



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

April 24, 2018

Weather Study

METEOROLOGY

WPR18FA095

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A. ACCIDENT

Location: Monticello, Utah
Date: February 22, 2018
Time: about 1056 mountain standard time (1756 UTC)¹
Airplane: Type: PA-32-300; Registration: C-GYGY

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 standard time (MST) for February 22, 2018 (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: 37.78179444° north latitude, 109.17333056° west longitude, at an elevation of about 6,840 feet.

D. WEATHER INFORMATION

1.0 Synoptic Conditions

The Southwestern portion of the continental United States National Weather Service (NWS) Surface Analysis Chart for 1100 MST is presented in figure 1. The surface analysis chart depicted a low-pressure center with a minimum pressure of 1012 hectopascals (hPa) to the east of the accident site over south central Colorado. From this low-pressure center a trough was depicted extending north-northwest and an occluded front was depicted extending southward from the low. Station models in the region surrounding the accident site depicted wind directions as variable with wind magnitudes between 5 and 10 knots, with overcast skies, with an area of moderate snow over Colorado to the north through northeast of the accident site. Temperatures in these areas ranged from the mid-20°s to mid-30°s Fahrenheit (F), and dew point depressions were greater than 9°F.

¹ UTC – abbreviation for Coordinated Universal Time

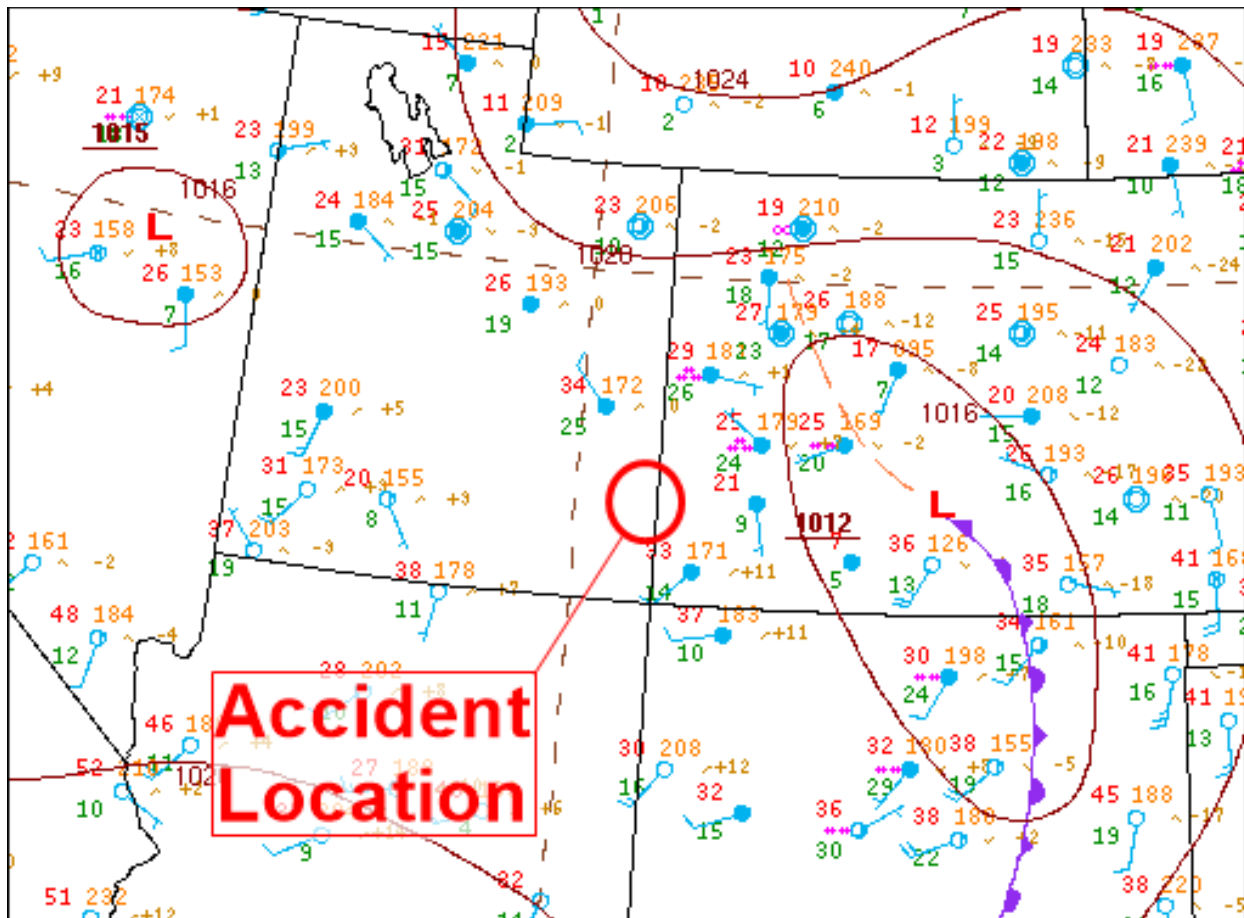


Figure 1 – Portion of the southwestern continental United States NWS Surface Analysis Chart for 1100 MST.

2.0 Weather Radar

The WSR-88D² Level-II weather radar imagery from Grand Junction, Colorado (KGJX), is presented in figure 2. KGJX was located approximately 88 miles south-southwest of the accident location at an elevation of about 10,100 feet. Assuming standard refraction and considering the 0.95° beam width³ for the WSR-88D radar beam, the KGJX 0.456° tilt would have “seen” altitudes above the accident location of between about 15,000 and 23,800 feet above msl. Very light values of reflectivity were identified coincident with the accident location.

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.

