



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

June 26, 2019

Weather Study

METEOROLOGY

WPR19FA148

Table Of Contents

A.	ACCIDENT	3
B.	METEOROLOGIST	3
C.	DETAILS OF THE INVESTIGATION	3
D.	WEATHER INFORMATION	3
1.0	Surface Observations	3
2.0	Weather Radar	4
3.0	Upper Air Data.....	5
4.0	Satellite Imagery	6
5.0	Pilot Reports.....	8
6.0	Area Forecast Discussion.....	8
7.0	AIRMETs.....	9
8.0	SIGMETs	10
9.0	CWSU Products	10
10.0	Graphical Forecasts for Aviation	11
11.0	Flight Service	14

A. ACCIDENT

Location: Alpine, Utah
Date: May 17, 2019
Time: 1034 mountain daylight time (1634 UTC¹)
Airplane: R44 II; N744TW

B. METEOROLOGIST

Mike Richards
Senior Meteorologist
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 mountain daylight time (MDT) for May 17, 2019 (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).

Coordinates used for the accident location: 40.502500° north latitude, 111.743889° west longitude, at an elevation of about 7,700 feet.

D. WEATHER INFORMATION

1.0 Surface Observations

An Automated Weather Observing System (AWOS) was located at South Valley Regional Airport (U42²) in Salt Lake City, Utah, which was located about 13 miles northwest of the accident location at an elevation of about 4,600 feet. Automated reports from KU42 during the times surrounding the accident time are presented here.

¹ UTC – abbreviation for Coordinated Universal Time

² 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.

[0955 MDT] METAR KU42 171555Z AUTO 00000KT 10SM SCT032 BKN055 OVC085
06/05 A2983 RMK AO1 P0006 T00560053=

[1015 MDT] METAR KU42 171615Z AUTO 08005KT 10SM BKN050 BKN060
OVC085 07/06 A2982 RMK AO1 T00650056=

**[1035 MDT] METAR KU42 171635Z AUTO 08004KT 10SM SCT019 BKN043
OVC050 07/05 A2983 RMK AO1 T00680053=**

[1055 MDT] METAR KU42 171655Z AUTO 09006KT 10SM SCT015 OVC041 07/05
A2983 RMK AO1 T00670054=

At 1035 MDT, KU42 reported a wind from 080° at 4 knots, visibility of 10 statute miles or greater, scattered clouds at 1,900 feet above ground level (agl), ceiling broken at 4,300 feet agl, overcast clouds at 5,000 feet agl, temperature of 7° Celsius (C) and a dew point temperature of 5°C, altimeter setting of 29.83 inches of mercury; remarks: station without a precipitation discriminator, temperature of 6.8°C and dew point temperature of 5.3°C.

An AWOS was located at Heber City Municipal Airport (Russ McDonald Field; HCR) in Heber, Utah, which was located about 15 miles east of the accident location at an elevation of about 5,600 feet. Automated reports from KHCR during the times surrounding the accident time are presented here.

[0955 MDT] METAR KHCR 171555Z AUTO 22012KT 7SM SCT023 BKN032 OVC070
06/01 A2978 RMK AO2=

[1015 MDT] METAR KHCR 171615Z AUTO 22009KT 10SM SCT023 BKN032
BKN055 06/01 A2978 RMK AO2=

**[1035 MDT] METAR KHCR 171635Z AUTO 22011G15KT 10SM SCT060 SCT110
07/01 A2977 RMK AO2=**

[1055 MDT] METAR KHCR 171655Z AUTO 21011KT 10SM SCT049 SCT060 08/01
A2978 RMK AO2=

At 1035 MDT, KHCR reported a wind from 220° at 11 knots with gusts to 15 knots, visibility of 10 statute miles or greater, scattered clouds at 6,000 feet agl, scattered clouds at 11,000 feet agl, temperature of 7°C and a dew point temperature of 1°C, altimeter setting of 29.77 inches of mercury; remarks: station with a precipitation discriminator.

2.0 Weather Radar

The WSR-88D³ Level-II weather radar imagery from the KMTX site is presented in figure 1. KMTX was located approximately 55 miles northwest of the accident location at an elevation of about 6,600 feet. Assuming standard refraction and considering the 0.95° beam width⁴ for the

³ Weather Surveillance Radar 88 Doppler (WSR-88D)

⁴ Here we define the angular width of the radar beam as the region of transmitted energy that is bounded by one-half

WSR-88D radar beam, the KMTX 0.48° tilt would have “seen” altitudes above the accident location of between about 8,600 and 14,200 feet. The radar imagery identified reflectivity consistent with light rain coincident with the final portion of the accident aircraft’s flight path. A review of KMTX weather radar imagery for times leading to the accident time indicated this area of reflectivity had been advancing southeast and the final portion of the accident aircraft’s flight was coincident with the leading edge of this area of reflectivity.

