	8.4	7.3	93	301/ 14		
9,204	730	5.9	4.1	88	296/ 14		
10,636	692	3.0	1.5	90	295/ 16		LGT

4.0 Satellite Imagery

The NOAA Geostationary Operational Environmental Satellite number 16 (GOES-16) imagery were obtained from an archive at the Space Science Engineering Center (SSEC) at the University of Wisconsin-Madison in Madison, Wisconsin, and processed using the Man-computer Interactive Data Access System (McIDAS) software. The

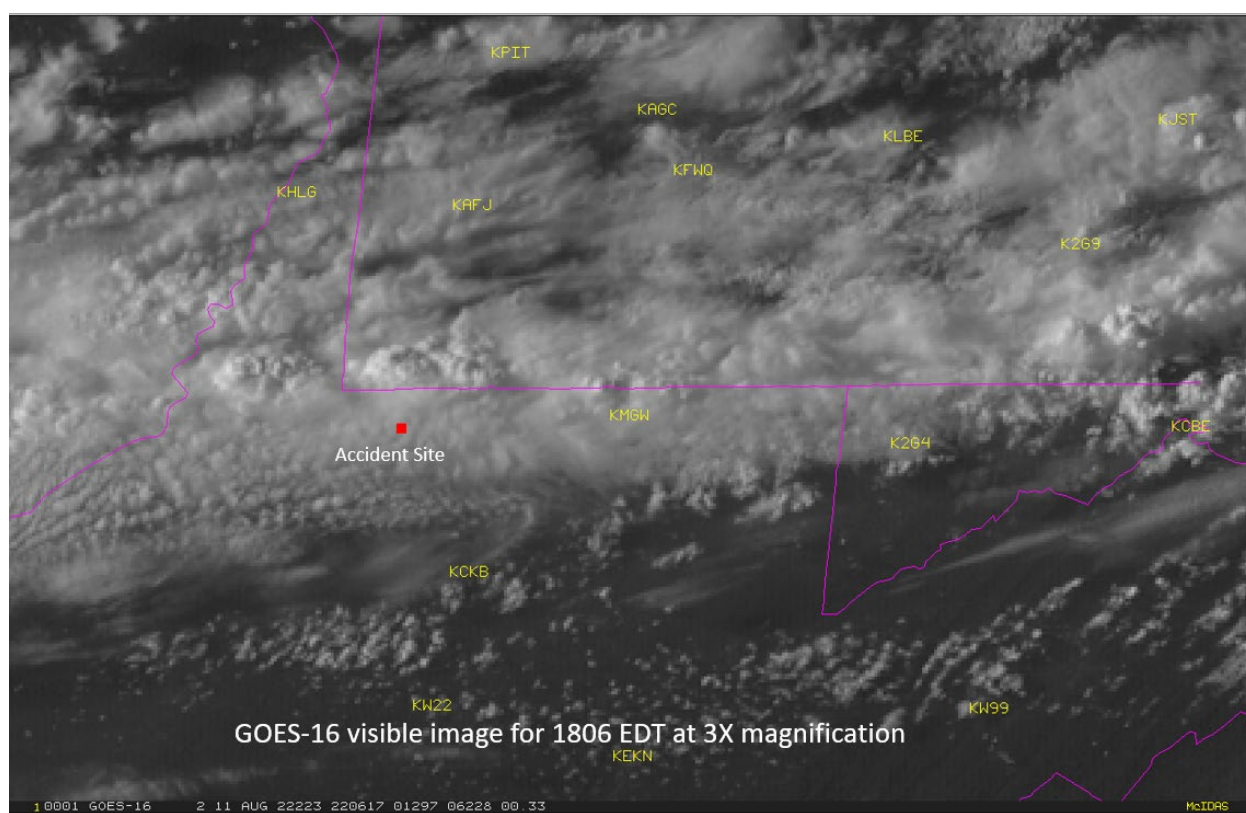
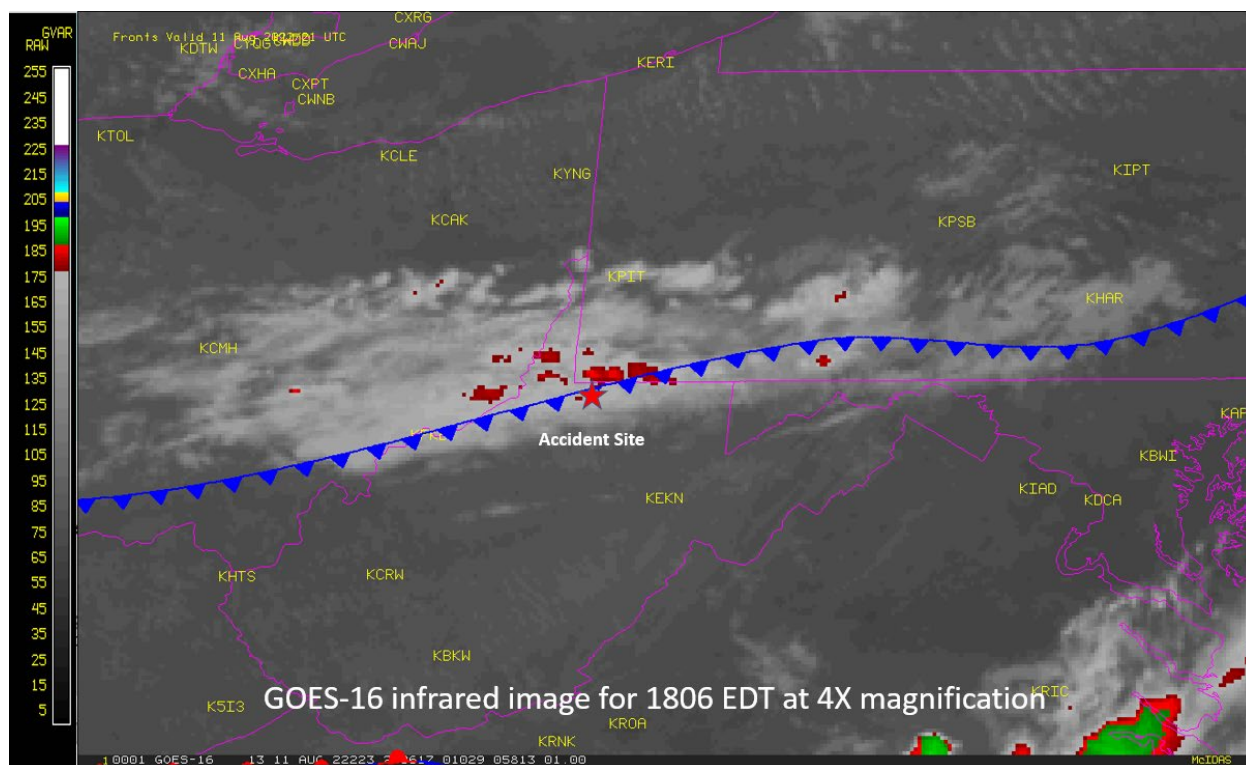
¹⁹ Based on the equilibrium level (LFC-EL).

infrared and visible imagery were reviewed surrounding the period, and the closest images to the accident time documented. The infrared long wave imagery (band 13) at a wavelength of 10.3 microns (μ m) provided radiative cloud top temperatures with a nominal spatial resolution of 2 km. The visible imagery (band 2) at a wavelength of 0.64 μ m provided images at a resolution of 0.5 km. The following satellite imagery have not been corrected for parallax error.

Figure 6 is the GOES-16 infrared image for 1806 EDT at 4X magnification with a standard MB temperature enhancement curve applied to highlight the higher colder clouds typically associated with deep convection. The accident site is marked by the red star, and the frontal positions from 1700 EDT. The image depicted the accident site in the vicinity of the cold front and a cumulonimbus cloud with a radiative cloud top temperature near 233 Kelvin or -40° C (red area immediately north of accident site), which corresponded to cloud tops near 34,000 ft based on the HRRR sounding. An animation of the cumulonimbus clouds indicated that they were moving east-southeastward with time.

The GOES-16 visible image for 1806 EDT at 3X magnification is included as figure 7 with the accident site marked by the red square. The accident site was located near the southern side of an embedded cumulonimbus cloud with vertical development immediately north of the accident site. Attachment 2 is the GOES-16 RGB²⁰ multichannel visible imagery between 1612 through 1902 EDT over the northeast showing the growth and movement of the cumulus clouds over the area surrounding the period of the accident.

²⁰ Red-green-blue (RGB) indication of the multichannel used to create the image in true colors.



5.0 Weather Radar Imagery

The closest Weather Surveillance Radar 1988 Doppler (WSR-88D) was located at the NWS Pittsburgh (KPBZ) Weather Forecast Office (WFO)²¹ approximately 55 miles north of the accident site. The level II and III archive data were obtained from the NCEI using the Hierarchical Data Storage System and displayed using the NWS NEXRAD Interactive Viewer and Data Exporter software. During the period the KPBZ WSR-88D was operating in the standard precipitation mode volume scanning pattern 215 (VCP-215) where the radar makes 15 different elevation scans during the 6-minute scan, which is depicted in figure 8.

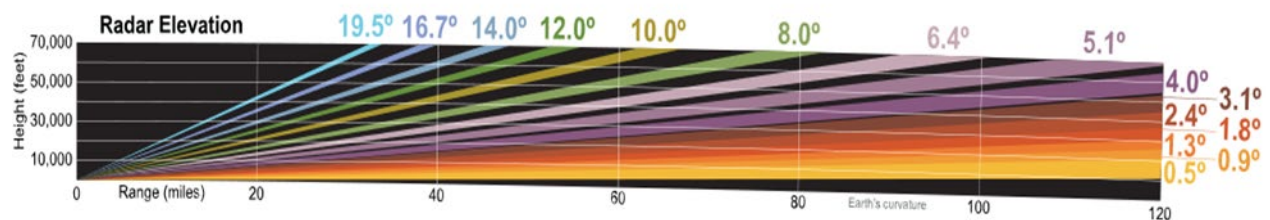


Figure 8 - VCP-215 scanning mode depiction.

5.1 Reflectivity Scales

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors²², 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)²³ and is a general measure of echo intensity of the precipitation within the cloud. Figure 9 relates the NWS video integrator and processor (VIP) intensity levels versus the WSR-88D's display levels, precipitation mode reflectivity in decibels, and rainfall rates²⁴.

²¹ The WSR-88D weather surveillance radar is often referred to as NEXRAD (Next generation RADar).

²² Hydrometeors are any product of condensation or sublimation of atmospheric water vapor, whether formed in the free atmosphere or at 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.

²³ dBZ stands for decibels relative to Z and is mathematically defined as $10 \log Z_e$, which is the logarithmic dimensional unit.

²⁴ Table based on NWS Operations Manual (WSOM), Appendix C, 96-6 with updated rainfall rates calculations.

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

Figure 9 - NWS VIP/DBZ Intensity levels, reflectivity, and rainfall rates.

Air traffic control (ATC) Air Route Traffic Control Center (ARTCC) weather display systems also use radar weather processors with the ability to determine precipitation intensity, with controllers instructed to describe the intensity to pilots based on the following table. One exception is that the ARTCC's weather and radar processor system does not display light intensity echoes below 30 dBZ. This table is also referenced for pilots in the FAA Advisory Circular AC 00-24C - "Thunderstorm" which defines echoes less than 30 dBZ as "light" in intensity, "moderate" echoes 30-40 dBZ, "heavy" with echoes of >40-50 dBZ, and "extreme" intensity with echoes above >50 dBZ. These are the standard radio phraseology terms used by air traffic controllers to describe weather conditions to pilots as shown in figure 10.

Reflectivity (dBZ) Ranges	Weather Radar Echo Intensity Terminology
< 30 dBZ	Light
30-40 dBZ	Moderate
>40-50 dBZ	Heavy
>50 dBZ	Extreme

Figure 10 - Reflectivity Intensity Terminology.

Based on the distance of 55 miles from the KPBZ WSR-88D antenna at a height of 1,266 ft, the radar's 1.36° beam was scanning the altitudes between 8,610 ft to 14,150

ft, with the center of the beam at approximately 11,380 ft over the accident site assuming standard refraction²⁵ of the beam.

5.2 Composite Reflectivity Imagery

The KPBZ WSR-88D composite reflectivity image for 1806 EDT is included as figure 11 with the flight track of N720RP overlaid. The composite radar image depicts the highest reflectivity value from all the elevation scans for the period in dBZ, with a resolution at 0.54 x 0.54 nm and provides a synopsis of the most important features in the entire vertical coverage area. The image depicts echoes²⁶ up to 58 dBZ along the flight track and over the accident site at the time of the accident. Echoes over 40 dBZ and greater extended between KMGW westward to Graysville, OH, just off the left of the image or for approximately 100 miles.

Figure 12 is the NWS KPBZ WSR-88D composite reflectivity image at 1748 EDT or approximately 20-minutes earlier. The future accident site is noted, while the accident airplane's position is off the left of the image at that time. The image depicted a gap of about 5 miles between two extreme intensity echoes in the vicinity of the accident site at that time.

