

Specialist's Factual Report - Errata 001

METEOROLOGY

ANC21LA073

April 21, 2022

A. ACCIDENT

Location: Fairbanks, Alaska
Date: August 16, 2021
Time: 1452 Alaska daylight time
2252 Coordinated Universal Time (UTC)
Airplane: Cessna 208, Registration: N97HA

B. PURPOSE OF ERRATA

Update the Satellite Data section 4.0 with corrected factual information and more recent footnote links.

C. FACTUAL REPORT CORRECTIONS

REPLACE:

Additional satellite imagery was obtained from the Geographic Information Network of Alaska (GINA) and is provided in figure 6 and attachment 2¹. Imagery from the Polar Operational Environmental Satellite (POES)² from 1447 AKDT (figure 6)

Figure 6 - POES imagery at 1447 AKDT.

Experimental aviation cross-section imagery was viewed using POES satellite information³

WITH:

Additional satellite imagery was obtained from the Geographic Information Network of Alaska (GINA) and is provided in figure 6 and attachment 2⁴ using Joint Polar Satellite System (JPSS) data. Imagery from the Visible Infrared Imaging Radiometer Suite (VIIRS)⁵ from 1447 AKDT (figure 6)

¹ Additional information and imagery from the Joint Polar Satellite System (JPSS), Cooperative Institute for Research in the Atmosphere (CIRA), and Center for Satellite Applications and Research (STAR) can be found at: [AV Cloud Product Evaluation \(alaska.edu\)](http://AV.Cloud.Product.Evaluation.alaska.edu) and [RAMMB: RAMSDIS Online - Experimental Aviation Cross-section Product \(colostate.edu\)](http://RAMMB.RAMSDIS.Online.Experimantal.Aviation.Cross-section.Product.colostate.edu)

² Office of Satellite and Product Operations - POES (noaa.gov) and Suomi-NPP Operational Status - Office of Satellite and Product Operations (noaa.gov)

³ [RAMMB: RAMSDIS Online - Experimental Aviation Cross-section Product \(colostate.edu\)](http://RAMMB.RAMSDIS.Online.Experimantal.Aviation.Cross-section.Product.colostate.edu)

⁴ Additional information and imagery from the JPSS, Cooperative Institute for Research in the Atmosphere (CIRA), and Center for Satellite Applications and Research (STAR) can be found at: [AV Cloud Product Evaluation \(alaska.edu\)](http://AV.Cloud.Product.Evaluation.alaska.edu) and [CIRA Aviation Homepage \(colostate.edu\)](http://CIRA.Aviation.Homepage.colostate.edu)

⁵ [Suomi-NPP Operational Status - Office of Satellite and Product Operations \(noaa.gov\)](http://Suomi-NPP.Operational.Status.Office.of.Satellite.and.Product.Operations.noaa.gov)

Figure 6 - VIIRS imagery at 1447 AKDT.

Experimental aviation cross-section imagery was viewed using JPSS satellite information⁶

⁶ [CIRA Aviation Homepage \(colostate.edu\)](http://colostate.edu/cira)



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

April 21, 2022

Specialist's Factual Report

METEOROLOGY

ANC21LA073

Table Of Contents

A.	ACCIDENT	3
B.	METEOROLOGIST	3
C.	DETAILS OF THE INVESTIGATION	3
D.	FACTUAL INFORMATION	4
1.0	Synoptic Situation	4
1.1	Surface Analysis Chart	4
2.0	Surface Observations	5
3.0	Upper Air Sounding	9
4.0	Satellite Data	11
5.0	Regional Radar Imagery Information	15
5.1	Volume Scan Strategy	15
5.2	Beam Height Calculation	17
5.3	Reflectivity	17
5.4	Base Reflectivity and Lightning Data	18
6.0	Pilot Reports	20
7.0	Significant Meteorological Information	20
8.0	Center Weather Service Unit Advisories	20
9.0	Airmen's Meteorological Information	21
10.0	Area Forecast	22
11.0	Alaska Aviation Weather Unit Graphics	23
12.0	Terminal Aerodrome Forecast	24
13.0	NWS Area Forecast Discussion	24
14.0	Pilot Preflight Weather Information	26
15.0	Icing Potential	26
16.0	FAA Web Camera Images	36
17.0	Witness Information	36
18.0	Astronomical Data	37
E.	LIST OF ATTACHMENTS	38

A. ACCIDENT

Location: Fairbanks, Alaska
Date: August 16, 2021
Time: 1452 Alaska daylight time
2252 Coordinated Universal Time (UTC)
Aircraft: Cessna 208; Registration: N97HA

B. METEOROLOGIST

Paul Suffern
Senior Meteorologist
Operational Factors Division (AS-30)
National Transportation Safety Board

C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's (NTSB) Meteorologist did not travel for this investigation and gathered the weather data for this investigation from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources and also from the National Centers for Environmental Information (NCEI). This specialist factual contains the meteorological factors pertinent to the weather surrounding the accident time. All times are Alaska daylight time (AKDT) on August 16, 2021, and are based upon the 24-hour clock, where local time is -8 hours from UTC, and UTC=Z. Directions are referenced to true north and distances in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles. 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 and "P" for OCONUS¹ airports.

The accident location was at approximate latitude 65.03874° N, longitude 149.61914° W, at an approximate altitude of 10,300 feet (ft).

¹ Outside Continental United States – Overseas, refers to any country or place beyond CONUS. Alaska, Hawaii, and the U.S. territories are considered overseas under the Space-A Regulation.

D. FACTUAL INFORMATION

1.0 Synoptic Situation

The synoptic or large-scale migratory weather systems influencing the area were documented using standard NWS charts issued by the National Center for Environmental Prediction and the Weather Prediction Center, located in College Park, Maryland. These are the base products used in describing synoptic weather features and in the creation of forecasts and warnings for the NWS. Reference to these charts can be found in the joint NWS and Federal Aviation Administration (FAA) Advisory Circular “Aviation Weather Services”, AC 00-45H.²

1.1 Surface Analysis Chart

The NWS Surface Analysis Chart centered over Alaska for 1600 AKDT is provided as figure 1 with the approximate location of the accident location within the red circle. The chart depicted several low-pressure centers located along a frontal boundary that extended from northwestern Canada westward across northern Alaska and into the Chukchi Sea. The low-pressure centers were located in western Alaska, near the Brooks Range in northern Alaska, and in northwestern Canada with pressures of 1005-, 1004-, and 1002-hectopascals (hPa), respectively. A surface trough³ was located from the Alaskan Panhandle northwestward through Canada and into eastern Alaska. The accident site was located south of the stationary frontal boundary and west of the trough’s position.

The station models around the accident location depicted air temperatures in the low 50’s degrees Fahrenheit (°F), dew point temperatures in the upper 40’s °F with temperature-dew point spreads of 3°F or less, a southwest wind at 5 knots or less, and overcast skies with light rain reported in Fairbanks, Alaska.

²

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

³ Trough – An elongated area of relatively low atmospheric pressure or heights.

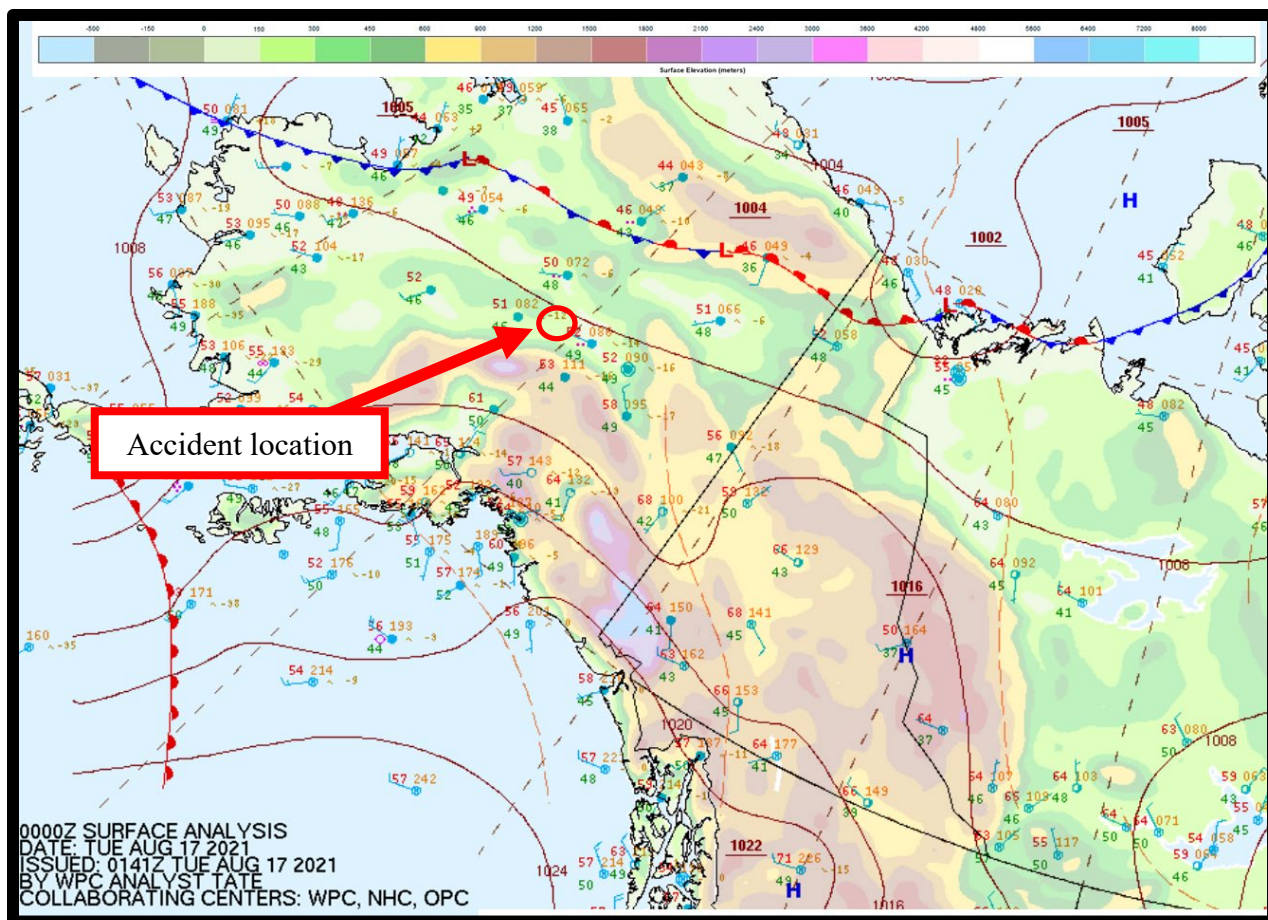


Figure 1 – NWS Surface Analysis Chart for 1600 AKDT.

2.0 Surface Observations

The area surrounding the accident location was documented using official Aviation Routine Weather Reports (METARs) and Specials (SPECIs). The following observations were taken from standard code and are provided in plain language. Figure 2 is a local sectional chart with the accident location and the closest weather reporting locations marked.



Figure 2 – Sectional map of the accident area with the location of the accident and surface observation sites.

Nenana Municipal Airport (PANN) had the closest official airport weather station to the accident location. PANN had an Automated Surface Observing System (ASOS⁴) whose longline⁵ reports were not supplemented. PANN ASOS was located 33 miles southeast of the accident location, at an elevation of 368 ft, and had a 16° easterly magnetic variation⁶ (figure 2). The following automated longline observations were disseminated during the times surrounding the accident:⁷

[1021 AKDT] SPECI PANN 161821Z AUTO 22007KT 190V260 4SM -RA BR SCT028
OVC036 11/09 A2983 RMK AO2 P0002 T01110094 TSNO=

[1053 AKDT] METAR PANN 161853Z AUTO 21007KT 6SM -RA BR OVC037 11/09 A2982
RMK AO2 SLP106 P0005 T01110094 TSNO=

⁴ ASOS – Automated Surface Observing System is equipped with meteorological instruments to observe and report wind, visibility, weather phenomena, ceiling, temperature, dewpoint, altimeter, and barometric pressure.

⁵ “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.

⁶ Magnetic variation – The angle (at a particular location) between magnetic north and true north. Latest measurement taken from <https://skyvector.com/>

⁷ The bold sections in this NWS product and the rest of the products in this report are intended to highlight the text that directly reference the weather conditions that affected the accident location around the accident time. The local times in this section next to the METARs are provided for quick reference between UTC and local times around the accident time.

[1153 AKDT] METAR PANN 161953Z AUTO 23007KT 10SM OVC038 11/08 A2982 RMK
AO2 RAE42 SLP104 P0002 T01110083 TSNO=

[1253 AKDT] METAR PANN 162053Z AUTO VRB05KT 10SM OVC040 11/09 A2981 RMK
AO2 SLP100 60007 T01110089 58007 TSNO=

***[1353 AKDT] METAR PANN 162153Z AUTO 23003KT 10SM OVC050 11/09 A2979 RMK
AO2 RAB2057E16 SLP094 P0000 T01110089 TSNO=***

ACCIDENT TIME 1452 AKDT

***[1453 AKDT] METAR PANN 162253Z AUTO 00000KT 10SM -RA OVC048 12/09 A2978
RMK AO2 RAB34 SLP090 P0000 T01170094 TSNO=***

[1553 AKDT] METAR PANN 162353Z AUTO 25005KT 10SM -RA OVC043 11/09 A2976
RMK AO2 SLP086 P0001 60008 T01110094 10117 20111 56014 TSNO=

The bold type observations decoded in plain language were as follows:

PANN weather at 1353 AKDT, automated, wind from 230° at 3 knots, visibility 10 miles or greater, overcast ceiling at 5,000 ft above ground level (agl), temperature of 11°Celsius (C), dew point temperature of 9°C, and an altimeter setting of 29.79 inches of mercury (inHg). Remarks: automated station with a precipitation discriminator, rain began at 1257 and ended at 1316 AKDT, sea level pressure 1009.4 hPa, a trace of precipitation since 1253 AKDT, temperature 11.1°C, dew point temperature 8.9°C, thunderstorm information not available.

PANN weather at 1453 AKDT, automated, wind calm, visibility 10 miles or greater, light rain, overcast ceiling at 4,800 ft agl, temperature of 12°C, dew point temperature of 9°C, and an altimeter setting of 29.78 inHg. Remarks: automated station with a precipitation discriminator, rain began at 1434 AKDT, sea level pressure 1009.0 hPa, a trace of precipitation since 1353 AKDT, temperature 11.7°C, dew point temperature 9.4°C, thunderstorm information not available.