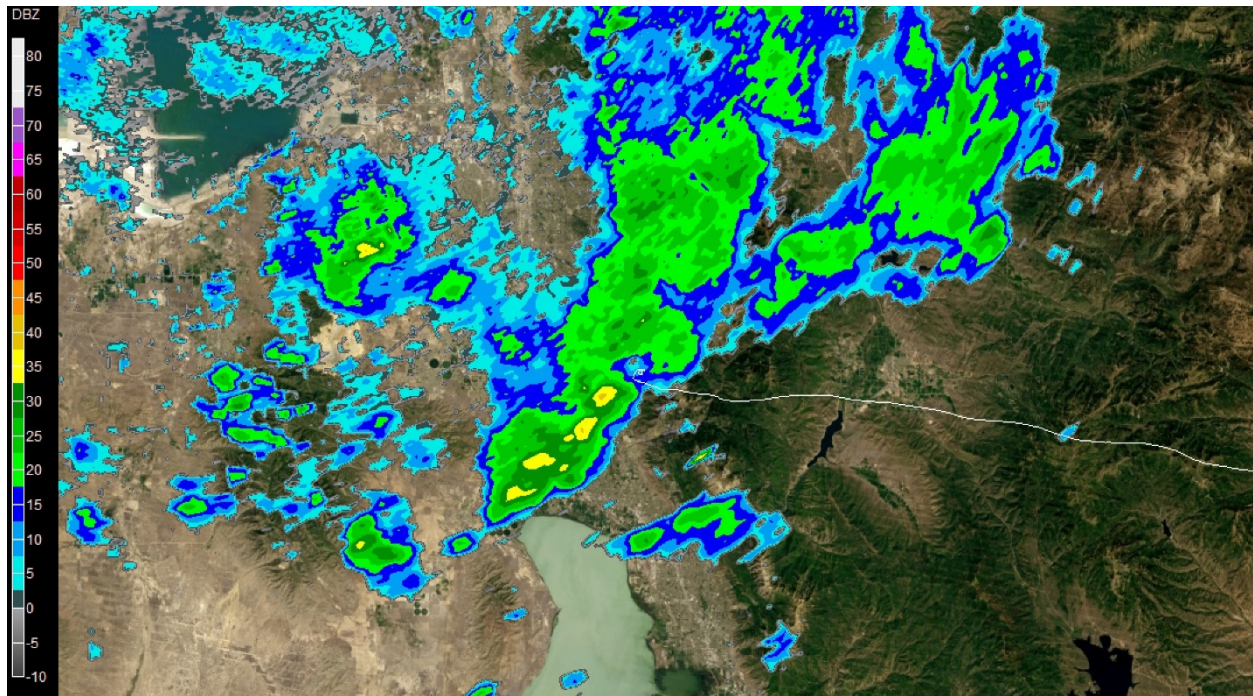


Figure 1 – KMTX 0.48° Level-II reflectivity product from a sweep initiated at 1040:14 MDT. Accident aircraft’s flight path denoted by white line.

3.0 Upper Air Data

A High-Resolution Rapid Refresh (HRRR) model⁵ sounding for the accident site at 1000 MDT (figure 2) was retrieved from the National Oceanic and Atmospheric Administration’s Air Resources Laboratory. The sounding presented relative humidity values of 94 percent or greater for the atmosphere below 14,300 feet, and the Rawinsonde OBservation Program (RAOB) projected overcast cloud conditions throughout this layer above about 8,400 feet. The wind below 20,000 feet was generally from the west at magnitudes below 20 knots. RAOB identified the potential for light or moderate clear, rime or mixed icing below about 17,000 feet.

the maximum power. The maximum power lies along the beam centerline and decreases outward.

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.

