



## **NATIONAL TRANSPORTATION SAFETY BOARD**

Office of Aviation Safety  
Washington, D.C. 20594

June 9, 2022

### **Specialist's Factual Report**

## **METEOROLOGY**

WPR22FA173

## **A. ACCIDENT**

Location: Grasmere, Idaho  
Date: May 8, 2022  
Time: 1416 mountain daylight time (MDT)  
2016 universal coordinated time (UTC)  
Airplane: COMP AIR 8-SS52; Registration: N801DT

## **B. METEOROLOGY SPECIALIST**

Specialist Donald Eick  
National Transportation Safety Board  
Senior Meteorologist  
Washington, D.C.

## **C. DETAILS OF THE INVESTIGATION**

The National Transportation Safety Board's Senior Meteorologist was not on scene for this investigation and conducted the meteorology phase of the investigation remotely, collecting data from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the Weather Prediction Center (WPC) and the National Center for Environmental Information (NCEI). All times are reported as MDT based upon the 24-hour clock, local time is -6 hours from UTC, and UTC=Z. NWS airport and station identifiers use the standard International Civil Aviation Organization 4-letter station identifiers versus the International Air Transport Association 3-letter identifiers, which deletes the initial country code designator "K" for U.S. airports. Directions are referenced to true north and distances in nautical miles. Heights are in feet (ft) above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles.

The accident airplane departed from Boulder City, Nevada (KBVU) at 1025 PDT with the planned destination of Ontario, Oregon (KONO). The accident site was located at latitude 42.1880° N and longitude 115.58407° W, at an elevation of approximately 5,290 ft.

## **D. FACTUAL INFORMATION**

### **1.0 Synoptic Conditions**

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 (NCEP) and the WPC located in College Park, Maryland. These are the base products used in describing weather features and in the creation of forecasts and warnings. Reference to these charts can be found in the joint NWS and Federal Aviation Administration (FAA) Advisory Circular "Aviation Weather Services", AC 00-45H change 2<sup>1</sup>.

## **1.1 Surface Analysis Chart**

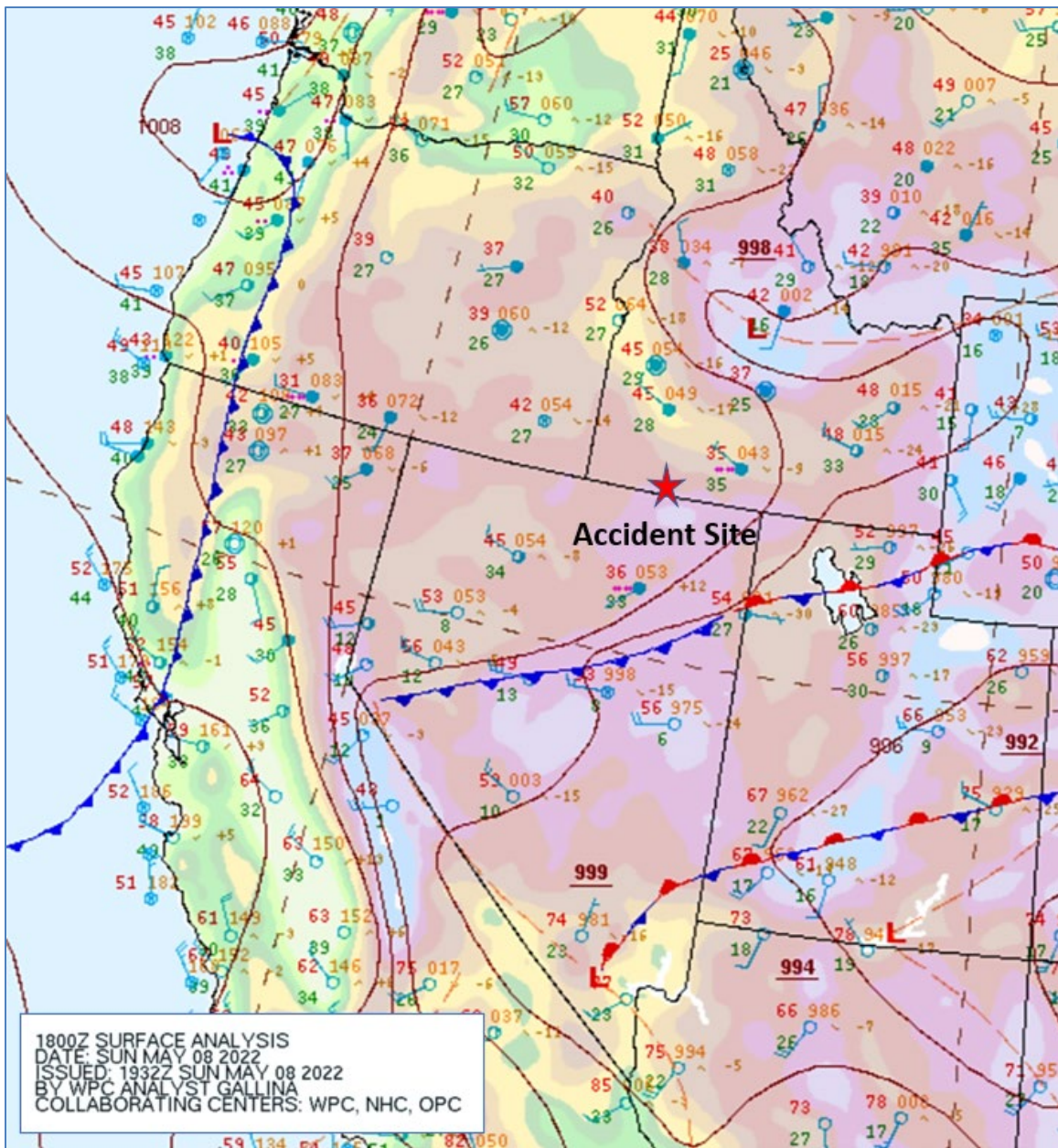
The western section of the NWS WPC Surface Analysis Chart for 1200 MDT is included as figure 1 with the approximate accident site marked by the red star. The chart depicted a low-pressure system at 998-hectopascals (hPa)<sup>2</sup> over central Idaho, north of the accident site with a trough of low pressure extending east and west from the low. A cold front extended across central Nevada with another stationary front over southern Nevada with an associated low-pressure system at 999-hPa. The accident site was located on the cold air side or north of the cold front and south of the low-pressure system in central Idaho.

The station models in the vicinity of the accident site depicted a general cyclonic or counterclockwise circulation related to the low-pressure system to the north with northwesterly to southwesterly winds of 5 to 10 knots, light snow showers, overcast cloud cover, with temperatures from 35° to 36° Fahrenheit (F), with dew point temperatures from 33° to 35° F.

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<sup>1</sup> [https://www.faa.gov/regulations\\_policies/advisory\\_circulars/index.cfm/go/document.information/documentID/1030235](https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/1030235)

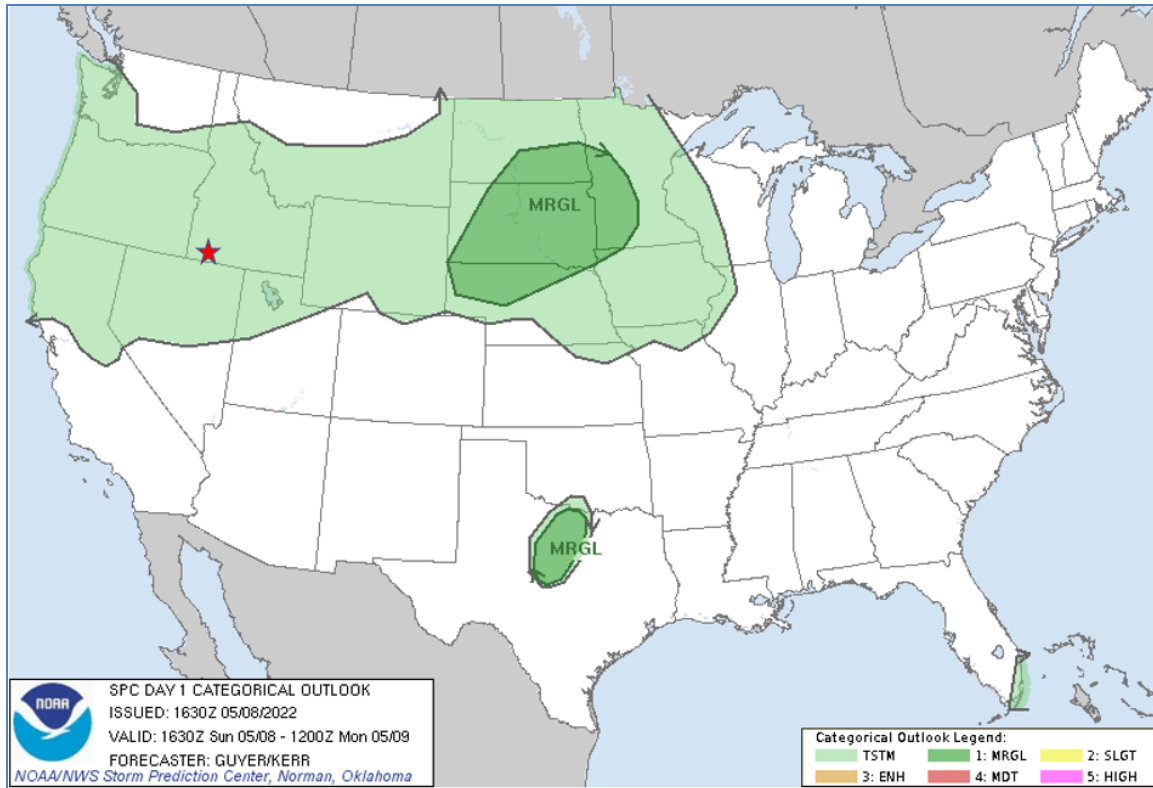
<sup>2</sup> Hectopascals (hPa) is the standard unit for reporting pressure and is interchangeable with the former term millibar (mb) with the same units. Standard sea-level pressure is 1013.25-hPa at 59° Fahrenheit (F) or 15 Celsius (C).



**Figure 1 - NWS Surface Analysis Chart for 1200 MDT with the accident site marked by the red star.**

## 1.2 Convective Outlook

The NWS Storm Prediction Center's (SPC) Convective Outlook Chart issued at 1030 MDT and valid for the period is included as figure 2 with the approximate accident site marked by the red star. The chart depicted a general risk of thunderstorms over northern Nevada, Idaho, and Oregon during the period. The convective outlook (AC) bulletin associated with the issuance of the chart made no specific reference to any risk of severe thunderstorms or organized thunderstorms over Idaho for the period and thus was not reproduced here for this report.

