



## **NATIONAL TRANSPORTATION SAFETY BOARD**

Office of Aviation Safety  
Washington, D.C. 20594

October 26, 2020

### **Weather Study Report**

# **METEOROLOGY**

CEN20LA389

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## **A. ACCIDENT**

Location: Groton, South Dakota  
Date: September 13, 2020  
Time: 1100 central daylight time  
1600 Coordinated Universal Time (UTC)  
Aircraft: American Champion 8KCAB; Registration: N83DH

## **B. METEOROLOGIST**

Paul Suffern  
Senior Meteorologist  
Operational Factors Division (AS-30)  
National Transportation Safety Board

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

The National Transportation Safety Board's (NTSB) Meteorologist did not travel for this investigation and gathered the weather data for this investigation from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the National Centers for Environmental Information (NCEI). All times are central daylight time (CDT) on September 13, 2020, and are based upon the 24-hour clock, where local time is -5 hours from UTC, and UTC=Z (unless otherwise noted). Directions are referenced to true north and distances in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles. 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.

The accident site location used was at latitude 45.5286° N, longitude 98.0931° W, with an approximate elevation of 1,305 feet (ft).

## **D. WEATHER INFORMATION**

### **1.0 Synoptic Situation**

The synoptic or large-scale migratory weather systems influencing the area were documented using standard NWS charts issued by the National Center for Environmental Prediction and the Weather Prediction Center, located in College Park, Maryland. These are the base products used in describing synoptic weather features and in the creation of forecasts and warnings for the NWS. Reference to these charts can be found in the joint NWS and Federal Aviation Administration (FAA) Advisory Circular "Aviation Weather Services", AC 00-45H.<sup>1</sup>

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<sup>1</sup>

[https://www.faa.gov/regulations\\_policies/advisory\\_circulars/index.cfm/go/document.information/documentID/1030](https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/1030)

## 1.1 Surface Analysis Chart

The Northern Plains section of the NWS Surface Analysis Charts for 1000 and 1300 CDT are provided as figures 1 and 2 with the approximate location of the accident site marked by the red circles. The charts identified a frontal system moving from north to south over the accident site between 1000 and 1300 CDT. A low pressure system was located over central South Dakota (west of the accident site) with a pressure of 1016-hectopascals (hPa).

The station models around the accident site depicted air temperatures in the mid 50's to low 60's degrees Fahrenheit (°F), dew point temperatures in the mid 50's °F with temperature-dew point spreads of 7°F or less, and a south wind around 5 knots and clear skies at 1000 CDT with the wind becoming northerly 15 knots at 1300 CDT under cloudy skies.