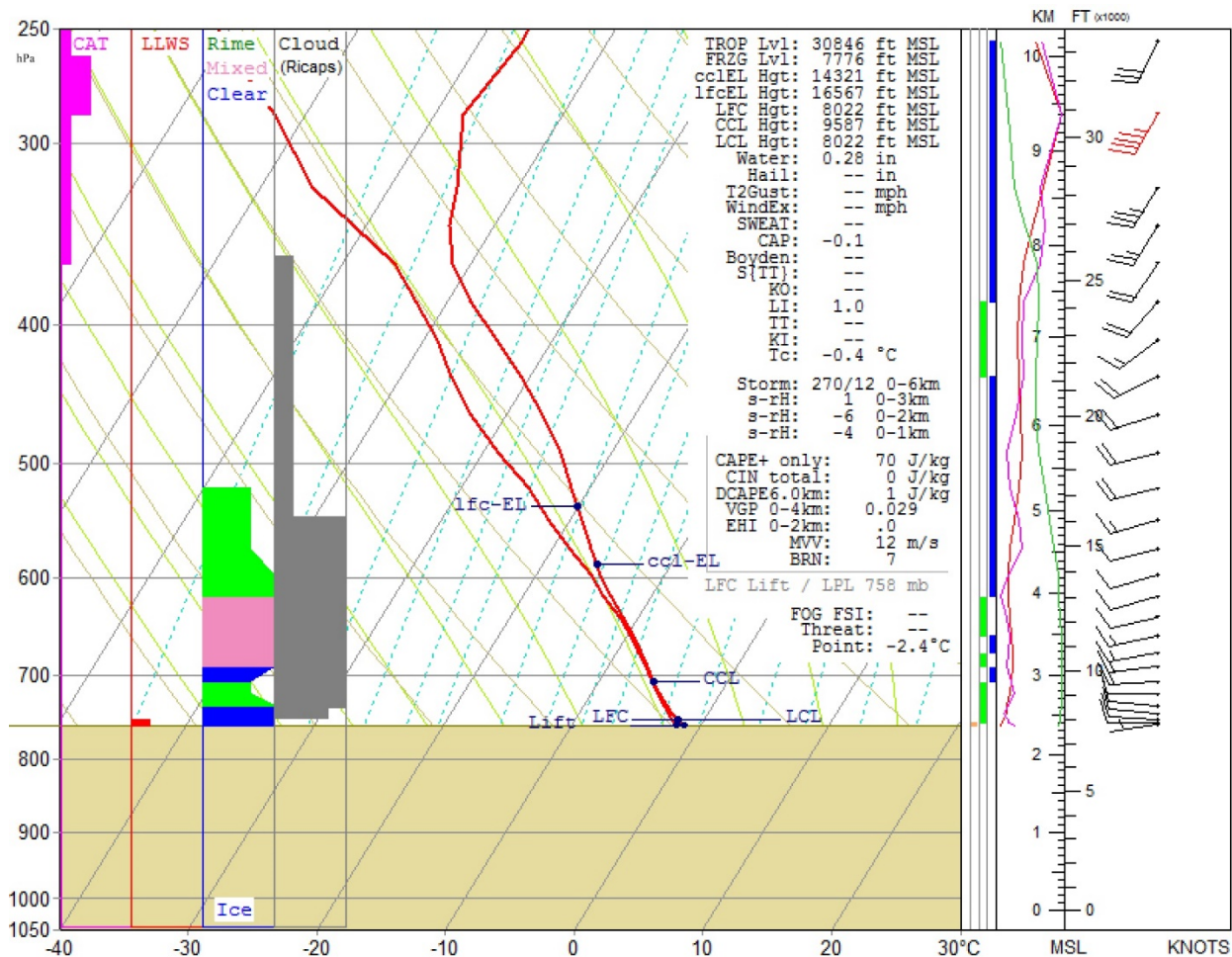


Figure 2 – HRRR model sounding data in SkewT/LogP format for 1000 MDT at the accident site, surface to 250 hectopascals (hPa).

4.0 Satellite Imagery

Geostationary Operational Environmental Satellite (GOES)-17 visible (0.64 μ m) and infrared (10.3 μ m) data were obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison. Images from 1041 MDT are presented in figures 3 and 4. The satellite imagery identified cloudy conditions over the accident region. Brightness temperatures along the accident aircraft's flight path, when considering the HRRR model sounding, suggest maximum cloud tops of about 13,000 feet along the route. However, the final portion of the accident aircraft's flight path is coincident with an area of lower brightness temperatures with a minimum brightness temperature of about -26°C. When considering the HRRR model sounding, -26°C corresponds to a cloud top height of about 19,500 feet.