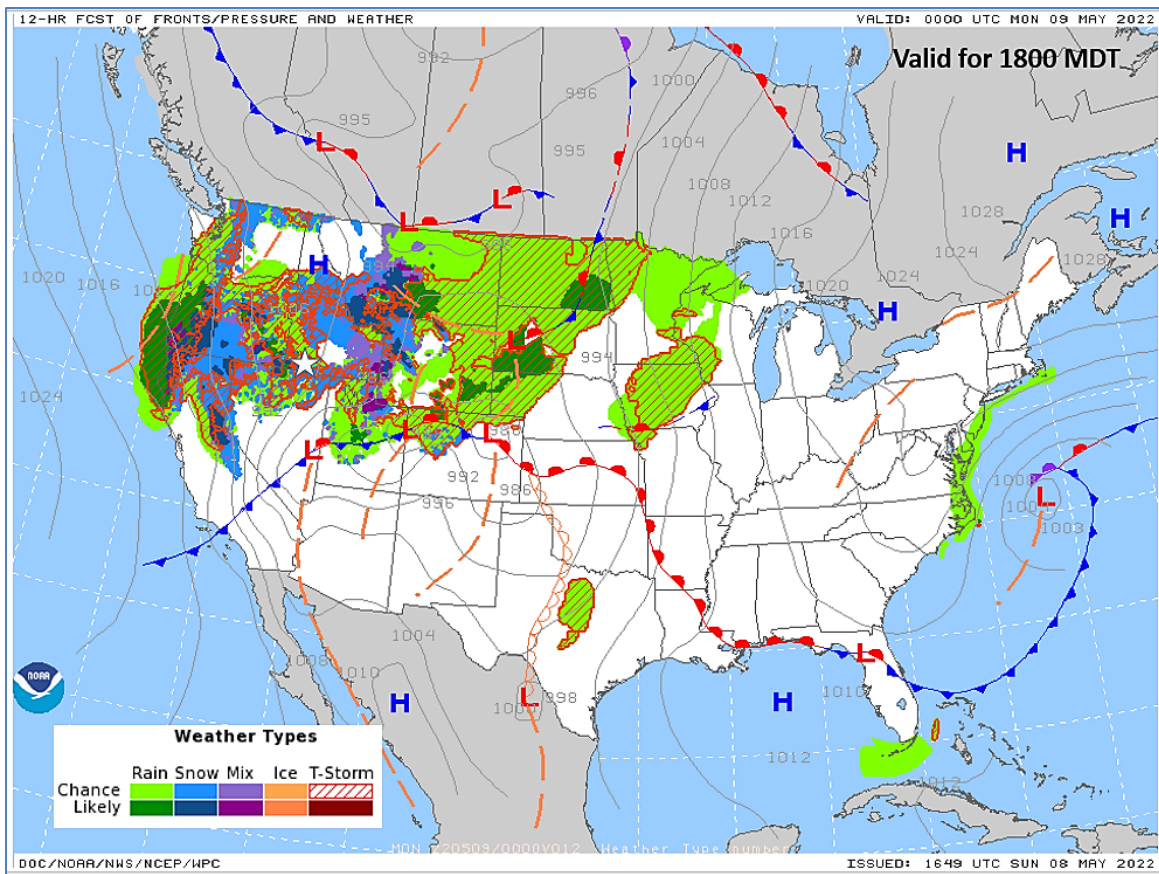


**Figure 2 - NWS Convective Outlook for 1030 MDT with the approximate accident site.**

A regional view of the National Reflectivity Radar for the period is included under section 2.4 NWS METAR Display and under section 5.0 Radar Imagery.

### 1.3 Short Term Forecast

The NWS WPC 12-hour Short Term Forecast Chart current during the period and valid for 1800 MDT is included as figure 3 with the approximate accident site marked by a white star. The chart depicted scattered or a chance of precipitation in the form of rain, snow and thunderstorms over northern Nevada, southern Idaho, and Oregon during the period.



**Figure 3 - NWS 12-hour Short Term Forecast valid for 1800 MDT.**

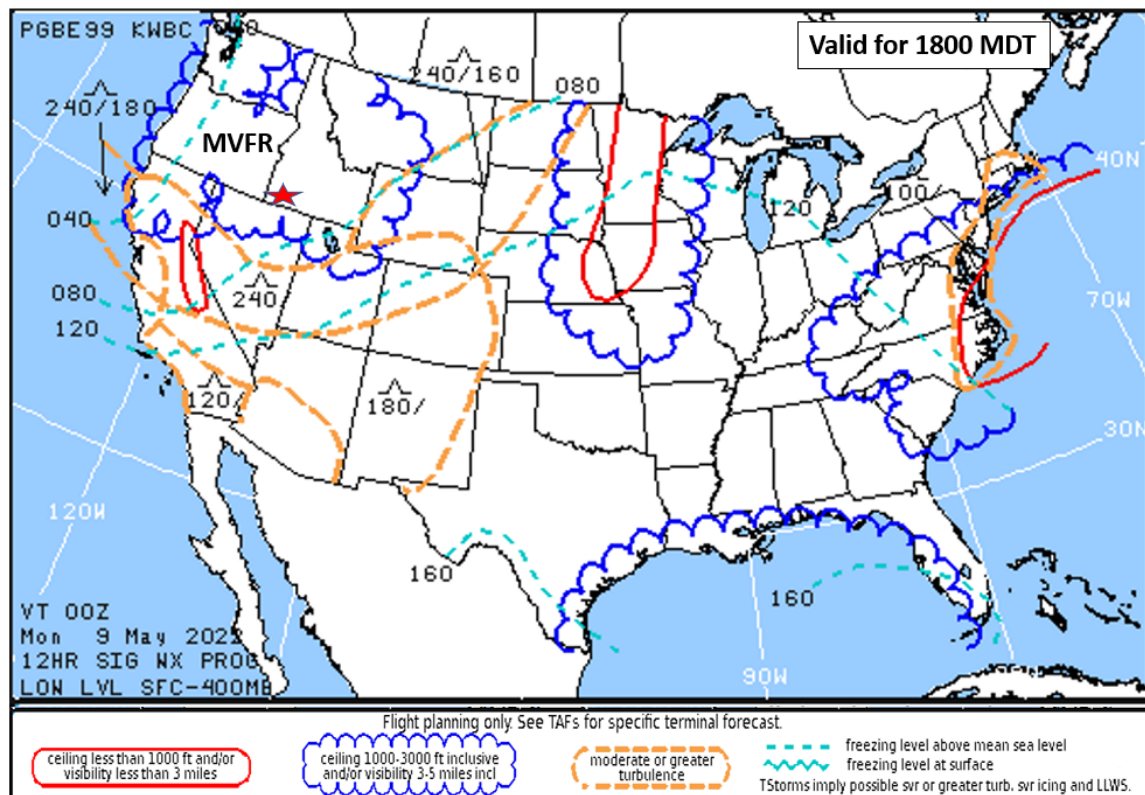
#### 1.4 Low-Level Significant Weather Prognostic Chart

The NWS 12-hour Low-Level Significant Weather Prognostic Chart valid for 1800 PDT is included as figure 4 with the approximate accident site marked by the red star. The chart depicted the forecast general flight categories<sup>3</sup>, freezing level, and forecast low-level turbulence during the period. The chart depicted general MVFR conditions expected to prevail over northern Nevada, Idaho, and Oregon during the period, with the freezing level between 4,000 and 8,000 ft. No significant turbulence below 24,000 ft was expected over northern Nevada, Idaho, or Oregon for the period.

<sup>3</sup> As defined by the NWS and the FAA Aeronautical Information Manual (AIM) section 7-1-7 defines the following general flight categories:

- Low Instrument Flight Rules (LIFR\*) - ceiling below 500 ft above ground level (agl) and/or visibility less than 1 statute mile.
- Instrument Flight Rules (IFR) - ceiling between 500 to below 1,000 feet agl and/or visibility 1 to less than 3 miles.
- Marginal Visual Flight Rules (MVFR\*\*) - ceiling from 1,000 to 3,000 ft agl and/or visibility 3 to 5 miles.
- Visual Flight Rules (VFR) - ceiling greater 3,000 ft agl and visibility greater than 5 miles.

\* By definition, IFR is a ceiling less than 1,000 ft agl and/or visibility less than 3 miles while LIFR is a sub-category of IFR.



**Figure 4 - NWS 12-hour Low Level Significant Weather Prognostic Chart valid for 1800 MDT.**

## 2.0 Surface Observations

The observations surrounding the accident site were documented using official Aviation Routine Weather Reports (METAR<sup>4</sup>) and Aviation Select Special Weather Reports (SPECI). Cloud heights are reported above ground level (agl) in the following section, and the magnetic variation over the accident site was estimated at 13° east based on the latest sectional chart for the area.

### 2.1 Grasmere, Idaho

The accident airplane's flight track passed approximately 6 miles south of Grasmere Airport (KU91), Grasmere, ID, which lists an elevation of 5,144 ft. The airport is unattended and does not have an aircraft control tower or other buildings and has no weather reporting capability. The airport has a single runway 5/23 dirt runway which is 2,750 ft long and 150 ft wide and reported in fair conditions by AirNav website<sup>5</sup>.

<sup>4</sup> Abbreviation for Meteorological Aerodrome Report.

<sup>5</sup> <http://www.airnav.com/airports/>

## 2.2 Twin Falls, Idaho

The closest weather reporting location to the accident site was from Joslin Field/Magic Valley Regional Airport (KTWF), Twin Falls, ID, located about 51 miles east-northeast of the accident site at an elevation of 4,154 ft. The airport had a federally installed and maintained Automated Surface Observation System (ASOS) and was augmented by air traffic control tower personnel during normal operating hours. The following conditions were reported surrounding the time of the accident.