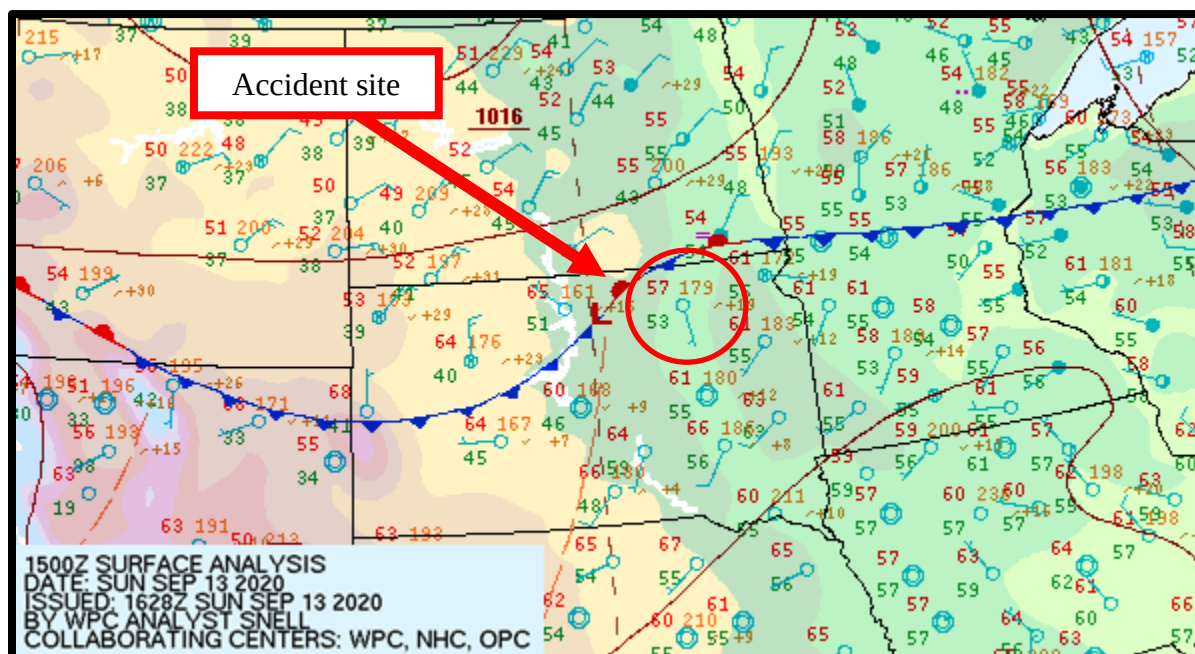


Figure 1 – NWS Surface Analysis Chart for 1000 CDT

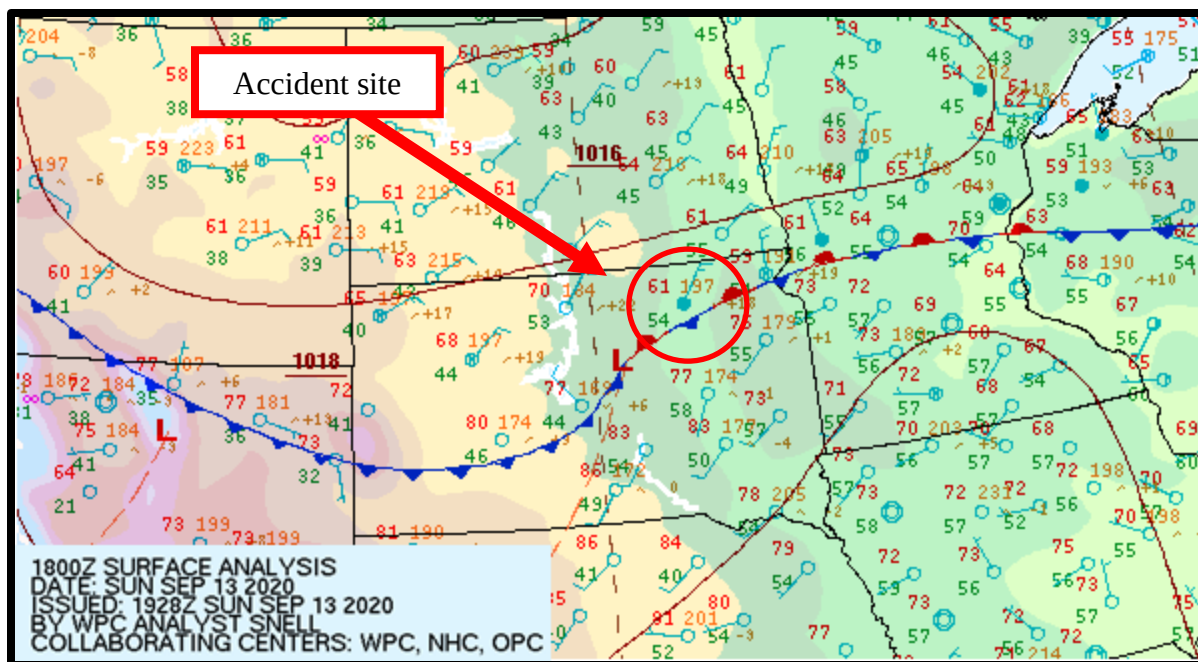
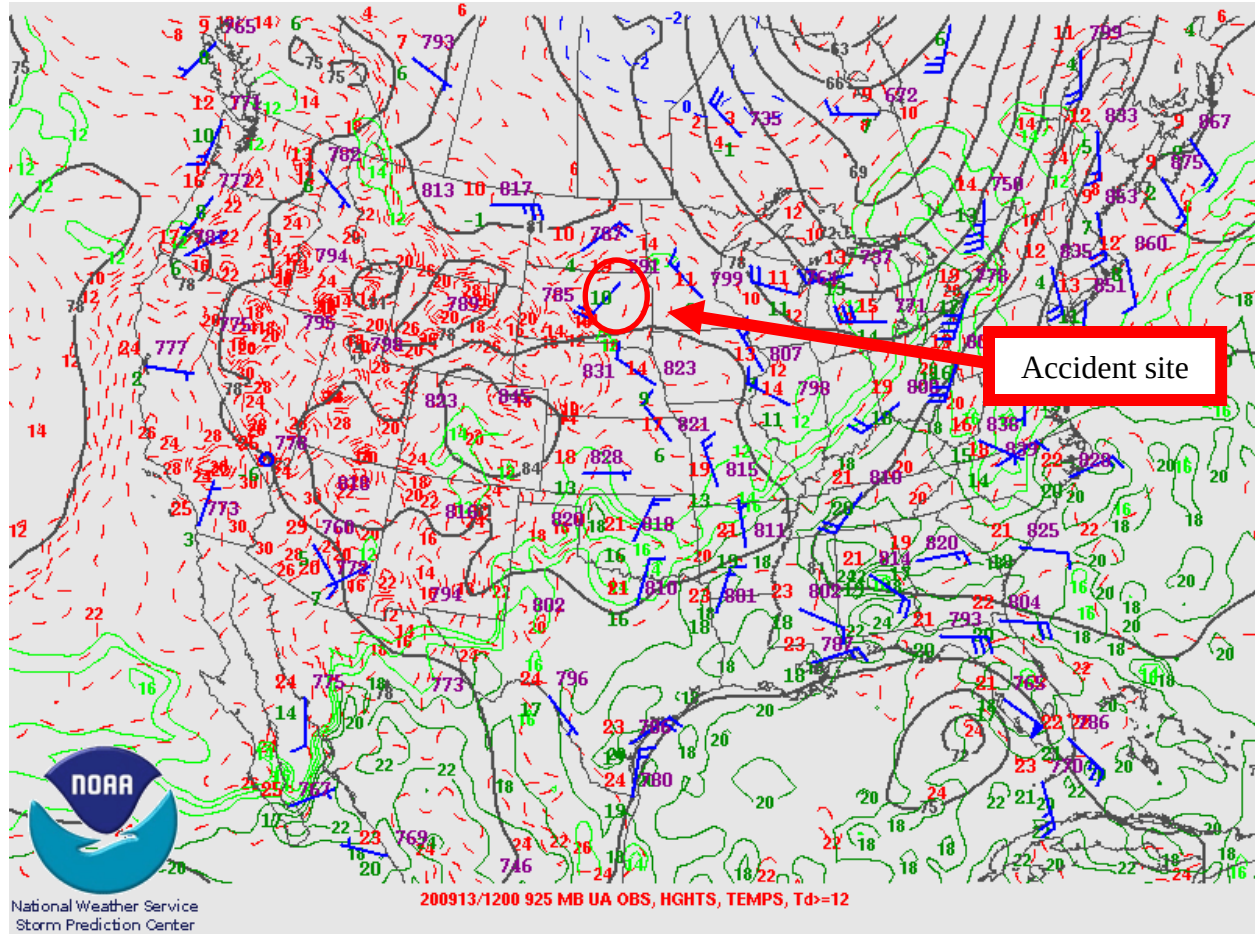


Figure 2 – NWS Surface Analysis Chart for 1300 CDT

## 1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 0700 CDT at 925-, 850-, 700-, 500-, and 300-hPa are presented in figures 3 through 7. There was a trough<sup>2</sup> that reached from the low- and mid-levels in the troposphere located just to the northwest of the accident site from 850- through 700-hPa at 0700 CDT. Troughs can act as lifting mechanisms to help produce clouds and precipitation if sufficient moisture is present. There was a southwest wind at 20 knots at 925-hPa above the accident site with the wind remaining southwesterly through 850-hPa (figure 4). By 700-hPa the wind was from the northwest at 25 knots and the wind remained from the northwest through 300-hPa. The wind speed increased to 50 knots by 300-hPa.

<sup>2</sup> Trough – An elongated area of relatively low atmospheric pressure or heights.