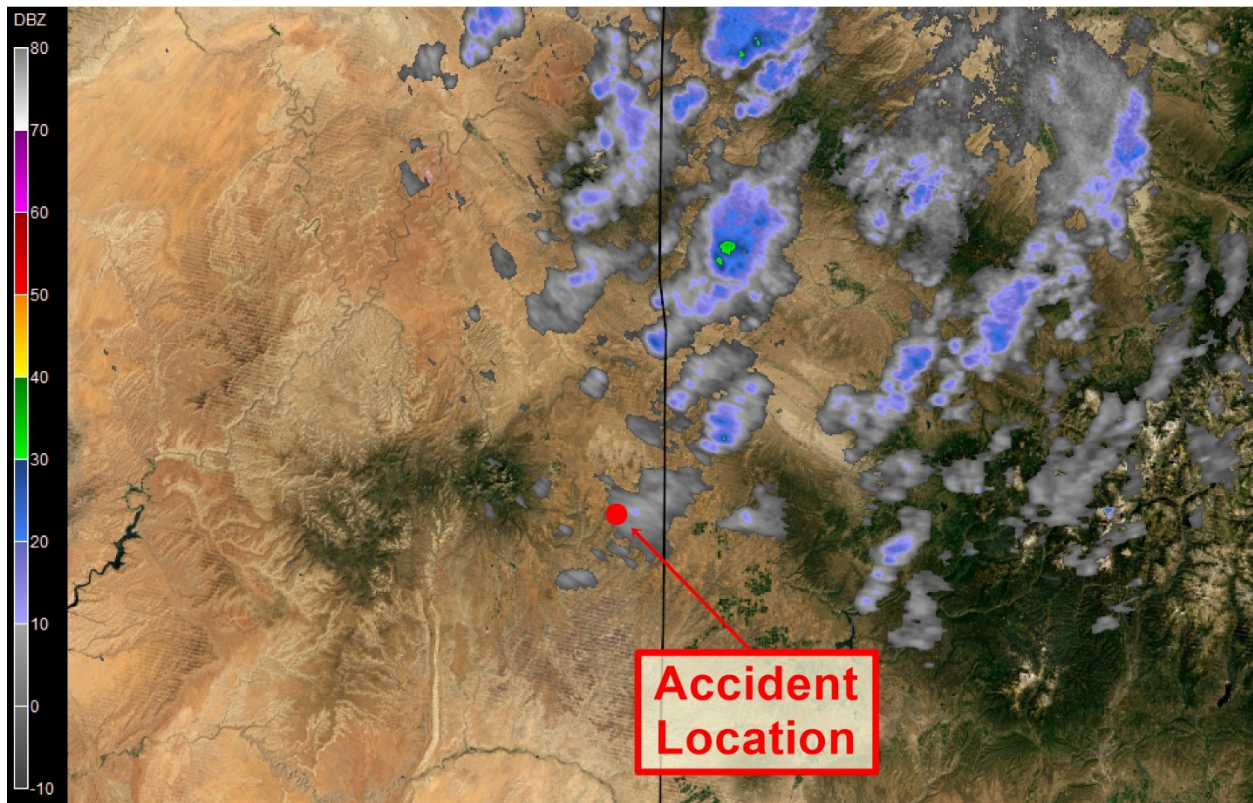


Figure 2 – KGJX 0.456° Level-II reflectivity product from a sweep initiated at 1055 MST.

3.0 Surface Observations

An Automated Weather Observing System was located at Blanding Municipal Airport (BDG)⁴ in Blanding, Utah, which was located about 19 miles southwest of the accident location at an elevation of 5,870 feet. Automated reports from BDG during the times surrounding the accident time are presented here. This station did not have a precipitation discriminator and sky condition was not reported.

[0955 MST] METAR KBDG 221655Z AUTO 21009KT 10SM M01/M09 A3008 RMK
AO1 T10061089=

[1015 MST] METAR KBDG 221715Z AUTO 21007KT 10SM 00/M08 A3008 RMK
AO1 T00001076=

[1035 MST] METAR KBDG 221735Z AUTO 21008KT 10SM 00/M08 A3008 RMK
AO1 T00001080=

⁴ The National Weather Service uses the 4-digit International Civil Aviation Organization (ICAO) format for station identifiers (as seen in the body of some formatted weather observations). This report uses the 3-digit International Air Transport Association format for station identification, which does not use the geographic designating digit (“K” for stations in the continental U.S. and “P” for U.S. stations in Alaska and the Pacific region) as found in the ICAO format.

[1055 MST] METAR KBDG 221755Z AUTO 18008KT 10SM 00/M08 A3008 RMK AO1 T00001085 10006 21060=

[1115 MST] METAR KBDG 221815Z AUTO 19011G15KT 10SM 00/M08 A3008 RMK AO1 T00011083=

[1135 MST] METAR KBDG 221835Z AUTO 20013G19KT 10SM 01/M10 A3007 RMK AO1 T00061105=

At 1055 MST, BDG reported a wind from 180° at 8 knots, visibility of 10 statute miles or greater, temperature of 0° Celsius (C) and a dew point temperature of -8°C, altimeter setting of 30.08 inches of mercury; remarks included: station without a precipitation discriminator, temperature of 0.0°C and dew point temperature of -8.5°C.

An Automated Surface Observing System was located at Cortez Municipal Airport (CEZ) in Cortez, Colorado, which was located about 39 miles southeast of the accident location at an elevation of about 5,920 feet. Automated reports from CEZ during the times surrounding the accident time are presented here. CEZ is believed to have the closest reporting official ceilometer to the accident site.

[0853 MST] METAR KCEZ 221553Z AUTO 17006KT 10SM OVC060 M02/M03 A3002 RMK AO2 SLP170 T10171028=

[0953 MST] METAR KCEZ 221653Z AUTO 19013KT 10SM BKN055 BKN070 02/M04 A3002 RMK AO2 SLP164 T00171044=

[1053 MST] METAR KCEZ 221753Z AUTO 23011G18KT 10SM BKN048 OVC065 01/M10 A3003 RMK AO2 SLP171 60000 T00061100 10017 21050 51011=

[1153 MST] METAR KCEZ 221853Z AUTO 22014G21KT 10SM FEW060 FEW070 02/M13 A3003 RMK AO2 SLP169 T00171133=

At 1053 MST, CEZ reported a wind from 230° at 11 knots with gusts to 18 knots, visibility of 10 statute miles or greater, ceiling broken at 4,800 feet above ground level (agl), overcast clouds at 6,500 feet agl, temperature of 1°C and a dew point temperature of -10°C, altimeter setting of 30.03 inches of mercury; remarks included: station with a precipitation discriminator, temperature of 0.6°C and dew point temperature of -10.0°C.