*Routine weather observation for KTWF at 1253 MDT, wind from 280° at 15 knots, visibility 3 statute mile in light snow and mist, scattered clouds at 800 ft, ceiling broken at 2,100 ft, overcast at 2,900 ft, temperature 2° Celsius (C) (36° F), dew point temperature 2° C (36° F), altimeter setting 29.67 inches of mercury (inHg). Remarks: automated station with a precipitation discriminator, sea-level pressure 1003.9-hPa, hourly precipitation 0.02 inches, temperature 2.2° C, dew point temperature 2.2° C, maintenance indicator on.*

*Routine weather observation for KTWF at 1353 MDT, wind from 210° at 4 knots, visibility 10 statute mile or more, scattered clouds at 2,000 ft, ceiling broken at 11,000 ft, temperature 4° C (39° F), dew point temperature 2° C (36° F), altimeter setting 29.65 inHg. Remarks: automated station with a precipitation discriminator, snow ended at 1303 MDT, sea-level pressure 1003.3-hPa, hourly precipitation less than 0.01 inches, temperature 3.9° C, dew point temperature 2.2° C.*

### *Accident 1416 MDT*

*Routine weather observation for KTWF at 1453 MDT, wind from 230° at 9 knots, wind from 190° variable 280°, visibility 10 statute mile or more, scattered clouds at 2,800 ft, temperature 6° C (43° F), dew point temperature 3° C (38° F), altimeter setting 29.65 inHg. Remarks: automated station with a precipitation discriminator, sea-level pressure 1002.7-hPa, 6-hour precipitation 0.02 inches, temperature 6.1° C, dew point temperature 3.3° C, 3-hour pressure tendency fallen 0.08-hPa.*

The general flight categories and raw observations were reported between 1000 and 1800 MDT in standard code and abbreviations were as follows.

*IFR SPECI KTWF 081605Z 29007KT 1SM -SN BKN005 OVC011 01/ A2968 RMK AO2 P0000 T0011 \$=*

*IFR SPECI KTWF 081616Z 30008KT 3SM -SN BKN005 OVC011 01/ A2968 RMK AO2 P0000 T0011=*

*IFR METAR KTWF 081653Z 33008KT 10SM -RA BKN007 OVC011 02/02 A2967 RMK AO2  
UPB42E44RAB44SNE42 CIG 005V010 SLP039 P0000 T00220022=*

**MVFR** SPECI KTFW 081715Z 30011KT 10SM BKN010 OVC014 02/02 A2967 RMK AO2  
RAE1654UPB1658E07 CIG 007V012 P0000 T00220022 \$=

**IFR** SPECI KTFW 081729Z 32008KT 10SM BKN009 BKN016 OVC022 02/02 A2967 RMK AO2  
RAE1654UPB1658E07 P0000 T00170017 \$=

**VFR** SPECI KTFW 081739Z 31007KT 10SM SCT011 SCT015 OVC022 02/02 A2967 RMK AO2  
RAE1654UPB1658E07 P0000 T00220022 \$=

**IFR** SPECI KTFW 081748Z 30008KT 4SM -SN BR BKN009 BKN016 OVC021 02/02 A2967 RMK AO2  
RAE1654UPB1658E07SNB42 CIG 005V012 P0001 \$=

**IFR** METAR KTFW 081753Z 30007KT 2 1/2SM -SN BR SCT006 BKN011 OVC024 02/02 A2967 RMK  
AO2 RAE1654UPB1658E07SNB42 SLP043 P0001 60005 T00170017 10022 20006  
55009 \$=

**IFR** SPECI KTFW 081803Z 28012G18KT 3SM -SN BR BKN006 BKN011 OVC022 02/02 A2968 RMK  
AO2 CIG 005V009 P0001 T00170017 \$=

**MVFR** SPECI KTFW 081813Z 27011KT 5SM -SN BR SCT008 BKN015 OVC020 02/02 A2968 RMK AO2  
P0001 T00170017 \$=

**MVFR** SPECI KTFW 081821Z 28011KT 7SM -SN FEW006 BKN012 OVC027 02/02 A2968 RMK AO2  
P0001 T00220022 \$=

**MVFR** SPECI KTFW 081830Z 27011KT 5SM -SN BR SCT011 BKN015 OVC040 02/02 A2967 RMK AO2  
P0001 T00220022 \$=

**MVFR** **METAR KTFW 081853Z 28015KT 3SM -SN BR SCT008 BKN021 OVC029 02/02 A2967 RMK  
AO2 SLP039 P0002 T00220022 \$=**

**VFR** **METAR KTFW 081953Z 21004KT 10SM SCT020 BKN110 04/02 A2965 RMK AO2 SNE03  
SLP033 P0000 T00390022=**

**Accident 2016Z**

**VFR** **METAR KTFW 082053Z 23009KT 190V280 10SM SCT028 06/03 A2965 RMK AO2 SLP027  
60002 T00610033 58008=**

**VFR** METAR KTFW 082153Z 22011G15KT 10SM -RA SCT033 BKN042 OVC070 07/04 A2963 RMK  
AO2 RAB37 SLP018 P0000 T00720039=

**VFR** METAR KTFW 082253Z 30010G17KT 10SM FEW048 SCT060 08/01 A2960 RMK AO2 RAE2158  
SLP009 P0000 T00780006=

**VFR** METAR KTFW 082353Z 29013KT 10SM FEW022 07/01 A2959 RMK AO2 PK WND 28027/2324  
RAB32E42 SLP008 P0000 60002 T00670011 10089 20011 56017=

A review of the observations for KTFW indicated that IFR conditions prevailed during the morning prior to the accident due to low ceilings and snow, with general improving conditions to MVFR and then VFR conditions at the time of the accident with rain in the vicinity.

## 2.3 Mountain Home, Idaho

The next closest weather reporting location to the accident site was from Mountain Home Air Force Base (KMUO), Mountain Home, ID, at an elevation of 2,996 ft, located approximately 53 miles north of the accident site. The airport had a military equivalent of the Automated Surface Observation System (ASOS) and was augmented by weather observers during normal operating hours. The following conditions were reported surrounding the time of the accident.

*Routine weather observation for KMUO at 1358 MDT, wind from 250° at 9 knots gusting to 18 knots, visibility 10 statute mile or more, a few clouds at 6,000 ft, ceiling broken at 8,000 ft, broken clouds at 11,000 ft, temperature 10° C (49° F), dew point temperature -5° C (23° F), altimeter setting 29.63 inHg. Remarks: automated station with manual augmentation, sea-level pressure 1003.9-hPa, temperature 9.5° C, dew point temperature -4.8° C, maintenance indicator on.*

### *Accident 1416 MDT*

*Routine weather observation for KMUO at 1458 MDT, wind from 320° at 10 knots, visibility 10 statute mile or more, a few clouds at 6,000 ft, scattered clouds at 8,000 ft, temperature 10° C (49° F), dew point temperature -6° C (21° F), altimeter setting 29.62 inHg. Remarks: automated station with manual augmentation, sea-level pressure 1003.6-hPa, temperature 10.4° C, dew point temperature -6.0° C, 3-hour pressure tendency fallen 1.4-hpa, maintenance indicator on.*

The general flight conditions and raw longline METAR observations disseminated surrounding the period were as follows. The time of the accident and the observation above are provided in bold italic type.

VFR    *METAR KMUO 081658Z AUTO 29007KT 10SM SCT040 07/M03 A2968 RMK AO2 SLP054 T00691028 \$=*

VFR    *SPECI KMUO 081743Z AUTO 27006KT 10SM SCT041 BKN055 08/M03 A2967 RMK AO2 SLP051 \$=*

VFR    *METAR KMUO 081758Z AUTO 30008KT 10SM BKN042 OVC055 07/M02 A2966 RMK AO2 SLP049 60000 T00741021 10079 20027 57017 \$=*

VFR    *METAR KMUO 081858Z 29009KT 10SM BKN048 OVC070 09/M03 A2965 RMK AO2A SLP044 T00881031 \$=*

***VFR    METAR KMUO 081958Z 25009G18KT 10SM FEW060 BKN080 BKN110 10/M05 A2963 RMK AO2A SLP039 T00951048 \$=***

### ***Accident 2020Z***

**VFR    METAR KMUO 082058Z 32010KT 10SM FEW060 SCT080 10/M06 A2962 RMK AO2A  
SLP036 T01041060 57014 \$=**

VFR    SPECI KMUO 082143Z 30009KT 10SM SCT060 10/M05 A2961 RMK AO2A SLP030 \$=

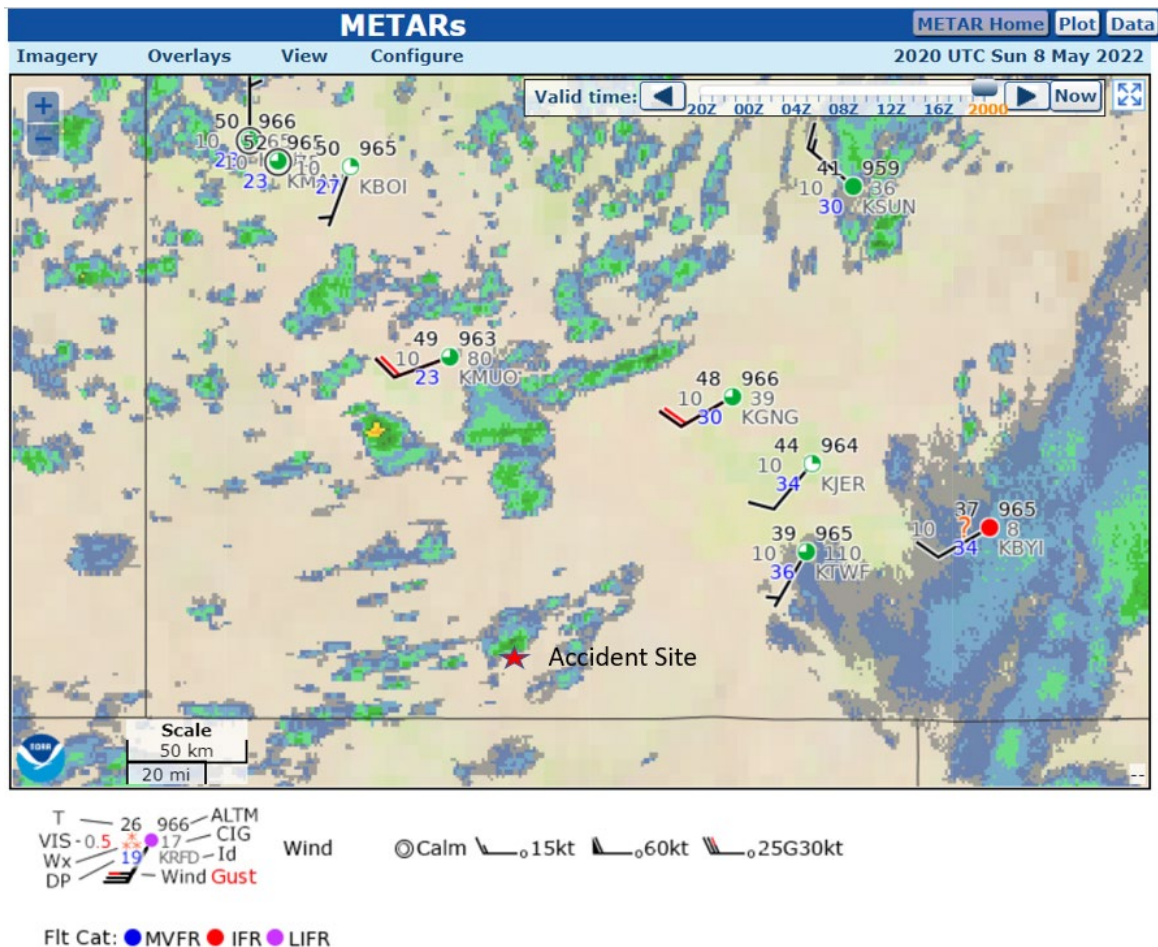
VFR    METAR KMUO 082158Z 34007KT 10SM SCT060 11/M05 A2960 RMK AO2A SLP026  
T01051051 \$=