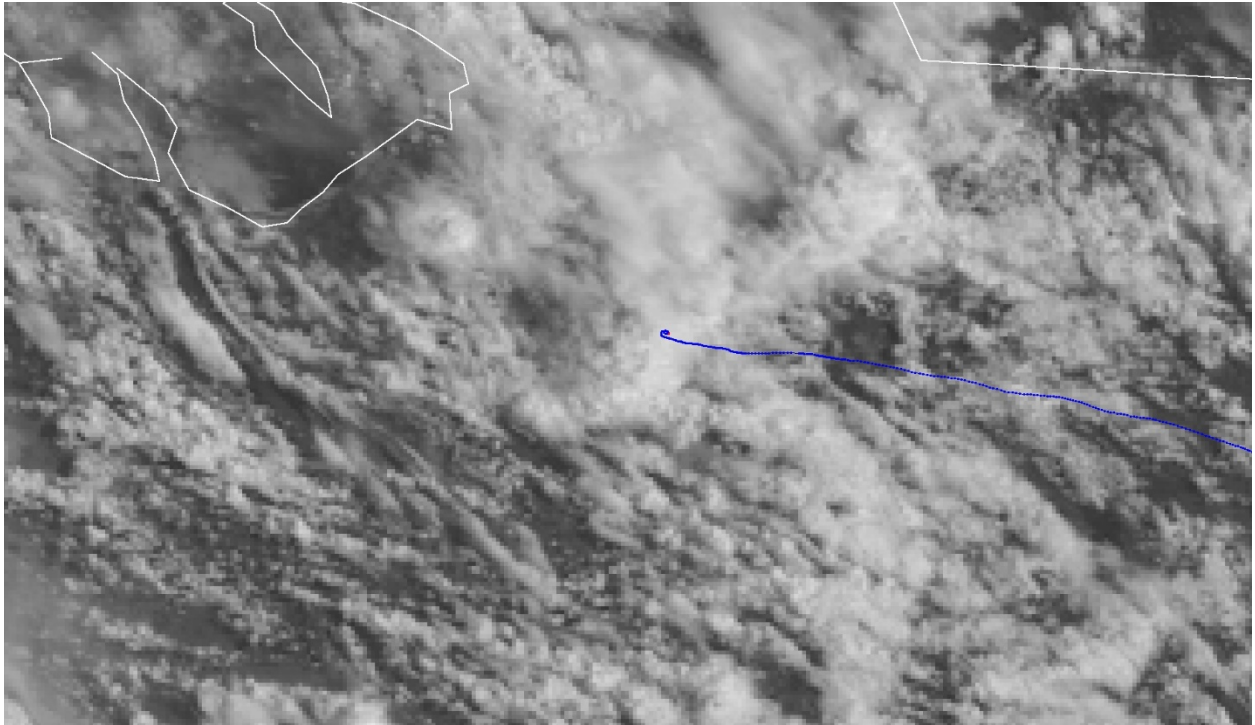


Figure 3 – GOES-17 visible imagery from 1041 MDT. Accident aircraft's flight path denoted by blue line. This image has not been corrected for any parallax error.

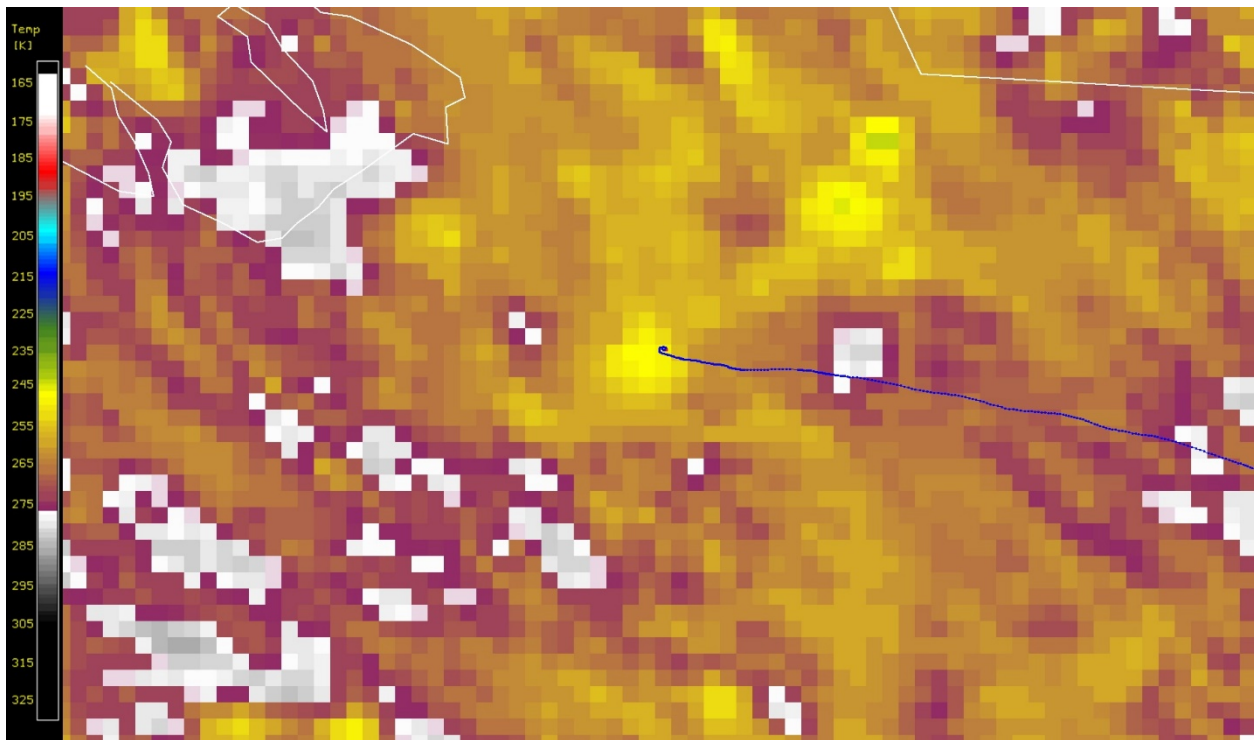


Figure 4 – GOES-17 infrared imagery (brightness temperature in degrees Kelvin) from 1041 MDT. Accident aircraft's flight path denoted by blue line. This image has not been corrected for any parallax error.

5.0 Pilot Reports

Publicly disseminated pilot reports⁶ (PIREPs and AIREPs) made within 100 miles of the accident location between 0800 and 1200 MDT at or below 40,000 feet are presented here. There were numerous reports of icing between 10,000 feet and FL180⁷.

