NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

October 1, 2020

Weather Study

METEOROLOGY

WPR20CA262

Table Of Contents

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

A. ACCIDENT

Location: Jackson, Wyoming
Date: August 3, 2020
Time: 0813 mountain daylight time (1413 UTC)[1]
Aircraft: Type – Lindstrand 310A; Registration – N971LB

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 August 3, 2020 (based upon the 24-hour clock), directions are referenced to true north, distances are in nautical miles and heights are above mean sea level (msl).

The accident site was located at: 43.587500° north latitude, 110.827778° west longitude, at an elevation of about 6,330 feet.

D. WEATHER INFORMATION

1.0 Synoptic Conditions

A western portion of the National Weather Service (NWS) Surface Analysis Chart for 0900 MDT is presented in figure 1. The surface analysis chart identified a high-pressure center near the accident site. A cold front stretched from western Montana southwestward into southern Idaho, and a stationary front extended from central Montana in central Wyoming. A trough of low-pressure was also depicted extending from southeastern Idaho into northern Utah. Temperatures in the accident region were in the mid-50°s Fahrenheit (F) to mid-60°s F, with dew point temperatures generally in the low 40°s F. Station models in the region depicted clear skies and a calm wind was observed near the accident location.

[1] UTC – abbreviation for Coordinated Universal Time

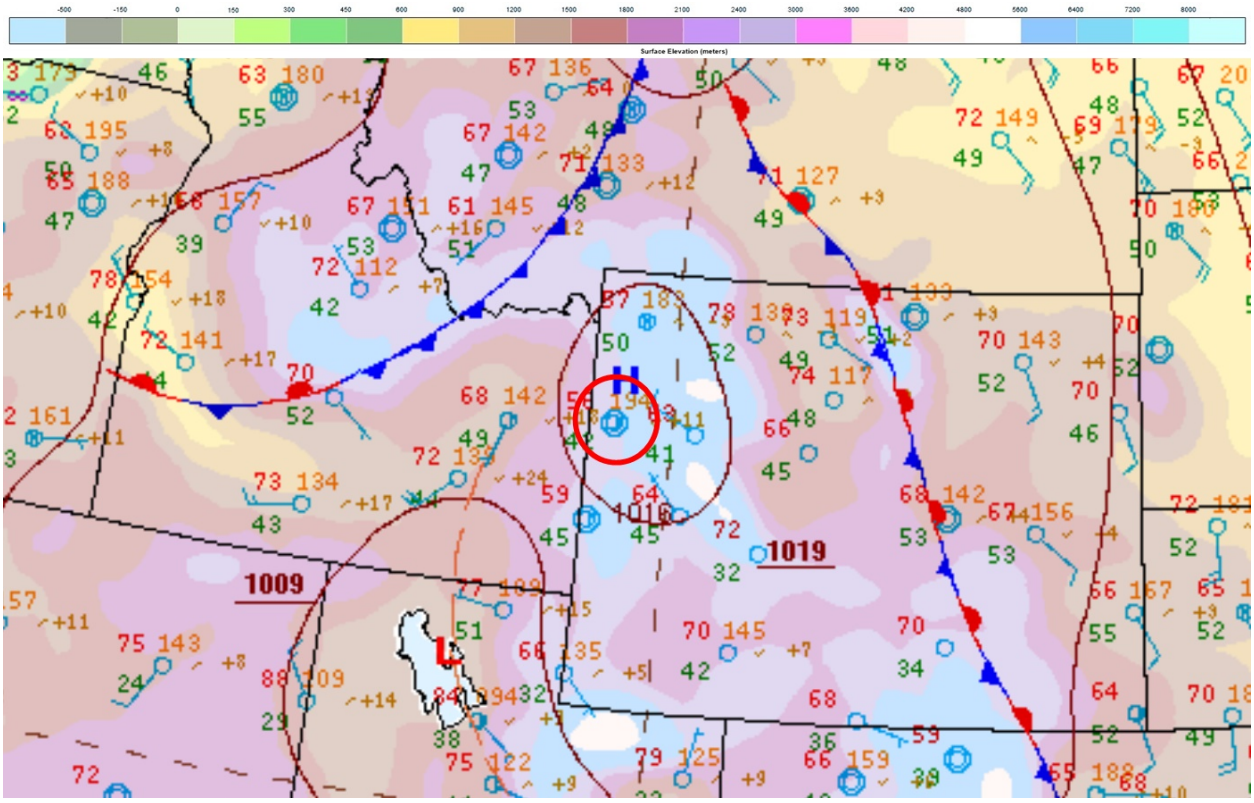

Figure 1 - NWS Surface Analysis Chart for 0900 MDT. Accident location is inside the red circle.

2.0 Surface Observations

An Automated Weather Observing System (AWOS) was located at Jackson Hole Airport (JAC[2]) in Jackson, Wyoming, which was located about 4 miles east-northeast of the accident location at an elevation of 6,450 feet and had a magnetic variation of about 11° east. Augmented longline[3] reports from the JAC AWOS during the times surrounding the accident time are presented here.

[0556 MDT] METAR KJAC 031156Z AUTO VRB03KT 10SM CLR 08/03 A3023 RMK AO2 SLP170 T00830028 10150 20067 50006=

[0656 MDT] METAR KJAC 031256Z 03003KT 10SM CLR 08/04 A3024 RMK AO2 SLP176 T00780039=

[2] 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.

