

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



ERA24FA209

METEOROLOGY

Specialist's Factual Report

June 27, 2024

TABLE OF CONTENTS

A. ACCIDENT	3
B. METEOROLOGY SPECIALIST	3
C. DETAILS OF THE INVESTIGATION	3
D. WEATHER INFORMATION	3
1.0 WEATHER RADAR	3
2.0 HRRR MODEL SOUNDING	5
3.0 SATELLITE IMAGERY	6
4.0 PILOT REPORTS	8
5.0 SURFACE OBSERVATIONS	8
6.0 CURRENT ICING POTENTIAL	9
7.0 SIGMETs	11
8.0 CWSU PRODUCTS	11
9.0 G-AIRMETs FOR ICING	12
E. ATTACHMENTS	12

A. ACCIDENT

Location: Palmyra, Virginia

Date: 5 May 2024

Time: 0854 eastern daylight time (1254 UTC¹)

Aircraft: Type - Rockwell International; Registration - N690BM

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 meteorological specialist did not travel in support of this accident investigation and gathered all weather data remotely. Unless otherwise noted, all times are in eastern daylight time for 5 May 2024 (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: 37.859827° north latitude; 78.229488° west longitude at an elevation of about 400 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 Wakefield, Virginia (site KAKQ) at 0851 is presented in Figure 1, and the KAKQ Level-III hydrometeor classification algorithm product from that time is presented in Figure 2. KAKQ was located approximately 78 miles southeast of the accident location with an antenna elevation of about 255 feet. Assuming standard refraction and considering the 0.95° beam width³ for the WSR-88D radar beam, the KAKQ 1.8° tilt would have "seen"

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

altitudes above the accident location of between about 15,200 and 23,100 feet. The accident aircraft's flight path through 0850 is also represented in Figures 1 and 2. The weather radar imagery identified light values of reflectivity along the final portion of the accident aircraft's flight path, which the hydrometeor classification algorithm identified as "dry snow" and "ice crystals."