SLC UA /OV TCH010020/TM 1400/FL160/TP B190/TA M06/IC MOD RIME /ZLC
PVU UA /OV FFU/TM 1406/FL175/TP E75S/SK BASEUNKN-TOP180/TA M22/IC
LGT RIME/ZLC
PVU UA /OV FFU180020/TM 1429/FL150/TP B737/SK BASEUNKN-TOP150/TB
NEG/ZLC
SLC UA /OV SLC200010/TM 1440/FL120/TP SR22/TA M12/IC LGT-MOD RIME
130-110/RM DURD SLC DOWNWIND
PUC UA /OV PUC/TM 1500/FL340/TP B738/TB MOD CHOP 340-350 /ZLC
SLC UA /OV OGD220005/TM 1547/FL130/TP E75L/TA 04/TB LGT CHOP/IC LGT
CLR/RM DURD
SLC UA /OV TCH020020/TM 1551/FL110/TP PC12/SK OVC/TA M08/IC TRACE
RIME/RM DURC
SLC UA /OV TCH 17011/TM 1555/FL065/TP E175/SK BASE 365/WX VMC 6 MILE
FINAL BELOW 065
EVW UA /OV EVW/TM 1600/FL130/TP BE36/IC NEG/RM OGD.V6.FBR /ZLC
ARP UAL328 3918N 11115W 1650 F340 M46 220/043 TB NONE SK CLEAR IC
NONE RM B772 OV 3918N 11115W LGHT MTN WAVE + - 10KTS
SLC UA /OV SLC/TM 1706/FL270/TP F18S/SK OVC-TOP170/SKC/TB NEG
SLC UA /OV TCH310012/TM 1719/FL150/TP B739/WX TOPS 150/TB LGT CHOP

6.0 Area Forecast Discussion

An Area Forecast Discussion (AFD) was issued at 1001 MDT by the National Weather Service (NWS) Weather Forecast Office in Salt Lake City, Utah. The “Discussion” and “Aviation” sections of that AFD are presented here.

*FXUS65 KSLC 171601
AFDSLC
Area Forecast Discussion
National Weather Service Salt Lake City UT*

⁶ Pilot reports publicly-disseminated only over radio were not captured.

⁷ 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.

1001 AM MDT Fri May 17 2019

.DISCUSSION...Showers continue across the north...with temperatures more reminiscent of mid-March than mid-May. A few higher elevation locations have picked up a few inches of snow with a report of around 6 inches in the higher Cottonwoods.

With the upper level trough directly overhead and a series of waves rotating around the trough through the day...unsettled conditions will continue. 700mb winds will become more westerly as the upper level trough shifts slowly eastward by this afternoon. With moist...unstable upslope flow, expect showers to continue along the higher terrain through the day with periods of showers impacting much of northern and western Utah. Snow levels will remain somewhere around 7000 feet or so. Little accumulation is expected during the daytime hours below 8000 feet.

Updated the forecast to cool temperatures a bit based on current trends and to make a few changes to PoPs across southern/eastern Utah this afternoon. No additional updates are anticipated.

&&

.AVIATION...VFR conditions are expected throughout the day at the SLC terminal, though cigs at or below 6000 feet AGL will prevail in rain showers. There is a 30 percent chance of brief MVFR conditions in heavier showers. West winds are expected to become more northwesterly by 19Z.

7.0 AIRMETs

AIRMETs for moderate turbulence below FL180, moderate icing between the freezing level and FL180 and mountain obscuration by clouds, precipitation or mist were issued at 0845 MDT by the NWS Aviation Weather Center (AWC) and were active for the accident site at the accident time.⁸

WAUS45 KPCI 171445

WA5T

-SLCT WA 171445

AIRMET TANGO UPDT 3 FOR TURB VALID UNTIL 172100

. AIRMET TURB...ID WY UT CO AZ NM

*FROM 60SW RAP TO BFF TO GLD TO 50W LBL TO 30ESE TBE TO INK TO ELP TO 60SSW SSO TO 30S PGS TO 20SW BCE TO 30S SLC TO 30SSW JAC TO 60SW RAP
MOD TURB BLW FL180. CONDS CONTG BYD 21Z THRU 03Z.*

WAUS45 KPCI 171445

WA5Z

-SLCZ WA 171445

AIRMET ZULU UPDT 2 FOR ICE AND FRZLVL VALID UNTIL 172100

⁸ Only AIRMETs applicable to altitudes below FL180 were considered.

*AIRMET ICE...ID WY NV UT AZ OR CA
FROM 20N LKV TO BPI TO 50SSW MTU TO 60W TBC TO 30ESE LAS TO 30E BTY
TO 70SSW FMG TO 20SE OED TO 20N LKV
MOD ICE BTN FRZLVL AND FL180. FRZLVL 060-090. CONDS CONTG BYD 21Z
THRU 03Z.*

WAUS46 KKCI 171445

WA6S

-SFOS WA 171445

AIRMET SIERRA UPDT 4 FOR IFR AND MTN OBSCN VALID UNTIL 172100

*.
AIRMET MTN OBSCN...WA OR ID MT WY NV UT
FROM 40ESE YDC TO 40SSW YQL TO 20NW GTF TO 20N HVR TO CZI TO 30SW
MTU TO 40NE DTA TO 60SW MLD TO 20SSE ELY TO 80WSW ELY TO 30W BAM TO
40SW BOI TO 50WSW BKE TO 50NNE EPH TO 40ESE YDC
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 21Z THRU 03Z.*

At 1021 MDT, the NWS AWC reissued the AIRMET for mountain obscuration in an amended AIRMET product.