[3] "Longline" refers to the dissemination of weather observations with the intent that they are available in near-real time to national databases (effectively, the whole world) and accessible to the general global public from a large number of vendors. This does not include public accessibility to observations from a reporting station's Very High Frequency (VHF; line-of-site) or telephone broadcast, where applicable. Longline-dissemination of weather observations is the primary vehicle through which the general global public has access to surface weather observations, particularly outside of the aviation community.

[0756 MDT] METAR KJAC 031356Z 34004KT 10SM CLR 11/06 A3026 RMK AO2 SLP181 T01110056=

[0856 MDT] METAR KJAC 031456Z 00000KT 10SM BKN120 13/06 A3027 RMK AO2 SLP194 T01330056 53011=

[0956 MDT] METAR KJAC 031556Z 29008KT 10SM CLR 16/06 A3023 RMK AO2 SLP182 T01610061=

At 0756 MDT, the JAC AWOS reported a wind from 340° at 4 knots, visibility greater than 10 statute miles, clear skies below 12,000 feet above ground level (agl), temperature of 11° Celsius (C) and a dew point temperature of 6°C, altimeter setting of 30.26 inches of mercury; remarks: automated station with a precipitation discriminator, sea level pressure of 1018.1 hectopascals (hPa), temperature of 11.1°C and a dew point temperature of 5.6°C.

At 0856 MDT, the JAC AWOS reported a calm wind, visibility greater than 10 statute miles, ceiling broken at 12,000 feet agl, temperature of 13°C and a dew point temperature of 6°C, altimeter setting of 30.27 inches of mercury; remarks: automated station with a precipitation discriminator, sea level pressure of 1019.4 hPa, temperature of 13.3°C and a dew point temperature of 5.6°C, pressure increased 1.1 hPa over previous 3 hours.

3.0 Upper Air Data

A High-Resolution Rapid Refresh (HRRR) model[4] sounding (figure 2) for the accident site at 0800 MDT was retrieved from the National Oceanic and Atmospheric Administration's Air Resources Laboratory. Nearest the surface the wind was from the southwest at 8 knots; the wind veered[5] slightly to an approximately west wind of 17 knots near 12,000 feet. Calculations made by the Rawinsonde OBservation Program (RAOB) indicated the potential for "light" low-level wind shear around 6,500 feet (about 200 feet agl). The sounding exhibited characteristics of an "Inverted-V" sounding[6], and the downdraft convective available potential energy (DCAPE; 6 kilometers above ground level; density weighted average method) was measured at 1,098 Joules/kilogram which was considered a strong value.[7]

[4] The HRRR is a NOAA real-time three-kilometer resolution, hourly-updated, cloud-resolving, convection-allowing atmospheric model, initialized by three-kilometer grids with three-kilometer radar assimilation. Radar data is assimilated in the HRRR every 15 minutes over a one-hour period.

