



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

December 13, 2018

Factual Report

METEOROLOGY

CEN19FA021

Table Of Contents

A.	ACCIDENT	3
B.	METEOROLOGIST	3
C.	DETAILS OF THE INVESTIGATION	3
D.	FACTUAL INFORMATION	4
1.0	Synoptic Situation	4
1.1	Surface Analysis Chart	4
1.2	Upper Air Charts	5
2.0	SPC Products	10
3.0	Surface Observations	10
4.0	Upper Air Data	16
5.0	Satellite Data	19
6.0	Radar Imagery Information	20
7.0	Pilot Reports	21
8.0	SIGMET	22
9.0	CWSU Advisories	22
10.0	AIRMETs	23
11.0	Graphical Forecasts for Aviation	26
12.0	Terminal Aerodrome Forecast	27
13.0	NWS Area Forecast Discussion	27
14.0	Winds and Temperature Aloft Forecast	30
15.0	Pilot Weather Briefing	31
16.0	Astronomical Data	31
E.	LIST OF ATTACHMENTS	31

A. ACCIDENT

Location: Near Bradley, South Dakota
Date: November 2, 2018
Time: 1130 central daylight time
1630 Coordinated Universal Time (UTC)
Aircraft: Cessna 210, Registration: N81KD

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 November 2, 2018, 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.

The final wreckage location was located at latitude 45.1086° N, longitude 97.6944° W, at an approximate elevation of 1,873 feet (ft).

D. FACTUAL 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.¹

1.1 Surface Analysis Chart

The northcentral United States section of the NWS Surface Analysis Chart for 1000 CDT is provided as figure 1 with the approximate location of the accident site marked with the red circle. The chart indicated a trough² oriented northwest to southeast stretched across the accident area from central North Dakota southeastward to southern Iowa. A low pressure center was located in southern Iowa with a pressure of 1009-hectopascals (hPa). A high pressure center at 1017-hPa was located in southwestern South Dakota. Another low pressure center was located in southeastern Wyoming with a pressure of 1012-hPa, and its associated frontal boundaries stretched from central Montana southeastward into western Kansas.

The station models around the accident site depicted air temperatures in the mid 30’s to low 40’s degrees Fahrenheit (°F), dew point temperatures in the mid and upper 30’s °F with temperature-dew point spreads of 2° F or less, a north to east wind of 5 to 10 knots, overcast sky cover, mist, and light rain.

¹

https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/1030235

² Trough – An elongated area of relatively low atmospheric pressure or heights.

