



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

July 25, 2018

Group Chairman's Factual Report

METEOROLOGY

CEN18FA101

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A. ACCIDENT

Location: Near Evanston, Wyoming
Date: February 18, 2018
Time: 1505 mountain standard time
2205 Coordinated Universal Time (UTC)
Aircraft: Socata TBM-700A, Registration: N700VX

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 including the National Centers for Environmental Information (NCEI). All times are mountain standard time (MST) on February 18, 2018, and are based upon the 24-hour clock, where local time is -7 hours from UTC, and UTC=Z (unless otherwise noted). 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.

The approximate location of the accident site was at 41:17:16.7 N, 110:58:54.9 W, with an approximate elevation of 6,880 feet (ft).

D. WEATHER 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.¹

¹

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

1.1 Surface Analysis Chart

The northwestern section of the NWS Surface Analysis Chart for 1400 MST is provided as figure 1 with the approximate location of the accident site marked within the red circle. The chart indicated a cold frontal boundary extending immediately south of the accident and over southwestern Wyoming, into Utah, southwestward into eastern Nevada. A stationary frontal boundary was located northeast of the accident stretching from central Idaho southeastward into southern Wyoming, then eastward into center Nebraska. A surface low pressure center with a pressure of 990-hectopascals (hPa) was located in southcentral Wyoming. Other surface low pressure centers were located along and near the frontal boundaries in central Idaho, southeastern Wyoming, and in eastern Nevada.

The station model for Evanston, Wyoming, immediately west of the accident site depicted a temperature of 36° Fahrenheit (F), dew point temperature of 24° F, a west-southwest wind of 20 knots, overcast sky cover, and light snow.

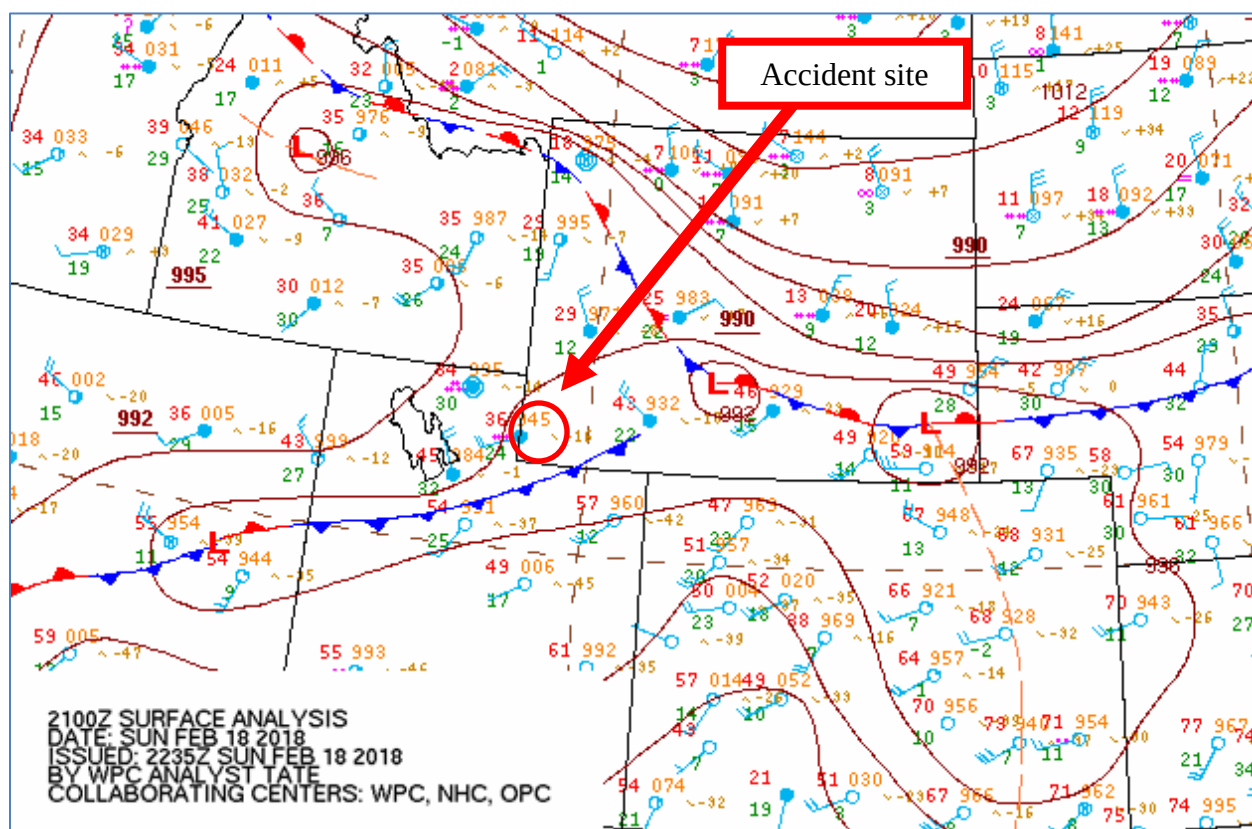


Figure 1 – NWS Surface Analysis Chart for 1400 MST

1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 1700 MST at 700-, 500-, and 300-hPa are presented in figures 2 through 4. There were mid-level troughs² located west and east of the accident site at 1700 MST (figure 2). A mid-level trough at 500-hPa was located west of the accident site over Washington, Oregon, Nevada, and Idaho (figure 3). Mid-level troughs are the upper level support for the fronts and act as lifting mechanisms to help produce clouds and precipitation if sufficient moisture is present. There was a southwest wind of 10 knots at 700-hPa (figure 2) with the wind increasing in speed to 70 knots by 500-hPa. By 300-hPa, the wind was still from the southwest at 115 knots (figure 4).

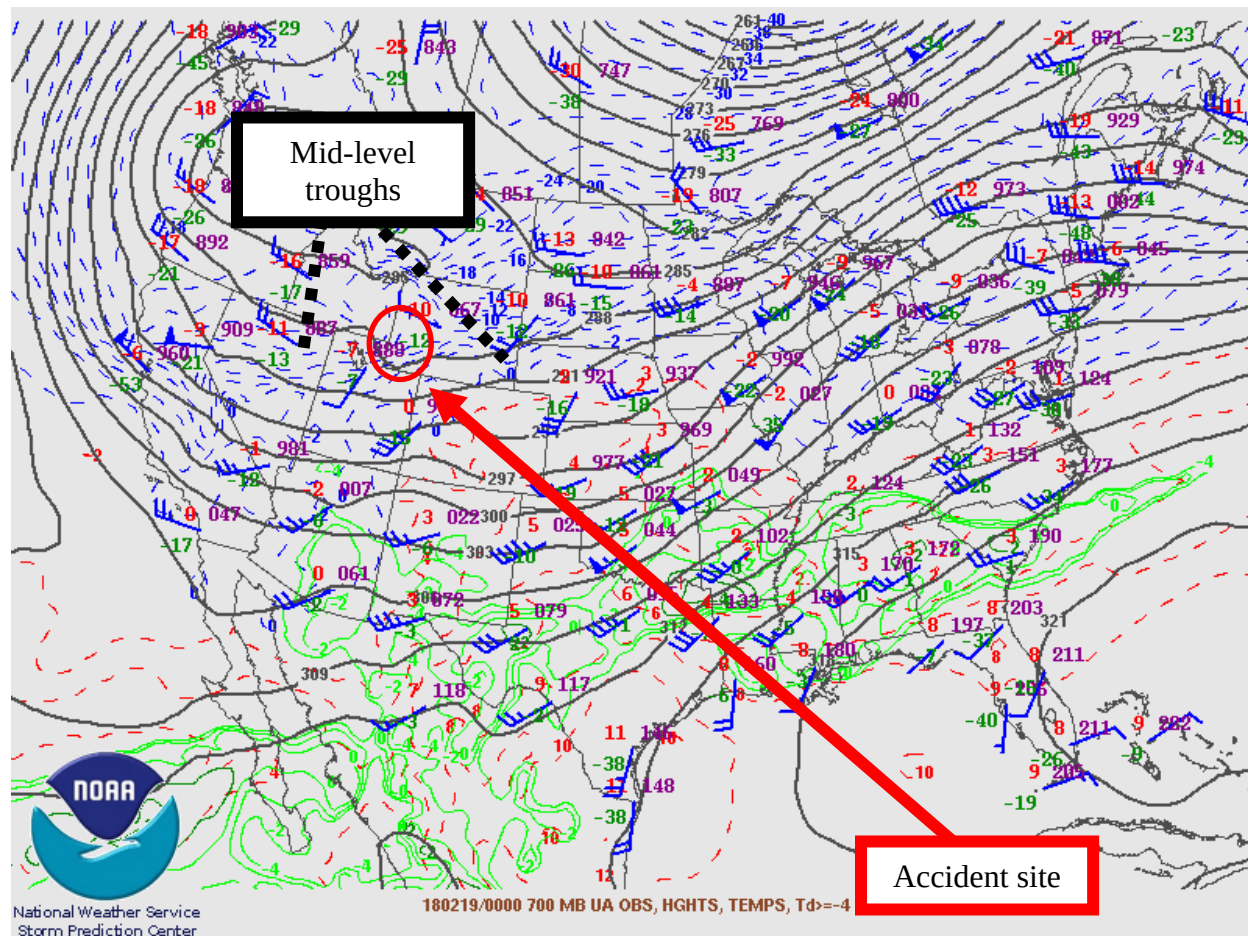


Figure 2 – 700-hPa Constant Pressure Chart for 1700 MST

² Trough – An elongated area of relatively low atmospheric pressure or heights.

