

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



ERA23FA380

METEOROLOGY

Specialist's Factual Report

September 1, 2024

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A. ACCIDENT

Location: Whitesville, Kentucky

Date: 27 September 2023

Time: 2249 central daylight time (0349 UTC¹ on 28 September 2023)

Aircraft: Type - Piper PA28; Registration - N3079M

B. METEOROLOGY SPECIALIST

Mike Richards

Senior Meteorologist

Office of Aviation Safety

Operational Factors Division (AS-30)

National Transportation Safety Board

C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's (NTSB) meteorological specialist did not travel in support of this accident investigation and gathered all weather data remotely. Unless otherwise noted, all times are in central daylight time for 27 September 2023 (based upon the 24-hour clock), directions are referenced to true north, distances are in nautical miles and heights are above mean sea level (msl). The accident site was located at about: 37.634366° north latitude; 86.890423° west longitude at an elevation of about 570 feet.

This report provides information on weather conditions and forecasts applicable to the accident flight.

D. WEATHER INFORMATION

1.0 Weather Radar

WSR-88D² Level-II base reflectivity weather radar imagery from Louisville, Kentucky, (site: KLVX) is presented in Figure 1. KLVX was located approximately 49 miles east-northeast of the accident location with an antenna elevation of about 835 feet. Assuming standard refraction and considering the 0.95° beam width³ for the WSR-88D

¹ UTC - abbreviation for Coordinated Universal Time

² Weather Surveillance Radar 88 Doppler (WSR-88D)

³ Here we define the angular width of the radar beam as the region of transmitted energy that is bounded by one-half the maximum power. The maximum power lies along the beam centerline and decreases outward from the radar antenna.

radar beam, the KLVX 0.85° tilt would have “seen” altitudes above the accident location of between about 4,400 and 9,300 feet. Light to extreme values of reflectivity⁴ were present along and near the final portion of the accident aircraft’s flight path.

Figure 2 presents the WSR-88D Level-III hydrometeor classification product applicable to the 0.5° tilt about the time of the accident. The KLVX 0.5° tilt would have “seen” altitudes above the accident location of between about 2,600 and 7,500 feet. The hydrometeor classification product depicted various intensities of rain and sizes of hail around the final portion of the accident aircraft’s flight path.

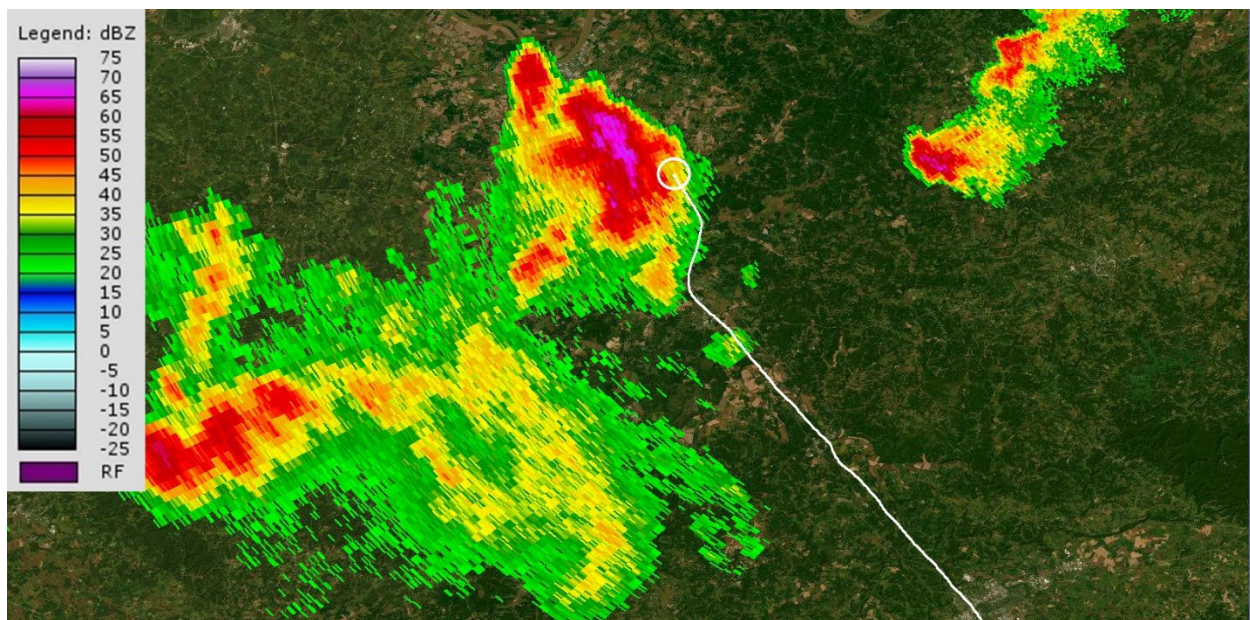


Figure 1 – KLVX 0.85° Level-II base reflectivity product from a sweep initiated at 2245:50. The accident aircraft’s flight path through 2236 is represented by the white line.

4

https://www.faa.gov/sites/faa.gov/files/other_visit/aviation_industry/airline_operators/airline_safety/in_FO07008.pdf

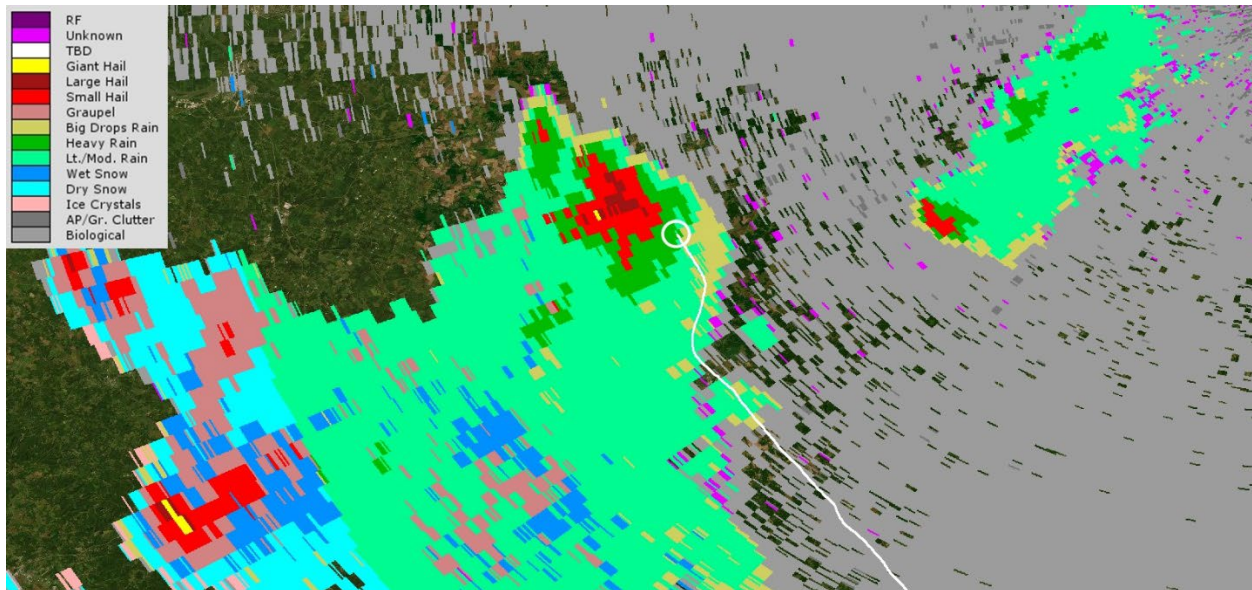


Figure 2 - KLVX 0.50° Level-III hydrometeor classification product from a sweep initiated at 2247:14. The accident aircraft's flight path through 2236 is represented by the white line.

