National Transportation Safety Board

Office of Aviation Safety
Washington, D.C. 20594-2000
December 28, 2012

WEATHER STUDY

WPR13FA053

A. Accident

Location: Bondurant, Wyoming
Date: November 17, 2012
Time: about 1345 mountain standard time (2045 UTC[1])
Aircraft: Cessna 182D, registration: N61LN

B. Meteorological Specialist

Mike Richards
Senior Meteorologist
National Transportation Safety Board
Operational Factors Division, AS-30
Washington, DC 20594-2000

C. Details of the Investigation

The National Transportation Safety Board's meteorological specialist was not on scene and gathered weather data for this investigation from the Washington D.C. office from official National Oceanic and Atmospheric Administration (NOAA)'s National Weather Service (NWS) sources including the National Climatic Data Center (NCDC), except where noted. All times are in mountain standard time (MST) on November 17, 2012 - based upon the 24-hour clock. Directions are referenced to true north and distances in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Distances along the surface of the earth are calculated using the "Great Circle" formula.

Coordinates used for the accident location: 43.00835° North latitude, 110.56353° West longitude, elevation of 10,513 feet.

[1] UTC – abbreviation for Coordinated Universal Time

Synoptic Conditions

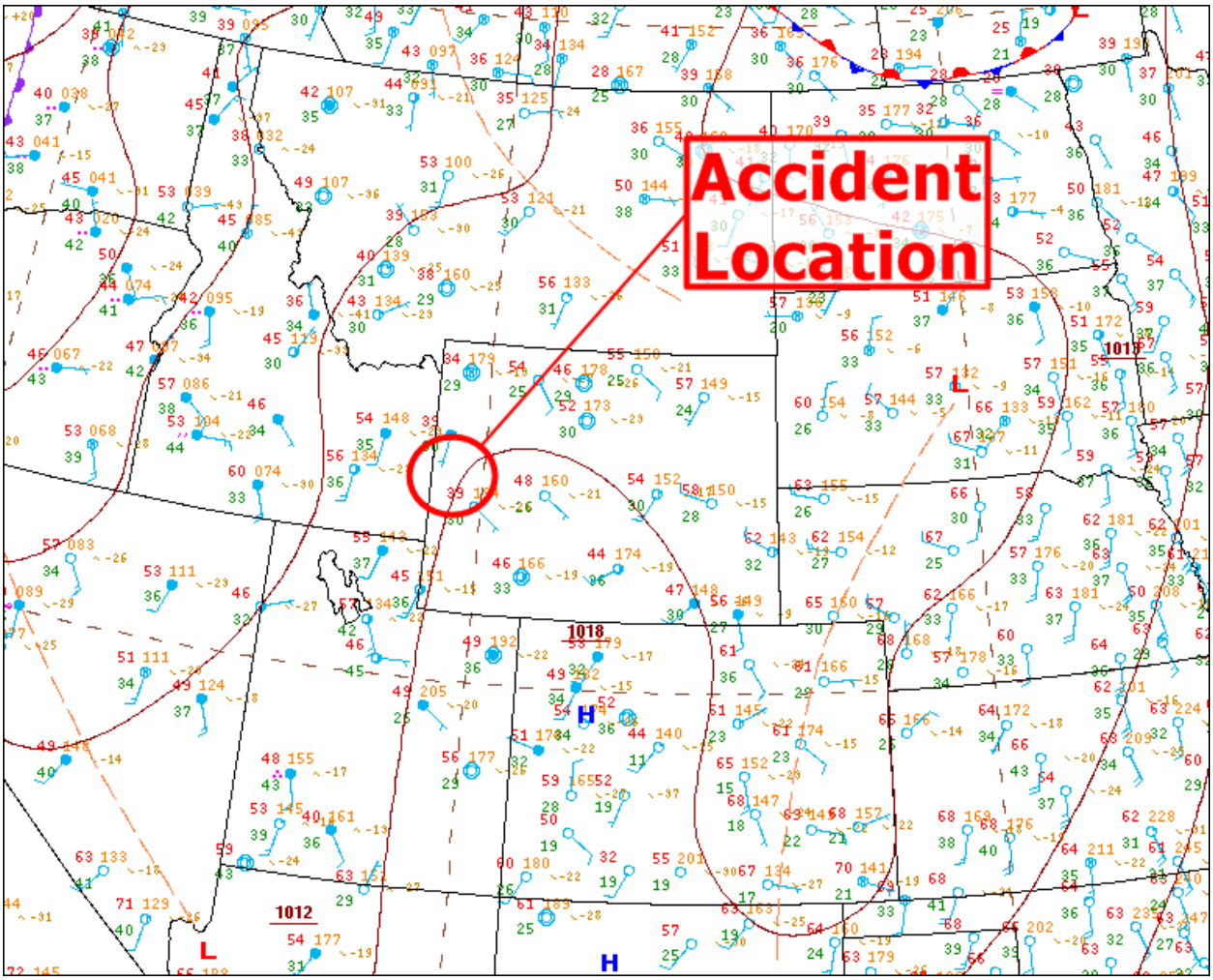

Figure 1 – NWS Surface Analysis Chart for 1400 MST.

The National Weather Service (NWS) Surface Analysis Chart for 1400 MST (figure 1) depicted a regional high-pressure center of 1018 hectopascals (hPa) in northwestern Colorado. Station models in the region of the accident site generally depicted a light and variable wind, however some stations reported wind magnitudes of 10-15 knots. Southwest of the accident site, stations were reporting cloudy conditions, while stations northeast of the accident site were reporting relatively clear sky conditions. Temperatures in this mountainous region varied between the mid-30s° Fahrenheit (F) and the mid-50sºF.

A regional Next-Generation Radar (NEXRAD) mosaic obtained from the NCDC for 1345 MST (figure 2) did not identify any areas of reflectivity close to the accident location.

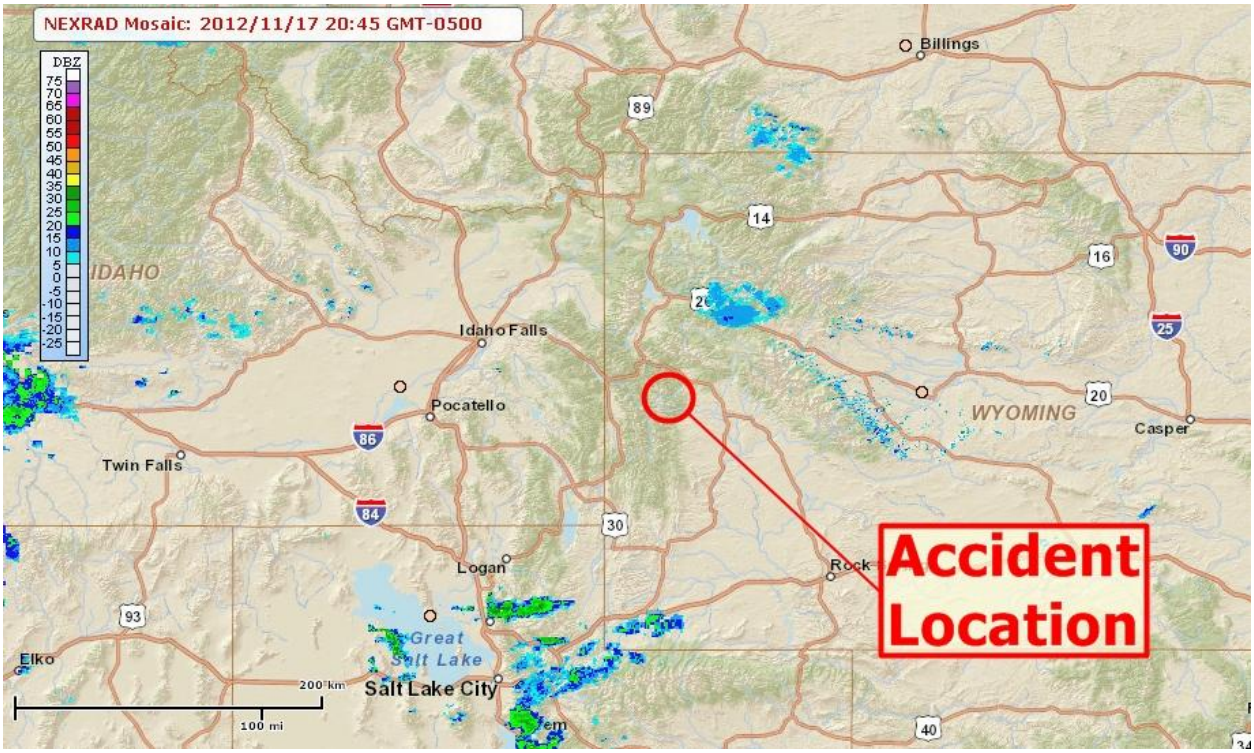

Figure 2 – NCDC NEXRAD mosaic from 1345 MST.

