



## **NATIONAL TRANSPORTATION SAFETY BOARD**

Office of Aviation Safety  
Washington, D.C. 20594

November 23, 2020

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

# **METEOROLOGY**

CEN21FA007

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## **A. ACCIDENT**

Location: Telluride, Colorado  
Date: October 5, 2020  
Time: about 1303 mountain daylight time  
1903 coordinated universal time (UTC)  
Airplane: Beechcraft Bonanza BE35; Registration: N4444K

## **B. SENIOR METEOROLOGIST**

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

The National Transportation Safety Board's (NTSB) Senior Meteorologist was not on scene for this investigation and conducted the meteorology phase of the investigation from the Washington D.C. office, collecting data from official National Weather Service (NWS) sources including the Weather Prediction Center (WPC) and the National Center for Environmental Information (NCEI). All times are mountain daylight time (MDT) based upon the 24 hour clock, local time is +6 hours to UTC, and UTC=Z. 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 site was located at latitude 37.914687° N and longitude 107.753064° W, at an elevation of approximately 11,830 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) 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.

### **1.1 Surface Analysis Chart**

The NWS Surface Analysis Chart for 1200 MDT centered over Colorado with a high resolution topographic map is included as figure 1 with the approximate accident site marked by a red star.

The chart depicted two high pressure systems<sup>1</sup> over central Colorado at 1026-hectopascals (hPa)<sup>2</sup> and 1027-hPa to the north-northeast and east-northeast of the accident site. The high pressure systems resulted in a weak pressure gradient over the area with general clear skies and subsiding motion. The station model for Telluride indicated a west wind at 15 knots, clear skies, temperature of 64° F, and a dew point of 10° F. No significant weather was reported over the region at the time of the chart.

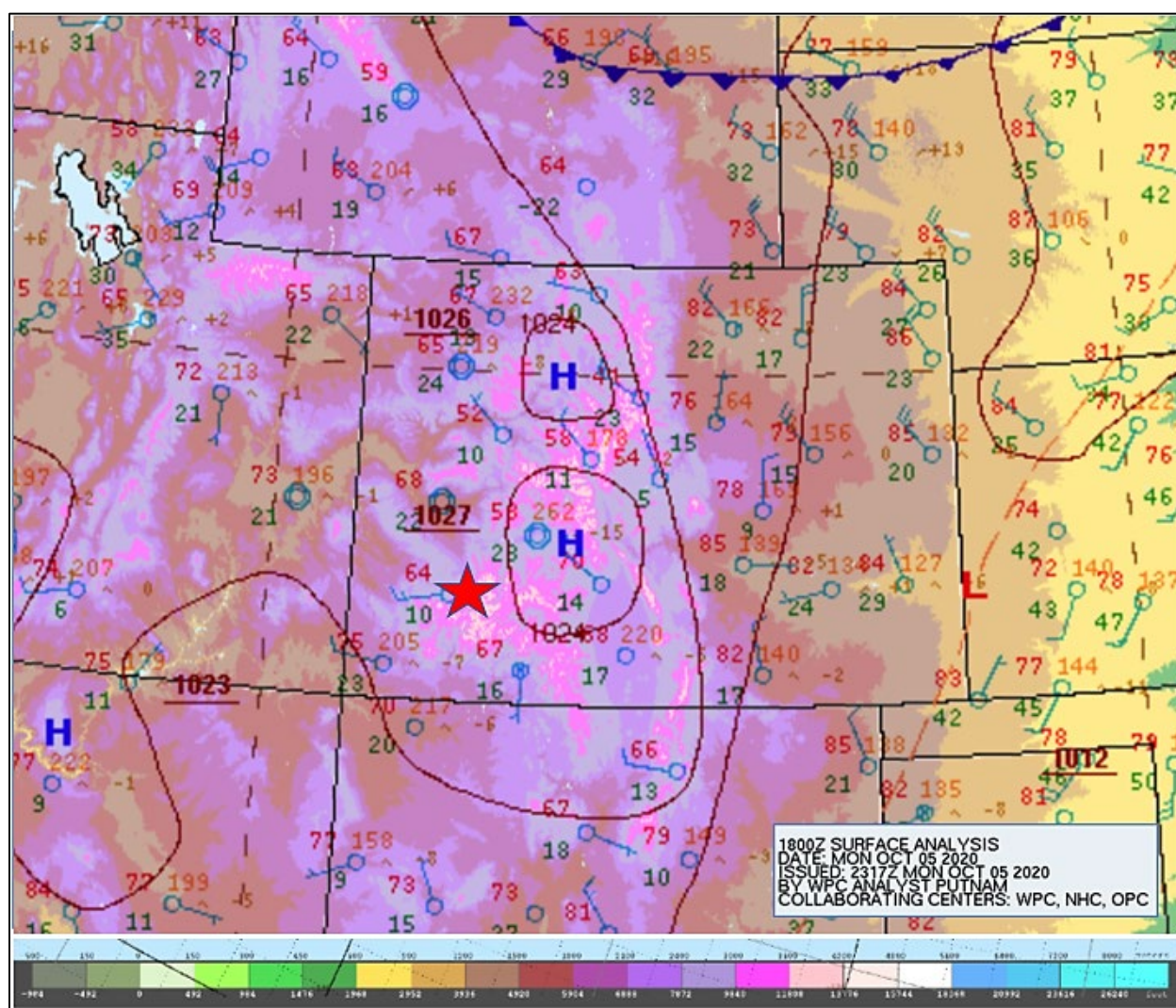


Figure 1 - NWS Surface Analysis Chart for 1200 MDT with the accident site indicated by red star

<sup>1</sup> High-pressure system, or anticyclone, is a region where the atmospheric pressure at the surface is greater than its surrounding environment. Winds within a high-pressure area flow outwards from the high towards lower pressure, with general subsiding or downward air over the region. As a result, high-pressure areas are typically associated with light winds, and clear sky cover.

<sup>2</sup> Hectopascal (hPa) is the new NWS standard for reporting sea-level 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).

## 2.0 Surface Observations

The official NWS Meteorological Aerodrome Reports (METARs) and special reports (SPECIs) surrounding the period were documented for the area. The cloud heights are reported above ground level (agl), and the magnetic variation over the region was estimated as 9° E based on the sectional chart for the area.

The closest weather reporting facility was from departure site of Telluride Regional Airport (KTEX), Telluride, Colorado, located 7 ½ miles west-northwest of the accident site at an elevation of 9,070 ft. The airport had an Automated Weather Observation System (AWOS), which was not augmented by any human observers and issued observations every 20-minutes. The following conditions were reported at the time the accident airplane departed.