[5] A veering wind's wind barbs turn clockwise with increasing height.

[6] Inverted-V sounding - Named so because in a Skew-T plot of the sounding's data, the dewpoint depression decreases significantly with height in the lower troposphere where the air in the middle troposphere is nearly saturated or saturated. The most common severe weather associated with these environments are strong winds greater than 58 miles-per-hour, which is due to the negative buoyancy of evaporationally-cooled air aloft that causes the air to accelerate toward the surface.

[7] The DCAPE can be used to estimate the potential strength of rain-cooled downdrafts within thunderstorm convection.

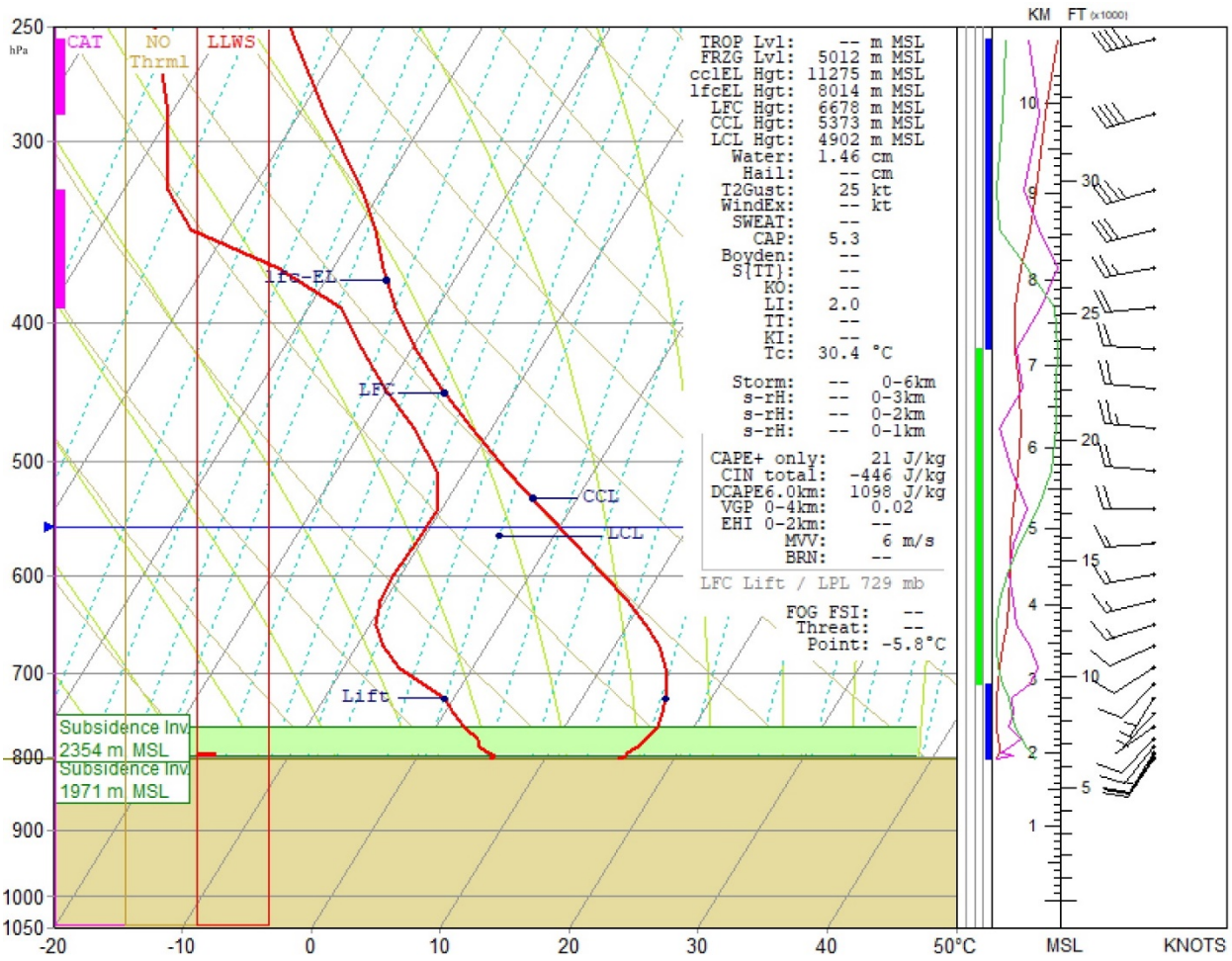

Figure 2 – HRRR model sounding data in SkewT/LogP format for 0800 MDT at the accident site, surface to 250 hPa.

4.0 Satellite Imagery

Geostationary Operational Environmental Satellite (GOES)-17 visible (0.64µm) and infrared (10.3µm) data were obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison. Imagery from 0811 MDT are presented in figures 3 and 4. The GOES-17 visible imagery depicted cloudy conditions over most of the accident region. Infrared cloud-top temperatures over the accident site were about -13°C, which, when considering the 0800 MDT HRRR sounding, corresponded to cloud top heights of about 19,000 feet.[8] In the visible image, it appears that the accident location was under cloudy conditions with a small clear area to its north. Because the image is not corrected for parallax error[9], to better understand if the accident

[8] Because the temperature profile was near-isothermal temperature profile near this level, the cloud top temperature may have corresponded to heights as low as near 7,000 feet,

[9] Parallax - In satellite meteorology, parallax is the apparent shift in an object's position (away from the sub-satellite point) because of viewing angle. Parallax generally increases as you move away from the sub-satellite point and is larger for higher clouds.

location was under clouds at the time of the satellite image, where the accident location would be moved to (in the image) if it was at a height of about 4.5 kilometers (about 15,000 feet) was calculated. The yellow "plus" symbols in figures 3 and 4 are the locations of the accident location relative to clouds that were at the height of 15,000 feet, and indicated that the accident location was more likely in clear conditions, or was under the eastern side of a cloudy area, at the time these satellite images were taken.