Surface Observations

Unofficial weather observations were retrieved from the Bridger Teton National Forest Avalanche Center station DEABT, which was located about 4.5 miles to the west of the accident site at an elevation of approximately 10,350 feet. Data from this station is presented in table 1.

Time	Temp(°C)	D Temp(°C)	RH(%)	W Sp(kts)	W Gust(kts)	W Dir.
1300	-2.8	-3.6	92	9.6	16.5	214°
1315	-2.8	-3.6	92	7.8	12.2	218°
1330	-2.8	-3.4	93	7.8	14.8	220°
1345	-2.8	-3.4	94	7.8	13.9	217°
1400	-3.3	-3.6	97	7.0	12.2	214°
1415	-3.3	-3.6	97	7.8	13.0	206°

Table 1 – Data collected from DEABT. D_Temp = dew point temperature; RH = relative humidity; W_Sp = wind speed; W_Gust = wind gust; W_Dir = wind direction.

Jackson Hole Airport (KJAC) in Jackson, Wyoming, was located approximately 37 miles north-northwest of the accident site at an elevation of 6,451 feet. It was the closest official observation station with a ceilometer. The following reports were issued from KJAC during the period surrounding the accident time while an observer was on duty:

[1151 MST] METAR KJAC 171851Z 00000KT 10SM OVC039 02/M02 A3009

[1251 MST] METAR KJAC 171951Z 00000KT 10SM OVC037 02/M01 A3007

[1351 MST] METAR KJAC 172051Z 19006KT 8SM VCSHSN FEW035 BKN050 OVC080 04/M01 A3006

1452 MST] METAR KJAC 172152Z 19005KT 10SM SCT045 BKN055 05/M01 A3004

At 1351 MST, KJAC reported a wind from 190° at 6 knots, visibility of 8 miles, snow showers between 5 and 10 miles from the aerodrome, few clouds at 3,500 feet above ground level (agl), ceiling broken at 5,000 feet agl, overcast cloud base at 8,000 feet agl, temperature of 4º Celsius (C) and dew point temperature of -1ºC, altimeter setting 30.06 inches of mercury.

Upper Air Data

A North American Mesoscale (NAM) model sounding (figure 3) for the accident location at 1400 MST was retrieved from NOAA's Air Resources Laboratory. Model data does not provide actual observations. The Lifting Condensation Level[2] (LCL) and Level of Free Convection[3] (LFC) were calculated to be at 9,576 feet. The wind profile indicated there was a light south-southeasterly wind near the surface. Above this level the wind increased in magnitude and veered[4] to the southwest with height and reached a magnitude of 25 knots at 14,000 feet. The NAM model sounding identified the freezing level as being at about 9,000 feet. Calculations made by the RAwindsonde OBservation Program (RAOB) identified the potential for light rime, clear and mixed icing between about 9,000 and 18,000 feet.

[2] Lifting Condensation Level - The level at which a parcel of moist air lifted dry-adiabatically would become saturated.

[3] Level of Free Convection - The level at which a parcel of air lifted dry-adiabatically until saturated and saturation-adiabatically thereafter would first become warmer than its surroundings in a conditionally unstable atmosphere. On a thermodynamic diagram the level of free convection is given by the point of intersection of the process curve, representing the process followed by the ascending parcel, and the sounding curve, representing the lapse rate of temperature in the environment.

[4] A veering wind is a wind (as noted by a standard wind barb) that turns clockwise with height.

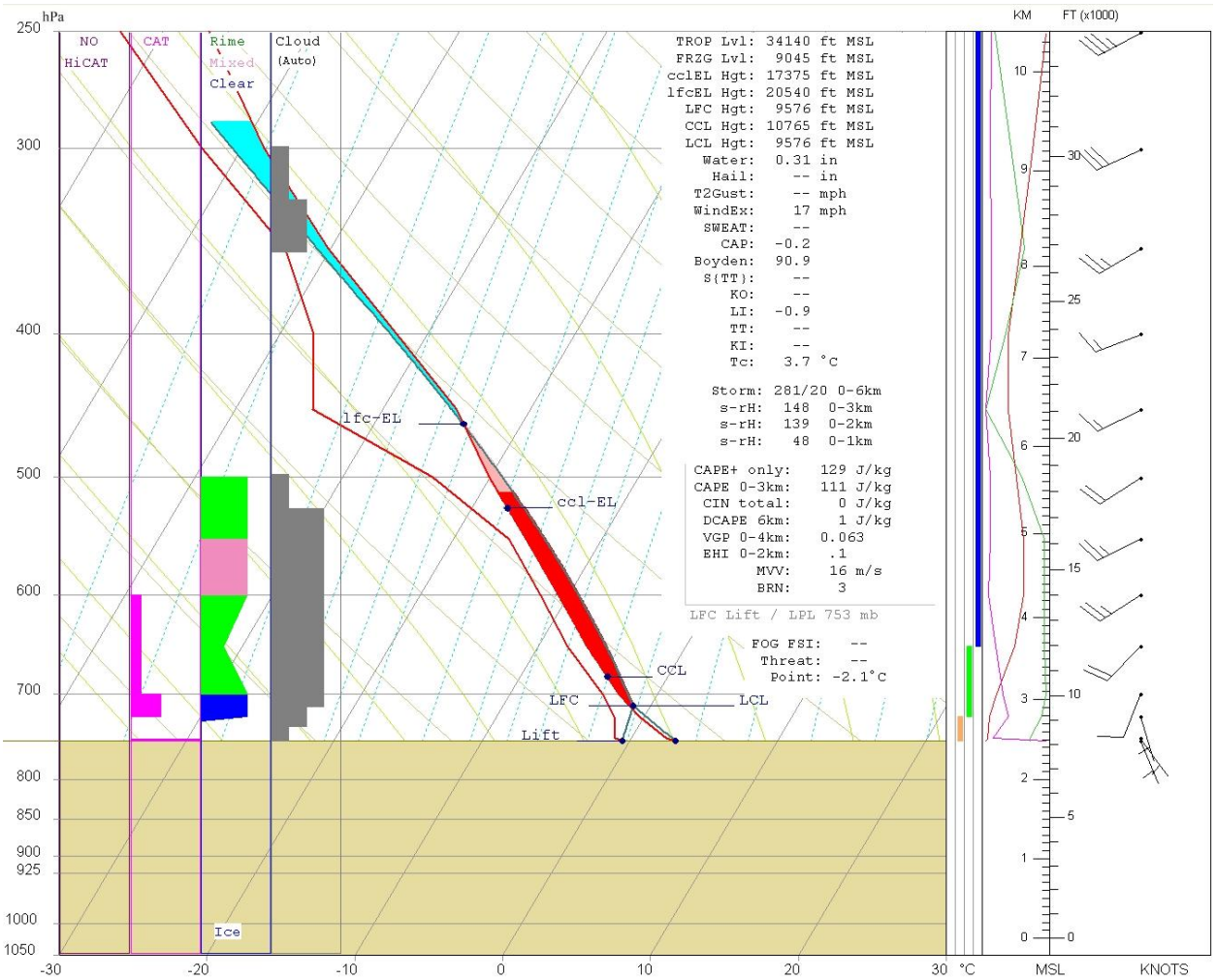

Figure 3 – NAM model sounding for the accident site in SkewT/LogP[5] format for 1400 MST, surface to 250 hPa.