A US Department of Agriculture Natural Resources Conservation Service (NRCS) Soil Climate Analysis Network (SCAN) reporting station was located about 1,250 feet south-southeast of the accident site at an elevation of about 6,835 feet. Calibration, maintenance and siting standards of this instrument, as well as the overall quality of the data, are not known. According to the NRCS, this SCAN station was set up primarily for soil observation, and for information regarding precipitation during the growing season. For precipitation measurements it had a nonheated tipping bucket gauge. When it snows, the tipping bucket collects snow and measures the liquid equivalent of the snow. However, because the tipping bucket is not heated, melting of the snow may not occur immediately, leading to erroneous times for snow liquid equivalent measurements. Therefore, this

SCAN station should not be used for snow liquid equivalent (precipitation in the form of snow) measurements.

Reports⁵ from this SCAN station during the times surrounding the accident time are presented here:

<u>Time</u>	<u>Temp</u>	<u>D-Temp</u>	<u>RH</u>	<u>W_Mag</u>	<u>W_Dir</u>	<u>G_Mag</u>	<u>Precip</u>	<u>Solar</u>
0900	21.6	20.4	95%	3.7	192°	4.6	0.00	151.8
1000	24.3	20.1	84%	5.0	199°	6.9	0.00	330.4
1100	21.6	20.9	97%	9.0	188°	12.3	0.00	295.4
1200	25.0	17.8	74%	8.6	197°	18.4	0.01	339.0

4.0 Pilot Reports

There were no publicly-disseminated pilot reports⁶ made within about 40 miles and two hours of the accident location below 15,000 feet.

5.0 Upper Air Data

A High-Resolution Rapid Refresh (HRRR) model⁷ sounding (figure 3) valid for the accident location at 1100 MST was retrieved from the NOAA Air Resources Laboratory. The wind near the surface was from the south-southwest at about 10 knots. Above this level, the wind *veered*⁸ and increased steadily in magnitude to a west-southwest wind of about 30 knots at about 15,000 feet. Between about 9,000 and 13,000 feet the relative humidity was between 88 and 93 percent. The freezing level was below the surface. Calculations made by the Rawinsonde Observation Program (RAOB) identify a risk of light mixed and rime icing between about 9,000 and 13,000 feet. RAOB did not identify any layers of potential significant turbulence below 20,000 feet.

⁵ Temp=temperature(°F); D_Temp=dew point temperature(°F); RH=relative humidity; W_Mag=average wind magnitude(knots); W_Dir=average wind direction(true); G_Mag=gust wind magnitude(knots); Precip=one hour precipitation accumulation(inches); Solar=solar radiation(watts/meters²)

⁶ Only pilot reports with the World Meteorological Organization headers UBUT** and UBCO** were considered.

⁷ The HRRR is a National Oceanic and Atmospheric Administration (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.

⁸ A veering wind's wind barbs turns clock-wise with increasing height.

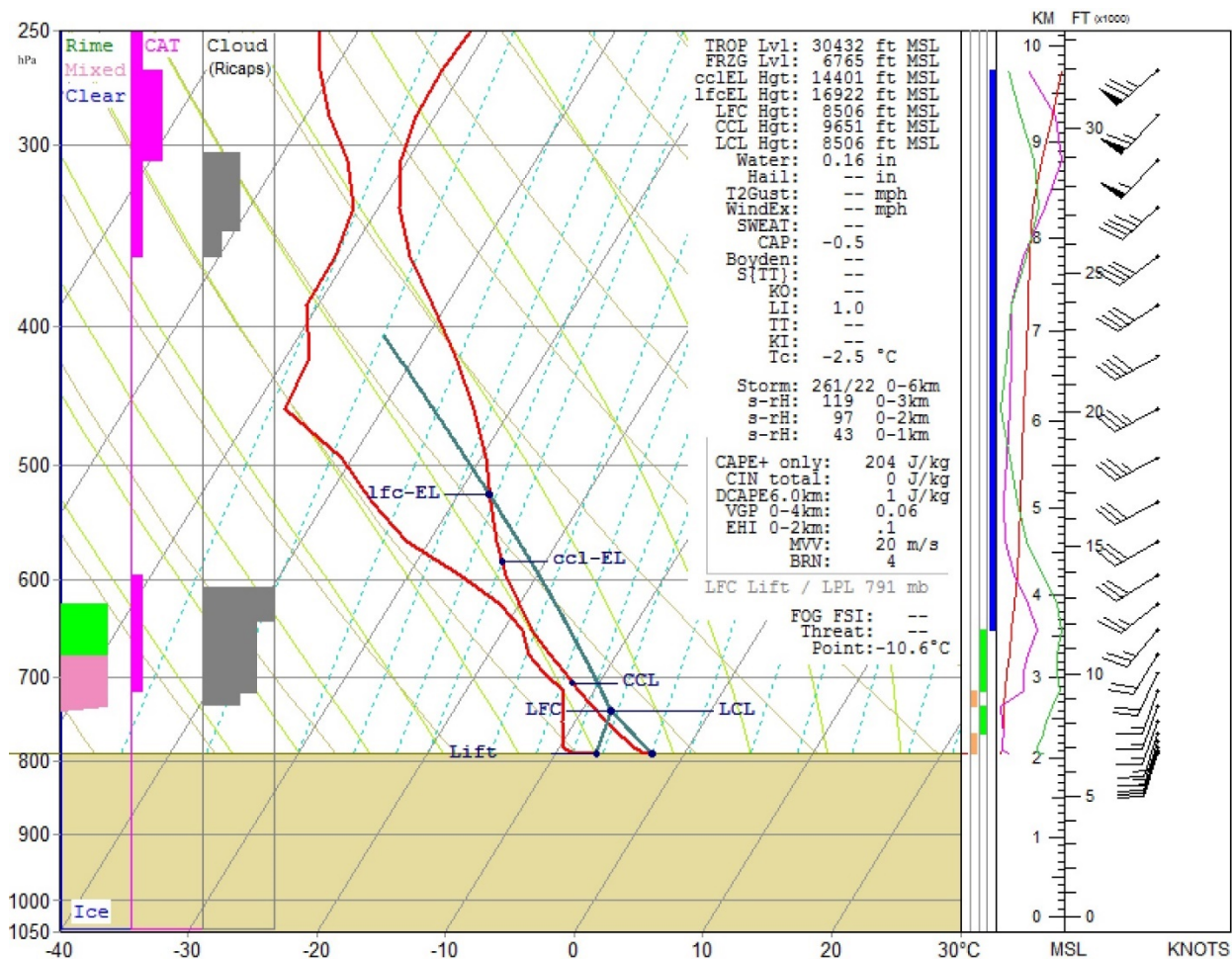


Figure 3 – HRRR model sounding data in SkewT/LogP format for 1100 MST at the accident site, surface to 250 hPa.