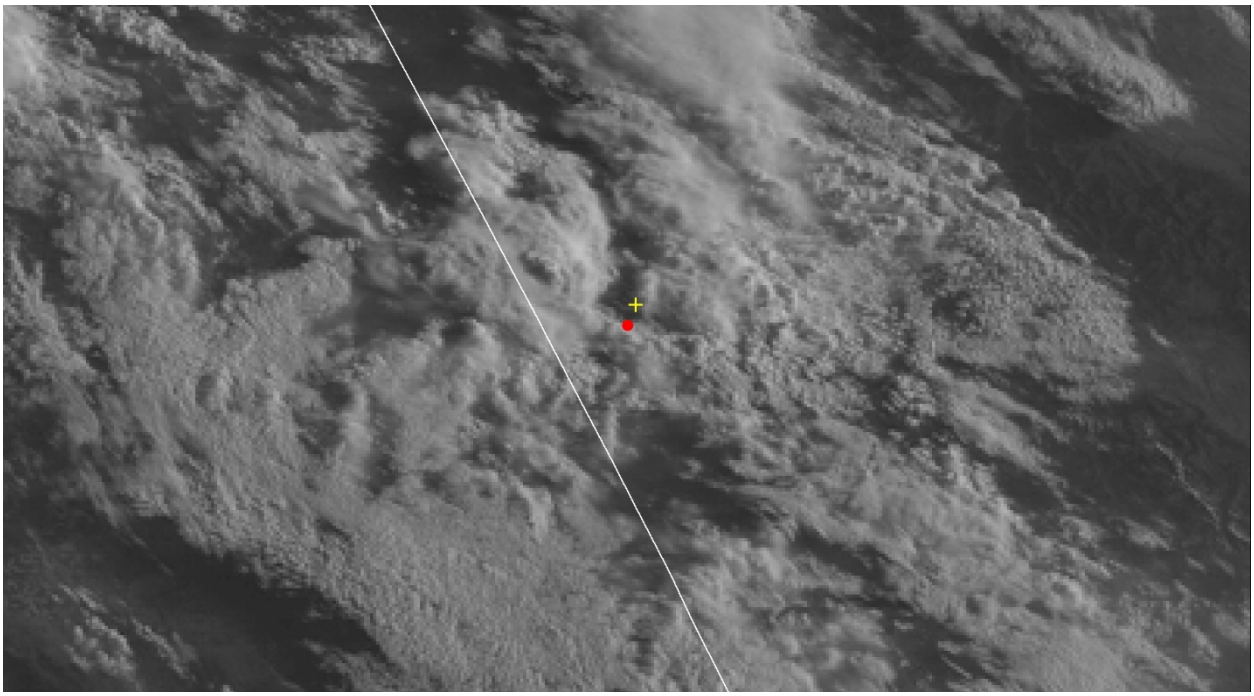

Figure 3 – GOES-17 visible imagery from 0811 MDT. Accident location denoted by red dot. The yellow "plus" symbol is the accident location relative to clouds that were at the height of 15,000 feet.