[5] SkewT/LogP - A thermodynamic diagram, using the temperature and the logarithm of pressure as coordinates, which allows the plotting of the vertical profile of the temperature, humidity, and atmosphere above a particular point on the earth's surface.

Pilot Reports

Publically disseminated pilot reports[6] made within 100 miles of the accident site within about three hours of the accident time are presented here.

JAC UA /OV JAC/TM 1725/FL130/TP BE20/TA M05/TB NEG/IC LGT RIME SFC-130/RM BASE 102 TOPS 125 ZLC=

JAC UA /OV JAC /TM 1812 /FLUNKN /TP LJ45 /SK BKN100-TOP120/BKN140-TOP150 /TA M13 /TB NEG /IC LGT MX 140-150 /RM NEG IC 100-120 TA M05/ TA M13 140-150 / DURC SOUTH=

JAC UA /OV JAC /TM 1813 /FLUNKN /TP BE99 /SK BKN100-TOP120 /TA UNKN /TB NEG /IC NEG /RM ILS RY 19=

JAC UA /OV JAC /TM 1956 /FL100 /TP CRJ7 /SK OVC100-TOPUNKN /TA M05 /TB NEG /IC NEG /RM DURD RWY 19=

JAC UA /OV JAC /TM 2017 /FL150 /TP CRJ7 /SK OVC100-TOP157 /TA 00 /TB LGT /IC LGT RIME /RM DURC SOUTHBOUND=

Lightning

No lightning was observed.

Satellite Imagery

Geostationary Operational Environmental Satellite (GOES)-13 and GOES-15 visible (0.65μm) and infrared (10.7μm) data were obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison in Madison, Wisconsin, and processed using the Man computer Interactive Data Access System. The imagery from these platforms are presented in figures 4 and 5. Both the 1345 MST GOES-13 and 1330 MST GOES-15 visible imagery (panel A in figures 4 and 5) indicated that there were clouds in the accident region. While it can be difficult to discriminate meteorological cloud from snow-covered terrain in individual visible images, an animation of the visible imagery surrounding the accident time assisted in identifying the meteorological cloud in the area. GOES-13 infrared data (panel B in figure 4) indicated cloud-top brightness temperatures near the accident site at 1345 MST were approximately -16°C, which, when considering the NAM model sounding, corresponded to cloud-top heights of about 16,700 feet. GOES-15 infrared data (panel B in figure 5) indicated cloud-top brightness temperatures near the accident site at 1330 MST were approximately -15°C, which, when considering the NAM model sounding, corresponded to cloud-top heights of about 16,100 feet.

It should be noted that all satellite data presented in this section have not been corrected for any parallax error. In addition, the spatial resolutions for the instruments whose data is presented in this section vary. Additional care must be taken in interpreting retrieved parameters (e.g. brightness temperatures) when cloud elements are smaller than the instrument's instantaneous field of view.

[6] Only pilot reports distributed with the UBID**, UBMT**, UBUT** and UBWY** headers were considered.

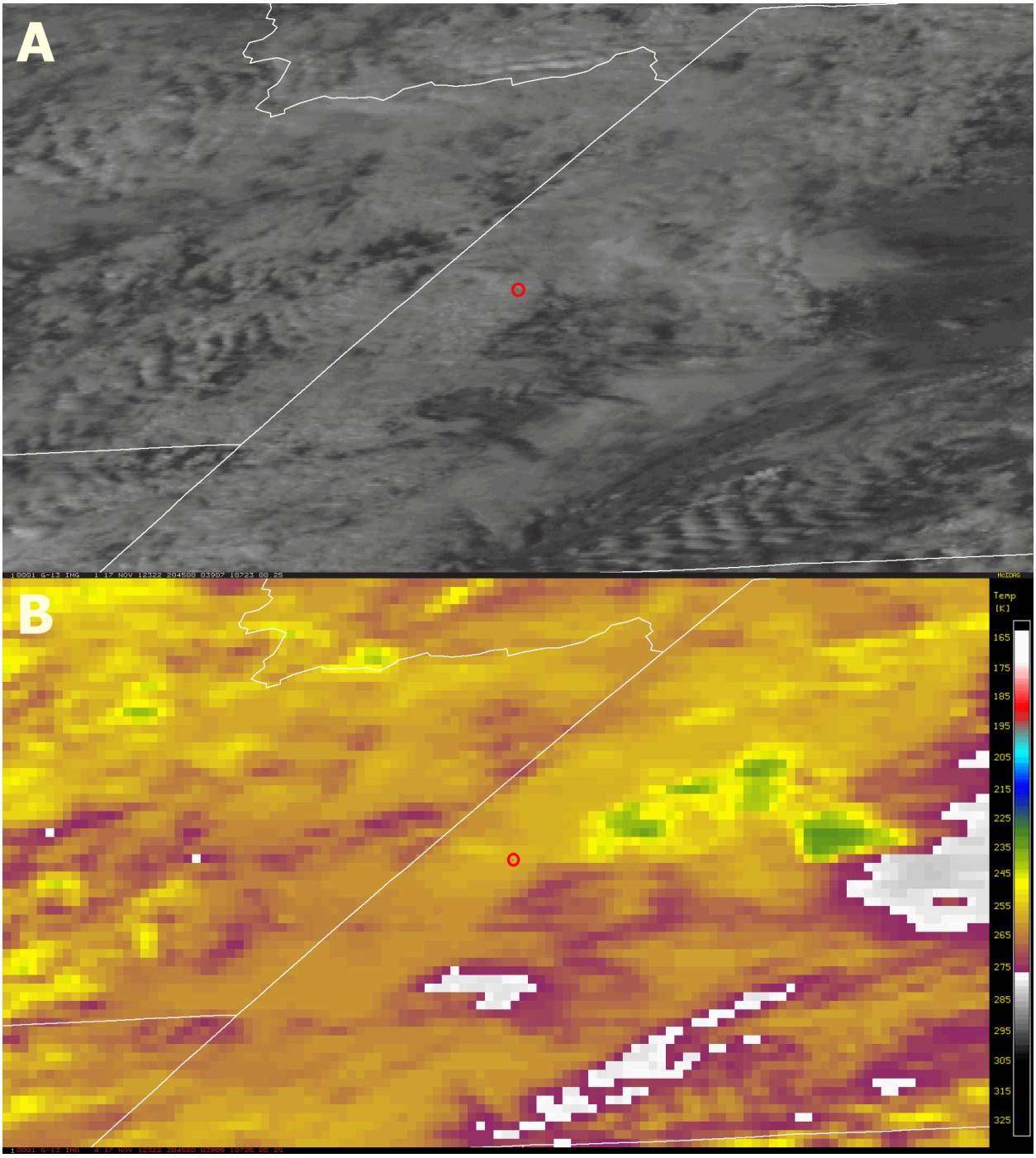

Figure 4 – GOES-13 imagery from 1345 MST. Image A: visible 0.65µm; Image B: infrared 10.7µm color-enhanced: Images not corrected for parallax. Red circles denote accident location.