6.0 Satellite Imagery

Advanced Very-High-Resolution Radiometer (AVHRR) visible (0.63 μ m) and infrared (10.8 μ m) data from the METOP-A platform were obtained from NOAA. Imagery from near the time of the accident are presented in figures 4 and 5. The visible AVHRR imagery depicted cloudy skies over the accident region, with the infrared data retrieving brightness temperatures near the accident location of between about 0°C and -47°C. When considering the HRRR sounding, -47°C corresponded to cloud top heights of about 26,600 feet and 0°C was likely a surface retrieval (cloud-free area). It should be noted these figures have not been corrected for any parallax error.

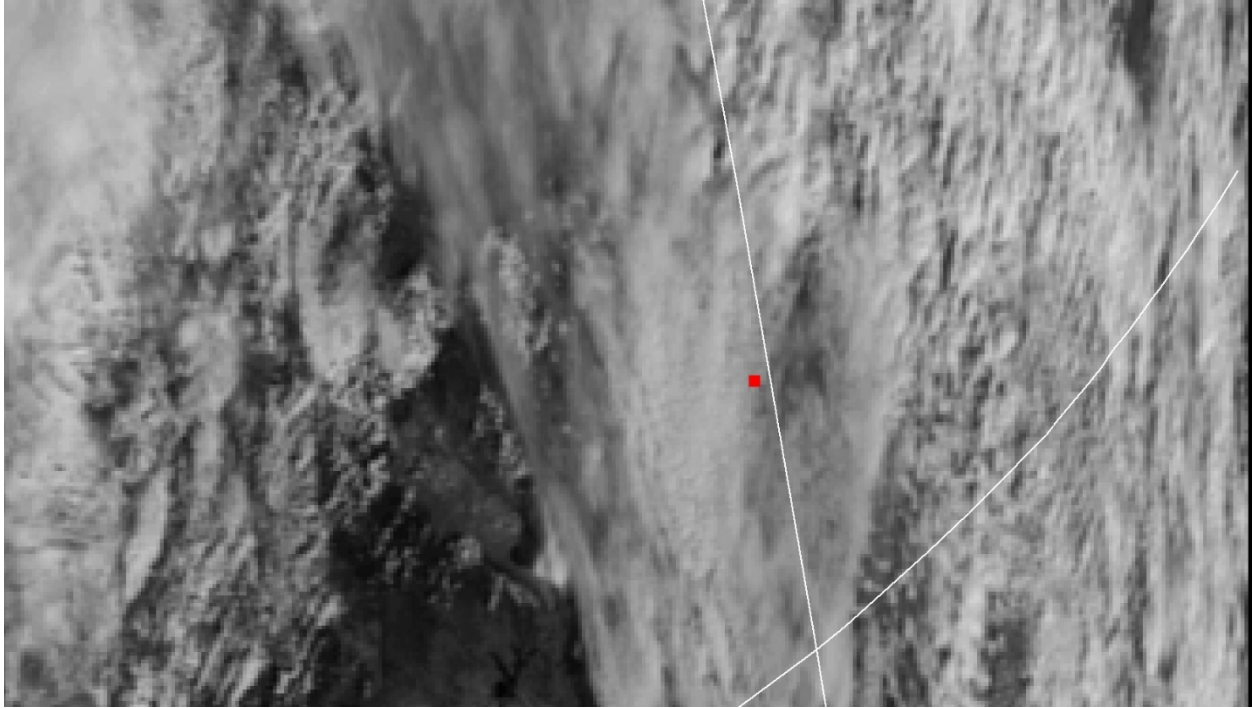


Figure 4 – AVHRR visible imagery from 1055 MST. Accident location denoted by red square. Image has not been corrected for any parallax error.

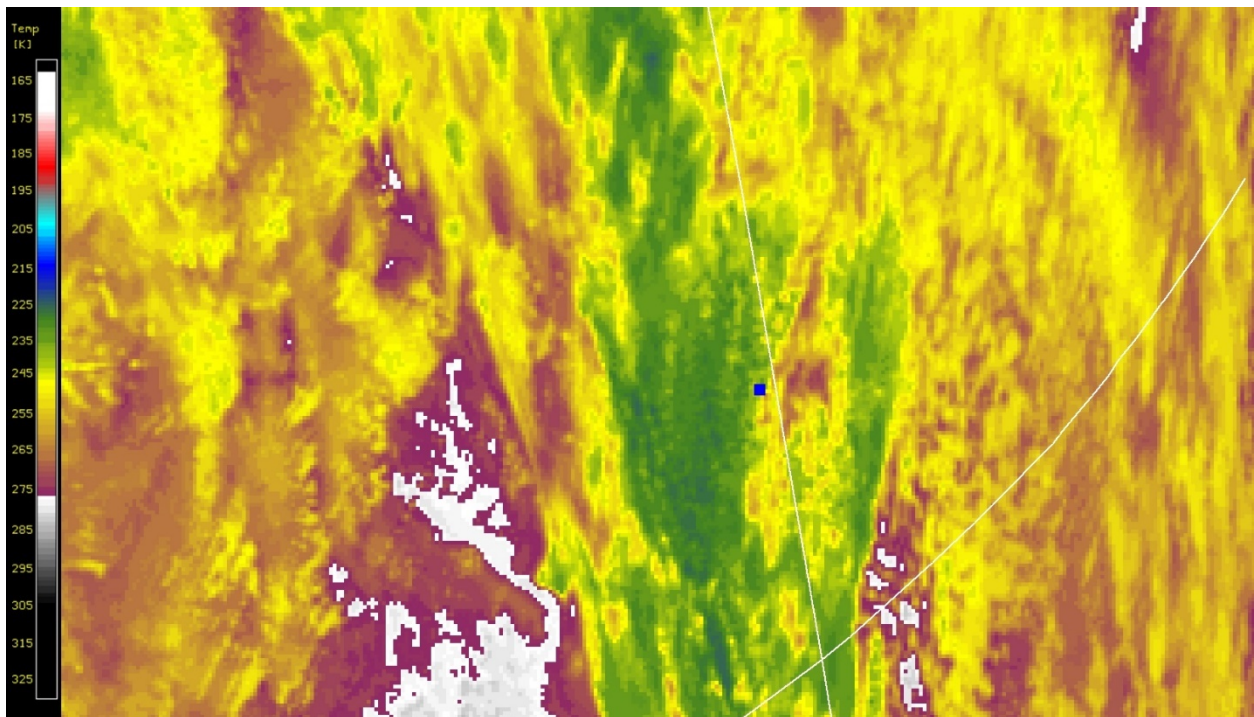


Figure 5 – AVHRR infrared imagery from 1055 MST. Accident location denoted by blue square. Image has not been corrected for any parallax error.