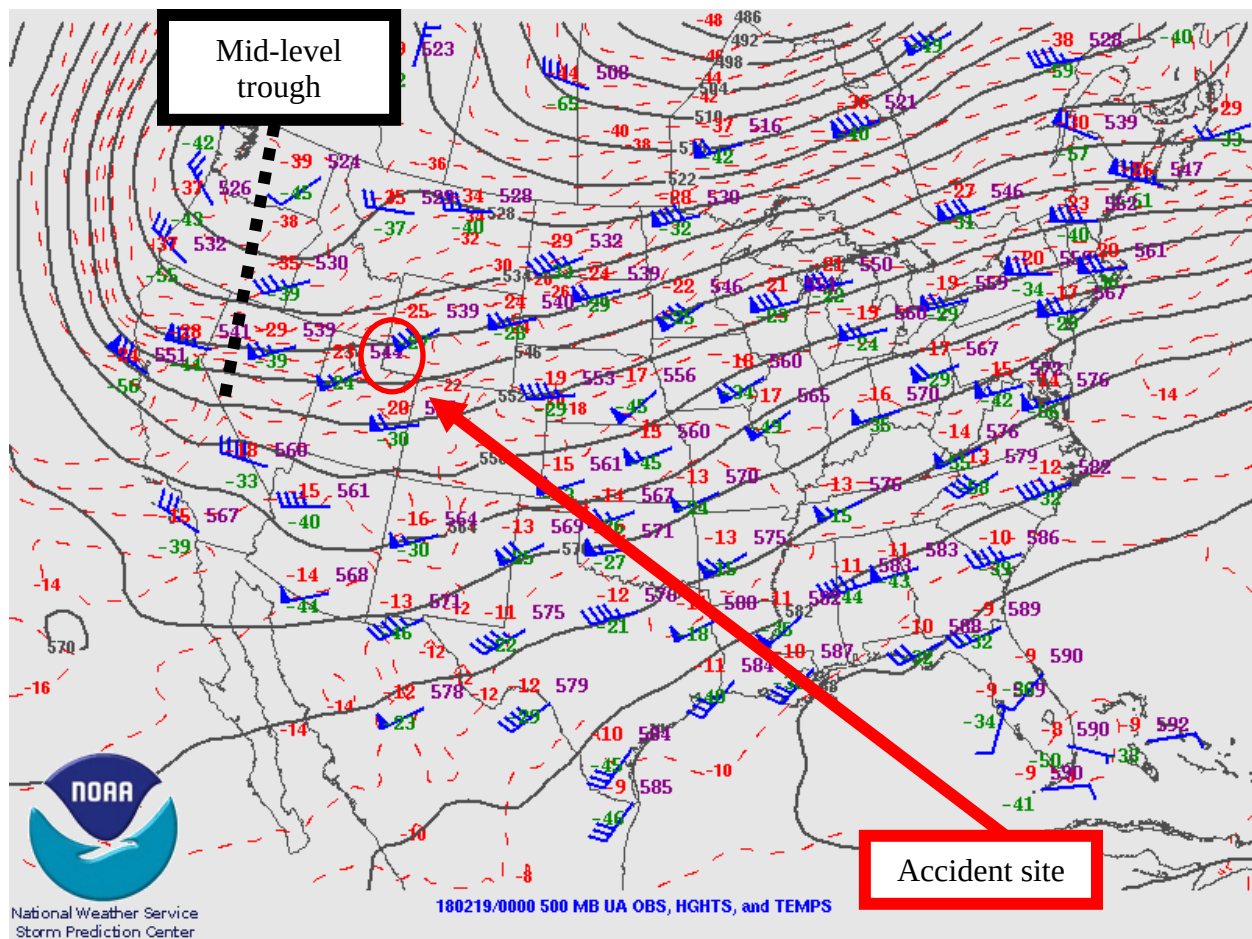


Figure 3 – 500-hPa Constant Pressure Chart for 1700 MST

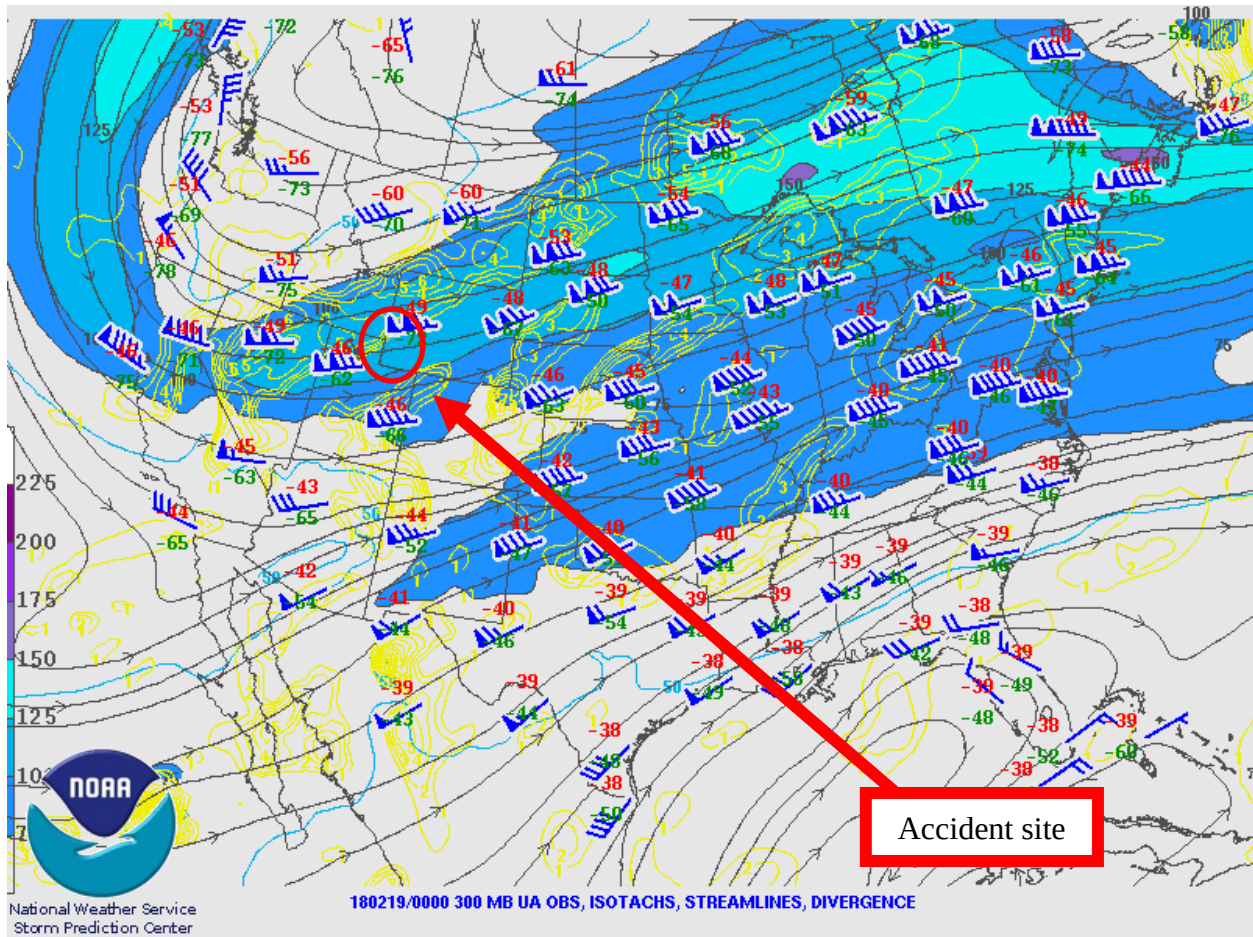


Figure 4 – 300-hPa Constant Pressure Chart for 1700 MST

2.0 SPC Products

The SPC issued the following Day 1 Convective Outlook at 1227 MST (figure 5) with areas of general thunderstorms forecast for the accident site. The SPC defines the “TSTM” area as an area that encloses where a 10 percent or higher probability of thunderstorms is forecast during the valid period. The SPC Day 1 Convective Outlook valid before the time of takeoff had general thunderstorms forecast for a similar area, including the accident site:

SPC AC 181927

Day 1 Convective Outlook
NWS Storm Prediction Center Norman OK
0127 PM CST Sun Feb 18 2018

Valid 182000Z - 191200Z

...THERE IS A MARGINAL RISK OF SEVERE THUNDERSTORMS FOR PORTIONS OF WEST AND SOUTHWEST TEXAS...

...SUMMARY...

A few thunderstorms are expected from the southern Plains today to

the middle Mississippi Valley tonight, and sporadic lightning strikes may also occur along the northern California and Oregon coasts in addition to parts of the interior West. Isolated large hail will be possible this evening in parts of west and southwest Texas.

...Discussion...

No change was made to the previously issued forecast.

..Smith.. 02/18/2018

.PREV DISCUSSION... /ISSUED 1026 AM CST Sun Feb 18 2018/

...Synopsis...

Large-scale pattern amplification is underway with a developing western trough and eastern ridge. Cold midlevel temperatures and associated steep low-midlevel lapse rates will support the threat for low-topped convection and isolated thunderstorms along the Pacific coast as the midlevel trough digs southward. Downstream, this amplifying pattern will favor air mass modification and northward-northeastward moisture transport across the southern Plains and lower MS Valley, to the east-southeast of a lee cyclone across the High Plains. Isolated thunderstorms are ongoing across southwest TX in association with a weak lead shortwave trough. This regime supporting moistening above the ground and elevated thunderstorms will spread northeastward in conjunction with a strengthening low-level jet from TX to the mid MS Valley through tonight.

...West/southwest TX late this afternoon/evening...

There will be a small window of opportunity for a strong storm or two late this afternoon/evening near and south of Midland. Surface heating along a weak surface trough/dryline and boundary-layer dewpoints in the mid-upper 50s feeding up the Pecos River valley will support surface-based CAPE near 1000 J/kg and weakening convective inhibition. Effective bulk shear around 40 kt and midlevel lapse rates near 7 C/km could support an isolated supercell capable of producing marginally severe hail.

CLICK TO GET WUUS01 PTSDY1 PRODUCT

NOTE: THE NEXT DAY 1 OUTLOOK IS SCHEDULED BY 0100Z

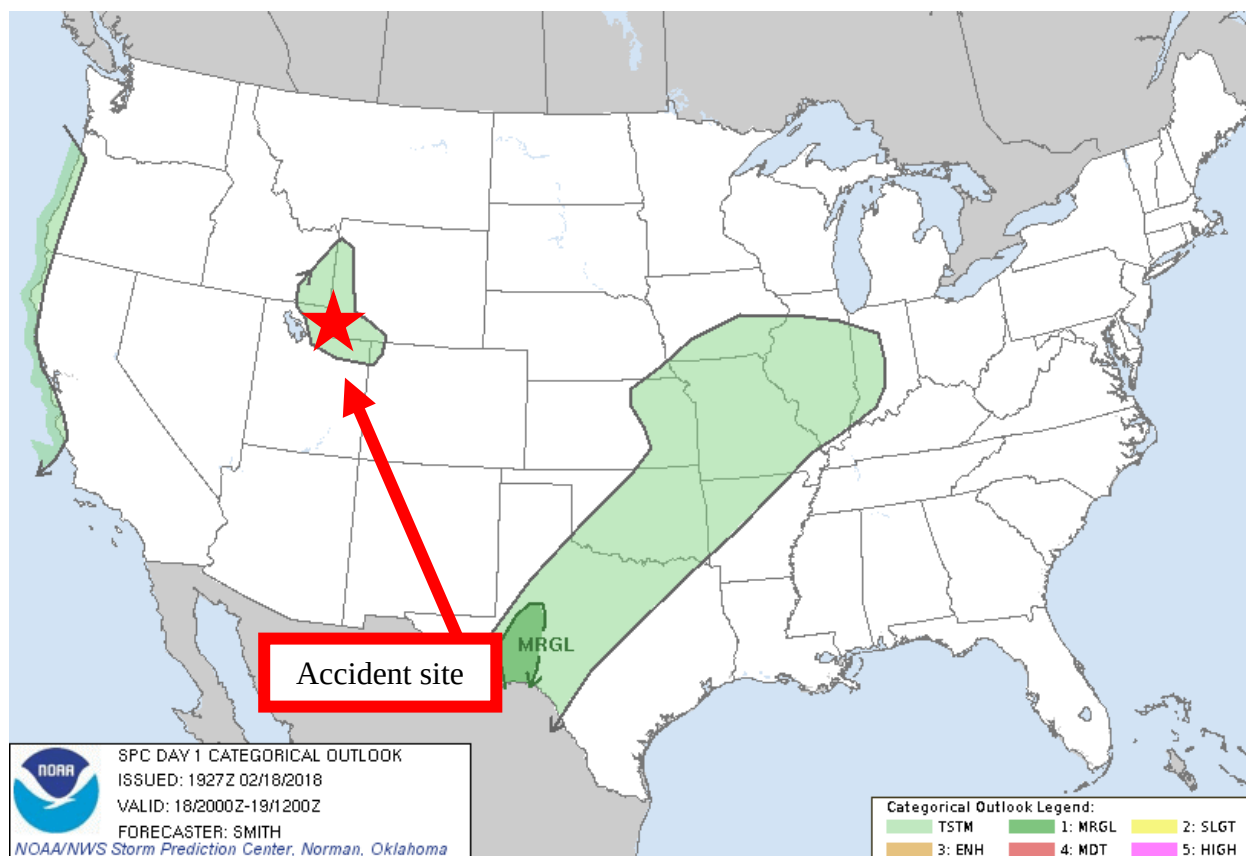


Figure 5 – SPC day 1 Convective Outlook valid at the time of the accident

3.0 Surface Observations

The area surrounding the accident site was documented using official Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). The following observations were taken from standard code and are provided in plain language with visibility reported in statute miles for this section. Figure 6 is a local sectional chart with the accident site and the closest weather reporting location marked.

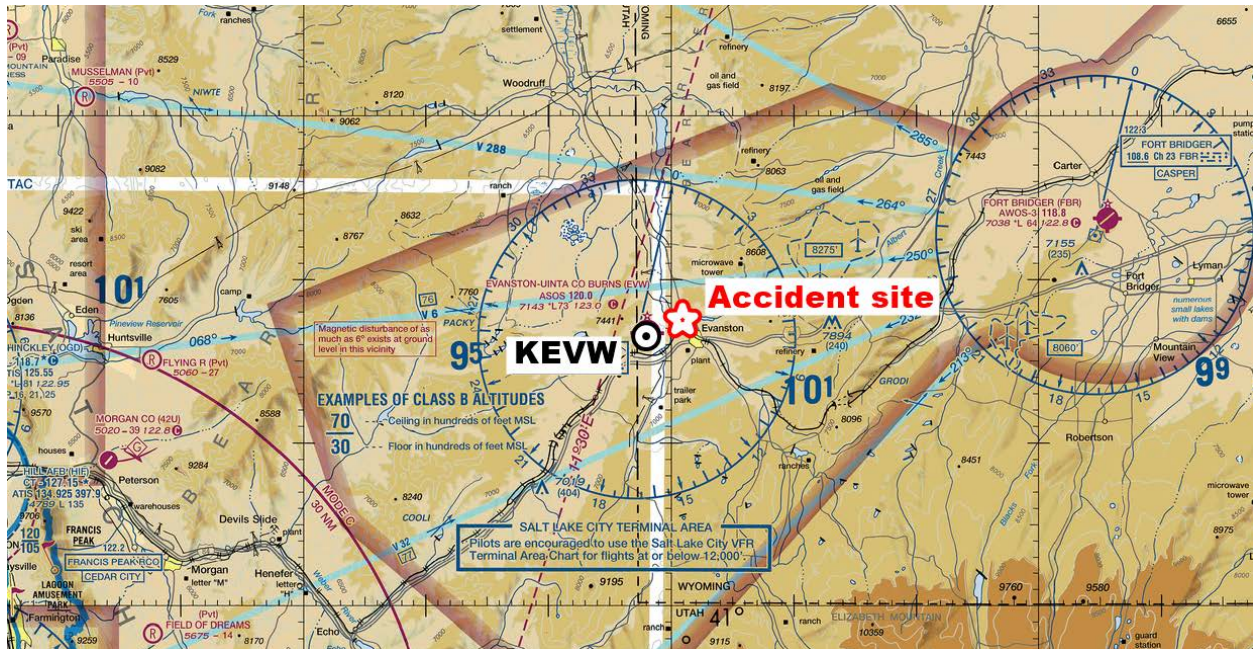


Figure 6 – Sectional map of the accident area with the location of the accident site and surface observation site