VFR    METAR KMUO 082258Z AUTO 30004KT 10SM FEW070 11/M08 A2958 RMK AO2 SLP020  
T01121076 \$=

VFR    METAR KMUO 082358Z AUTO 28007KT 10SM FEW075 SCT160 10/M07 A2956 RMK AO2  
SLP013 T01021075 10115 20072 57020 \$=

## **2.4    NWS METAR Display**

A depiction of the NWS Aviation Weather Center (AWC) METAR display for 1420 MDT is included as figure 5 with the approximate accident site marked by the red star. The surrounding stations reported VFR conditions prevailing, except for Burley Municipal Airport (KBYI), Burley, ID, east of the accident site which was reporting IFR conditions with a ceiling broken at 800 ft agl and unknown precipitation. The radar overlay depicted scattered echoes over the area and in the immediate vicinity of the accident site. The closest weather surveillance radar will be further documented below to evaluate any potential echoes along the flight track.



**Figure 5 - NWS Aviation Weather Center's METAR and radar display for 1420 MDT with the approximate accident site marked by the red star.**

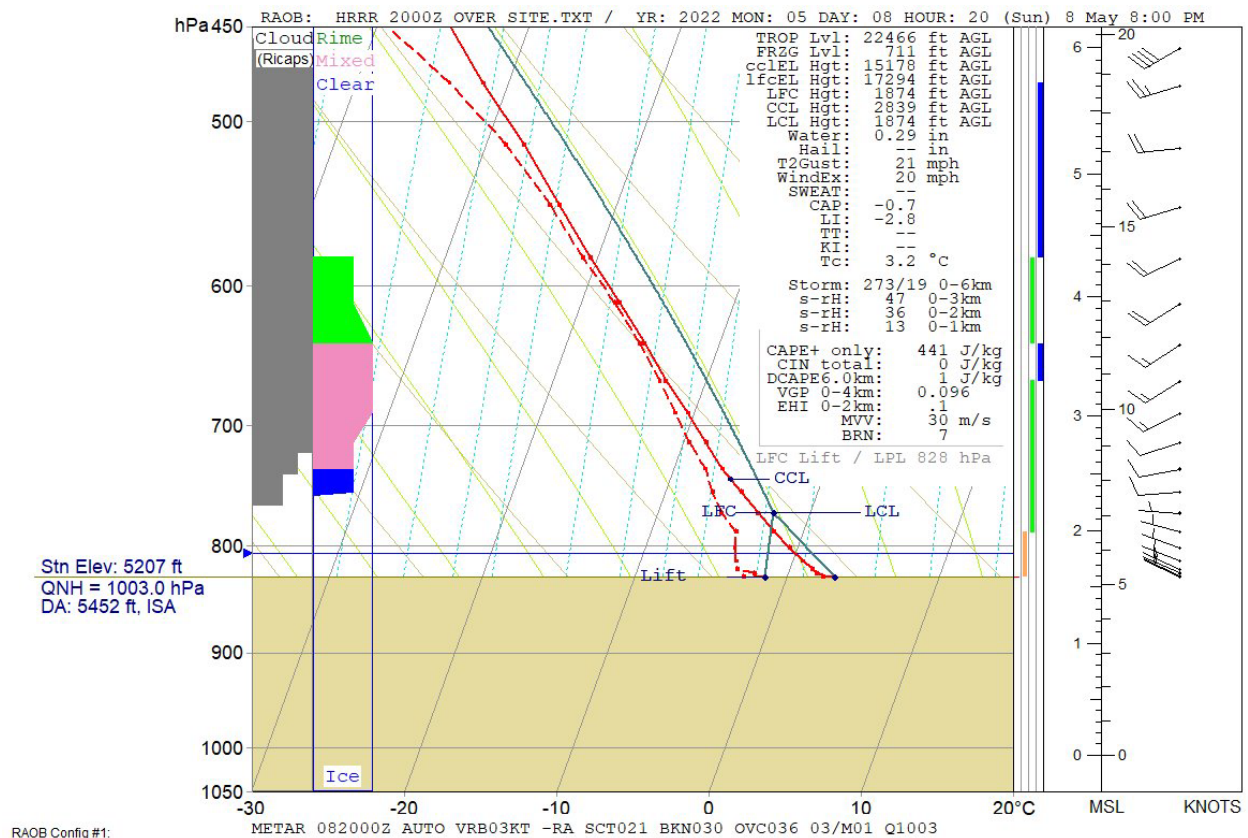
### 3.0 Sounding

To help determine the conditions over the accident site a High-Resolution Rapid Refresh (HRRR)<sup>6</sup> numerical model data was obtained from the NOAA Air Resource Laboratory archive using the closest grid point to the accident site coordinates. The HRRR model data was then plotted on a standard skew T log P diagram<sup>7</sup> using the RAWinsonde Observation (RAOB) analysis software<sup>8</sup> for 1400 MDT and is included as figure 6.

<sup>6</sup> 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.

<sup>7</sup> Skew T log P diagram - is a standard meteorological plot or thermodynamic diagram 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.

<sup>8</sup> RAOB -The Universal RAWinsonde OBservation program is an interactive sounding analysis program



**Figure 6 - HRRR numerical model sounding for 1400 MDT over the accident site.**

The HRRR sounding indicated an elevation of 5,207 ft at the nearest grid point to the accident site, with a near surface temperature of 3.2° C (38° F), a dew point temperature of -1.4° C (30° F), a relative humidity of 72%, with a density altitude of 5,452 ft. The sounding depicted the freezing level at 711 ft agl (or approximately 6,000 ft msl indicated by the blue horizontal line in figure 6), with the lifted condensation level (LCL)<sup>9</sup> and level of free convection (LFC)<sup>10</sup> identified at 1,874 ft agl, with the convective condensation level (CCL)<sup>11</sup> at 2,839 ft agl. The atmosphere was characterized as conditionally unstable with the Lifted Index (LI)<sup>12</sup> of -2.8, and a convective available

developed by Eosonde Research Services (ERS) previously known as Environmental Research Services, The Villages, Florida.

<sup>9</sup> Lifted Condensation Level - the level at which a lifted parcel becomes saturated. The LCL height corresponds to cloud base height for forced ascent.

<sup>10</sup> Level of Free Convection - the level where a parcel becomes buoyant, or "warmer" than the environmental temperature at the same level.

<sup>11</sup> Convective Condensation Level - the height at which a parcel of air, when heated sufficiently from below, rises and becomes saturated. It is where newly forming convective clouds should form bases.

<sup>12</sup> Lifted Index (LI) - A common measure of atmospheric instability. Its value is obtained by computing the temperature that air near the ground would have if it were lifted to 500-hPa or approximately 18,000 feet and comparing that temperature to the actual temperature at that level. Negative values indicate instability - the more negative, the more unstable the air is, and the stronger the updrafts are likely to be

potential energy (CAPE)<sup>13</sup> of 441 J/kg and supported broken to overcast cumulus clouds (gray bar on left axis) capable of producing light rain from the CCL through 20,000 ft. The precipitable water content was 0.29 inches. The RAOB analysis program expected light-to-moderate icing conditions in clouds with clear to mixed type icing below 12,000 ft.

The HRRR sounding wind profile indicated west-northwesterly winds near 300° at 3 knots with winds backing or turning counterclockwise with height to the west-southwest with wind speeds near 20 knots between 12,000 and 17,000 ft. The mean 0 to 6 kilometer (or 18,000ft) wind was from 240° at 25 knots. The RAOB analysis software used to plot the sounding indicated little support for any turbulence below 16,000 ft over the area outside of cumulus clouds.

A table of the HRRR parameters of height, pressure, temperature (T), dew point temperature (Td), relative humidity (RH), wind, and potential Clear Air Turbulence (CAT) intensity and icing conditions below 16,000 ft is included below.

| Height<br>(ft-msl) | Pres<br>(hPa) | T<br>(C) | Td<br>(C) | RH<br>(%) | Wind<br>(deg/kts) | CAT<br>(FAA) | Icing<br>(USAF) |
|--------------------|---------------|----------|-----------|-----------|-------------------|--------------|-----------------|
| 5207               |               | 828      | 3.2       | -1.4      | 72                | 298/ 3       |                 |
| 5239               |               | 827      | 2.4       | -2.8      | 68                | 298/ 3       |                 |
| 5335               |               | 824      | 1.9       | -2.2      | 74                | 296/ 3       |                 |
| 5464               |               | 820      | 1.5       | -3.4      | 70                | 295/ 3       |                 |
| 5690               |               | 813      | 0.7       | -3.7      | 72                | 293/ 4       |                 |
| 6081               |               | 801      | -0.5      | -4.1      | 77                | 291/ 4       |                 |
| 6543               |               | 787      | -1.9      | -4.4      | 83                | 287/ 4       |                 |
| 7078               |               | 771      | -3.4      | -5.8      | 83                | 274/ 6       |                 |
| 7690               |               | 753      | -5.0      | -6.9      | 86                | 265/ 8       | LGT Clear       |
| 8347               |               | 734      | -6.8      | -7.9      | 92                | 258/ 9       | LGT Clear       |
| 9089               |               | 713      | -8.5      | -9.6      | 92                | 250/ 11      | LGT Mixed       |
| 9921               |               | 690      | -10.4     | -11.2     | 94                | 242/ 13      | MDT Mixed       |
| 10812              |               | 666      | -12.6     | -13.0     | 97                | 235/ 15      | MDT Mixed       |
| 11845              |               | 639      | -14.9     | -15.2     | 98                | 234/ 17      | MDT Mixed       |
| 12953              |               | 611      | -17.5     | -17.8     | 97                | 235/ 18      | LGT Rime        |
| 14184              |               | 581      | -20.5     | -21.0     | 96                | 242/ 19      | LGT Rime        |
| 15595              |               | 548      | -23.8     | -24.4     | 95                | 252/ 20      |                 |

The accident airplane had been cruising near 12,500 ft for most of the flight, then he climbed to 13,400 ft around 1322 MDT, and then began a slow descent at 1338 MDT down to 6,200 ft immediately prior to the accident. The last radar target for N801DT at 1410 MDT indicated the accident airplane at 6,200 ft msl which indicated a temperature of -1° C, a dew point temperature of -4° C, with wind from 290° at 4 knots.