The NTSB requested reproductions of the weather radar mosaics broadcast via the Flight Information Service-Broadcast (FIS-B) applicable to the accident region during the accident flight from L3 Harris. According to L3 Harris (Attachment 1), L3 Harris received the weather radar mosaic data from the Multi-Radar/Multi-Sensor System (MRMS) every two minutes, and public broadcast times for each mosaic were approximately two minutes after the creation time for each mosaic (for example, if a mosaic was received from the MRMS that had a mosaic creation time of 1224, that mosaic would have been broadcast to the public via the FIS-B at about 1226). Figures 3-8 present FIS-B weather radar mosaics created by L3 Harris from the MRMS mosaic data, along with MRMS weather radar mosaics that were valid at the time that each FIS-B mosaic was broadcast to the public.

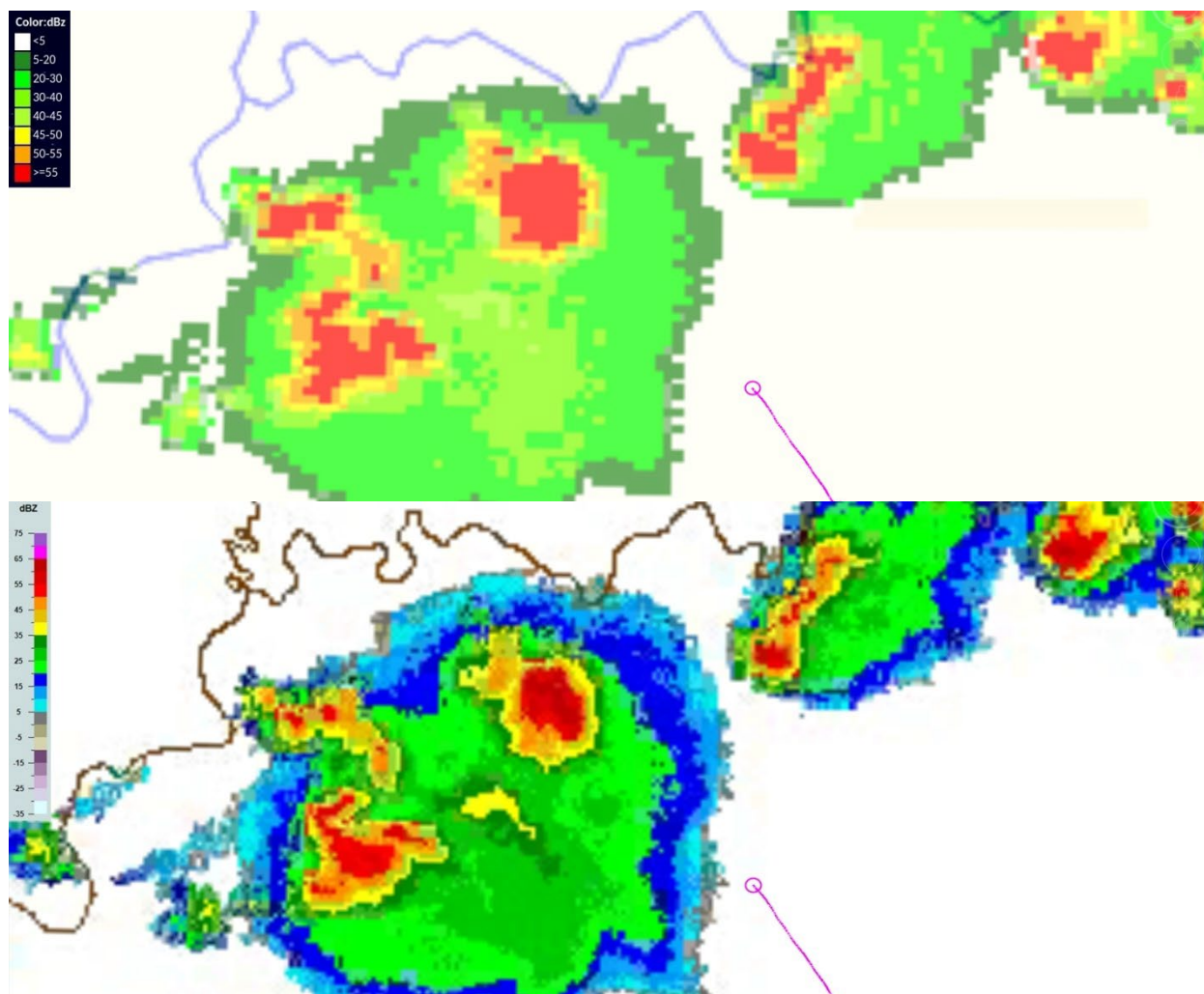


Figure 3 – Top: FIS-B weather radar mosaic created at 2228 and broadcast at 2230; Bottom: MRMS weather radar mosaic valid at 2230; accident aircraft's flight path through 2230 is represented by the pink line.