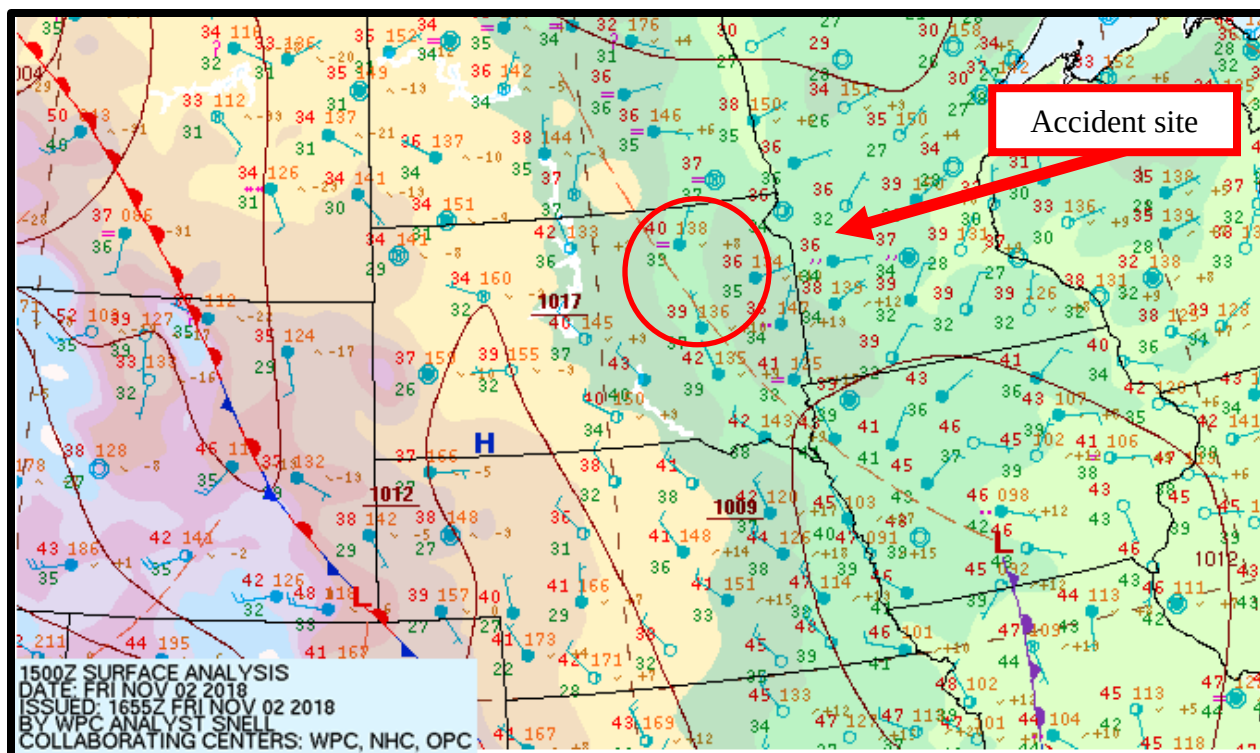


Figure 1 – NWS Surface Analysis Chart for 1000 CDT

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 2 through 6. There was a low pressure center at 925- and 850-hPa (figures 2 and 3) located over western Iowa associated with the surface low pressure center (figure 1) in Iowa. In addition, at 700-, 500-, and 300-hPa there were mid- and upper-level troughs located over Iowa just southeast of the accident site. Troughs can act as lifting mechanisms to help produce clouds and precipitation if sufficient moisture is present. The wind was from the north at 10 knots at both 925- and 850-hPa with the wind becoming northwesterly at 20 knots by 500-hPa (figure 5). At 300-hPa, the wind was from the northwest at 120 knots (figure 6).