²⁵ The refraction of the radar beam assuming a standard atmosphere, where the refractive index is reduced uniformly with height.

²⁶ Echo - Energy back scattered from a target (precipitation, clouds, etc.) and received by and displayed on a radar screen.

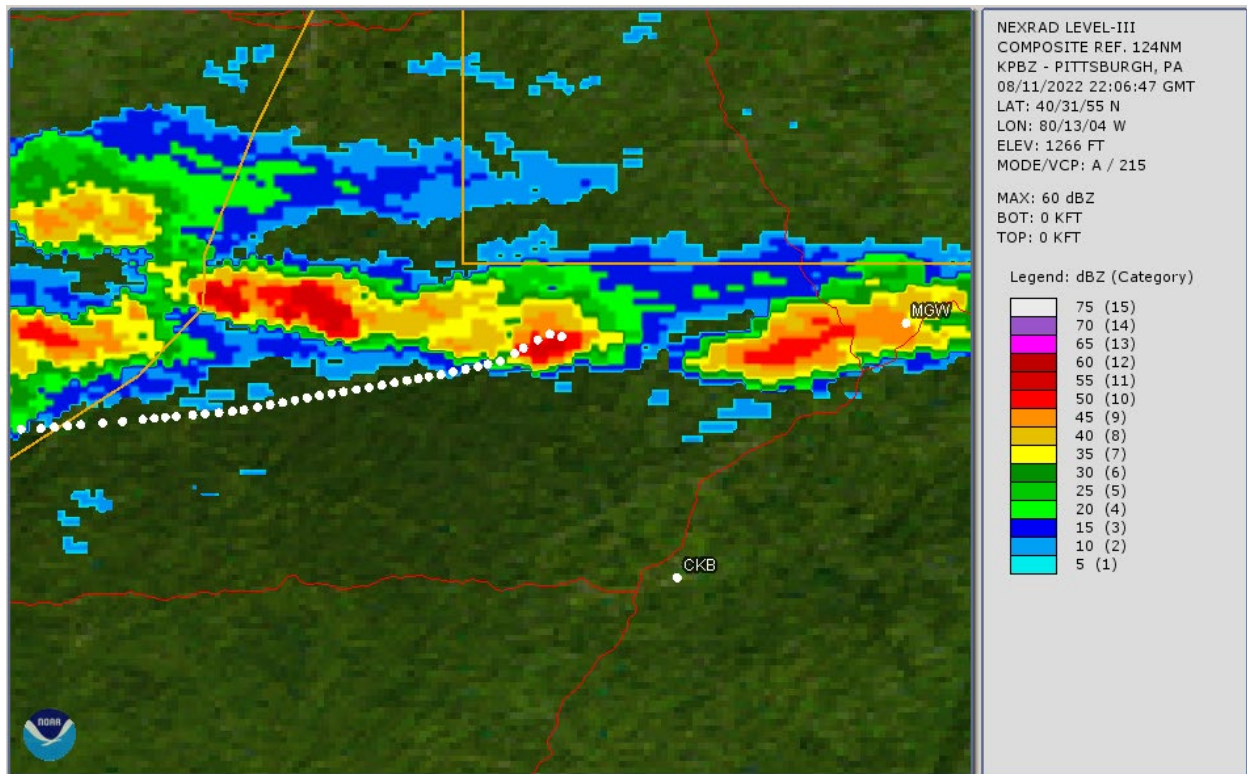


Figure 11 - KPBZ WSR-88D composite radar image for 1806 EDT with flight track.

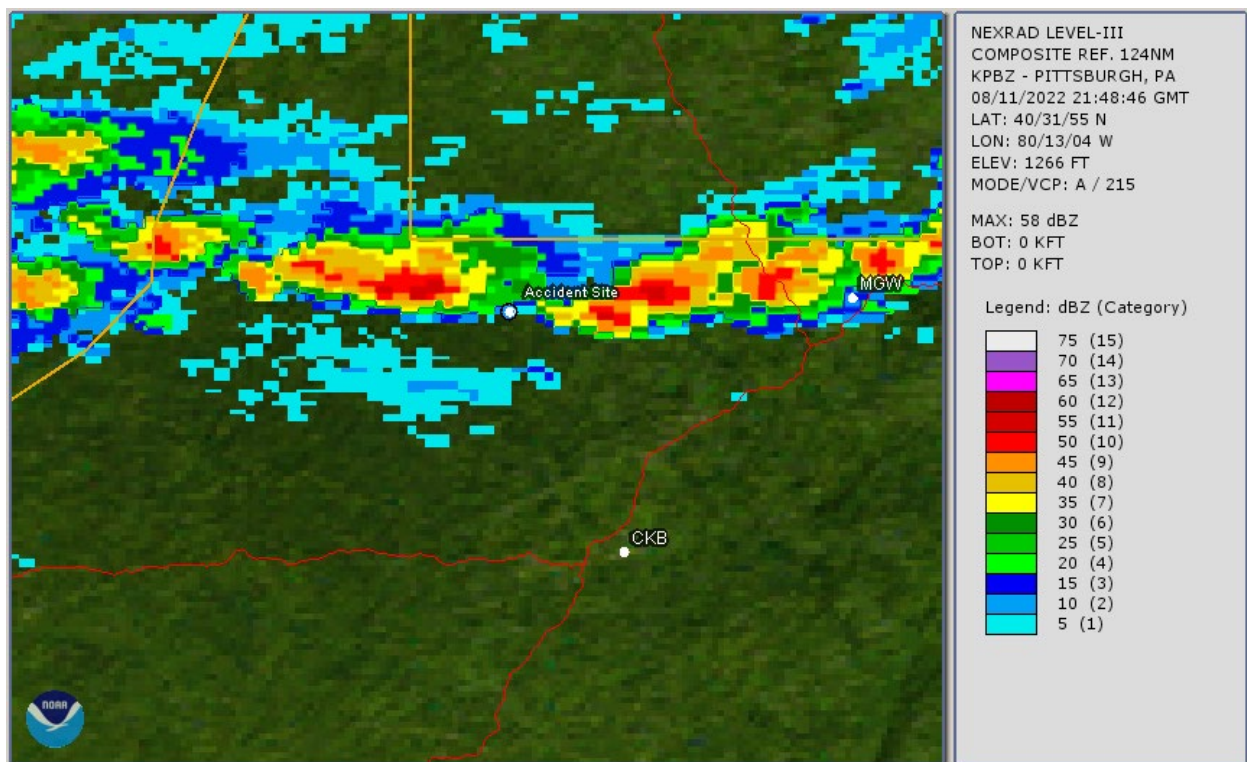


Figure 12 - KPBZ WSR-88D composite radar image for 1748 EDT showing a gap in echoes in the vicinity of the accident site.

5.3 Base Reflectivity Imagery

The KPBZ WSR-88D 1.36° base reflectivity imagery depicting the conditions at the accident aircraft's cruising altitude for 1753, 1757, 1802 and 1806 EDT are included as figures 13 through 16, with resolutions of 0.5° x 0.25 km (0.13nm) over the area with the flight track overlaid. The higher resolution base reflectivity images depicted echoes up to 62 dBZ over the flight track and 50 dBZ extreme intensity over the accident site between 1802 and 1806 EDT. The echo tops²⁷ product depicted echoes of 18.5 dBZ near 23,400 ft over the accident site, with higher tops near 35,000 ft approximately 14 miles west in the other area of extreme intensity echoes.

An animation of the KPBZ WSR-88D 1.36° base reflectivity imagery from 1735 through 1815 EDT is included as attachment 3, which shows the growth and decay of the echoes as they move east-southeastward across the accident site.

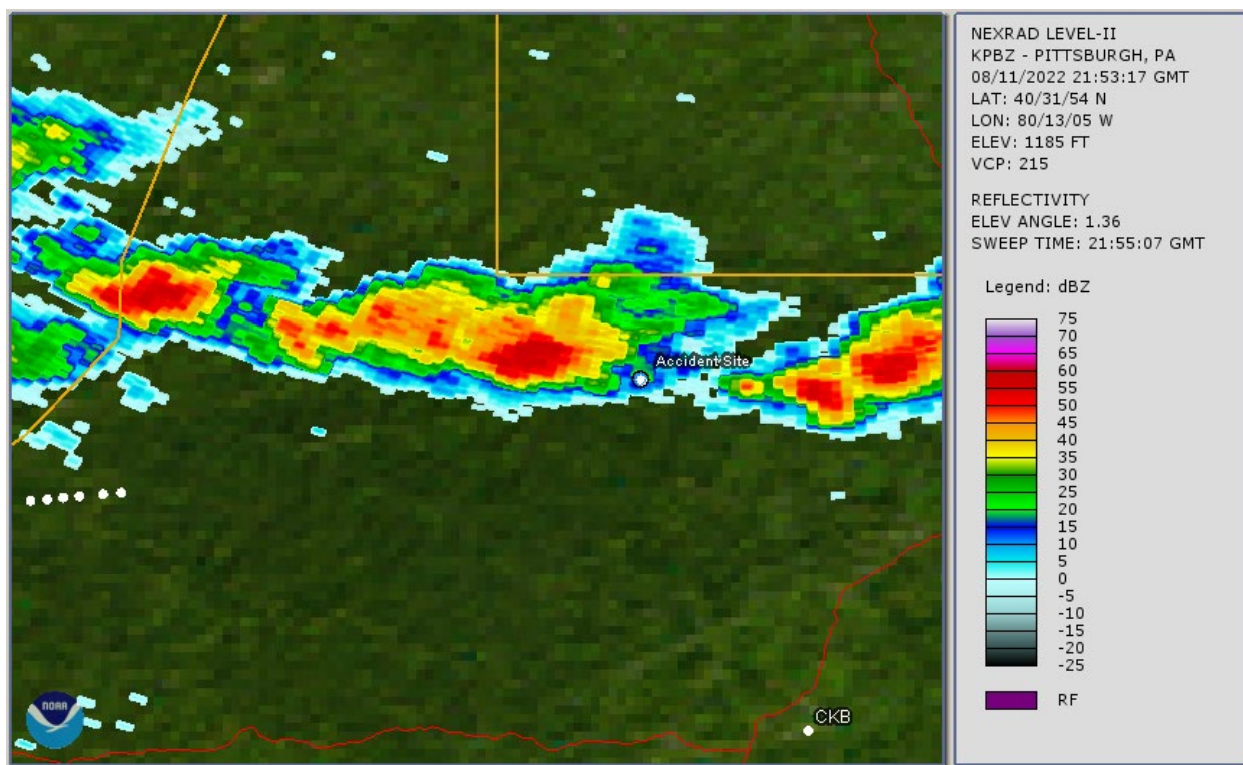


Figure 13 - KPBZ WSR-88D 1.36° base reflectivity image at 1753 EDT with flight track.

²⁷ Echo Tops - The height above ground of the center of the radar beam using the tilt, or scan, that contains the highest elevation where reflectivities greater than 18 dBZ can be detected.

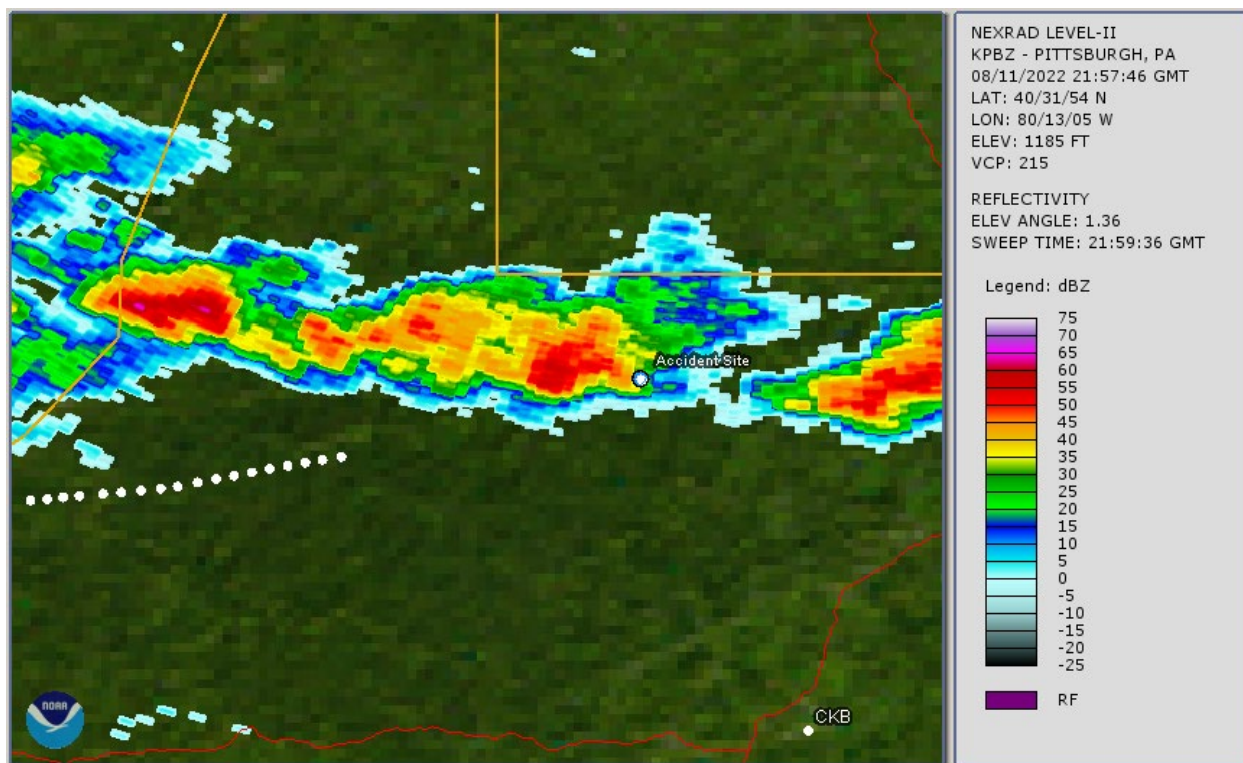


Figure 14 - KPBZ WSR-88D 1.36° base reflectivity image at 1757 EDT with flight track.