Fairbanks International Airport (PAFA) was the departure airport and had an ASOS whose longline reports were supplemented by an official weather observer. PAFA ASOS was located 47 miles east-southeast of the accident location (figure 2), at an elevation of 439 ft, and had a 17° easterly magnetic variation. The following automated longline observations were disseminated during the times surrounding the accident and the departure:

[1253 AKDT] METAR PAFA 162053Z VRB06KT 7SM -RA SCT008 BKN016 OVC048 12/09
A2982 RMK AO2 SLP101 P0003 60016 T01170094 58006

[1336 AKDT] SPECI PAFA 162136Z VRB04KT 7SM -RA FEW008 SCT018 OVC050 11/09
A2981 RMK AO2 P0001 T01110089

***[1353 AKDT] METAR PAFA 162153Z 24007KT 7SM -RA FEW008 SCT018 OVC050 11/09
A2981 RMK AO2 SLP098 P0001 T01110089***

DEPARTURE TIME 1424 AKDT

ACCIDENT TIME 1452 AKDT

***[1453 AKDT] METAR PAFA 162253Z 17007KT 5SM -RA BR FEW008 SCT017 OVC038
11/09 A2979 RMK AO2 RAE13B41 SLP094 P0001 T01110094***

***[1553 AKDT] METAR PAFA 162353Z 18003KT 3SM -RA BR FEW010 BKN023 OVC036
11/09 A2978 RMK AO2 SLP088 P0000 60018 T01110094 10122 20111 58013***

The bold type observations decoded in plain language were as follows:

PAFA weather at 1353 AKDT, wind from 240° at 7 knots, visibility 7 miles, light rain, few clouds at 800 ft agl, scattered clouds at 1,800 ft agl, overcast ceiling at 5,000 ft agl, temperature of 11°C, dew point temperature of 9°C, and an altimeter setting of 29.81 inHg. Remarks: automated station with a precipitation discriminator, sea level pressure 1009.8 hPa, 0.01 inches of precipitation since 1253 AKDT, temperature 11.1°C, dew point temperature 8.9°C.

PAFA weather at 1453 AKDT, wind from 170° at 7 knots, visibility 5 miles, light rain and mist, few clouds at 800 ft agl, scattered clouds at 1,700 ft agl, overcast ceiling at 3,800 ft agl, temperature of 11°C, dew point temperature of 9°C, and an altimeter setting of 29.79 inHg. Remarks: automated station with a precipitation discriminator, rain ended at 1413 and began at 1441 AKDT, sea level pressure 1009.4 hPa, 0.01 inches of precipitation since 1353 AKDT, temperature 11.1°C, dew point temperature 9.4°C.

The observations from PANN surrounding the accident time indicated VFR⁸ conditions with light rain and ceilings between 4,000 and 5,000 ft agl. PAFA indicated MVFR conditions due to visibility restriction with mist and light rain, while ceilings remained between 3,600 and 5,000 ft agl.

⁸ As defined by the NWS and the FAA Aeronautical Information Manual (AIM) section 7-1-7 defines the following general flight categories:

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

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

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

3.0 Upper Air Sounding

Fairbanks, Alaska, had an upper air sounding (PAFA sounding) that had a station ID of 70261. The 1600 AKDT PAFA sounding was plotted on a standard Skew-T Log P diagram⁹ with the derived stability parameters included in figure 3 with data from the surface to 500-hPa (or approximately 18,000 ft msl). These data were analyzed using the RAOB¹⁰ software package. The sounding depicted the lifted condensation level (LCL)¹¹ at 580 ft msl, the convective condensation level (CCL)¹² at 2,395 ft msl, and the level of free convection (LFC)¹³ at 2,861 ft msl. The freezing level was located at 6,833 ft msl. The precipitable water value was 0.91 inches.

⁹ Skew T log P diagram – is a standard meteorological plot using temperature and the logarithmic of pressure as coordinates, used to display winds, temperature, dew point, and various indices used to define the vertical structure of the atmosphere.

¹⁰ RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Eosonde Research Services, The Villages, Florida.

¹¹ LCL - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

¹² CCL – The level in the atmosphere to which an air parcel, if heated from below, will rise dry adiabatically, without becoming colder than its environment just before the parcel becomes saturated.

¹³ LFC – The level at which a parcel of saturated air becomes warmer than the surrounding air and begins to rise freely. This occurs most readily in a conditionally unstable atmosphere.

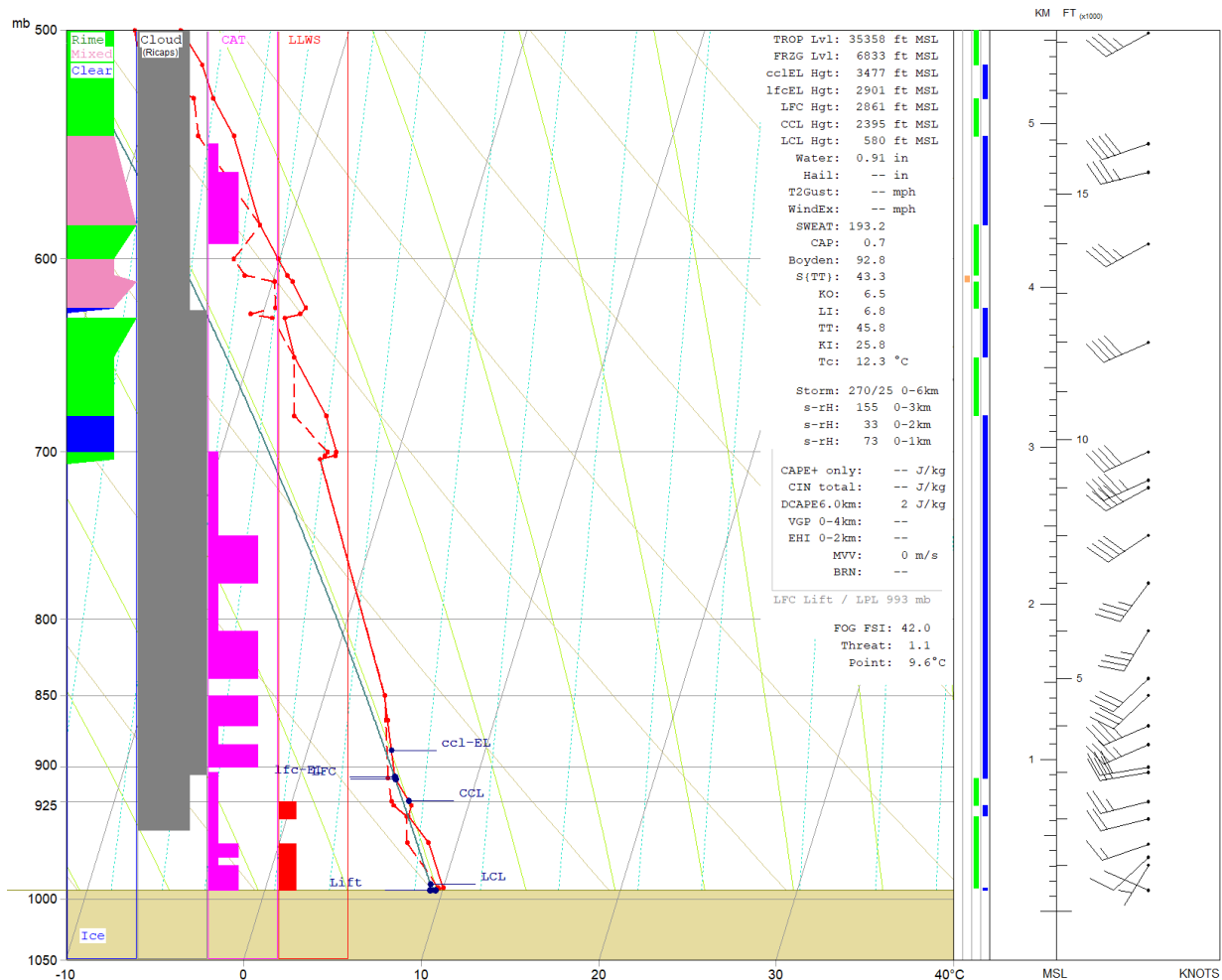


Figure 3 – 1600 AKDT PAFA sounding.

The 1600 AKDT PAFA sounding indicated a stable layer from the 3,000 to 10,500 ft msl (depicted in blue on right axis), with a conditionally unstable layer between 10,500 to 14,000 ft msl. RAOB indicated clouds from 2,000 ft msl through 18,000 ft msl and moderate or greater icing (including rime, clear, and mixed) above 9,500 ft msl. Inversions¹⁴ were present around 10,000 and 13,000 ft msl.

The 1600 AKDT PAFA sounding wind profile indicated the near surface wind from 295° at 1 knot with winds from the west to southwest immediately above the surface and increasing to 30 knots at 3,000 ft. The mean 0-to-6-kilometer (km) (approximately 18,000 ft) wind was from 240° at 33 knots. RAOB indicated the possibility of light to moderate clear-air turbulence in several layers between the surface and 18,000 ft msl. Near the aircraft's altitude (around 10,000 ft)¹⁵ before the accident the wind was from 245° at 39 knots with a temperature of -3.6°C and a dewpoint temperature near -4.1°C with a relative humidity of 96%.

¹⁴ Inversion – A departure from the usual decrease of the value of an atmospheric property with increasing altitude; also, the layer through which this departure occurs (the "inversion layer"), or the lowest altitude at which the departure is found (the "base of the inversion").

¹⁵ For more information please see the docket of this accident.

4.0 Satellite Data

The Geostationary Operational Environmental Satellite number 17 (GOES-17) visible and infrared data were obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison in Madison, Wisconsin, and processed using the Man-computer Interactive Data Access System software. Visible and infrared imagery (GOES-17 bands 2 and 13) at wavelengths of 0.64 microns (μm) and 10.3 μm , respectively, were retrieved for the period from 1100 AKDT through 1700 AKDT and reviewed, and the closest images to the time of the accident were documented.

Figure 4 presents the GOES-17 visible imagery from 1450 AKDT at 2X magnification with the accident location highlighted with a red square. There was cloud cover above the accident location at 1450 AKDT. The cloud cover had a transverse wave pattern or transverse band¹⁶ (attachment 1) near the accident location and points south and eastward. Figure 5 presents the GOES-17 infrared imagery from 1450 AKDT at 6X magnification with the accident location highlighted with a red square. The lower brightness temperatures (green colors; higher cloud tops) were located west through northeast of the accident location. The brightness temperature of about 250 Kelvin would have been near 20,000 ft msl based on the vertical temperature profile provided by the 1600 AKDT PAFA sounding. It should be noted these figures have not been corrected for any parallax error.

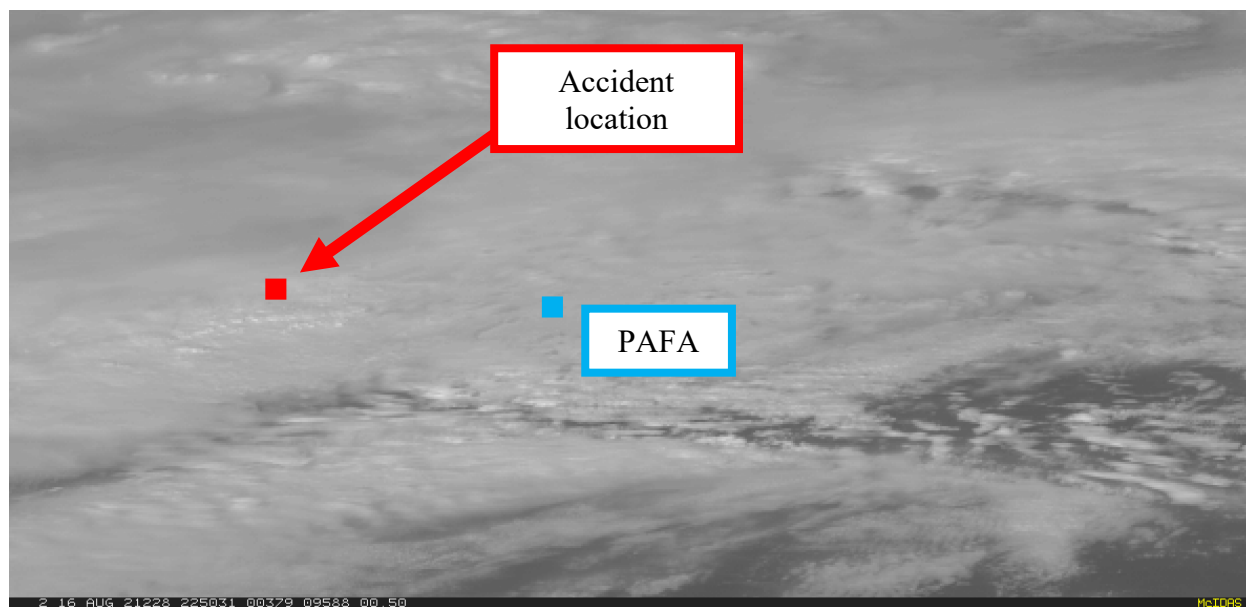


Figure 4 – GOES-17 visible image at 1450 AKDT.

¹⁶ Transverse Bands - Bands of clouds oriented perpendicular to the flow in which they are embedded. They often are seen best on satellite photographs. When observed at high levels (i.e., in cirrus formations), they may indicate turbulence.

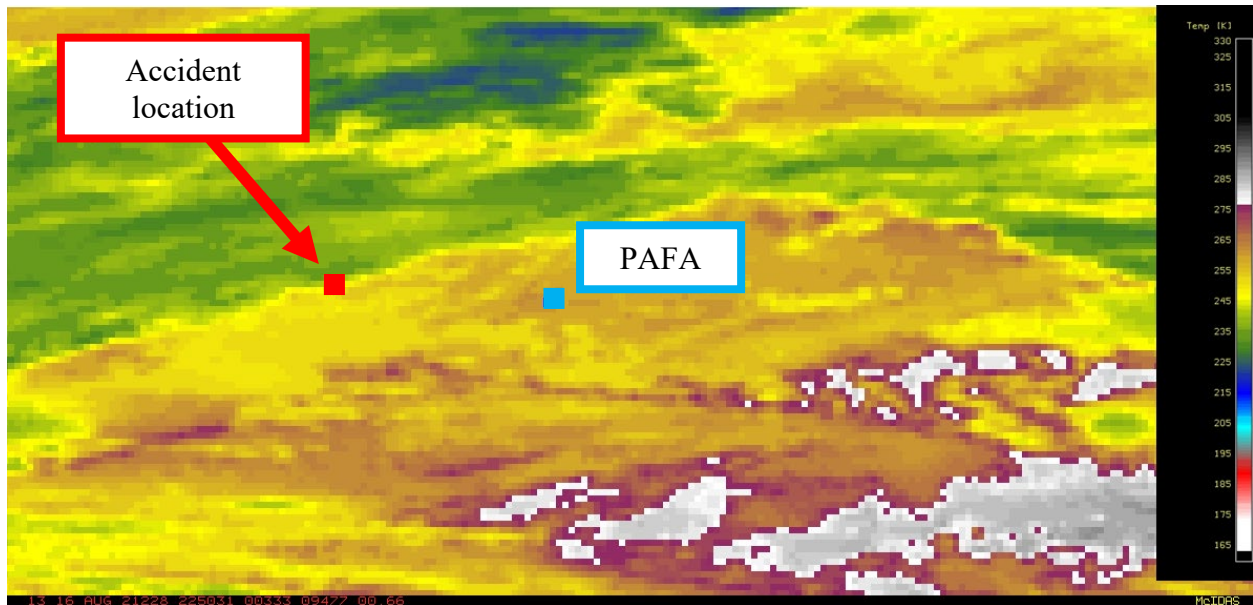


Figure 5– GOES-17 infrared image at 1450 AKDT.

Additional satellite imagery was obtained from the Geographic Information Network of Alaska (GINA) and is provided in figure 6 and attachment 2¹⁷ using Joint Polar Satellite System (JPSS) data. Imagery from the Visible Infrared Imaging Radiometer Suite (VIIRS)¹⁸ from 1447 AKDT (figure 6) continued to highlight the cloud cover above the accident location with the cloud tops above 20,000 ft msl (attachment 2).