**Figure 3 – 925-hPa Constant Pressure Chart for 0700 CDT**

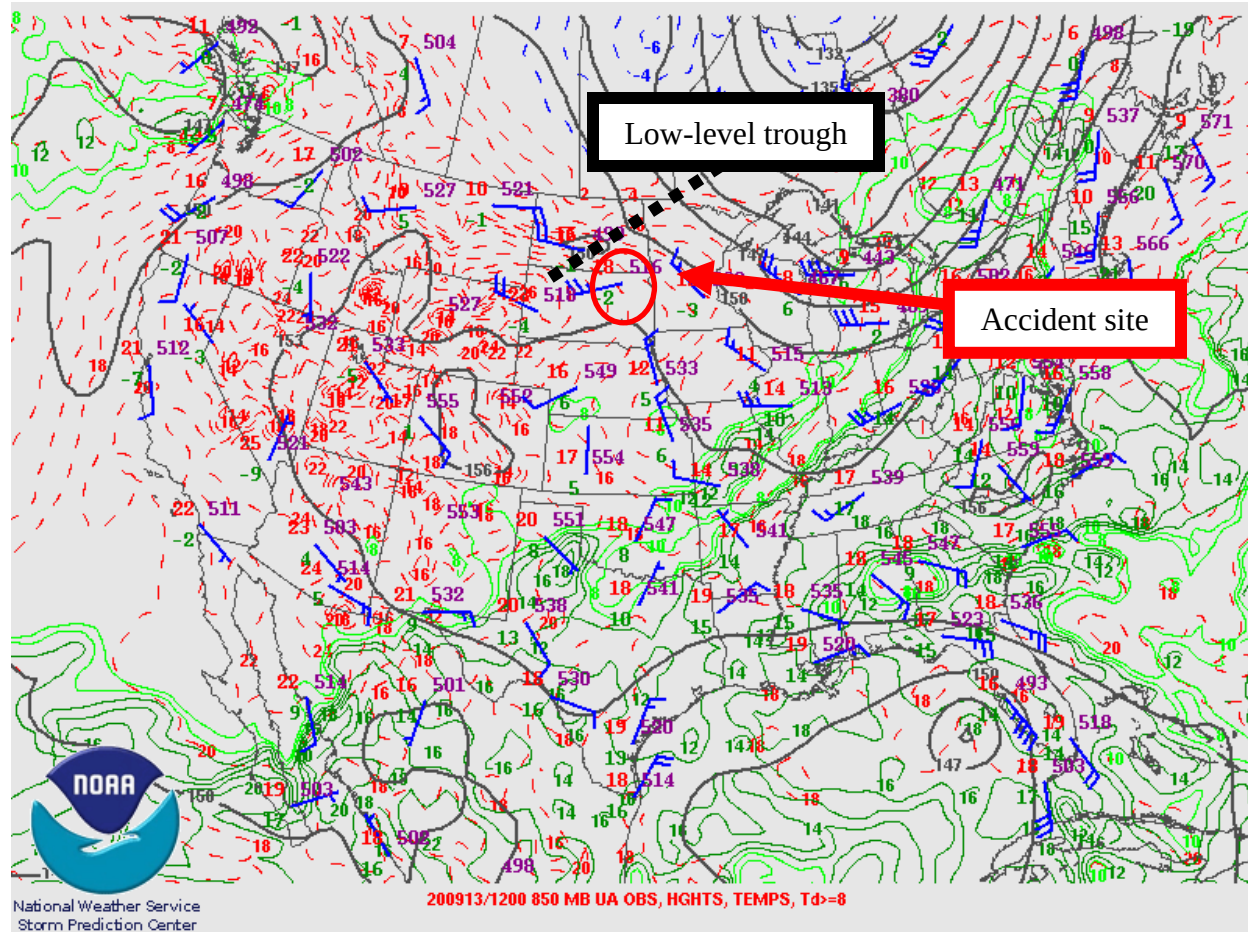


Figure 4 – 850-hPa Constant Pressure Chart for 0700 CDT

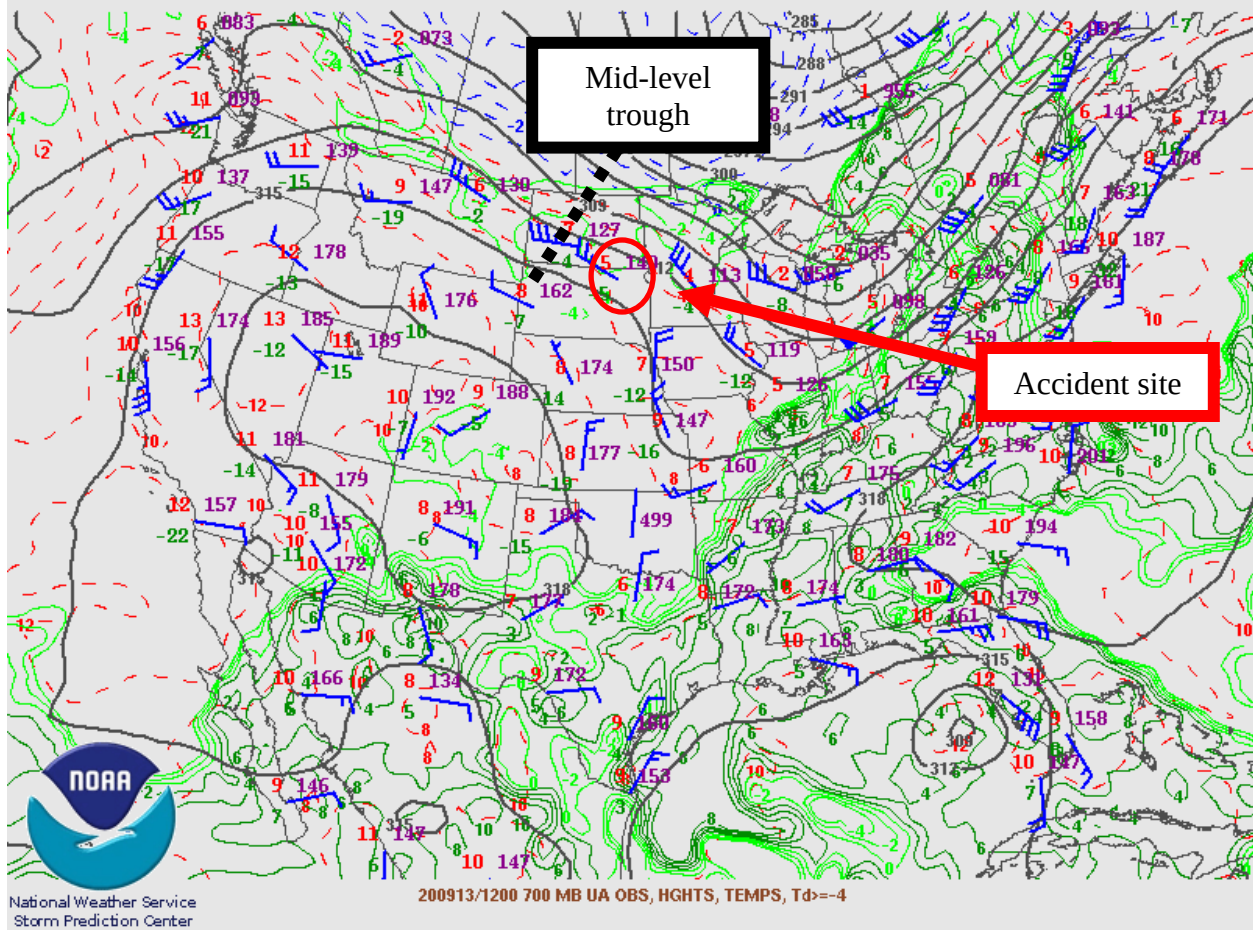
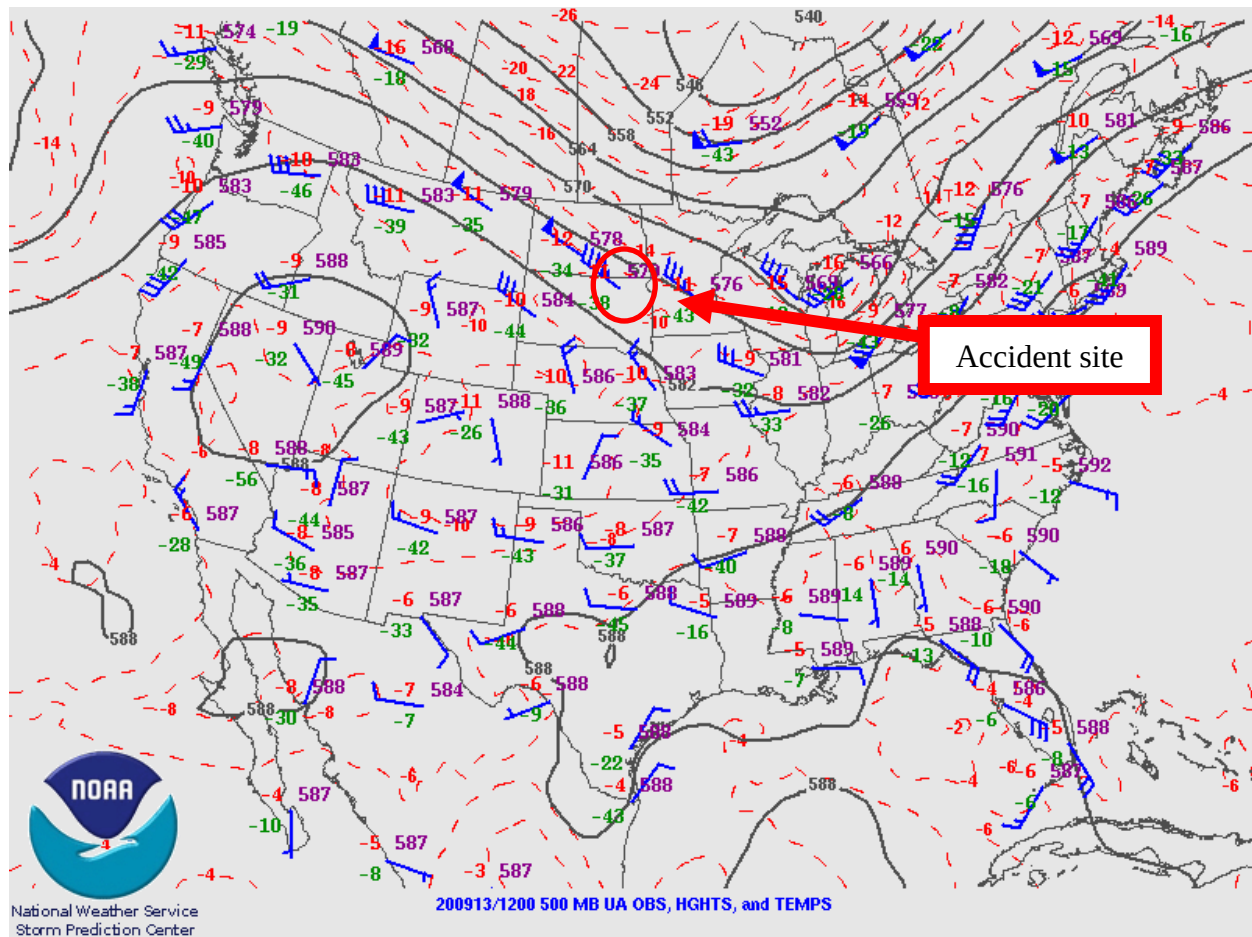
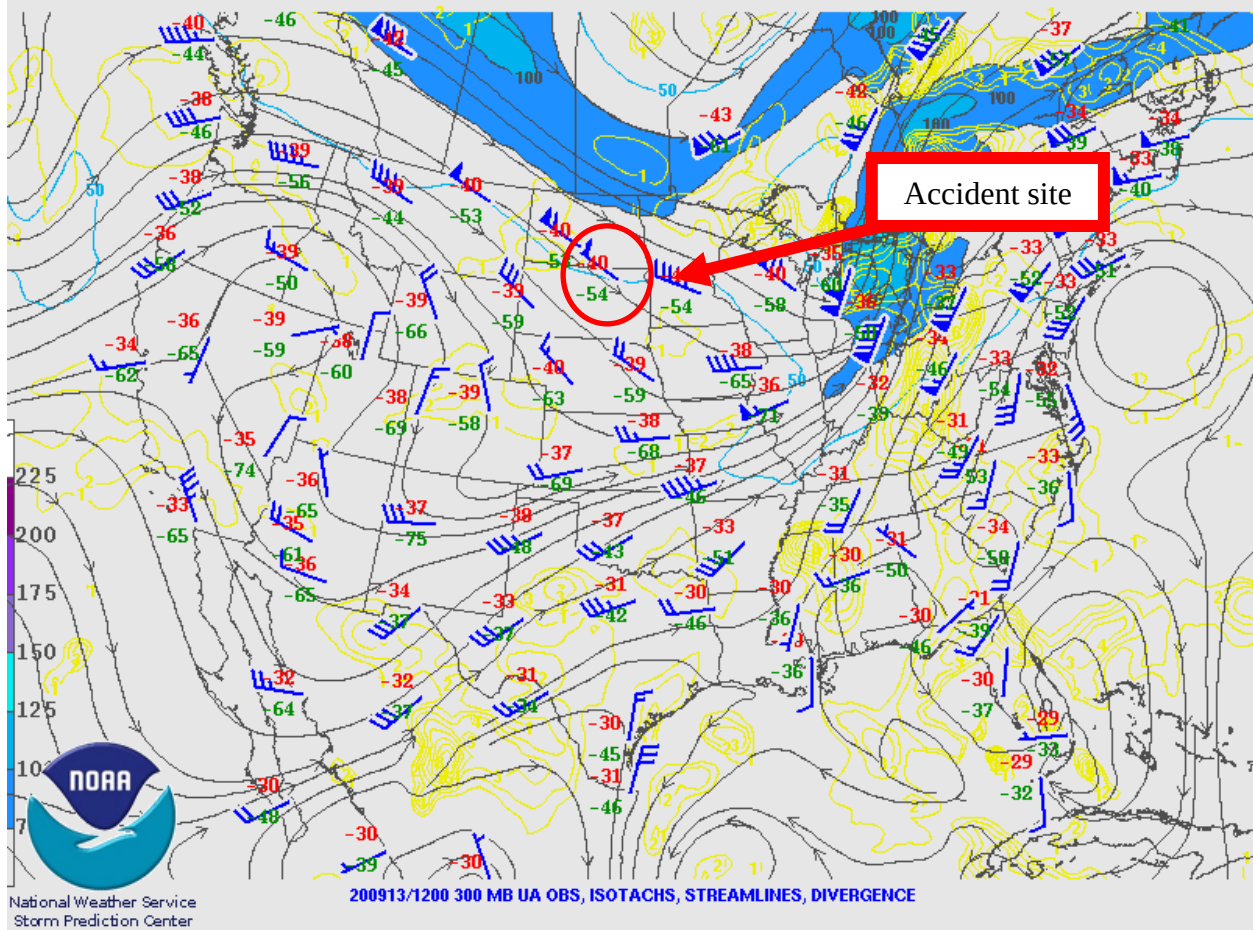