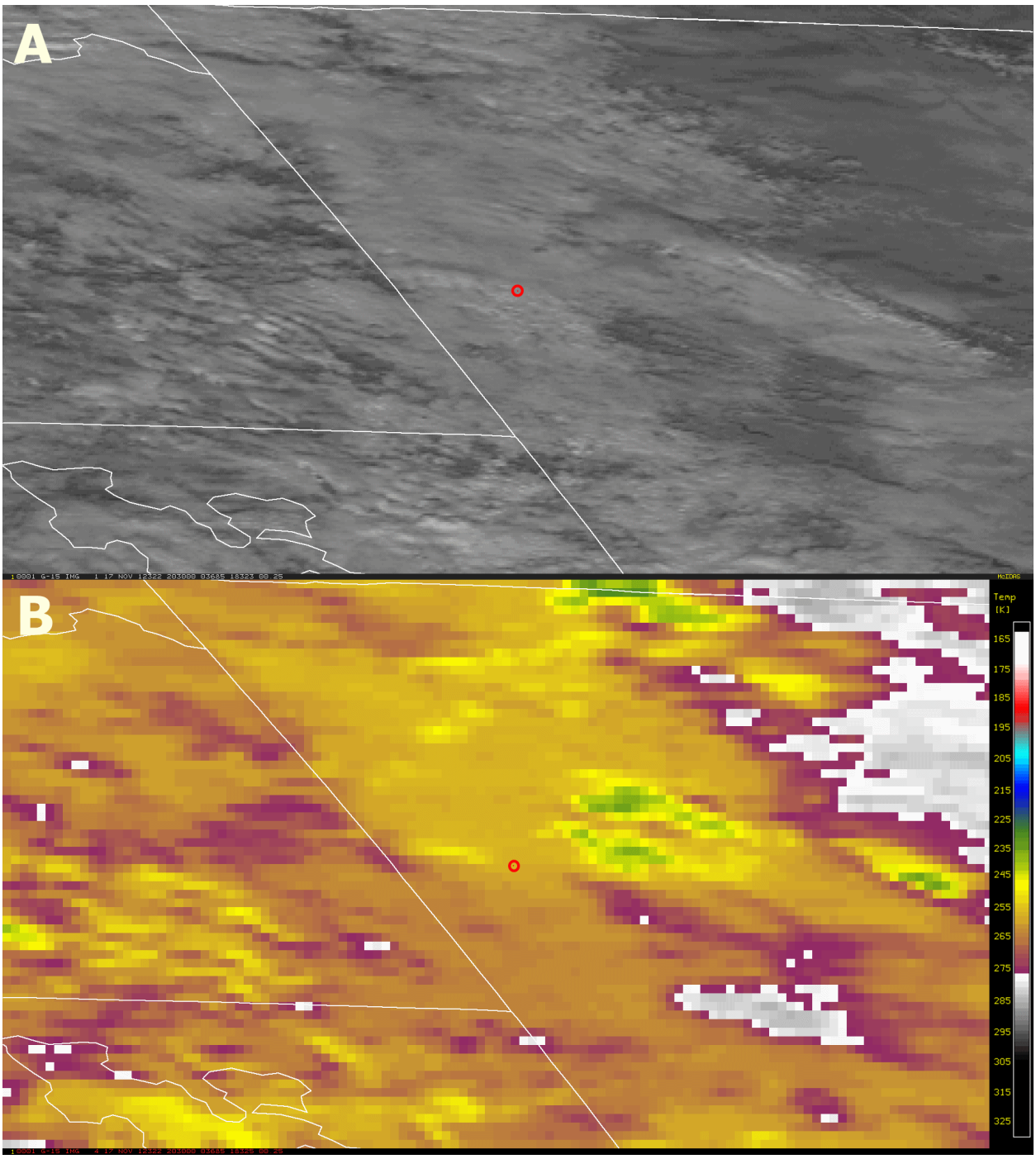

Figure 5 – GOES-15 imagery from 1330 MST. Image A: visible 0.65µm; Image B: infrared 10.7µm color-enhanced: Images not corrected for parallax. Red circles denote accident location.

Visible (0.63µm) and infrared (10.8µm) data from the Advanced Very High Resolution Radiometer (AVHRR) onboard polar-orbiting satellites NOAA-19 (figure 6) and NOAA-18 (figure 7) were captured at 1319 MST and 1401 MST, respectively. Both visible images (panel A in figures 6 and 7) identify clouds in the region of the accident. The visible data from NOAA-19 also highlights wave activity throughout the region. NOAA-19 infrared data (panel B in figure 6) indicated cloud-top brightness temperatures near the accident site at 1319 MST were approximately -15°C. NOAA-18 infrared data (panel B in figure 7) indicated cloud-top brightness temperatures near the accident site at 1400 MST were approximately -17°C, which, when considering the NAM model sounding, corresponded to cloud-top heights of about 17,100 feet.

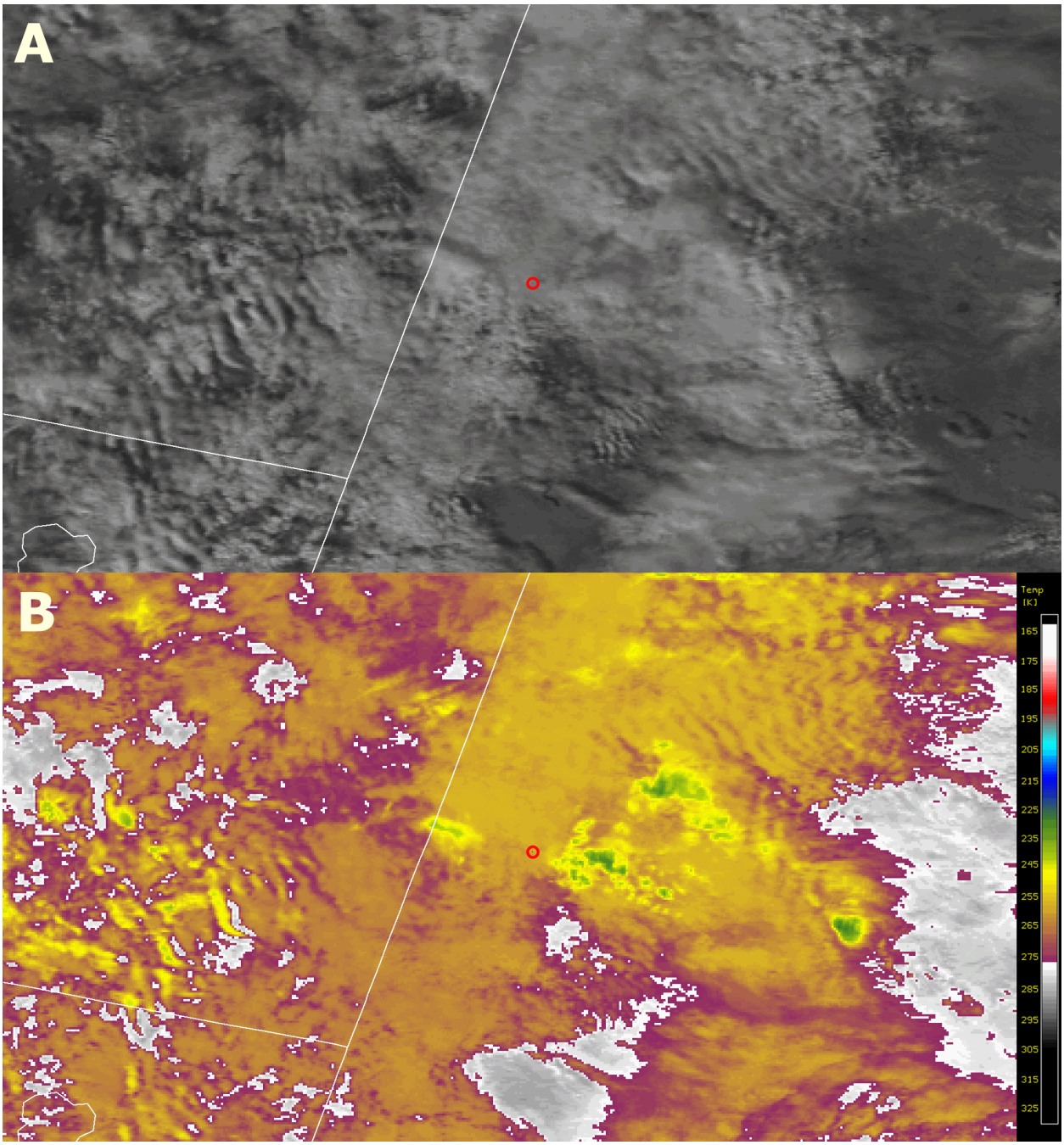

Figure 6 – NOAA-19 AVHRR imagery from 1319 MST. Image A: "visible" 0.63µm; Image B: infrared 10.8µm color-enhanced: Images not corrected for parallax. Red circles denote accident location.