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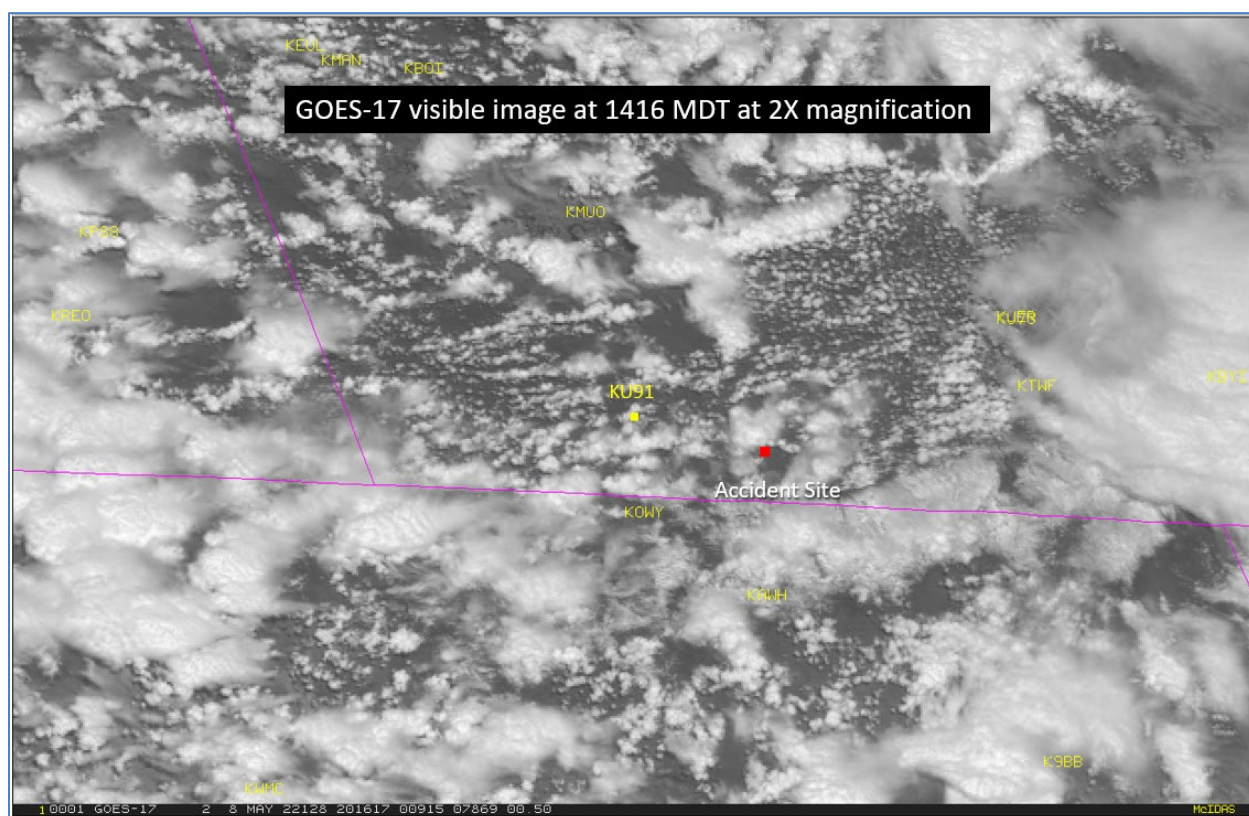
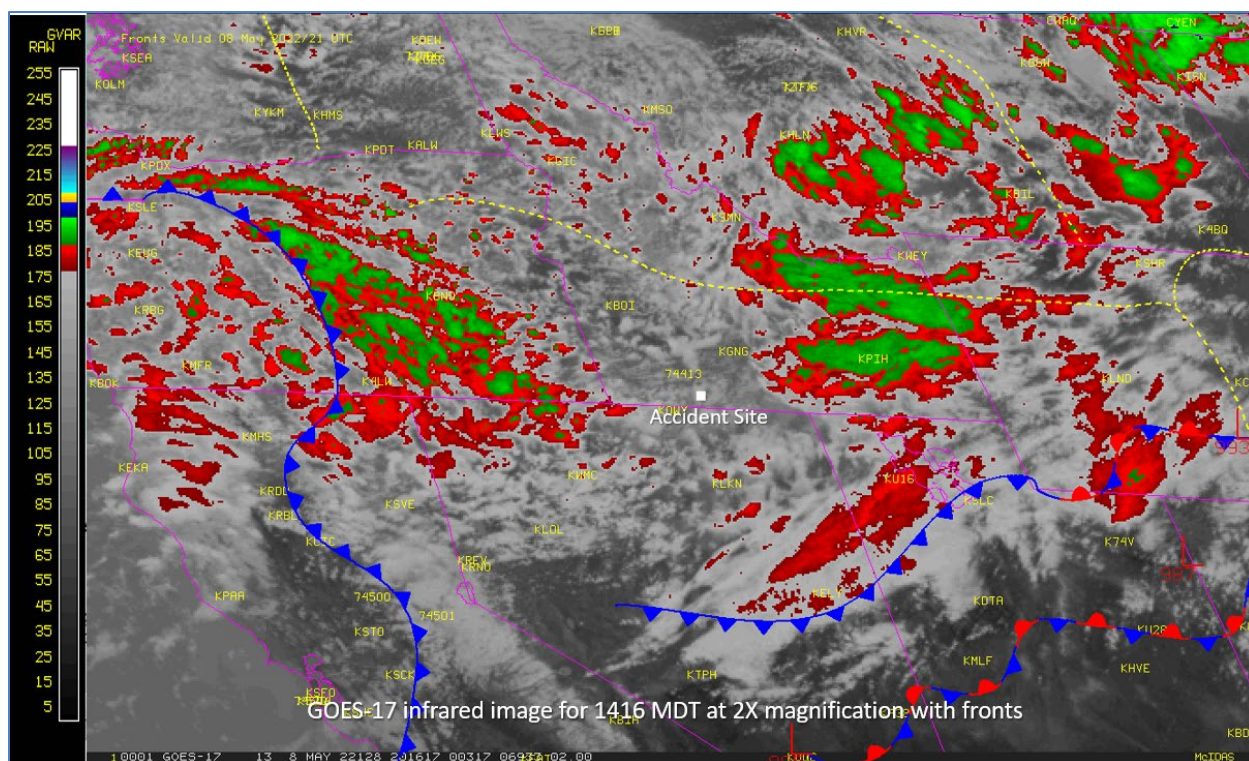
with any developing thunderstorms

<sup>13</sup> Convective Available Potential Energy (CAPE) - is a measure of the amount of energy available for convection. CAPE is directly related to the maximum potential vertical speed within an updraft; thus, higher values indicate greater potential for severe weather.

## 4.0 Satellite Imagery

The Geostationary Operational Environmental Satellite number 17 (GOES-17) imagery were obtained from an archive at the Space Science Engineering Center (SSEC) at the University of Wisconsin-Madison in Madison, Wisconsin, and processed using the Man-computer Interactive Data Access System (McIDAS) software. The infrared and visible imagery were reviewed surrounding the period, and the closest images to the accident time documented. The infrared long wave imagery (band 13) at a wavelength of 10.3 microns ( $\mu\text{m}$ ) provided radiative cloud top temperatures with a nominal spatial resolution of 2 km, while the visible (band 2) at a wavelength of 0.64  $\mu\text{m}$  provided images at a resolution of 0.5 km. The following satellite imagery have not been corrected for parallax error.

The GOES-17 infrared image for 1416 MDT at 2X magnification with a MB temperature enhancement curved applied and the frontal positions at 1500 MDT are included as figure 7. The image depicted scattered to broken clouds over northern Nevada, Idaho, and western Oregon. The radiative cloud top temperature in the immediate vicinity of the accident site indicated cloud top temperature of 247 Kelvin or  $-26^{\circ}\text{C}$ , which corresponded to tops near 16,500 ft based on the HRRR sounding. Figure 8 is the GOES-17 visible image for the same period and also at 2X magnification. A band of tower cumulus type clouds extended along and north of the Nevada and Idaho border, with the accident site on the southeastern side of the smaller band of cumulus clouds.



## 5.0 Weather Radar Imagery

The closest NWS Weather Surveillance Radar 1988 Doppler (WSR-88D)<sup>14</sup> was from the NWS Boise, ID (KCBX) located approximately 84 miles north of the accident site. The level II archive data were obtained from the NCEI using the Hierarchical Data Storage System and displayed using the NWS NEXRAD Interactive Viewer and Data Exporter software. During the period, the KCBX WSR-88D was operating in the standard precipitation mode identified as volume scanning pattern 215 (VCP-215) where the radar makes 15 different elevation scans during the 6 minute scan. Based on the location of the radar's antenna, at a height of 3,171 ft, the radar's lowest 0.5° elevation scan assuming standard refraction<sup>15</sup> of the 0.95° beam, the center of the beam was near 12,300 ft over the accident site. With the KCBX 0.5° elevation beam scanning the altitudes between approximately 8,070 ft and 16,530 ft over the accident site.

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors<sup>16</sup>, it is a function of the drop size distribution, number of particles per unit volume, physical state (ice or water), shape, and aspect. Reflectivity is normally displayed in decibels (dBZ)<sup>17</sup> and is a general measure of echo intensity. The FAA Advisory Circular AC 00-24C - "Thunderstorm" defines echoes less than 30 dBZ as "light" in intensity, "moderate" echoes 30-40 dBZ, "heavy" with echoes of >40-50 dBZ, and "extreme" intensity with echoes above >50 dBZ. These are the new standard radio phraseology terms used by air traffic controllers to describe weather conditions to pilots as shown in the following table. Light rain is typically reported at the surface when reflectivities reach 20 dBZ, while air traffic control will not display echoes less than 30 dBZ or light intensity echoes on their weather displays.

| Reflectivity (dBZ) Ranges | Weather Radar Echo Intensity Terminology |
|---------------------------|------------------------------------------|
| < 30 dBZ                  | Light                                    |
| 30-40 dBZ                 | Moderate                                 |
| >40-50 dBZ                | Heavy                                    |
| >50 dBZ                   | Extreme                                  |

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<sup>14</sup> The WSR-88D is a S-band 10-centimeter wavelength radar with a power output of 750,000 watts, with a 28-foot parabolic antenna concentrating the energy into a 0.95° beam width. The radar produces three basic types of products reflectivity, radial velocity, and spectral width.