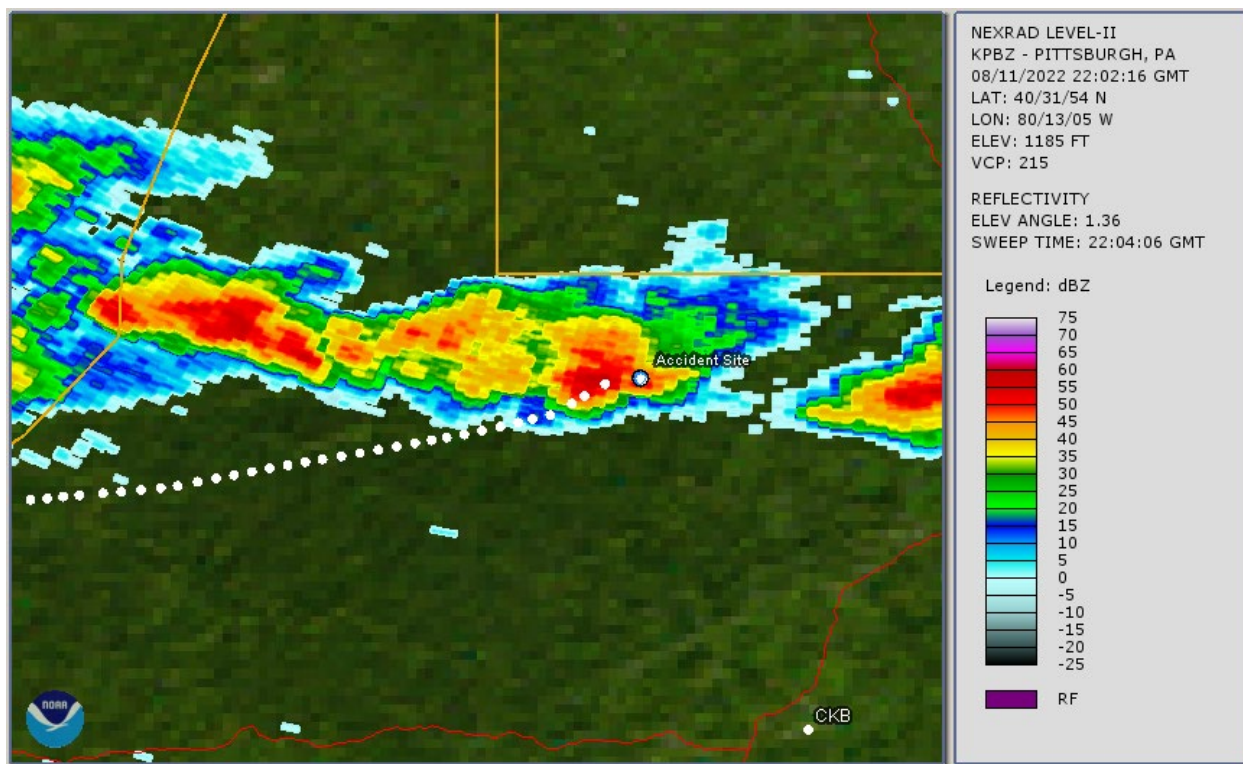


Figure 15 - KPBZ WSR-88D 1.36° base reflectivity image at 1802 EDT with flight track.

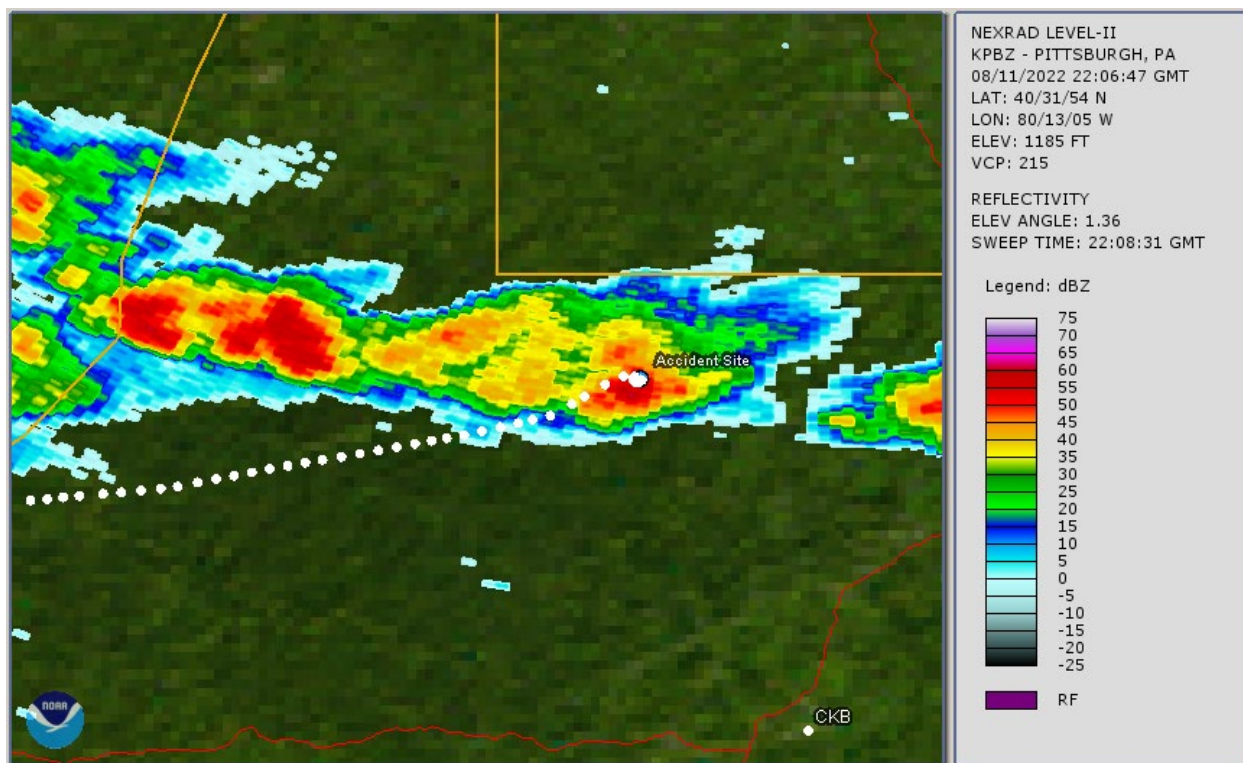


Figure 16 - KPBZ WSR-88D 1.36° base reflectivity image at 1806 EDT with flight track.

A cross section of the echoes along the approximate flight track at 1802 and 1806 EDT are included as figures 17 and 18 using the GR2 Analysis software, with the approximate flight track at 9,500 ft. The images depicts a defined area of echoes aloft on the southern side of the echoes associated with an updraft region and a bounded weak echo region²⁸, with the maximum reflectivity core of 58.5 to 62 dBZ extreme intensity located along the flight track and in the immediate vicinity of the accident site. The echo tops of 18.5 dBZ were in the range of 23,000 ft with detectable echoes near 28,900 ft over the accident site at 1802 EDT, which decreased at 1806 EDT. Both images confirm that the accident airplane had penetrated an area of extreme intensity precipitation at the time of the inflight breakup. A review of the air traffic control track data indicated that the accident airplane was in cruise flight at 9,500 ft undisturbed until 1802:16 when it entered into the area of strong echoes and when it's altitude increased to 9,700 ft, then descended back to 9,500 ft and then flucated between 9,400 and 9,300 ft and then descended to 7,200 ft at the last radar contact at 1803:10 EDT.

²⁸ Bounded Weak Echo Region (BWER) - (Also known as a vault.) Radar signature within a thunderstorm characterized by a local minimum in radar reflectivity at low levels which extends upward into, and is surrounded by, higher reflectivities aloft. This feature is associated with a strong updraft and is almost always found in the inflow region of a thunderstorm. It cannot be seen visually.

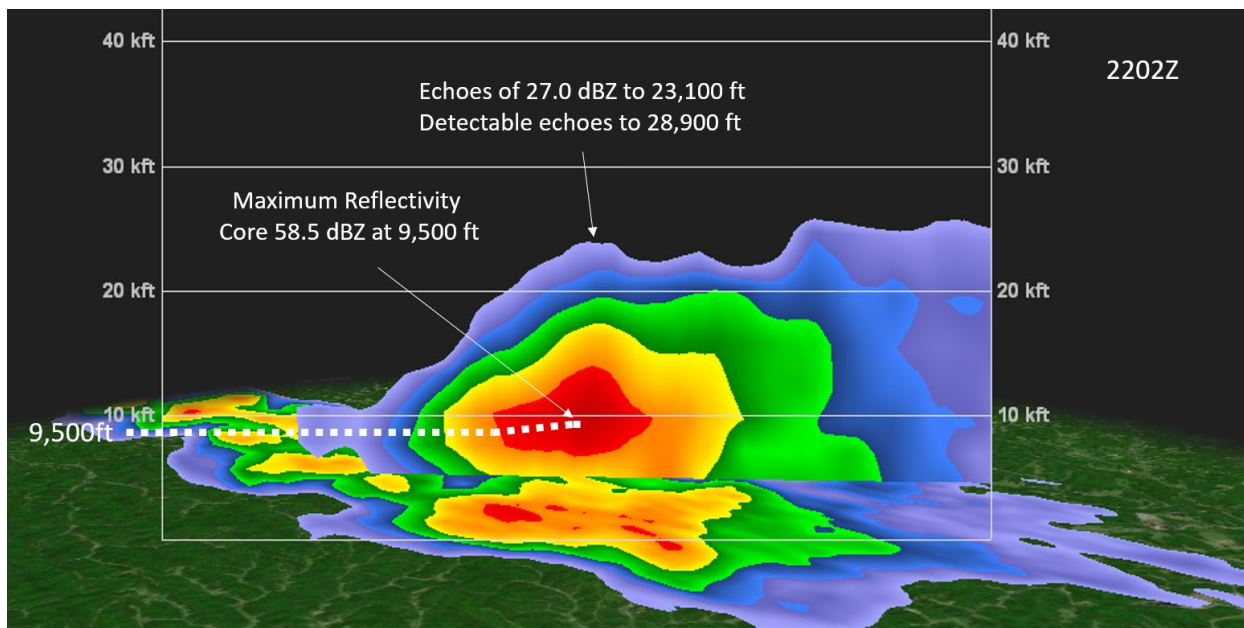


Figure 17 - GR2 Cross section along the flight track at 1802 EDT.