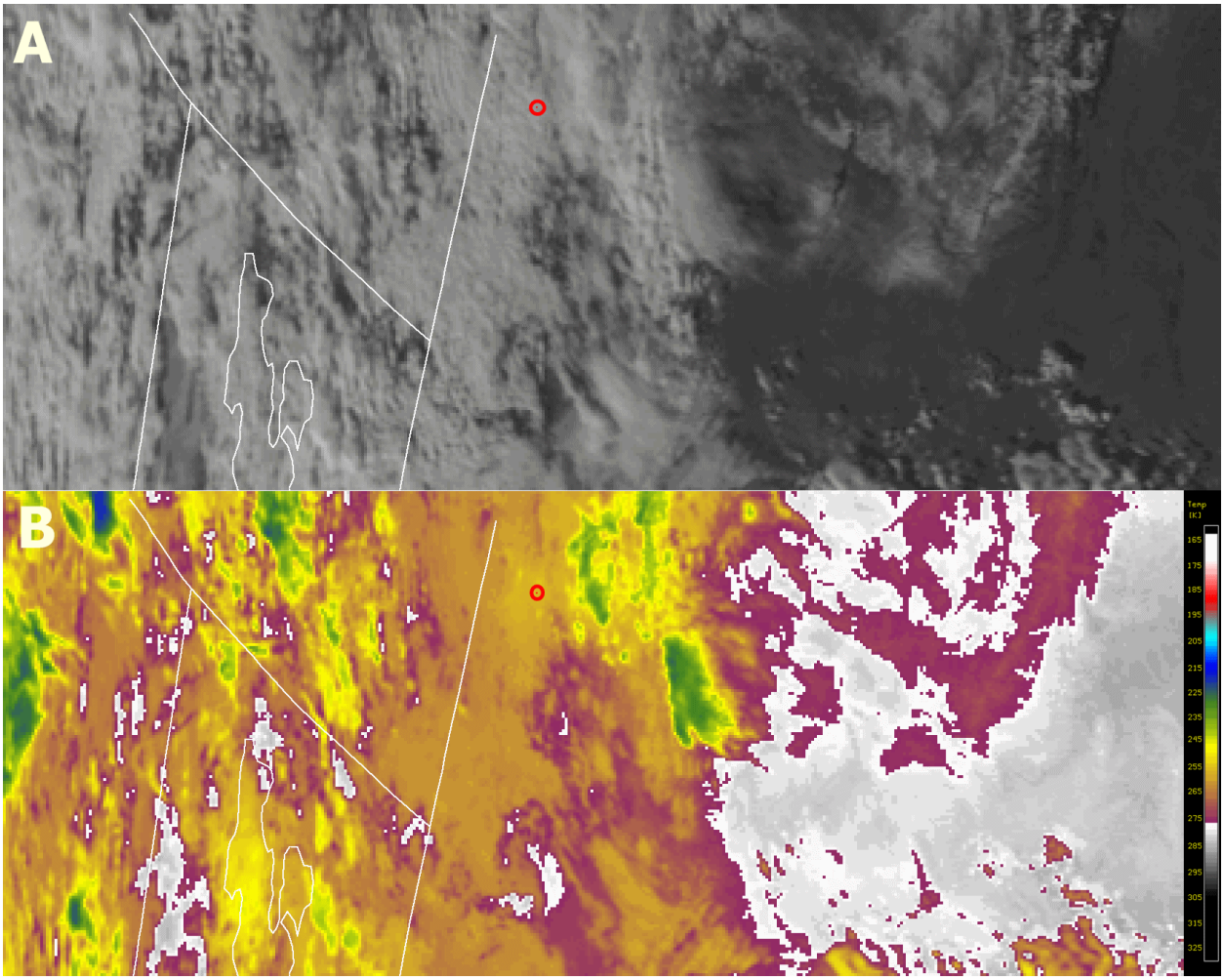

Figure 7 – NOAA-18 AVHRR imagery from 1401 MST. Image A: "visible" 0.63µm; Image B: infrared 10.8µm color-enhanced: Images not corrected for parallax. Red circles denote accident location.

"True-color" imagery from the Moderate Resolution Imaging Spectroradiometer (MODIS) onboard the polar-orbiting AQUA spacecraft, which was obtained from the National Aeronautics and Space Administration, provided a unique view of the cloud cover present near the accident location at 1330 MST (figure 8). This true-color imagery was created using MODIS Band 1 (0.65µm) as the red color component, MODIS band 4 (0.55µm) as the green color component, and MODIS band 3 (0.47µm) as the blue color component, where spatial resolution is 250 meters for red and 500 meters for green and blue. Visible inspection of the true-color imagery identifies cloud features in the area of the accident site, much of which take the form of wave clouds. The imagery also identified snow-covered terrain. Low clouds can be difficult to separate from snow-covered terrain in this imagery.

MODIS "false-color" imagery is presented in figure 9, where MODIS band 7 (2.11µm) is used as the red component, MODIS Band 2 (0.85µm) is used as the green component and MODIS Band 1 is used as the blue component. This false color imagery is able to discriminate water cloud (appear more white) from ice cloud and snow on the ground (appear more cyan).