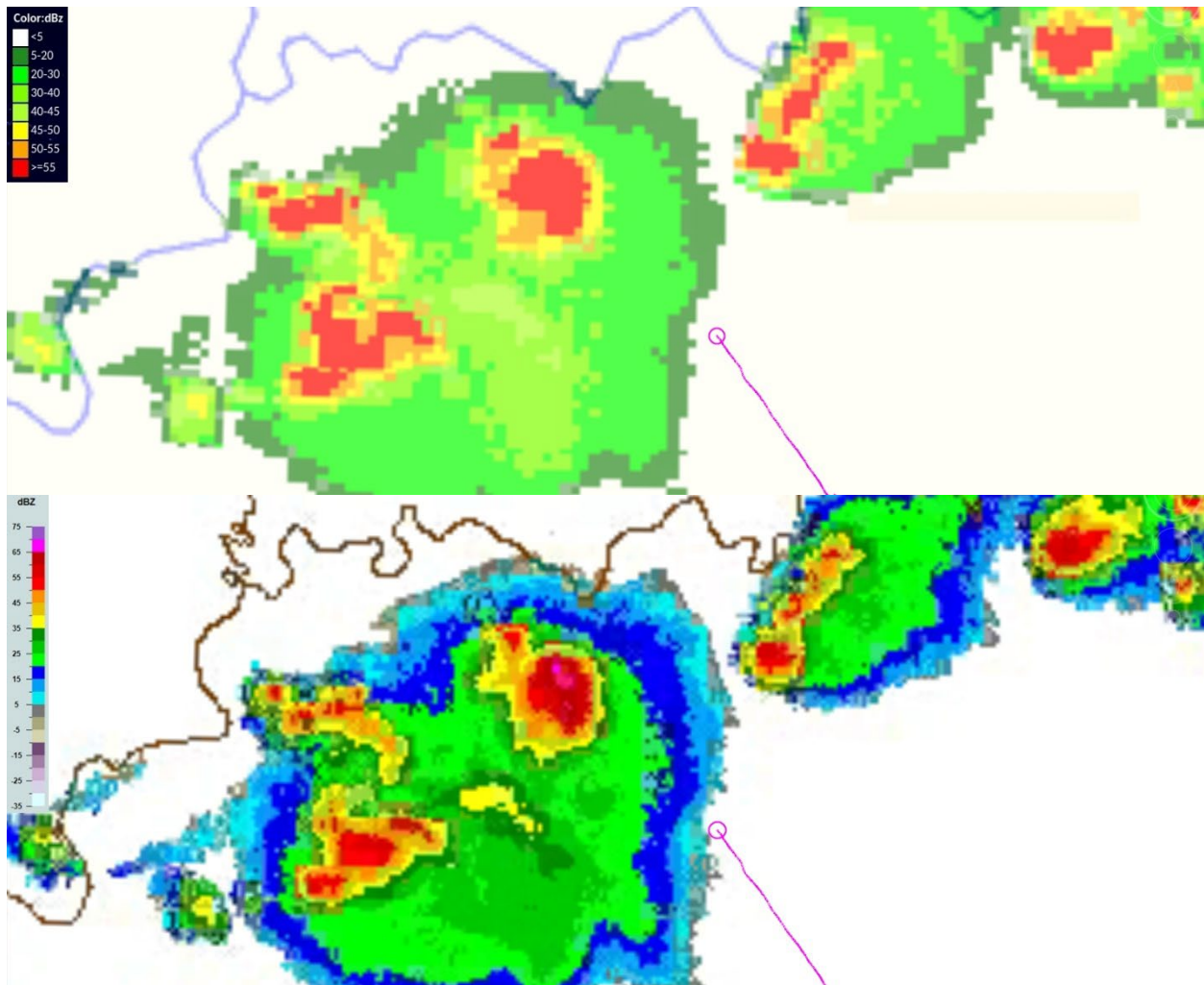


Figure 4 - Top: FIS-B weather radar mosaic created at 2232 and broadcast at 2234; Bottom: MRMS weather radar mosaic valid at 2234; accident aircraft's flight path through 2234 is represented by the pink line.

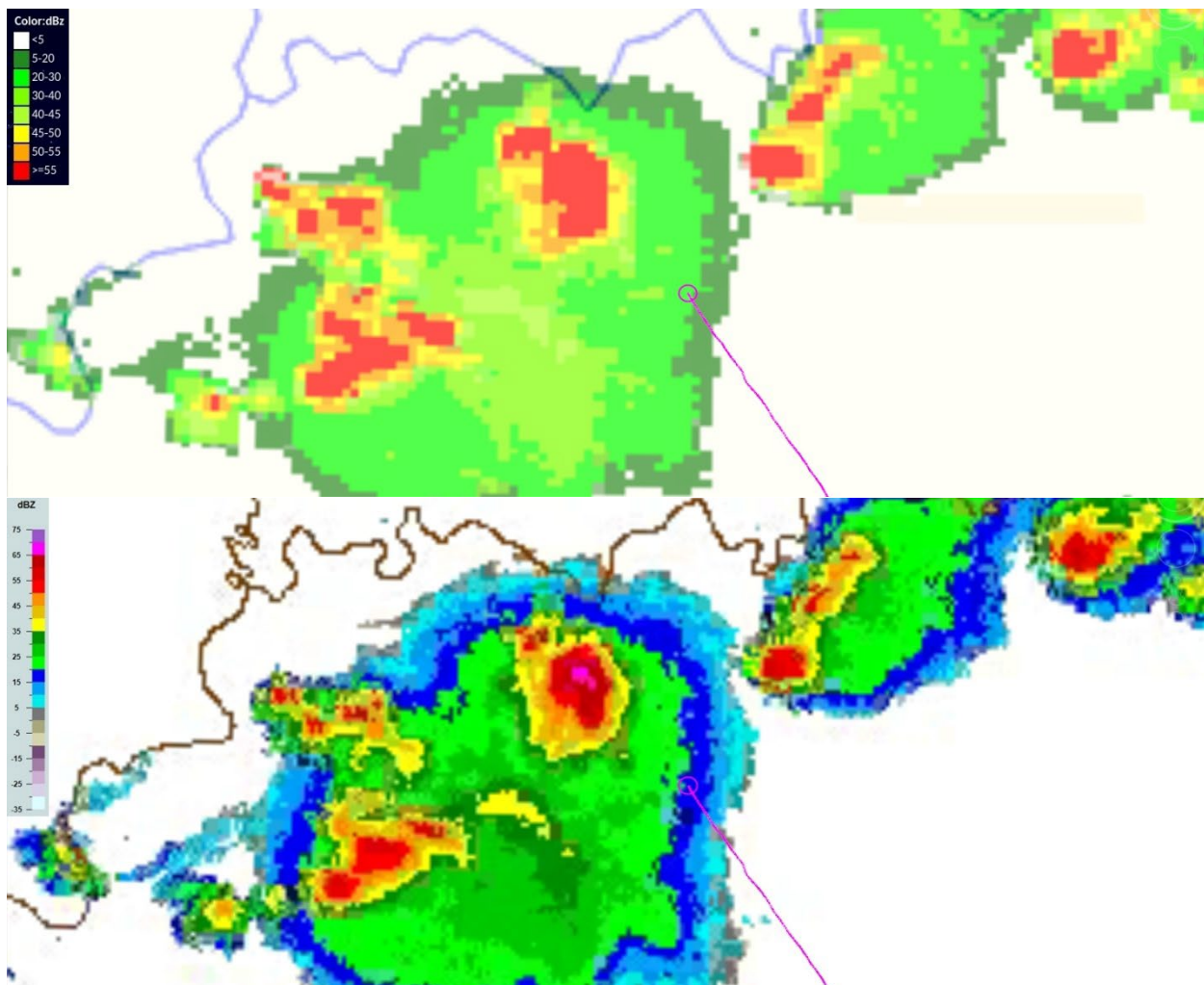


Figure 5 - Top: FIS-B weather radar mosaic created at 2236 and broadcast at 2238; Bottom: MRMS weather radar mosaic valid at 2238; accident aircraft's flight path through 2238 is represented by the pink line.