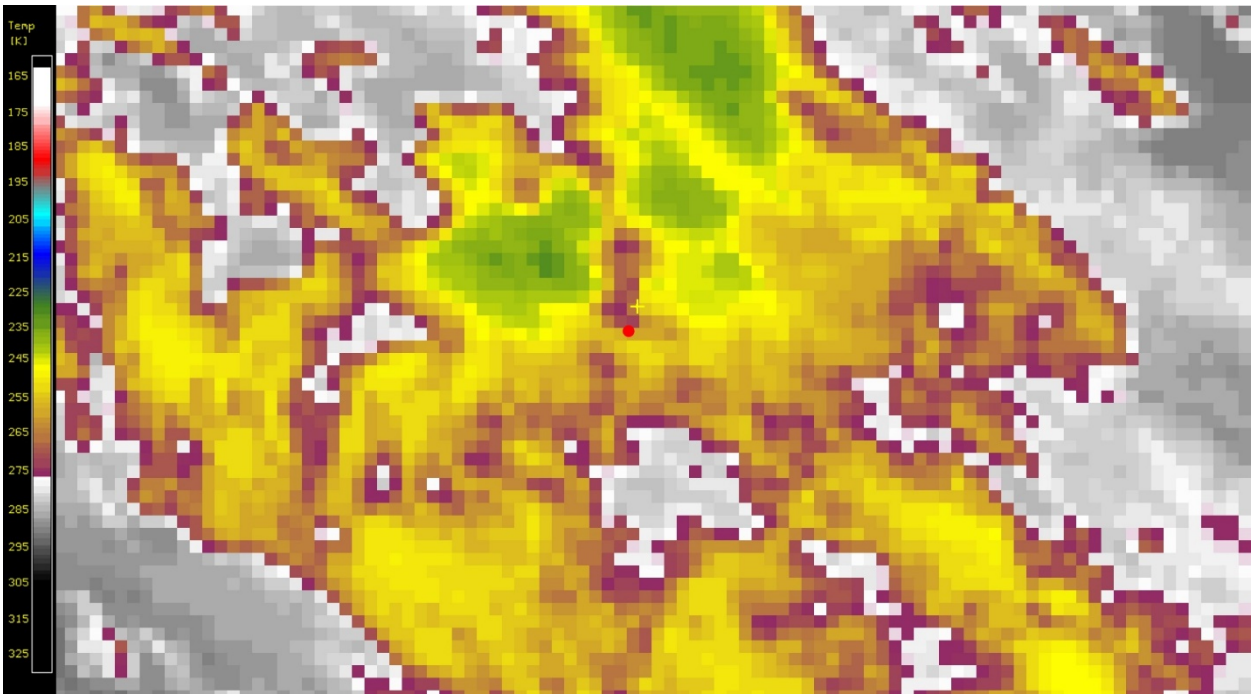

Figure 4 – GOES-17 infrared imagery from 0811 MDT. Accident location denoted by red dot. The yellow "plus" symbol is the accident location relative to clouds that were at the height of 15,000 feet.