Evanston-Uinta County Airport (KEVW) had the closest official weather station to the accident site located 3 miles west of Evanston, Wyoming. KEVW had an Automated Surface Observing System (ASOS³) whose reports were not supplemented. KEVW was located 2 miles west-southwest of the accident site, at an elevation of 7,143 ft, and had an 10.5° easterly magnetic variation⁴ (figure 6). The following raw observations were disseminated during the times surrounding the accident:⁵

[1153 MST] METAR KEVW 181853Z AUTO 24020G27KT 10SM OVC065 03/M07 A2951
RMK AO2 PK WND 26030/1805 SNE03 SLP966 P0000 T00331067=

[1253 MST] METAR KEVW 181953Z AUTO 25025G30KT 10SM FEW045 BKN055
OVC075 03/M04 A2949 RMK AO2 PK WND 24043/1916 SLP952 T00281044=

[1353 MST] METAR KEVW 182053Z AUTO 25022G31KT 8SM -SN BKN035 OVC045
02/M04 A2947 RMK AO2 PK WND 24031/2049 SNB50 SLP945 P0000
60000 T00221044 57016=

³ ASOS – Automated Surface Observing System is equipped with meteorological instruments to observe and report wind, visibility, ceiling and sky condition, temperature, dewpoint, altimeter, and barometric pressure.

⁴ Magnetic variation – The angle (at a particular location) between magnetic north and true north. Latest measurement taken from <http://airnav.com/airport/KEVW>

⁵ The bold sections in this NWS product and the rest of products in this report are intended to highlight the sections that directly reference the weather conditions that effected 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.

[1410 MST] SPECI KEVW 182110Z AUTO 28019G32KT 2 1/2SM -SN FEW020 BKN026 OVC036 01/M02 A2947 RMK AO2 PK WND 26032/2101 P0000 T00061022=

[1426 MST] SPECI KEVW 182126Z AUTO 30019G24KT 1 3/4SM -SN BR FEW007 BKN024 OVC034 00/M02 A2947 RMK AO2 PK WND 26032/2101 P0000 T00001017=

[1433 MST] SPECI KEVW 182133Z AUTO 33012G23KT 1 1/4SM -SN BR SCT007 BKN022 OVC034 M02/M03 A2948 RMK AO2 PK WND 26032/2101 P0000 T10171028=

[1441 MST] SPECI KEVW 182141Z AUTO 33012KT 3/4SM -SN BR BKN007 BKN018 OVC034 M03/M03 A2948 RMK AO2 PK WND 26032/2101 P0000 T10281033=

[1453 MST] METAR KEVW 182153Z AUTO 34013KT 1/4SM SN FZFG VV008 M03/M03 A2947 RMK AO2 PK WND 26032/2101 SLP961 P0000 T10281033=

ACCIDENT TIME 1505 MST

[1545 MST] SPECI KEVW 182245Z AUTO 36006KT 1SM -SN BR FEW004 BKN014 OVC019 M03/M04 A2946 RMK AO2 P0001 T10331039=

[1553 MST] METAR KEVW 182253Z AUTO 35004KT 1 1/2SM -SN BR BKN014 OVC020 M03/M03 A2946 RMK AO2 SLP962 P0001 T10331033=

[1600 MST] SPECI KEVW 182300Z AUTO 34005KT 1SM -SN BR BKN016 OVC020 M03/M04 A2946 RMK AO2 P0000 T10331039=

[1627 MST] SPECI KEVW 182327Z AUTO 31007KT 3/4SM -SN BR VV018 M03/M03 A2947 RMK AO2 P0001 T10281033=

KEVW weather at 1441 MST, automated, wind from 330° at 12 knots, three quarters of a mile visibility, light snow and mist, broken ceiling at 700 ft above ground level (agl), broken skies at 1,800 ft agl, overcast skies at 3,400 ft agl, temperature of -3° Celsius (C), dew point temperature of -3° C, and an altimeter setting of 29.48 inches of mercury. Remarks: automated station with a precipitation discriminator, peak wind from 260° at 32 knots occurred at 1401 MST, a trace of precipitation since 1353 MST, temperature -2.8° C, dew point temperature -3.3° C.

KEVW weather at 1453 MST, automated, wind from 340° at 13 knots, a quarter of a mile visibility, moderate snow and freezing fog, vertical visibility at 800 ft agl, temperature of -3° C, dew point temperature of -3° C, and an altimeter setting of 29.47 inches of mercury. Remarks: automated station with a precipitation discriminator, sea level pressure 996.1 hPa, peak wind from 260° at 32 knots occurred at 1401 MST, a trace of precipitation since 1353 MST, temperature -2.8° C, dew point temperature -3.3° C.

KEVW weather at 1545 MST, automated, wind from 360° at 6 knots, a mile visibility, light snow and mist, few clouds at 400 ft agl, broken ceiling at 1,400 ft agl, overcast skies at 1,900 ft agl, temperature of -3° C, dew point temperature of -4° C, and an altimeter setting of 29.46 inches of mercury. Remarks: automated station with a precipitation discriminator, 0.01 inches of precipitation since 1453 MST, temperature -3.3° C, dew point temperature -3.9° C.

KEVW weather at 1553 MST, automated, wind from 350° at 4 knots, a mile and a half visibility, light snow and mist, broken ceiling at 1,400 ft agl, overcast skies at 2,000 ft agl, temperature of -3° C, dew point temperature of -3° C, and an altimeter setting of 29.46 inches of mercury. Remarks: automated station with a precipitation discriminator, sea level pressure 996.2 hPa, 0.01 inches of precipitation since 1453 MST, temperature -3.3° C, dew point temperature -3.3° C.

3.1 Five and One Minute Wind Observations

The five- and one-minute KEVW ASOS surface data were provided by the NWS for the time surrounding the accident. One-minute raw wind data was provided with two separate magnitudes and wind directions⁶. The following is a selection of the 5 minutes KEVW observations around the accident time.

KEVW weather at 1500 MST, wind from 350° at 14 knots, a half mile visibility, moderate snow and freezing fog, vertical visibility 800 ft agl, temperature of -3° C, dew point temperature of -3° C, altimeter setting of 29.47 inches of mercury, pressure altitude 7,570 ft, relative humidity 96%, density altitude 7,300 ft, magnetic wind 340° at 14 knots. Remarks: automated station with a precipitation discriminator, a trace of precipitation since 1453 MST, temperature -2.8° C, dew point temperature of -3.3° C.

KEVW weather at 1505 MST, wind from 340° at 11 knots, a half mile visibility, moderate snow and freezing fog, vertical visibility 800 ft agl, temperature of -3° C, dew point temperature of -4° C, altimeter setting of 29.47 inches of mercury, pressure altitude 7,570 ft, relative humidity 96%, density altitude 7,200 ft, magnetic wind 320° at 11 knots. Remarks: automated station with a precipitation discriminator, a trace of precipitation since 1453 MST, temperature -3.3° C, dew point temperature of -3.9° C.

KEVW weather at 1510 MST, wind from 340° at 8 knots, a half mile visibility, moderate snow and freezing fog, vertical visibility 800 ft agl, temperature of -3° C, dew point temperature of -4° C, altimeter setting of 29.47 inches of mercury, pressure altitude 7,560 ft, relative humidity 96%, density altitude 7,200 ft, magnetic wind 330° at 8 knots. Remarks: automated station with a precipitation discriminator, a trace of precipitation since 1453 MST, temperature -3.3° C, dew point temperature of -3.9° C.

In addition, the 1-minute KEVW observations indicated heavy snow at KEVW from 1500 to 1504 MST, moderate snow at 1505 MST, and then heavy snow again at 1506 MST. Additional KEVW 1- and 5-minute ASOS data can be found in attachment 1.

⁶ The wind directions are in reference to true north.

The observations from KEVW surrounding the accident time indicated that strong gusty winds prevailed prior to the flights arrival with IFR⁷ to LIFR⁸ conditions in light to heavy snow, and fog, with ceilings between 700 and 1,400 ft agl.

4.0 Upper Air Data

A High-Resolution Rapid Refresh (HRRR)⁹ model sounding was created for the accident site for 1500 MST with station elevation of 6,722 ft. The 1500 MST HRRR sounding was plotted on a standard Skew-T Log P diagram¹⁰ with the derived stability parameters included in figure 7 (with data from the surface to 500-hPa, or around 18,000 ft msl.) This data was analyzed using the RAOB¹¹ software package. The sounding depicted the lifted condensation level (LCL)¹² at 9,313 ft msl (2,591 ft agl), the convective condensation level (CCL)¹³ at 9,547 ft msl (2,825 ft agl), and the LFC at 9,313 ft msl (2,591 ft agl). The sounding had a greater than 80% relative humidity from 7,500 ft msl through 18,000 ft msl. The freezing level was at 6,931 ft msl (209 ft agl). The precipitable water value was 0.29 inches.

⁷ Instrument Flight Rules (IFR) – Refers to the general weather conditions pilots can expect at the surface. IFR criteria means a ceiling below 1,000 ft agl and/or less than 3 miles visibility.

⁸ Low Instrument Flight Rules (LIFR) – Refers to the general weather conditions pilots can expect at the surface. LIFR criteria means a ceiling below 500 ft agl and/or less than 1-mile visibility.

⁹ 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.

¹⁰ 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.

¹¹ RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamoras, Pennsylvania.

¹² LCL - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

¹³ 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.

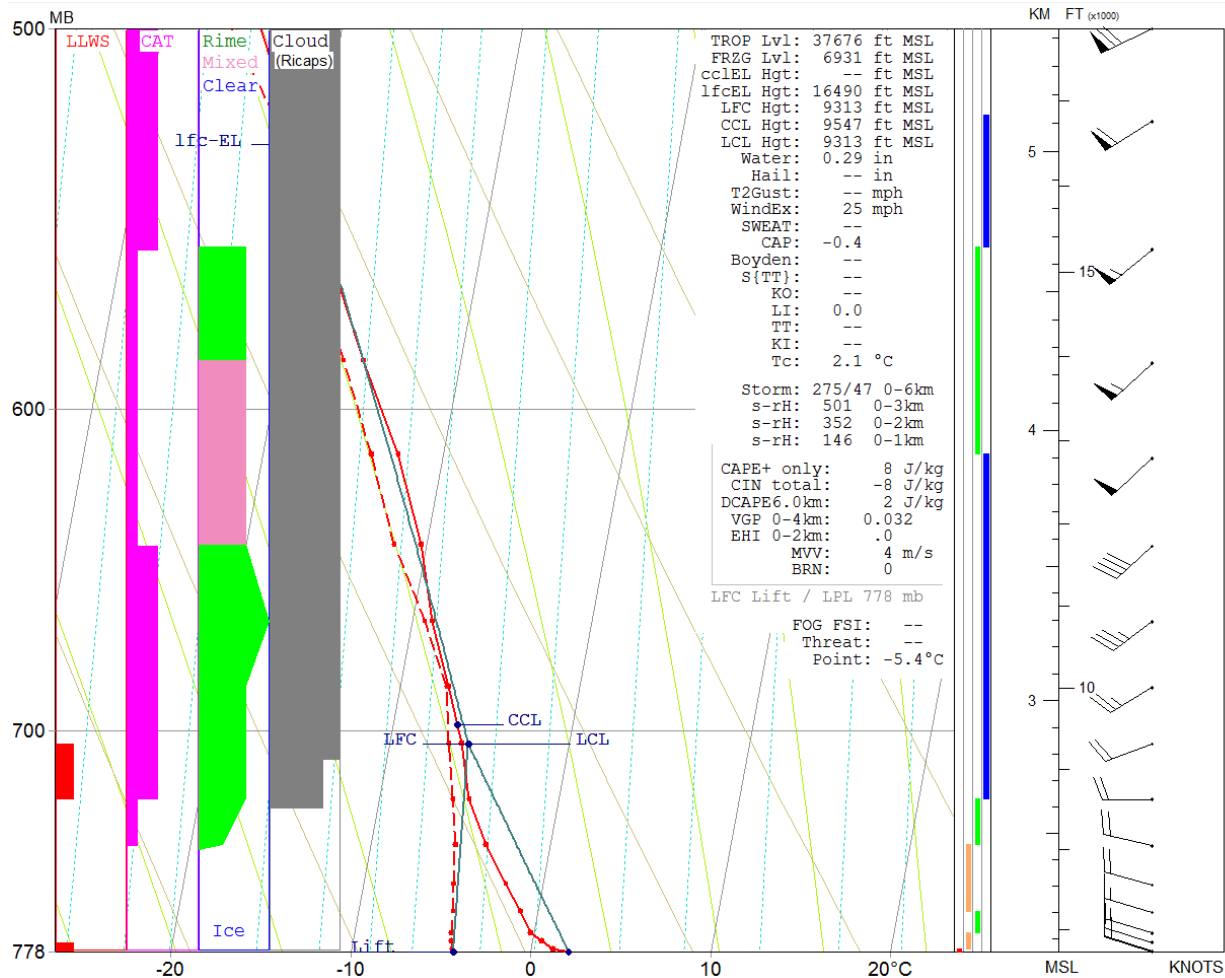


Figure 7 – 1500 MST HRRR sounding for the accident site

The 1500 MST HRRR sounding indicated an unstable to conditionally unstable environment from the surface through 8,500 ft followed by a stable environment from 8,500 ft through 12,750 ft. RAOB identified the possibility of clouds between 8,750 ft through 18,000 ft. Light to heavy rime and mixed icing were indicated by RAOB between 8,000 and 15,000 ft msl. Icing potential will be further discussed in section 18.0.¹⁴