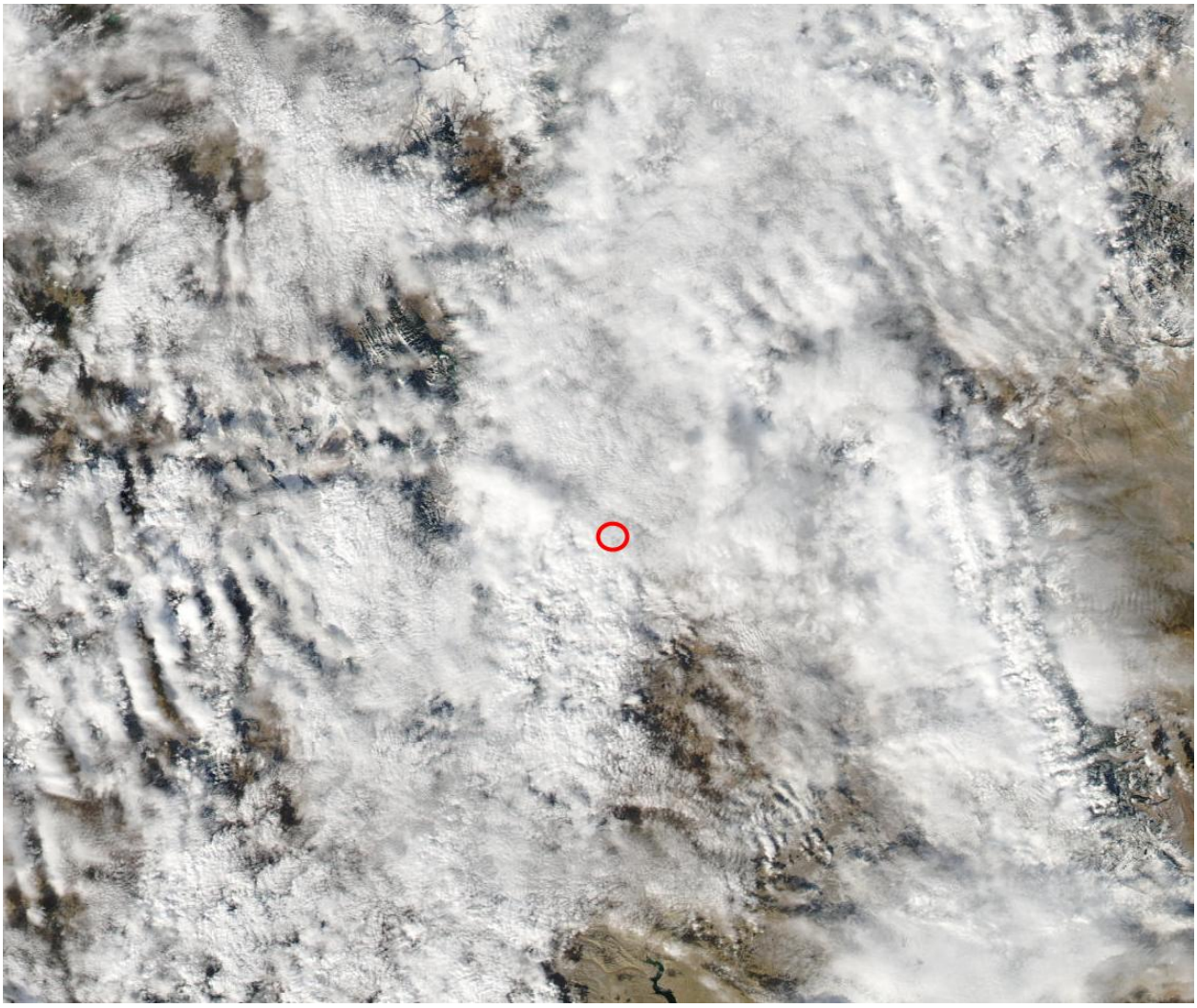

Figure 8 – MODIS "true-color" imagery from AQUA at 1330 MST. Image is not corrected for any parallax error. Red circle denotes accident location.

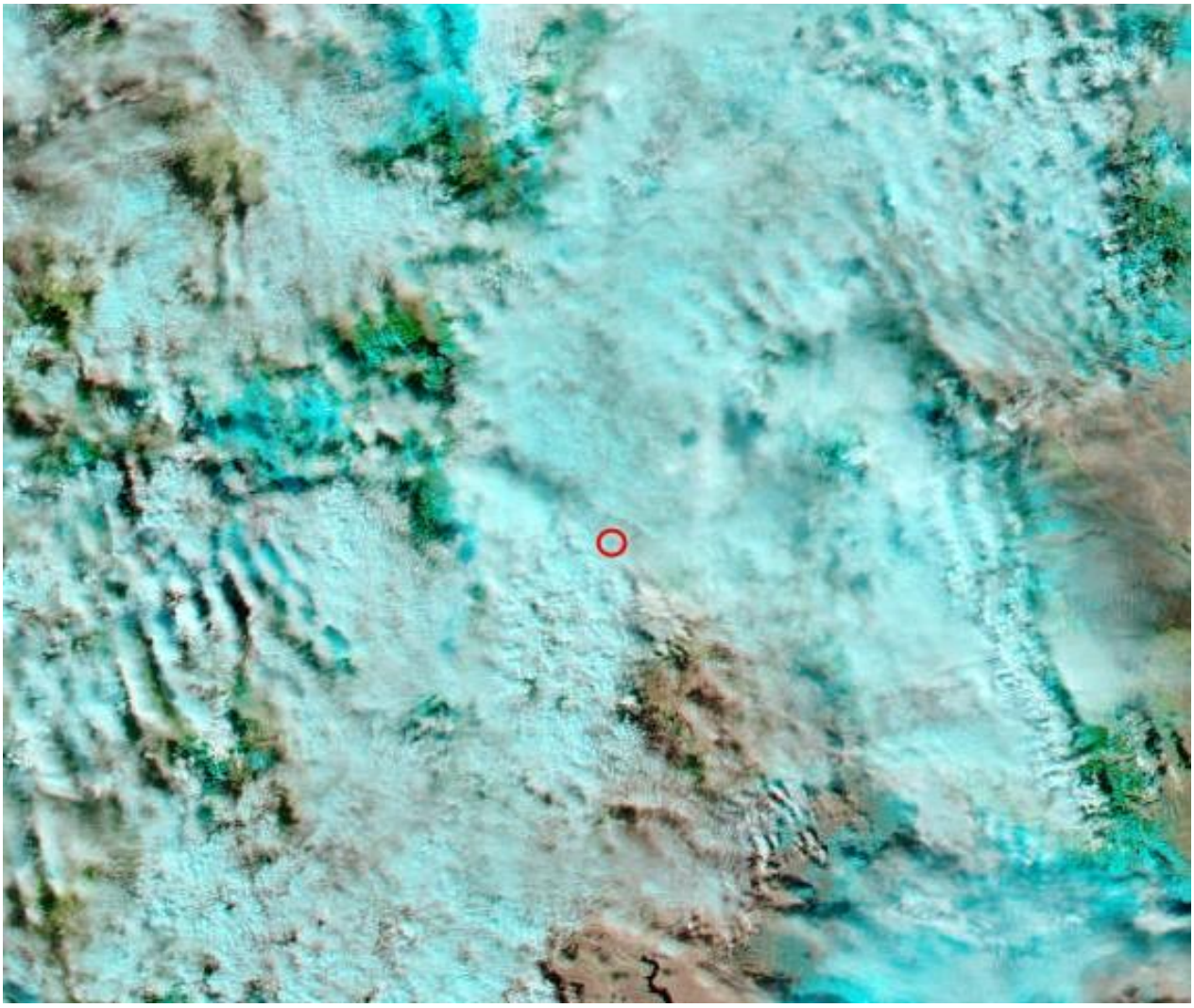

Figure 9 – MODIS "false-color" imagery from AQUA at 1330 MST. Image is not corrected for any parallax error. Red circle denotes accident location.

Area Forecast

An Area Forecast that included Wyoming was issued at 0445 MST. The portion of the Area Forecast directed toward the southwestern portion of Wyoming forecasted for the accident time: ceiling broken between 13,000 and 15,000 feet msl, with cloud tops to FL180[7].

FAUS45 KKCI 171145
FA5W
_SLCC FA 171145
SYNOPSIS AND VFR CLDS/WX
SYNOPSIS VALID UNTIL 180600
CLDS/WX VALID UNTIL 180000...OTLK VALID 180000-180600
ID MT WY NV UT CO AZ NM
.

[7] Flight Level (FL) - standard nominal altitude of an aircraft, in hundreds of feet. This altitude is calculated from the International standard atmosphere using 1013.25 hPa (29.92 in Hg) for surface pressure.

SEE AIRMET SIERRA FOR IFR CONDS AND MTN OBSCN.
TS IMPLY SEV OR GTR TURB SEV ICE LLWS AND IFR CONDS.
NON MSL HGTS DENOTED BY AGL OR CIG.
.
SYNOPSIS...ALF...MOD-STG WSWLY FLOW WL CONT ACRS SRN SXNS OF THE FA AREA WITH LGT WSWLY FLOW NRN SXNS. WK SHRTWV TROF ERN MT-NERN WY WL CONT EWD INTO THE NRN PLAINS THRU THE PD.
SFC...NO SGFNT SFC FEATURES SEEN. WK RDG WL CONT ERN SXNS OF THE FA AREA.
.
WY
NWRN MTNS...BKN100-120 TOPS FL180. OTLK...VFR.
SWRN SXNS...BKN130-150 TOPS FL180. OTLK...VFR.
CNTRL-ERN SXNS...SCT140 SCT-BKN CI. OTLK...VFR.