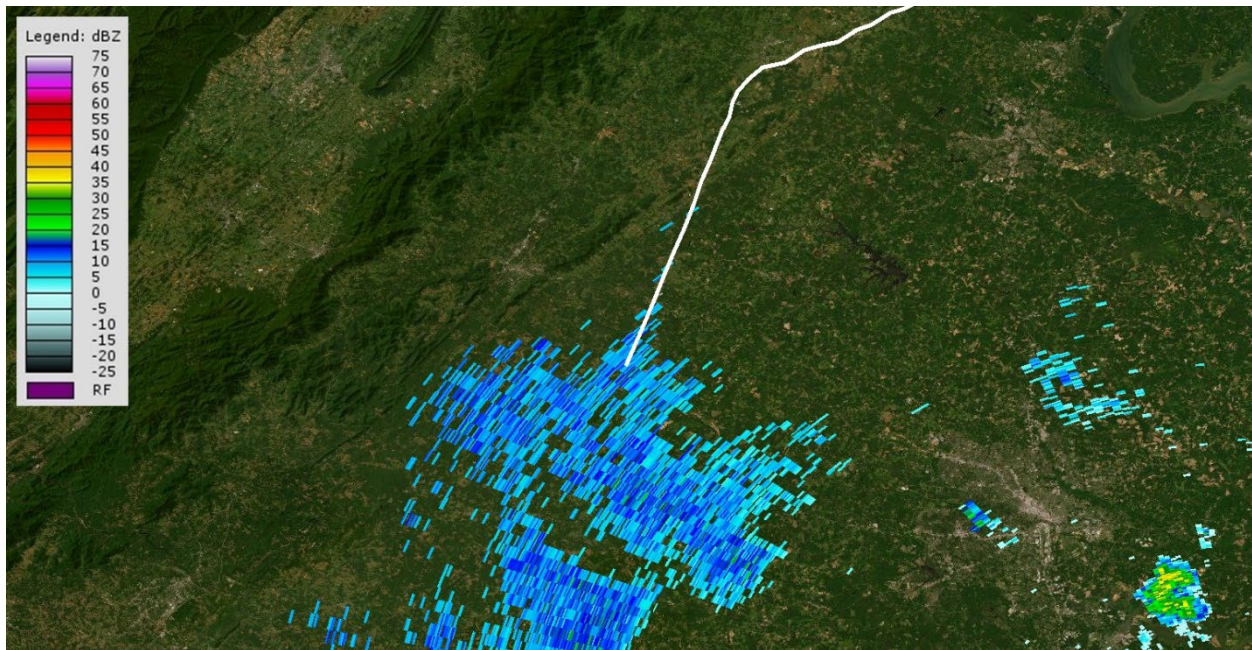


Figure 1 – KAKQ 1.8° Level-II base reflectivity product from a sweep initiated at 0851. The accident aircraft's flight path through 0850 is represented by the white line.

by one-half the maximum power. The maximum power lies along the beam centerline and decreases outward from the radar antenna.