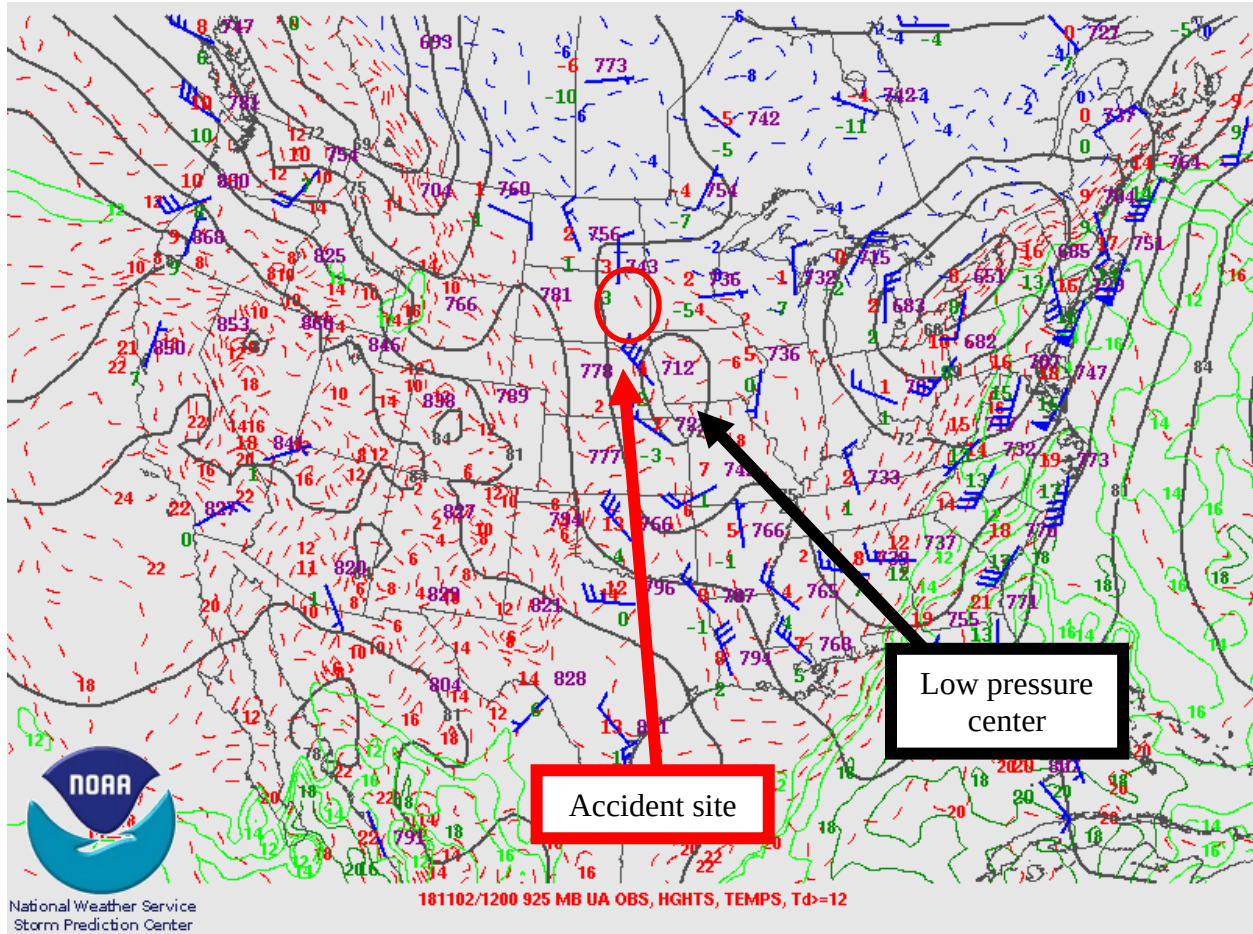


Figure 2 – 925-hPa Constant Pressure Chart for 0700 CDT

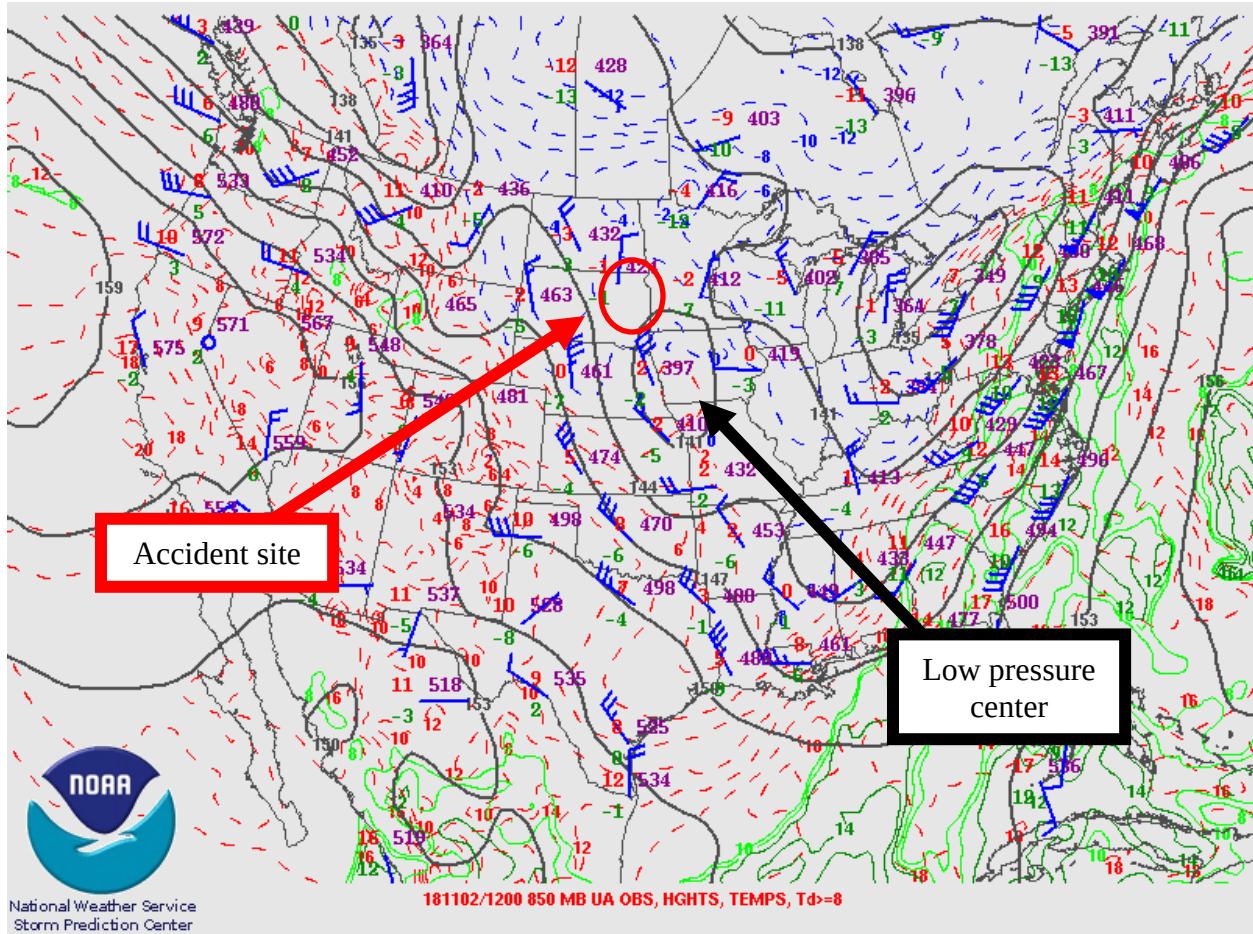


Figure 3 – 850-hPa Constant Pressure Chart for 0700 CDT

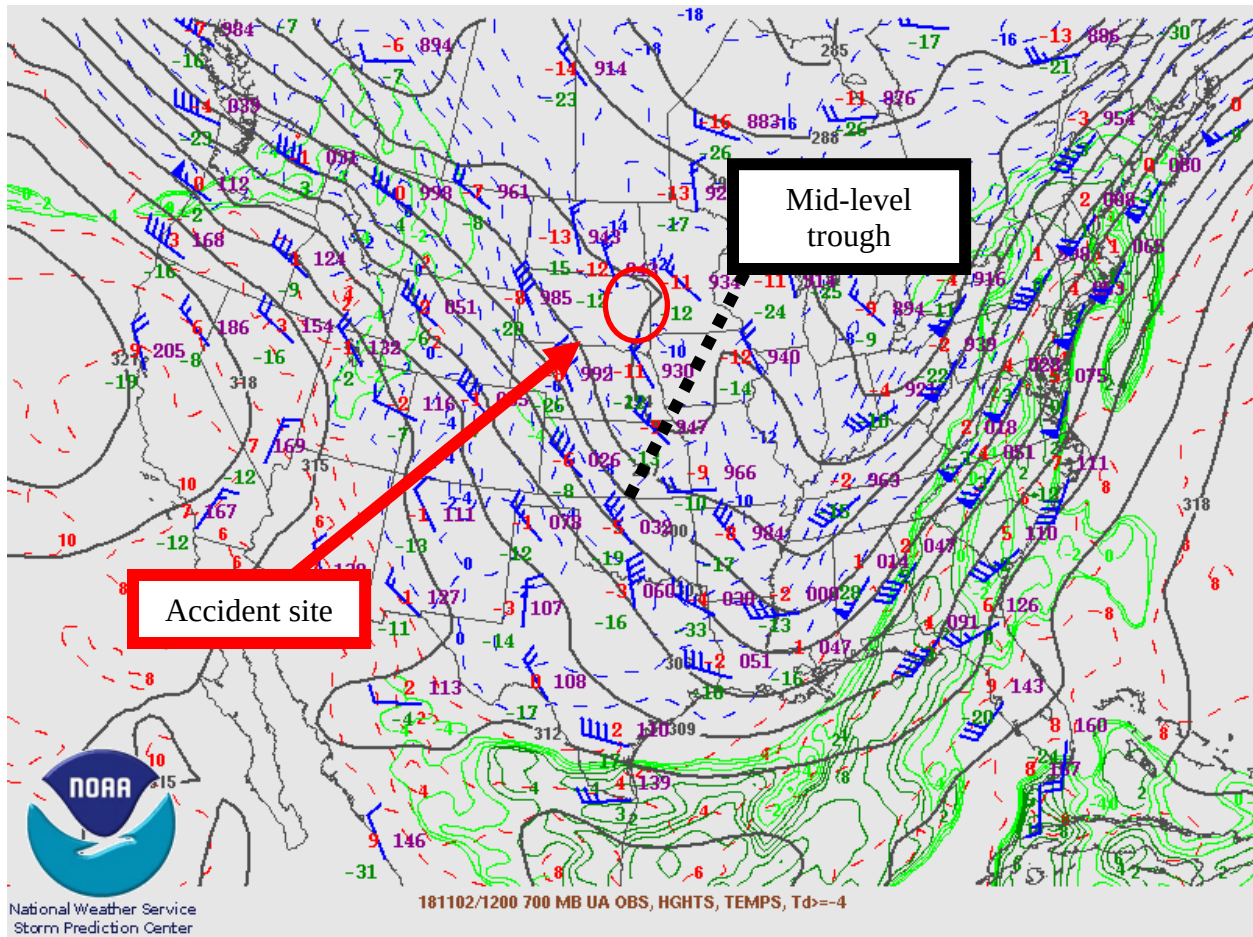


Figure 4 – 700-hPa Constant Pressure Chart for 0700 CDT