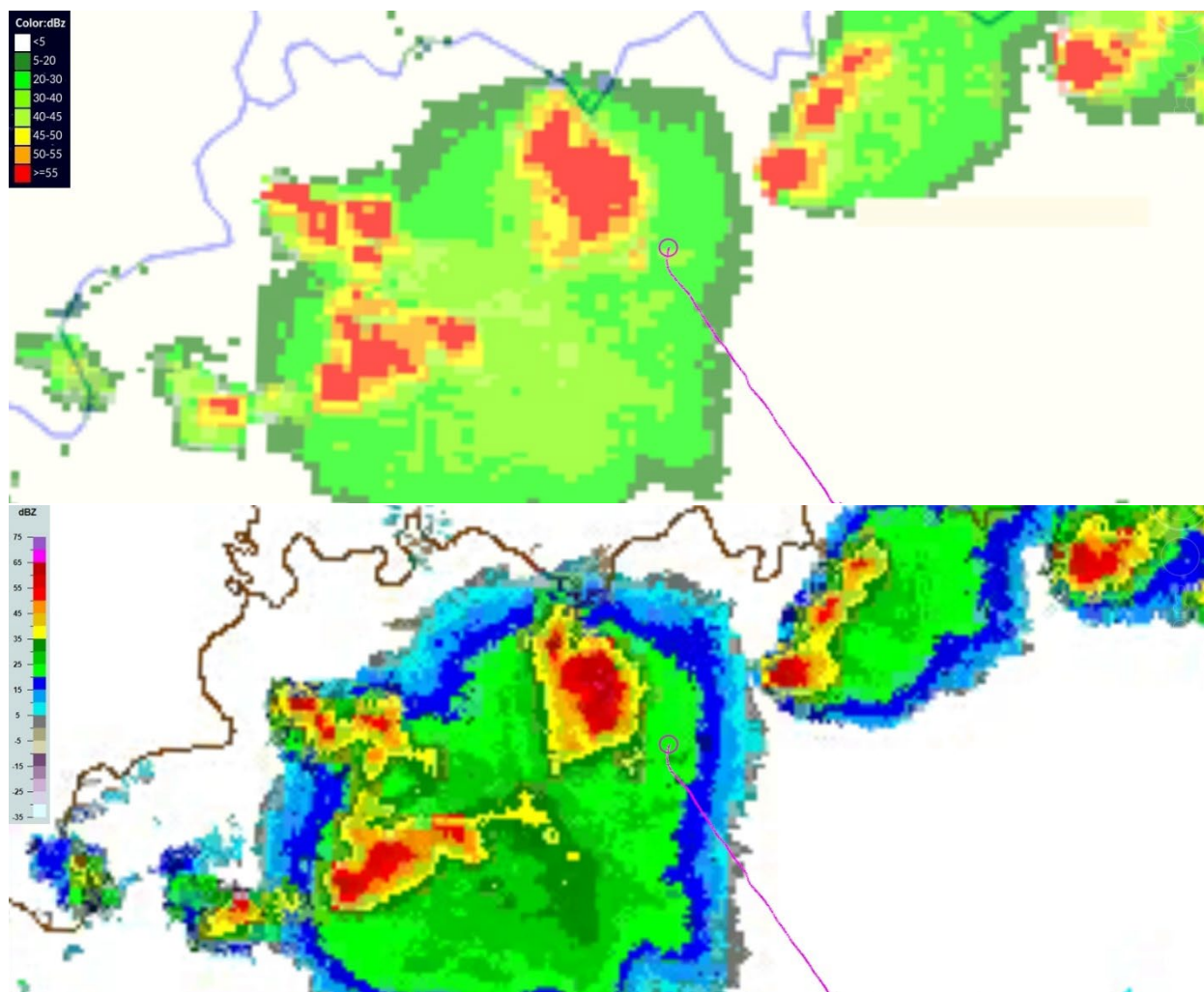


Figure 6 – Top: FIS-B weather radar mosaic created at 2240 and broadcast at 2242; Bottom: MRMS weather radar mosaic valid at 2242; accident aircraft's flight path through 2242 is represented by the pink line.

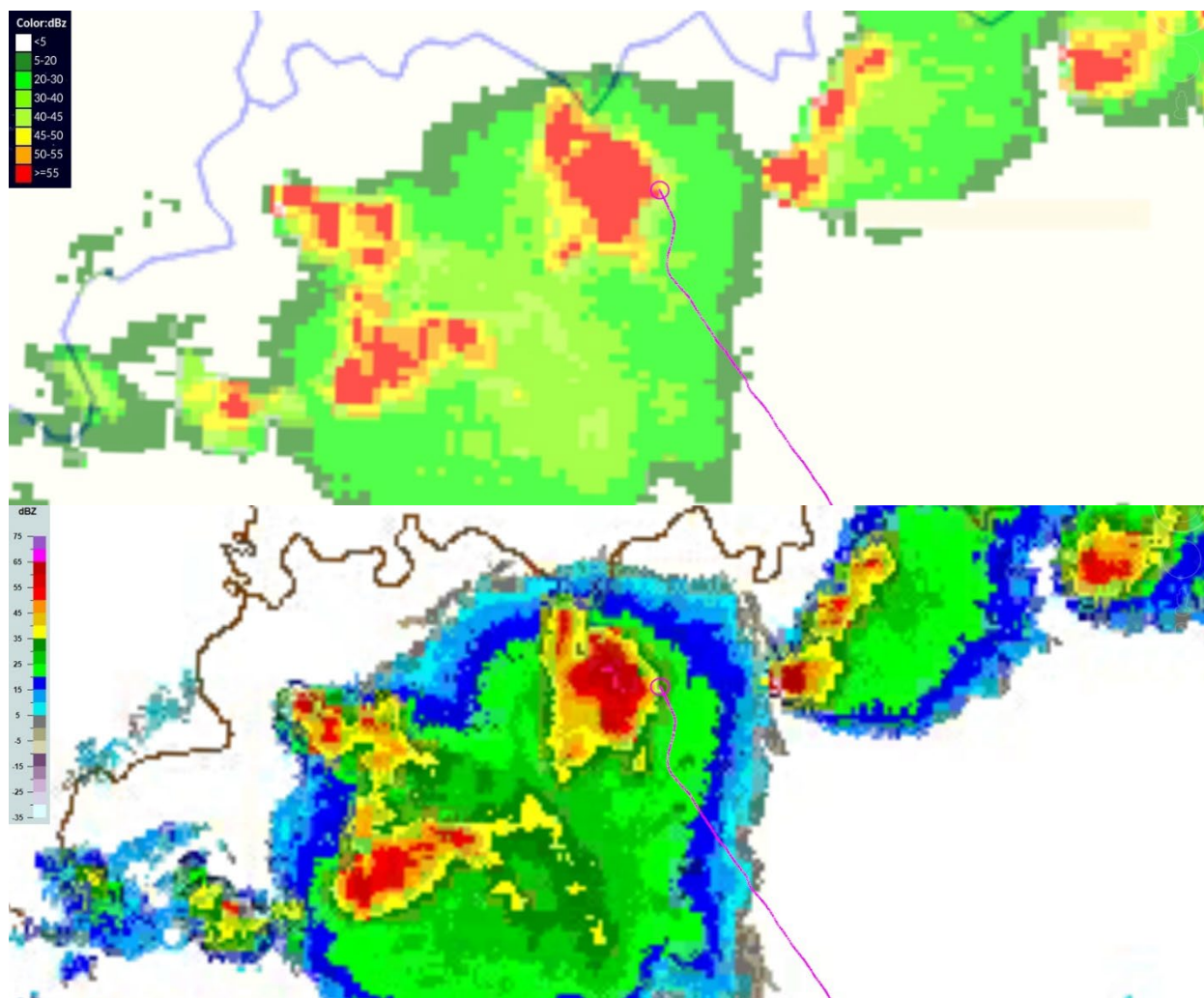


Figure 7 - Top: FIS-B weather radar mosaic created at 2244 and broadcast at 2246; Bottom: MRMS weather radar mosaic valid at 2246; accident aircraft's flight path through 2246 is represented by the pink line.