¹⁴ S.G. Cober, G. A. Isaac, and J. W. Strapp, Characterizations of Aircraft Icing Environments that Include Supercooled Large Drops (Journal of Applied Meteorology, 2001), pp. 1984-2002.
B.C Bernstein, C.A. Wolff, and F. McDonough, An Inferred Climatology of Icing Conditions Aloft, Including Supercooled Large Drops. Part I: Canada and the Continental United States (Journal of Applied Meteorology and Climatology, 2007), pp. 1857-1878.

Williams, E.R., D.J. Smalley, M.F. Donovan, R.G. Hallowell, K.T. Hood, B.J. Bennett, R. Evaristo, A. Stepanek, T. Bals-Elsholz, J. Cobb, J. Ritzman, A. Korolev, M. Wolde, Measurements of Differential Reflectivity in Snowstorms in Warm Season Stratiform Systems (Journal of Applied Meteorology and Climatology, in press).

The 1500 MST HRRR sounding wind profile indicated a surface wind from 289° at 14 knots with the wind remaining westerly through 10,000 ft. The wind speed was as high as 25 knots between the surface and 10,000 ft. Above 10,000 ft the wind became southwesterly through 18,000 ft. By 18,000 ft the wind speed had increased to 70 knots. RAOB indicated the possibility of low-level wind shear (LLWS) in two layers from the surface to 9,500 ft msl. RAOB indicated the possibility of clear-air turbulence above 8,000 ft.

5.0 Satellite Data

Visible and infrared data from the Geostationary Operational Environmental Satellite number 16 (GOES-16) data was 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-16 bands 2 and 13) at wavelengths of 0.64 microns (μm) and 10.3 μm , respectively, were retrieved for the period. Satellite imagery surrounding the time of the accident, from 1300 MST through 1700 MST at approximately 15-minute intervals were reviewed, and the closest images to the time of the accident are documented here.

Figures 7 and 8 present the GOES-16 visible imagery at 1500 and 1515 MST at 3X magnification with the accident site highlighted with a red square. Inspection of the visible imagery indicated an overcast layer of cloud cover over the accident site with the cloud cover moving from southwest to northeast with time. Figure 9 is the GOES-16 infrared imagery at 1515 MST at 4X magnification with the accident site highlighted with a red square. Inspection of the infrared imagery also indicated cloud cover extending over the accident site. The lower brightness temperatures (green colors; higher cloud tops) were located northwest of the accident site. In addition, while the cloud cover was moving from southwest to northeast with time, the area of weather impacting the accident site and associated mid-level trough (section 1.2) was moving from west to east (attachments 2 and 3). Based on the brightness temperatures above the accident site and the vertical temperature profile provided by the 1500 MST HRRR sounding, the approximate cloud-top heights over the accident site were 18,000 ft at 1515 MST. It should be noted these figures have not been corrected for any parallax error.

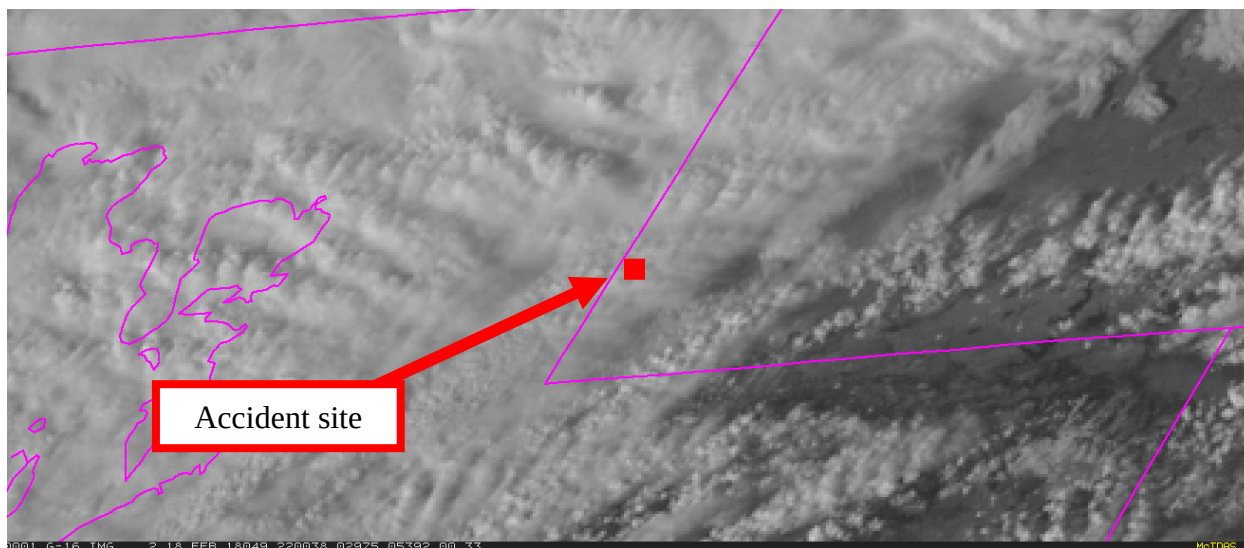


Figure 8 – GOES-16 visible image at 1500 MST

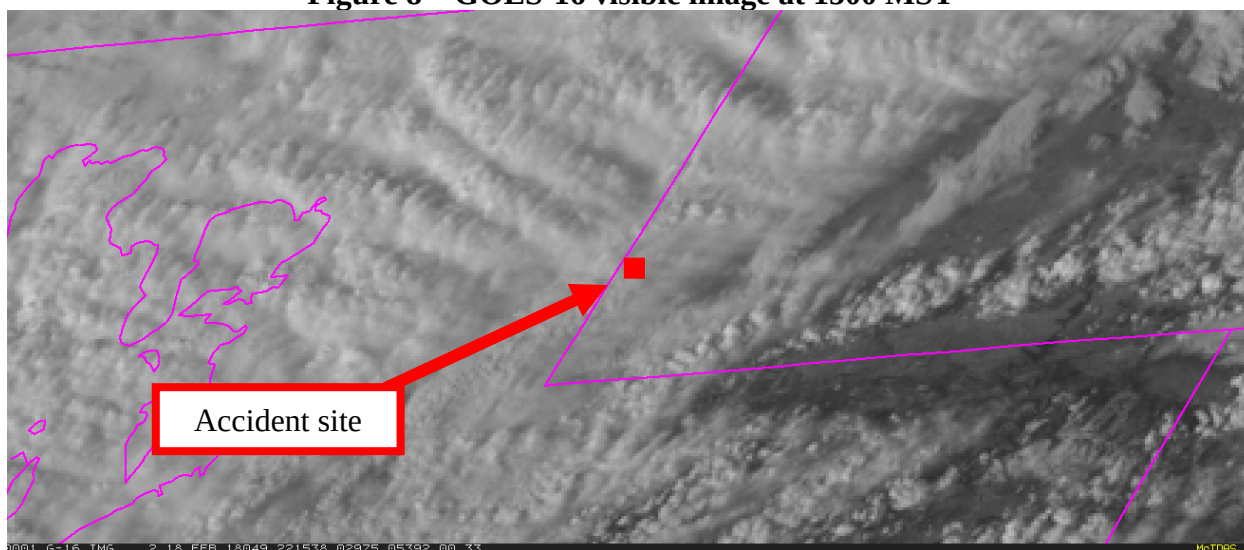


Figure 9 – GOES-16 visible image at 1515 MST

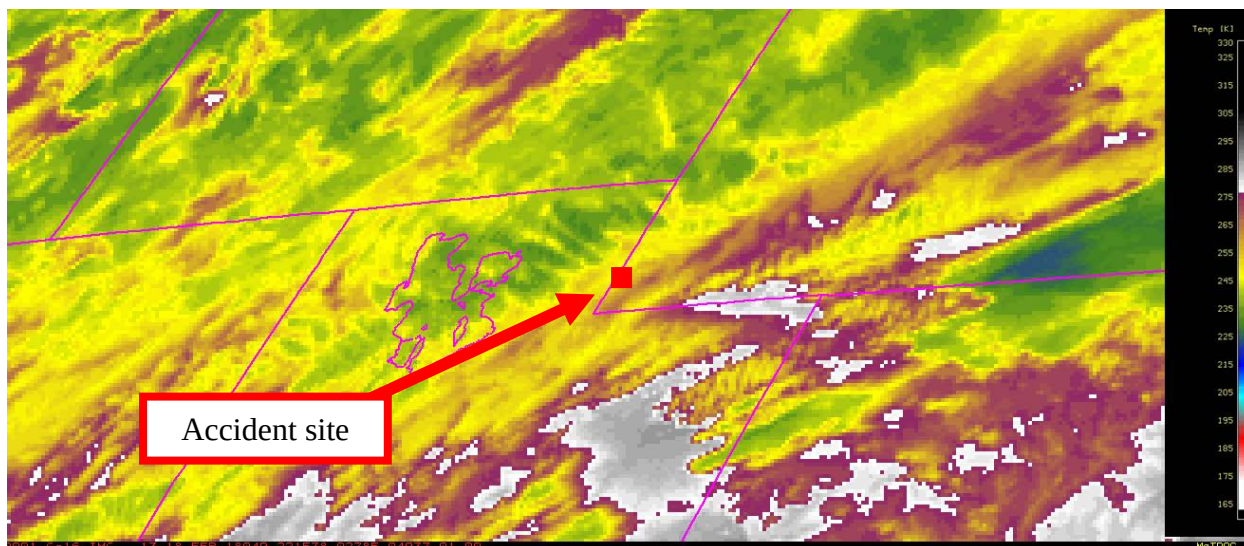


Figure 10 – GOES-16 infrared image at 1515 MST

6.0 Radar Imagery Information

The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D)¹⁵ to the accident site was the Elder County, Utah, radar (KMTX), which was located 66 miles west of the accident site at an elevation of 6,460 ft. At the time of the accident, KMTX had an outage that began at 1040 MST when commercial power failed at the site and the switch over to generator power failed. A NWS employee traveled up to KMTX site despite the winter driving conditions and restored KMTX capabilities by 1603 MST (attachment 4). Therefore, no weather radar data was able to be retrieved above the accident site from KMTX around the accident time. The next 2 closest WSR-88Ds were located over 130 miles from the accident site and neither of those WSR-88Ds showed any precipitation targets above the accident site at the accident time. There were no lightning strikes around the accident site at the accident time.¹⁶

7.0 Pilot Reports¹⁷

All publicly disseminated pilot reports (PIREPs) within 150 miles of the accident site from about two hours prior to the accident time to about two hours after the accident time for below FL200¹⁸ are provided below:

SLC UA /OV TCH260030/TM 2015/FL160/TP E75L/TB MOD/RM 160-220 / ZLC

CDC UA /OV TCH340011/TM 2110/FL095/TP CRJ2/TA -9/IC LT RIME/RM DURC 095-125

¹⁵ The WSR-88D is an S-band 10-centimeter wavelength radar with a power output of 750,000 watts, and with a 28-foot parabolic antenna that concentrates the energy between a 0.87° and 0.96° beam width. The radar produces three basic types of products: base reflectivity, base radial velocity, and base spectral width.