¹⁷ Additional information and imagery from the JPSS, Cooperative Institute for Research in the Atmosphere (CIRA), and Center for Satellite Applications and Research (STAR) can be found at: [AV Cloud Product Evaluation \(alaska.edu\)](#) and [CIRA Aviation Homepage \(colostate.edu\)](#)

¹⁸ [Suomi-NPP Operational Status - Office of Satellite and Product Operations \(noaa.gov\)](#)

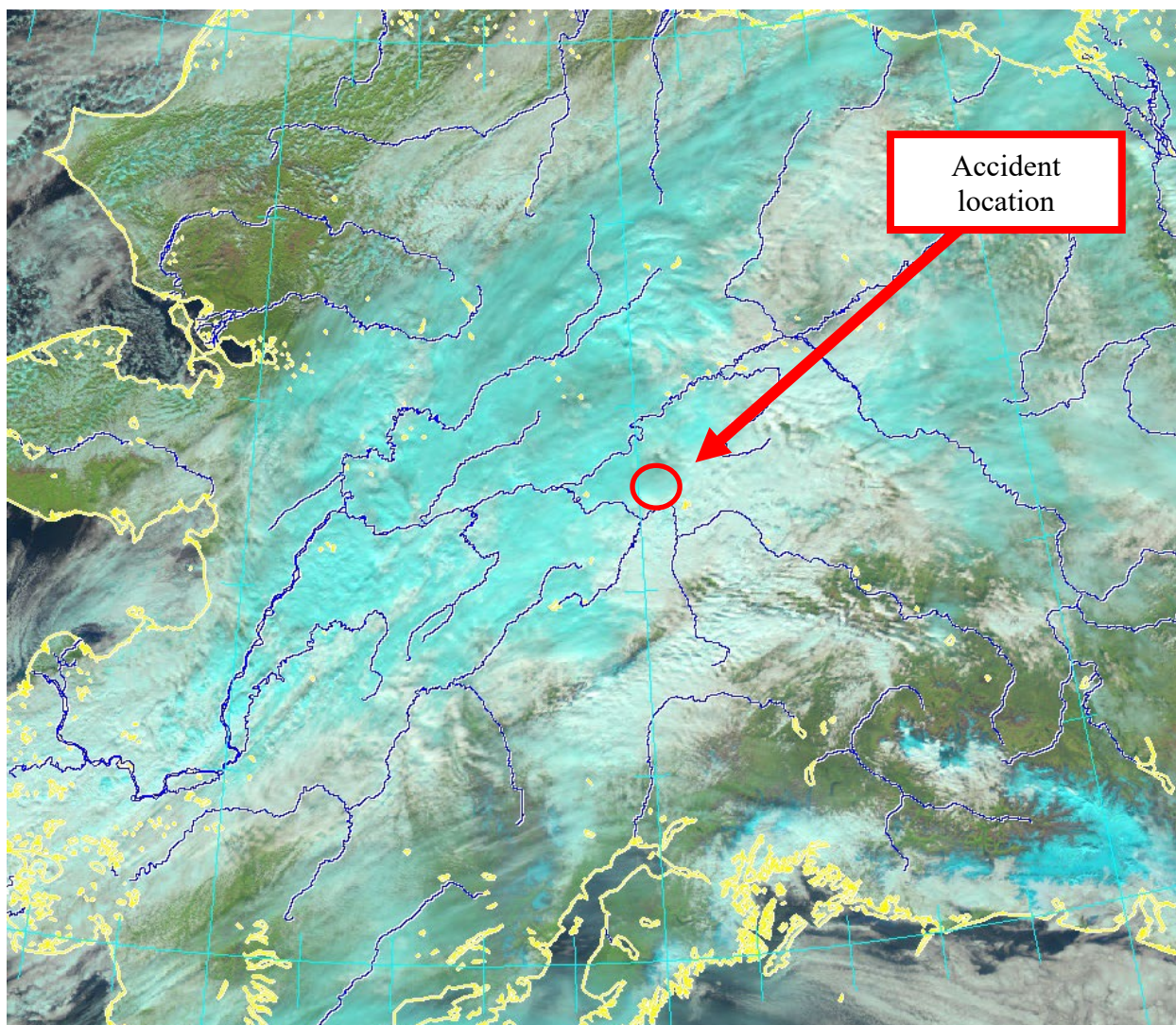


Figure 6 – VIIRS imagery at 1447 AKDT.

Experimental aviation cross-section imagery was viewed using JPSS satellite information¹⁹ with the Fairbanks to Barrow cross-section location noted in the exemplar imagery of figure 7. Figure 8 shows the Fairbanks to Barrow Experimental Aviation Cross-section Product valid at 1447 to 1500 AKDT with altitudes above 6,000 ft msl with cloud cover having supercooled icing²⁰ conditions. For more information on the cross-section imagery please see attachment 3.

¹⁹ [CIRA Aviation Homepage \(colostate.edu\)](http://cira.colostate.edu)

²⁰ [CIRA Aviation Introduction/FAQ \(colostate.edu\)](http://cira.colostate.edu)

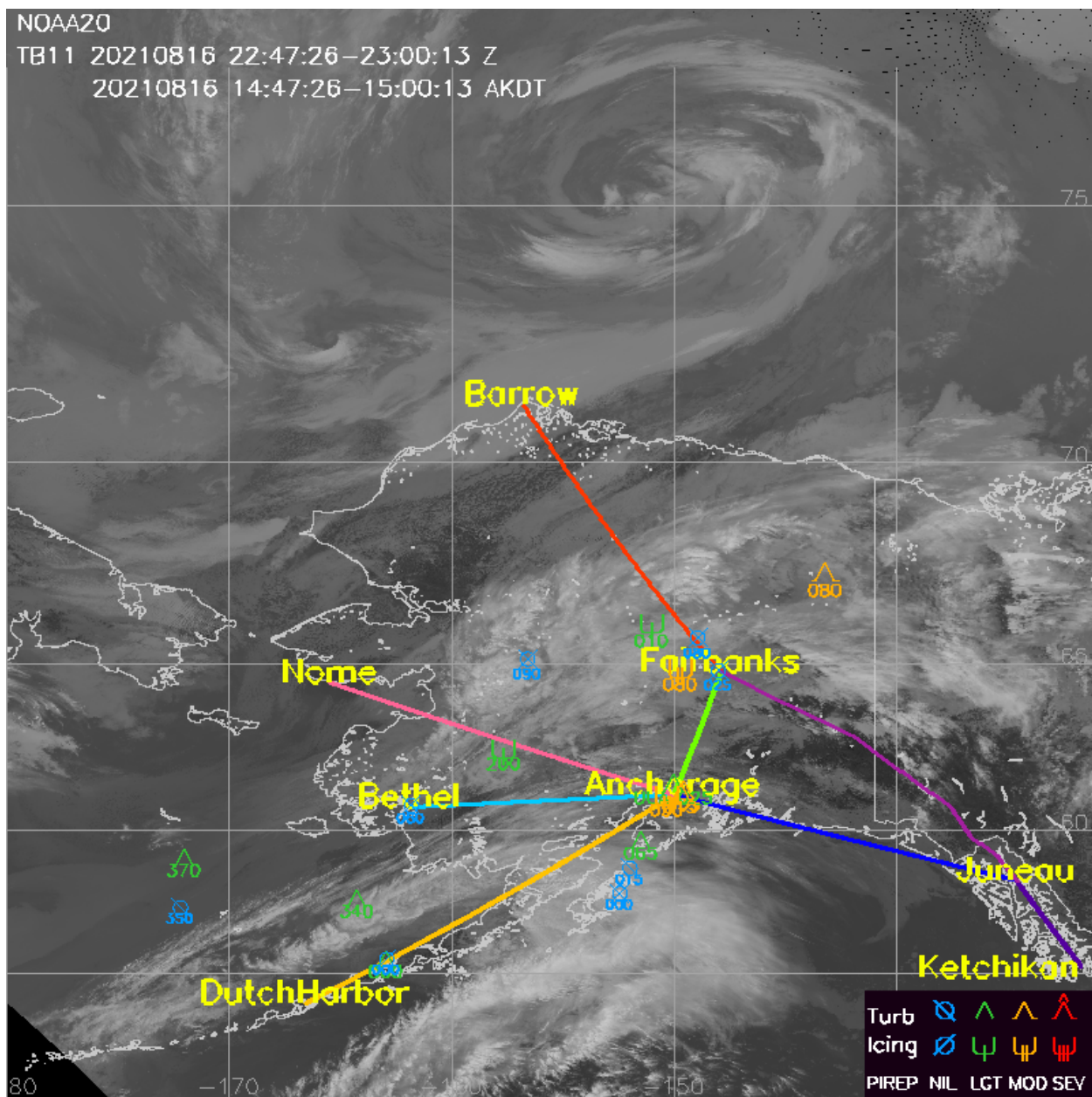


Figure 7 – Exemplar Experimental Aviation Cross-section Product cross-section locations.

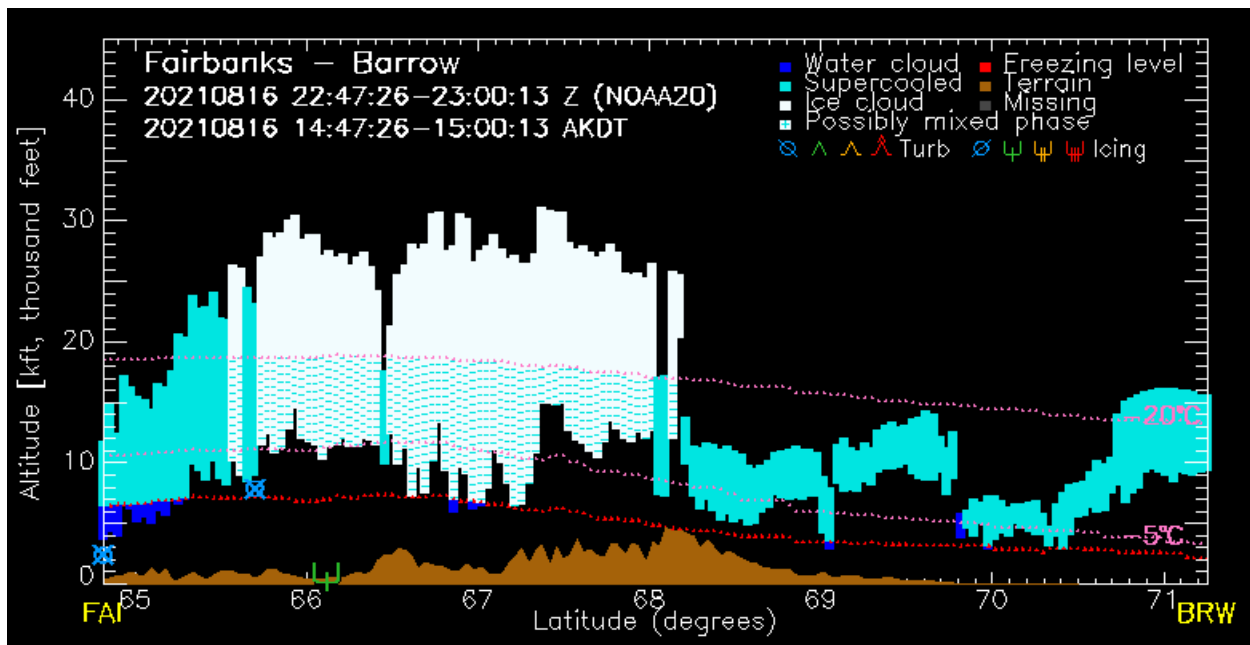


Figure 8 – Fairbanks to Barrow Experimental Aviation Cross-section Product valid at 1447 to 1500 AKDT.

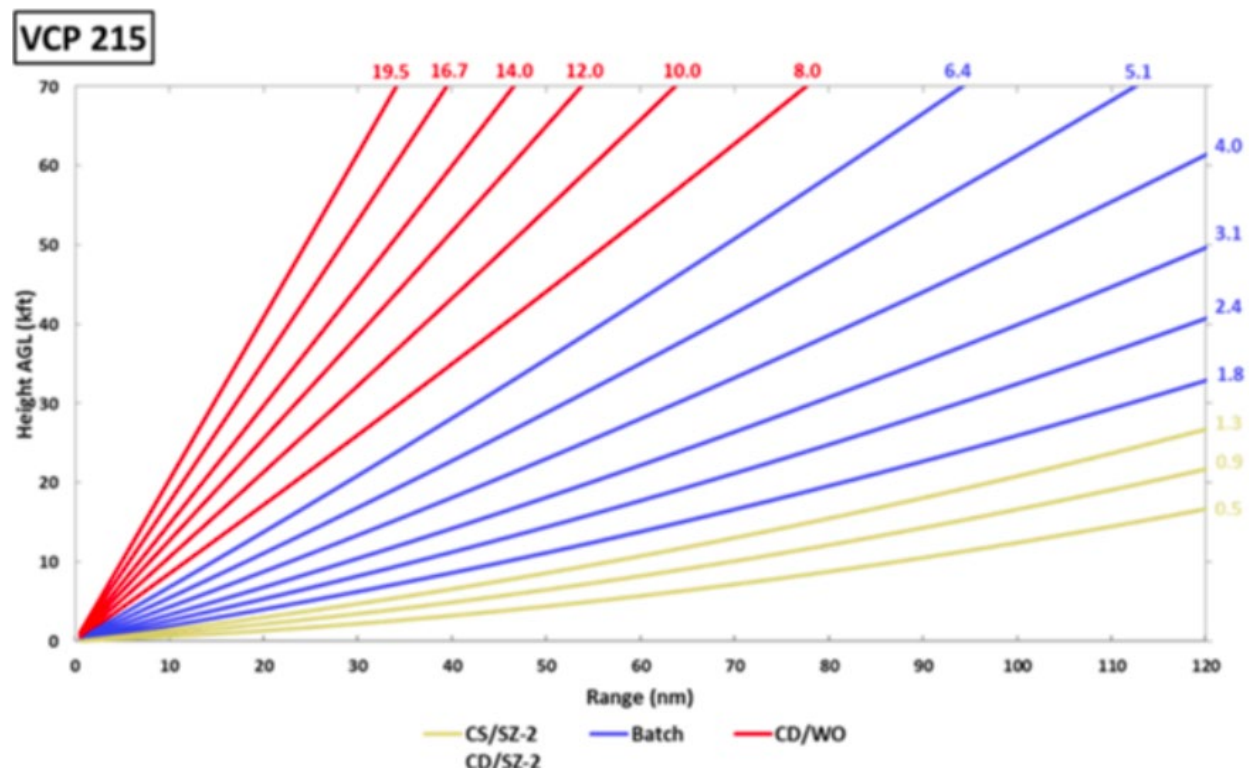
5.0 Regional Radar Imagery Information

The closest NWS weather radar was from Fairbanks/Pedro Dome (PAPD), Alaska, 54 miles east of the accident location. Level II archive radar data were obtained from the NCEI utilizing the NEXRAD Data Inventory Search and displayed using the NOAA's Weather and Climate Toolkit software.

5.1 Volume Scan Strategy

The WSR-88D is a computer-controlled radar system, which automatically creates a complete series of specific scans in a specific sequence known as a volume scan. Individual elevation scans are immediately available. Products that require data from multiple elevation scans are not available until the end of the four-to-ten-minute volume scan.