5.0 Weather Radar

The WSR-88D[10] Level-II base reflectivity weather radar imagery from the Pocatello, Idaho, site (KSFX) are presented in figures 5-7. KSFX was located approximately 86 miles west-southwest of the accident location at an elevation of about 4,540 feet. Assuming standard refraction and considering the 0.95° beam width[11] for the WSR-88D radar beam, the KSFX 0.527° tilt would have "seen" altitudes above the accident location of between about 9,900 and 18,600 feet above msl. Around the time of the accident, the weather radar depicted reflectivity with values of less than 25 dBZ moving from the west-southwest over the accident site.

[10] Weather Surveillance Radar 88 Doppler (WSR-88D)

[11] 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 from the radar antenna.

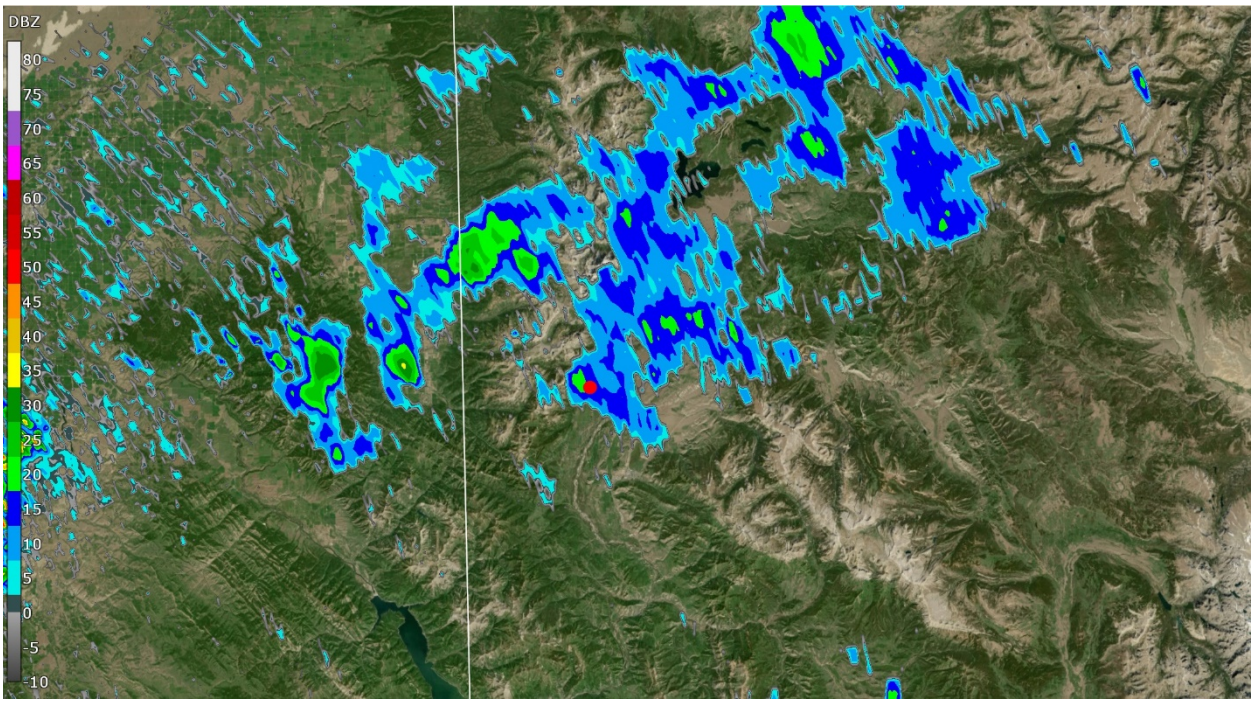

Figure 5 – KSFX 0.527° Level-II base reflectivity product from a sweep initiated at 0807:05 MDT. Accident location marked by red circle.