*Weather observation for KTEX at 1255 MDT, automated, wind from 260° at 10 knots gusting to 17 knots, visibility 10 miles or more, sky clear below 12,000 ft agl, temperature 18° Celsius (C) (or 64° Fahrenheit (F)), dew point temperature -13° C (or 9° F), altimeter 30.49 inches of mercury.*

The raw observations reported surrounding the period from approximately 1200 through 1400 MDT were as follows, with the observation above and the time of the accident in bold type for reference.

*METAR KTEX 051755Z AUTO 26013G17KT 10SM CLR 18/M12 A3051 RMK AO2=*

*METAR KTEX 051815Z AUTO 27012KT 10SM CLR 17/M13 A3051 RMK AO2=*

*METAR KTEX 051835Z AUTO 27012G17KT 10SM CLR 18/M13 A3050 RMK AO2=*

***METAR KTEX 051855Z AUTO 26010G17KT 10SM CLR 18/M13 A3049 RMK AO2=***

***Accident 1903Z***

*METAR KTEX 051915Z AUTO 25008G16KT 10SM CLR 18/M13 A3049 RMK AO2=*

*METAR KTEX 051935Z AUTO 28011G18KT 240V300 10SM CLR 18/M13 A3048 RMK AO2=*

*METAR KTEX 051955Z AUTO 27010G16KT 10SM CLR 19/M13 A3048 RMK AO2=*

Based on a relative humidity of 10%, the density altitude at 1255 MDT was calculated at 10,845 ft. There was no recorded precipitation during the 24-hour period prior to the accident, and no significant weather reported during the period. The minimum temperature recorded during the period was 5° C (41° F), which was reported at 0535 MDT, with a high temperature of 20° C (68° F) at 1555 MDT.

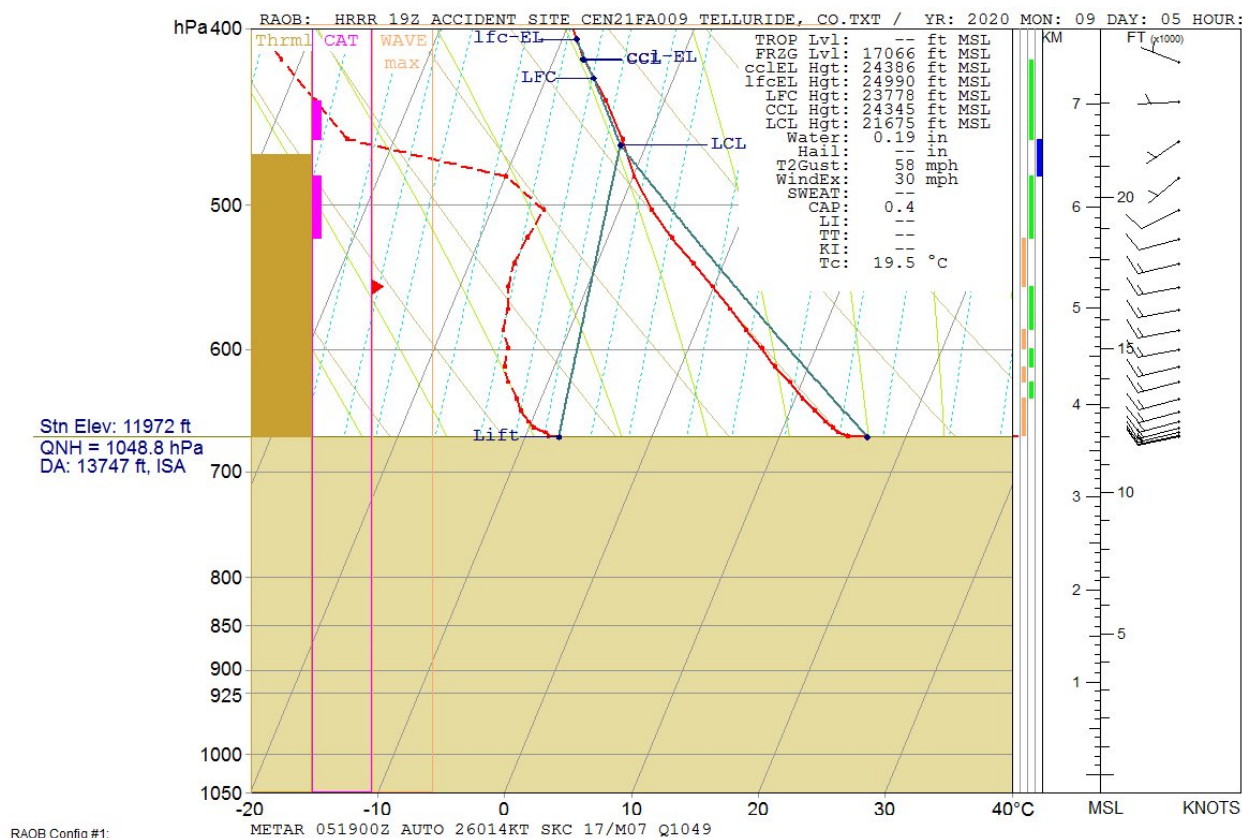
## 3.0 Numerical Model Sounding

To determine the vertical structure and state of the atmosphere over the accident site a High Resolution Rapid Refresh (HRRR)<sup>3</sup> numerical model was retrieved from the NOAA Air Resources

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<sup>3</sup> The HRRR is a National Oceanic and Atmospheric Administration (NOAA) real-time three-kilometer resolution,

Laboratory and run over the accident site coordinates for 1300 MDT. The HRRR data was then and plotted on a standard Skew T log P diagram<sup>4</sup> from the surface to 400-hPa or approximately 24,000 ft and is included as figure 2.



**Figure 2 - Figure 2 HRRR numerical model sounding for 1300 MDT over the accident site**

The HRRR model sounding had an elevation of 11,972 ft over the accident site's coordinates with a near surface temperature of 17° C (63° F), a dew point of -7° C (19° F), with a density altitude of 13,747 ft. The sounding depicted a dry and unstable atmosphere below 20,000 ft, and the RAOB software indicated strong thermals. The lifted condensation level (LCL)<sup>5</sup> was identified at 21,675 ft msl (9,703 ft agl), with the level of free convection (LFC)<sup>6</sup> at 23,778 ft msl, and the convective condensation level (CCL)<sup>7</sup> at 24,345 ft msl. The precipitable water<sup>8</sup> content was 0.19

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>4</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>5</sup> Lifting Condensation Level (LCL) - the level at which a lifted parcel becomes saturated. The LCL height corresponds to cloud base height for forced ascent.