The WSR-88D operates in two main scanning modes, identified as Mode A and Mode B. Mode A is the precipitation scan and has several scanning strategies²¹. The most common is where the radar makes 15 elevation scans from 0.5° to 19.5° every six minutes. This scanning strategy is documented as volume coverage pattern 215 (VCP-215), which the radar was operating at during the time of the accident. The following chart provides an indication of the different elevation angles in this VCP, and the approximate height and width of the radar beam with distance from the radar site.



VCP-215 Precipitation Mode Scan Strategy.

²¹ Contiguous Surveillance (CS)--The low Pulse Repetition Frequency (PRF) scan of the split cut. Gives a high R_{max} value to determine proper target location and intensity, but a low V_{max} value limits the velocities that can be measured. Contiguous Doppler (CD)--The high PRF scan of the split cut. Gives a low R_{max} value causing more range folded (multiple trip) echoes, but a high V_{max} value to get higher, more accurate velocity values.

Batch Mode – Uses alternating low and high PRFs on each radial for one full rotation at each elevation angle. The two resulting data sets (low PRF and high PRF) are combined to resolve range ambiguity. Used in the middle elevation angles.

W – With range unfolding (W)

WO – Without range unfolding (WO)

5.2 Beam Height Calculation

Assuming standard refraction²² of the PAPD WSR-88D radar beam with the antenna elevation at 2,707 ft, and considering a beamwidth²³ of 0.95°, the following table shows the approximate heights for the radar beam center, base, and top for an antenna elevation over the accident location. These heights have been rounded to the nearest 10 ft.

ANTENNA ELEVATION	BEAM CENTER	BEAM BASE	BEAM TOP
PAPD 0.5°	7,680 ft	5,010 ft	10,350 ft
PAPD 0.9°	9,970 ft	7,310 ft	12,630 ft

Based on the radar height calculations, the elevation scan from PAPD listed in the above table depicted the conditions between 5,010 ft and 12,630 ft msl and these scans “saw” the closest altitudes to the aircraft’s altitude before descent.

5.3 Reflectivity

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors²⁴ 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 (dBZ²⁵) and is a general measure of echo intensity. FAA Advisory Circular AC 00-24C²⁶, “Thunderstorms,” dated February 19, 2013, also defines the echo intensity levels and weather radar echo intensity terminology associated with those levels (Table 1). For dBZ values less than 30 the weather radar echo intensity terminology should be “light”. For dBZ values between 30 and 40, the terminology should be “moderate.” “Heavy” terminology is used for dBZ values greater than 40 dBZ but less than 50 dBZ, inclusive. Finally, any dBZ values above 50 dBZ shall be described as “extreme.”

²² Standard Refraction in the atmosphere is when the temperature and humidity distributions are approximately average, and values set at the standard atmosphere.

²³ Beamwidth - the angular separation between the half power points on the antenna radiation pattern, where the gain is one half the maximum value.

²⁴ Hydrometeors are any product of condensation or sublimation of atmospheric water vapor, whether formed in the free atmosphere or at the earth’s surface; also, any water particles blown by the wind from the earth’s surface. Hydrometeors are classified as: (a) Liquid or solid water particles suspended in the air: cloud, water droplets, mist, or fog. (b) Liquid precipitation: drizzle and rain. (c) Freezing precipitation: freezing drizzle and freezing rain. (d) Solid (frozen) precipitation: ice pellets, hail, snow, snow pellets, and ice crystals. (e) Falling particles that evaporate before reaching the ground: virga. (f) Liquid or solid water particles lifted by the wind from the earth’s surface: drifting snow, blowing snow, blowing spray. (g) Liquid or solid deposits on exposed objects: dew, frost, rime, and glazed ice.

²⁵ dBZ – A non-dimensional “unit” of radar reflectivity which represents a logarithmic power ratio (in decibels , or dB) with respect to radar reflectivity factor, Z.

²⁶

https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/1020774

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

Table 1 - Reflectivity values and precipitation intensity terminology.

5.4 Base Reflectivity and Lightning Data

Figures 9, 10, and 11 present the PAPD WSR-88D base reflectivity images for the 0.5° and 0.9° elevation scan initiated at 1447:23, 1448:17, and 1452:55 AKDT, respectively, with a resolution of 0.5° X 250 meters (m). The accident location was in an area of reflectivity values between 0 and 10 dBZ at the accident time. The reflectivity bands were moving from west to east across the area at the accident time (attachments 4 and 5).

A separate review of Earth Networks Total Lightning archive indicated that there were no lightning flashes²⁷ near the accident location during the period.

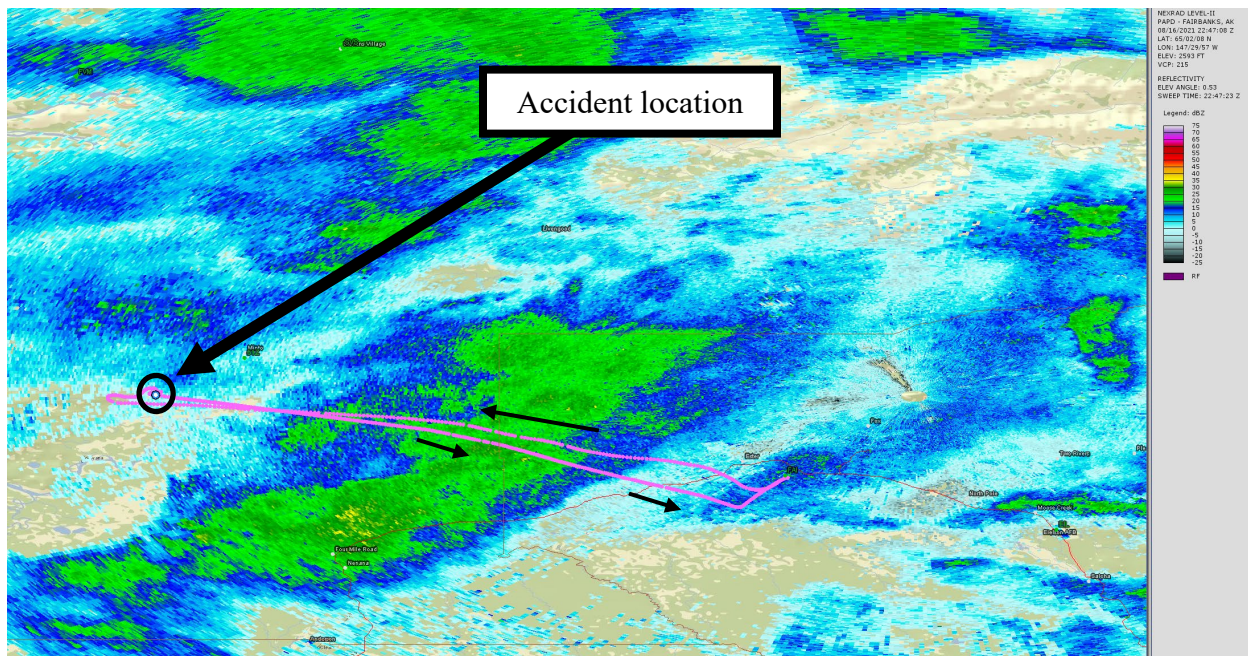


Figure 9 – PAPD WSR-88D 0.5° base reflectivity image for 1447:23 AKDT with the total flight track with arrows pointing in the direction of travel.

²⁷ Lightning Flash – This is one contiguous conducting channel and all the current strokes/pulses that flow through it. There are two types of flashes: ground flashes and cloud flashes. A review of Earth Networks Total Lightning network was done.

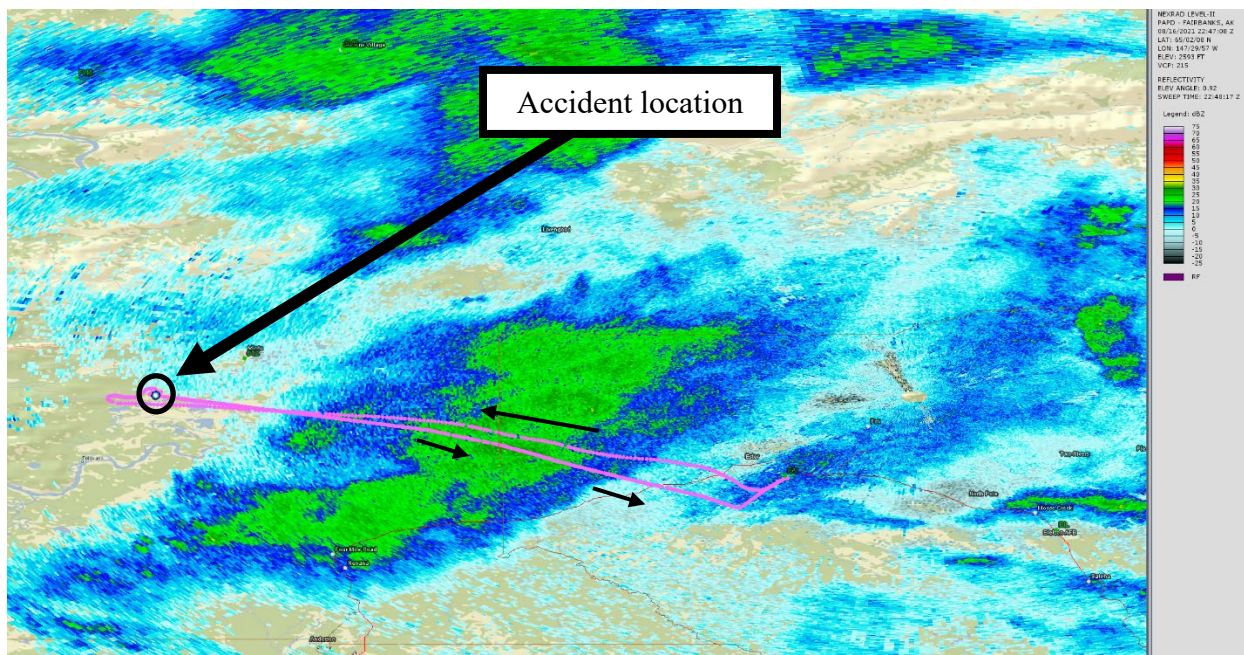


Figure 10 – PAPD WSR-88D 0.9° base reflectivity image for 1448:17 AKDT with the total flight track with arrows pointing in the direction of travel.

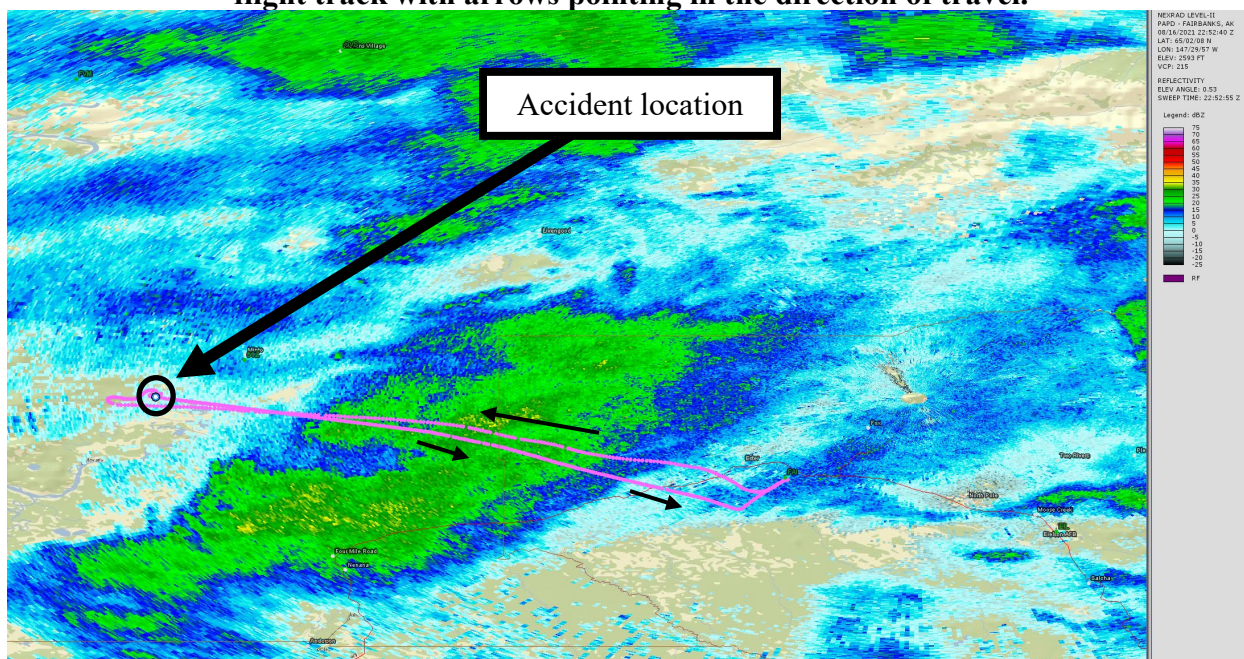


Figure 11 – PAPD WSR-88D 0.5° base reflectivity image for 1452:55 AKDT with the total flight track with arrows pointing in the direction of travel.

6.0 Pilot Reports

The longline-disseminated pilot reports²⁸ (PIREPs) distributed into the national airspace (NAS) were reviewed from about two hours prior to the accident time to two hours after the accident time for around 100 miles of the accident location for below 20,000 ft and those PIREPs are shown below. The moderate icing PIREP from 1445 AKDT occurred 6 minutes prior to the accident time and was located approximately 22 miles south of the accident location:

FAI UA /OV FAI316059/TM 2120/FL080/TP PA31/TA M04/TB NEG/IC NEG/RM SMOOTH RIDE /AKFSS/

FAI UA /OV FAI360054/TM 2146/FL105/TP C208/WV 24054KT/RM FAI ATCT /AKFSS/

FAI UA /OV FAI/TM 2241/FL025/TP B737/SK SCT025/TB NEG/IC NEG/RM ON FINAL RWY 20R AIS 7SM SMOOTH /AKFSS/

ENN UA /OV ENN300025/TM 2245/FL080/TP C208/TA M02/IC MOD MX/RM ZAN

FAI UA /OV FAI360002/TM 2333/FL015/TP PA31/SK SCT015/TB LGT CHOP/RM DURD RGD BASES 015-020 50KT FAI ATCT /AKFSS/

FAI UA /OV FAI360002/TM 2333/FL050/TP PA31/TA 02/RM DURD LGT CHOP 50KT HDWND A070 FAI ATCT /AKFSS/

FAI UA /OV FAI180015/TM 0010/FL105/TP E75L/TA M05/IC LGT RIME 105-075/RM DURD FAI ATCT /AKFSS/

FAI UA /OV FAI045015/TM 0015/FL070/TP PA31/WX BR -RA/TA M02/RM FAI ATCT /AKFSS/

FAI UA /OV FAI360004/TM 0043/FL017/TP PA31/TB LGT 017-000/RM RGD BASES 017 FAI ATCT /AKFSS/

FAI UA /OV FAI306065/TM 0059/FL060/TP C208/TA 01/TB MOD/IC LGT MX

7.0 Significant Meteorological Information

There were no convective or non-convective Significant Meteorological Information (SIGMET) advisories valid for the accident location at the accident time.