7.0 Terminal Aerodrome Forecasts

The closest Terminal Aerodrome Forecast (TAF)⁹ site to the accident location was located 61 miles to the east (Telluride Regional Airport [TEX] in Telluride, Colorado).

8.0 Area Forecast Discussion

An Area Forecast Discussion (AFD) was issued at 0401 MST by the NWS Weather Forecast Office (WFO) in Grand Junction, Colorado. The “Short Term” and “Aviation” sections of that AFD are presented here and discuss impending snow activity.

FXUS65 KGJT 221101
AFDGJT

Area Forecast Discussion
National Weather Service GRAND JUNCTION CO
401 AM MST Thu Feb 22 2018

.SHORT TERM...(Today through Friday)
Issued at 401 AM MST Thu Feb 22 2018

As models had predicted, a low pressure trough was moving eastward across western Utah/Arizona early this morning. Ahead of the trough a broad swath of snow had developed which extended from southwest Colorado to KHDN in the north, primarily east of a K4V0 to KCNY to KCEZ line. Snotel sites in the southeastern San Juan Mountains indicated the best accumulations, with estimated accumulations of 3 to 6 inches or more.

The base of the trough will rotate through with a negative tilt this morning. Jet divergence, mid-level lift and orographics continued to favor the southwest San Juan Mountains according to models. Understandably, models center the best accumulations over the Pagosa Springs and the San Juan Mountains to the north through noon. Snow will impact the central, and to a lesser extend, northern Colorado Mountains and adjacent valleys as well, but accumulations likely to remain below advisory criteria. During the afternoon, dynamic forcing becomes less of a factor and snowfall will become more showery in nature as the 5H cold pool approaches yielding steep lapse rates.

Poorly organized snow shower activity is expected to continue tonight and Friday as a second trough makes its way across the Great Basin. As the system draws closer snow should begin to fill in, becoming more widespread as the day progresses. This activity may require additional highlights for Friday and beyond, but confidence with respect impacts and timing not quite there yet.

⁹ According to National Weather Service 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.”

Temperatures will remain cooler than normal today as clouds and snow limit insolation across the region. Little change in readings were indicated for tonight or Friday.

.AVIATION...(For the 06Z TAFS through 06Z Thursday night)

Issued at 1035 PM MST Wed Feb 21 2018

Snow has started across the southern valleys with low ceilings and visibilities being reported there, except KDRO though expect they'll start soon. A few other spots are also reporting snow at this hour to include KGJT. TAF forecasts for the next 24 hours will be tricky as ceilings and visibilities drop to MVFR/IFR and then back to VFR through the day. This trend will continue through the day. Southern TAFs will be most affected though central TAFs will likely see this from time to time as well. ILS breakpoints will be reached for central and southern TAFs. Expect mountains to be obscured for most of the day due to snow and lower ceilings.

An AFD was issued at 1028 MST by the NWS WFO in Grand Junction, Colorado. The Aviation section of that AFD is presented here.

FXUS65 KGJT 221728

AFDGJT

Area Forecast Discussion

National Weather Service GRAND JUNCTION CO

1028 AM MST Thu Feb 22 2018

.AVIATION...(For the 06Z TAFS through 06Z Thursday night)

Issued at 1035 PM MST Wed Feb 21 2018

Snow has started across the southern valleys with low ceilings and visibilities being reported there, except KDRO though expect they'll start soon. A few other spots are also reporting snow at this hour to include KGJT. TAF forecasts for the next 24 hours will be tricky as ceilings and visibilities drop to MVFR/IFR and then back to VFR through the day. This trend will continue through the day. Southern TAFs will be most affected though central TAFs will likely see this from time to time as well. ILS breakpoints will be reached for central and southern TAFs. Expect mountains to be obscured for most of the day due to snow and lower ceilings.

An AFD was issued at 1047 MST by the NWS WFO in Grand Junction, Colorado. The Aviation section of that AFD is presented here.

FXUS65 KGJT 221747

AFDGJT

Area Forecast Discussion

National Weather Service GRAND JUNCTION CO

1047 AM MST Thu Feb 22 2018

.AVIATION...(For the 18Z TAFS through 18Z Friday afternoon)

Issued at 1044 AM MST Thu Feb 22 2018

A challenging aviation forecast on Thursday afternoon with several instances of convective snow bands producing highly variable conditions from the Colorado border eastward. These bands have been capable of dropping visibility to under a mile and lowering ceiling heights to LIFR levels, however only for short periods of time. Short term models indicate the best chances for brief spouts of IFR and below will be at GJT, MTJ, RIL, ASE and HDN through the afternoon hours. After sunset, generally lighter snowfall will continue in the mountains with CIGs rising in valley terminals.

9.0 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 may 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.

The following images (figures 6-9) depict GFA forecast information on sky condition, icing, mountain obscuration, instrument flight rule (IFR)¹⁰ condition and surface wind Airmen's Meteorological Information (AIRMET) advisories, surface visibility, surface wind, precipitation, and other obscurations and hazards, valid for about the time of the accident.

¹⁰ IFR conditions - Ceilings less than 1,000 feet agl and/or visibility less than three statute miles.