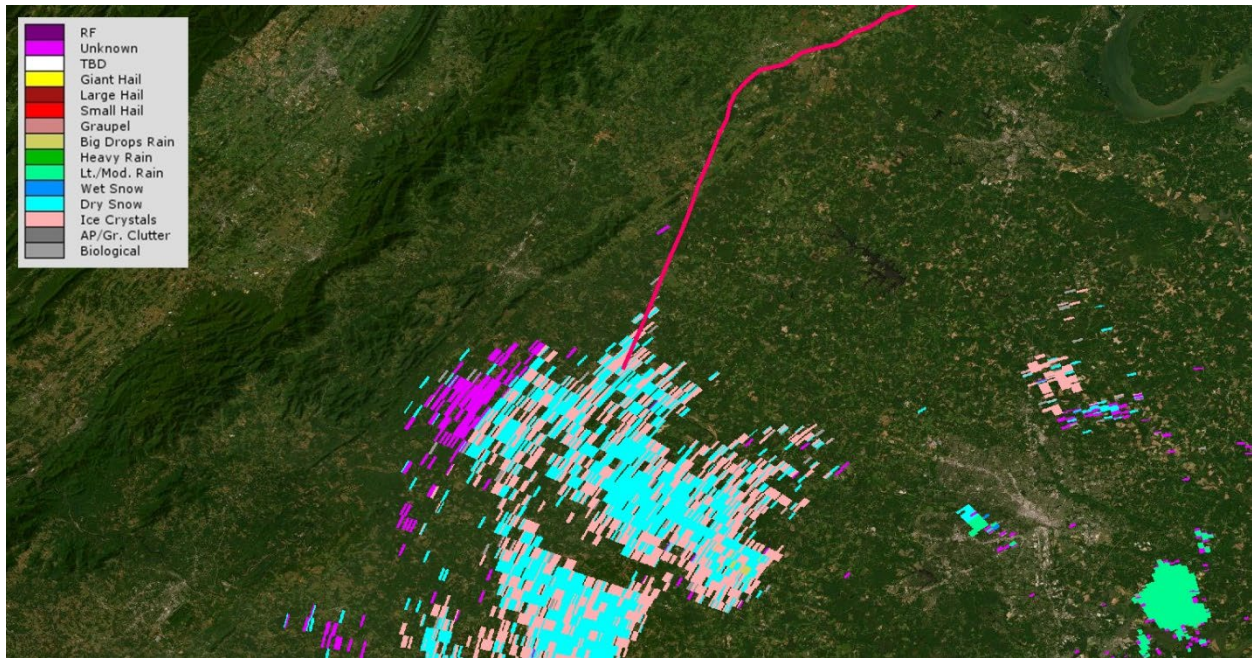


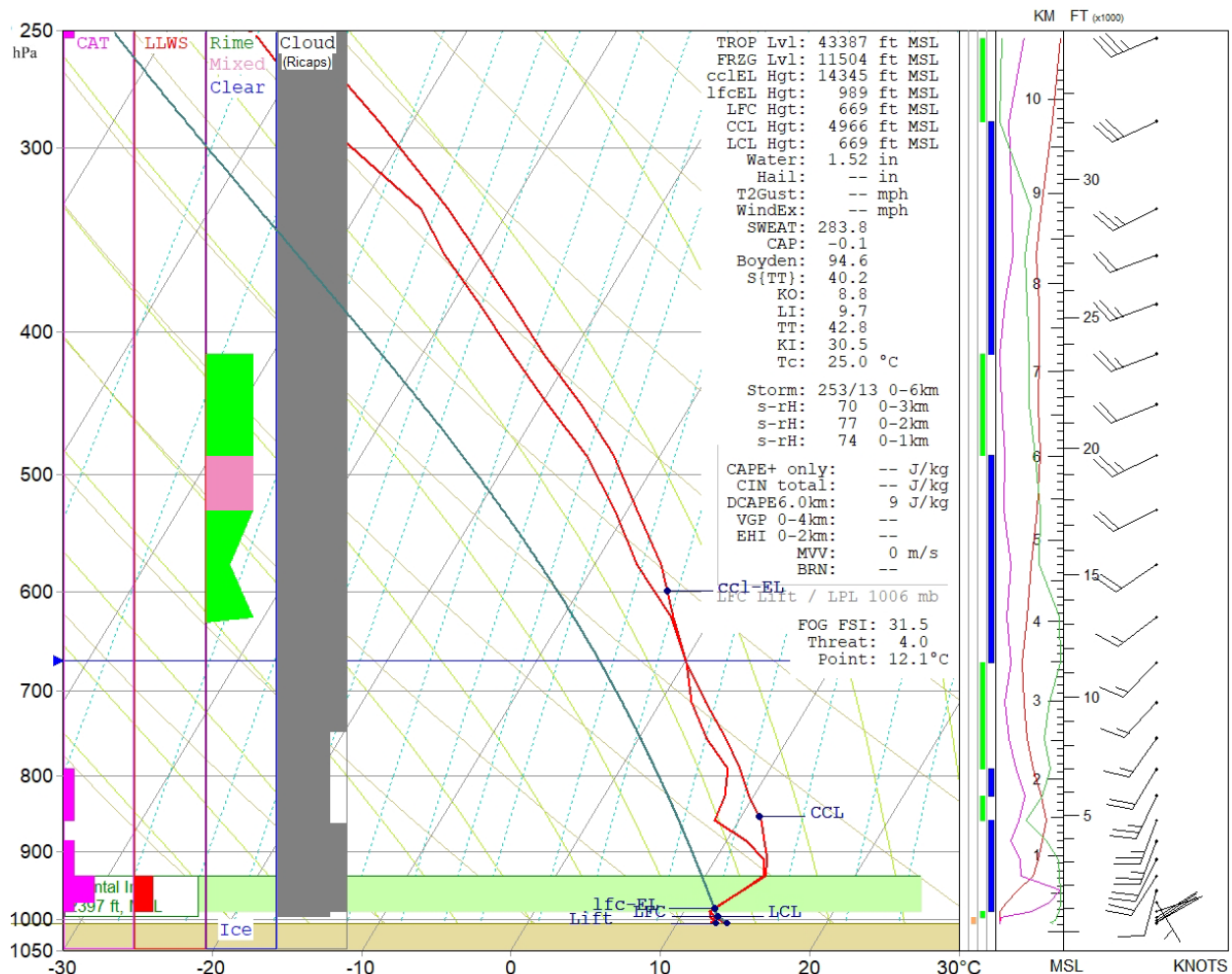
Figure 2 - KAKQ 1.8° Level-III hydrometeor classification product from a sweep initiated at 0851. The accident aircraft's flight path through 0850 is represented by the red line.