Figure 5 – 700-hPa Constant Pressure Chart for 0700 CDT



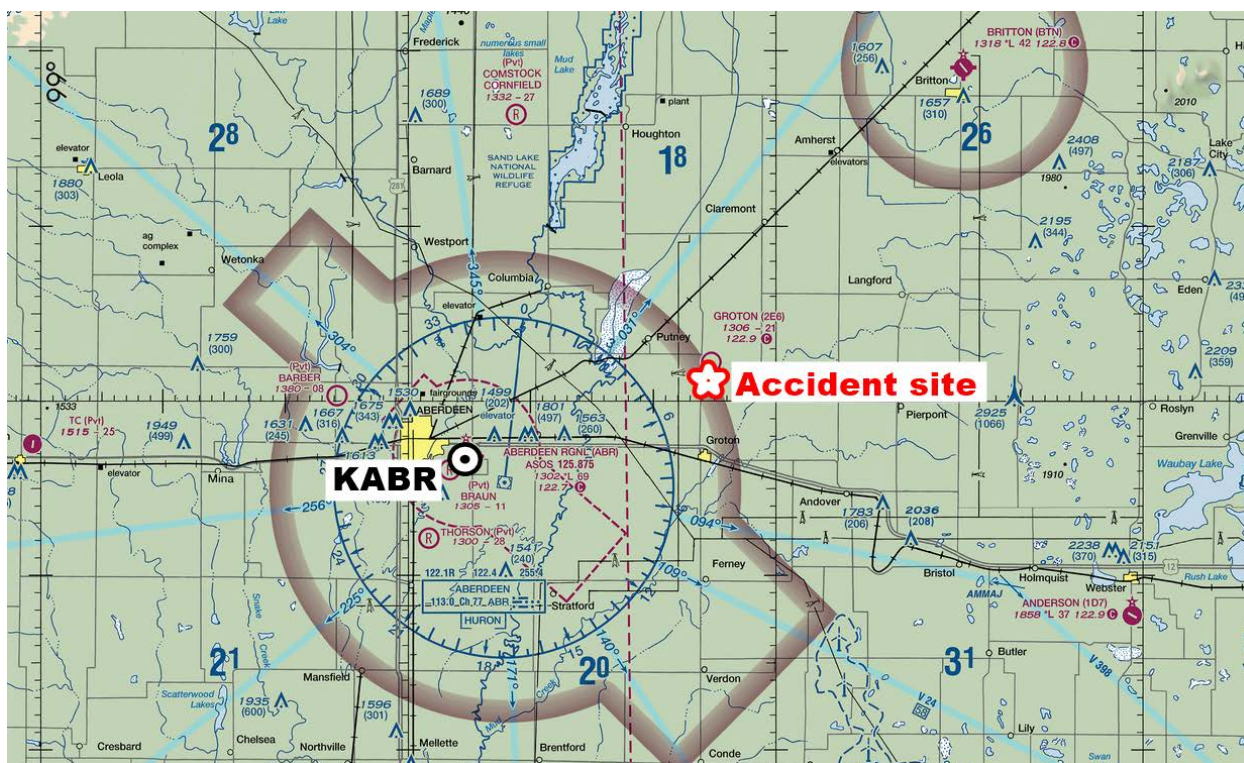
**Figure 6 – 500-hPa Constant Pressure Chart for 0700 CDT**