<sup>6</sup> Level of Free Convection (LFC) - the last level where a parcel becomes buoyant, or "warmer" than the environmental temperature at the same level.

<sup>7</sup> Convective Condensation Level (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.

<sup>8</sup> Precipitable Water (PW) - The total amount of (condensed) water available within the lowest 400 mb of the sounding.

inches. The freezing level was at 17,066 ft msl, with no structural icing conditions indicated by the RAOB software.

The HRRR wind profile on the right side of the sounding diagram indicated a surface wind from 260° at 14 knots, with little change in wind direction with height through 19,000 ft. The mean 0 to 6 kilometer (or approximately 18,000 ft) wind was from 260° at 15 knots. The RAOB software did not indicate any significant low-level vertical wind shears below 18,000 ft to suggest anything other than light turbulence due to thermals and did not support any well-defined mountain wave conditions over the area.

#### 4.0 Satellite Imagery

The Geostationary Operational Environmental Satellite number 16 (GOES-16) data was 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 visible (band 2) at a wavelength of 0.64  $\mu\text{m}$  and a resolution of 0.5 km (0.26 nm) imagery were obtained surrounding the time of the accident.

Figure 3 is the GOES-16 visible image at 1301 MDT at 2X magnification over the southwest Colorado with the accident site marked by the red square. The image depicted clear skies over the region.

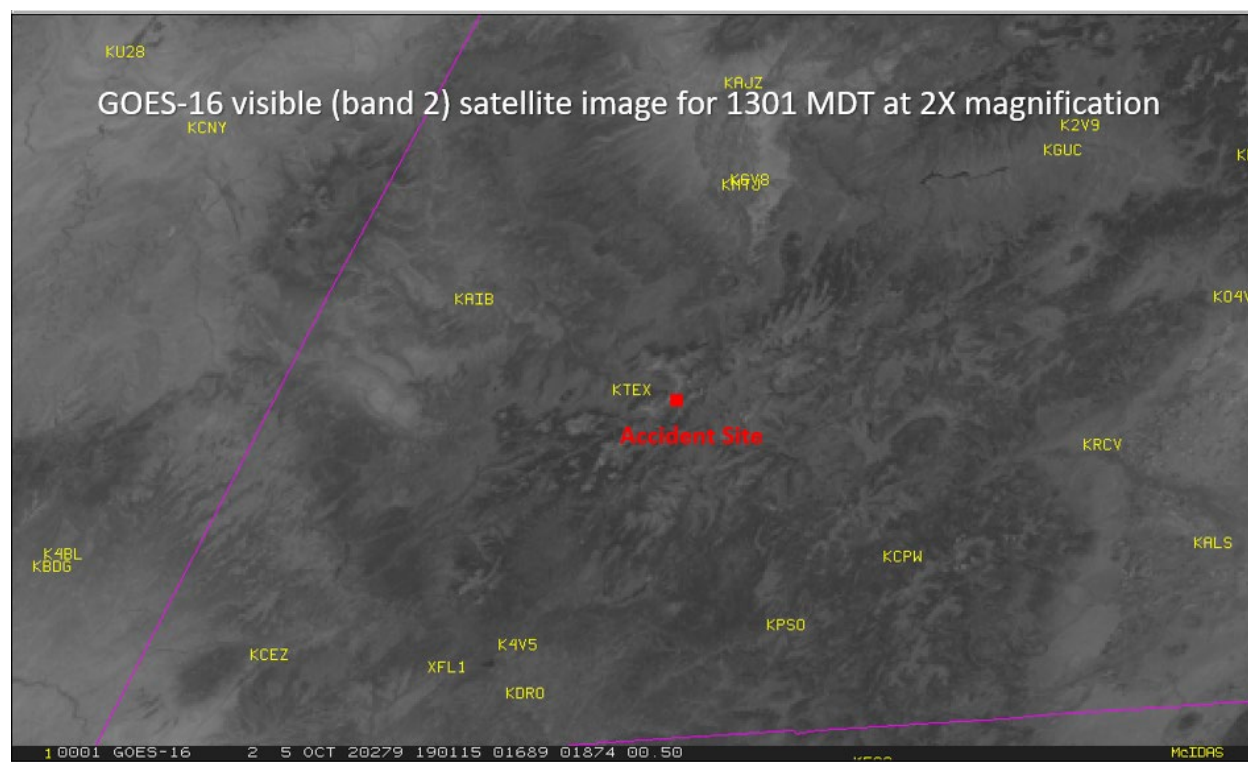


Figure 3 - GOES-16 visible image for 1301 MDT at 2 X magnification

## 5.0 Pilot Reports

A search of pilot reports or PIREPs over the region from 0830 to 1630 MDT provided the following reports over Colorado and New Mexico below 18,000 ft and within approximately 300 miles of the accident site. There were no reports noted within 100 miles of the accident site. The reports are provided in original code and abbreviations, followed by a plain language report with time converted from UTC to local. The reports were as follows.

*AKO UA /OV 7V5090030 /TM 1454/FL075 /TP C182 /WX FV10SM HZ*

*Colorado Plains Regional Airport (AKO), Akron, CO routine pilot report (UA); Over – 30 miles east of Brush Municipal Airport (7V5) (approximately 275 miles northeast of TEX); Time – 0854 MDT; Altitude – 7,500 ft; Type aircraft – Cessna Skylane; Weather – flight visibility 10 miles in haze.*

*GUP UA /OV AEG-XNI135005/TM 1458/FL105/TP C172/TB NEG/RM WB*

*Gallup Municipal Airport (GUP), Gallup, NM, routine pilot report; Over – between Double Eagle II Airport (AEG), Albuquerque, NM, to 5 miles southeast of Andrew Othole Memorial Airport (XNI), Zuni, NM (between 177 to 180 miles south-southwest of TEX); Time – 0858 MDT; Altitude – 10,500 ft; Type aircraft – Cessna Skyhawk; Turbulence – negative.*

*LAA UA /OV AFF090026-LAA/TM 1900/FL085/TP PA18/TB OCNL LGT*

*Southeast Colorado Regional Airport (LAA), Lamar, CO, routine pilot report; Over – 26 miles east of USAF Academy Airfield (AFF), Colorado Springs, CO, to LAA (approximately 180 to 270 miles east-northeast of TEX); Time – 1300 MDT; Altitude – 8,500 ft; Type aircraft – Piper Super Cub; Turbulence – occasional light turbulence.*