8.0 Center Weather Service Unit Advisories

The Anchorage (ZAN) Air Route Traffic Control Center (ARTCC) Center Weather Service Unit (CWSU) was responsible for the accident region. ZAN CWSU did not issue a Meteorological Impact Statement (MIS) or a Center Weather Advisory (CWA) for the accident location at the accident time.

²⁸ Only pilot reports with the World Meteorological Organization headers UBAK** were considered. These do not include pilot reports only broadcast via radio.

9.0 Airmen's Meteorological Information

There were Airmen's Meteorological Information (AIRMET) advisories valid for the accident location at the accident time with the AIRMET forecast below issued at 1232 AKDT. AIRMETs Sierra and Tango for mountain obscuration due to clouds and precipitation and moderate turbulence below 4,000 ft msl for were valid at the accident time. There were no AIRMET Zulu advisories current during the period for any moderate icing conditions over the region.

WAAK49 PAWU 162032

WA90

FAIS WA 162015

AIRMET SIERRA FOR IFR AND MT OBSC VALID UNTIL 170415

.

UPR YKN VLY FB

MTS N PAEG OBSC BY CLDS/PCPN. NC.

.

TANANA VLY FC

W TOK MTS OBSC CLDS/PCPN. NC.

.

KOYUKUK AND UPR KOBUK VLY FE

MTS OCNL OBSC BY CLDS/PCPN. IMPR.

.

LWR YKN VLY FF UPDT

MTS OCNL OBSC CLDS/PCPN. NC.

.

ARCTIC SLP CSTL FG

AFT 02Z PABR W OCNL CIG BLW 010/ISOL VIS BLW 3SM -SHRA/SHSN/BR. DTRT.

.

NORTH SLOPES OF BROOKS RANGE FH

MTS OBSC BY CLDS/PCPN. NC.

.

NRN SEWARD PEN AND LWR KOBUK VLY FI

SEWARD PEN MTS OBSC BY CLDS. NC.

.

SRN SEWARD PEN AND ERN NORTON SOUND FJ

TIL 02Z S PAUN OCNL CIG BLW 010/ISOL VIS BLW 3SM -RA BR. IMPR.

.

SRN SEWARD PEN AND ERN NORTON SOUND FJ

TIL 02Z NULATO HILLS OBSC BY CLDS/PCPN. IMPR.

.

=FAIT WA 162015

AIRMET TANGO FOR TURB/STG SFC WINDS VALID UNTIL 170415

.

UPR YKN VLY FB

PACE SW OCNL MOD TURB BLW 040. NC.

.

TANANA VLY FC

TIL 05Z PAFA-PAMH LN NW OCNL MOD TURB BLW 040. WKN.

.

TANANA VLY FC

AFT 02Z VCY AK RANGE ISABEL PASS W OCNL MOD TURB BLW 080. INTSF.

.

LWR YKN VLY FF UPDT

TIL 02Z PAGA E OCNL MOD TURB BLW 040. WKN.

.

=FAIZ WA 162015
AIRMET ZULU FOR ICING VALID UNTIL 170415

.
LWR YKN VLY FF UPDT
PANV-PAHC LN SW OCNL MOD ICEIC 080-160.
FZLVL 060 EXC 080 SW. NC.

.
SO AUG 2021 AAWU

10.0 Area Forecast

The Area Forecast valid for the accident location issued at 1230 AKDT is below with few clouds at 1,000 ft, scattered clouds at 2,000 ft, broken clouds at 4,000 ft with cloud tops at FL240²⁹ and light rain. Occasional broken clouds down to 2,000 ft in light rain was forecast with AIRMETs Sierra and Tango, and isolated moderate in-cloud icing between 8,000 and 14,000 ft msl with the freezing level at 8,000 ft:

FAAK49 PAWU 162030 CCA
FA9H
FAIH FA 162026 COR
AK NRN HLF...

.
AIRMETS VALID UNTIL 170415
CB IMPLY POSSIBLE SEV OR GREATER TURB SEV ICE LLWS AND IFR CONDS.
NON MSL HEIGHTS NOTED BY AGL OR CIG.

.
SYNOPSIS VALID UNTIL 171400
STNRY FNT STRETCHES BTN PABA AND 1006MB QSTNRY LO OVR ERN
NORTON SND. HI PRES BLDS OVR BERING STRAIT.

.
UPR YKN VLY FB...VALID UNTIL 170800
...CLOUDS/WX...
AIRMET MT OBSCMTS N PAEG OBSC BY CLDS/PCPN. NC...
NW PAEG FEW010 SCT020 OVC040 TOP FL250 -RA. OCNL BKN020/VIS 3-5SM -RA BR.
ELSW SCT050 BKN080 TOP FL250/ISOL -RA.
OTLK VALID 170800-171400...NW PAEG MVFR CIG RA.
ELSW VFR SHRA.
...TURB...
AIRMET TURBPACE SW OCNL MOD TURB BLW 040. NC...
OTRW PFYU SW ISOL MOD TURB BLW 040.
...ICE AND FZLVL...
YKN FLATS N ISOL MOD ICEIC 060-120.
S PARC ISOL MOD ICEIC 080-140.
FZLVL 060.

.
TANANA VLY FC...VALID UNTIL 170800
...CLOUDS/WX...
*****AIRMET MT OBSC***W TOK MTS OBSC CLDS/PCPN. NC...**
NW ISABEL PASS-PABI LN FEW010 SCT020 BKN040 TOP FL240 -RA.

²⁹ Flight Level – A Flight Level (FL) is a standard nominal altitude of an aircraft, in hundreds of ft. This altitude is calculated from the International standard pressure datum of 1013.25 hPa (29.92 inHg), the standard sea-level pressure, and therefore is not necessarily the same as the aircraft's true altitude either above mean sea level or above ground level.

OCNL BKN020 -RA. TIL 00Z ISOL VIS 3SM/CIG BLW 010 RA BR.
 ELSW ALG AK RANGE W MENTASTA PASS SCT040 BKN070 TOP FL240.
 OCNL BKN040 -RA. ELSW BKN080 TOP 150 WI LYRS TO FL250.
 VCY GAPS IN AK RANGE SFC WND S 25 G40KTS.
 OTLK VALID 170800-171400...W PABI MVFR CIG RA BR. ELSW VFR.
 PASSES...
 ISABEL..MVFR CIG RA BR.
 MENTASTA...VFR.
 ...TURB...
 AIRMET TURBTIL 05Z PAFA-PAMH LN NW OCNL MOD TURB BLW 040. WKN...
 AIRMET TURBAFT 02Z VCY AK RANGE ISABEL PASS W OCNL MOD TURB BLW 080. INTSF...
 ...ICE AND FZLVL...
 ISOL MOD ICEIC 080-140. FZLVL 080 EXC 060 N.
 .
 KOYUKUK AND UPR KOBUK VLY FE...VALID UNTIL 170800
 ...CLOUDS/WX...
 AIRMET MT OBSCMTS OCNL OBSC BY CLDS/PCPN. IMPR...
 SCT020 BKN030 FL250 -RA. OCNL BKN020/VIS 5SM -RA BR.
 AFT 00Z PAFM NW SCT030 BKN040 TOP 060 WI LYRS ABV 150.
 OTLK VALID 170800-171400...E PAFM-PAHL LN MVFR CIG VIS RA BR.
 ELSW VFR.
 ...TURB...
 TIL 05Z SE PAIM ISOL MOD TURB BLW 040.
 ...ICE AND FZLVL...
 SE PAFM ISOL MOD ICEIC 060-120.
 KOBUK VLY W PAFM ISOL MOD ICEIC 040-100.
 FZLVL 025 NW TO 045 SE.
 .
 LWR YKN VLY FF...VALID UNTIL 170800 UPDT
 ...CLOUDS/WX...UPDT
 AIRMET MT OBSCMTS OCNL OBSC CLDS/PCPN. NC...
 FEW008 SCT025 BLN040 TOP FL250 -RA. OCNL BKN025/VIS 5SM -RA BR.
 TIL 00Z PANV S ISOL CIG BLW 010. AFT 04Z PAGA-PARY LN NW SCT030 BKN045 TOP 080.
 OTLK VALID 170800-171400...PANV-PARY LN NW VFR. ELSW MVFR CIG RA.
 ...TURB...
 AIRMET TURBTIL 02Z PAGA E OCNL MOD TURB BLW 040. WKN...
 OTRW SE PAGA-PANV LN ISOL MOD TURB BLW 040.
 ...ICE AND FZLVL...
 AIRMET ICEPANV-PAHC LN SW OCNL MOD ICEIC 080-160.
 FZLVL 060 EXC 080 SW. NC...
 PAKV-PAMC LN NE ISOL MOD ICEIC 060-120.
 .

11.0 Alaska Aviation Weather Unit Graphics

The Alaska Aviation Weather Unit (AAWU) produced graphical forecast information valid at the accident time and that information can be found in attachment 6. Isolated moderate icing conditions were forecast between 8,000 and 14,000 ft msl for the departure and accident locations. Isolated moderate turbulence conditions between the surface and 8,000 ft were forecast for the accident location for 1200 AKDT.

12.0 Terminal Aerodrome Forecast

There was no NWS³⁰ Terminal Aerodrome Forecast (TAF) valid within 40 miles of the accident location.

13.0 NWS Area Forecast Discussion

The NWS office in Fairbanks, Alaska, (WFO AFG) issued the following Area Forecast Discussion (AFD) at 1421 AKDT and this was the AFD valid at the accident time:

FXAK69 PAFG 162221
AFDAFG

Northern Alaska Forecast Discussion
National Weather Service Fairbanks AK
221 PM AKDT Mon Aug 16 2021

.SYNOPSIS...

More rainfall today as another low moves from Norton Sound eastward through the Interior through tomorrow afternoon. Another additional 0.5-1" is expected across most of the Interior. Drier weather briefly returns on Wednesday before the next rain event moves in on Wednesday night and shifts east through Friday.

&&

.DISCUSSION...

Upper Levels and Analysis...

The anomalous closed arctic low remains north of the North Slope, which is analyzed around 513 dam, which is approximately -3 sigma. There is a shortwave trough merging with the larger arctic trough moving across the Lower Yukon Valley and Delta, with the associated surface low moving from Norton Sound into the Western Interior. Rain along the front is moving into the Interior in a southwest flow pattern.

Central and Eastern Interior...

Rain will continue as a low shifts east through tomorrow, tapering off and ending during the evening, although showers will persist over the AK Range and Fortymile until Wednesday. An additional .5-.75" is expected across the Interior, heaviest over the White Mountains and AK Range. Partial clearing will dry the region out with cooling overnight lows and possibly fog Tuesday night and Wednesday night. Another front moves in with more rain Thursday and Friday, although this will not be as copiously wet given a gradient from the south across the Alaska Range.

West Coast and Western Interior...

Rain finally comes to an end tonight with a few mixed rain and

³⁰ According to NWS Instruction 10-813: "An 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." www.nws.noaa.gov/directives/sym/pd01008013curr.pdf

snow showers over the NW Arctic along the Chukchi Coast. Otherwise, dry through most of Wednesday with another low moving into the West Coast and then Interior Wednesday afternoon through Thursday, bringing more accumulating rainfall from the Brooks Range southward.

North Slope and Brooks Range...

A cold front is moving east, bringing rain to the east Arctic and Brooks Range, with lowering snow levels through tomorrow morning. Light accumulations are still anticipated over the Brooks Range from Anaktuvuk Pass east before tapering off to showers by tomorrow morning. Cyclonic flow will keep shower threats in place through Wednesday.

Extended Forecast Days 4-7...

Beginning the extended forecast on Thursday night, there will be a low traversing from the West Coast east to the Interior, bringing more, you guessed it...rain. This low will bring widespread rainfall through Friday night before exiting to the Yukon. Still looking like a reprieve in the rainfall this weekend for most of the Mainland before the next possible low moves in Sunday night and Monday. We shall wait and see...

Coastal Hazard Potential Days 3 and 4...None.

&&

.FIRE WEATHER...

Rain ends tomorrow evening with a brief drying period Wednesday before more rain moves in Thursday. Continued breezy southwest winds through tonight especially over higher elevations.

&&

.HYDROLOGY...

Interior rivers and streams from the White Mountains southwest along the north slopes of the Alaska Range will rise through midweek to near bankfull. Rivers and streams draining from the Central and Western Alaska Range, including Denali Park, will see significant rises that push them to possibly near bankfull by Wednesday as additional rainfall of 0.5" to 1" falls through Tuesday evening.

For the latest river information go to www.weather.gov/aprfc.

&&

.AFG WATCHES/WARNINGS/ADVISORIES...

Small Craft Advisory for PKZ235-PKZ240.

&&

\$\$

14.0 Pilot Preflight Weather Information

The accident pilot did not request nor receive weather information³¹ from Alaskan Flight Services³² or ForeFlight. The accident pilot stated they checked weather before their first flight of the day. Before the accident flight the accident pilot stated they reviewed weather conditions. During the weather review before the accident flight, the accident pilot stated they checked multiple tabs on the AAWU forecast graphical products webpage³³ as well as the METARs and TAFs. In addition, they reviewed the FAA Weather Camera information.

The accident pilot stated that during the flight after leveling off around 10,000 ft they started to get some “light rime and ice” with the temperature near -1 °C and recalled starting to pick up ice at 9,500 ft. The accident pilot recalled being in light turbulence around the accident time with a significant headwind of 60 knots or so. For more information, please see the interview transcripts located in the docket of this accident.

15.0 Icing Potential

The NWS Current Icing Product (CIP) and Forecast Icing Product (FIP³⁴) products are created by the NWS AWC and are intended to supplement other icing advisories (e.g., AIRMETs and SIGMETs)³⁵. Figures 12 through 14 are the FIP icing probabilities and icing severity products and 2-hour forecast valid at 1500 AKDT at 9,000, 10,000, and 11,000 ft msl, and indicated a 30 to 60% probability of icing from 9,000 to 11,000 ft over the area. The FIP also indicated that the icing intensity near the accident site would range from “light” to “moderate” categories.³⁶

³¹ https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_91-92.pdf

³² https://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/systemops/fs/alaskan/alaska/

³³ [Alaska Aviation Weather Unit](#)

³⁴ B.C. Bernstein, F. McDonough, M. K. Politovich, B. G. Brown, T. P. Ratvasky, D. R. Miller, C.A. Wolff, and G. Cuning, Current Icing Potential: Algorithm Description and Comparison with Aircraft Observations (Journal of Applied Meteorology, 2005), pp. 969-986.

C.A. Wolff, F. McDonough, M. K. Politovich, B.C. Bernstein, and G. Cuning, FIP Severity Technical Document (Prepared for the Aviation Weather Technology Transfer Technical Review Board), pp. 1-44.

<https://arc.aiaa.org/doi/abs/10.2514/6.2009-3531>

Wolff, C. A., D. R. Adriaansen, and M. K. Politovich, 2014: Diagnosing and Forecasting In-Flight Icing Conditions in Alaska. Preprints, 6th AIAA Atmospheric and Space Environments Conference, Atlanta, GA, Amer. Inst. Aero. Astro., 2014-2070, available at: <http://arc.aiaa.org/doi/abs/10.2514/6.2014-2070>.

[Icing Product Alaska \(IPA\) - Experimental | NCAR Research Applications Laboratory | RAL \(ucar.edu\)](#)

³⁵ NCAR re-ran the CIP and FIP algorithms to produce the data highlighted in this report.