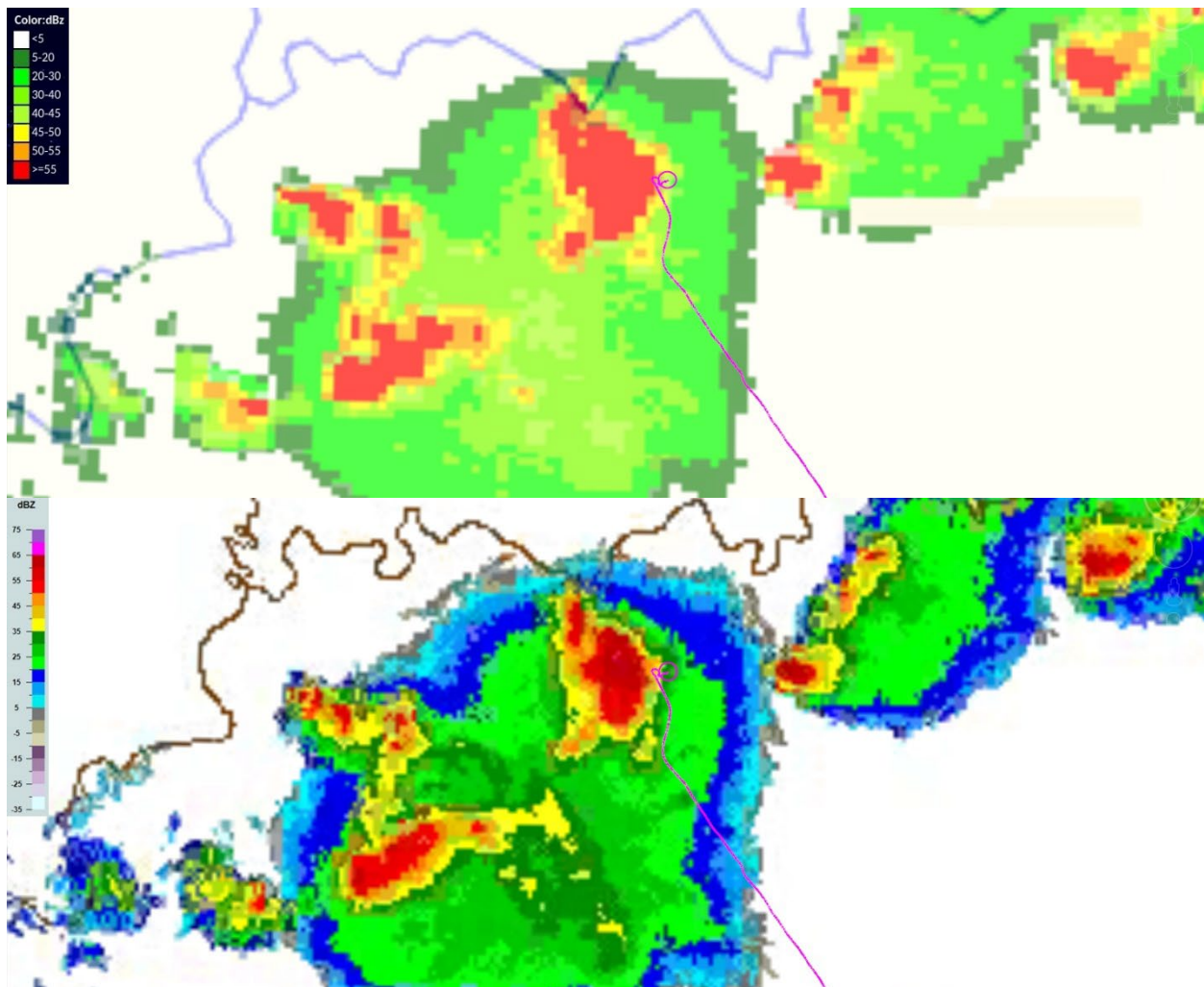


Figure 8 – Top: FIS-B weather radar mosaic created at 2246 and broadcast at 2248; Bottom: MRMS weather radar mosaic valid at 2248; accident aircraft's flight path through 2248 is represented by the pink line.

2.0 Lightning

Imagery depicting cloud-to-ground lightning strikes from the National Lightning Detection Network (NLDN) were obtained from the Consolidated Storm Prediction for Aviation (CoSPA) and is presented in Figure 9.

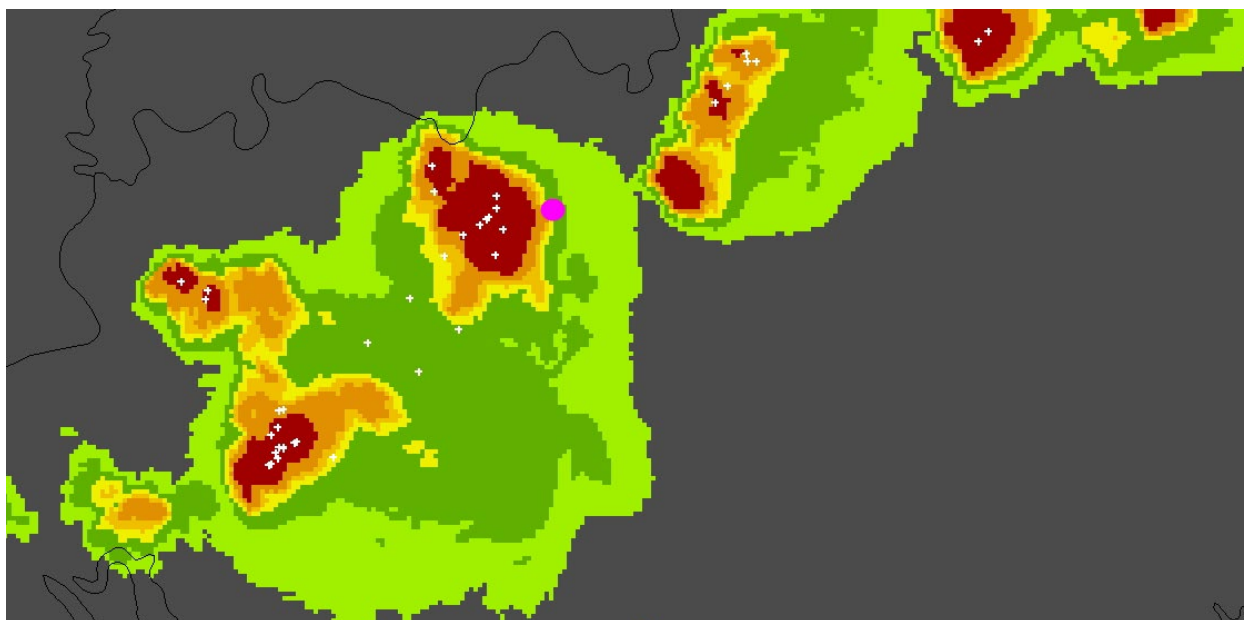


Figure 9 - CoSPA NLDN cloud-to-ground lightning data overlaid on weather radar imagery. Data are valid at 2245 and contain lightning strikes over the previous 6 minutes. Lightning strikes are indicated by the white "+" symbol. The accident location is denoted by the purple dot.

3.0 HRRR Model Sounding

A High-Resolution Rapid Refresh (HRRR) model⁵ sounding (Figure 10) for near the accident site⁶ at 2300 with an elevation of 469 feet was retrieved from the National Oceanic and Atmospheric Administration's (NOAA) Air Resources Laboratory and analyzed by the RAwinsonde OBservation (RAOB) program. Scattered to few clouds were identified by RAOB between about 5,000 and 12,000 feet. The freezing level was at about 12,000 feet. The wind near the surface was from the east at about 5 knots and veered⁷ and increased in magnitude to a west wind of about 30 knots near 10,000 feet. Above this level up through 25,000 feet the wind remained westerly at about 30 knots. The most-unstable Convective Available Potential Energy (CAPE) parameter was 1,261 Joules/kilogram (from 992 hectopascals [hPa]). The Lifting Condensation Level (LCL) and the Level of Free Convection (LFC) were at 2,448 feet and 6,668 feet, respectively. Downdraft CAPE (DCAPE; 6 kilometers above ground level; coldest wetbulb temperature method) was measured at 1,003 Joules/kilogram.

⁵ 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.

⁶ Coordinates used for the model were latitude: 37.63°N; longitude: 86.89°W.

⁷ A veering wind's wind barbs turn clockwise with increasing height.