*FLY UA /OV AFF-AFF090025/TM 1900/FL085/TP PA18/TB CONS LGT*

*Meadow Lake Airport (FLY), Colorado Springs, CO, routine pilot report; Over – between AFF to 25 miles east of AFF (158 to 183 miles east-northeast of TEX); Time – 1300 MDT; Altitude – 8,500 ft; Type aircraft – Piper Super Cub; Turbulence – continuous light turbulence.*

*DEN UA /OV BJC179029/TM 1903/FL138/TP B737/TB CONT MOD/RM DURG DESCENT SSKIII  
ARRIVAL AWC-WEB*

*Denver International Airport (DEN), Denver, CO, routine pilot report; Over – 29 miles south of Jeffco VORTAC<sup>9</sup> (BJC), Denver, CO (approximately 175 miles northeast of TEX); Time – 1303 MDT; Altitude – 13,800 ft; Type aircraft – Boeing 737; Turbulence – continuous moderate turbulence; Remarks – during descent on SSKII One arrival<sup>10</sup>.*

*DEN UA /OV DEN080020/TM 2015/FL100/TP B737/TB LGT TURB 100-230/RM SMOKE*

*DEN routine pilot report; Over – 20 miles east of Denver VORTAC (approximately 210 miles northeast of TEX); Time – 1415 MDT; Altitude – 10,000 ft; Type aircraft – Boeing 737; Turbulence – light turbulence between 10,000 through 23,000 ft; Remarks – smoke.*

*DEN UA /OV DEN220045/TM 2135/FL145/TP B738/TB MOD CHOP*

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<sup>9</sup> A VORTAC is a radio-based navigational aid for aircraft pilots consisting of a co-located VHF omnidirectional range (VOR) beacon and a tactical air navigation system (TACAN) beacon for distance information.

<sup>10</sup> SSKIII is A Standard Terminal Arrival Route (STAR) is an ATC coded IFR arrival route established for application to arriving IFR aircraft destined for certain airports. STARs simplify clearance delivery procedures, and also facilitate transition between en route and instrument approach procedures.

*DEN routine pilot report; Over – 45 miles southwest of Denver VORTAC (approximately 145 miles northeast of TEX); Time – 1535 MDT; Altitude – 14,500 ft; Type aircraft – Boeing 737-800; Turbulence – moderate chop.*

*FNL UA /OV FNL067008/TM 2157/FL080/TP C172/WX FV04SM FU*

*Northern Colorado Regional Airport (FNL), Fort Collins/Loveland, CO, routine pilot report; Over – 8 miles northeast of FNL (approximately 200 miles northeast of TEX); Time – 1557 MDT; Altitude – 8,000 ft; Type aircraft – Cessna Skyhawk; Weather – flight visibility 4 miles in smoke.*

During the period there were numerous reports from air carrier type aircraft reporting light to moderate turbulence over northern and central Colorado between 37,000 and 41,000 ft. With four aircraft reporting light to moderate mountain wave conditions with airspeed variations of +/- 15 knots or less and altitude deviations of +/- 50 ft or less.

## 6.0 NWS Forecasts and Advisories

### 6.1 Terminal Aerodrome Forecast

The Terminal Aerodrome Forecast (TAF) for KTEX issued by the NWS Boulder Weather Forecast office (WFO) at 1120 MDT was as follows. The forecast valid at the time of the accident is in bold type.

*TAF KTEX 051720Z 0518/0618 29008KT P6SM SKC  
**FM051900 28010G18KT P6SM FEW250**  
FM060100 14008KT P6SM SCT250  
FM060600 14006KT P6SM FEW250=*

The forecast valid from 1300 through 1900 MDT expected wind from 280° at 10 knots gusting to 18 knots, visibility 6 miles or more, with a few clouds at 25,000 ft agl.

### 6.2 Winds Aloft Forecast

The NWS Winds and Temperature Aloft Forecast valid for the region through 39,000 ft and valid for 1200 MDT, and for use between 0800 and 1500 MDT was as follows.

*WINDS ALOFT FORECASTS  
DATA BASED ON 051200Z  
VALID 051800Z FOR USE 1400-2100Z. TEMPS NEG ABV 24000*

|                   |             |             |                       |                       |                |                |               |               |               |
|-------------------|-------------|-------------|-----------------------|-----------------------|----------------|----------------|---------------|---------------|---------------|
| <i>FT</i>         | <i>3000</i> | <i>6000</i> | <i>9000</i>           | <i>12000</i>          | <i>18000</i>   | <i>24000</i>   | <i>30000</i>  | <i>34000</i>  | <i>39000</i>  |
| <i><b>FMN</b></i> |             |             | <i><b>3117+14</b></i> | <i><b>3122+07</b></i> | <i>3015-06</i> | <i>3224-21</i> | <i>313338</i> | <i>303347</i> | <i>302354</i> |
| <i>GJT</i>        |             |             | <i>3305+12</i>        | <i>3508+05</i>        | <i>3026-07</i> | <i>3135-22</i> | <i>332237</i> | <i>352146</i> | <i>332154</i> |
| <i><b>ALS</b></i> |             |             |                       | <i><b>3218+06</b></i> | <i>3023-07</i> | <i>3236-22</i> | <i>313738</i> | <i>293345</i> | <i>292153</i> |
| <i>PUB</i>        |             |             | <i>3511+14</i>        | <i>2905+06</i>        | <i>3028-08</i> | <i>3238-23</i> | <i>313037</i> | <i>303245</i> | <i>282752</i> |

The closest forecast location to the accident site was Farmington (FMN), New Mexico, approximately 74 miles south-southwest of KTEX, which expected a wind at 9,000 ft from 310° at 17 knots, with a temperature of 14° C, and at 12,000 ft from 310° at 22 knots with a temperature of 7° C. The forecast for Alamosa (ALS), Colorado, approximately 100 miles east-southeast of KTEX expected a wind at 12,000 ft from 320° at 18 knots with a temperature of 6° C.