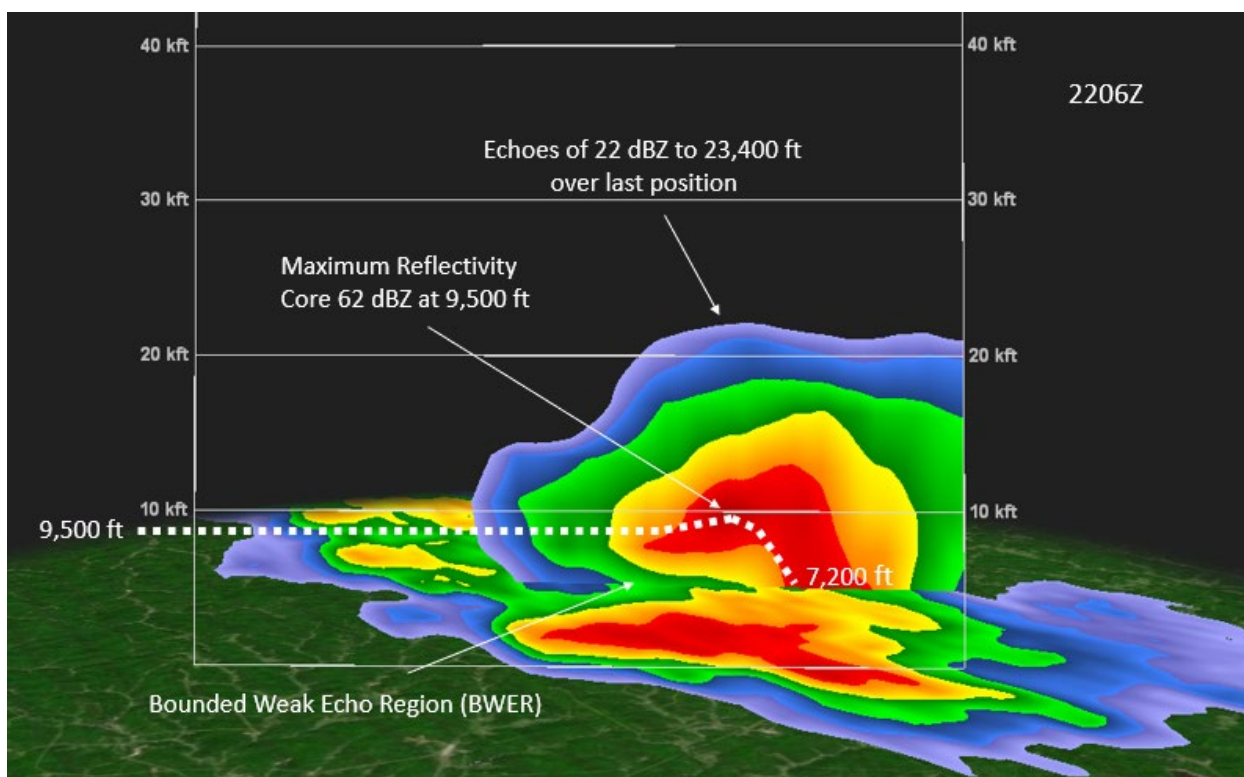


Figure 18 - GR2 Cross section along flight path at 1806 EDT.

5.4 Lightning Data

A review of Earth Networks archives for lightning data between 1715 and 1815 EDT on August 11, 2022, is included as figure 19, with a close up in figure 20. A high frequency of in-cloud lightning (purple) associated with several of the areas of echoes, and cloud-to-ground lightning (yellow) were depicted over the area, which confirmed that the area of precipitation was associated with a cumulonimbus cloud. The accident site was located on the eastern side of one of the clusters of lightning, with several cloud-to-ground lightning strikes confirmed within 3 miles of the accident site and multiple in-cloud strokes within a mile of the flight path immediately prior to the accident.

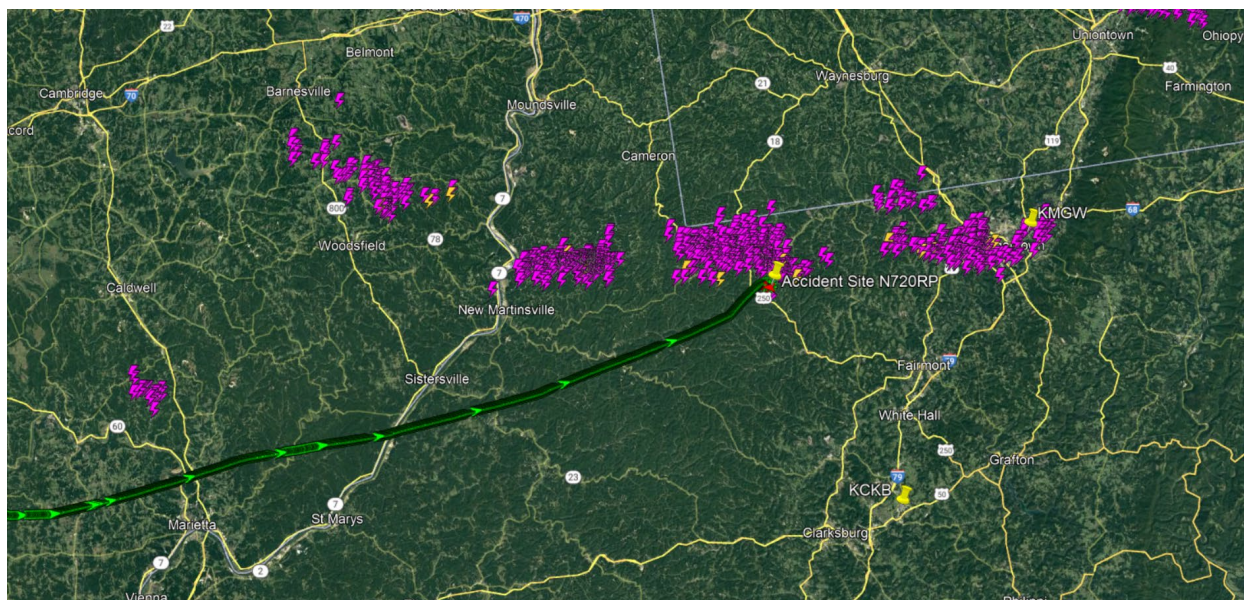


Figure 19 - Earth Networks display of cloud-to-cloud (purple lightning symbols) and cloud-to-ground lightning (yellow lightning symbols) between 1715 and 1815 EDT with the accident site and KMGW and KCKB indicated by the yellow pin and the flight track by the green line.

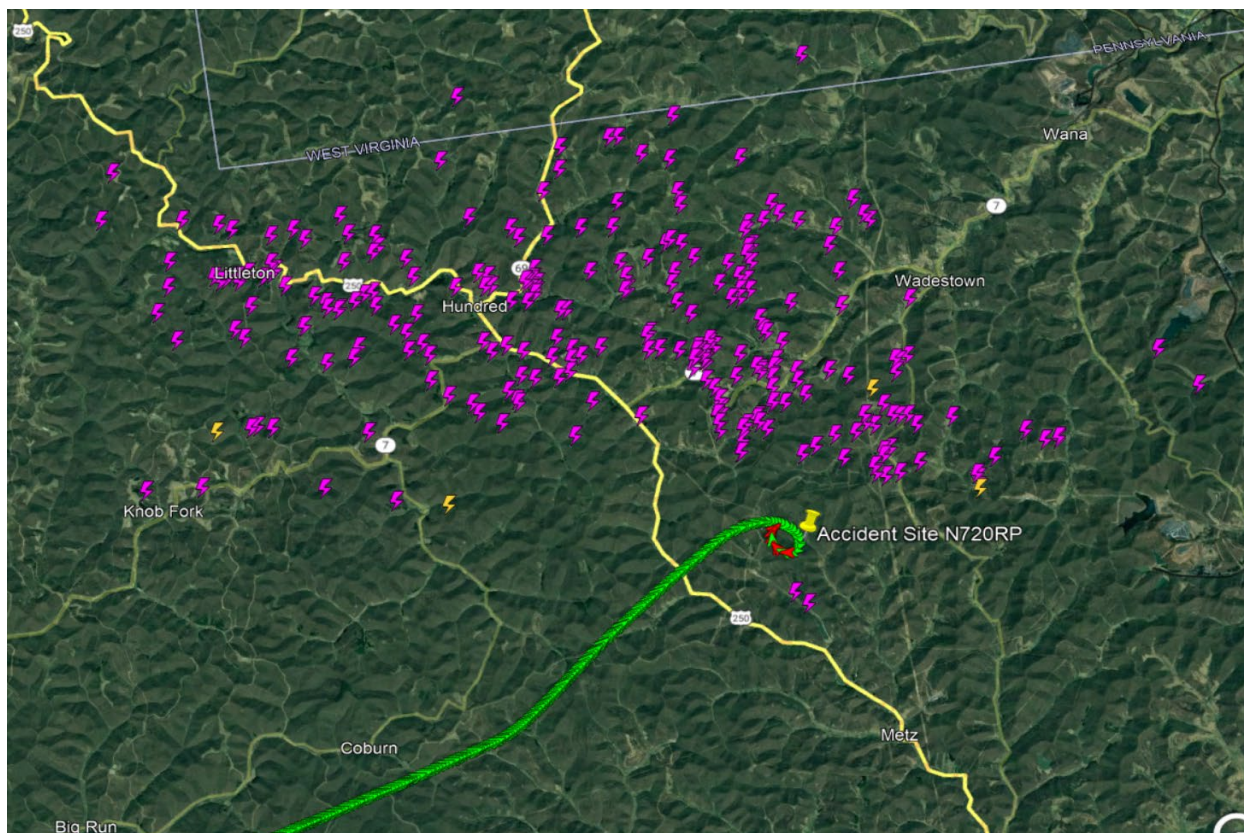


Figure 20 - Close-up of the Earth Networks Lightning and the accident airplanes flight track.

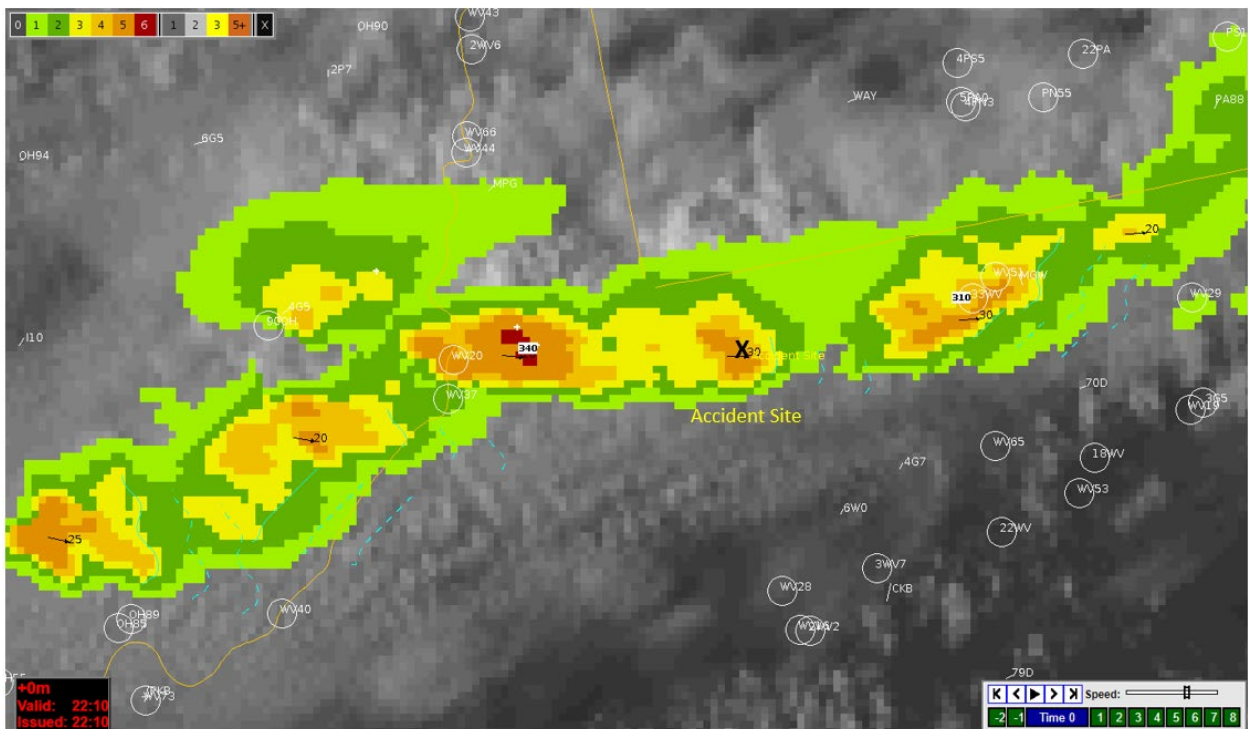
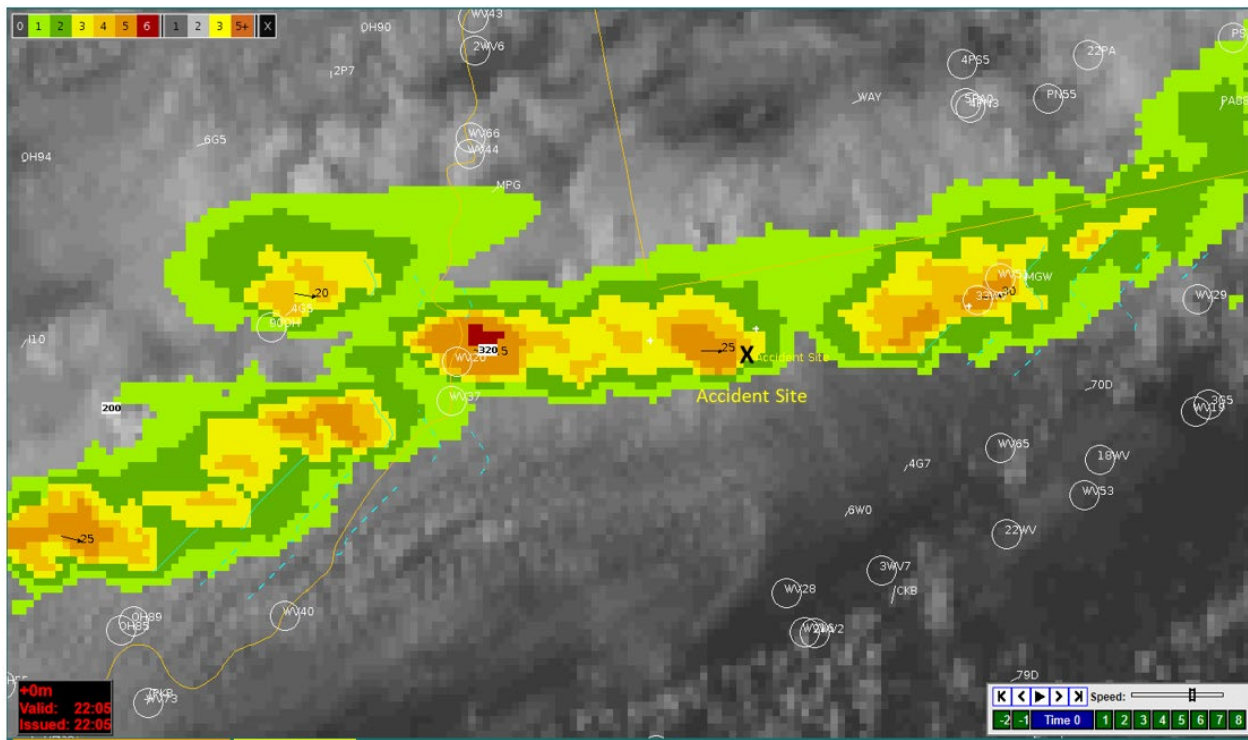
5.5 Consolidated Storm Prediction for Aviation