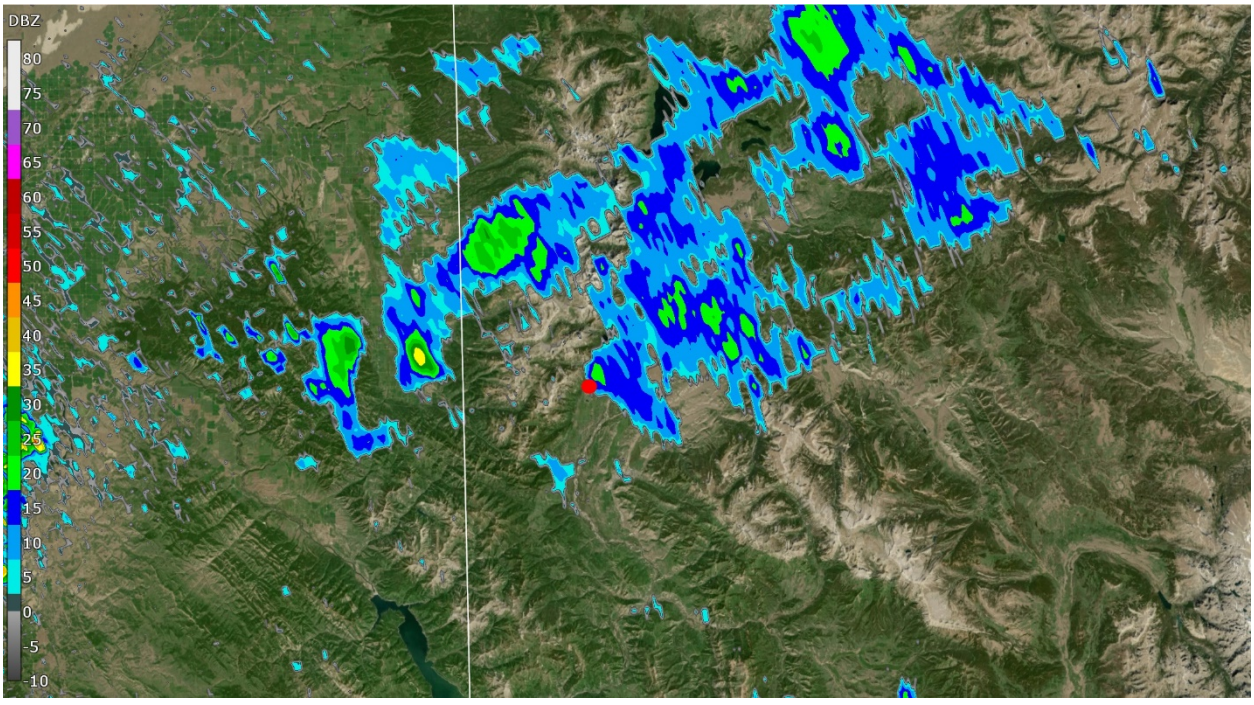

Figure 6 – KSFX 0.527° Level-II base reflectivity product from a sweep initiated at 0811:24 MDT. Accident location marked by red circle.