### 6.3 Graphic Turbulence Guidance

The Graphic Turbulence Guidance (GTG) was developed by the National Center for Atmospheric Research (NCAR) and is now run operationally at NOAA NCEP and is available to users on the AWC website from the surface to 45,000 ft. The current GTG version 3.0 model is generated from the NOAA Rapid Refresh numerical model with a horizontal spacing of 13.5 kilometers with 50 vertical levels, and provides a computer-generated four-dimensional forecast related to the expected intensity of atmospheric turbulence provided as energy or in eddy dissipation rate (EDR)<sup>11</sup>. Typical EDR varies from close to 0, “smooth”, to near 1, “extreme” for most aircraft types. NCAR defines the following EDR values and turbulence thresholds to various aircraft class-specific thresholds or weight classes and is included as figure 4, the Beechcraft Bonanza fits the light-weight category<sup>12</sup>.

| AC weight class | Estimated EDR Threshold * 100 |          |        |         |
|-----------------|-------------------------------|----------|--------|---------|
|                 | Light                         | Moderate | Severe | Extreme |
| Light           | 13                            | 16       | 36     | 64      |
| Medium (Large)  | 15                            | 20       | 44     | 79      |
| Heavy           | 17                            | 24       | 54     | 96      |

Figure 4 - EDR values versus turbulence intensity for various aircraft weight categories

The NWS Aviation Weather Center issued the following GTG products for Clear Air Turbulence (CAT) and Mountain Wave Turbulence (MWT) during the period. The accident airplane reached a maximum altitude of 12,125 ft immediately prior to the accident, so the GTG forecast level of 12,000 ft were documented. Figure 5 is the NWS GTG CAT 2-hour forecast for the first available level over the region for 12,000 ft valid at 1300 MDT, which depicted EDR values of less than 20 over the region or generally light turbulence to possible moderate turbulence. The values of EDR increased from 20 to 30 across central Colorado where moderate turbulence was indicated.

Figure 6 is the GTG MWT forecast for 12,000 ft valid for 1300 MDT, which expected EDR values near 10 over southwestern Colorado, with values increasing to near 20 across central Colorado in the vicinity of Denver.

<sup>11</sup> Eddy Dissipation Rate (EDR) to the 1/3 power, i.e.  $EDR = \varepsilon^{1/3}$  where  $\varepsilon$  is the eddy dissipation rate in units of  $m^2/s^3$ )

<sup>12</sup> ICAO Light weight classification is for aircraft with less than 15,500 pounds maximum takeoff weight

GTG Clear Air Turbulence at FL120

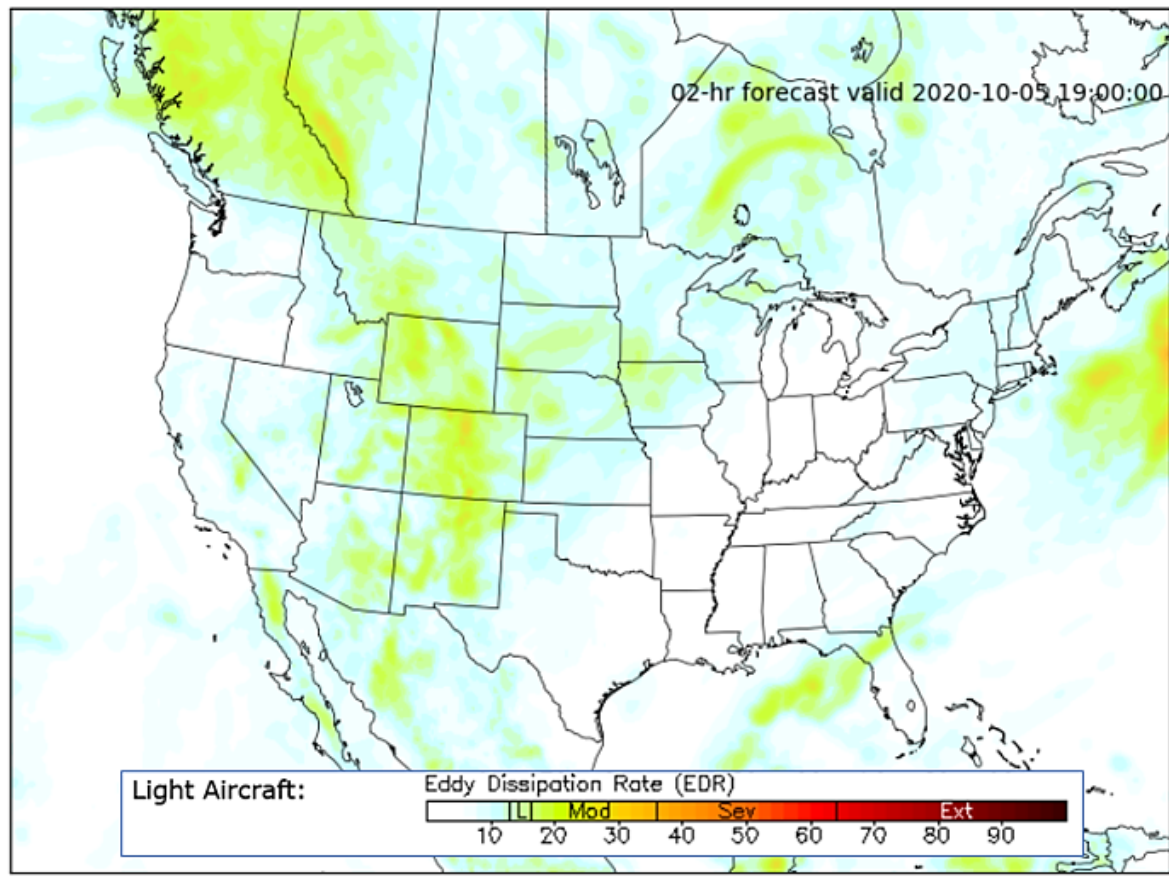


Figure 5 - Graphic Turbulence Guidance Clear Air Turbulence potential at 12,000 ft valid at 1300 MDT