³⁶ <https://www.aviationweather.gov/icing/fip>

The CIP product indicated a 30 to 60% probability of icing at 9,000, 10,000 and 11,000 ft msl at 1500 AKDT at the accident site (figures 15, 16, and 17). The CIP also indicated that the icing near the accident site would be in the “trace to moderate” category above 9,000 ft msl. In addition, the CIP indicated an unknown probability of Supercooled Large Droplets (SLD)³⁷ between 8,000 and 11,000 ft msl at the accident location at 1500 AKDT (attachment 7). For more FIP and CIP data please see attachment 7. For additional icing information please see Federal Aviation Administration (FAA) Advisory Circular “Pilot Guide: Flight in Icing Conditions”, AC 91-74B.³⁸

Additionally information was received from the National Center for Atmospheric Research (NCAR) which showed favorable conditions for SLD (figures 18 through 20 and attachment 8).

³⁷ [AWC - Icing \(aviationweather.gov\)](http://aviationweather.gov)

³⁸ [AC 91-74B - Pilot Guide: Flight In Icing Conditions – Document Information \(faa.gov\)](http://faa.gov)

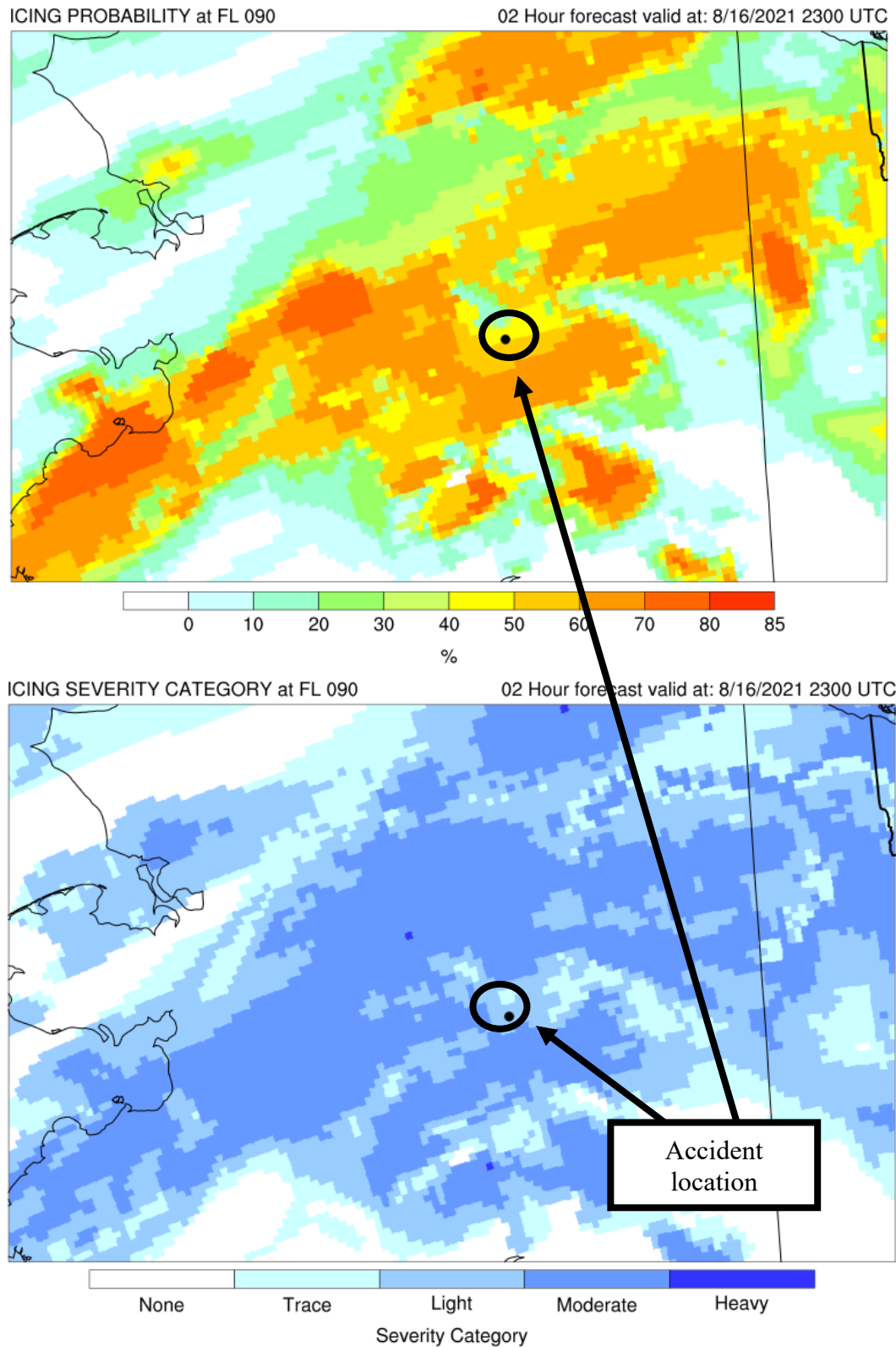


Figure 12 – (top) FIP probability of icing at 9,000 ft above msl and (bottom) FIP severity of icing at 9,000 ft above msl 2-hour forecast valid for 1500 AKDT.

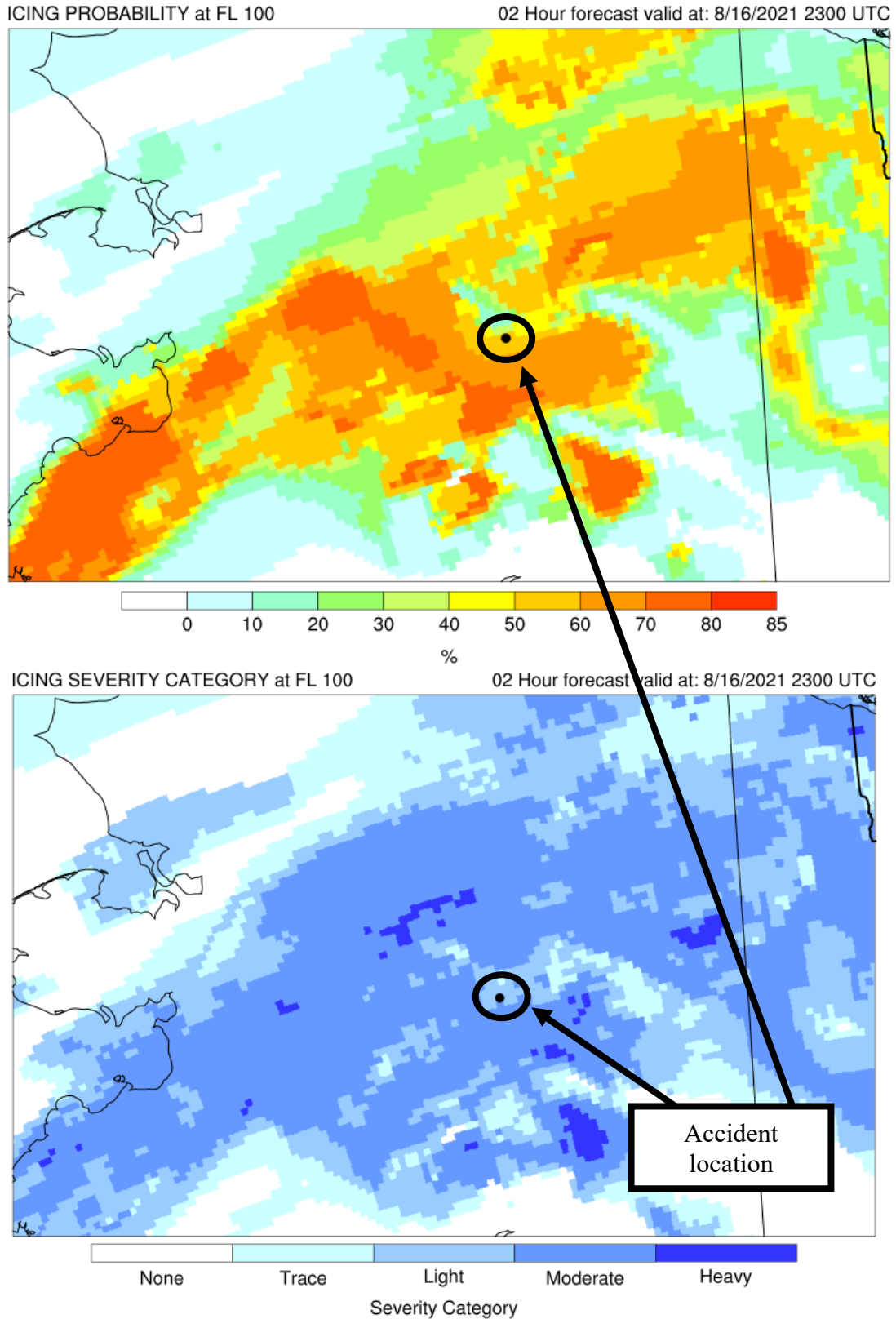
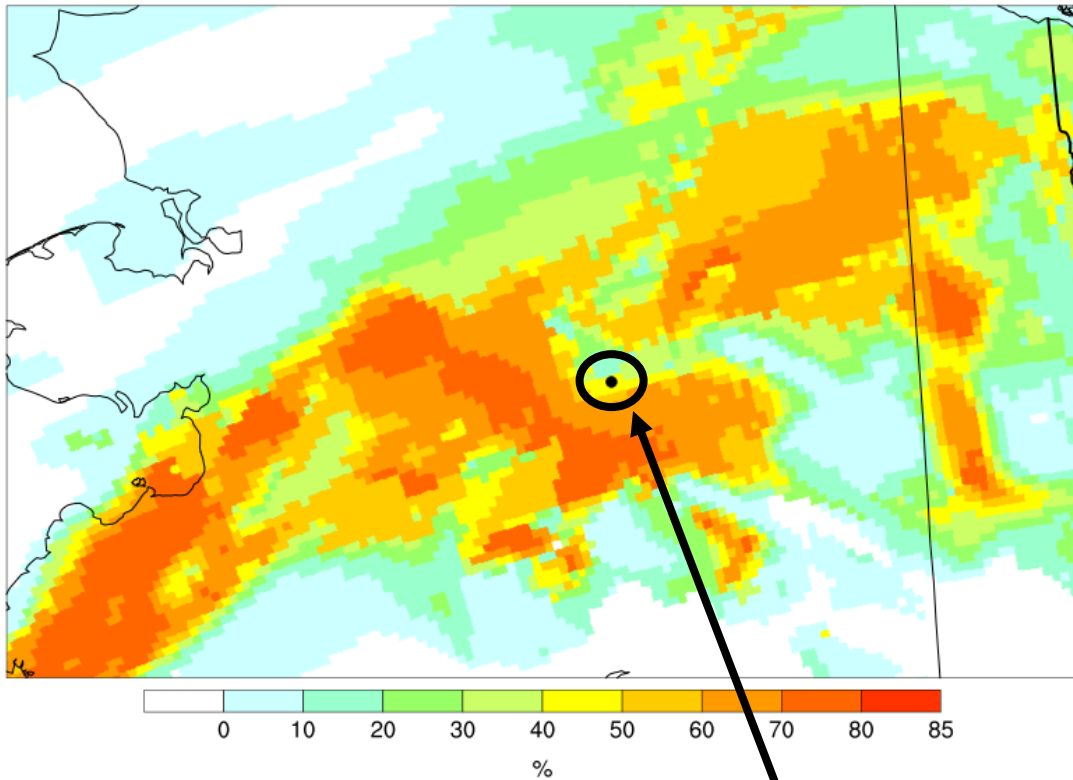


Figure 13 – (top) FIP probability of icing at 10,000 ft above msl and (bottom) FIP severity of icing at 10,000 ft above msl 2-hour forecast valid for 1500 AKDT.

ICING PROBABILITY at FL 110

02 Hour forecast valid at: 8/16/2021 2300 UTC



ICING SEVERITY CATEGORY at FL 110

02 Hour forecast valid at: 8/16/2021 2300 UTC

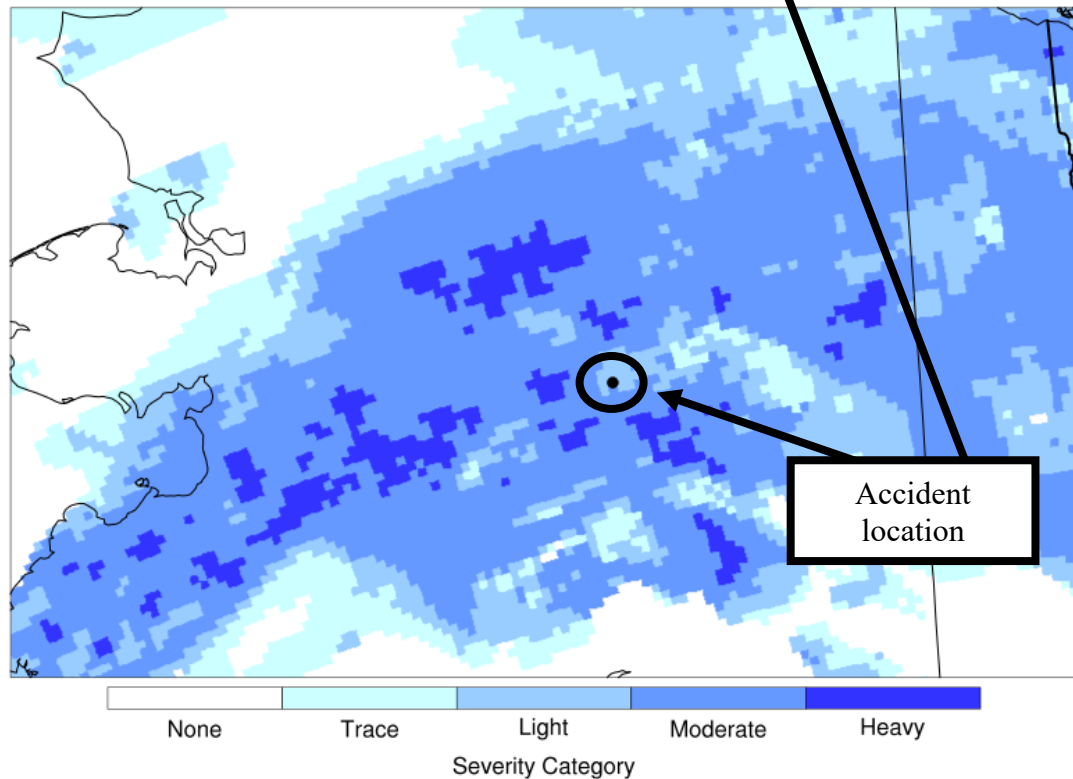
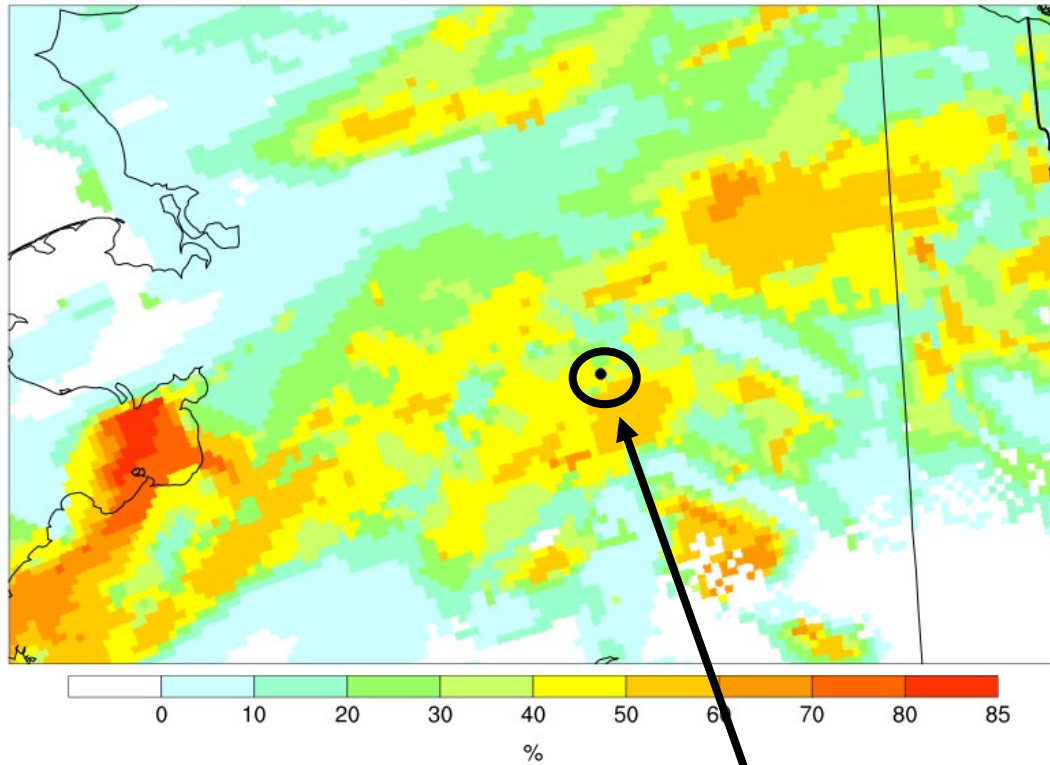


Figure 14 – (top) FIP probability of icing at 11,000 ft above msl and (bottom) FIP severity of icing at 11,000 ft above msl 2-hour forecast valid for 1500 AKDT.