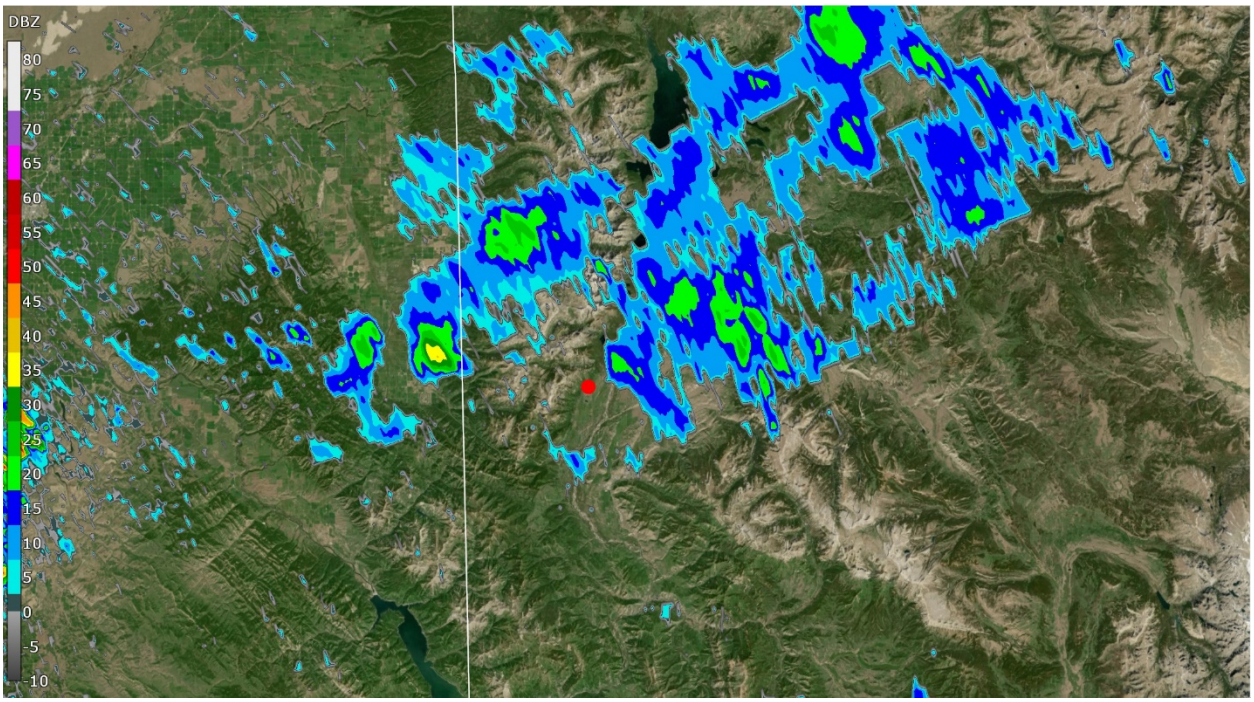

Figure 7 – KSFX 0.527° Level-II base reflectivity product from a sweep initiated at 0815:43 MDT. Accident location marked by red circle.

6.0 Pilot Reports

There were no publicly longline-disseminated pilot reports[12] (PIREPs) made within 50 miles of the accident location within 2 hours of the accident time below 15,000 feet above msl.

7.0 Terminal Aerodrome Forecasts

At 0521 MDT a Terminal Aerodrome Forecast was issued by the NWS for JAC that forecasted for the accident time: a variable wind at 4 knots, visibility greater than six statute miles, scattered clouds at 12,000 feet agl.

TAF KJAC 031121Z 0312/0412 01005KT P6SM SCT110
FM031400 VRB04KT P6SM SCT120
FM031800 19010KT P6SM FEW120
FM032200 24012G20KT P6SM SCT120
FM040500 36007KT P6SM SKC=

[12] These do not include pilot reports only broadcast via radio.

8.0 Area Forecast Discussion

Presented here is the "Update" section of the Area Forecast Discussion issued by the NWS Weather Forecast Office (WFO) in Pocatello, Idaho, at 0846 PDT. The accident occurred in the County Warning Area (CWA) for the NWS WFO in Rivertown, Wyoming, but close to the Pocatello office's CWA.

> *FXUS65 KPIH 031446*
> *AFDPIH*
> *Area Forecast Discussion*
> *National Weather Service Pocatello ID*
> *846 AM MDT Mon Aug 3 2020*
>
> *.UPDATE...Minor update today to add thunder chances to the remainder of this morning and early afternoon. Band of weak radar echoes across central mountains, stretching into the region along the MT and WY borders. Have already seen lightning pulses from this activity. Other concern is winds. There are a few observation sites that are showing much stronger wind gusts than forecast. Some of the gusts may be attributed to the early weak convective activity, which may be a concern as stronger convection develops this afternoon. DMH*

9.0 AIRMETs

There were no AIRMETs active for the accident site at the accident time.

10.0 SIGMETs

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

11.0 CWSU Products

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

Submitted by:

_____
Mike Richards
Senior Meteorologist