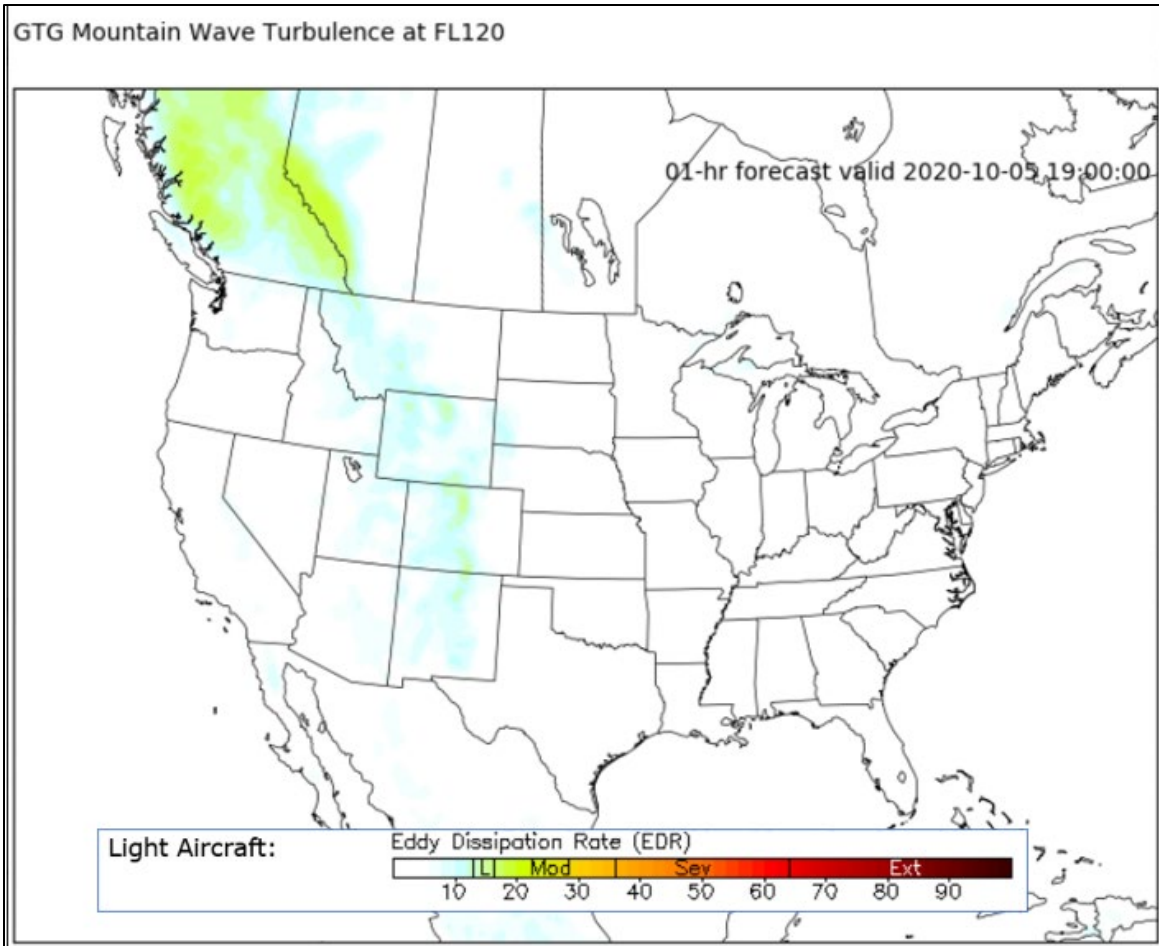
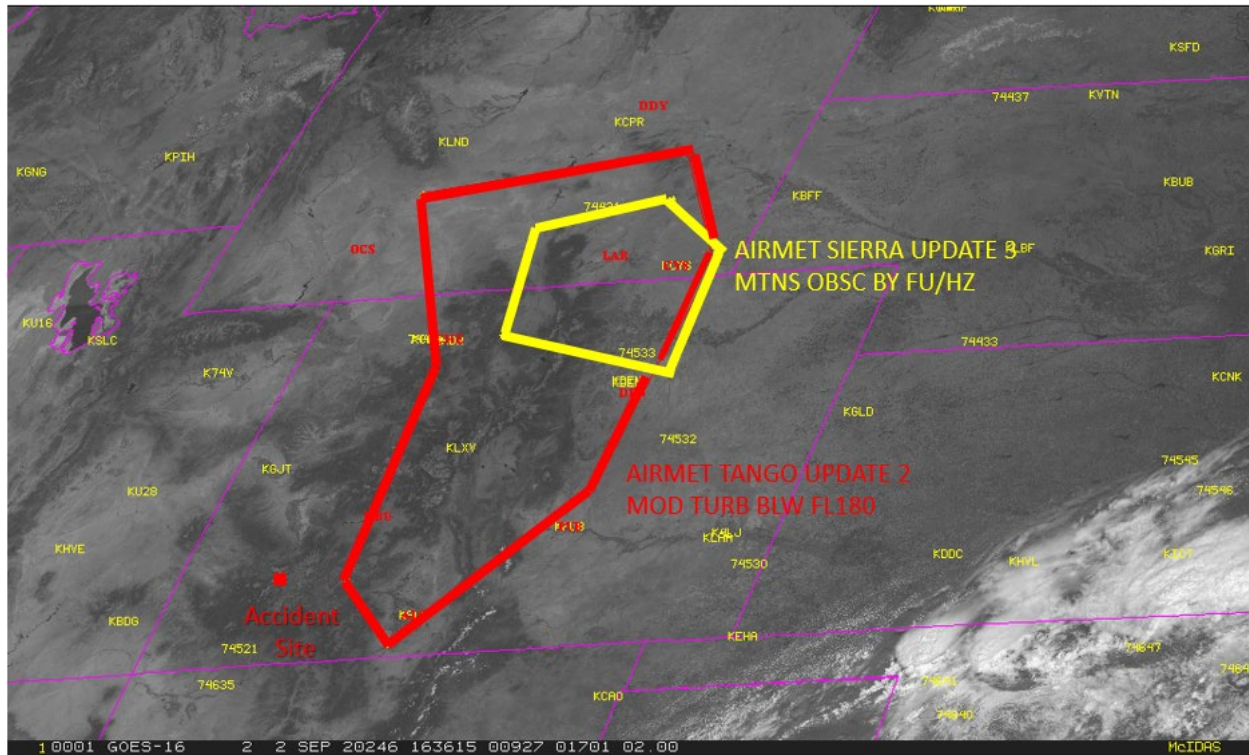


Figure 6 - Graphic Turbulence Guidance for Mountain Wave Turbulence for 12,000 ft valid for 1300 MDT

#### 6.4 Inflight Weather Advisories

A search of the NWS indicated that no SIGMET, Convective SIGMETs, or Center Weather Advisories (CWA), were current over the region during the period of the accident. The NWS Aviation Weather Center had issued AIRMETs for a limited area of mountain obscuration over northern Colorado and Wyoming, and for turbulence below 18,000 ft over central Colorado and Wyoming, the advisories did not extend over the accident site. Figure 7 is a depiction of the AIRMETs over the GOES-16 visible image at the time of issuance of the advisories at 1036 MDT.



The full text of the advisories were as follows.

WA5S  
SLCS WA 051636 AMD  
AIRMET SIERRA UPDT 3 FOR IFR AND MTN OBSCN VALID UNTIL 052100  
.  
NO SGFNT IFR EXP OUTSIDE OF CNVTV ACT.  
.  
AIRMET MTN OBSCN...WY CO...UPDT  
FROM 40NNE LAR TO 20ENE CYS TO 20NE DEN TO 30E CHE TO 60WNW LAR TO 40NNE LAR  
MTNS OBSC BY FU/HZ. CONDS ENDG BY 18Z.