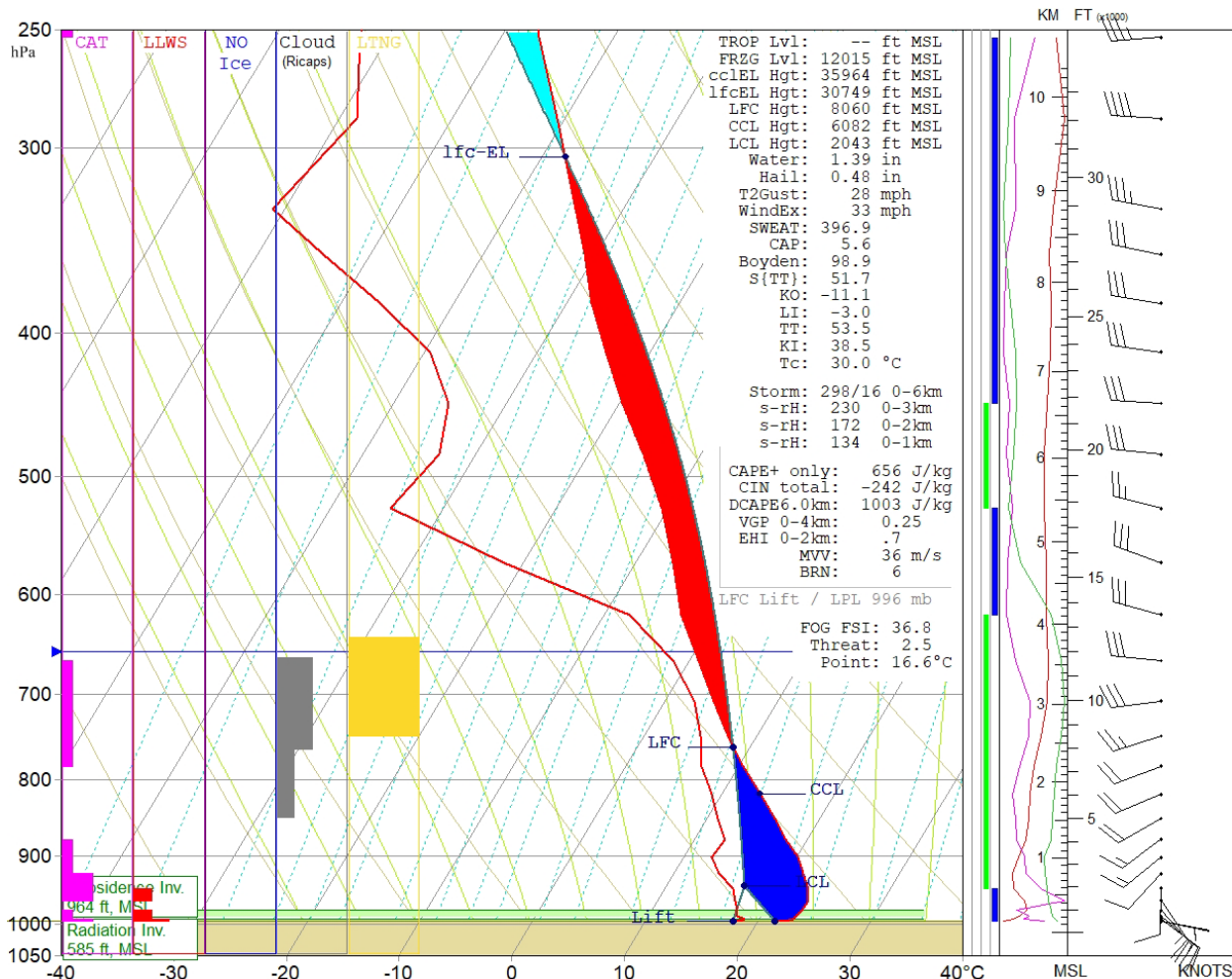


Figure 10 - HRRR model sounding data in SkewT/LogP format for 2300 near the accident site, surface to 250 hPa.

4.0 Satellite Imagery

Geostationary Operational Environmental Satellite (GOES)-16 infrared (10.3 μ m) data were obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison. An image of these data is presented in Figure 11. Brightness temperatures over the accident location were about -50°C, which, when considering the 2300 HRRR sounding, corresponded to cloud top heights of over 35,000 feet.

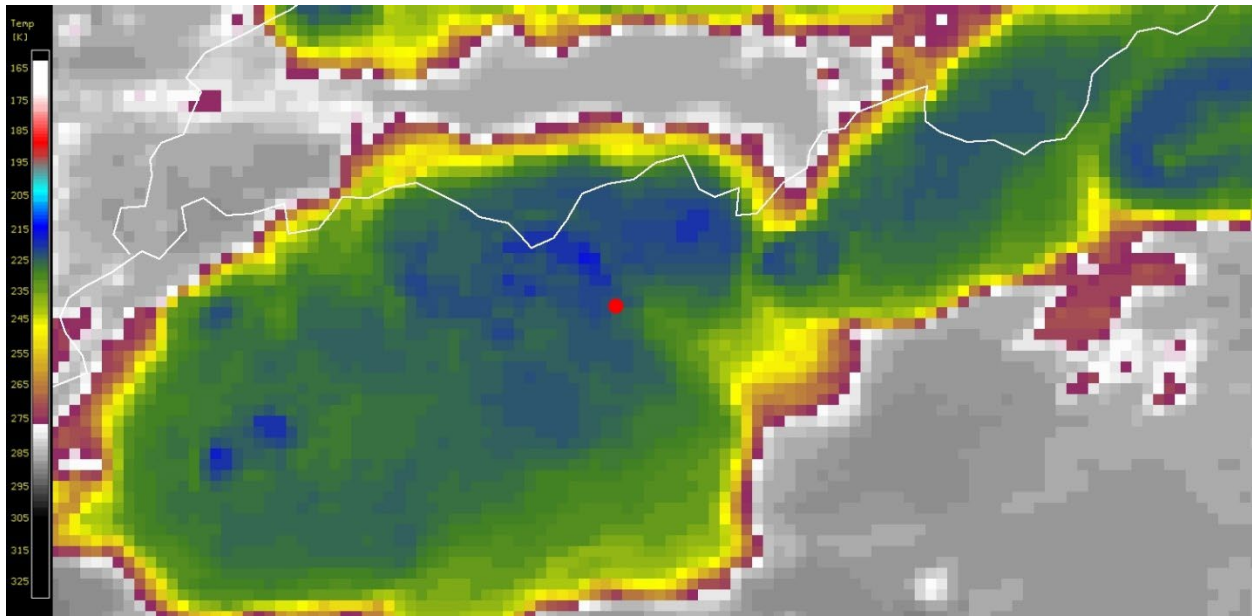


Figure 11 - GOES-16 infrared imagery from 2246. Image is not corrected for parallax error. The accident location is denoted by the red dot.

5.0 Pilot Reports

There were no longline-disseminated pilot reports⁸ (PIREPs) reported between 2100 and 0000 (on 28 September 2023) within 40 miles of the accident location.

6.0 Surface Observations

An Automated Weather Observing Station (AWOS) was located at Owensboro/Daviess County Regional Airport (OWB⁹) in Owensboro, Kentucky, which was located about 14 miles west-northwest of the accident site at an elevation of about 405 feet. It had a magnetic variation of about 4° west. Automated and augmented longline¹⁰ reports

⁸ These do not include pilot reports only broadcast via radio.

⁹ This report uses the 3-digit International Air Transport Association format for airport identification, which does not use the geographic designating digit (e.g., "K" for stations in the continental U.S. and "P" for U.S. stations in Alaska and the Pacific region) as found in the 4-digit International Civil Aviation Organization (ICAO) identifier format. Weather observations from airports in this report are referenced by their reporting station's identifier (using ICAO format that includes the geographic designating digit), not by the airport at which the reporting station is located.

¹⁰ "Longline" refers to the dissemination of weather observations with the intent that they are available in near-real time to national databases (effectively, the whole world) and accessible to the general global public from a large number of vendors. This does not include public accessibility to observations from a reporting station's Very High Frequency (VHF; line-of-site) or telephone broadcast, where applicable. Longline-dissemination of weather observations is the primary vehicle through which the general global

from the OWB AWOS during the times surrounding the accident time are presented here.