¹⁶ A review of data from the Earth Networks Total Lightning Network was performed.

¹⁷ Only pilot reports with the WMO header UBUT**, UBWY**, UBCO**, and UBID** identifier were considered.

¹⁸ 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 average 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.

SLC UA /OV FFU110010/TM 2201/FL160/TP A319/TA M06/TB CONT MOD CHOP/IC LGT RIME/RM DURD 160-150

SLC UA /OV TCH260005/TM 2220/FL070/TP CRJ9/SK OVC065/RM BASES 065

SLC UA /OV TCH200015/TM 2234/FL110/TP B712/TA 01/TB LGT CHOP/IC LGT [MIXED]/RM DURD 110-090

SLC UA /OV 20 NM NW SLC/TM 2333/FL140/TP E75L/SK 140-110/TA M15/TB LGT CHOP/IC LGT RIME/RM DURING DESCENT

The pilot reports in plain language and converted to local MST from above were as follows:

Salt Lake City, Utah, (SLC) routine pilot report (UA); Over - 30 miles from the Wasatch VORTAC (TCH) on the 260° radial; Time – 1315 MST (2015Z); Altitude – 16,000 ft; Type aircraft – Embraer 175; Turbulence – Moderate; Remarks – Between 16,000 ft and FL220, entered by SLC Air Route Traffic Control Center (ZLC).

Cedar City, Utah, (CDC) routine pilot report (UA); Over - 11 miles from TCH VORTAC on the 340° radial; Time – 1410 MST (2110Z); Altitude – 9,500 ft; Type aircraft – Bombardier CRJ-200; Temperature – -9° C; Icing – Light rime; Remarks – During climb between 9,500 and 12,500 ft.

SLC routine pilot report (UA); Over -10 miles from Fairfield VORTAC (FFU) on the 110° radial; Time – 1501 MST (2201Z); Altitude – 16,000 ft; Type aircraft – Airbus A319; Temperature – -6° C; Turbulence – Continuous moderate chop; Icing – Light rime; Remarks – During descent between 16,000 and 15,000 ft.

SLC routine pilot report (UA); Over -5 miles from TCH VORTAC on the 260° radial; Time – 1520 MST (2220Z); Altitude – 7,000 ft; Type aircraft – Bombardier CRJ-900; Sky – Overcast at 6,500 ft; Remarks – Bases at 6,500 ft.

SLC routine pilot report (UA); Over -15 miles from TCH VORTAC on the 200° radial; Time – 1534 MST (2234Z); Altitude – 11,000 ft; Type aircraft – Boeing 717-200; Temperature – 1° C; Turbulence – Light chop; Icing – Light mixed; Remarks – During descent between 11,000 and 9,000 ft.

SLC routine pilot report (UA); Over - 20 miles northwest of SLC; Time – 1633 MST (2333Z); Altitude – 14,000 ft; Type aircraft – Embraer 175; Sky – Clouds 14,000 to 11,000 ft; Temperature – -15° C; Turbulence – Light chop; Icing – Light rime; Remarks – During descent.

8.0 SIGMET and CWSU Advisory

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

There were no Center Weather Service Unit (CWSU) Advisories (CWA) that were valid for the accident site at the accident time.

The ZLC Center Weather Service Unit did issue a Meteorological Impact Statement (MIS) issued by ZLC CWSU at 1212 MST and was valid for the accident site at the accident time. The MIS warned of a strong cold front and associated winter storm system moving southward through ZLC airspace with associated winter time aviation hazards:

FAUS20 KZLC 181912

ZLC MIS 01 VALID 181910-190400

...FOR ATC PLANNING PURPOSES ONLY...

WIDESPREAD SNOW AND STRONG WINDS CONTINUE THROUGH MONDAY AS A STRONG COLD FRONT AND WINTER STORM MOVE SOUTH ACROSS ZLC. EXPECT WIDESPREAD TURBULENCE WITH MOUNTAIN WAVES AND LLWS WITH BLOWING DUST AHEAD OF THE FRONT AND BLOWING SNOW BEHIND THE FRONT. WIDESPREAD ICING WITH LOW CLOUDS...MOUNTAINS OBSCURED AND IFR CONDITIONS IN SNOW...AND AREAS OF BLOWING SNOW WITH LOWER VISIBILITY. PILOTS SHOULD CONTINUE TO MONITOR CURRENT CONDITIONS AND UPDATED FORECASTS AS THIS SYSTEM SLOWLY MOVES SOUTH.

=

9.0 AIRMETs

There were Airmen's Meteorological Information (AIRMET)s Sierra, Tango, and Zulu that were valid for the area that included the accident site. The AIRMETs warned of IFR conditions due to precipitation and mist, mountain obscuration conditions due to clouds, moderate icing below FL200, and moderate turbulence below FL180. AIRMETs Sierra, Tango, and Zulu were also valid for the destination airport before the accident flight departed Tulsa, Oklahoma, (TUL). The advisories were as follows:

WAUS45 KKCI 182045

WA5S

-SLCS WA 182045

AIRMET SIERRA UPDT 6 FOR IFR AND MTN OBSCN VALID UNTIL 190300

.

AIRMET IFR...ID MT WY NV UT

FROM 30N HVR TO 80SW DIK TO 70SW RAP TO 30NNW BFF TO 30N CYS TO 30S OCS TO 60SSE SLC TO 20WSW BVL TO 20ESE JAC TO 50NNE DNJ TO 30W GEG TO 70SW YXC TO 40SSE FCA TO 40S YQL TO 30N HVR CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 03Z THRU 09Z.

.

AIRMET MTN OBSCN...AZ NM

FROM 50WNW ABQ TO 20E ABQ TO 40SSE TCS TO 40SSE DMN TO 50S TUS TO 20NW PHX TO 30NW DRK TO 20S INW TO 50WNW ABQ MTNS OBSC BY CLDS/PCPN. CONDS CONTG BYD 03Z THRU 09Z.

.

AIRMET MTN OBSCN...ID MT WY NV UT CO

FROM 50WSW YXC TO 50SSW YQL TO GTF TO 40NNE HVR TO CYS TO 40E DBL TO 20NNE HBU TO 40SSW FMG TO 40SE LKV TO 50SE REO TO 50WSW YXC MTNS OBSC BY CLDS. CONDS CONTG BYD 03Z THRU 09Z.

.

OTLK VALID 0300-0900Z

AREA 1...IFR ID MT WY NV UT CO

BOUNDED BY 30SSW YQL-20E LWT-20ESE MLS-60NW RAP-70SW RAP-BFF-GLD-

40SSW GLD-50W DEN-20WSW LAR-40SSE OCS-20NE ILC-30WNW BVL-50NE
SLC-30ESE BPI-40E JAC-50ENE DBS-20N DLN-80SE HLN-30SSW YQL
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG THRU 09Z.

.
AREA 2...MTN OBSCN ID MT WY NV UT CO AZ
BOUNDED BY 40NNE HVR-20SSE CYS-30S DBL-30WSW ALS-40SSE BCE-50SSW
DTA-50W OAL-40SSW FMG-40SE LKV-50SE REO-50NNE GEG-50SW YQL-GTF-
40NNE HVR
MTNS OBSC BY CLDS. CONDS CONTG THRU 09Z.

.
AREA 3...MTN OBSCN UT AZ NM
BOUNDED BY 40SSE BCE-20S ALS-70S FTI-50E ELP-50S TUS-PHX-30ESE
EED-40SSE BCE
MTNS OBSC BY CLDS/PCPN. CONDS CONTG THRU 09Z.

....

WAUS45 KPCI 182045
WA5T
-SLCT WA 182045
AIRMET TANGO UPDT 5 FOR TURB STG WNDZ AND LLWS VALID UNTIL 190300

.
...SEE SIGMET VICTOR SERIES...

.
...SEE SIGMET XRAY SERIES...

.
...SEE SIGMET YANKEE SERIES...

.
AIRMET TURB...ID MT WY NV UT CO AZ NM WA OR CA AND CSTL WTRS
FROM 50NNW ISN TO 70SW RAP TO BFF TO GLD TO 50W LBL TO 30ESE TBE
TO INK TO ELP TO 50S TUS TO BZA TO 160SW RZS TO 140WSW FOT TO
150WNW FOT TO 30WNW LKV TO 30W LKT TO 50NNW ISN
MOD TURB BTN FL180 AND FL440. CONDS CONTG BYD 03Z THRU 09Z.

.
AIRMET TURB...WY NV UT CO AZ NM CA
FROM 30WNW DDY TO 70SW RAP TO GLD TO 50W LBL TO 30ESE TBE TO INK
TO ELP TO 50S TUS TO BZA TO 50WSW BZA TO 40ESE RBL TO 40SSE MLD
TO 30WNW DDY
MOD TURB BLW FL180. CONDS CONTG BYD 03Z THRU 09Z.

.
AIRMET STG SFC WNDZ...WY
FROM 50SE DDY TO CYS TO 50SE OCS TO 70SSE BOY TO 50SE DDY
SUSTAINED SURFACE WINDS GTR THAN 30KT EXP. CONDS ENDG 00-03Z.

.
LLWS POTENTIAL...NV UT CA
BOUNDED BY 70NNW FMG-30N OAL-20WNW ILC-30NE LAS-50S BTY-60ESE
EHF-70SSW FMG-30ENE RBL-70NNW FMG
LLWS EXP. CONDS CONTG BYD 03Z THRU 09Z.

.
LLWS POTENTIAL...WY NV UT CO AZ NM
BOUNDED BY 40E DDY-PUB-20ESE FTI-40WSW FTI-60SW ALS-40W RSK-50S
SJN-30ESE LAS-20SSW ELY-MTU-50SSW BOY-40E DDY
LLWS EXP. CONDS CONTG BYD 03Z THRU 09Z.

....

WAUS45 KPCI 182045
WA5Z

-SLCZ WA 182045

AIRMET ZULU UPDT 3 FOR ICE AND FRZLVL VALID UNTIL 190300

.
AIRMET ICE...ID MT WY NV UT CO

**FROM 50SSE YQL TO 50SSW ISN TO 70SW RAP TO BFF TO 60WNW PUB TO
20SW HBU TO 30SW MTU TO 40WSW OAL TO 40SSW FMG TO 40SE LKV TO
50SE REO TO 70SW YXC TO 50SSE YQL**

**MOD ICE BTN FRZLVL AND FL200. FRZLVL SFC-090. CONDS CONTG BYD 03Z
THRU 09Z.**

.
FRZLVL...RANGING FROM SFC-120 ACRS AREA

MULT FRZLVL BLW 090 BOUNDED BY 70SW RAP-BFF-40NNW GLD-40SSW

CYS-60ESE DDY-70SW RAP

SFC ALG 60W OAL-30SSE BVL-50WSW CHE-20NNW HBU-30E HBU-50SSW

CYS-20SE SNY

080 ALG 20W BTY-60WSW ILC-30NW BCE-40NNW JNC-40S CHE

080 ALG 40WNW DEN-50E AKO

....

10.0 Graphical Forecasts for Aviation

The Graphical Forecasts for Aviation (GFA) products made available before the accident time and before the accident flight departed TUL indicated IFR to LIFR conditions near KEVW with light to moderate snow and an AIRMET for IFR conditions (attachment 5). The GFA aviation cloud forecast varied between an overcast ceiling and no cloud ceiling with cirrus above, but the AIRMETs for icing and mountain obscuration include KEVW (attachment 5). The reason for the differences in the GFA surface forecast and the aviation cloud forecast, is that the surface forecast and the aviation cloud forecast are computed automatically by two different weather models (attachment 6). The RAP weather model is used for the aviation cloud forecast and the LAMP weather model is used for the surface forecast charts, with both forecast issued with no human intervention except for the AIRMET overlays on the charts (attachment 6).

11.0 Terminal Aerodrome Forecast

KEVW was the closest site to the accident site with a NWS Terminal Aerodrome Forecast (TAF). The TAF valid at the time of the accident was an amended forecast issued at 1505 MST and was valid for a 20-hour period beginning at 1500 MST. The TAF for KEVW was as follows:

AMD TAF KEVW 182205Z 1822/1918 **24012G20KT 1/2SM SN FZFG SCT003 OVC008**
FM190200 28011KT 2SM -SHSN BR SCT005 BKN015=

After 1500 MST, the forecast expected a wind from 240° at 12 knots with gusts to 20 knots, a half mile visibility, moderate snow and freezing fog, scattered clouds at 300 ft agl, and an overcast ceiling at 800 ft agl.