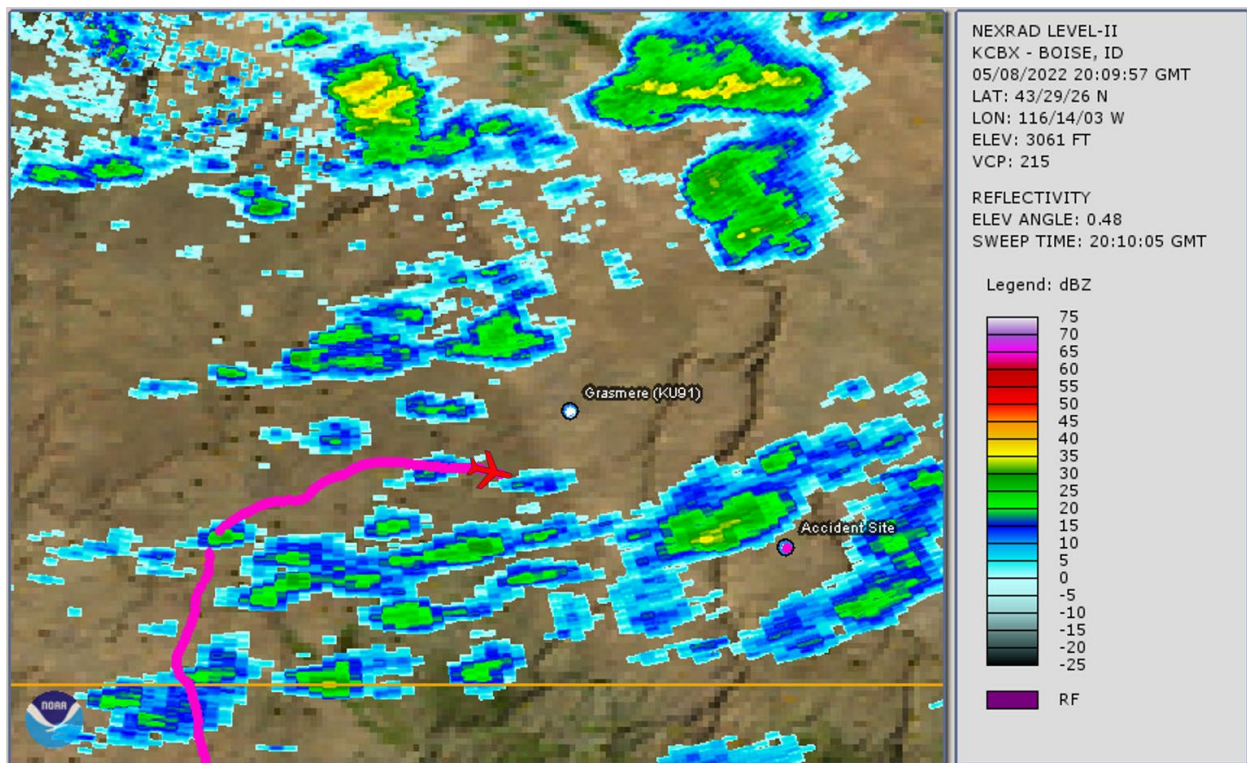
<sup>15</sup> Standard refraction implies a standard atmosphere with no ducting or bending of the radar beam due to any inversions or isothermal layers.

<sup>16</sup> Hydrometeors are any product of condensation or sublimation of atmospheric water vapor, whether formed in the free atmosphere or at the earth's surface. Hydrometeors are classified as; (a) Liquid or solid water particles suspended in the air: cloud, water droplets, mist or fog. (b) Liquid precipitation: drizzle and rain. (c) Freezing precipitation: freezing drizzle and freezing rain. (d) Solid (frozen) precipitation: ice pellets, hail, snow, snow pellets, and ice crystals.

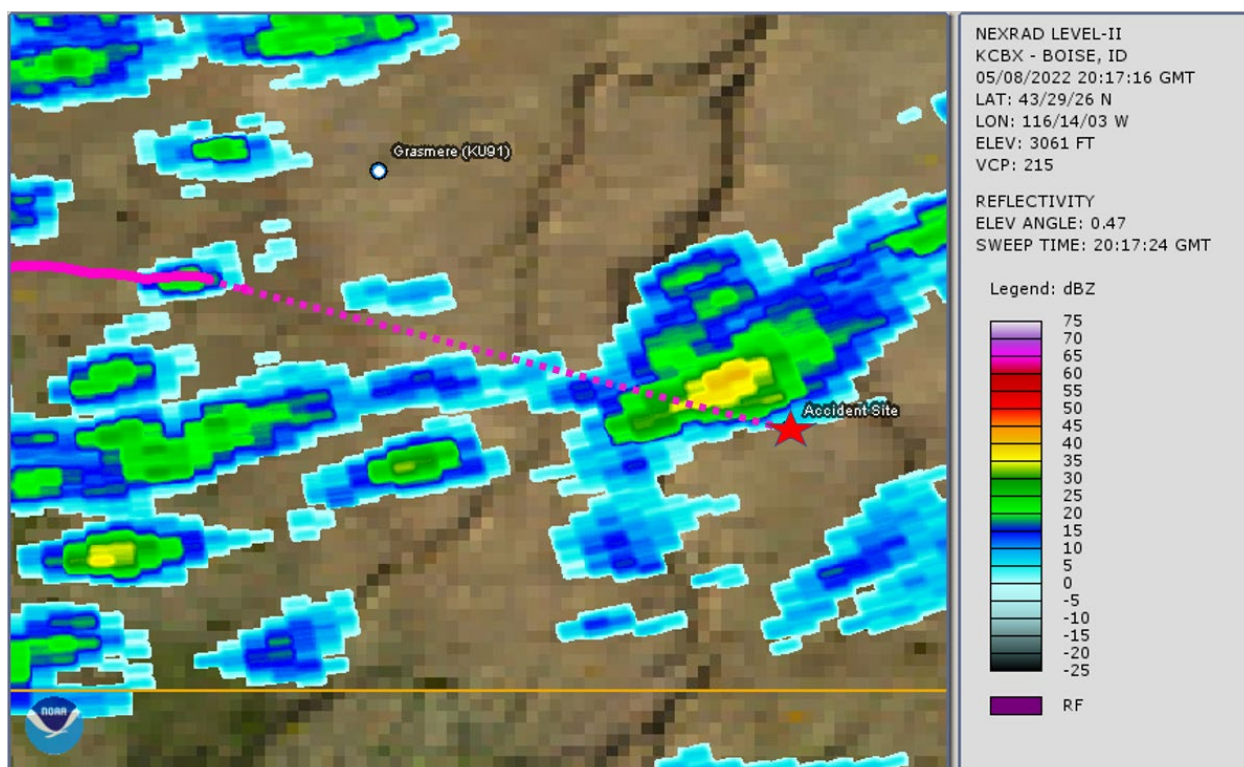
<sup>17</sup> dBZ stands for decibels relative to Z or the amount of energy backscattered and is mathematically defined as  $10 \log Z_e$ , which is the logarithmic dimensional unit.

The KCBX WSR-88D lowest 0.48° elevation scan base reflectivity image with a resolution of 0.5° x 0.13 nm over the area for 1409 MDT is included as figure 9 with the flight track overlaid in magenta and the approximate accident airplane position by the aircraft symbol. The image depicted scattered areas of echoes of over the area, with the accident airplane flying through or generally under several of the light to moderate intensity echoes of 30 dBZ or less as it proceeds northward and then turning eastward. The location of KU91 is also noted about 8 miles to the northeast of the aircraft's position. Figure 10 is a closeup of the KCBX WSR-88D 0.48° base reflectivity image at 1417 MDT with the estimated track provided by the magenta dashed line and final accident location by the red star. The track is through an area of echoes of 30 to 43 dBZ or "moderate to heavy" intensity echoes with the accident site on the southeast edge of the echo. The echo tops or the height of echoes of 18.5 dBZ reached 16,100 ft with the area of echoes and supported precipitation.

A search of Earth Networks archive lightning data indicated that between 1330 and 1440 MDT there were no cloud-to-ground or in-cloud lightning strikes associated with cumulonimbus clouds or thunderstorms within an 80 mile radius of the accident site.



**Figure 9 - KCBX WSR-88D 0.48° base reflectivity image for 1409 MDT with flight track.**



**Figure 10 - KCBX WSR-88D 0.48° base reflectivity image for 1417 MDT with flight track.**

## 6.0 Pilot Reports

The following pilot reports or PIREPs<sup>18</sup> were reported within 120 miles and within 3 hours prior and after the accident below 18,000 ft. The reports are included as received, with cloud height referenced in msl heights, followed by a decoded plain language report with time referenced to MDT.

*TWF UA /OV KTWF 073006/TM 1928/FL060/TP C56X/WX 10 SM/RM FIELD IN SIGHT 6 SM CLOUDS PATCHY*

*Joslin Field/Magic Valley Regional Airport (TWF), Twin Falls, ID routine pilot report; Over - 073° and 6 miles from KTWF (approximately 58 miles east-northeast of the accident site); Time - 1328 MDT; Altitude - 6,000 ft; Type aircraft - Cessna Citation Excel business jet; Weather - field in sight at 6 miles with clouds patchy.*

*BOI UA /OV 30 E/TM 1942/FL120/TP PC12/TB MOD*

*Boise Air Terminal (BOI), Boise, ID routine pilot report; Over - 30 miles east of the airport (about 87 miles north of the accident site); Time - 1342 MDT; Altitude - 12,000 ft; Type aircraft - Pilatus PC12 turboprop; Turbulence - moderate.*

<sup>18</sup> Only includes PIREPs which were disseminated through normal weather circuits and do not include reports only broadcast to air traffic controllers via radio and not transcribed into the database.

BOI UA /OV 20 NE/TM 1944/FL100/TP A320/TA M05/IC LGT CLR

BOI routine pilot report; Over - 20 miles northeast of the airport (82 miles north of accident site); Time - 1344 MDT; Altitude - 10,000 ft; Type aircraft - Airbus A320 air carrier jet; Temperature - minus 5° C; Icing - light clear type icing conditions.

BOI UUA /OV 10NM FINAL/TM 1948/FL060/TP PC12/TB MOD CHOP 060

BOI urgent pilot report (UUA); Over - on 10 miles final into KBOI (82 miles north of accident site); Time - 1348 MDT; Altitude - 6,000 ft; Type aircraft - Pilatus PC12 turboprop; Turbulence - moderate chop at 6,000 ft.