2.0 HRRR Model Sounding

A High-Resolution Rapid Refresh (HRRR) model⁴ sounding (Figure 3) for near the accident site⁵ at 0900 with an elevation of 374 feet was retrieved from the National Oceanic and Atmospheric Administration's (NOAA) Air Resources Laboratory and analyzed by the RAwinsonde OBservation (RAOB) program. Broken to overcast cloud layers were identified from below 1,000 feet up through 34,000 feet. The freezing level was at about 11,500 feet. The wind between 10,000 and 25,000 feet was from the southwest at magnitudes between 15 and 25 knots. There were no areas of significant turbulence noted above 10,000 feet. Light rime and mixed icing were noted between about 13,000 and 23,000 feet.

⁴ 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.

⁵ Coordinates used for the model were latitude: 37.86°N; longitude: 78.23°W.



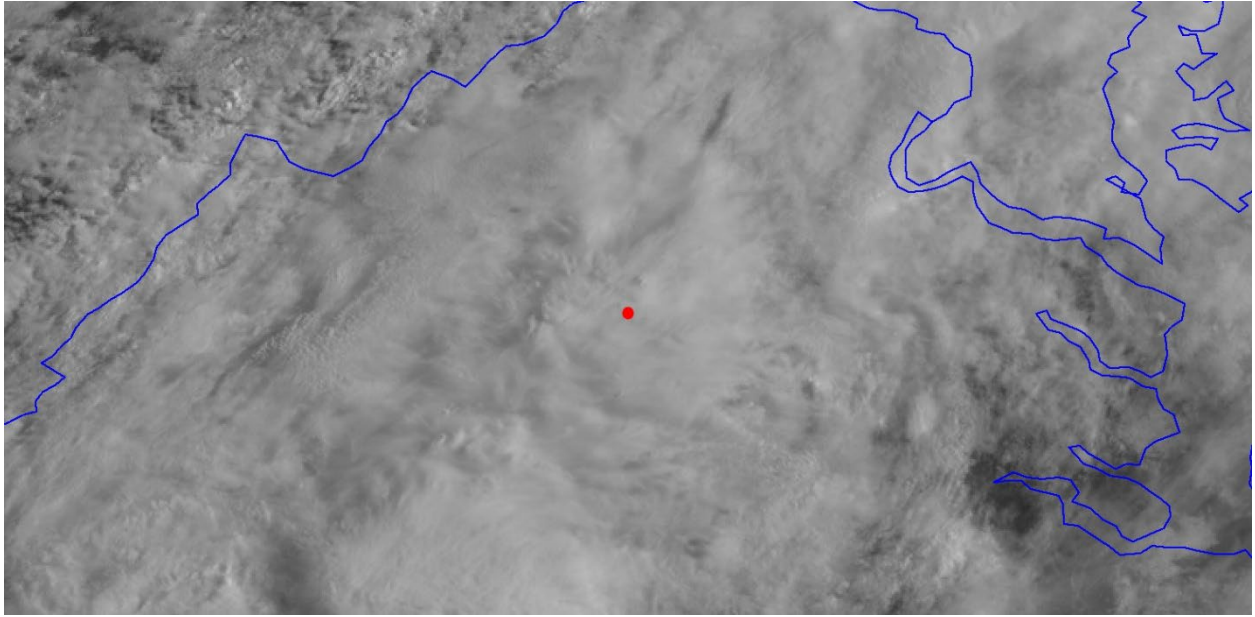


Figure 4 - GOES-16 visible imagery from 0856. Image is not corrected for parallax error. The accident location is denoted by the red dot.