The KEVW TAF valid before the accident flight left TUL was issued at 1021 MST and was valid for a 24-hour period beginning at 1100 MST. The 1021 MST TAF for KEVW was as follows:

TAF KEVW 181721Z 1818/1918 23035G45KT P6SM VCSH SCT020 BKN040
FM181900 24043G45KT 2SM -SHSN BR SCT005 BKN020
FM182000 25027G37KT 3/4SM -SN BLSN BKN005 OVC020
FM190000 28011KT 2SM -SHSN BR SCT005 BKN015=

After 1300 MST, the forecast expected a wind from 250° at 27 knots with gusts to 37 knots, three quarters of a mile visibility, light snow and blowing snow, a broken ceiling at 500 ft agl, and overcast skies at 2,000 ft agl.

12.0 NWS Area Forecast Discussion

The NWS office in Salt Lake City, Utah, issued the following Area Forecast Discussion (AFD) at 1059 MST (closest AFD to the accident time). The aviation section of the AFD discussed the impacts to the Salt Lake City terminal with the passage of the strong cold front across the region:

FXUS65 KSLC 181759
AFDSLCL

Area Forecast Discussion
National Weather Service Salt Lake City UT
1059 AM MST Sun Feb 18 2018

.SYNOPSIS...The very cold upper level trough over the Pacific Northwest will move into the western Great Basin this evening, then track slowly east across the region through Tuesday. The coldest air of the season will accompany this storm, and remain over the area through much of the upcoming week.

&&

.DISCUSSION...The very cold upper trough with a circulation center along the Washington coast will continue southeast and developing into a full latitude trough across the interior west for the first half of the upcoming week. This very cold trough will move slowly east across the Great Basin, resulting in several areas of Utah receiving significant snowfall before precip ends late Tuesday.

The associated surface cold front appears in the mesonet data to be just near SLC late this morning. Precipitation remains north of this feature along and north of the near 700mb baroclinic zone. Intensities so far have generally been light to locally moderate with snow confined to near the Idaho border and over the higher terrain. Expecting the intensities and areal coverage to increase a good clip later this afternoon and evening as convergence into the low-level baroclinic zone increases, colder mid-level arrives with increasing dynamic and jet-level support as the upper trough enters the western Great Basin.

By late tonight through Monday the heaviest precip, mostly as snow, will shift into central, southern and northeast Utah as low-level cold advection increases and dynamic support for deep layer lift also increases as the upper trough advances through Nevada.

One area that may see a decrease in snow would be northwest Utah. A potential weak circulation center developing along the baroclinic zone over northeast Utah would create some easterly component to the low/mid-level flow, leading to a short period of downslope flow and modest drying west of Wasatch range late tonight through early Monday. Snow may not end entirely, but accumulations will be reduced during that time period.

Snow will pick up again later Monday as the upper reaches western Utah, then tracks east across the state through Monday night/early Tuesday. This last portion of this storm will see low density snows, so the inches of accumulation could be impressive, but water equivalence will be on the low side.

For this afternoon and early evening rather strong southerly winds will exist ahead of the advancing cold front. Near 700mb winds in the 40-50 knot range with the supporting surface gradient and decent mixing will bring strong and gusty pre-frontal surface winds to most valleys of central and southern Utah through early this evening. These winds will drop off gradually early in the evening, but still remain elevated until frontal passage and the onset of the trailing precip tonight.

The other story through midweek will be the very cold temperatures. Both highs and lows will drop substantially from the warm weekend readings, with these readings remaining below to well below normals across most of the state throughout the week.

Issued an earlier update to adjust a few of the wetter parameters and to drop the mention of blowing snow in some of the northern valley locations today/tonight.

&&

.AVIATION...At the SLC terminal, gusty southerly winds are expected to shift to the northwest between 19Z and 21Z with the passage of a strong cold front. Cigs are expected to drop to or below 6000 ft AGL as the front approaches and conditions are expected to deteriorate to IFR within three hours of the passage of the front with any rain changing over to snow. The heaviest snow will fall during the late afternoon/early evening with snow continuing into the overnight hours.

&&

.SLC WATCHES/WARNINGS/ADVISORIES...

UT...Wind Advisory until 9 PM MST this evening for UTZ013>016-020-021-517-518.

Winter Storm Warning until 4 PM MST Monday for UTZ006-008>010.

Winter Storm Warning until 5 AM MST Monday for UTZ007.

Winter Weather Advisory until 5 AM MST Monday for UTZ005.

Winter Storm Warning until noon MST Monday for UTZ003-004.

Winter Storm Warning until 11 PM MST this evening for UTZ001-002.

Winter Storm Warning from 5 PM this afternoon to 9 PM MST Monday for UTZ014>016-517-518.

WY...Winter Storm Warning until noon MST Monday for WYZ021.

&&

\$\$

13.0 NWS Winter Storm Warning

The NWS office in Salt Lake City, Utah, issued the following Winter Storm Warning (WSW) for Uinta County, including Evanston, Wyoming, at 0432 MST. The WSW warned that heavy snow would likely fall after 0900 MST with a total snow accumulation of 8 to 14 inches. Some of the wording included, "This looks to be the most significant storm for the region all winter season."

WYZ021-190000-
/O.CON.KSLC.WS.W.0002.180218T1600Z-180219T1900Z/
Southwest Wyoming-
Including the city of Evanston
432 AM MST Sun Feb 18 2018

...WINTER STORM WARNING REMAINS IN EFFECT FROM 9 AM THIS MORNING
TO NOON MST MONDAY...

* WHAT...Heavy snow. Total snow accumulations of 8 to 14 inches
through Tuesday.

* WHERE...Uinta County in Southwest Wyoming.

* WHEN...From Sunday morning through Monday morning.

* ADDITIONAL DETAILS...This looks to be the most significant storm
for the region all winter season. Those planning to travel
through Tuesday should be prepared for winter driving conditions
including snow covered roads and reduced visibilities. Roads may
become treacherous, so make sure to have a winter storm survival
kit in your car. These kits should include warm blankets, extra
clothing, extra food and water, flashlight, cell phone and
batteries. Also make sure to gas up before traveling. Strong
gusty winds may result in areas of blowing and drifting snow for
a few hours after the cold front passes.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

A Winter Storm Warning for heavy snow means that significant
accumulations of snow are expected or occurring. Driving
conditions may be hazardous. Use caution. Keep a winter storm
survival kit in your vehicle in case of an emergency.

For winter road conditions from the Wyoming Department of
Transportation, visit <http://www.wyoroad.info> or dial 511.

&&

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14.0 NWS Hazardous Weather Outlook

The NWS office in Salt Lake City, Utah, issued the following Hazardous Weather Outlook (HWO) at 0603 MST. The HWO discussed that the storm system affecting the Utah and southwestern Wyoming region would likely be the coldest and strongest winter storm of the season to date:

FLUS45 KSLC 181303
HWOSLC

Hazardous Weather Outlook
National Weather Service Salt Lake City UT
603 AM MST Sun Feb 18 2018

UTZ001>016-019>021-517-518-WYZ021-191400-
Cache Valley/Utah Portion-Northern Wasatch Front-
Salt Lake and Tooele Valleys-Southern Wasatch Front-
Great Salt Lake Desert and Mountains-Wasatch Mountain Valleys-
Wasatch Mountains I-80 North-Wasatch Mountains South of I-80-
Western Uinta Mountains-Wasatch Plateau/Book Cliffs-
Western Uinta Basin-Castle Country-San Rafael Swell-
Sanpete/Sevier Valleys-West Central Utah-Southwest Utah-
Utahs Dixie and Zion National Park-South Central Utah-
Glen Canyon Recreation Area/Lake Powell-Central Mountains-
Southern Mountains-Southwest Wyoming-
603 AM MST Sun Feb 18 2018

This Hazardous Weather Outlook is for the western two thirds of Utah and southwest Wyoming.

.DAY ONE...Today and Tonight

The coldest and strongest winter storm of the season will affect the region through Tuesday. Strong gusty southwest winds are occurring today and will persist into tonight for some southern areas ahead of the cold front.

Widespread heavy snow and much colder temperatures will spread across the outlook area from north to south through tonight. The cold front could bring near whiteout conditions to the mountain passes in heavy snow and strong winds for a few hours as it moves south on Sunday. Snow will taper off many northern areas tonight.

.DAYS TWO THROUGH SEVEN...Monday through Saturday

The snow will re-develop for northern areas Monday and Monday night, while persisting across the south. The snow could continue into Tuesday across mountainous locations favored in northwest flow, as well as locations downwind of the Great Salt Lake and Utah lake. Accumulating snow will be possible across Dixie and

Lake Powell region Monday into Monday night. By Tuesday afternoon most areas will have seen a moderate to heavy snowfall.

The very cold temperatures that spread into the outlook area tonight will continue through Tuesday night into Wednesday. At this time it looks like Wednesday morning will be the coldest in this stretch with lows ranging from the low teens to below zero. Any plants or trees that have starting budding out will be affected by this cold snap.

.SPOTTER INFORMATION STATEMENT...

Weather spotters are encouraged to report significant weather conditions according to standard operating procedures.

\$\$

For more information from NOAA/s National Weather Service visit...
<http://weather.gov/saltlakecity>

For information on potential road travel impacts visit...
<http://www.udottraffic.utah.gov/roadweatherforecast.aspx>

15.0 Winds and Temperature Aloft Forecast

The NWS 1301 MST Winds and Temperature Aloft forecast valid for the closest point to the accident site is included below:

```
FBUS31 KWN0 182001
FD1US1
DATA BASED ON 181800Z
VALID 190000Z   FOR USE 2000-0300Z. TEMPS NEG ABV 24000

FT   3000    6000    9000    12000    18000    24000    30000    34000    39000
SLC           3408  2419-05 2342-10 2461-25 2582-37 751646 741753 751961
```

The accident site was closest to the Salt Lake City, Utah, (SLC) forecast point. The 1301 MST SLC forecast for use between 1300 MST and 2000 MST indicated a wind at 6,000 ft from 340° at 8 knots, a wind at 9,000 ft from 240° at 19 knots with a temperature of -5° C, a wind at 12,000 ft from 230° at 42 knots with a temperature of -10° C, and a wind at 18,000 ft from 240° at 61 knots with a temperature of -2° C.

16.0 Pilot Weather Briefing and Witness Information

A search of official weather briefing sources, such as Leidos Flight Service and Direct User Access Terminal Service (DUATS), revealed that the accident pilot did not request a weather briefing from Leidos or DUATS.

A search of archived ForeFlight information indicated that the accident pilot received a standard weather briefing package from ForeFlight at 1934 MST on February 17 (attachments 7, 8, and 9). Most of the advisories included in the briefing expired before the estimated time of departure. The TAF for KEVW included in that briefing indicated that IFR to LIFR conditions were expected with winds from 240 at 25 knots gusting to 40 knots, visibility 3/4 mile in light snow, mist, and blowing snow, with vertical visibility 600 ft agl. Based on the length of time before the expected departure, new products and observations were issued to update the initial briefing.

With no internet access while in flight, ForeFlight is still able to access weather information directly from the FAA, but leaving no remote record of such access. There is no record of the accident pilot receiving or retrieving any other weather information before or during the accident flight. It is therefore unknown what additional updates the pilot received.

17.0 CWSU Information

The CWSU at ZLC provided a weather package that they produced for ZLC air traffic control (ATC) (attachment 10). The weather package contained all the weather observation and forecasts that were available before and during the accident timeframe, including a social media graphic available at 0834 MST warning of the strong winter storm impacting ZLC airspace and that “aviation interests should closely monitor current and forecast weather conditions and plan accordingly.”

18.0 Icing Potential¹⁹

Current Icing Potential (CIP) and Forecast Icing Potential (FIP) products are created by the NWS Aviation Weather Center (AWC) and are intended to be supplemental to other icing advisories (e.g. AIRMETs and SIGMETs). Figures²⁰ 11 through 13 (headers are illegible due to formatting error) were the FIP 1-hour icing probabilities and icing severity forecast products valid at 1500 MST for 9,000, 10,000, and 11,000 ft msl (similar values in the FIP are seen in the 2-hour forecast valid at both 1500 and 1600 MST, attachment 11). The FIP images indicated between a 50 to 60 percent probability of icing at 9,000, 10,000, and 11,000 ft at 1500 MST at the accident site (figures 11, 12, and 13). The FIP also indicated that the icing near the accident site would likely be moderate (figures 11, 12, and 13). The FIP indicated no potential for any Supercooled Large Droplet (SLD) over the region during the period. This FIP information was available on the NWS AWC website.²¹

¹⁹ B.C. Bernstein, F. McDonough, M. K. Politovich, B. G. Brown, T. P. Ratvasky, D. R. Miller, C.A. Wolff, and G. Cunning, 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. Cunning, 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>

²⁰ Headers are illegible due to formatting error.