**Figure 7 – 300-hPa Constant Pressure Chart for 0700 CDT**

## 2.0 Surface Observations

The area surrounding the accident site was documented using official Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). The following observations were taken from standard code and are provided in plain language. Figure 8 is a local sectional chart with the accident site and the closest weather reporting location marked.



**Figure 8 – Sectional map of the accident area with the location of the accident site and surface observation site**

Aberdeen Regional Airport (KABR) had the closest official weather station to the accident site. KABR had an Automated Surface Observing System (ASOS<sup>3</sup>) whose reports were not supplemented. The KABR ASOS was located 15 miles west-southwest of the accident site (figure 8), at an elevation of 1,302 ft. KABR had a 4° easterly magnetic variation<sup>4</sup>. The following observations were taken and disseminated during the times surrounding the accident:<sup>5</sup>

[0653 CDT] METAR KABR 131153Z AUTO 17005KT 8SM CLR 09/07 A3000 RMK AO2 SLP158 70011 T00890072 10106 20089 53006=

[0753 CDT] METAR KABR 131253Z AUTO 02003KT 8SM CLR 09/08 A3004 RMK AO2 SLP175 T00940078=

[0853 CDT] METAR KABR 131353Z AUTO 11003KT 10SM CLR 11/09 A3005 RMK AO2 SLP177 T01110094=

<sup>3</sup> ASOS – Automated Surface Observing System is equipped with meteorological instruments to observe and report wind, visibility, weather, ceiling, temperature, dewpoint, altimeter, and barometric pressure.

<sup>4</sup> Magnetic variation – The angle (at a particular location) between magnetic north and true north. Latest measurement taken from <https://skyvector.com/>

<sup>5</sup> The bold sections in this NWS product and the rest of the products in this report are intended to highlight the sections that directly reference the weather conditions that affected the accident location around the accident time. The local times in this section next to the METARs are provided for quick reference between UTC and local times around the accident time.

[0953 CDT] METAR KABR 131453Z AUTO 17006KT 10SM CLR 14/12 A3005 RMK  
AO2 SLP179 T01390117 51019=

**[1053 CDT] METAR KABR 131553Z AUTO 17006KT 10SM CLR 17/13 A3006 RMK  
AO2 SLP178 T01670128=**

**ACCIDENT TIME 1100 CDT**

**[1153 CDT] METAR KABR 131653Z AUTO 01014G19KT 10SM SCT015 18/13 A3008  
RMK AO2 SLP188 T01830133=**

[1201 CDT] SPECI KABR 131701Z AUTO 36014KT 10SM BKN015 17/13 A3009 RMK  
AO2 T01720128=

KABR weather at 1053 CDT, automated, wind from 170° at 6 knots, 10 miles visibility or greater, clear skies below 12,000 ft above ground level (agl), temperature of 17°Celsius (C), dew point temperature of 13°C, and an altimeter setting of 30.06 inches of mercury. Remarks: automated station with a precipitation discriminator, sea level pressure 1017.8 hPa, temperature 16.7°C, dew point temperature 12.8°C.

KABR weather at 1153 CDT, automated, wind from 010° at 14 knots gusts to 19 knots, 10 miles visibility or greater, scattered clouds at 1,500 ft agl, temperature of 18°C, dew point temperature of 13°C, and an altimeter setting of 30.08 inches of mercury. Remarks: automated station with a precipitation discriminator, sea level pressure 1018.8 hPa, temperature 18.3°C, dew point temperature 13.3°C.

The 5-minute KABR ASOS data is contained in attachment 1 with the wind variable under 5 knots during the morning of September 13 through 0900 CDT. After 0900 until 1120 CDT the wind at KABR was from the south to 6 knots and the wind became northerly at the surface at 1120 CDT.

The observations from KABR surrounding the accident time indicated VFR<sup>6</sup> conditions with the wind gusting to 19 knots by 1153 CDT as the frontal boundary moved southward across the accident site (section 1.1).

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<sup>6</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.

\*\*By definition, VFR is a ceiling greater than or equal to 3,000 ft agl and visibility greater than 5 miles while MVFR is a sub-category of VFR.

### 3.0 Upper Air Data

High-Resolution Rapid Refresh (HRRR)<sup>7</sup> model soundings were created for the accident site for 1100 and 1200 CDT with station elevations of 1,312 ft.<sup>8</sup> The 1100 and 1200 CDT HRRR soundings were plotted on a standard Skew-T Log P diagram<sup>9</sup> with the derived stability parameters included in figures 9 and 10 with data from the surface to 700-hPa (or approximately 10,000 ft msl). These data were analyzed using the RAOB<sup>10</sup> software package. The sounding depicted the lifted condensation level (LCL)<sup>11</sup> between ~1,200 and 2,000 ft agl, the convective condensation level (CCL)<sup>12</sup> around ~9,000 ft msl, and the level of free convection (LFC)<sup>13</sup> above 13,000 ft msl. The freezing level was located above 12,000 ft msl. The precipitable water value was 0.89 inches.

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<sup>7</sup> The HRRR is a NOAA real-time three-kilometer resolution, hourly-updated, cloud-resolving, convection-allowing atmospheric model, initialized by three-kilometer grids with three-kilometer radar assimilation. Radar data is assimilated in the HRRR every 15 minutes over a one hour period.

<sup>8</sup> HRRR sounding was created using NOAA Air Resource Laboratory: <https://ready.arl.noaa.gov/READYamet.php>

<sup>9</sup> Skew T log P diagram – is a standard meteorological plot using temperature and the logarithmic of pressure as coordinates, used to display winds, temperature, dew point, and various indices used to define the vertical structure of the atmosphere.

<sup>10</sup> RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamoras, Pennsylvania.

<sup>11</sup> LCL - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

<sup>12</sup> 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>13</sup> LFC – The level at which a parcel of saturated air becomes warmer than the surrounding air and begins to rise freely. This occurs most readily in a conditionally unstable atmosphere.