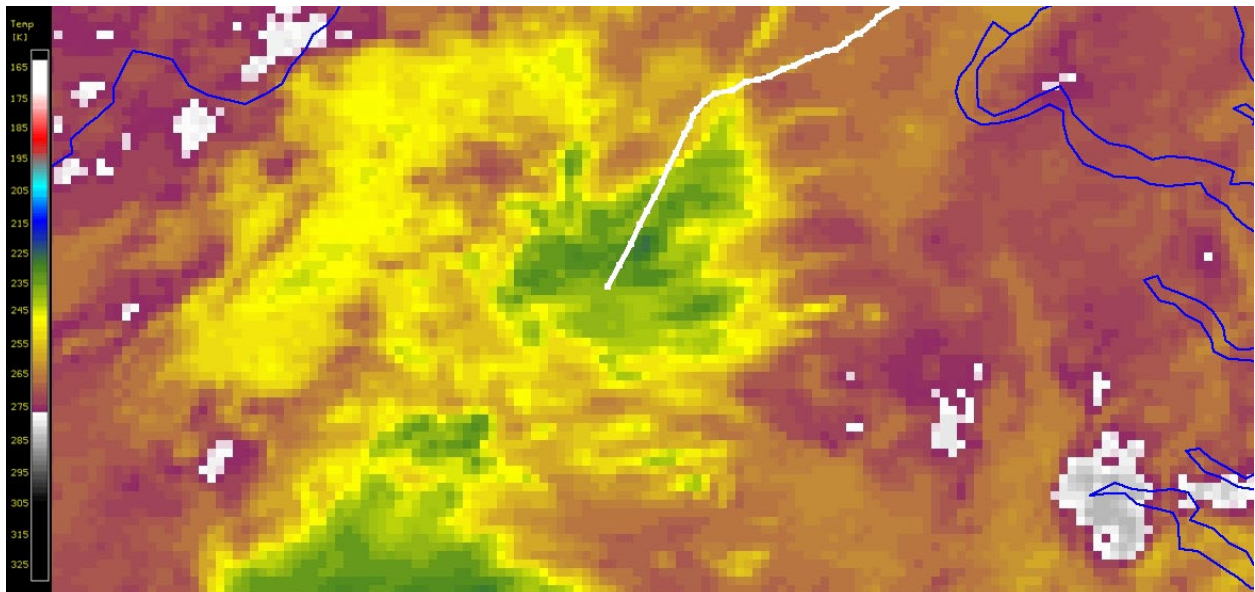


Figure 5 - GOES-16 infrared imagery from 0856. Image is not corrected for parallax error. The accident aircraft's flight path through 0850 is represented by the white line.

4.0 Pilot Reports

Longline-disseminated pilot reports⁶ (PIREPs) reported between 0700 and 1100 within 100 miles of the accident location are presented here. The report of light icing was about 95 miles from the accident location.

FKN UA /OV FKN/TM 1229/FL190/TP B757/TA M14/IC LGT RIME

RIC UA /OV LILLS/TM 1323/FL150/TP B737/TB MOD

ROA UA /OV ROA/TM 1415/FL310/TP CRJ9/TB CONS LGT CHOP

5.0 Surface Observations

An Automated Weather Observing Station (AWOS) was located at Louisa County Airport (LKU⁷) in Louisa, Virginia, which was located about 15 miles northeast of the accident site at an elevation of about 495 feet. It had a magnetic variation of about 10° west. Automated longline⁸ reports from the LKU AWOS during the times surrounding the accident time are presented here.

[0815] KLKU 051215Z AUTO 0000KT 10SM OVC003 12/12 A3015 RMK AO2
T01230120

[0835] KLKU 051235Z AUTO 36003KT 10SM OVC003 13/12 A3015 RMK AO2
T01270123

**[0855] KLKU 051255Z AUTO 35003KT 10SM OVC003 13/12 A3015 RMK
AO2 T01270123**

[0915] KLKU 051315Z AUTO 32005KT 10SM OVC003 13/12 A3016 RMK AO2
T01280123

⁶ These do not include pilot reports only broadcast via radio.

⁷ 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.

⁸ "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 public has access to surface weather observations, particularly outside of the aviation community.