²¹ <https://www.aviationweather.gov/icing/fip>

The CIP product indicated between a 60 to 80 percent probability of icing at 9,000, 10,000, and 11,000 ft at 1500 MST at the accident site (figures 14, 15, and 16). The CIP also indicated that the icing near the accident site would likely be moderate to heavy intensity (figures 14, 15, and 16). The CIP indicated an unknown chance of SLD near the accident site around the accident time . For more FIP and CIP information and altitudes please see attachment 11.

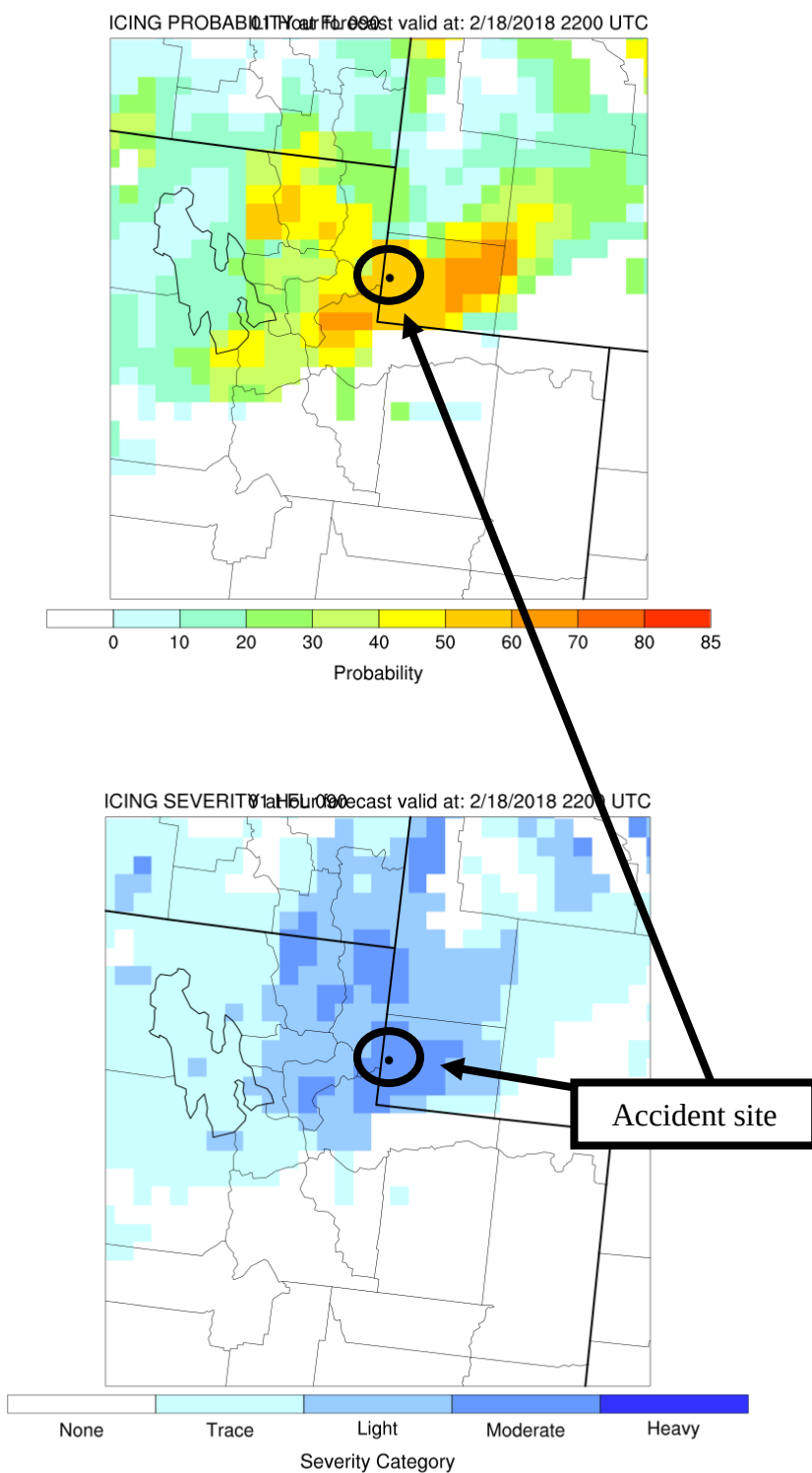


Figure 11 – (top) FIP probability of icing at 9,000 ft msl and (bottom) FIP severity of icing at 9,000 ft msl 1-hour forecast valid for 1500 MST

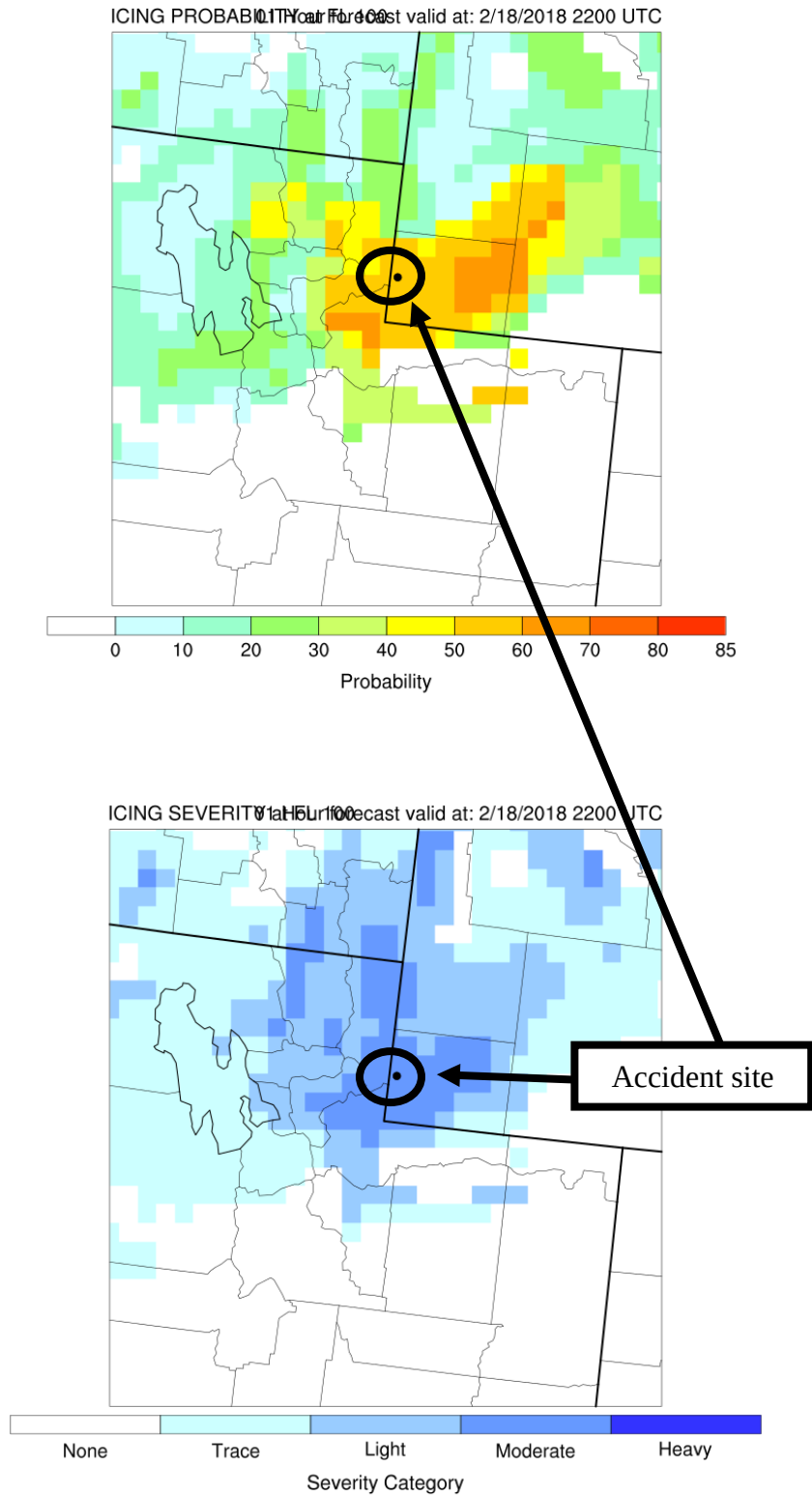


Figure 12 – (top) FIP probability of icing at 10,000 ft msl and (bottom) FIP severity of icing at 10,000 ft msl 1-hour forecast valid for 1500 MST

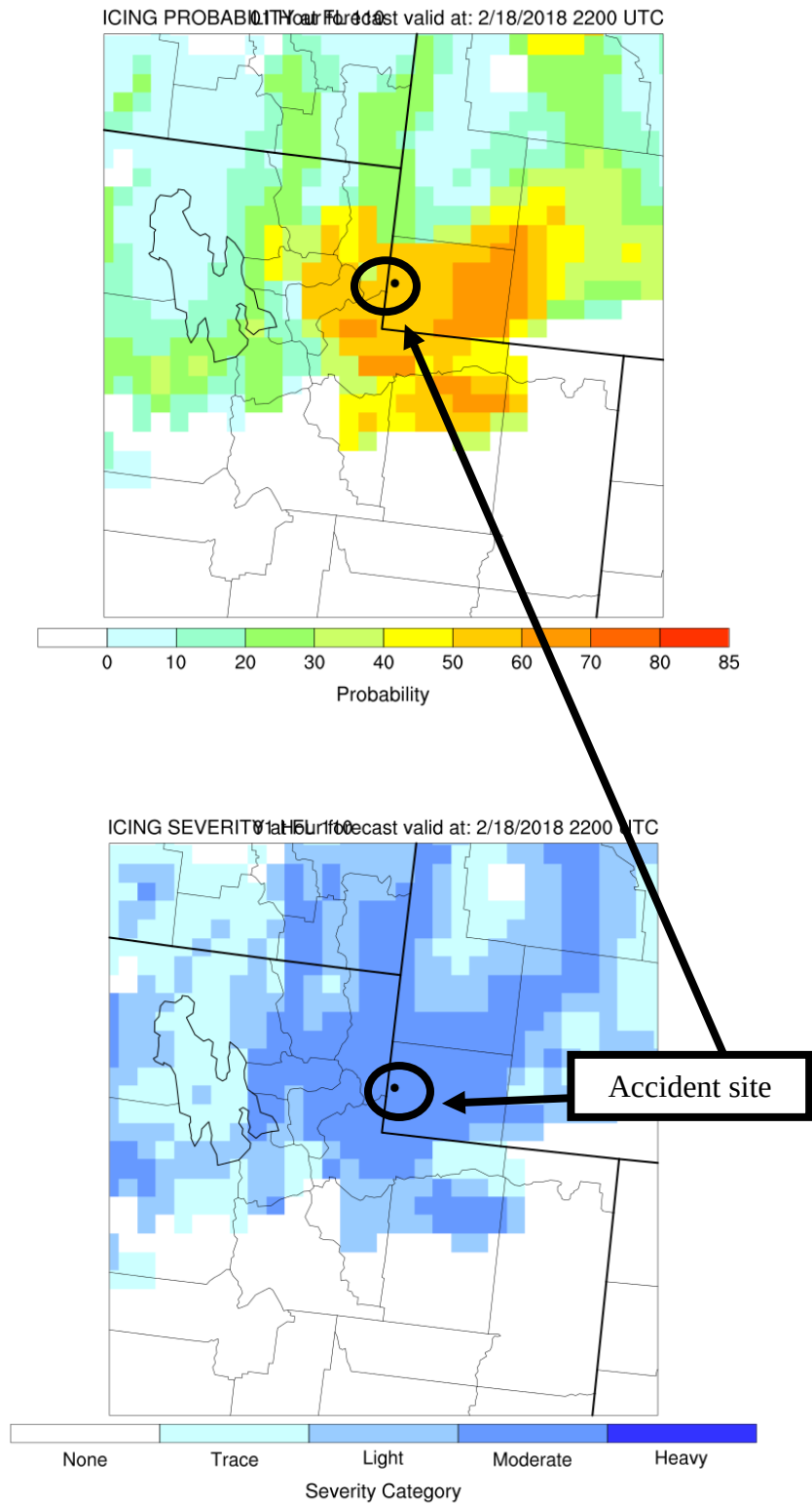


Figure 13 – (top) FIP probability of icing at 11,000 ft msl and (bottom) FIP severity of icing at 11,000 ft msl 1-hour forecast valid for 1500 MST