The FAA Consolidated Storm Prediction for Aviation (CoSPA) weather display, which integrates several of the NWS and FAA weather systems into a single display were also documented. The CoSPA system also integrates lightning, and convective initiation and growth into a display. These images were available in the Cleveland (KZOB) Air Route Traffic Control Center (ARTCC) at various positions. The CoSPA display is of vertical integrated liquid (VIL) and not reflectivity. VIL is the vertical estimation of the mass of water, or liquid water content in a column of air. VIL uses the full volume scan of all the elevation scans and looks similar to reflectivity images. The VIL levels 1 through 6 correspond to the following table.

VIP or VIL Levels	VIL (digital VIL)	VIL (kg/m ²)	Past and Current VIL
1	16	0.15	Level 1
2	74	0.76	Level 2
3	133	3.47	Level 3
4	160	6.92	Level 4
5	181	12.0	Level 5
6	219	31.6	Level 6

The CoSPA images at 1805 and 1810 EDT are depicted as figures 21 and 22, respectively with the accident site noted by an "X" and overlaid on the GOES visible satellite image for the period. The intensity of the echoes are marked in VIP²⁹ or VIL levels 1 through 6 in various colors. Also included are the echo tops or the highest detection of 18 dBZ in hundreds of feet, cell movement indicated by a black arrow with the speed in knots, cloud-to-ground lightning strikes with the white "+" symbols from the National Lightning Detection Network (NLDN), and the 2-hour storm movement prediction. The CoSPA images at 1605 and 1610 EDT depicted a line of convective echoes moving eastward at 20 to 25 knots with a VIL Level 4 to 5 echo over the accident site during the period. The maximum VIL Level 6 echo was identified about 20 miles west of the accident site with maximum echo top near FL320, similar to that detected in section 5.2 above. Several cloud-to-ground lightning strikes were also depicted at 1805 EDT image along the line of echoes and in the vicinity of the accident site.

²⁹ Video Integrated Processor (VIP)



6.0 Pilot Reports

A search of the NWS database for any relevant pilot reports or PIREPs³⁰ immediately surrounding the period, provided the following reports within 120 miles of the accident site from 1400 through 2000 EDT. The reports are in standard code and format as received and include only those reports disseminated longline.

LOZ UA /OV RNL/TM 1800/FL160/TP P51/SK SKC/TB NEG
AGC UA /OV 5E KAGC/TM 1835/FLDURD/TP BE58/SK BASES RAGGED 038/TB LGT CHOP BELOW BASES
ZZV UA /OV ZZV/TM 1934/FL280/TP A320/TA M32/TB NEG/IC NEG
ZZV UA /OV ZZV/TM 2019/FL250/TP C56X/TB NEG
ZZV UA /OV ZZV/TM 2104/FL240/TP LJ70/SK TOP320-270
HTS UA /OV EKN260020/TM 2106/FL280/TP B737/TB NEG /IC NEG
CRW UA /OV HVQ/TM 2218/FL380/TP C560/TB OCNL MOD CHOP
CDI UA /OV CDI/TM 2224/FL240/TP A320/SK IMC/TB NEG
HGR UA /OV HGR280010/TM 2316/FL140/TP B58T/TA 0/IC LGT RIME=
PKB UA /OV JPU340018/TM 2335/FL210/TP PC12/TA M14/IC LGT MX

Several of the PIREPs indicated light rime to mixed icing above 14,000 ft, with a Lear Jet over Zanesville, OH, at 1710 EDT reporting cloud tops between 27,000 to 32,000 ft. There were no urgent PIREPs noted during the period or other reports of any severe turbulence or convection noted.

7.0 NWS Forecasts and Advisories

The applicable NWS forecast products issued surrounding the period are documented below.

7.1 Terminal Aerodrome Forecast

The NWS KPBZ WFO was responsible for the issuance of the Terminal Aerodrome Forecast (TAF) for KMGW, the closest station to the accident site. While a TAF is valid for a 5 mile radius of the airport's center point, pilot's will often review the TAFs along their general route of flight for a review of the forecast of conditions enroute. The forecast current at the time of the accident was issued at 1320 EDT and valid for a 24-hour period. The section highlighted in bold italic type was the section of the forecast current at the time of the accident.

TAF KMGW 111720Z 1118/1218 31005KT P6SM SCT035

³⁰ Includes PIREPs making into the NWS database and may not include "ride reports" or other reports made on radio frequency to air traffic control and not formally entered as a PIREP into the national database.

FM112100 30006KT P6SM BKN045
TEMPO 1121/1201 6SM -TSRA BKN035CB
FM120400 00000KT P6SM SKC
FM121500 01005KT P6SM SKC=

The forecast current at the time of the accident for KMGW expected from 1700 through 2400 EDT the wind from 300° at 6 knots, visibility better than 6 miles, with a ceiling broken at 4,500 ft agl, with a temporary period³¹ between 1700 and 2100 EDT of visibility 6 miles in thunderstorms and light rain, with a ceiling broken at 3,500 ft agl in cumulonimbus clouds.

7.2 Area Forecast Discussion

The NWS Area Forecast Discussions (AFD) are issued by each WFO to describe the short-term weather conditions within their region with an aviation section that includes the general conditions as they relate to the creation of the TAF. These are useful for additional aviation-related issues that cannot be encoded into the TAF and provide some reasoning behind the forecast. These are generated roughly every 6 hours and correspond to the release of the latest TAFs for that office. The AFD short term, and aviation sections issued by the KPBZ WFO at 1156 EDT was as follows.

FXUS61 KPBZ 111556
AFDPBZ

Area Forecast Discussion
National Weather Service Pittsburgh PA
1156 AM EDT Thu Aug 11 2022

.SYNOPSIS...

Isolated showers and thunderstorms are expected this afternoon with a cold front. Dry weather is then expected through Saturday under high pressure.

.NEAR TERM /THROUGH TONIGHT/...

A cold front will bring nwly flow aloft, allowing for convection to develop this afternoon and evening. Given lack of boundary layer moisture and instability, severe weather is not anticipated but a few showers and t storms cannot be ruled out.

Behind the boundary, expect dew points to drop as well as temperature. This will provide a nice change of pace for the overnight. Patchy fog is possible particularly in the ridges where temperature drops closer to dewpt.

.SHORT TERM /FRIDAY THROUGH SATURDAY NIGHT/...

High pressure with cool, nwly flow will prevail through Saturday night with early Fall like temperature in the 70s and lows in the 50s.

³¹ Temporary period implies a greater than 50% probability of occurrence, with conditions lasting at least 30-minutes, but less than half of the period.

A shortwave coming down from the Great Lakes may provide a brief rain chance on Saturday night.

.AVIATION /16Z THURSDAY THROUGH MONDAY/...

A crossing cold should support iso shra/tsms development this afn, with low confidence on direct terminal impacts provided anticipated iso coverage due to lack of boundary layer moisture and instability. Predominant VFR should prevail during this timeframe, with gusty nwly wind accompanying that cold front passage. Building high pressure should support high confidence VFR thereafter.

.Outlook...

VFR conditions are expected through Saturday under the influence of high pressure. Periodic thunderstorms chances are expected early next week.

.PBZ WATCHES/WARNINGS/ADVISORIES...

PA...None.

OH...None.

WV...None.

7.3 Graphic Forecast for Aviation

The NWS Graphic Forecast for Aviation (GFA) is a graphical depiction of surface wind, thunderstorms, precipitation, color coded general flight categories, and cloud cover bases and tops, from graphical output from the NWS's National Digital Forecast Data (NDFD) with the Graphic-Airmen's Meteorological Information (G-AIRMET)³² for IFR conditions, mountain obscuration, icing conditions, and strong surface wind overlaid. The GFA provides a forecast for the enroute phase of flight and for locations without a TAF. The GFA is available at the NWS AWC website and through other weather briefing services.

The east-central GFA 3-hour surface and cloud forecasts issued around 1500 EDT and valid for period from 1800 EDT are included as figures 23 and 24, respectively. The surface forecast expected wind from the northwest at 5 knots, visibility unrestricted, with a chance of isolated thunderstorms, with a 10-20% probability of occurrence. The chart depicted no G-AIRMETs for IFR or strong gusting wind conditions over the region during the period. The GFA cloud forecast a few clouds at 6,000 ft msl with broken clouds at 9,000 to 11,000 ft over Ohio and southern Pennsylvania. A G-AIRMET for mountain obscurations conditions extended well south of the route of flight over southern West Virginia, Virginia, eastern Kentucky, Tennessee, the western Carolina's, and northern Georgia.

³² AIRman's METeorological Information (AIRMET) is a concise description of weather phenomena that are occurring or may occur (forecast) along an air route that may affect aircraft safety. Compared to SIGMETs, AIRMETs cover less severe weather: moderate turbulence and icing, sustained surface winds of 30 knots or more, low-level wind shear, or widespread restricted visibility.

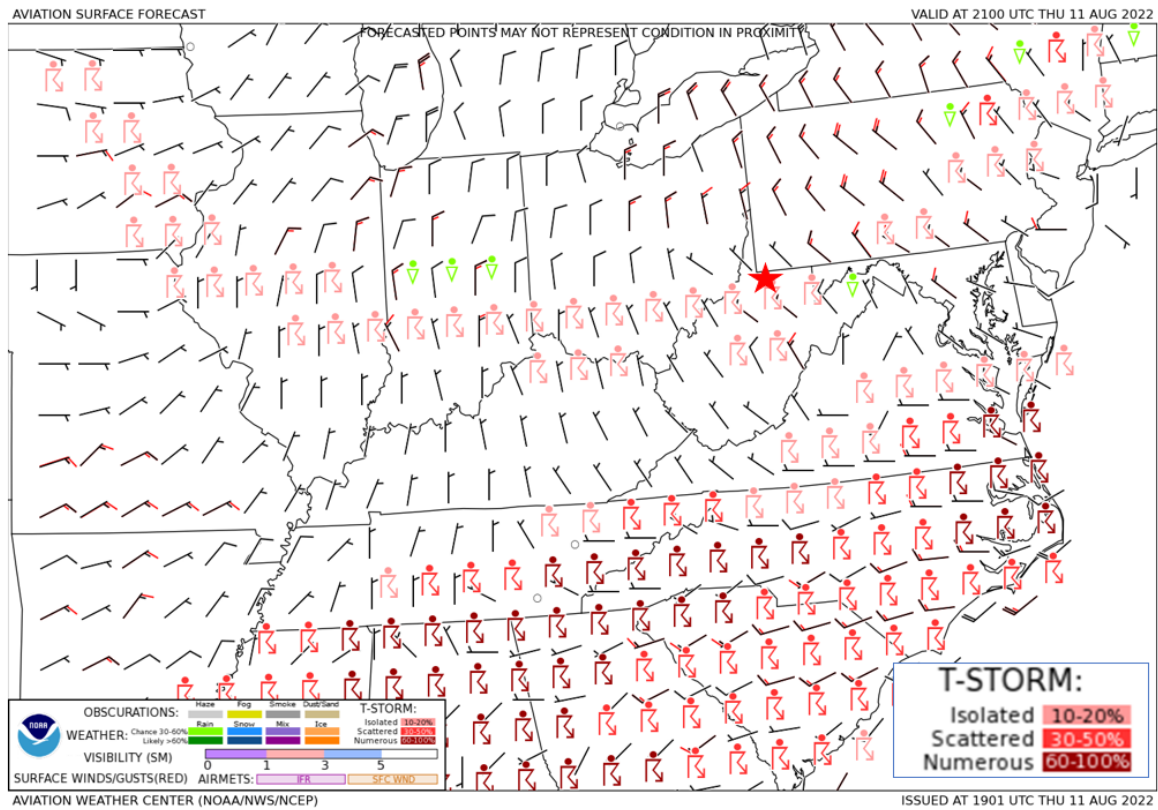


Figure 23 - GFA 3-hour Surface Forecast valid for 1800 EDT.