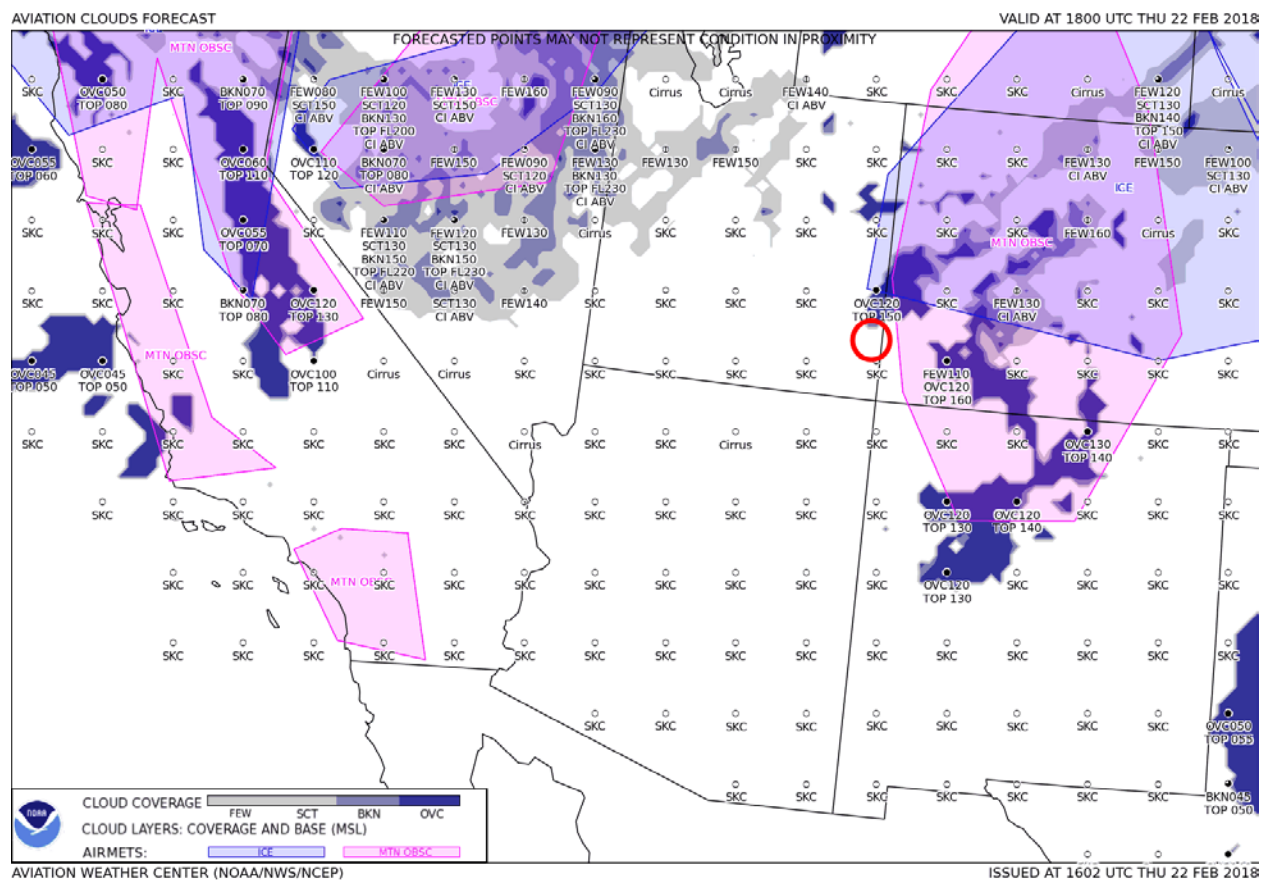


Figure 6 – GFA forecast imagery depicting sky condition and icing and mountain obscuration AIRMETs. Issued about 0900 MST and valid for 1100 MST. This GFA forecast imagery depicted an area of cloud near to and north of the accident location, with the closest data points indicating clear skies and cloud bases of 12,000 feet above msl and cloud tops of 15,000 feet above msl. An AIRMET for mountain obscuration was depicted to the east near the Utah/Colorado border. Accident location denoted by the red circle.