ICING PROBABILITY at FL 090

8/16/2021 2300 UTC



ICING SEVERITY at FL 090

8/16/2021 2300 UTC

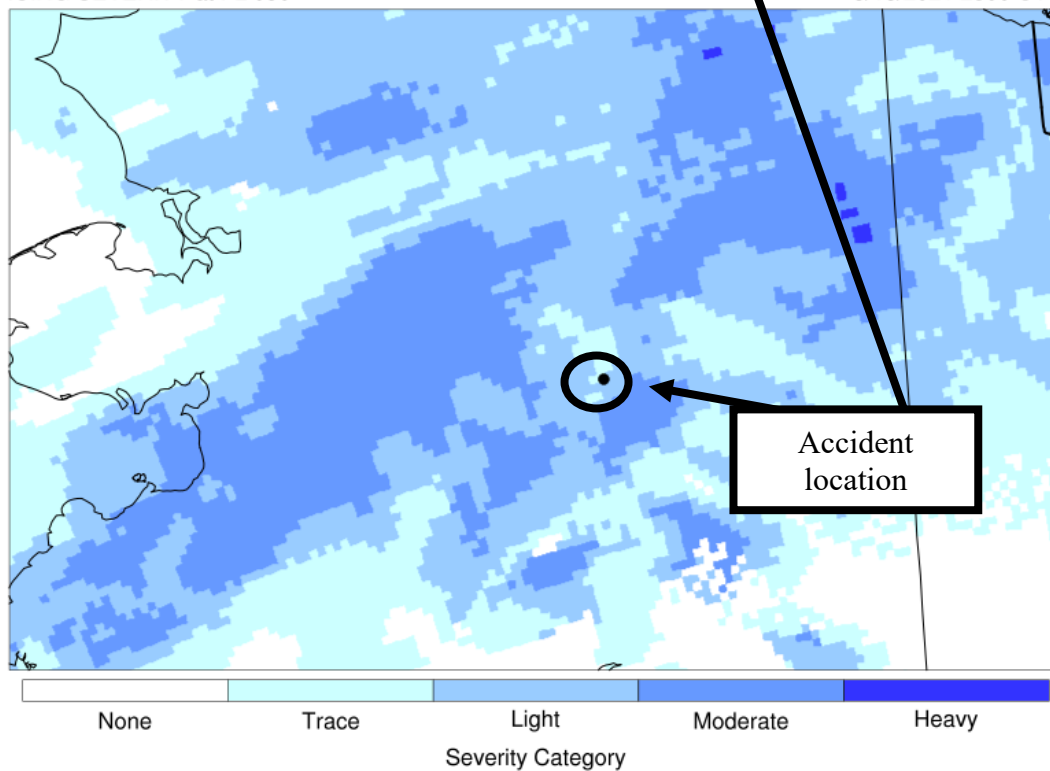
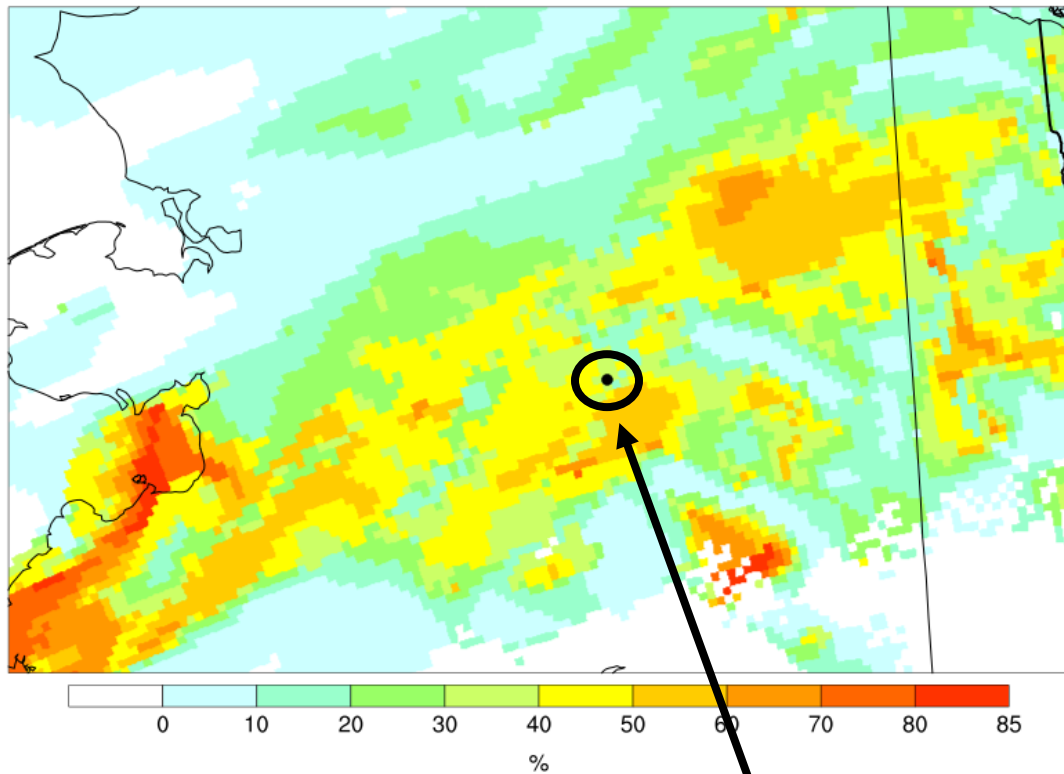


Figure 15 – (top) CIP probability of icing at 9,000 ft above msl and (bottom) CIP severity of icing at 9,000 ft above msl valid for around 1500 AKDT.

ICING PROBABILITY at FL 100

8/16/2021 2300 UTC



ICING SEVERITY at FL 100

8/16/2021 2300 UTC

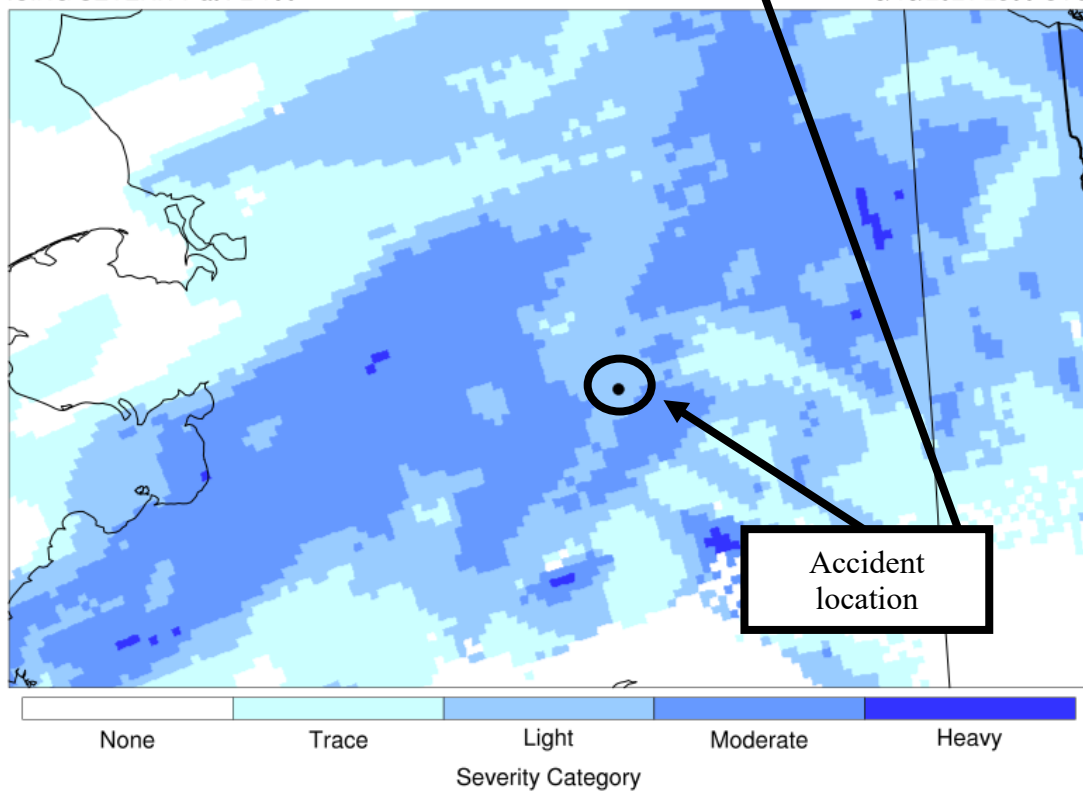
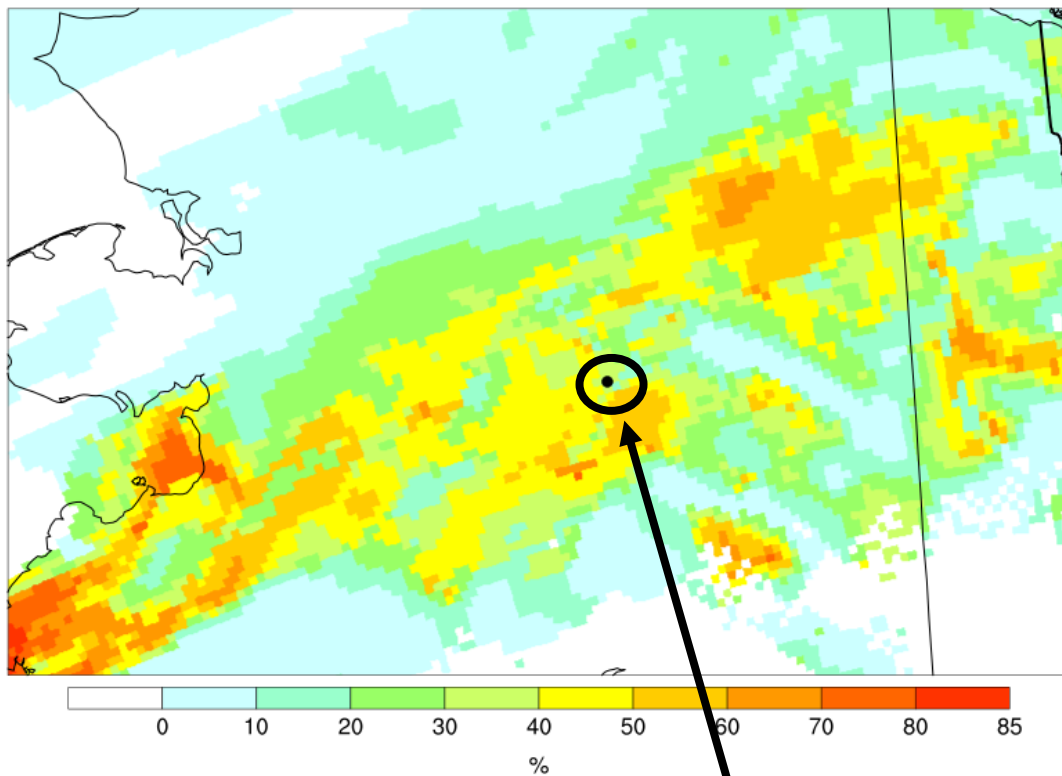


Figure 16 – (top) CIP probability of icing at 10,000 ft above msl and (bottom) CIP severity of icing at 10,000 ft above msl valid for around 1500 AKDT.

ICING PROBABILITY at FL 110

8/16/2021 2300 UTC



ICING SEVERITY at FL 110

8/16/2021 2300 UTC

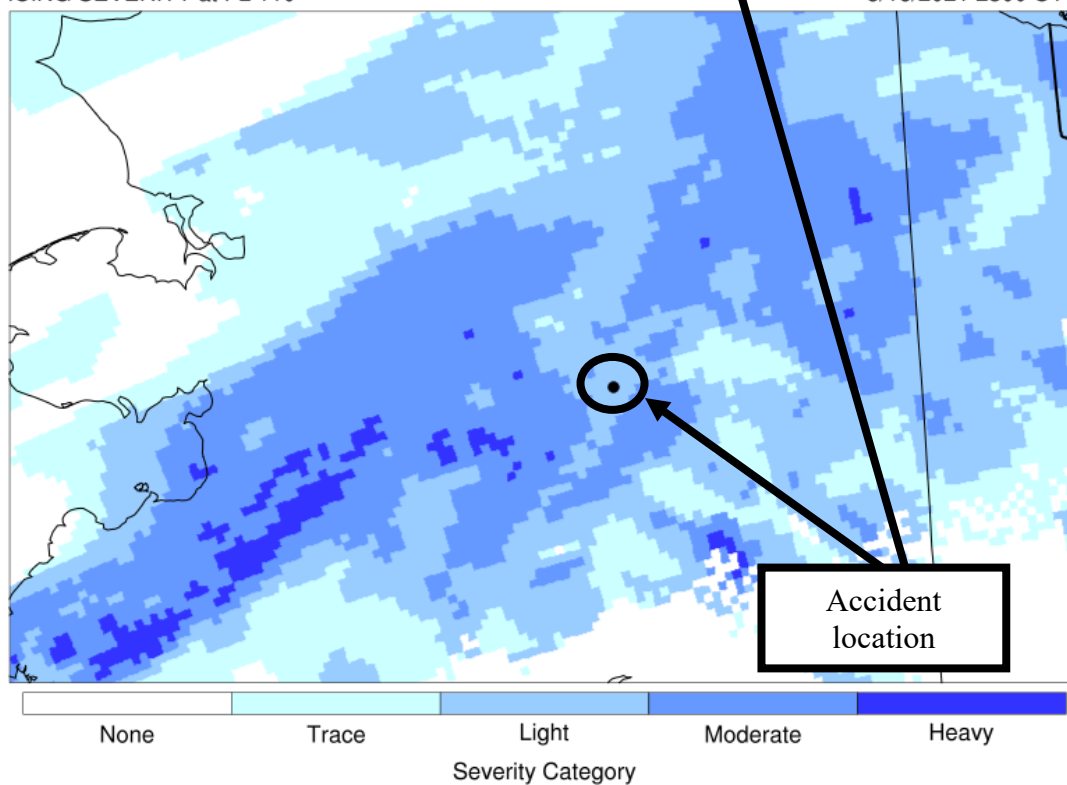


Figure 17 – (top) CIP probability of icing at 11,000 ft above msl and (bottom) CIP severity of icing at 11,000 ft above msl valid for around 1500 AKDT.