[2056] KOWB 280156Z 13005KT 10SM VCTS BKN085 23/18 A2997 RMK AO2
LTG DSNT NW-NE TSB55 SLP146 T02330183

[2156] KOWB 280256Z 11004KT 10SM FEW055 23/18 A2997 RMK AO2 LTG
DSNT ALQDS TSE51 SLP147 T02280183 55002

[2228] KOWB 280328Z AUTO 08004KT 10SM VCTS BKN065 23/18 A2997 RMK
AO2 LTG DSNT ALQDS TSB22

**[2252] KOWB 280352Z AUTO 18005G20KT 10SM TSRA FEW025 SCT042
BKN055 19/16 A3000 RMK AO2 WSHFT 0332 LTG DSNT ALQDS
TSB22RAB43 P0006**

[2256] KOWB 280356Z AUTO 15006KT 10SM -TSRA FEW025 SCT046 BKN065
19/17 A2999 RMK AO2 WSHFT 0332 LTG DSNT ALQDS TSB22RAB43
SLP153 P0006 T01940167

[2329] KOWB 280429Z AUTO 15009KT 10SM FEW080 19/17 A2997 RMK AO2
LTG DSNT ALQDS TSE23RAE03 P0000

At 2252, the OWB AWOS reported a wind from 180° at 5 knots with gusts to 20 knots, visibility 10 statute miles or greater, thunderstorm with moderate rain, few clouds at 2,500 feet above ground level (agl), scattered clouds at 4,200 feet agl, broken ceiling at 5,500 feet agl, temperature of 19°C and dew point temperature of 16°C, altimeter setting of 30.00 inches of mercury; Remarks: automated station with a precipitation discriminator, wind shift at 2232, lightning distant¹¹ in all quadrants, thunderstorm began at 2222 and rain began at 2243, 0.06 inches of liquid equivalent precipitation since 2156.

7.0 Terminal Aerodrome Forecasts

The closest National Weather Service (NWS) Terminal Aerodrome Forecast (TAF) site to the accident location was OWB. According to NWS Instruction 10-813: "A NWS TAF consists of the expected meteorological conditions significant to aviation at an airport for a specified time period. For the U.S., this is the area within five (5) statute miles (SM) of the center of an airport's runway complex."¹²

public has access to surface weather observations, particularly outside of the aviation community.

¹¹ "Distant" means more than 10 statute miles from the point of observation (e.g., in a METAR) or from the center of the airport's runway complex (e.g., in a TAF).

¹² www.nws.noaa.gov/directives/sym/pd01008013curr.pdf

At 1834, a TAF was issued for OWB that forecasted for the accident time: a variable wind at 4 knots, visibility greater than 6 statute miles, rain showers in the vicinity¹³ and ceiling broken at 5,000 feet agl.

TAF KOWB 272334Z 2800/2824 VRB04KT P6SM SCT120
FM280300 **VRB04KT P6SM VCSH BKN050**
TEMPO 2806/2810 3SM TSRA BKN035CB
FM281000 22005KT P6SM BKN070
FM281800 26007KT P6SM SCT050=

At 2233, a TAF was issued for OWB that forecasted for the accident time: a variable wind at 15 knots with gusts to 30 knots, visibility of 3 statute miles, thunderstorms with moderate rain and ceiling broken at 3,500 feet agl with clouds of cumulonimbus type.

TAF KOWB 280333Z 2804/2824 **VRB15G30KT 3SM TSRA BKN035CB**
FM280430 VRB04KT P6SM VCSH BKN050
FM281000 22005KT P6SM BKN070
FM281800 26007KT P6SM SCT050=

8.0 Area Forecast Discussion

The accident site was located along the border of the NWS' Louisville, Kentucky, and Paducah, Kentucky, Weather Forecast Offices (WFO). At 1925 the NWS Louisville, Kentucky, WFO issued the following Aviation section of an Area Forecast Discussion.

*FXUS63 KLMK 280142
AFDLMK
Area Forecast Discussion
National Weather Service Louisville KY
942 PM EDT Wed Sep 27 2023
.Aviation...(00Z TAF Issuance)
Issued at 725 PM EDT Wed Sep 27 2023*

Weather across the region is relatively quiet this evening, but impacts to flight categories are still expected for later tonight and into the overnight. Currently have VFR flight cats at all terminals for now, but as our next round of showers and thunderstorms arrive, we expect to see a period of MVFR vis restrictions. This has been highlighted in TEMPO groups for all terminals expect HNB. Following the TSRA, should have a period of VCSH as cigs drop to fuel alternate

¹³ "In the vicinity" means 5 to 10 statute miles from the point of observation.

for some areas. However, this is forecast to be short-lived, and all terminals should return to VFR by the late morning or early afternoon.

At 1847 the NWS Paducah, Kentucky, WFO issued the following Aviation section of an Area Forecast Discussion.

FXUS63 KPAH 272347

AFDPAH

Area Forecast Discussion

National Weather Service Paducah KY

647 PM CDT Wed Sep 27 2023

AVIATION...

Issued at 647 PM CDT Wed Sep 27 2023

There will be potentially two rounds of convection tonight into Thursday morning. The first would be this evening into the overnight hours from KMVN through KEVV and KOWB, while the second one would be from KCGI through KPAH from the pre-dawn hours through the morning. Guidance is not in very good agreement in the coverage or intensity of convection, so just highlighted the time frame at each location with a VCSH for now and will amend if/when necessary. The exception is at KOWB where coverage will be the greatest and we mentioned TSRA in a TEMPO group. Behind the convection, mainly at KMVN, if skies can clear, IFR or lower ceilings/visibilities will be possible late tonight through daybreak.

9.0 SIGMETs

There were no non-convective Significant Meteorological Information (SIGMET) advisories active for the accident flight.

At 2155, the NWS Aviation Weather Center (AWC) issued Convective SIGMET 9C that was active for the accident location and valid until 2355. It warned of an area of severe thunderstorms with tops to FL420¹⁴, hail to 1.25 inches and wind gusts to 50 knots possible. The Convective SIGMETs polygon was moving from 280° at 15 knots. Convective SIGMETs imply severe or greater turbulence, severe icing, and low-level wind shear.

¹⁴ Flight Level (FL) - 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 inches of mercury), the average sea-level pressure, and therefore is not necessarily the same as the aircraft's true altitude either above msl or agl.

WSUS32 KPCI 280255
SIGC
MKCC WST 280255
CONVECTIVE SIGMET 9C
VALID UNTIL 0455Z
OH KY IN IL MO
FROM ROD-30WNW LOZ-40NNW DYP-60SSE COU-ROD
AREA SEV TS MOV FROM 28015KT. TOPS TO FL420.
HAIL TO 1.25 IN...WIND GUSTS TO 50KT POSS.

10.0 CWSU Products

There were no Center Weather Advisories or Meteorological Impact Statements issued by the Center Weather Service Unit (CWSU) at the Indianapolis Air Route Traffic Control Center that were active for the accident flight.

11.0 G-AIRMETs

A Graphical-Airmen's Meteorological Information (G-AIRMET) is a graphical advisory of weather that may be hazardous to aircraft but are less severe than what would be advised by a SIGMET. G-AIRMETs are only valid at discrete time "snapshots" that are three hours apart for a period of up to 12 hours into the future (i.e., 00-, 03-, 06-, 09- and 12-hour forecasts). They are issued at 0300 UTC, 0900 UTC, 1500 UTC and 2100 UTC (with updates issued as necessary).

A G-AIRMET for low level wind shear was issued at 2145 and valid at 0100 (on 28 September 2023) for a region that included the accident location.

12.0 Graphical Forecasts for Aviation

The Graphical Forecasts for Aviation (GFA) are intended to provide the necessary aviation weather information to give users a complete picture of the weather that might impact flight in the continental United States. Hourly model data and forecasts, including information on clouds, flight category, precipitation, icing, turbulence, wind, and other output from the NWS are available, however only certain imagery are archived by the NWS.

Figures 12 and 13 depict GFA forecast information on sky condition, icing, mountain obscuration, instrument flight rule (IFR) condition¹⁵ and surface wind G-AIRMET advisories, surface visibility, surface wind, precipitation, and other obscurations and hazards, valid for times near the accident time. These GFA forecast imagery depict few clouds to overcast sky conditions in the accident region (Figure 12). The GFA surface forecasts (Figure 13) depicted scattered to numerous thunderstorms near the accident location with visibilities greater than 5 statute miles. Surface winds of 5 knots were noted within about 75 miles of the accident location.