WAUS45 KCCI 051445  
WA5T  
SLCT WA 051445  
AIRMET TANGO UPGT 2 FOR TURB VALID UNTIL 052100  
.  
AIRMET TURB...WY CO  
FROM 50NW LAR TO 30SW LAR TO GLD TO 60W LBL TO 30W TBE TO 20WSW  
ALS TO 50NE RSK TO 20W DBL TO 60E MTU TO OCS TO 50NW LAR  
MOD TURB BTN FL180 AND FL380. CONDS ENDG 18-21Z.  
.  
AIRMET TURB...WY CO  
FROM 50SE DDY TO 20E CYS TO 20N PUB TO 20SSW ALS TO 40S HBU TO  
20S CHE TO 40NNE OCS TO 50SE DDY  
MOD TURB BLW FL180. CONDS ENDG 18-21Z.  
.  
OTLK VALID 2100-0300Z...TURB MT

*BOUNDED BY 50SE YXC-60ENE HVR-60ESE LWT-40WNW HLN-50SE YXC  
MOD TURB BLW 150. CONDS DVLPG 21-00Z. CONDS CONTG THRU 03Z.  
....*

## 7.0 Pilot Weather Briefing

A search of the FAA Automated Flight Service Station (AFSS) provider Leidos indicated that they had no flight plans or contact with the pilot for any weather briefing services. A separate search of third party weather vendors ForeFlight indicated that the pilot had entered a weather request at 1255 MDT for data for KTEX. The observations and airport information for KTEX, and winds aloft forecast were obtained. ForeFlight indicated that the data request was consistent for takeoff performance calculations. The pilot did not request any other specific weather products or graphics.

## 8.0 Numerical Model Simulation of Winds

A Weather Research and Forecast (WRF)<sup>13</sup> model simulation was run to help document the weather conditions, specifically the wind flow and vertical velocities or potential updrafts/downdrafts over the region at the time of the accident. Figure 8 is the model terrain used in the inner domain 3 simulation with the accident site in the center of the topography map at 37°54'5 2" N and 107°45'11" W. The WRF streamline analysis<sup>14</sup> at 660-hpa or approximately 12,000 ft for 1300 MDT is included as figure 9, which shows a general west-northwest wind flow into the canyon. The blank areas are the higher terrain in the immediate vicinity of the accident site above 12,000 ft.

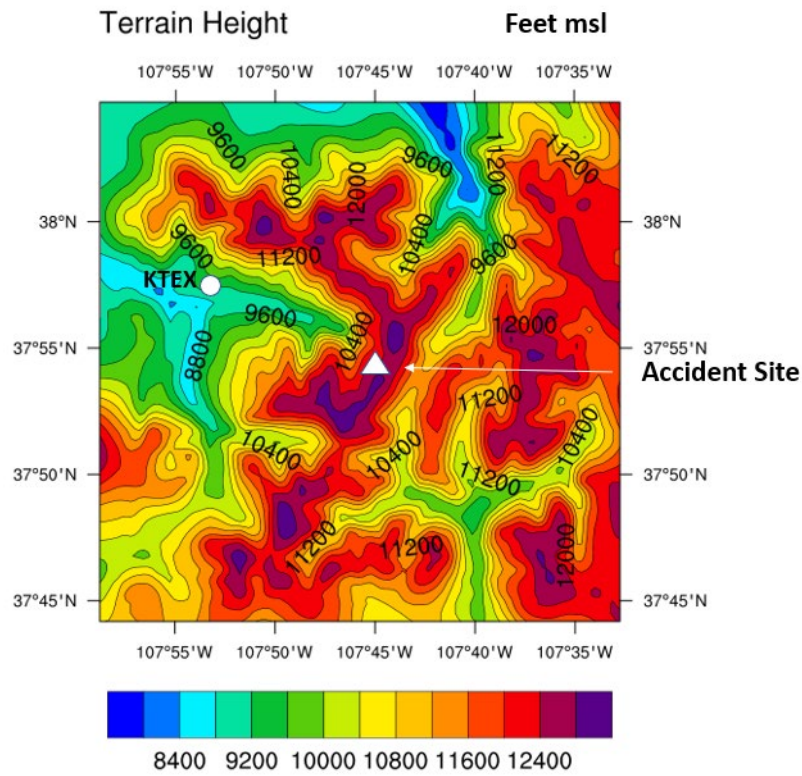
Figure 10 is the WRF simulation of the west to east cross section of horizontal wind in knots (color filled) and the potential temperature (solid lines)<sup>15</sup> in Kelvin for 1250, 1300, and 1310 MDT. The approximate accident site location is marked on the bottom of the figure at 1300 MDT by the red triangle or by grid position 46 to 47. The horizontal wind data indicated that the accident site was in an area of westerly winds of 12 to 14 knots, with wind speeds under 20 knots through 20,000 ft. Figure 11 is the WRF cross section of vertical velocity and potential temperature for the same periods. The vertical velocity cross section indicated the accident airplane was under a general 200 to 400 ft per minute updraft when flying eastward into the valley towards the higher terrain east of KTEX, then encountered a slight downdraft of 100 fpm and then another area of updrafts towards the accident site.

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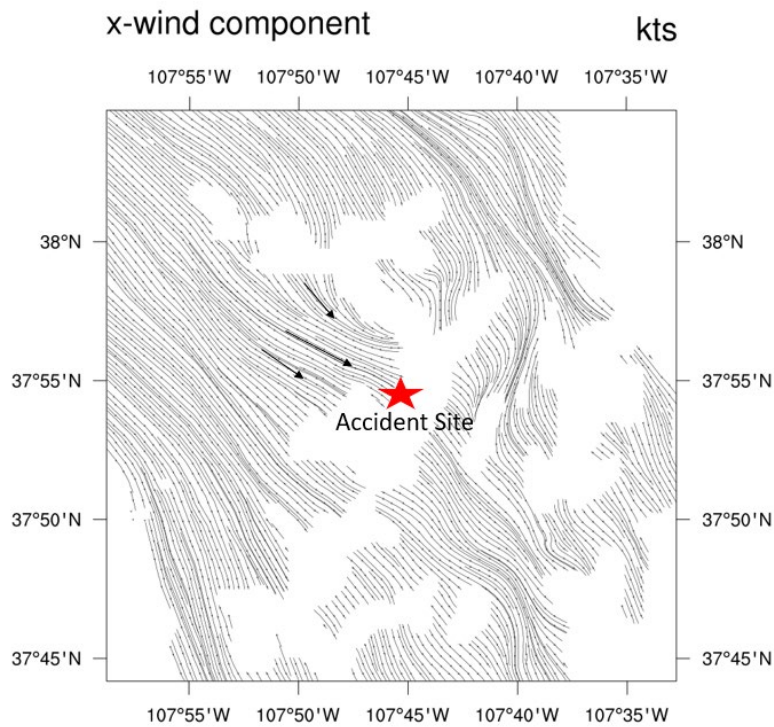
<sup>13</sup> An Advanced Research WRF (ARW) core version 4.1.2 was run with 3 domains with horizontal grid spacing of 8 km, 1.6 km, and 320 m over the accident site. Other WRF simulation parameters included: 60 vertical levels, the Kain-Fritsch cumulus parameterization scheme used on the outer domain, a Lin et al. microphysics scheme, a Yonsei University boundary layer scheme, Noah land surface physics, and the Dudhia scheme used for the long and short wave radiation.