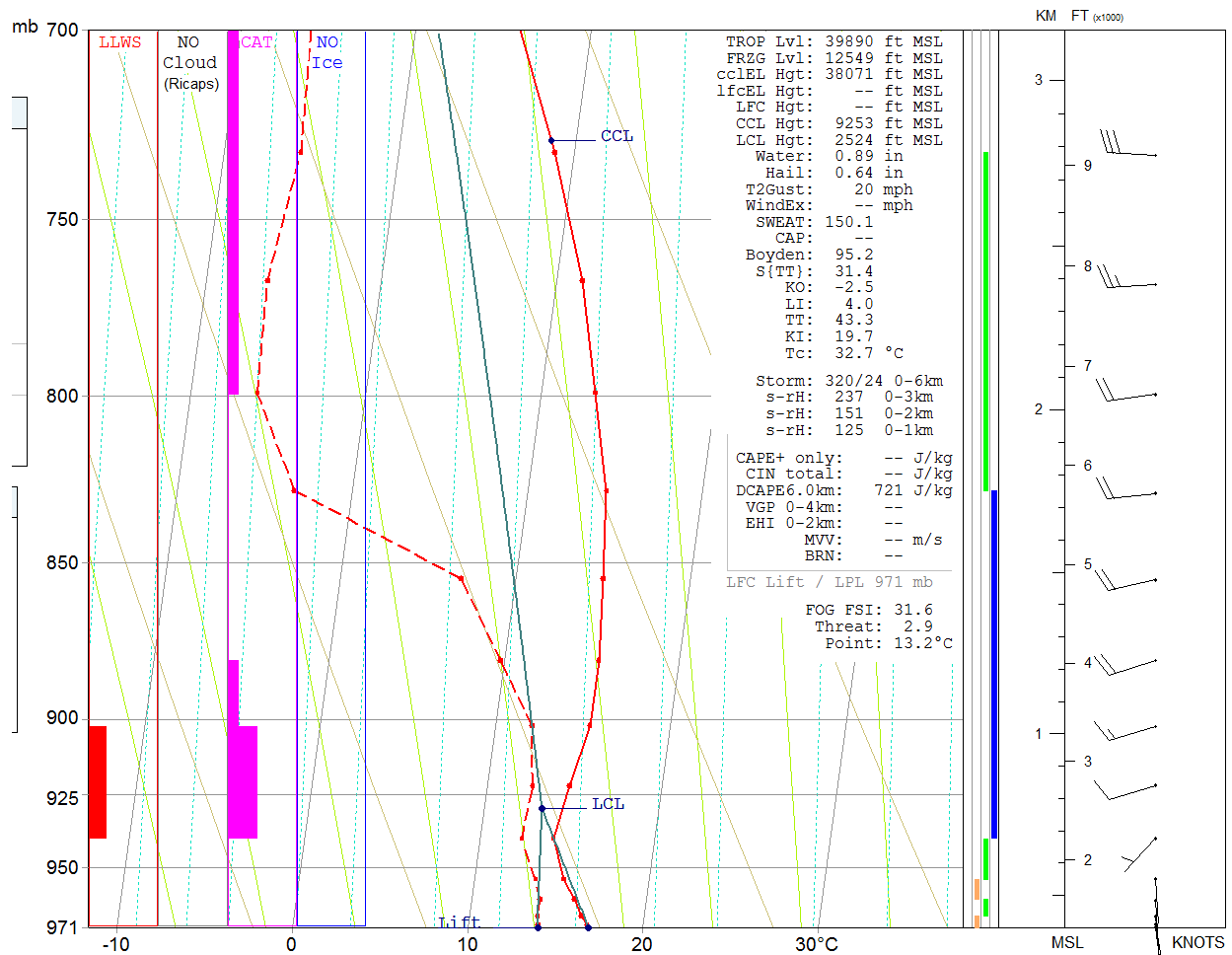
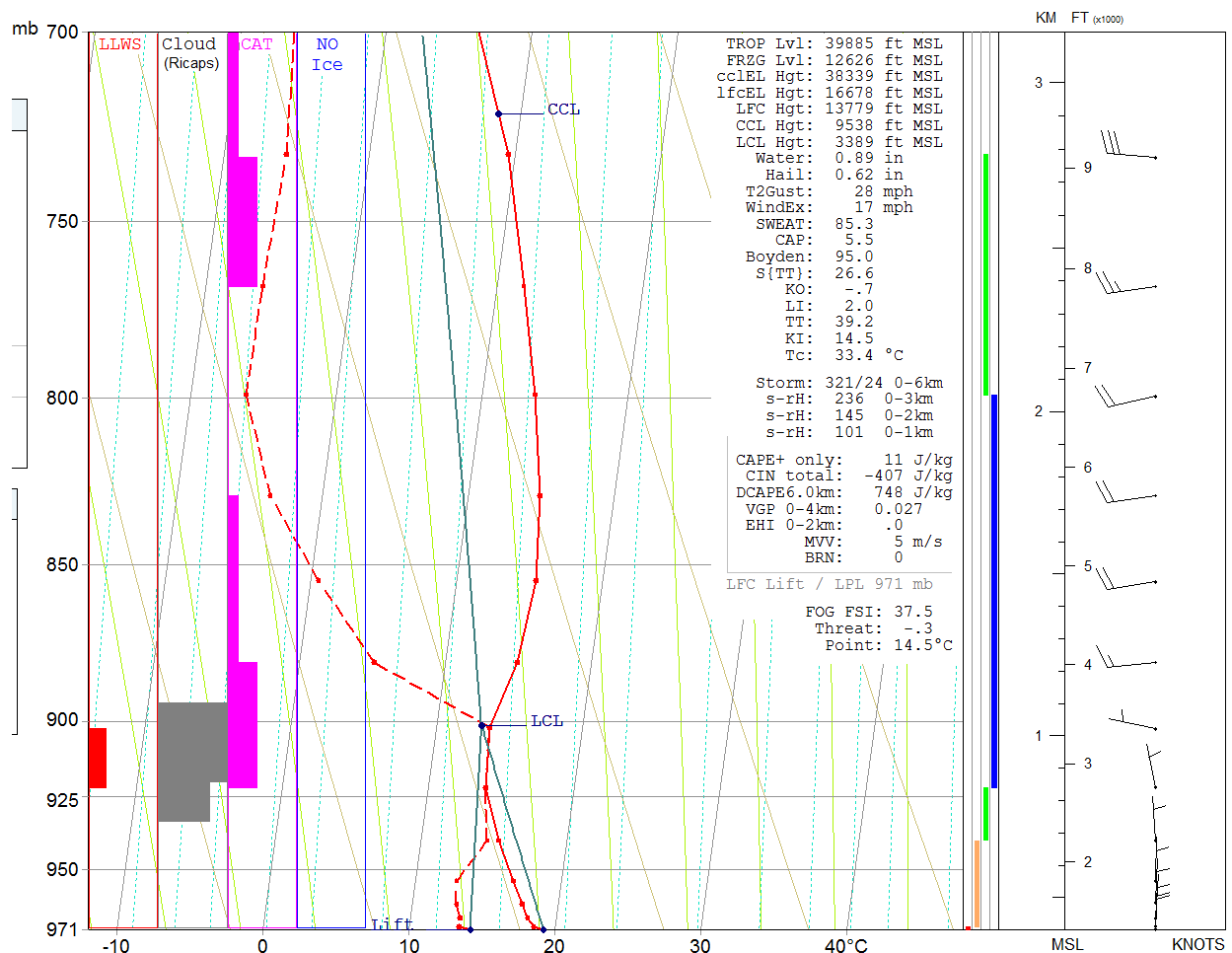