WAUS46 KKCI 171621 AAA

WA6S

-SFOS WA 171621 AMD

AIRMET SIERRA UPDT 5 FOR IFR AND MTN OBSCN VALID UNTIL 172100

*.
AIRMET MTN OBSCN...WA OR ID MT WY NV UT
FROM 40ESE YDC TO 40SSW YQL TO 20NW GTF TO 20N HVR TO CZI TO 30SW
MTU TO 40NE DTA TO 60SW MLD TO 20SSE ELY TO 80WSW ELY TO 30W BAM TO
40SW BOI TO 50WSW BKE TO 50NNE EPH TO 40ESE YDC
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 21Z THRU 03Z.*

8.0 SIGMETs

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

9.0 CWSU Products

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

10.0 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 5-8 depict GFA forecast information on sky condition, icing, mountain obscuration, instrument flight rule (IFR)⁹ condition and surface wind G-AIRMETS¹⁰, surface visibility, surface wind, precipitation, and other obscurations and hazards, valid for the times surrounding the accident.

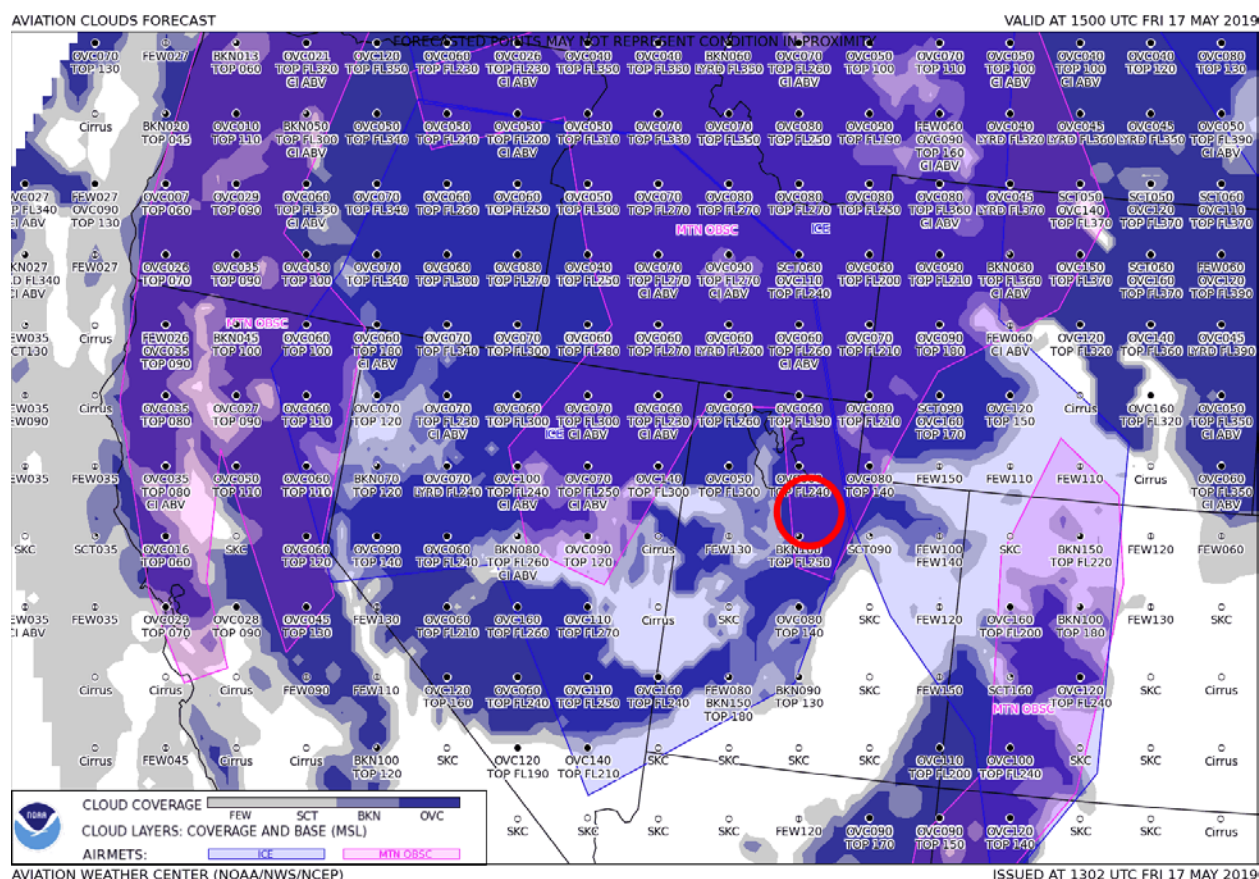


Figure 5 – GFA forecast imagery depicting sky condition and icing and mountain obscuration AIRMETS. Issued about 0700 MDT and valid for 0900 MDT. This GFA forecast imagery depicted overcast and broken sky conditions over the accident region with cloud tops above 20,000 feet and cloud bases of 6,000 and 10,000 above msl feet noted near the accident site. G-AIRMETS for icing

⁹ IFR conditions - Ceilings less than 1,000 feet agl and/or visibility less than three statute miles.