At 0855, the LKU AWOS reported a wind from 350° at 3 knots, visibility 10 statute miles or greater, ceiling overcast at 300 feet above ground level (agl), temperature of 13°C and dew point temperature of 12°C, altimeter setting of 30.15 inches of mercury; Remarks: automated station with a precipitation discriminator, temperature of 12.7°C and a dew point temperature of 12.3°C.

6.0 Current Icing Potential

The Current Icing Potential (CIP) imagery provides information on expected icing severity as five categories: none, trace, light, moderate, and heavy. The severity estimates are roughly based on the accretion rate of ice on an airplane, and the levels are determined by the time it would take for an airfoil to accrete 1/4 of an inch of ice: trace = 1 hour; light = 15 minutes to 1 hour; moderate = 5 to 15 minutes; severe = less than 5 minutes.⁹

This report shows data from the National Center for Atmospheric Research's (NCAR) prototype CIP algorithm that were generated using NCAR's visualization software. This algorithm differs in various ways from the operational CIP that provided data used to generate the publicly available images accessible through the NWS Aviation Weather Center (AWC) on the accident day. NCAR's prototype CIP represents the latest research and development conducted by their team of in-flight icing scientists and have passed internal validation exercises using voice PIREPs of icing conditions and scientific airborne research observations of in-flight icing (when available).

Images presenting output from the CIP valid for 0908 for altitudes 1,000 feet to FL210¹⁰ for the accident region, as well as email correspondence with NCAR on the CIP, are presented in Attachment 1. Figure 6 presents cross-sections of CIP icing probability, CIP icing severity and supercooled large drop potential from the CIP's underlying HRRR model along the accident aircraft's flight path during its accident flight through 0850. According to NCAR, "(there was) roughly a 50/50 chance of icing at the higher altitudes with severity up to moderate. Possible SLD [supercooled large drops] which would likely be in the form of freezing drizzle (freezing rain would be very unlikely). Accretion rate was trickier...there is no supercooled liquid water in the model along the flight track, despite some potential for icing according to CIP...using the relationship between CIP severity and liquid water content, my best estimate is 0.1 to 0.2 mm (of potential ice accretion), with above 0.35 mm being very unlikely."

⁹ These are general values. Users should always consider the icing susceptibility of their airframe and availability of icing protection provided by their aircraft. Different aircraft and different flight configurations (airspeed, angle of attack, etc.) will experience variations in accretion rate.

¹⁰ 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.