An Area Forecast that included Wyoming was issued at 2045 MST (accident time). The portion of the Area Forecast directed toward the southwestern and south central portions of Wyoming forecasted until 1800 MST: scattered clouds at 12,000 feet msl, ceiling broken at 14,000 feet msl, cloud tops to 17,000 feet msl.

FAUS45 KKCI 172045
FA5W
_SLCC FA 172045
SYNOPSIS AND VFR CLDS/WX
SYNOPSIS VALID UNTIL 181500
CLDS/WX VALID UNTIL 180900...OTLK VALID 180900-181500
ID MT WY NV UT CO AZ NM
.
SEE AIRMET SIERRA FOR IFR CONDS AND MTN OBSCN.
TS IMPLY SEV OR GTR TURB SEV ICE LLWS AND IFR CONDS.
NON MSL HGTS DENOTED BY AGL OR CIG.
.
SYNOPSIS...ALF...21Z SHRTWV TROF FM NERN CA TO THE SRN NV-CA BORDER...MOV EWD. BROAD UPR RDG OVR RMNDR FA AREA. 15Z SHRTWV TROF FM N CNTRL WY TO S CNTRL CO. AT THE SFC...21Z TROF FM THE NEB PNHDL THRU ERN CO TO S CNTRL NM. TROF FM CNTRL OR TO CNTRL NV. 15Z CDFNT ALG A YXH-DLN-TWF-40W OAL LN.
.
WY
NW MTNS...BKN100 TOPS 150. 00Z WDLY SCT -SHSN. 06Z BKN080 LYRD FL250. VIS 3SM -SN. OTLK...MVFR CIG SN.
SWRN-S CNTRL...SCT120 BKN140 TOPS 170. 01Z SCT100 BKN120-140. WDLY SCT -SHRASN. OTLK...MVFR CIG SHRASN.
RMNDR...SCT150 SCT CI. BECMG 0104 SCT-BKN150 TOPS 170. OTLK...VFR THRUT...WND ERN SXNS.

Aviation Section of the Area Forecast Discussion

An Area Forecast Discussion (AFD) was issued at 1043 MST by the NWS Weather Forecast Office (WFO) in Riverton, Wyoming (KRIW). The aviation portion of the AFD is presented here.

FXUS65 KRIW 171744 AAAAFDRIW
AREA FORECAST DISCUSSION...UPDATED
NATIONAL WEATHER SERVICE RIVERTON WY
1043 AM MST SAT NOV 17 2012

.AVIATION.../18Z ISSUANCE/
EAST OF THE CONTINENTAL DIVIDE...VFR CONDITIONS WILL OCCUR TODAY AND TONIGHT. THE ABSAROKA MOUNTAINS WILL SEE SOME RAIN AND SNOW SHOWERS DEVELOP AROUND 06Z SUNDAY AND CONTINUE THROUGH 12Z SUNDAY. EXPECT SOME MVFR CONDITIONS NEAR THE ABSAROKA MOUNTAINS WITH SOME MOUNTAIN OBSCURATION AROUND 06Z SUNDAY.
WEST OF THE CONTINENTAL DIVIDE...VFR CONDITIONS WILL PREVAIL OVER THE REGION THROUGH 00Z. EXPECT ISOLATED RAIN AND SNOW SHOWERS OVER AND NEAR THE WESTERN MOUNTAINS THROUGH 00Z SUNDAY WITH SOME OBSCURATION AT TIMES. AFTER 00Z CLOUDS WILL INCREASE AND LOWER WITH AN INCREASE IN RAIN AND SNOW SHOWERS BY 06Z THROUGH 16Z SUNDAY. EXPECT AN INCREASE OF MVFR CONDITIONS AFTER 06Z SUNDAY ACROSS THE WEST WITH MOUNTAIN OBSCURATION BECOMING MORE FREQUENT.
&&

AIRMETs

Airmen's Meteorological Information (AIRMET) advisories issued for the state of Wyoming leading up to and including the accident time are presented here.

At 0745 MST, two AIRMETs (figure 10) were issued for areas of Wyoming that included the accident site. The AIRMETs advised of mountain obscuration and moderate icing between the freezing level and FL220.

WAUS45 KKCI 171445
WA5S
-SLCS WA 171445
AIRMET SIERRA UPDT 3 FOR IFR AND MTN OBSCN VALID UNTIL 172100
.
AIRMET MTN OBSCN...ID MT WY UT WA OR
FROM 30SE YDC TO 40SSW YQL TO 40SW HLN TO 30WSW BIL TO 40NE OCS TO 20E MTU TO 20SSE SLC TO 30NNE BOI TO BKE TO 50S YKM TO 30SE YDC
MTNS OBSC BY CLDS. CONDS CONTG BYD 21Z THRU 03Z.

WAUS45 KKCI 171445
WA5Z
-SLCZ WA 171445
AIRMET ZULU UPDT 2 FOR ICE AND FRZLVL VALID UNTIL 172100
.
AIRMET ICE...ID MT WY NV UT OR CA
FROM 70NNE DNJ TO 50ENE JAC TO 20NE MTU TO 40S DTA TO 30NNE ILC TO 50SSE EHF TO 30NNW RZS TO 20W PYE TO 50S OED TO 50NE OED TO 70NNE DNJ
MOD ICE BTN FRZLVL AND FL220. FRZLVL 080-100. CONDS CONTG BYD 21Z THRU 03Z.