¹⁰ A G-AIRMET is a graphical advisory of weather and are only valid at specific time "snapshots". Forecasters create graphical objects depicting the areas and attributes of AIRMET hazards and issue G-AIRMETS at discrete times 3 hours apart for a period of up to 12 hours into the future (00, 03, 06, 09, and 12 hours). They are issued at 03:00, 09:00, 15:00 and 21:00 UTC (with updates issued as necessary).

AVIATION SURFACE FORECAST

FORECASTED POINTS MAY NOT REPRESENT CONDITION IN PROXIMITY

VALID AT 1500 UTC FRI 17 MAY 2019

OBSERVATIONS:

WEATHER: Chance 30-60% Rain, Snow, Mix, Ice, T-STORM: Isolated 30-60%, Scattered 60-90%, Numerous 90-100%

VISIBILITY (SM): 0, 1, 3, 5

SURFACE WINDS/GUSTS(RED) AIRMETS: IFR, SEC WND

AVIATION WEATHER CENTER (NOAA/NWS/NCEP)

ISSUED AT 1301 UTC FRI 17 MAY 2019

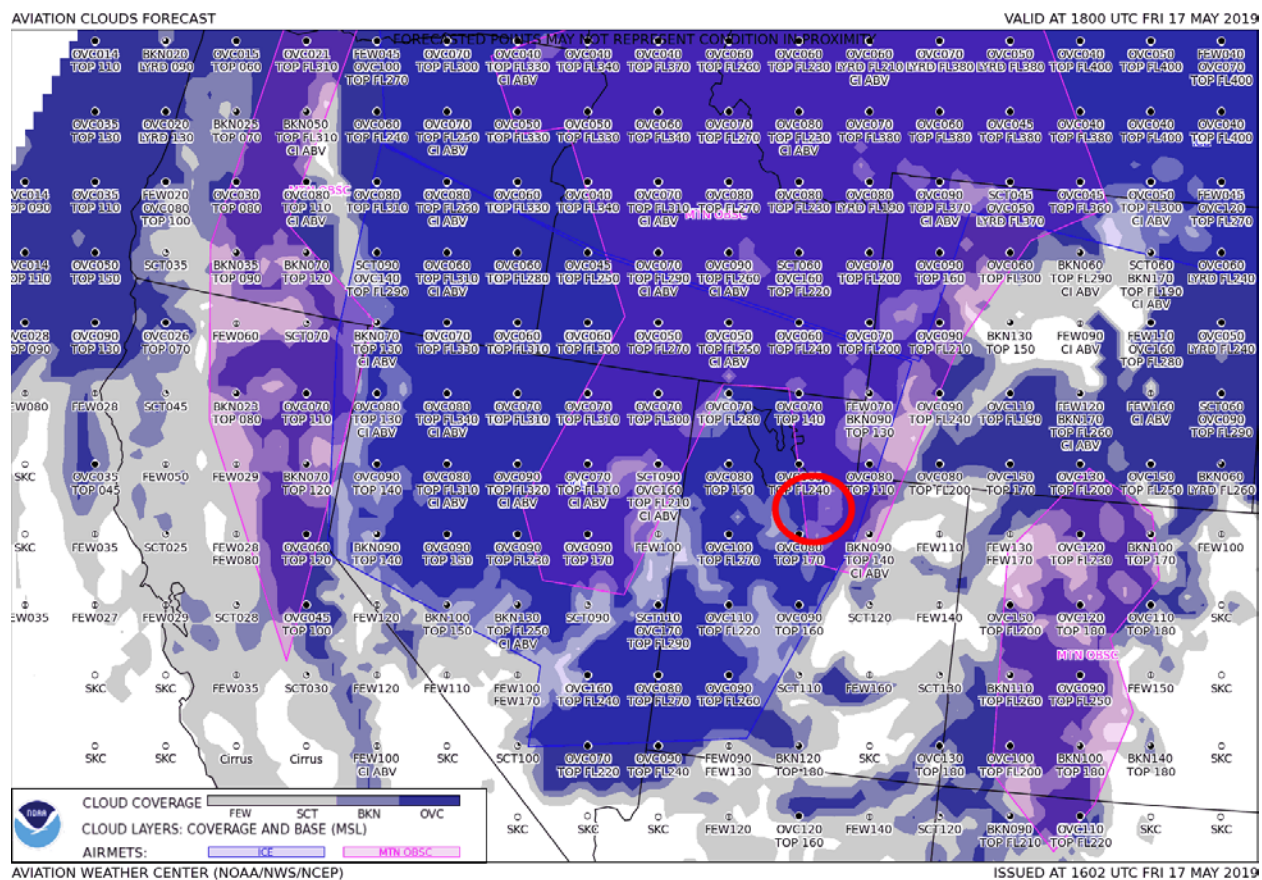


Figure 7 – GFA forecast imagery depicting sky condition and icing and mountain obscuration AIRMETs. Issued about 1000 MDT and valid for 1200 MDT. This GFA forecast imagery depicted overcast sky conditions over the accident region with cloud tops above 15,000 feet and cloud bases of 6,000 and 8,000 above msl feet noted near the accident site. G-AIRMETs for icing and mountain obscuration were identified over the accident site. The accident location was within the red circle.