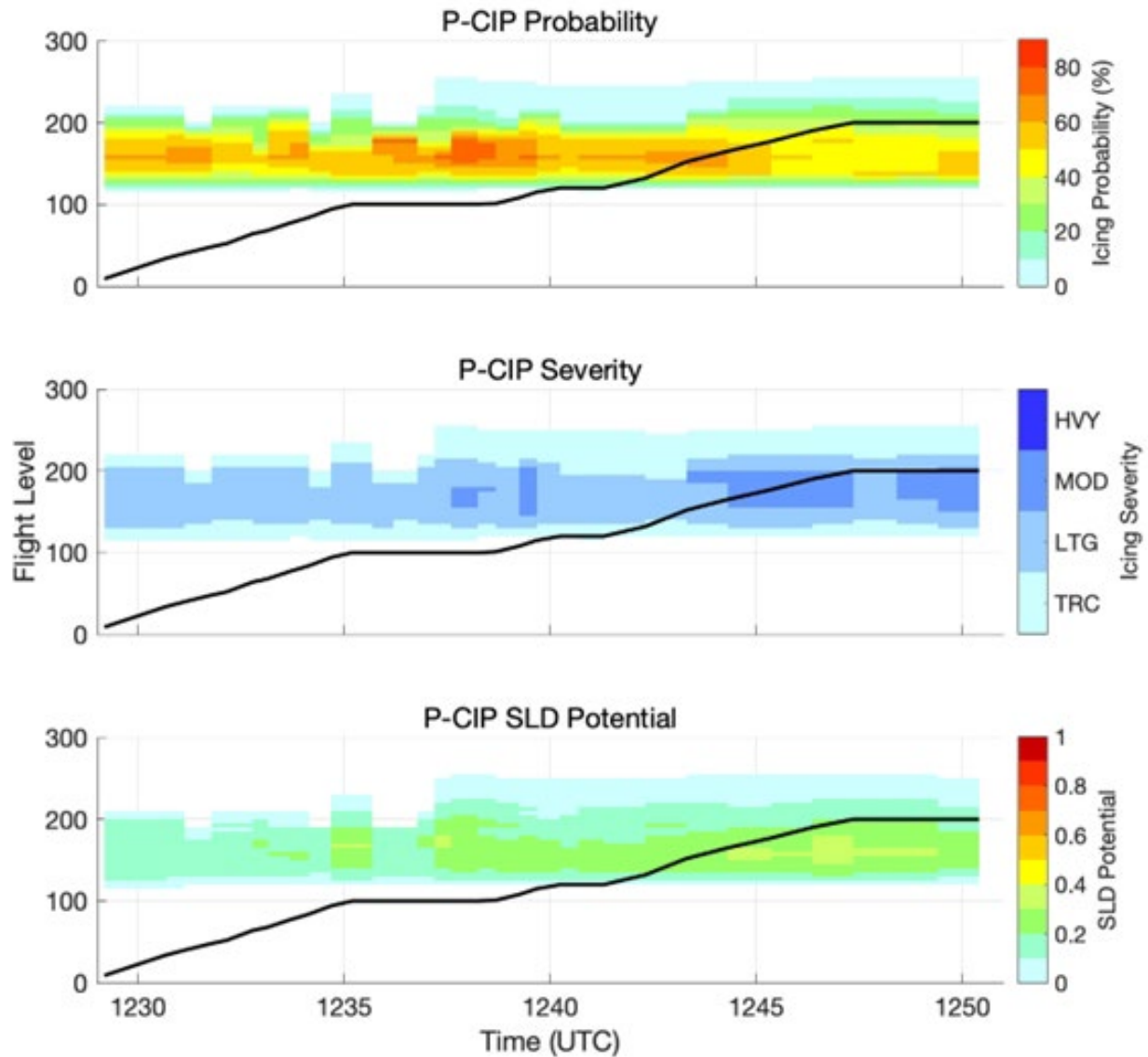


Figure 6 - Cross-sections of CIP icing probability, CIP icing severity and supercooled large drop potential from the CIP's underlying HRRR model along the accident aircraft's flight path during its accident flight through 0850.

NCAR also provided results from their "RadIA algorithm" (Figure 7) which analyzed the KAKQ 1.8° Level-II base reflectivity product from a sweep initiated at 0851 (Figure 1) to determine confidence in the presence of supercooled liquid water along the final portion of the accident aircraft's flight path where reflectivity was present. Further information about the RadIA algorithm may be found in Attachment 2. According to NCAR, the algorithm identified some support for mixed phase along that portion of the flight path, but there was no support for an environment made up of exclusively supercooled liquid water.