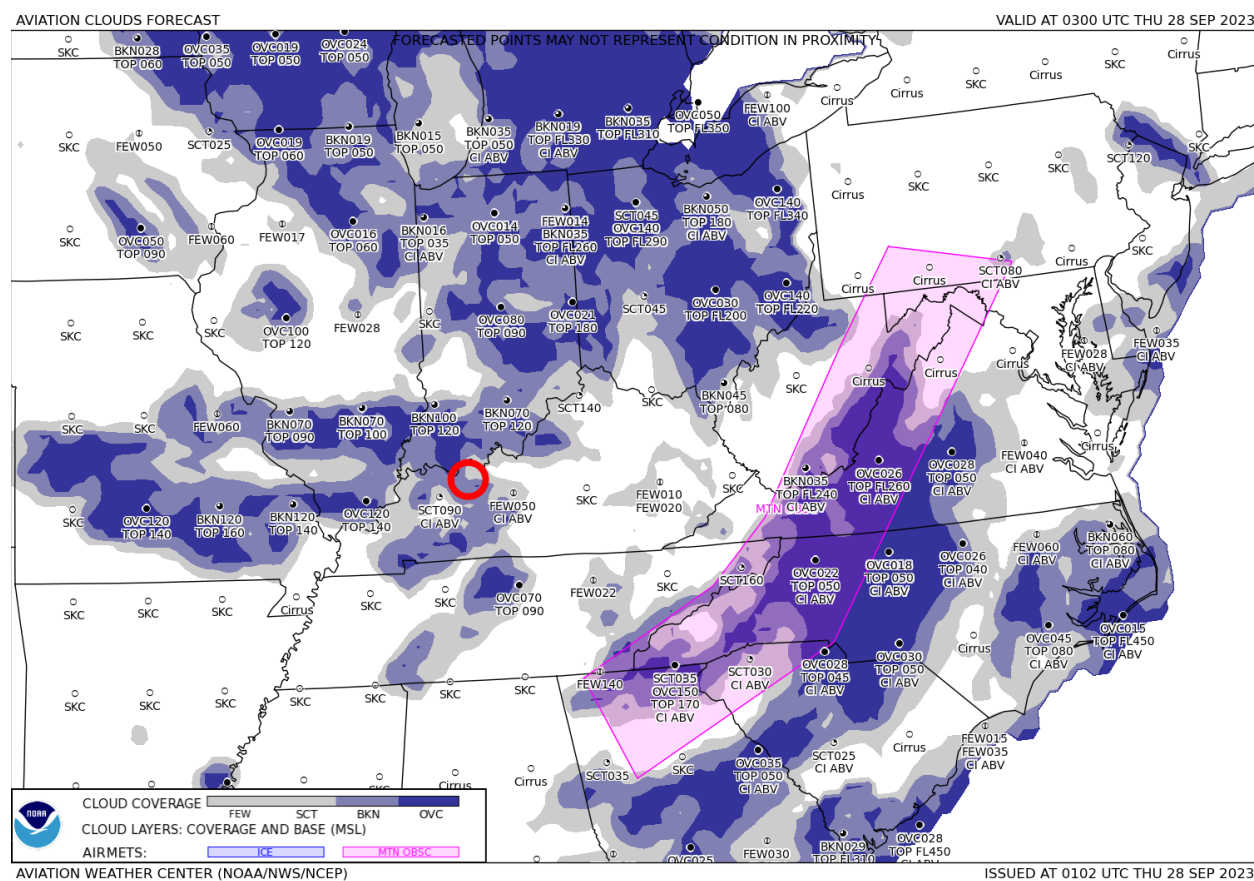


Figure 12 - GFA forecast imagery depicting sky condition and icing and mountain obscuration G-AIRMETS issued about 2000 and valid for 2200. The accident location is located within the red circle.

¹⁵ IFR conditions - Ceilings less than 1,000 feet agl and/or surface visibility less than three statute miles.

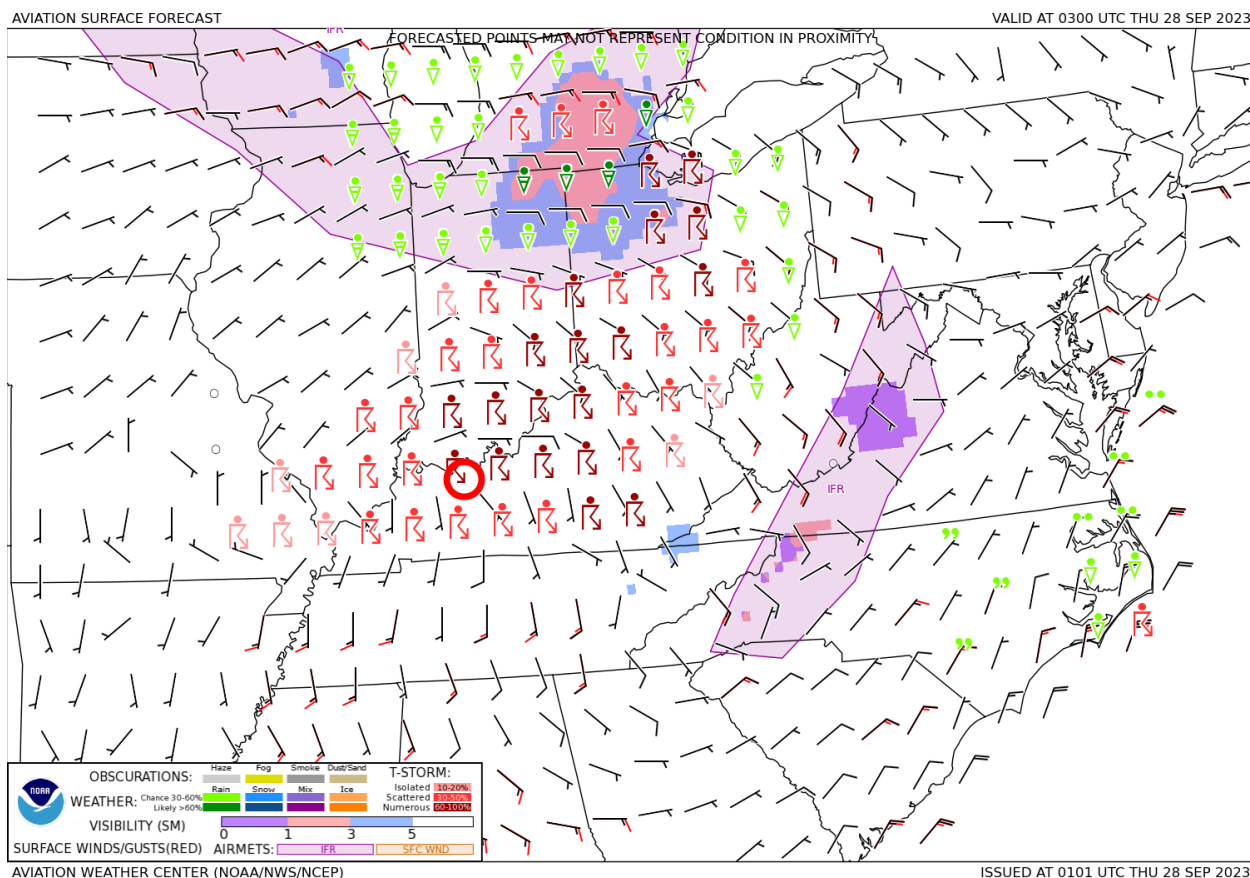


Figure 13 - GFA forecast imagery depicting IFR condition and surface wind G-AIRMETs, surface visibility, surface wind, precipitation, and other obscurations and hazards. Issued about 2000 and valid for 2200. The accident location is located within the red circle.

E. LIST OF ATTACHMENTS

Attachment 1 - Correspondence with L3 Harris.

Submitted by:

Mike Richards
Senior Meteorologist