FAT UA /OV FAT025300/TM 2240/FL080/TP C510/TB MOD TO SEV/RM DURC

Fresno Yosemite International Airport (FAT), Fresno, CA routine pilot report; Over - 253° and 300 miles from FAT (approximately 85 miles southwest of the accident site); Time - 1640 MDT; Altitude 8,000 ft; Type aircraft - Cessna Citation business jet; Turbulence - moderate to severe; Remarks - encountered during climb.

## 7.0 NWS Forecasts

The NWS Boise Weather Forecast Office (WFO) was responsible for weather advisories and forecasts for the county where the accident occurred. While the NWS AWC and WPC were responsible for the aviation en route forecast and inflight weather advisories over the area, which are documented below.

### 7.1 Terminal Aerodrome Forecast

The closest NWS station with a regular issued Terminal Aerodrome Forecast (TAF) was for KTFW. A TAF is valid for a 5 mile radius from the center of the airport complex, and provides a time specific breakdown of expected wind, visibility, weather phenomena, and clouds within that area. The forecast that was issued for was issued at 1120 MDT and valid for the period was as follows. While a TAF is only valid for a 5 miles radius of the airport center point, it provides a detail breakdown in time of wind, visibility, weather, and sky conditions over the area and are often included in weather briefing paperwork for the general conditions along the route of flight.

**TAF KTFW 081720Z 0818/0918 31010KT 4SM -SHRASN BR OVC007**  
**FM082100 27012KT 5SM -SHRA VCTS OVC040CB**  
FM090500 21012KT P6SM VCSH BKN070  
FM091600 24015G25KT 4SM -SHSN BR OVC020=

The forecast for KTFW expected IFR conditions to prevail until 1500 MDT, due to low ceilings, with visibility restricted in rain and snow showers, and mist. The forecast was for wind from 310° at 10 knots, visibility 4 miles in light rain and snow showers and mist, ceiling overcast at 700 ft agl. Between 1500 and 2300 MDT, the forecast expected

a wind from 270° at 12 knots, visibility 5 miles in light rain showers, with thunderstorms in the vicinity, ceiling overcast at 4,000 ft in cumulonimbus clouds.

## 7.2 Area Forecast Discussion

The NWS Area Forecast Discussions (AFD) are issued by each WFO to describe the short-term weather conditions within their region with an aviation section that includes the general conditions as it relates to the creation of the TAF. These are useful for additional aviation-related issues that cannot be encoded into the TAF and provide some reasoning behind the forecast. These are generated roughly every 6 hours and corresponds to the release of the latest TAFs for that office. The AFD issued at 1006 MDT was as follows.

*FXUS65 KBOI 081606  
AFDBOI*

*Area Forecast Discussion  
National Weather Service Boise ID  
1006 AM MDT Sun May 8 2022*

**.DISCUSSION...An area of snow showers in south-central Idaho, including Twin Falls and Jerome, will continue for the remainder of this morning. Temperatures are above freezing in the lower elevations, therefore only light snow accumulations are expected on the grassy areas.** Additional accumulations of around an inch are expected in the mountains along the ID/NV border. **Otherwise, a large deep trough will continue over the region today. Showers and isolated thunderstorms will develop during the afternoon. The storms will produce gusty winds, small hail or graupel, and brief heavy rain.** Temperatures will be unseasonably cool with valley highs only in the 40s and 50s. Forecast was updated earlier, mainly to remove mention of morning thunderstorms.

**.AVIATION...VFR to IFR in scattered showers with mountains obscured. Patchy mountain fog this morning. Another round of scattered showers and isolated thunderstorms this afternoon and evening. Storms capable of producing gusts to 35 kts and small hail.** Snow showers continuing overnight and into Monday morning. Snow levels: 3000-4000 ft MSL. Surface winds: generally NW to SW 5-15 kts this morning becoming W-NW this afternoon. Gusts up to 25 kts across southeast Oregon. Winds aloft near 10kft MSL: W-NW 5-20 kts.

*.PREV DISCUSSION...*

**SHORT TERM...Today through Tuesday night... A deep upper level low digging to our southwest will bring cold temperatures, breezy winds, and rain and snow showers through the short term period.** Temperatures will remain 10-15 degrees below normal throughout the short term, and will reach around or below freezing early on Monday and Tuesday morning. Daytime snow levels will stay around 4000-5000 feet MSL, but will drop to valley floors on Monday and Tuesday morning. A mix of rain and snow will fall in most valley locations on Monday morning with minimal accumulations expected, but higher accumulations of 2-4 inches are expected in the mountains above 6000 feet MSL. A break in precipitation is expected on Tuesday for most areas, but a few showers in the West Central Mountains and near the ID-NV and OR-NV border are possible. Embedded shortwave troughs will bring intermittent pockets of instability during

*Sunday and Monday afternoon, which will allow a few thunderstorms to occur among the scattered rain and snow showers.*

*.BOI WATCHES/WARNINGS/ADVISORIES...*

*ID...None.*

*OR...None.*

[www.weather.gov/Boise](http://www.weather.gov/Boise)

[www.facebook.com/NWSBoise](https://www.facebook.com/NWSBoise)

[www.twitter.com/NWSBoise](https://www.twitter.com/NWSBoise)

*DISCUSSION...BW*

*AVIATION.....AL*

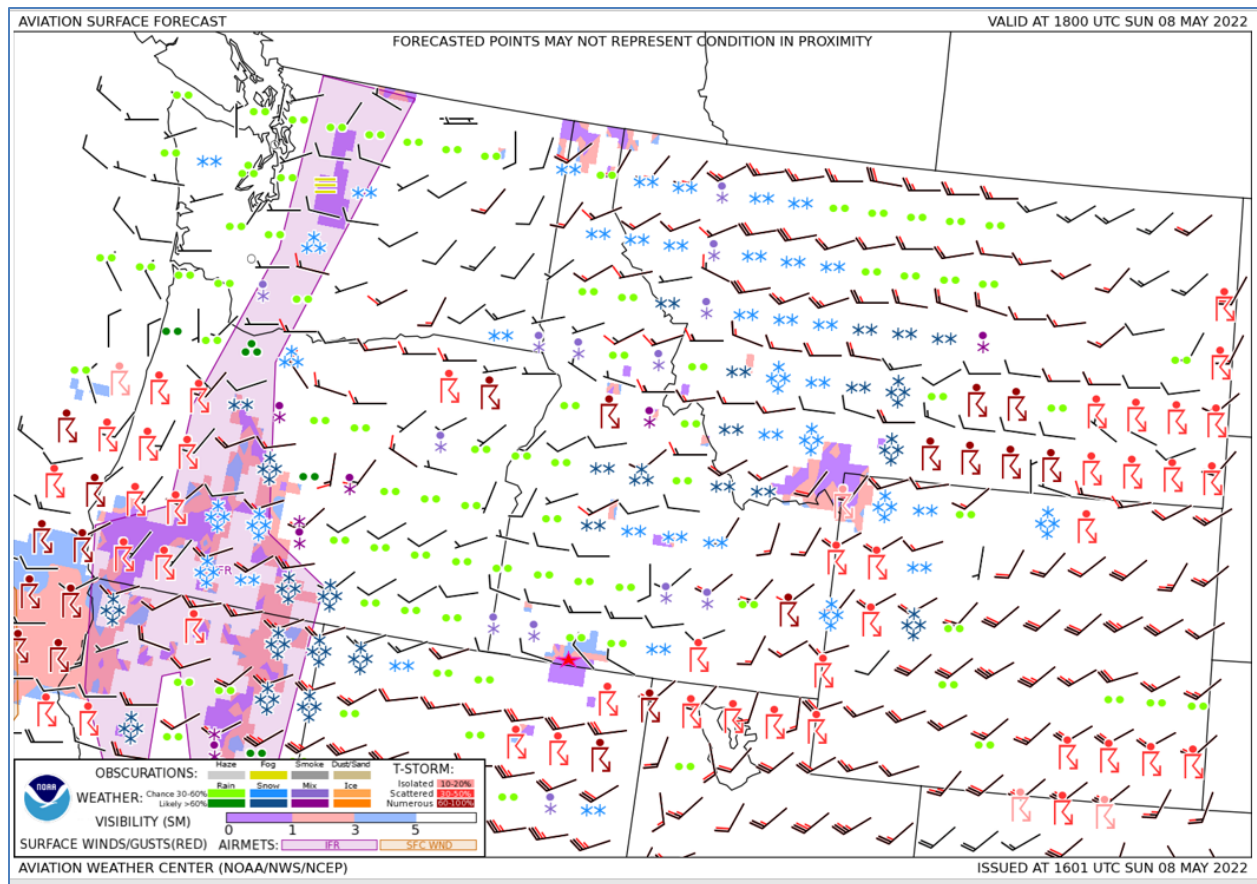
*PREV SHORT TERM...SA*

*PREV LONG TERM....KB*

### **7.3 Graphic Forecast for Aviation**

The NWS Graphic Forecast for Aviation (GFA) is a graphical depiction of surface wind, thunderstorms, precipitation, color coded general flight categories, and cloud cover bases and tops, from graphical output from the NWS's National Digital Forecast Data (NDFD) with the Graphic-Airmen's Meteorological Information (G-AIRMET) for IFR conditions, mountain obscuration, icing conditions, and strong surface wind overlaid. The GFA provides a forecast for the enroute phase of flight and for locations without a TAF. The GFA is available at the NWS AWC website and through other weather briefing services (Leidos and ForeFlight).

The GFA is available at the NWS AWC website and through other weather briefing services (Leidos and ForeFlight). The 3-hour GFA forecast issued at 1000 MDT and valid for the period between 1200 and 1500 MDT are included as figures 11-12. The forecast depicted a small area of IFR to MVFR conditions over the accident site with surface precipitation in the form of rain, with rain/snow east and west of the accident site marked by the red star. The GFA cloud forecast expected broken to overcast clouds with bases from 5,000 to 7,000 ft msl with tops to 22,000 ft, with a G-AIRMET current over the area for mountain obscuration conditions.