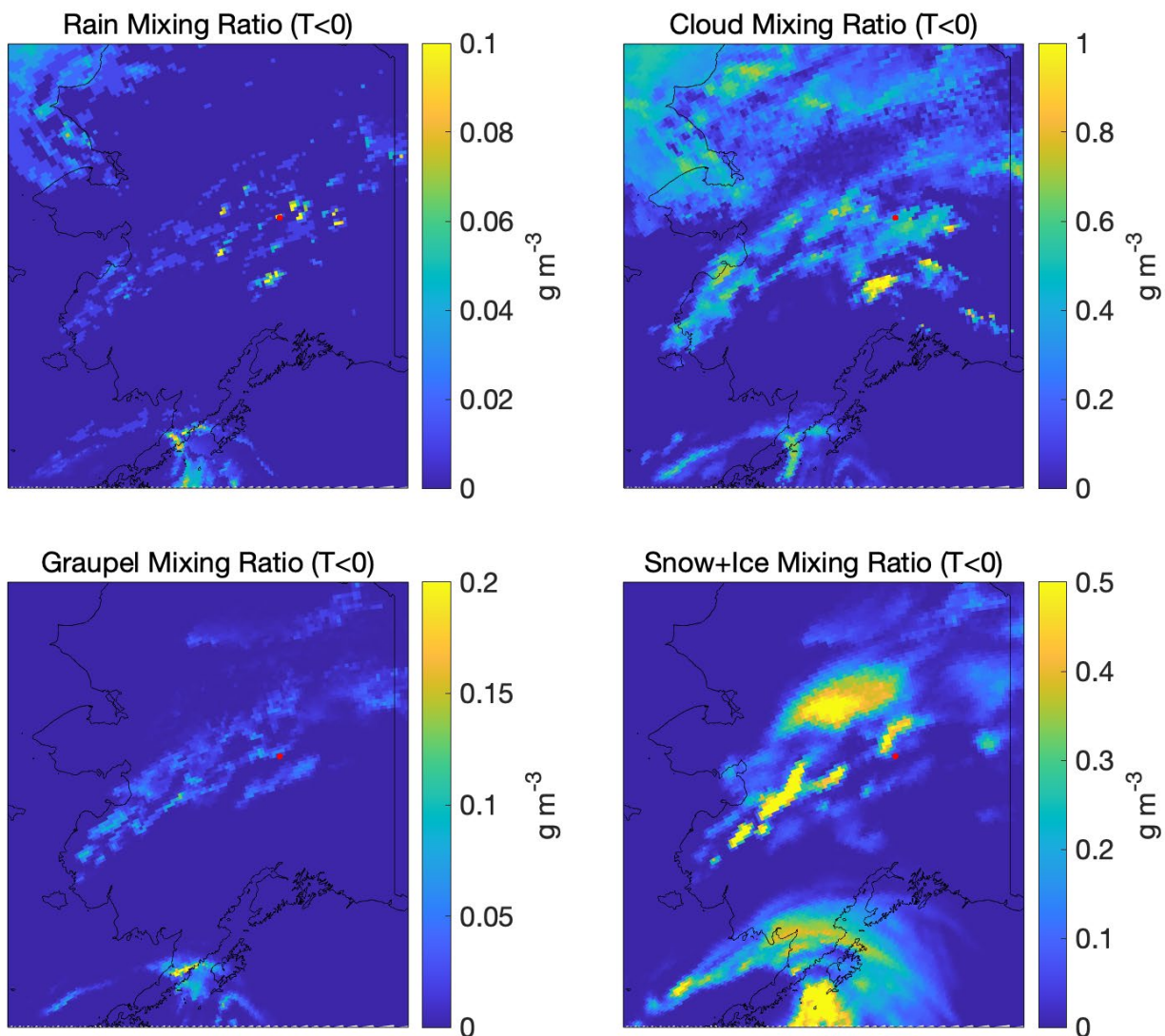


Figure 18 – Column-maximum (where T<0°C) mixing ratios for different hydrometeor classes from the Weather Research and Forecast model (WRF)- Rapid Refresh (RAP) model (~11.25 km horizontal resolution) initialized at 1200 AKDT and valid at 1500 AKDT. A red dot marks the location of the accident.

Low-Level Composite Reflectivity, 2253 UTC

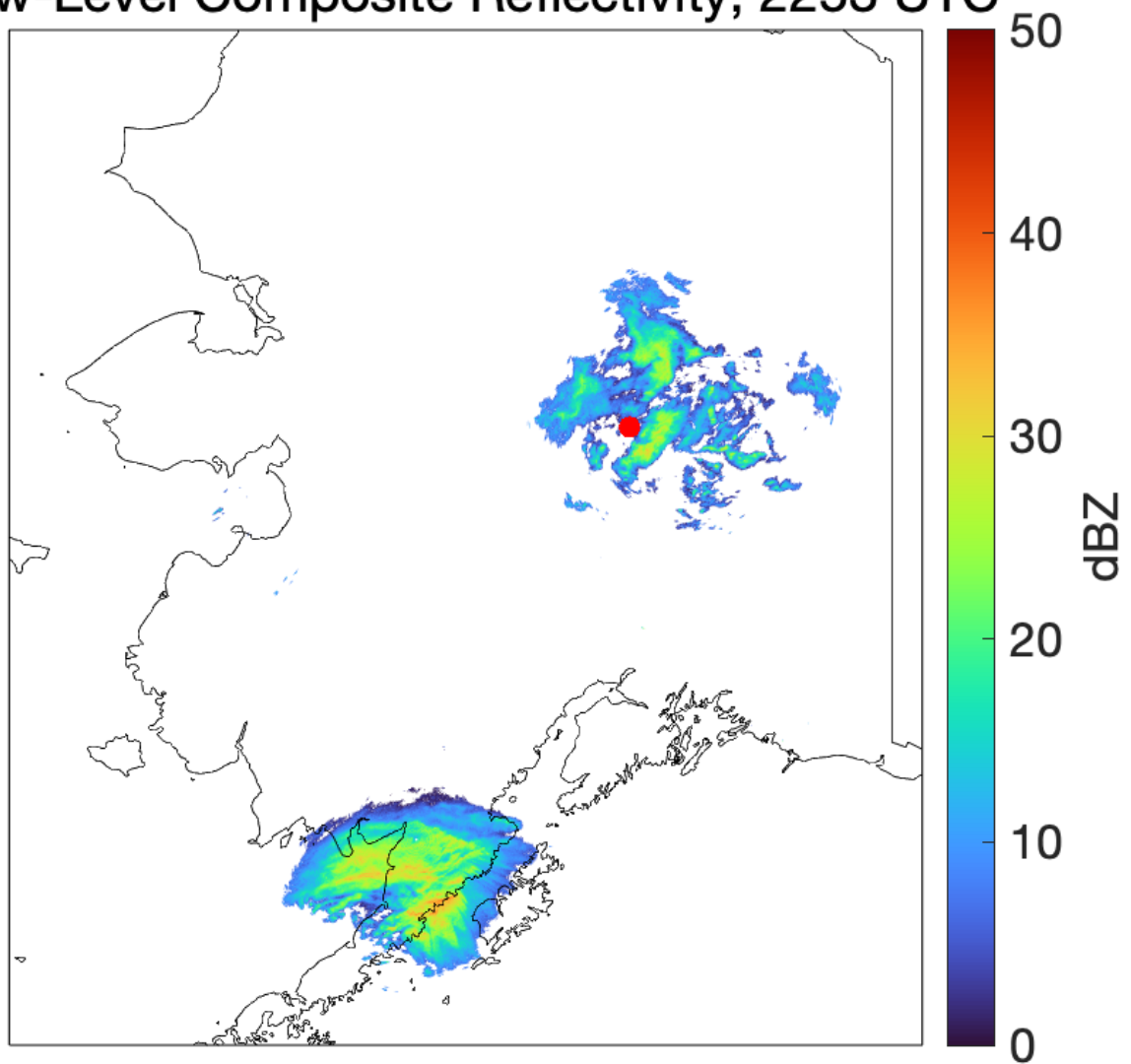


Figure 19 – Low-level weather radar composite reflectivity image for the majority of Alaska valid at 1453 AKDT with the accident location marked by a red circle.

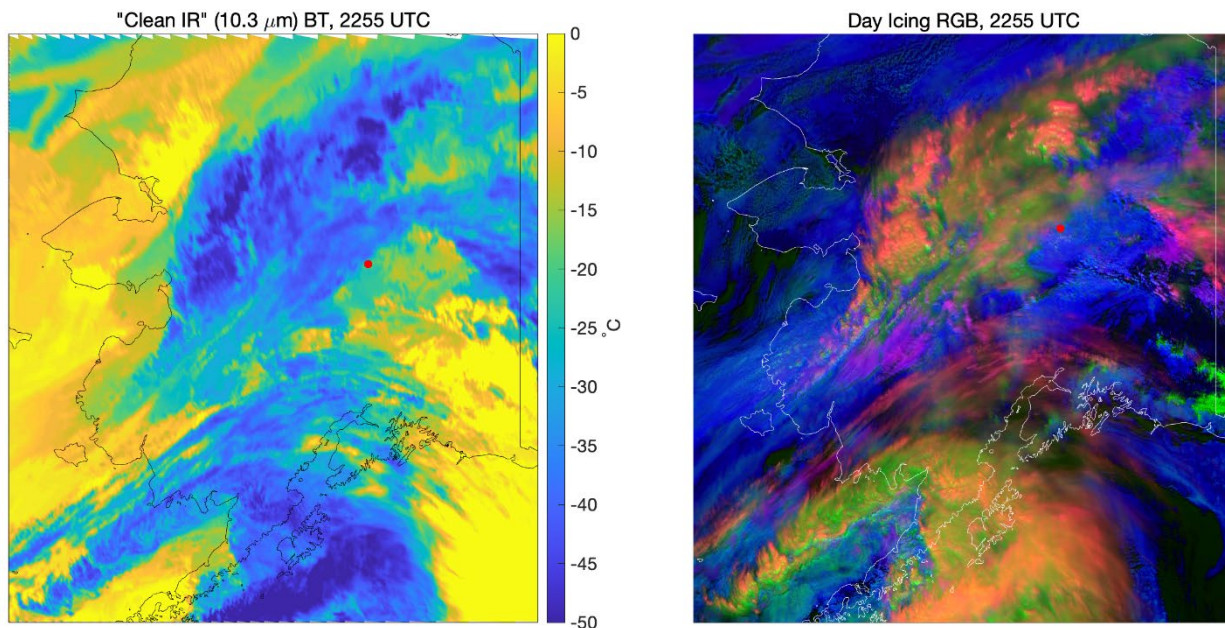


Figure 20 – GOES-17 10.3 μm imagery (left) and day icing Red Green Blue (RGB) (right) valid at 1455 AKDT with the accident location marked by a red circle.

16.0 FAA Web Camera Images

Images from the FAA's Aviation Weather Cameras were retrieved for Ester Dome and Minto and are contained in attachment 9.

17.0 Witness Information

Several passengers on the accident flight provided their observations about the weather conditions. One of the passengers stated that around the accident time the whole plane felt like it was getting "slammed with ice" and in turbulence. They viewed chunks or sheets of ice flying past the airframe while in descent after the initial upset. Another passenger stated that before the accident time there was ice built up on the front windshield and they noticed "heavy moisture" on the strut throughout the entire flight. A 3rd passenger stated that they observed snow and ice building up on the passenger side window before the accident time and the accumulation was thick enough that they could not see through it.

In addition to the passengers, two pilots in the area of the accident flying the same type of airplane around the accident time provided information. One of the pilots stated that through roughly 8,000 ft the icing intensified, and they reported it as moderate mixed icing. The icing continued to intensify in the climb to the point where they became concerned. They indicated the icing became severe with lots of clear run-back ice forming very rapidly on the windshield and rapidly spreading around the curved sections of the windshield between 9,000 ft and 9,300 ft. They requested a descent back to 7,000 ft, which they had previously heard a Navajo report as being better for icing. There was also approximately a half-inch of ice built up behind the landing lights on top of the wing in just this short time, but their wings stayed otherwise fairly clean. The 2nd pilot stated they encountered light mixed icing which accumulated rapidly enough that they had to deviate from their altitude. They were somewhere between Manly Hot Springs and Tanana on their way direct to Galena at 8,000 feet in cloud and drizzle. They requested a lower altitude with mixed ice and some ice sweep-back on the upper and lower wing surfaces, and some thick, coarse accumulations, which looked likely to develop into horns, on the upper and lower portions of the leading edge of their wings. The ice was accumulating rapidly and growing thick on all narrow protruding surfaces. The 2nd pilot did not accumulate notable ice on their windscreen. At 7,000 feet they quickly shed the ice and at 6,000 feet they were comfortable with no ice at all, in rain. The weather was mostly rainy and drizzly that day. Below 7,000 feet or so, the wings were washed clean by rain, but above that (within 1,000 feet) the wings accumulated ice rapidly. The 2nd pilot stated the difference in altitude between bad ice and no ice was surprisingly small, almost abrupt. For more information, please see the interview transcripts located in the docket of this accident.

18.0 Astronomical Data

The astronomical data obtained for the accident location on August 16, 2021, indicated the following:

SUN

Begin civil twilight	0440 AKDT
Sunrise	0548 AKDT
Sun transit	1403 AKDT
Accident time	1452 AKDT³⁹
Sunset	2215 AKDT
End civil twilight	2321 AKDT

At the time of the accident the Sun was located at an altitude of 37.72° and azimuth of 195.23°.

³⁹ Inserted accident time for reference and context.

E. LIST OF ATTACHMENTS

Attachment 1 – GOES-17 visible satellite animation from 1350 to 1530 AKDT

Attachment 2 – Additional satellite imagery for the accident time

Attachment 3 – Satellite Cloud Vertical Cross-section Quick Guide

Attachment 4 – PAPD weather radar animation from 1418 to 1515 AKDT for 0.5° elevation scan

Attachment 5 – PAPD weather radar animation from 1418 to 1515 AKDT for 0.9° elevation scan

Attachment 6 – AAWU graphical forecast information valid at the accident time

Attachment 7 – FIP and CIP icing information valid around the accident time

Attachment 8 – Additional SLD information

Attachment 9 – FAA Weather Camera Imagery valid around the accident time

Submitted by:

Paul Suffern
Senior Meteorologist