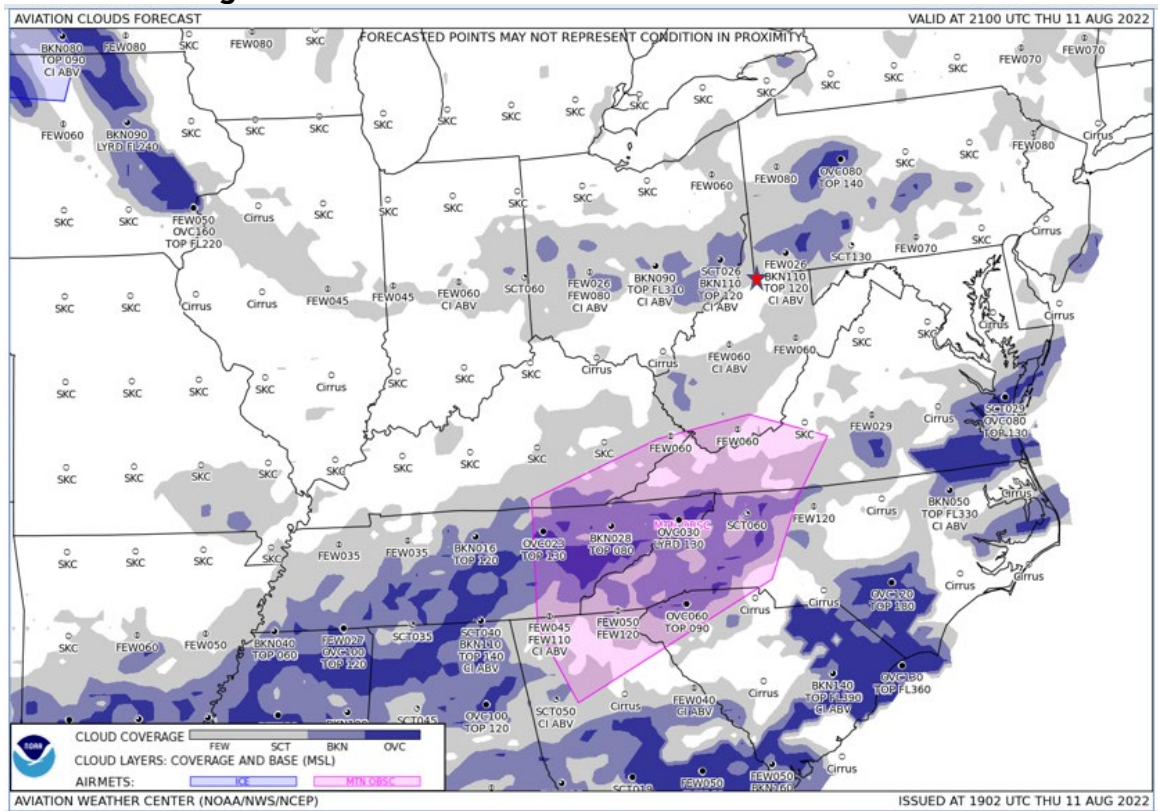


Figure 24 - GFA 3-hour Cloud Forecast valid for 1800 EDT.

7.4 Traffic Flow Management (TFM) Convective Forecast (TCF)

The Traffic Flow Management (TFM) Convective Forecast (TCF) is a high confidence graphical representation of forecast convection meeting specific criteria of coverage, intensity, and echo top height. The TCF is issued collaboratively by meteorologists at the NWS AWC, the FAA Command Center in Warrington, VA, Center Weather Service Units (CWSU) at the various FAA ARTCCs, and at various airlines and is graphically available on the NWS AWC website³³. The TCF is issued every 2 hours and valid for a 4-, 6-, and 8-hours after issuance time. Areas of convection in the TCF include a composite radar reflectivity of at least 40 dBZ, echo tops at or above FL250³⁴, coverage of 75% or greater of the area, and a forecaster confidence of at least 50% that the 3 elements of coverage, intensity, and tops will be met. For lines of convection the radar reflectivity of 40 dBZ having a length of at least 100 miles, with a similar coverage of 75% or greater, echo tops above FL250, and forecaster confidence criteria being met. The purpose and intent of the TCF is to provide air traffic control a common forecast baseline of forecast convection for strategic planning and decisions affecting the National Airspace System.

A review of the TCF forecast from the period from 2 hours prior to N720RP's departure through the time of the accident indicated that there was a low confidence of convection forming over the route of flight or the accident site that met the criteria. Figure 25 is the TCF forecast issued at about 1300 EDT with the 4-hour forecast valid for 1700 EDT, 6-hour forecast for 1900 EDT, and 8-hour forecast valid for 2100 EDT and depicted no convection meeting the criteria expected over the region surrounding the period.

A review of the NWS KZOB CWSU ATC Pre-Duty Weather Briefing (PDWB) recordings for the morning, afternoon, and evening shifts indicated that the cold front moving southward across the area was mentioned with a chance of precipitation and thunderstorms. The morning briefing identified the potential for "isolated" thunderstorms along the front, the afternoon shift briefing as "widely scattered", and the evening briefing issued immediately prior to the accident as the current thunderstorms will be over after 2000 EDT or "not a factor" during shift. The briefings are included as attachments 4-6.

³³ <https://www.aviationweather.gov/tcf>

³⁴ FL250 is 25,000 ft as expressed as Flight Level (FL) and is referenced to an aircraft's altitude based on standard sea-level pressure, or pressure altitude expressed in hundreds of feet and is typically used above 18,000 ft.

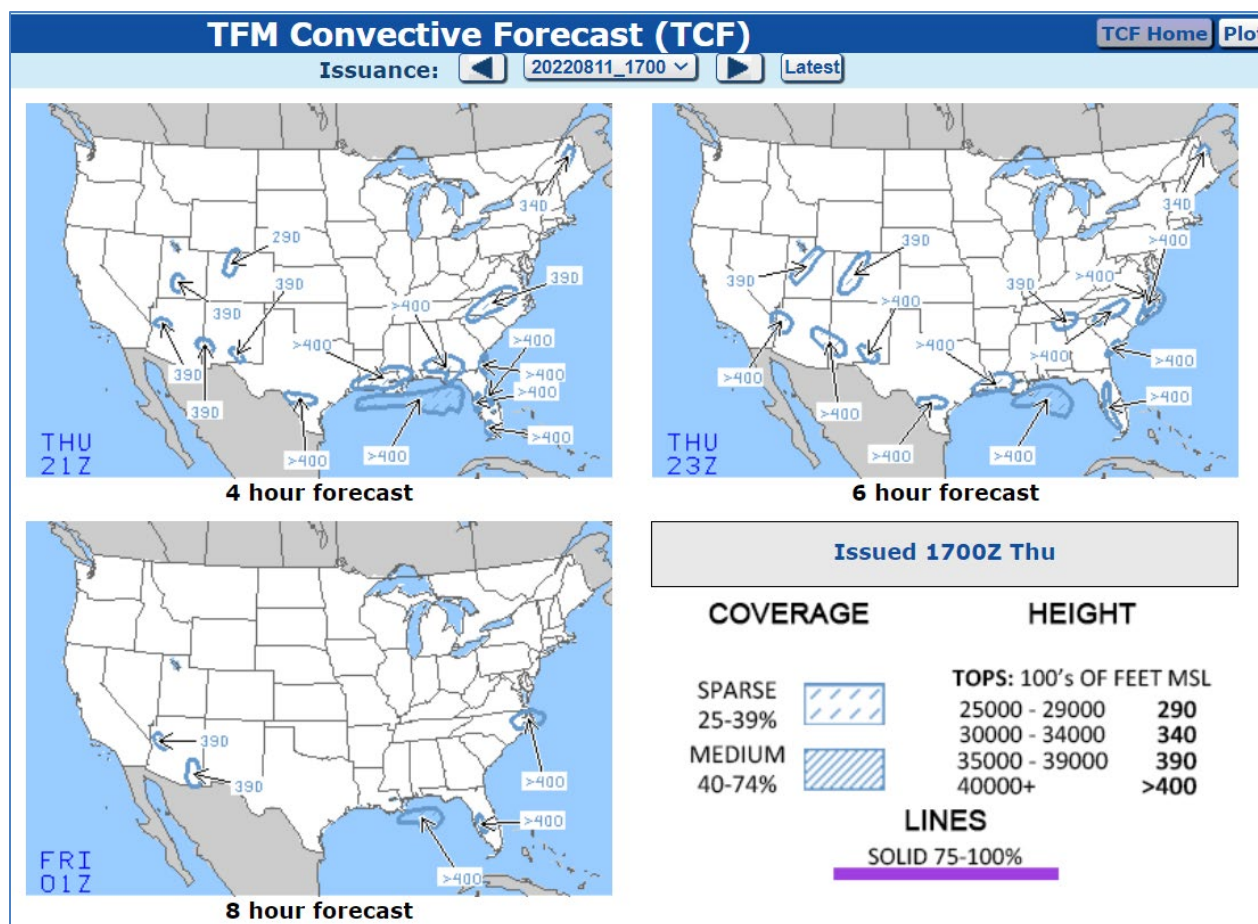


Figure 25 - TCF current prior to departure for convection at 1700-, 1900-, and 2100 EDT

7.5 Winds and Temperature Aloft Forecast

The NWS Winds and Temperature Aloft Forecast current during the period for the general route of flight issued at 1600 EDT was as follows. The closest forecast station to the accident site was for Elkins, WV (EKN) approximately 45 miles south of the accident site, which is indicated in red type.

FBUS31 KWNO 112000

FD1US1

-DATA BASED ON 111800Z

VALID 120000Z FOR USE 2000-0300Z. TEMPS NEG ABV 24000

FT	3000	6000	9000	12000	18000	24000	30000	34000	39000
-EVV	3611	0117+17	3519+11	3526+05	3236-06	3241-17	324433	314544	325155
-IND	0320	3414+12	3220+10	3229+04	3142-10	3163-20	318434	318444	318053
-CVG	3613	3407+13	3110+08	3118+04	3042-09	3060-20	307434	307445	307053
-CMH	0218	3512+11	2813+06	2823+01	2936-12	2946-22	296137	297244	297950
-AGC	3516	3214+11	2916+05	2822+02	2837-12	2750-23	275838	276745	276848
-EKN		3209+12	3008+07	2915+02	2831-10	2751-21	276535	276644	275151
-PSB		3412+11	2920+05	2723+00	2736-12	2653-24	265738	266346	256748
-EMI	3211	3211+14	3208+07	2818+01	2730-10	2651-21	255935	256343	245652

The EKN forecast current between 1600 through 2300 EDT, expected a wind at 6,000 ft from 320° at 9 knots with a temperature of 12° C, at 9,000 ft a wind from 300° at 8 knots with a temperature of 7° C, and at 12,000 ft a wind from 290° at 15 knots with a temperature of 2° C.

7.6 Inflight Weather Advisories

Inflight Aviation Weather Advisories are forecasts to advise en route aircraft of the development of potentially hazardous weather. Inflight aviation weather advisories in the conterminous U.S. are issued by the NWS AWC, as well as from the CWSU at the various ARTCCs. There are four basic types of inflight aviation weather advisories: the Significant Meteorological Information (SIGMET), the Convective SIGMET, the AIRMET, and the Center Weather Advisory (CWA). Inflight advisories serve to notify en-route pilots of the possibility of encountering hazardous flying conditions which may not have been forecast at the time of the preflight briefing. Whether or not the condition described is potentially hazardous to a particular flight is for the pilot to evaluate based on experience and the operational limits of the aircraft. Once issued they are broadcast by FAA controller upon issuance and available on inflight weather broadcasts.

On August 11, 2022, the NWS had issued several advisories prior to the accident in the form of a CWA and Convective SIGMET, which are documented below. There were no AIRMETs current over the route or accident site for any IFR conditions outside of convective activity, mountain obscuration, turbulence, or icing conditions surrounding the period.

7.6.1 Center Weather Advisories

The NWS KZOB CWSU issued one of the first advisories at about 1530 EDT for the convection over their airspace in the form of a CWA, which was as follows.

*FAUS21 KZOB 111931
ZOB1 CWA 111932
ZOB CWA 101 VALID UNTIL 112015
FROM 10NNW AIR-25NE JST
LINE EMBD TS 10NM WIDE MOV FROM 30020KT. TOPS TO FL290 WITH MOD/HVY
RAIN. TREND...LITTLE CHG. OH PA WV*

While the CWA was only current for approximately 45 minutes or until 1615 EDT, the advisory warned of a line of embedded thunderstorms 10 miles wide moving southeastward at 20 knots. The tops were to FL290 with the area associated with moderate to heavy rain. The trend expected little change in intensity, which were expected to continue to impact sections of Ohio, Pennsylvania, and West Virginia. A

depiction of the advisory over the GOES-16 visible satellite image for the time is included as figure 26.