Figure 9 – 1100 CDT HRRR sounding



**Figure 10 – 1200 CDT HRRR sounding**

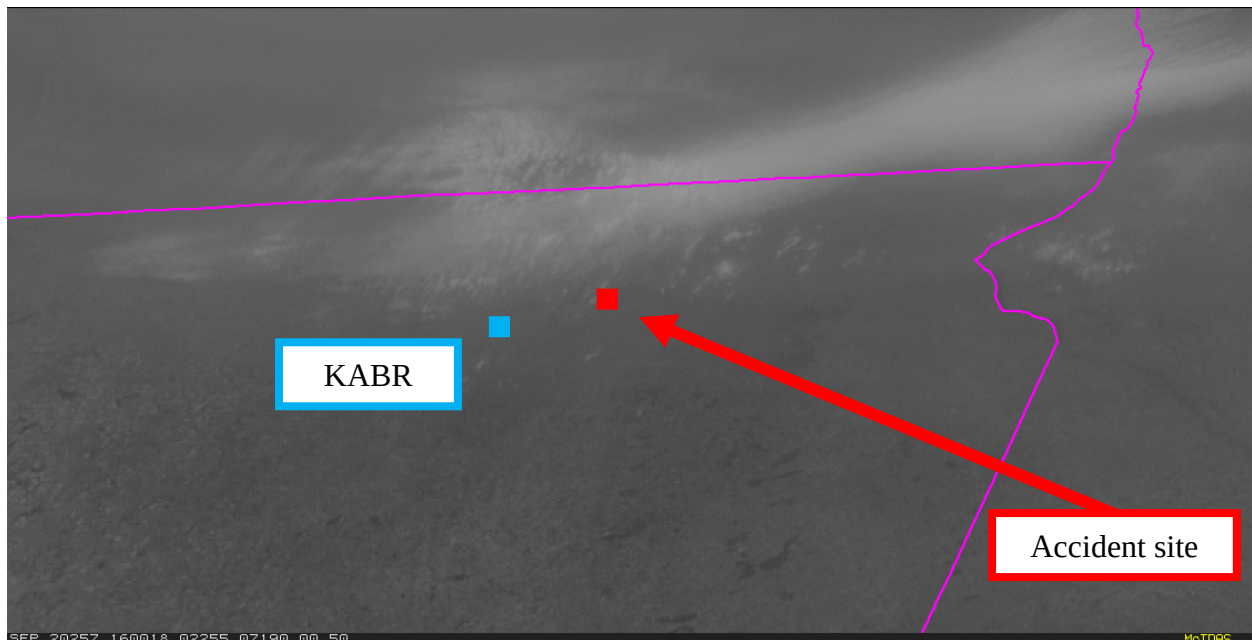
The 1100 and 1200 CDT HRRR soundings for the accident site indicated an unstable to conditionally unstable environment from the surface to near 2,500 ft msl (~1,200 ft agl). RAOB identified the possibility of clouds at 1200 CDT between ~2,750 and 4,000 ft msl.

The 1100 CDT HRRR sounding wind profile indicated a near surface wind from 173° at 2 knots with the wind remaining from the south through 2,000 ft msl. The wind turned to the southwest then west by 3,000 ft msl and the wind speed increased to 20 knots by 4,000 ft msl. At 1200 CDT, the HRRR sounding indicated a near surface wind from 002° at 7 knots with the wind remaining northerly through 3,000 ft msl with speeds between 5 and 10 knots. RAOB indicated the possibility of light low-level wind shear (LLWS) between 2,000 ft msl (~700 ft agl) and 3,500 ft msl at both 1100 and 1200 CDT. RAOB indicated areas of light to moderate clear-air turbulence existed in several layers between 2,250 ft msl (~900 ft agl) and 10,000 ft msl.

#### 4.0 Satellite Data

Geostationary Operational Environmental Satellite number 16 (GOES-16) visible and infrared 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 software. Visible and infrared imagery (GOES-16 bands 2 and 13) at wavelengths of 0.64 microns ( $\mu\text{m}$ ) and 10.3  $\mu\text{m}$ , respectively, were retrieved for the period from 0900 CDT through 1400 CDT and reviewed, and the closest visible image to the time of the accident was documented.

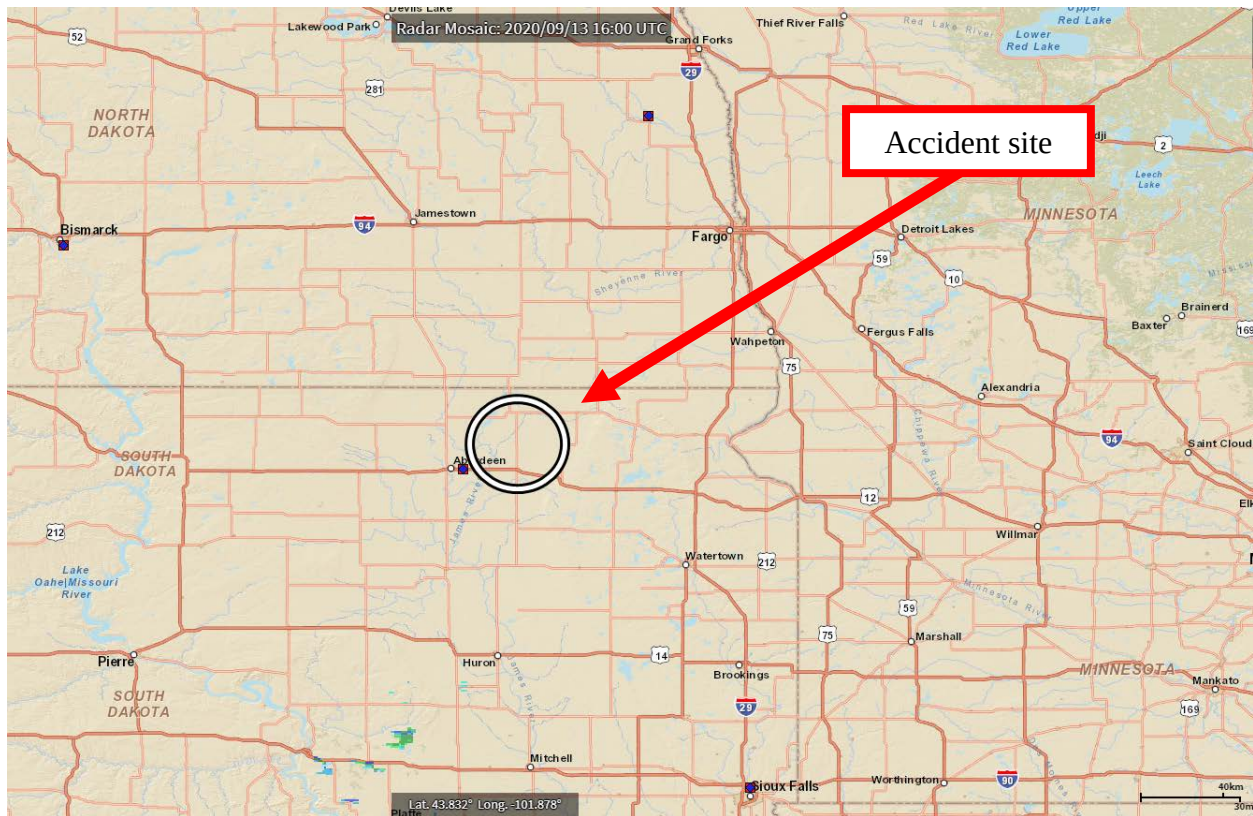
Figure 11 presents the GOES-16 visible imagery at 1100 CDT at 2X magnification with the accident site highlighted with a red square. The visible imagery indicated cloud cover north of the accident site at 1100 CDT. It should be noted these figures have not been corrected for any parallax error.