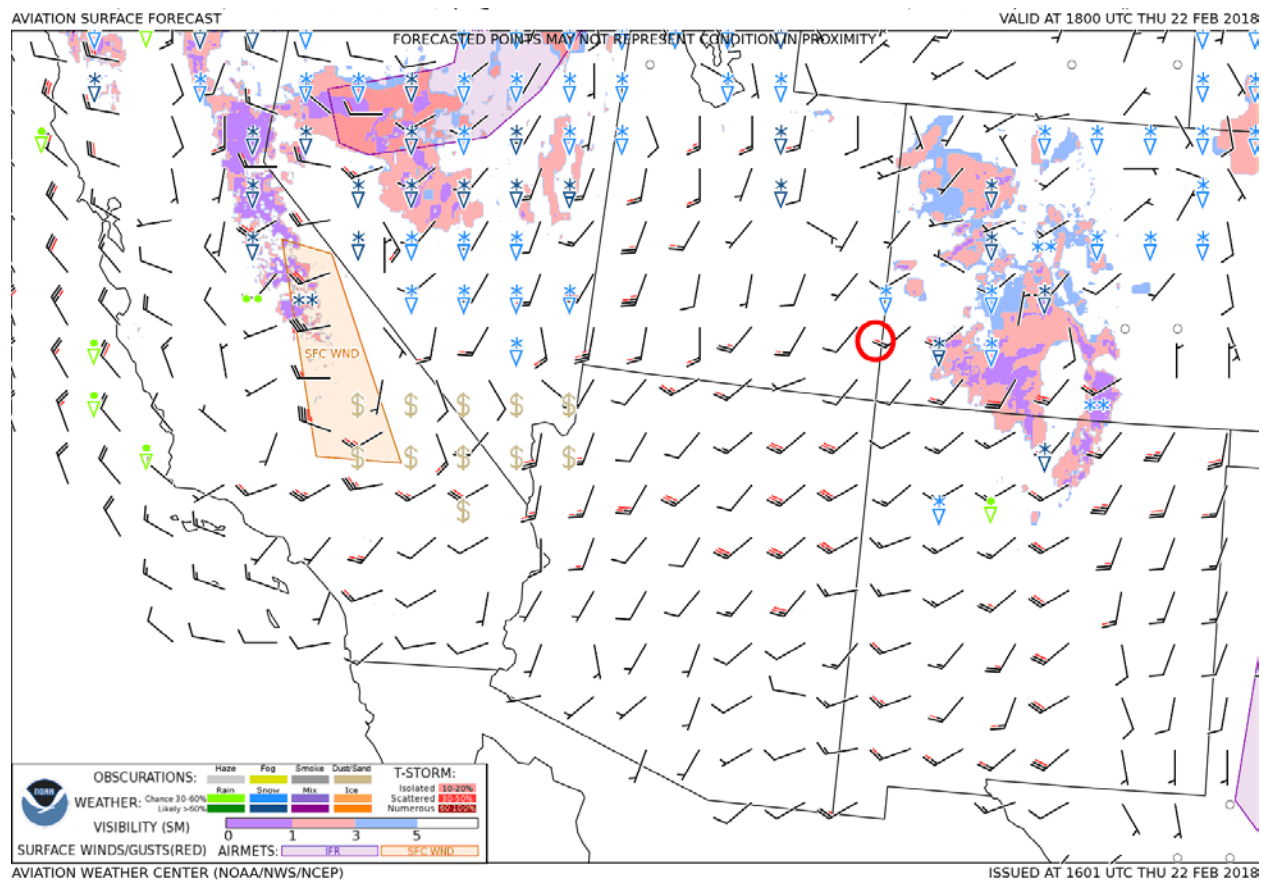


Figure 7 – GFA forecast imagery depicting IFR condition and surface wind AIRMETs, surface visibility, surface wind, precipitation, and other obscurations and hazards. Issued about 0900 MST and valid for 1100 MST. This GFA forecast imagery depicted a surface visibility of 5 statute miles or greater for the accident location, and the closest data points indicated a southwesterly surface wind of 5 knots and a southwesterly wind of 15 knots with gusts to 20 knots. Slight snow showers were depicted near the accident location. Accident location denoted by the red circle.

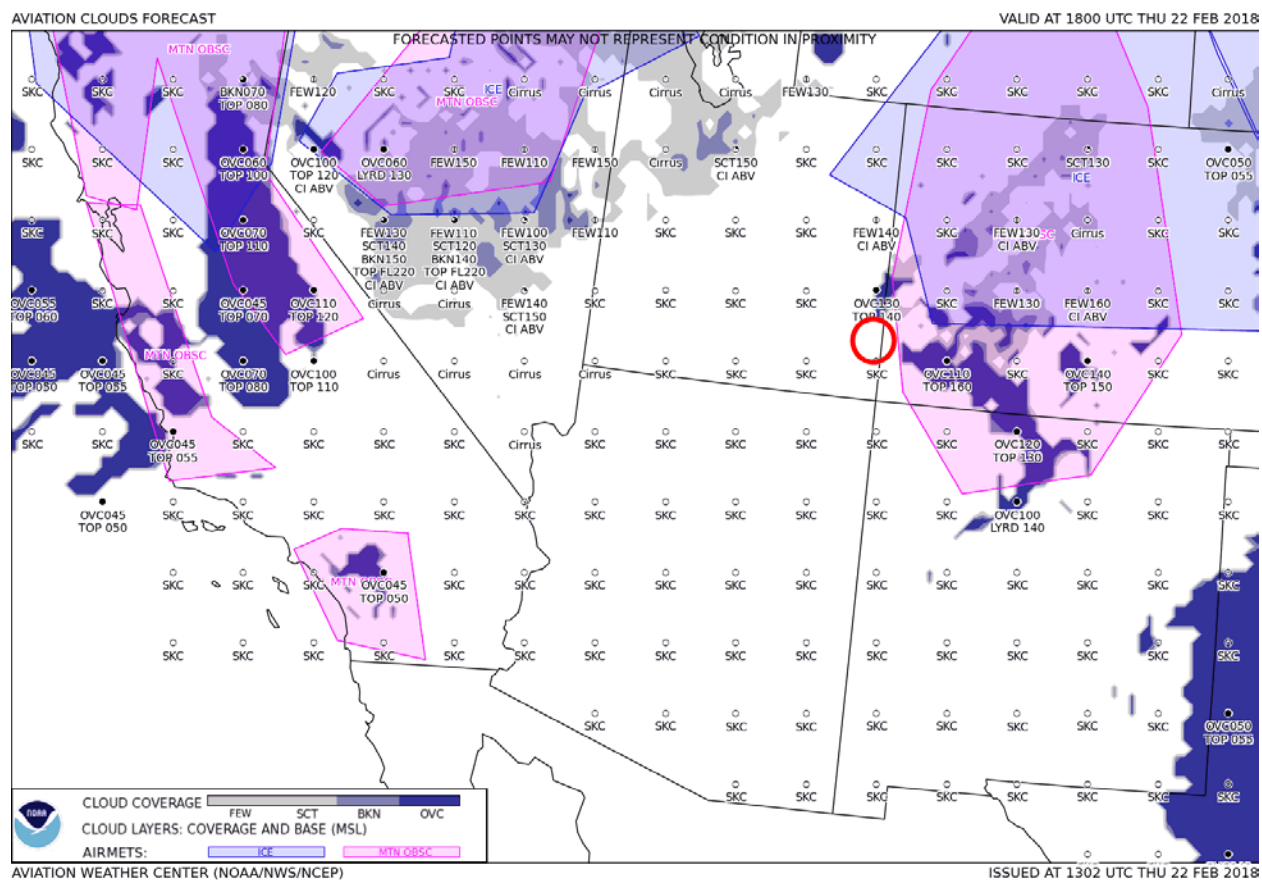


Figure 8 – GFA forecast imagery depicting sky condition and icing and mountain obscuration AIRMETs. Issued about 0600 MST and valid for 1100 MST. This GFA forecast imagery depicted an area of cloud near the accident location, with the closest data points indicating clear skies and cloud bases of 13,000 feet above msl and cloud tops of 14,000 feet above msl. An AIRMET for mountain obscuration was depicted to the east near the Utah/Colorado border and an AIRMET for icing conditions was depicted farther northeast. Accident location denoted by the red circle.