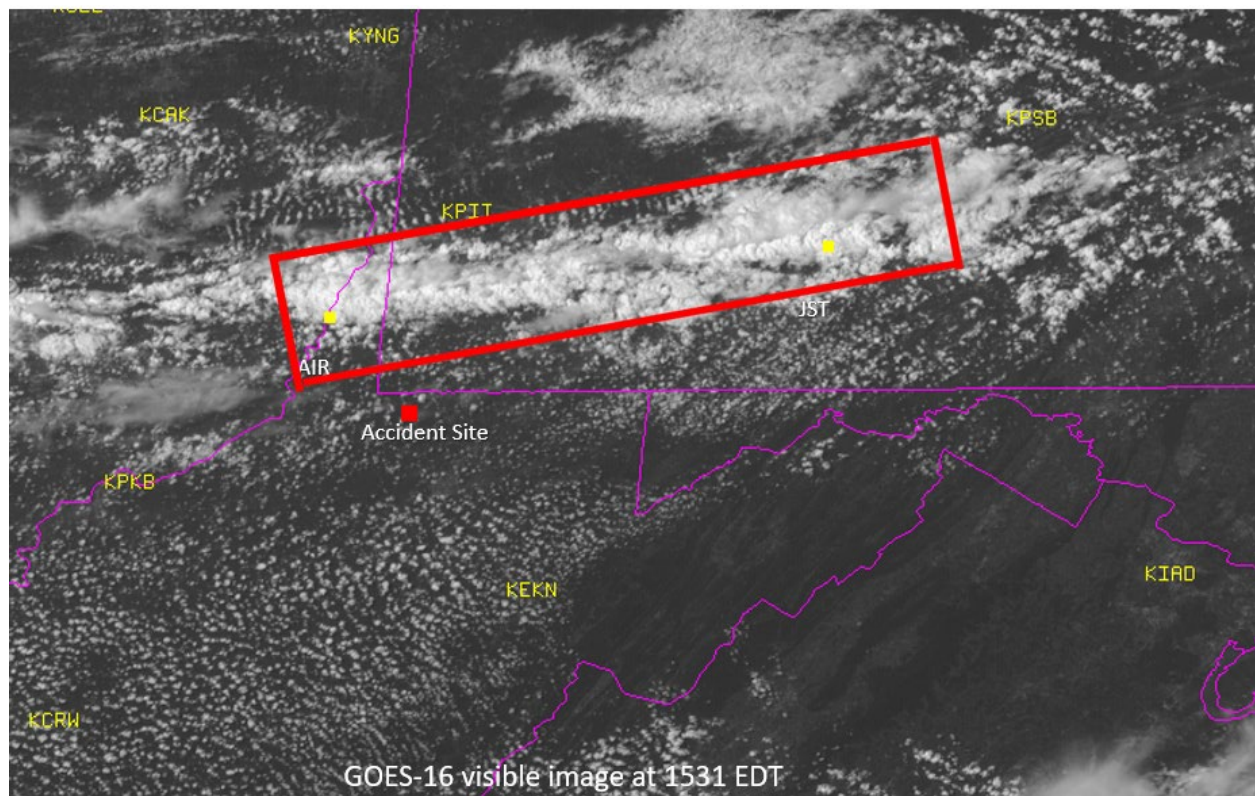


Figure 26 - CWA advisory issued at 1531 EDT for an embedded line of thunderstorms.

7.6.2 Convective SIGMETs

The NWS AWC issued Convective SIGMETs number 3E for a line of thunderstorms and 58C for an area of thunderstorms which extended over Ohio at 1655 EDT. The full text of the advisories are included below.

WSUS31 KNCI 112055
SIGE
-MKCE WST 112055
CONVECTIVE SIGMET 03E
VALID UNTIL 2255Z
PA WV OH
FROM 40E JST-10SSE AIR-30SSE ROD
LINE TS 30 NM WIDE MOV FROM 290020KT. TOPS TO FL380.

WSUS32 KNCI 112055
SIGC
-MKCC WST 112055
CONVECTIVE SIGMET 58C
VALID UNTIL 2255Z

OH IN IL
FROM 50SE IOW-40N CVG-30WNW CVG-30WSW AXC-50SE IOW
AREA TS MOV FROM 33020KT. TOPS ABV FL450.

The advisories were updated at 1755 EDT which superseded the previous advisories 03E and were current at the time of the accident. A depiction of Convective SIGMET 11E³⁵ is included as figure 27 from the NWS AWC website at 1800 EDT with the regional radar mosaic and accident site marked. The advisory warned of a line of thunderstorms 30 miles wide moving east southeastward at 20 knots, with tops to FL280. The light brown area over eastern Pennsylvania, Maryland, and New Jersey was associated with G-AIRMET for moderate turbulence between FL270 and FL420 and was not applicable to the accident.

WSUS31 KNCI 112155
SIGE
-MKCE WST 112155
CONVECTIVE SIGMET 11E
VALID UNTIL 2355Z
PA MD WV OH
FROM 40WSW HAR-30SE AIR-40SE ROD
LINE TS 30 NM WIDE MOV FROM 29020KT. TOPS TO FL280.

WSUS32 KNCI 112155
SIGC
-MKCC WST 112155
CONVECTIVE SIGMET 64C
VALID UNTIL 2355Z
OH KY IN IL
FROM 50NNE UIN-40SW ROD-20S CVG-30SW AXC-50NNE UIN
AREA TS MOV FROM 33020KT. TOPS TO FL390.

³⁵ Convection implies the possibility of localized IFR conditions, severe or greater turbulence, severe icing, strong variable winds, and the possibility of low-level wind shear and/or microbursts.

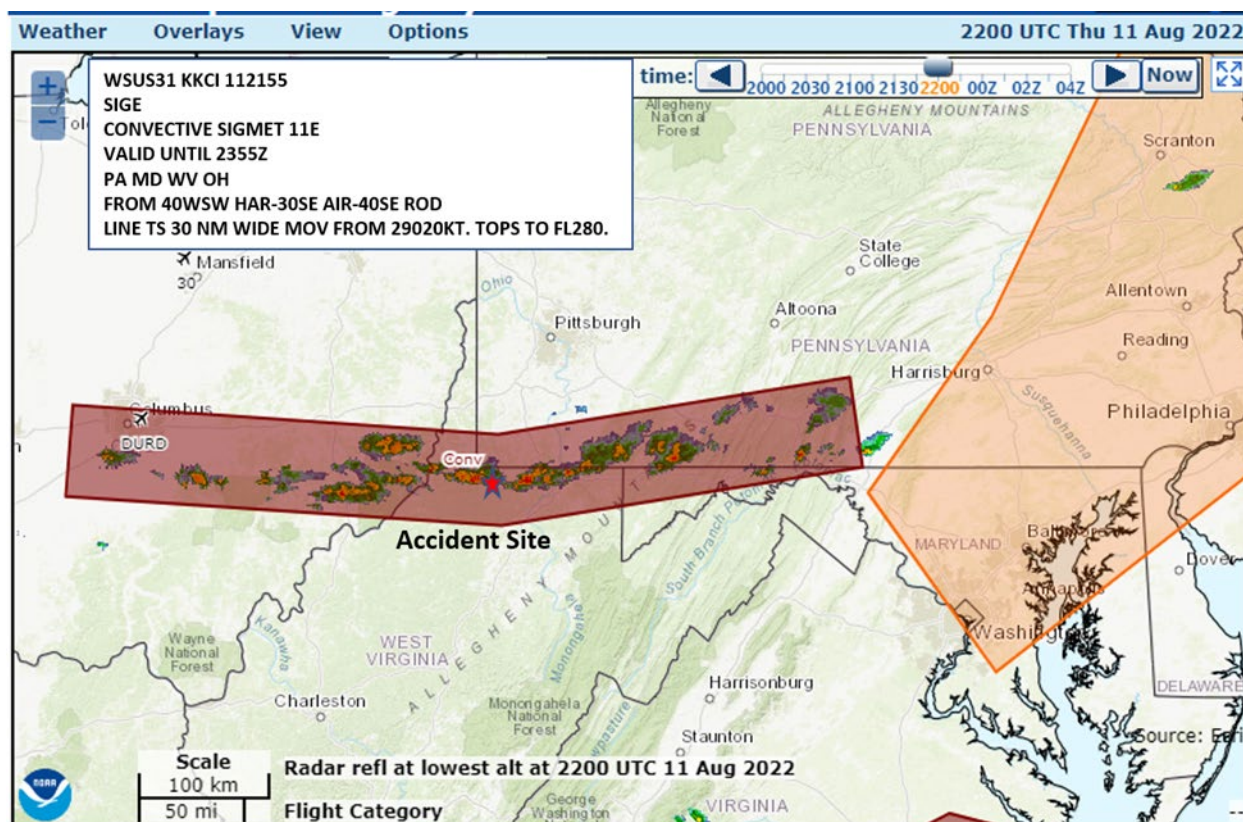


Figure 27 - Depiction of Convective SIGMET 11E and radar mosaic at 1800 EDT with approximate accident site marked by the red star.

There were no applicable G-AIRMETs current for IFR conditions, turbulence or icing conditions current over the route of flight current at the time of the accident.

8.0 Weather Briefing Information

A search of the FAA Contract Automated Flight Service Station (AFSS) Leidos indicated that they had no contact with N720RP nor did any 3rd party vendors utilizing the Leidos Flight Service (LFS) system on August 11, 2022. A search of ForeFlight³⁶ indicated that they did not have an account registered for the accident pilot in their system; however, they did have another customer with N720RP in their account.

9.0 FIS-B Weather Broadcasts

The FAA Flight Information Services - Broadcast (FIS-B) is a free service that automatically broadcasts a wide range of weather products with national and regional focus to equipped aircraft. The FIS-B broadcasts include METARs, PIREPs, NOTAMs,

³⁶ ForeFlight is a private company that creates flight planning software and apps for professional and general aviation pilots.

inflight weather advisories, and regional composite NEXRAD imagery, which were recreated for the period surrounding the time of the accident. The FAA website supporting FIS-B notes that the weather information provided are for advisory use for the sole purpose of assisting in long and near-term planning and decision making. In extreme scenarios, the NEXRAD radar data on the display can be up to 15 minutes older than the display's age indication. This warning is also stated in AC 00-24C "Thunderstorms" regarding the use of NEXRAD data in the cockpit.

"Unlike airborne weather avoidance radar, weather data linked from a ground weather surveillance radar system is not real-time information. The radar data displays recent rather than current weather conditions. As the current location of a thunderstorm cell may be different than the broadcast weather product, do not attempt to find a hole in a thunderstorm solely using data-linked weather. Pilots must avoid individual storms by visual sighting or by airborne weather radar."

A review of the FAA air traffic control conversation surrounding the period indicated that at approximately 1752 EDT the pilot of N720RP advised the air traffic controller³⁷ that he was looking at his NEXRAD display³⁸ and requested to deviate between what he described as a gap between the echoes. Figures 28 through 32 are the FIS-B regional NEXRAD images transmitted at 1752, 1756, 1800, 1803, and 1806 EDT with the approximate accident airplane's position and altitude marked by an airplane icon along the flight path. The time delay in the observation and the transmission of the image is not documented by the FAA, which indicated is only a matter of minutes old at the time of transmission. The location of the aircraft is based on time of the image, and not it's actual position upon reception of the image. The resolution is provided at 1.5nm X 1nm. Early in the imagery between 1752 and 1756 EDT, an approximate 5 mile gap in the line is noted in the imagery in the vicinity of the future accident site.

³⁷ See the Air Traffic Control Specialist Report for further details and transcripts.

³⁸ NEXRAD is an abbreviation for Next Generation of Weather Radar in reference to the WSR-88D. Various weather vendors and users often refer to term NEXRAD as the WSR-88D composite radar displays that are available for up-link on in-cockpit weather display and are similar to what is documented in section 5.2 of this report.