<sup>14</sup> Streamline is a line that is tangential to the instantaneous velocity directions to depict the airflow.

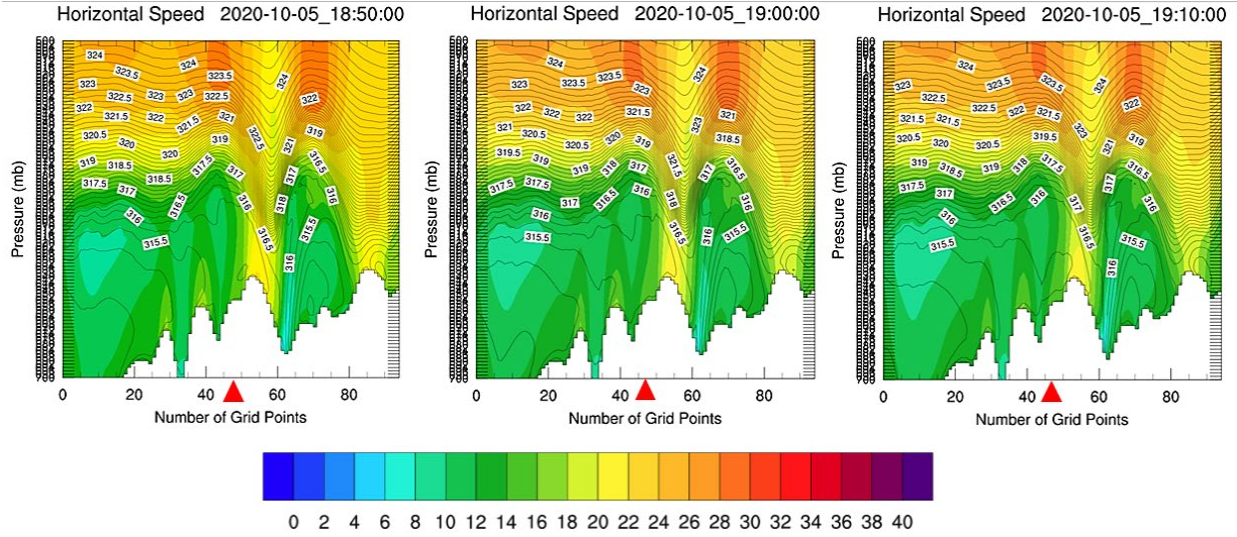
<sup>15</sup> The potential temperature of a parcel of fluid at pressure  $P$  is the temperature that the parcel would attain if adiabatically brought to a standard reference pressure  $P_0$  usually 1,000 hPa, and is denoted as  $\theta$ . Potential temperature can be used to compare the temperature of air parcels that are at different levels in the troposphere, as air parcels tend to move along constant potential surfaces.



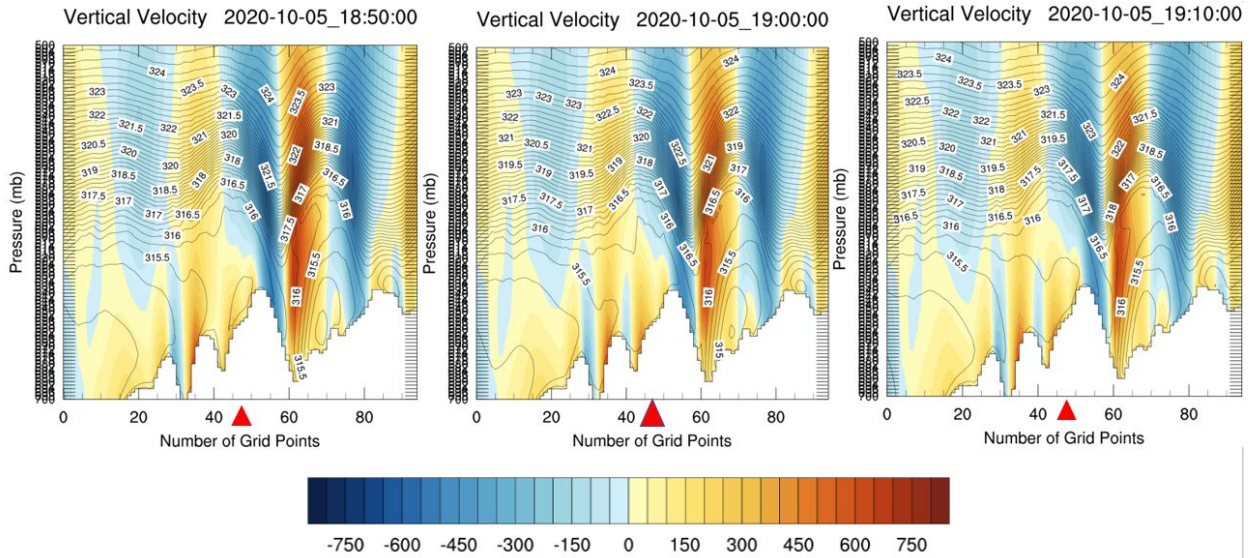
**Figure 8 - WRF inner domain topography with the accident site**



**Figure 9 - WRF simulation of streamlines at 1300 MDT**



**Figure 10 - WRF simulation of the west to east cross section of horizontal winds and potential temperature at 1250, 1300, and 1310 MDT**



**Figure 11 - WRF simulation of the west to east cross section of vertical velocity and potential temperature for 1250, 1300, and 1310 MDT**

Submitted by:

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Don Eick  
Senior Meteorologist