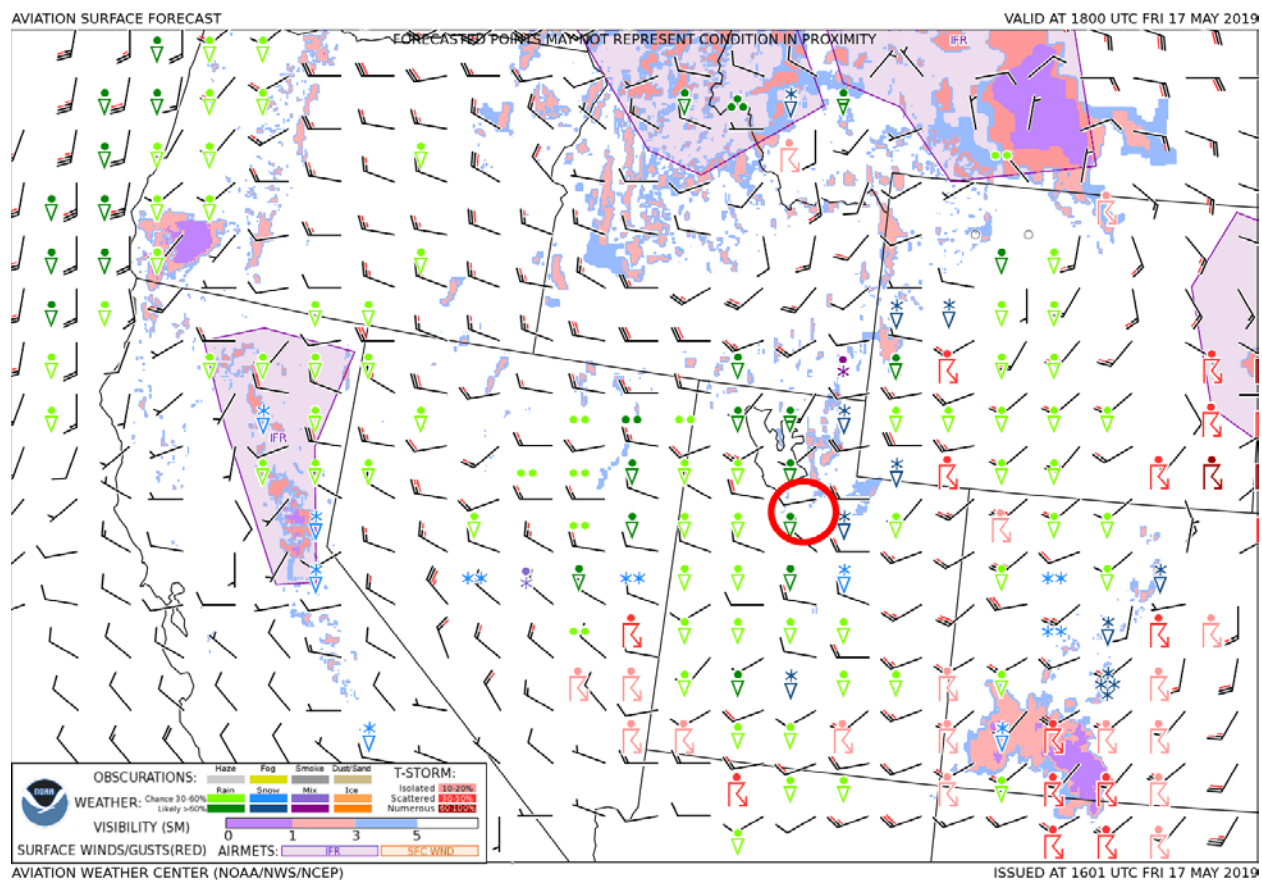


Figure 8 – GFA forecast imagery depicting IFR conditions and surface wind AIRMETs, surface visibility, surface wind, precipitation, and other obscurations and hazards. Issued about 1000 MDT and valid for 1200 MDT. This GFA forecast imagery depicted a surface visibility of greater than 5 statute miles and a greater than 60 percent chance of light rain showers around the accident location. Area of visibility less than 3 statute miles were depicted in the region. Wind in the accident area was forecast to be generally from the west to northwest at 10 knots. The accident location was within the red circle.

11.0 Flight Service

According to Leidos, neither they nor and third-party vendors utilizing the Leidos system had any contact with the accident aircraft on the accident day or the day prior to the accident day.

Submitted by:

Mike Richards
Senior Meteorologist

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