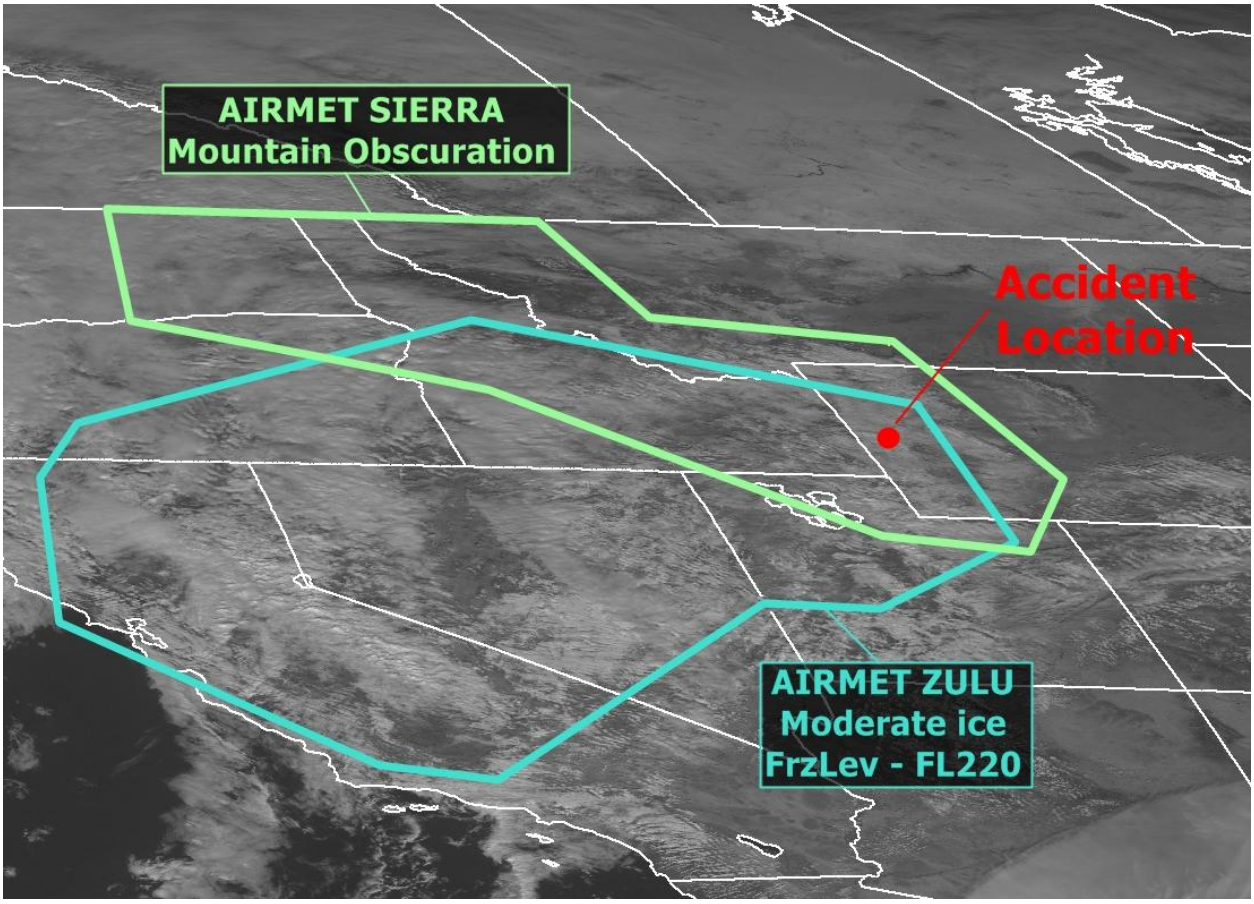

Figure 10 – AIRMETs issued at 0745 MST for areas that included the state of Wyoming.

At 1345 MST, two AIRMETs (figure 11) were issued for areas of Wyoming that included the accident site. The AIRMETs advised of mountain obscuration and moderate icing between the freezing level and FL220.

WAUS45 KKCI 172045
WA5Z
-SLCZ WA 172045
AIRMET ZULU UPDT 3 FOR ICE AND FRZLVL VALID UNTIL 180300

.
AIRMET ICE...ID MT WY NV UT CO WA OR CA
FROM 60SSE FCA TO 40NNE CHE TO 50SE BCE TO 40NE BTY TO 40S EHF TO 40SW CZQ TO 20NW CZQ TO 60SE LKV TO 20NNE BKE TO 70N LKT TO 60SSE FCA
MOD ICE BTN FRZLVL AND FL220. FRZLVL 080-100. CONDS CONTG BYD 03Z THRU 09Z.

WAUS45 KKCI 172045
WA5S
-SLCS WA 172045
AIRMET SIERRA UPDT 4 FOR IFR AND MTN OBSCN VALID UNTIL 180300
.
NO SGFNT IFR EXP OUTSIDE OF CNVTV ACT.
.
AIRMET MTN OBSCN...ID MT WY UT
FROM 40WSW HLN TO 40WSW BIL TO 50NE OCS TO 40ESE MTU TO 40W MTU TO 30N TWF TO 60SSE BKE TO 70N DNJ TO 40WSW HLN
MTNS OBSC BY CLDS/PCPN. CONDS CONTG BYD 03Z THRU 09Z.

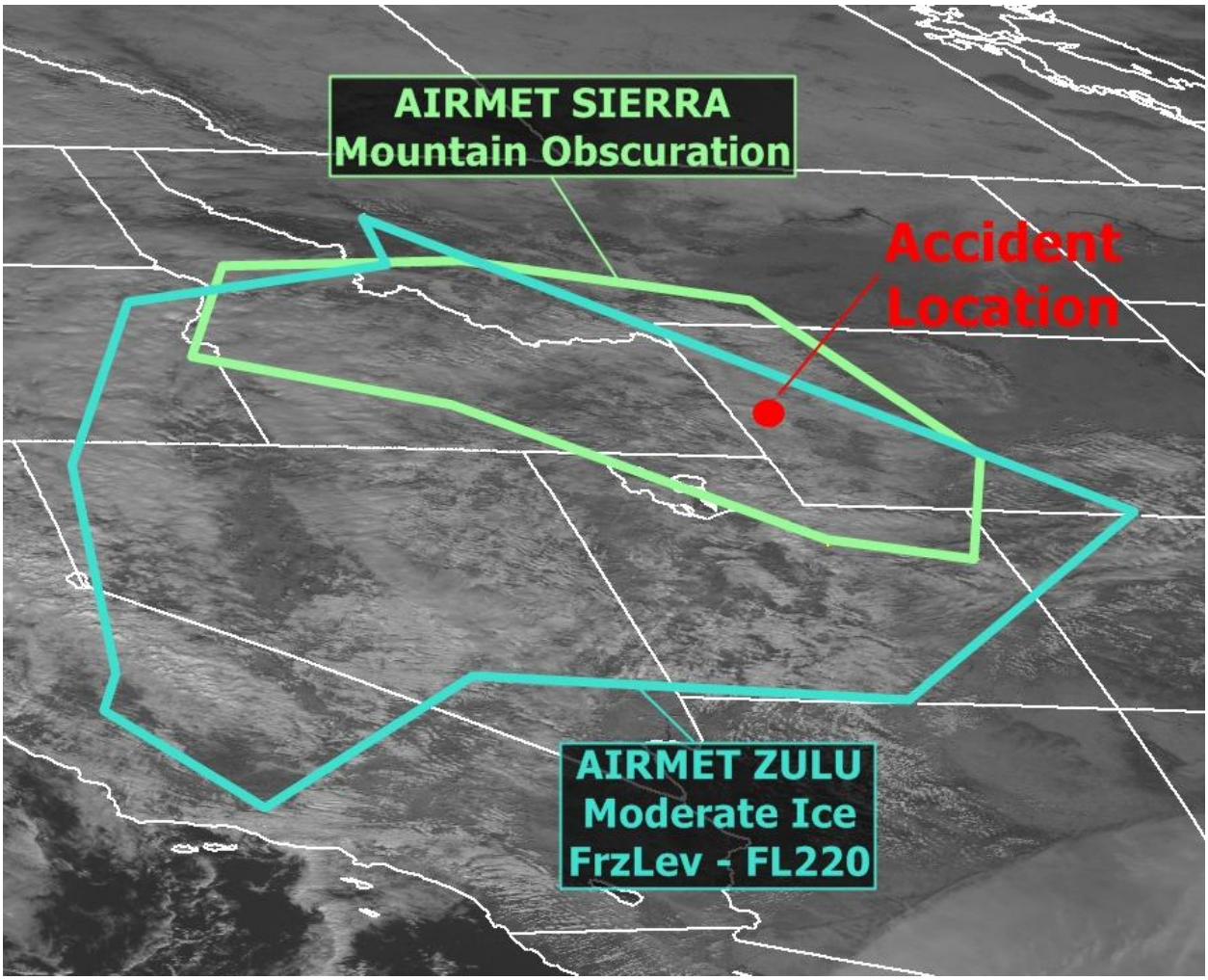

Figure 11 – AIRMETs issued at 1345 MST for areas that included the state of Wyoming.

SIGMETs

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

Convective SIGMETs

There were no convective SIGMETs active for the accident location at the accident time.

Center Weather Advisories/Meteorological Impact Statements

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

Pilot Weather Briefing

There was no record of a pre-flight weather briefing having been provided by Lockheed Martin Flight Services, DUAT or DUATS.

Astronomical Data

The astronomical data obtained from the United States Naval Observatory for 43.0°N and 110.6°W, indicated the following:

SUN	
Sunrise	0718 MST
Sunset	1656 MST
End Civil Twilight	1727 MST

Submitted by: Mike Richards
NTSB, AS-30