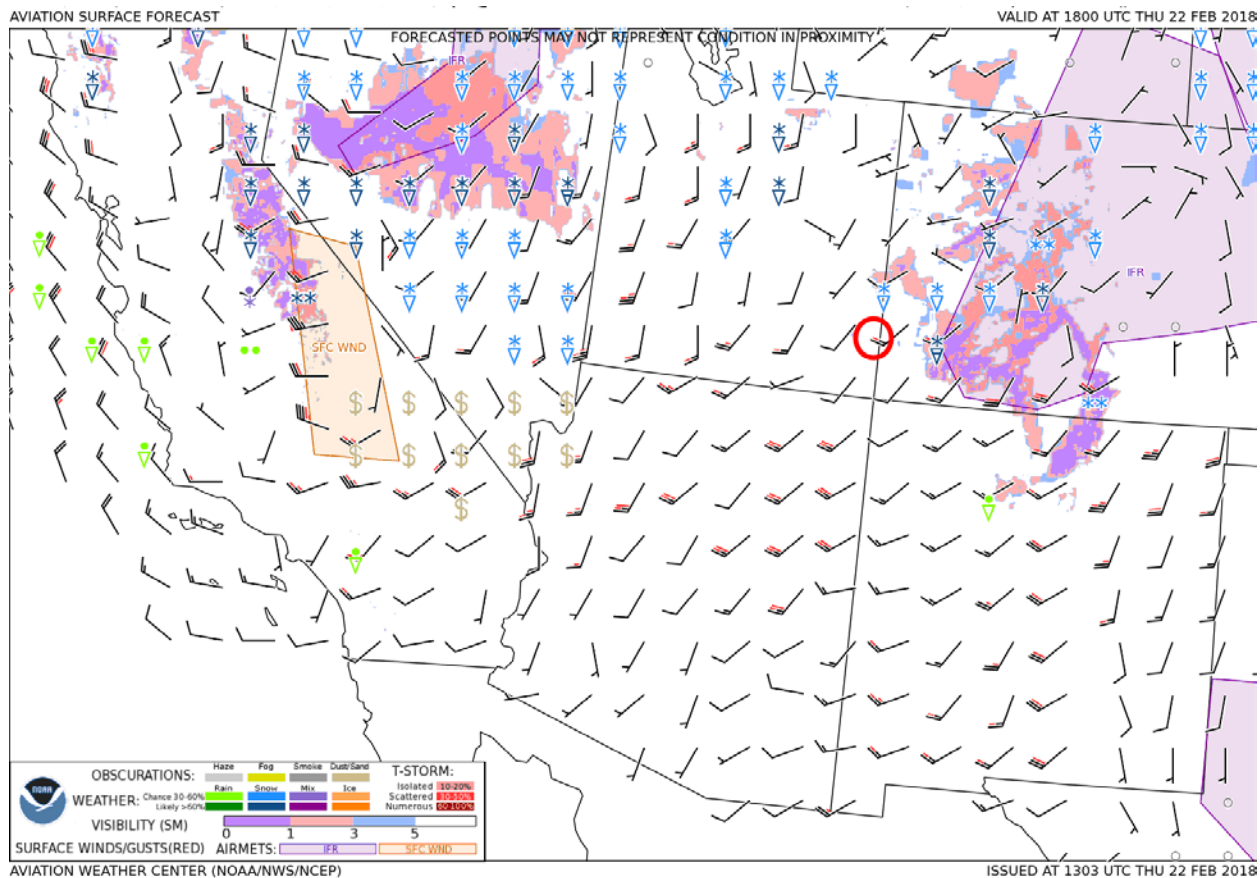


Figure 9 – GFA forecast imagery depicting IFR condition and surface wind AIRMETS, surface visibility, surface wind, precipitation, and other obscurations and hazards. Issued about 0600 MST and valid for 1100 MST. This GFA forecast imagery depicted a surface visibility of 5 statute miles or greater for the accident location, and the closest data points indicated a southwesterly surface wind of 5 knots and a southwesterly wind of 15 knots with gusts to 20 knots. Slight snow showers were depicted near the accident location. Accident location denoted by the red circle.

10.0 AIRMETS

There were no AIRMET advisories for IFR conditions, mountain obscuration or turbulence below FL180¹¹ active for the accident location at the accident time. The following AIRMET for moderate icing below 16,000 feet was active for the accident location at the accident time.

WAUS45 KPCI 221445

WA5Z

-SLCZ WA 221445

AIRMET ZULU UPDT 2 FOR ICE AND FRZLVL VALID UNTIL 222100

¹¹ 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.

AIRMET ICE...WY UT CO AZ NM
FROM 60NNW BFF TO BFF TO GLD TO 50W LBL TO 50SW PUB TO 30SSW FTI
TO 30SE SJN TO HVE TO 40NNE OCS TO 30SW DDY TO 60NNW BFF
MOD ICE BLW 160. CONDS CONTG BYD 21Z THRU 03Z.

11.0 SIGMETs

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

12.0 Center Weather Service Unit Advisories

There were no Center Weather Advisories or Meteorological Impact Statements issued by the Center Weather Service Unit at the Denver Air Route Traffic Control Center that were active for the accident location at the accident time.

13.0 Astronomical

The astronomical data obtained from the United States Naval Observatory for 35° 49' north latitude and 87° 03' west longitude, for the accident location, indicated the following:

SUN	
Sunrise	0657 MST
Sunset	1803 MST
MOON	
Moonrise	1103 MST

14.0 Preflight Weather Briefing

According to Leidos Flight Service, the accident aircraft did not have contact with either Leidos or DUATS on the accident day.

According to ForeFlight, no weather briefings were requested for CGYGY (or C-GYGY) using ForeFlight Mobile prior to the accident flight, or for any flights immediately preceding the accident flight. It also appeared that the accident pilot did not use his device signed-in to ForeFlight Mobile to view any weather imagery prior to the accident flight. ForeFlight did not record whether the

accident pilot viewed any "live" weather overlays such as radar or satellite imagery over the maps view prior to the flight. ForeFlight also did not record whether the accident pilot viewed any individual METARs, TAFs or "MOS" forecasts.

However, ForeFlight did identify that the accident pilot viewed the following airports in the days prior to the accident flight and indicated that it was possible the pilot also viewed weather information about them.

KCTB	2/16/2018	15:46:21 UTC
CYQL	2/15/2018	15:09:28 UTC
KGTF	2/14/2018	14:38:50 UTC
KHSR	2/14/2018	14:37:53 UTC
KHRX	2/14/2018	14:37:47 UTC
KPPA	2/14/2018	14:37:42 UTC

Submitted by:

Mike Richards
Senior Meteorologist

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