**Figure 11 – GOES-16 visible image at 1100 CDT**

#### 5.0 Regional Radar Imagery Information

A regional view of the NWS national composite radar mosaic is included as figure 12 for 1100 CDT with the approximate location of the accident site found within the white circle. The image depicted no precipitation echoes above the accident site at the accident time.



**Figure 12 – Regional Composite Reflectivity image for 1100 CDT**

## **6.0 Pilot Reports<sup>14</sup>**

There were no pilot reports (PIREP)s distributed into the national airspace within 100 miles of the accident site from about two hours prior to the accident time to two hours after the accident time.

## **7.0 SIGMETs**

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

## **8.0 CWSU Advisories**

There were no Center Weather Service Unit (CWSU) Meteorological Impact Statements (MIS) or Center Weather Advisories (CWA) valid for the accident site at the accident time.

<sup>14</sup> Only pilot reports with the World Meteorological Organization headers UBSD\*\*, UBND\*\*, and UBMN\*\* were considered.

## 9.0 AIRMETs

There were no Airmen's Meteorological Information (AIRMET) advisories valid at the accident site at the accident time.

## 10.0 Graphical Forecasts for Aviation

The Graphical Forecasts for Aviation (GFA) products made available before the accident flight and valid at 1000 CDT are shown in attachment 2. The GFA surface forecast products indicated VFR surface visibilities with a surface wind from the south at 5 to 10 knots south of the accident site and a surface wind from the north at 5 to 10 knots north of the accident site. The GFA cloud forecast valid before departure for 1000 CDT indicated clear skies. For more information please see attachment 2.

## 11.0 Terminal Aerodrome Forecast

KABR was the closest airport to the accident site with an NWS Terminal Aerodrome Forecast (TAF). The KABR TAF valid at the time departure was issued at 0640 CDT and was valid for a 24-hour period beginning at 0700 CDT. The TAF for KABR was as follows:

TAF KABR 131140Z 1312/1412 18006KT P6SM SKC  
**FM131600 36011KT P6SM SKC**  
FM131900 03013G22KT P6SM SKC  
FM140100 05010KT P6SM SKC=

At 1100 CDT, the forecast expected a wind from 360° at 11 knots, greater than 6 miles visibility, and clear skies. The surface wind was forecast to gust to 22 knots beginning at 1400 CDT.

## 12.0 NWS Area Forecast Discussion

The NWS office in Aberdeen, South Dakota, issued the following Area Forecast Discussion (AFD) at 0646 CDT (closest AFD to the accident time). The aviation section of the AFD discussed VFR conditions were expected to prevail all day with a wind shift to the north during the day due to a frontal boundary:

FXUS63 KABR 131146  
AFDABR

Area Forecast Discussion  
National Weather Service Aberdeen SD  
646 AM CDT Sun Sep 13 2020

.UPDATE...  
Issued at 645 AM CDT Sun Sep 13 2020

12z aviation discussion updated below.

&&

.SHORT TERM...(Today through Monday Afternoon)  
Issued at 346 AM CDT Sun Sep 13 2020

Radiational fog has developed over portions of the eastern forecast area, so have added patchy fog mentions through 14Z. Things look pretty quiet otherwise through the forecast period as upper level high pressure over most of the southwestern/south central CONUS lead to increasing heights over the region. This is leading to warmer temperatures for the next few days where the northern two thirds of the forecast area will see around average highs (mid 70s) today while highs for the southern third will be above average (mid to upper 80s). Everywhere will see well above average highs Monday as highs range from the low 80s to the low 90s. The one other main thing to note is conditions will become windy Monday afternoon as the region is sandwiched between surface low pressure over southern Saskatchewan and high pressure over the Great Lakes region. Southerly gusts of 25 to 35 mph are possible.

.LONG TERM...(Monday Evening through Saturday)  
Issued at 346 AM CDT Sun Sep 13 2020

The period starts out with modest upper level high pressure over the western U.S. with ridging extending northward into western Canada. We will have one more day with warm upper level heights over our region on Tuesday before they begin to fall into Wednesday and Thursday as the central Canadian upper level low pressure area drives cooler air south. Therefore, with sunshine on Tuesday with southwest winds becoming northwest as the leading edge of the cooler air moves in, highs will be in the 80s to lower 90s. Then the cool down will occur into Wednesday and Thursday as Canadian air pushes in on northeast to east winds. Highs Wednesday look to be mostly in the 70s with even cooler temperatures on Thursday in the 60s and lower 70s. The west coast upper ridge sharpens up and moves east into our region through the end of the week as an upper level low pressure area follows in behind. The cooler temperatures will remain across the cwa into Friday with a little warmer temperatures on Saturday.

Overall, the long term looks to be mostly dry. The best chances of rainfall look to be Saturday as the upper level low pressure area from the west moves near or into the region. At this time, have in some slight chances of showers/storms Thursday night and again Saturday afternoon.

&&

.AVIATION...(For the 12Z TAFS through 12Z Monday Morning)  
Issued at 645 AM CDT Sun Sep 13 2020

Terminals KABR,KATY,KPIR,KMBG

**VFR conditions are expected at all airports through today and tonight. A frontal boundary sinking in from the north today will bring winds around from south southwest to north northeast.**

\*\*\*Construction to improve taxiways at both KABR/KPIR terminals may cause an occasional temporary visibility reduction due to blowing dust (bldu), mainly during daytime hours UFN.

&&

.ABR WATCHES/WARNINGS/ADVISORIES...

SD...None.

MN...None.

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### 13.0 Winds and Temperature Aloft Forecast

The NWS 0855 CDT Winds and Temperature Aloft forecast valid for the closest point to the accident site is included below:

FBUS31 KWN0 131355

FD1US1

DATA BASED ON 131200Z

VALID 131800Z FOR USE 1400-2100Z. TEMPS NEG ABV 24000

FT 3000 6000 9000 12000 18000 24000 30000 34000 39000

**ABR 0211 2722+16** 2928+10 2931+02 3142-11 3046-24 304939 305049 305257

The accident site was located closest to the Aberdeen, South Dakota, (ABR) forecast point. The 0855 CDT ABR forecast for use between 0900 CDT and 1600 CDT indicated a wind at 3,000 ft from 020° at 11 knots and a wind at 6,000 ft from 270° at 22 knots with a temperature of 16°C.

### 14.0 Pilot Weather Briefing

The accident pilot did not request nor receive a weather briefing through Leidos Flight Service. A check of ForeFlight was done and revealed that the accident pilot did not request weather information through ForeFlight. There was no record of the accident pilot receiving or retrieving any other weather information before or during the accident flight.

## 15.0 Astronomical Data

The astronomical data obtained for the accident site on September 13, 2020, indicated the following:

|                      |                              |
|----------------------|------------------------------|
| <b>SUN</b>           |                              |
| Begin civil twilight | 0639 CDT                     |
| Sunrise              | 0709 CDT                     |
| <b>Accident time</b> | <b>1100 CDT<sup>15</sup></b> |
| Sun transit          | 1328 CDT                     |
| Sunset               | 1947 CDT                     |
| End civil twilight   | 2016 CDT                     |

## E. LIST OF ATTACHMENTS

Attachment 1 – KABR 5-minute ASOS information

Attachment 2 – GFA products valid for the accident flight

Submitted by:

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Paul Suffern  
Senior Meteorologist

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<sup>15</sup> Inserted accident time for reference and context.

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