**Figure 11 - GFA 3-hour Surface Forecast valid for 1200 through 1500 MDT.**

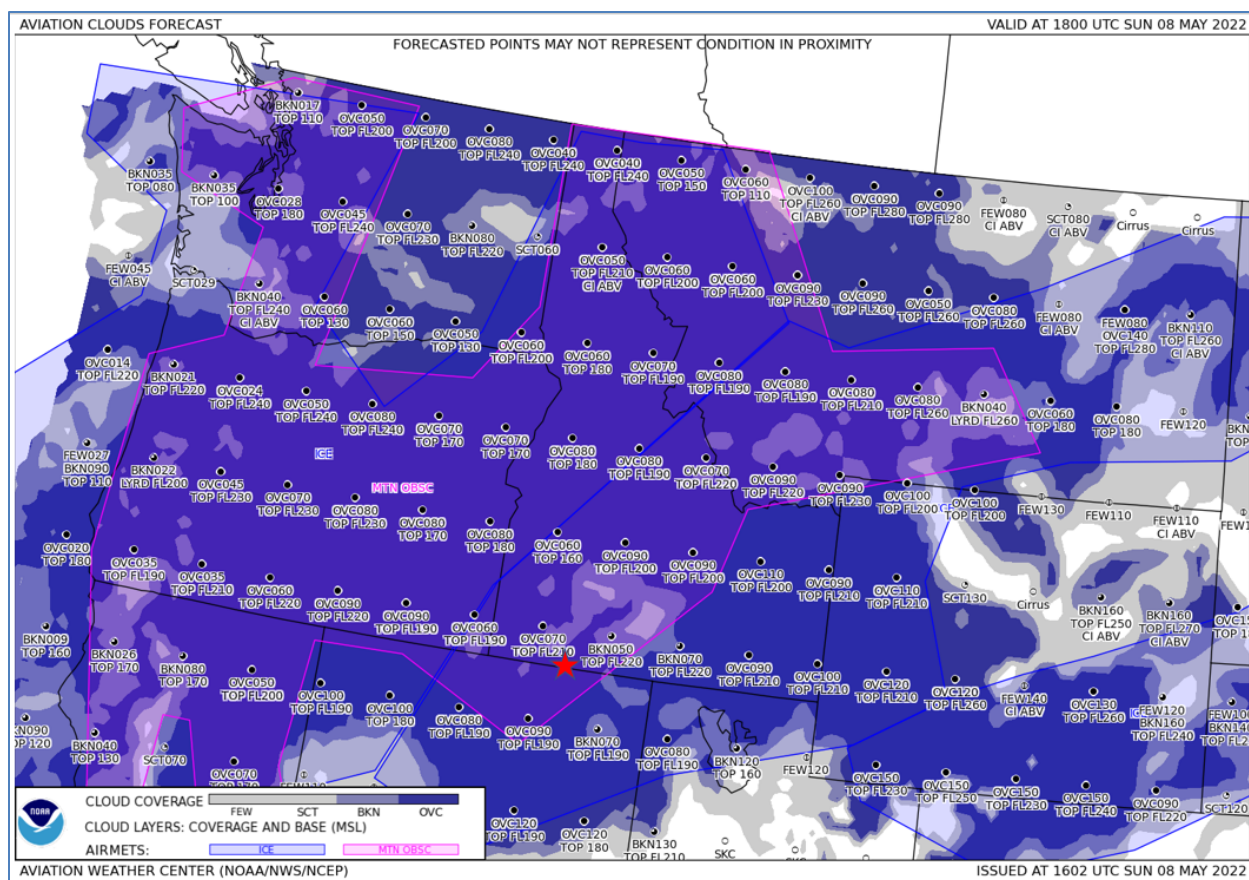


Figure 12 - GFA 3-hour Cloud Forecast valid for 1200 through 1500 MDT.

## 7.4 Winds and Temperature Aloft Forecast

The NWS Winds and Temperature Aloft Forecast (FD) current for the period was issued at 0758 MDT and was as follows for the general route of flight.

FBUS31 KWN0 081358

FD1US1

DATA BASED ON 081200Z

VALID 081800Z FOR USE 1400-2100Z. TEMPS NEG ABV 24000

| FT         | 3000           | 6000           | 9000           | 12000   | 18000   | 24000  | 30000  | 34000  | 39000 |
|------------|----------------|----------------|----------------|---------|---------|--------|--------|--------|-------|
| LAS        | 2210+12        | 2316+06        | 2427+01        | 2758-10 | 2774-23 | 267938 | 268348 | 269658 |       |
| ELY        |                | 2421+01        | 2423-08        | 2472-20 | 2488-31 | 752440 | 762247 | 751155 |       |
| BAM        |                | 2623-07        | 2529-13        | 2436-27 | 2464-38 | 258244 | 268144 | 268148 |       |
| <b>BOI</b> | <b>9900-03</b> | <b>2913-10</b> | <b>2625-17</b> | 2131-29 | 2332-42 | 244448 | 244845 | 254546 |       |
| IMB        |                | 2211-12        | 2614-18        | 2413-31 | 2523-45 | 242749 | 252945 | 263445 |       |

The closest forecast point was for Boise, Idaho (BOI), which expected a wind at 6,000 ft as light and variable at 10 knots or less with a temperature of -3° C, at 9,000 ft from

290° at 13 knots with a temperature of -10° C, and at 12,000 ft from 260° at 25 knots with a temperature of -17° C.

## **7.5 Inflight Weather Advisories**

Inflight Aviation Weather Advisories are forecasts to advise en route aircraft of development of potentially hazardous weather. Inflight aviation weather advisories in the conterminous U.S. are issued by the NWS AWC, as well as from the Center Weather Service Units (CWSU) associated with FAA air route traffic control centers (ARTCCs). There are four basic types of inflight aviation weather advisories: the Significant Meteorological Information (SIGMET), the Convective SIGMET, the Airmen's Meteorological Information (AIRMET), and the Center Weather Advisory (CWA). Inflight advisories serve to notify en route pilots of the possibility of encountering hazardous flying conditions which may not have been forecast at the time of the preflight briefing. Whether or not the condition described is potentially hazardous to a particular flight is for the pilot to evaluate on the basis of experience and the operational limits of the aircraft.

At the time of the accident there were no SIGMETs, Convective SIGMETs, or CWA current for the route, the NWS did have a G-AIRMET current for mountain obscuration conditions over Idaho and Oregon and included the accident site. The advisory warned of mountains obscured in clouds, precipitation, and mist and is depicted in figure 13 with the accident site marked by the red star.

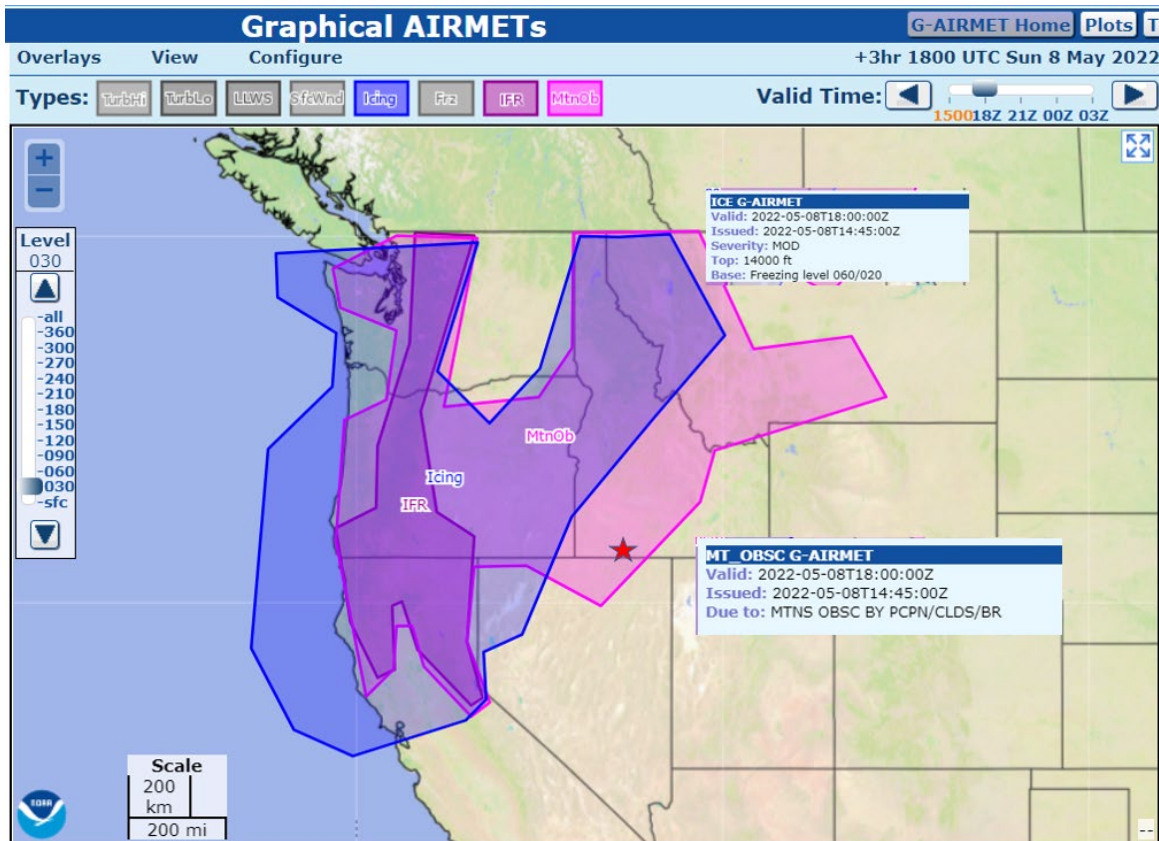


Figure 13 - Graphic-AIRMETs current for the period.

## 8.0 Astronomical Conditions

The United States Naval Observatory's Multiyear Interactive Computer Almanac (MICA) software provided the following astronomical conditions for the accident coordinates. The time of the accident has been added in **italic bold print** for reference.

| <b>Sun</b>             | <b>Time (MDT)</b>  |
|------------------------|--------------------|
| Begin civil twilight   | 0557               |
| Sunrise                | 0628               |
| Culminative            | 1338               |
| <b><i>Accident</i></b> | <b><i>1416</i></b> |
| Sunset                 | 2049               |
| End civil twilight     | 2120               |

At the time of the accident the Sun was 63° above the horizon and at an azimuth of 200°.

## **9.0 Weather Briefing Information**

A search of the FAA contract Automated Flight Service Station (AFSS) provider Leidos indicated that they and no 3rd party vendors utilizing the Lockheed Flight Service (LFS) system had any contact with the pilot of N801DT on May 8, 2022. A separate search of ForeFlight indicated that the accident pilot had an account which included N801DT; however, no flight plans were filed for the accident flight and no weather imagery or charts were viewed using the ForeFlight app. The pilot of N801DT created a route string from KBVU to KONO with a cruising altitude of 7,500 ft, and he did review airport pages for KBVI at 1154 MDT which includes METAR, TAFs, and NOTAMs. There was no indications the pilot reviewed the GFA enroute forecast or inflight weather advisories prior to or in-flight.

Submitted by:

Donald Eick  
Senior Meteorologist