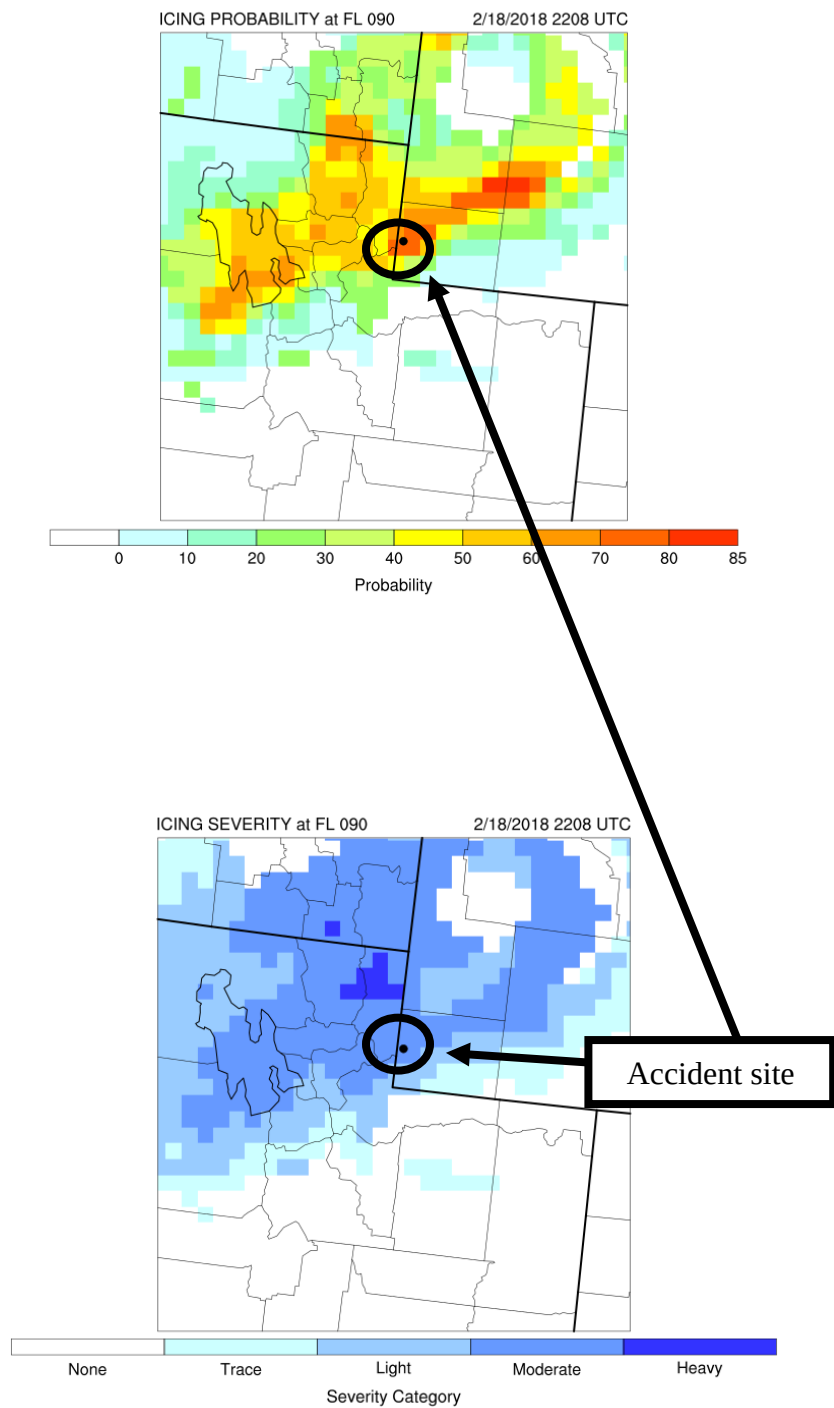


Figure 14 – (top) CIP probability of icing at 9,000 ft msl and (bottom) CIP severity of icing at 9,000 ft msl valid for 1500 MST

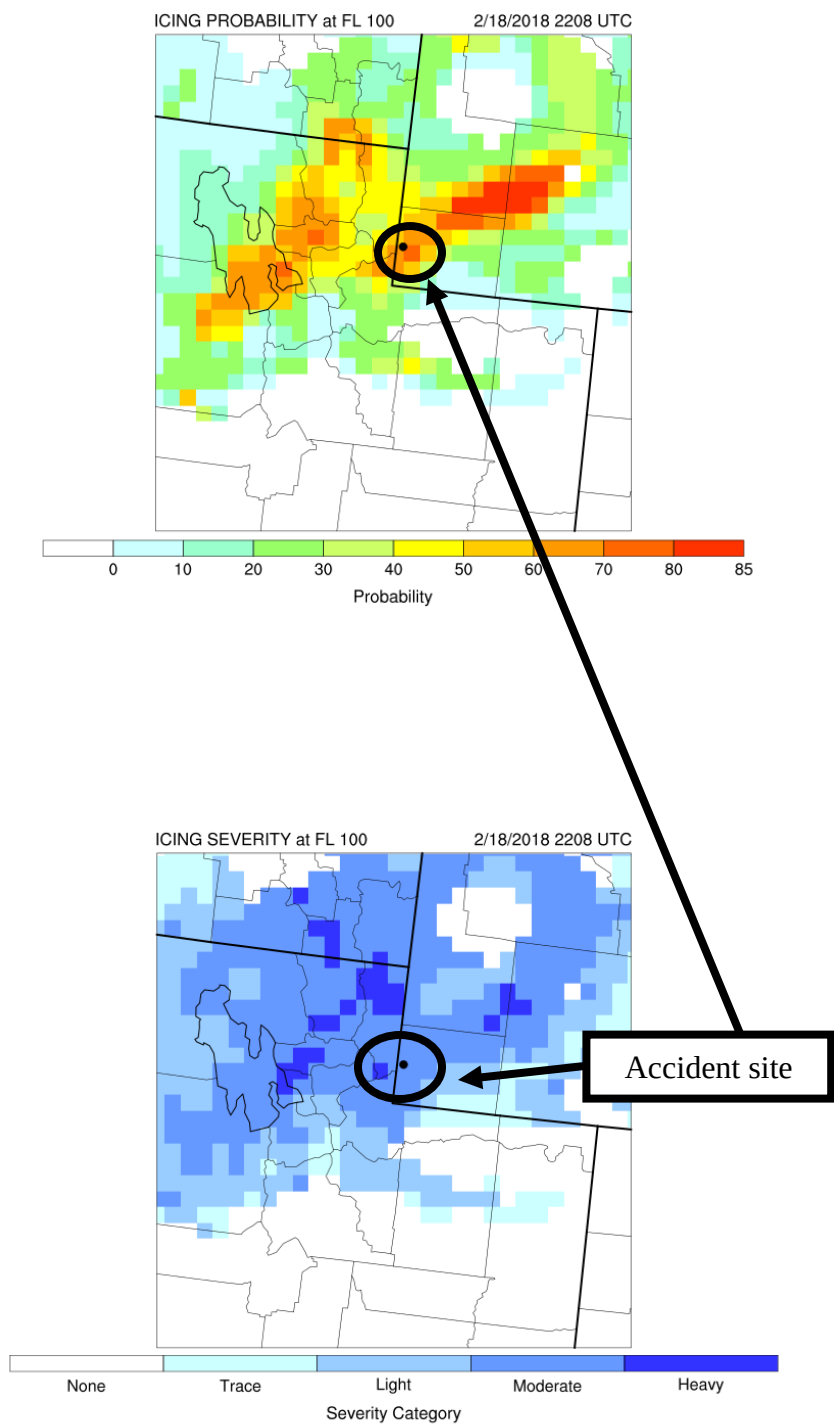


Figure 15 – (top) CIP probability of icing at 10,000 ft msl and (bottom) CIP severity of icing at 10,000 ft msl valid for 1500 MST

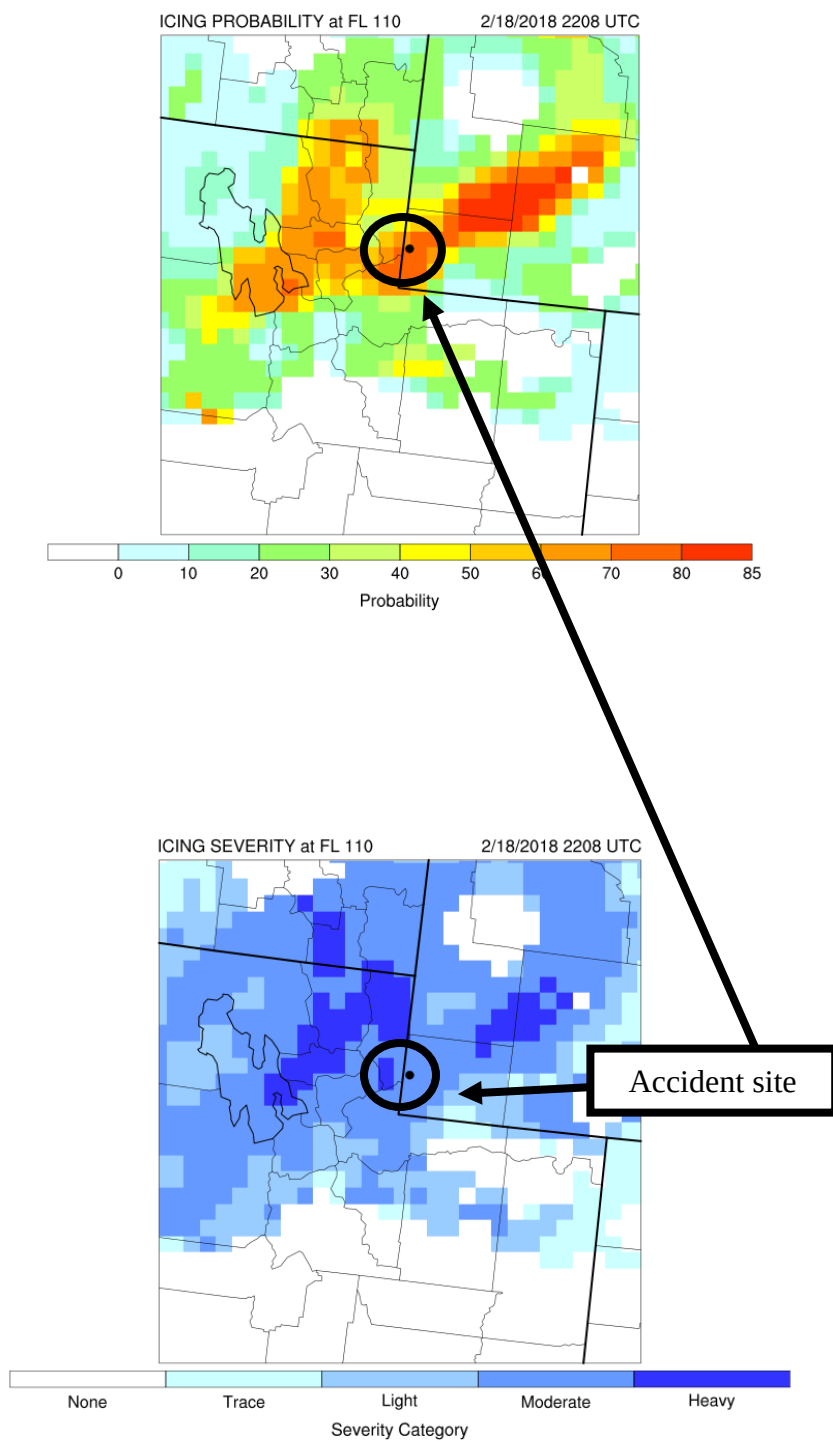


Figure 16 – (top) CIP probability of icing at 11,000 ft msl and (bottom) CIP severity of icing at 11,000 ft msl valid for 1500 MST

19.0 Astronomical Data

The astronomical data obtained from the United States Naval Observatory for the accident site on February 18, 2018, indicated the following:

SUN

Begin civil twilight	0646 MST
Sunrise	0714 MST
Sun transit	1238 MST
Accident time	1505 MST²²
Sunset	1802 MST
End civil twilight	1830 MST

²² Inserted accident time for reference and context.

E. LIST OF ATTACHMENTS

Attachment 1 – 1- and 5-minute KEVW ASOS observations around the accident time

Attachment 2 – Western United States view GOES-16 Band 14 longwave infrared satellite animation from 1402 to 1702 MST

Attachment 3 – Western United States view GOES-16 Band 10 lower-level water vapor infrared satellite animation from 1402 to 1702 MST

Attachment 4 – NWS email correspondence

Attachment 5 – GFA products valid for the accident site around the accident time and before the accident flight departed TUL

Attachment 6 – Email correspondence with NWS about GFA

Attachment 7 – Email correspondence with ForeFlight

Attachment 8 – Email correspondence with ForeFlight

Attachment 9 – ForeFlight weather briefing information

Attachment 10 – ZLC CWSU weather package document

Attachment 11 – CIP/FIP data for 1500 and 1600 MST around the accident site

Submitted by:

Paul Suffern
Senior Meteorologist

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