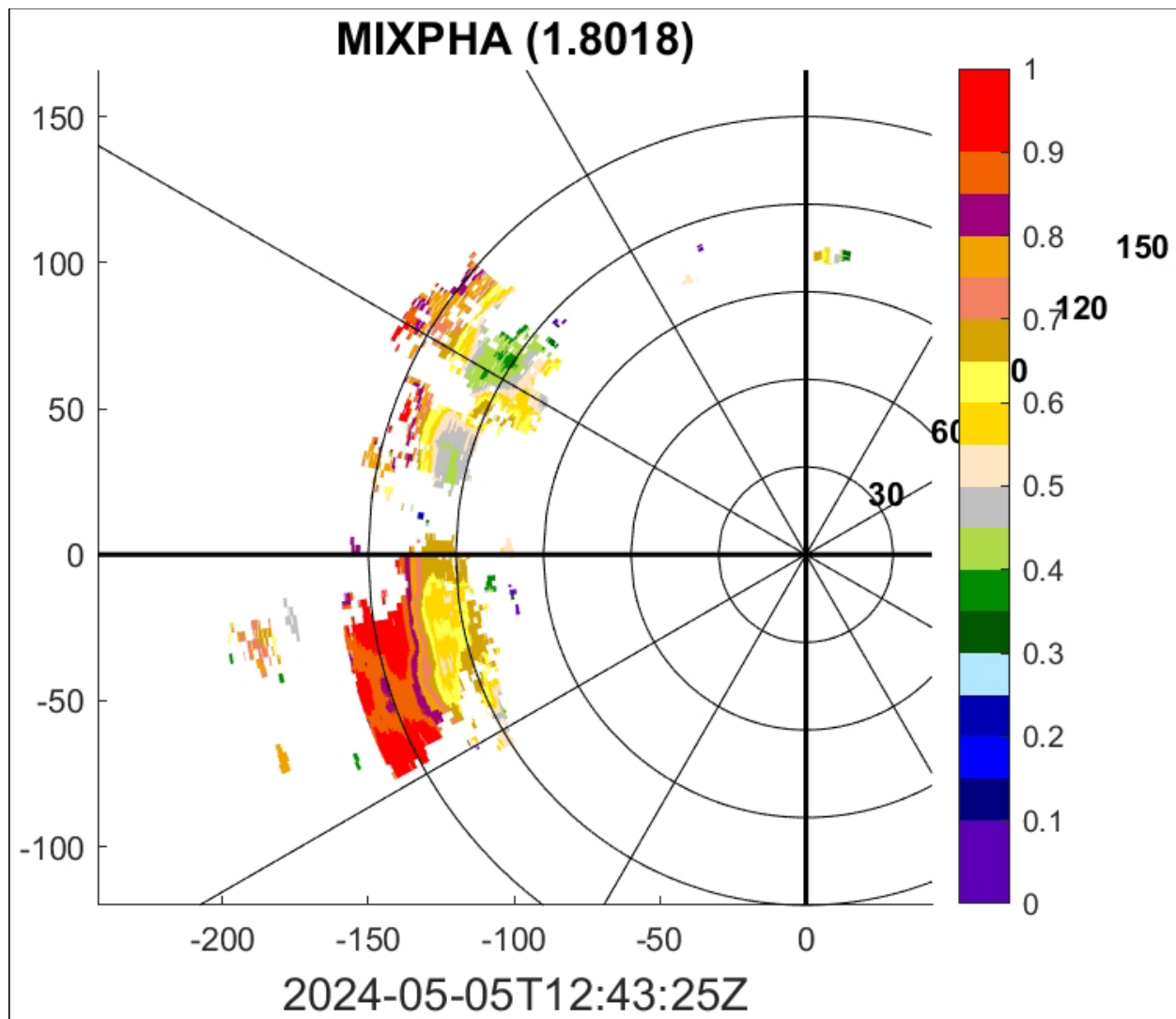


Figure 7 - Graphical output from NCAR's RadIA algorithm.

7.0 SIGMETs

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

8.0 CWSU Products

There were no Center Weather Advisories or Meteorological Impact Statements issued by the Center Weather Service Unit (CWSU) at the Washington Air Route Traffic Control Center.

9.0 G-AIRMETs for Icing

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 SIGMETs. They are only valid at specific time "snapshots". G-AIRMETs are issued at discrete times 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).

G-AIRMETs for moderate icing from the freezing level to FL240 were issued at 0445 and valid at 0800 and 1100 for a region that included the accident location.

E. ATTACHMENTS

Attachment 1 - Images presenting output from the CIP valid for 0908 for altitudes at and below FL210 for the accident region. Email correspondence with NCAR.

Attachment 2 - Email correspondence and attachment regarding the RadIA algorithm.

Submitted by:

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