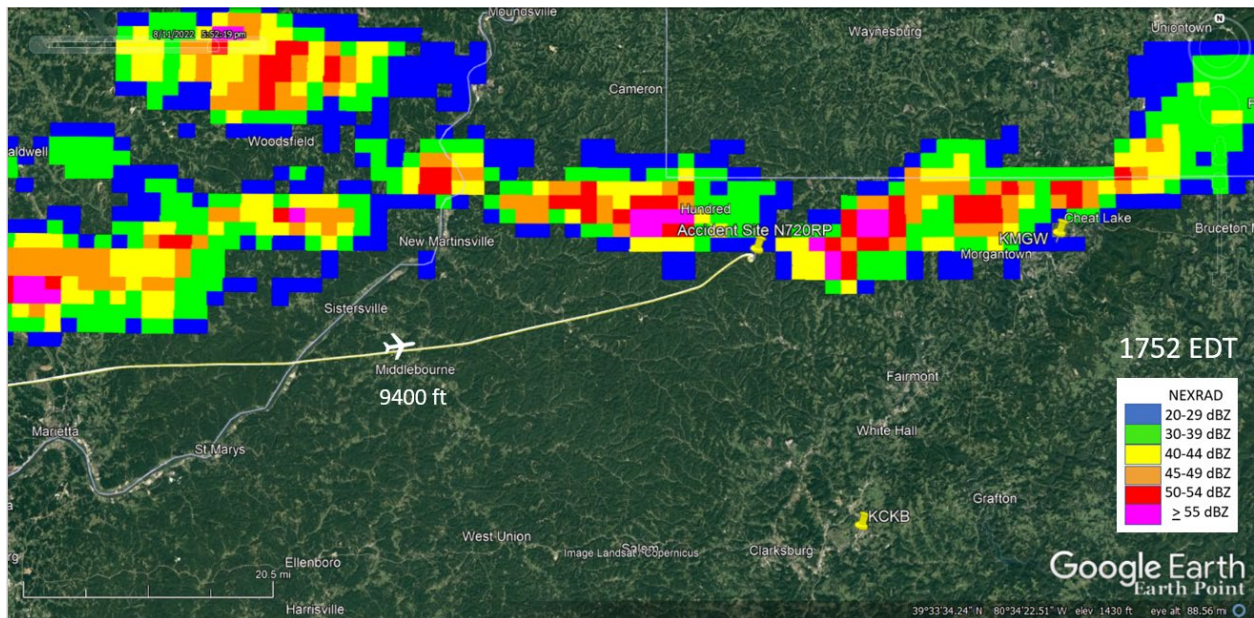


Figure 28 - FIS-B NEXRAD radar display for 1752 EDT with the accident airplanes position.

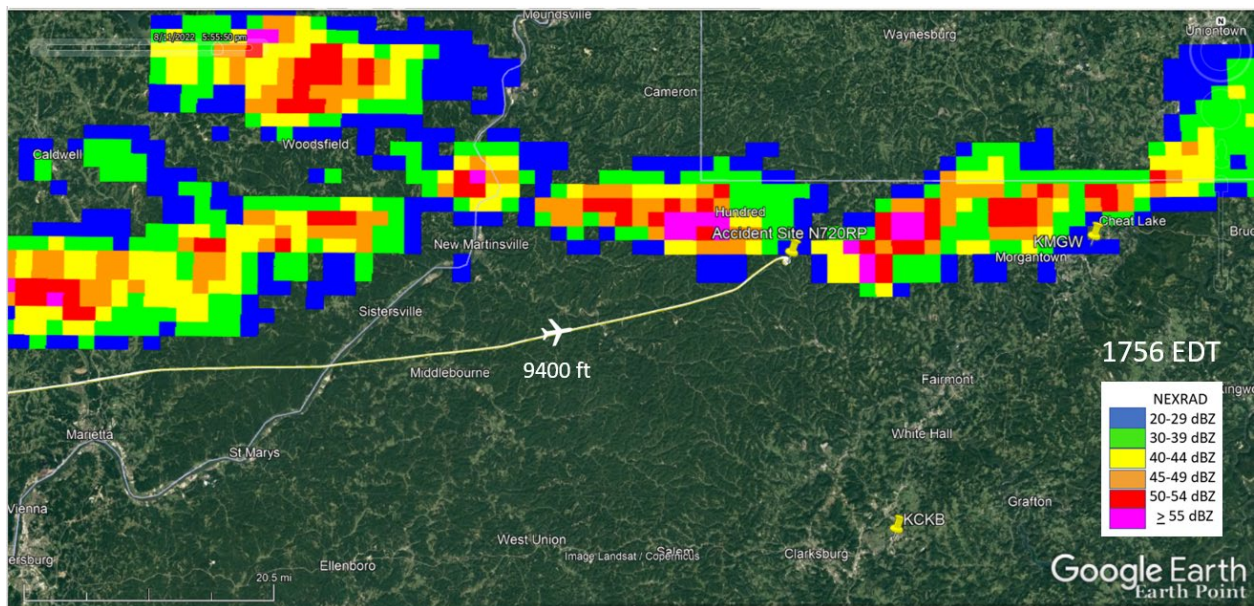


Figure 29 - FIS-B NEXRAD radar display for 1756 EDT with the accident airplanes position.

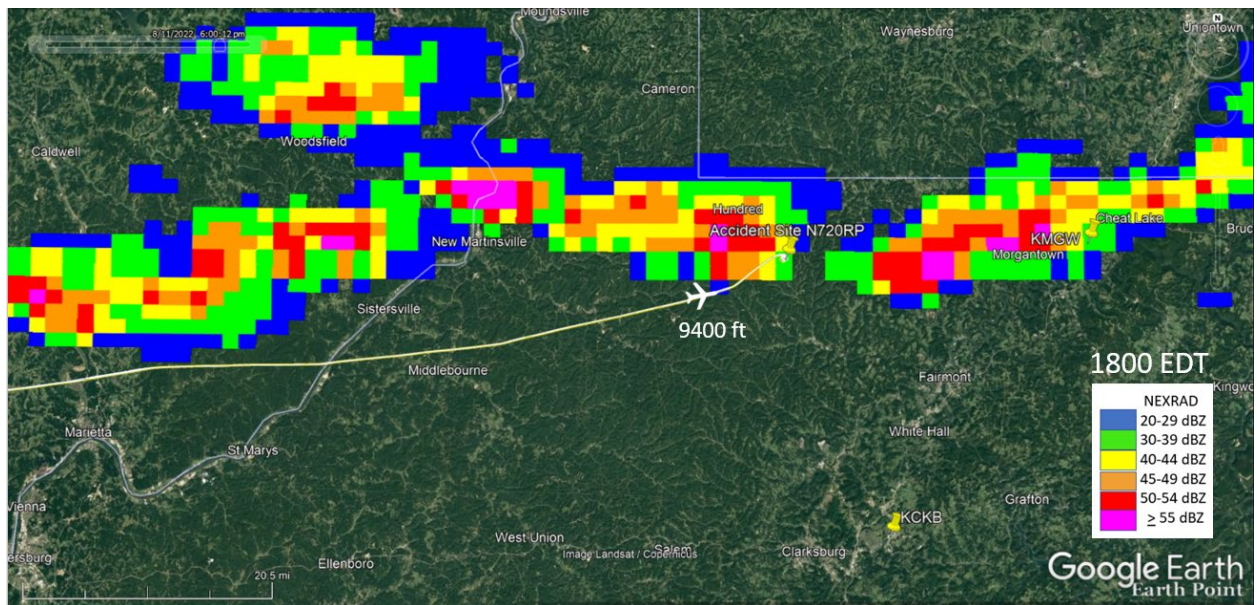


Figure 30 - FIS-B NEXRAD radar display for 1800 EDT with the accident airplanes position.

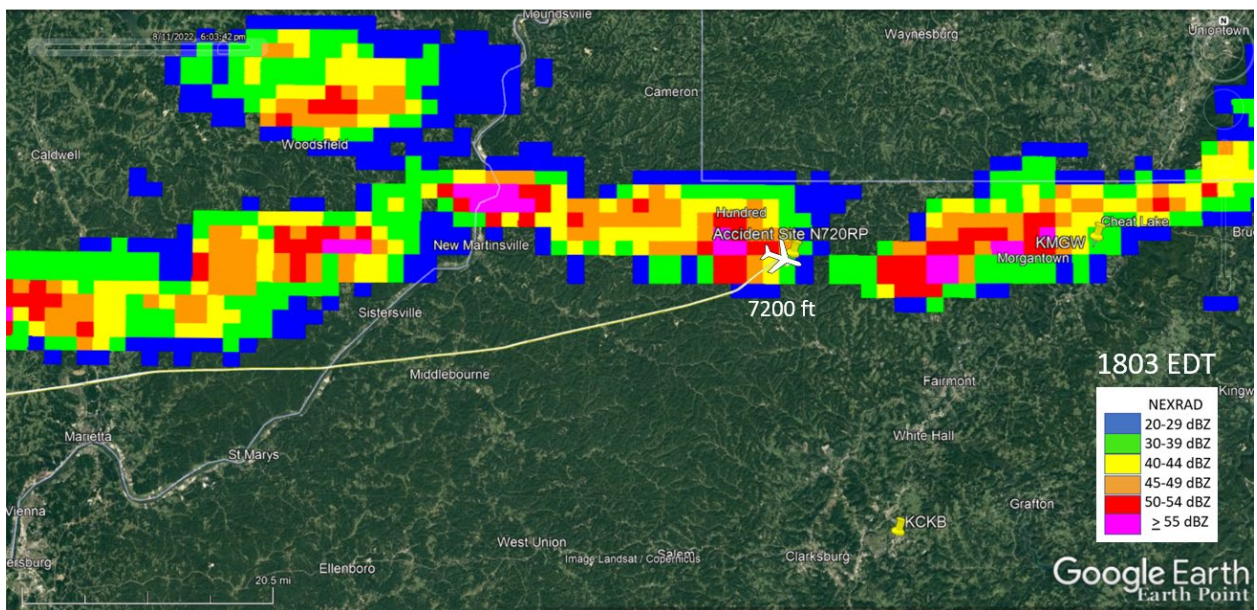


Figure 31 - FIS-B NEXRAD radar display for 1803 EDT with the accident airplanes position.

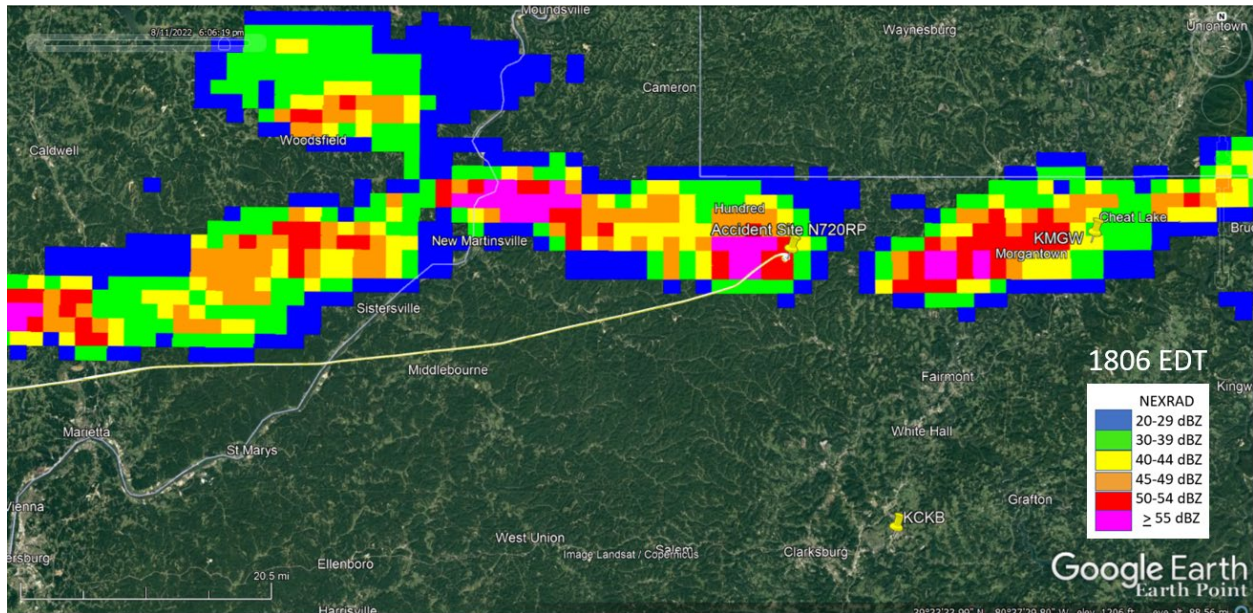


Figure 32 - FIS-B NEXRAD radar image for 1806 EDT with the flight track.

10.0 Astronomical Conditions

The United States Naval Observatory website provided the following astronomical conditions over the accident site coordinates on August 11, 2022. The time of the accident has been added in bold italic type for reference.

<u>Sun</u>	<u>Time (EDT)</u>
Begin Civil Twilight	0601
Sunrise	0630
Upper Transit	1327
<i>Accident</i>	<i>1806</i>
Sunset	2023
End Civil Twilight	2052

At the time of the accident the Sun was 29° above the horizon at an azimuth of 269°

ATTACHMENTS

Attachment 1 - KMGW 1-min and 5-min observations

Attachment 2 - GOES-16 RGB multichannel visible imagery 1612-1902 EDT

Attachment 3 - KPBZ WSR-88D 1.36° base reflectivity imagery 1735-1815 EDT

Attachment 4 - KZOB CWSU ATC morning Pre-Duty Weather Briefing

Attachment 5 - KZOB CWSU ATC afternoon Pre-Duty Weather Briefing

Attachment 6 - KZOB CWSU ATC evening Pre-Duty Weather Briefing

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