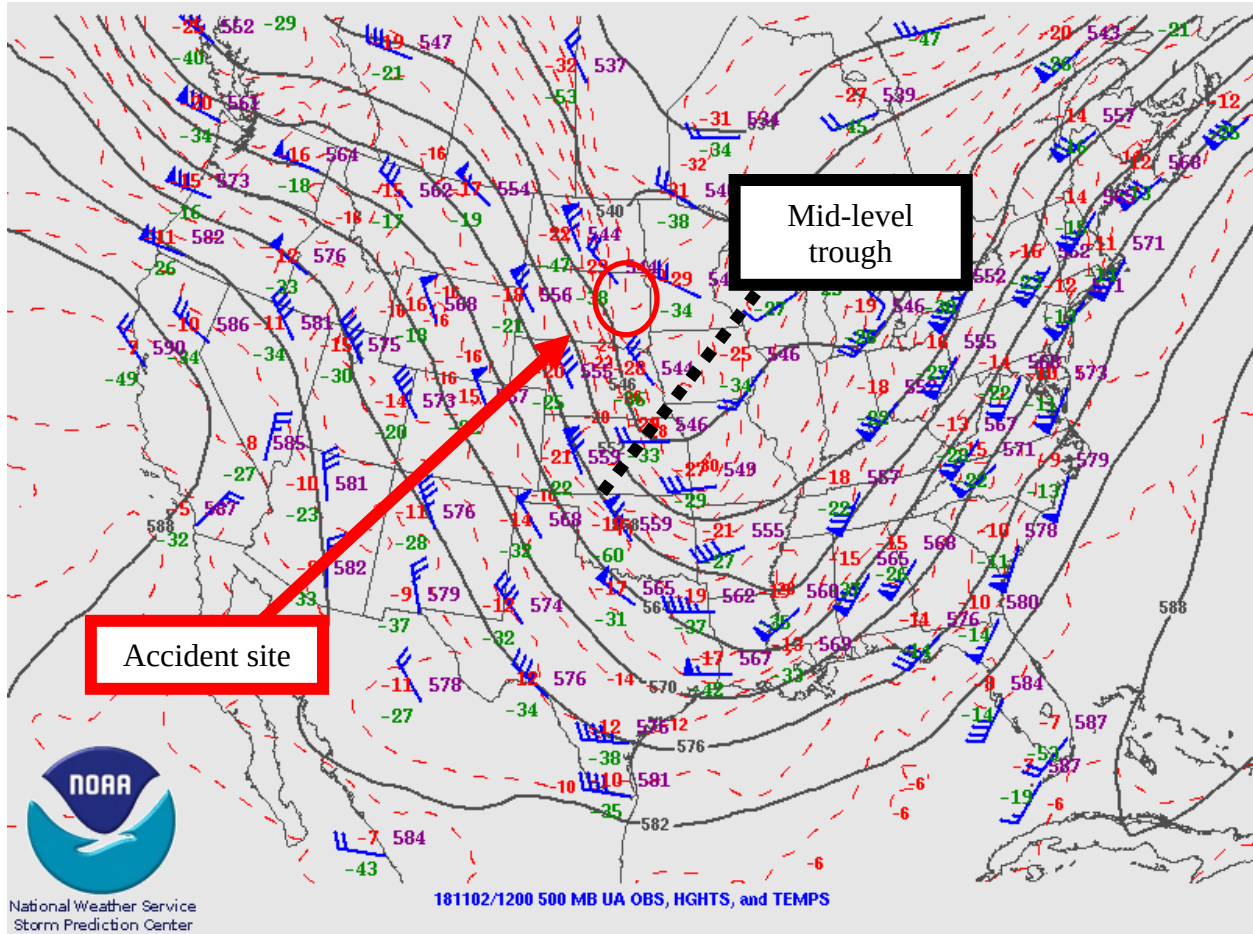


Figure 5 – 500-hPa Constant Pressure Chart for 0700 CDT

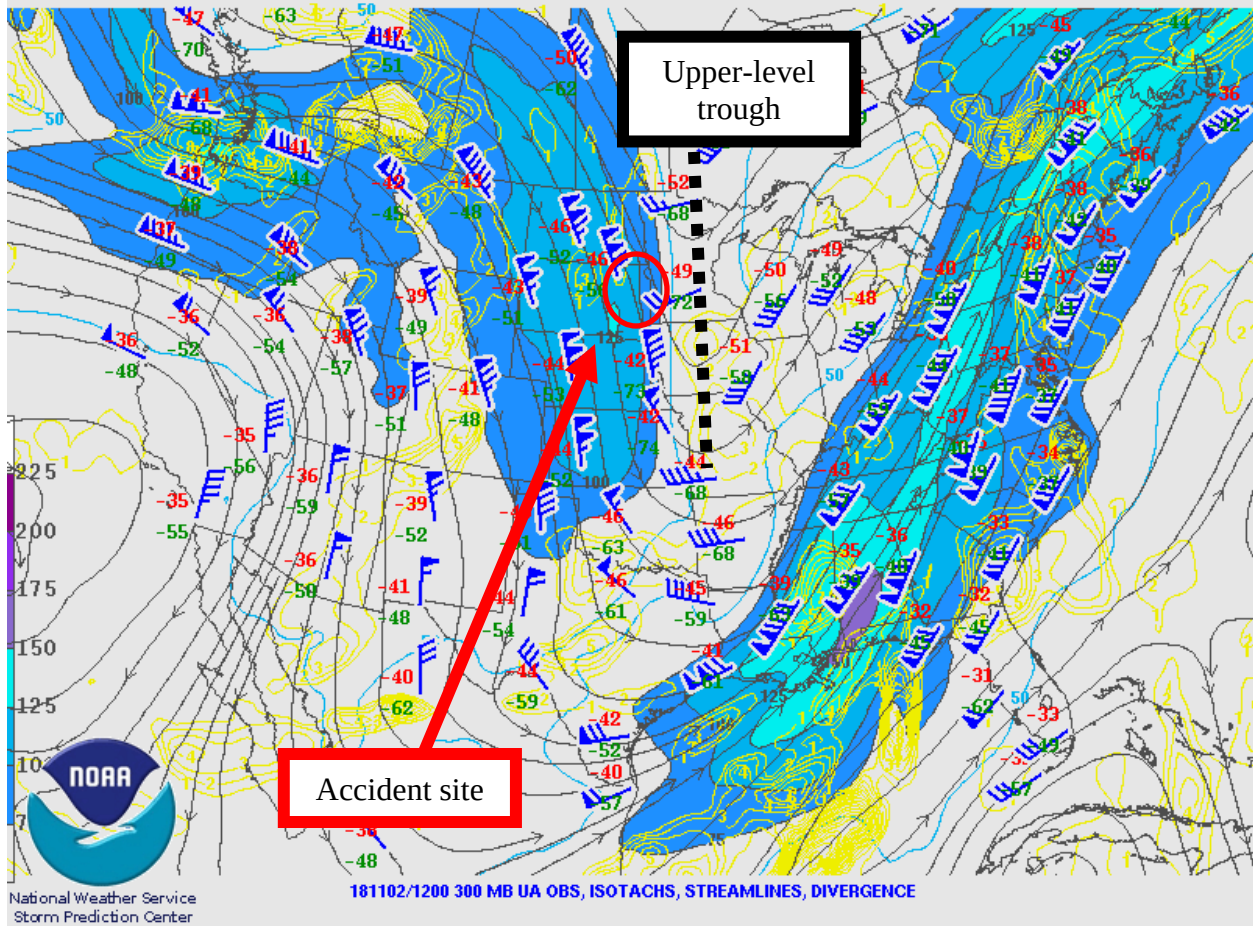


Figure 6 – 300-hPa Constant Pressure Chart for 0700 CDT

2.0 SPC Products

SPC did not forecast any thunderstorms to impact South Dakota around the accident time.

3.0 Surface Observations

The area surrounding the accident site was documented using official Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). Figure 7 is a sectional chart with the accident site and the closest weather reporting locations to the accident site marked. The intended route of flight is also marked on figure 7 (pink line) with the accident flight departing from Clark County Airport (8D7) at 1108 CDT and destined for The Sigurd Anderson Airport (1D7). The accident pilot had made a flight earlier in the day from Joe Foss Field Airport (KFSD) to 8D7 between approximately 0853 to 0940 CDT.

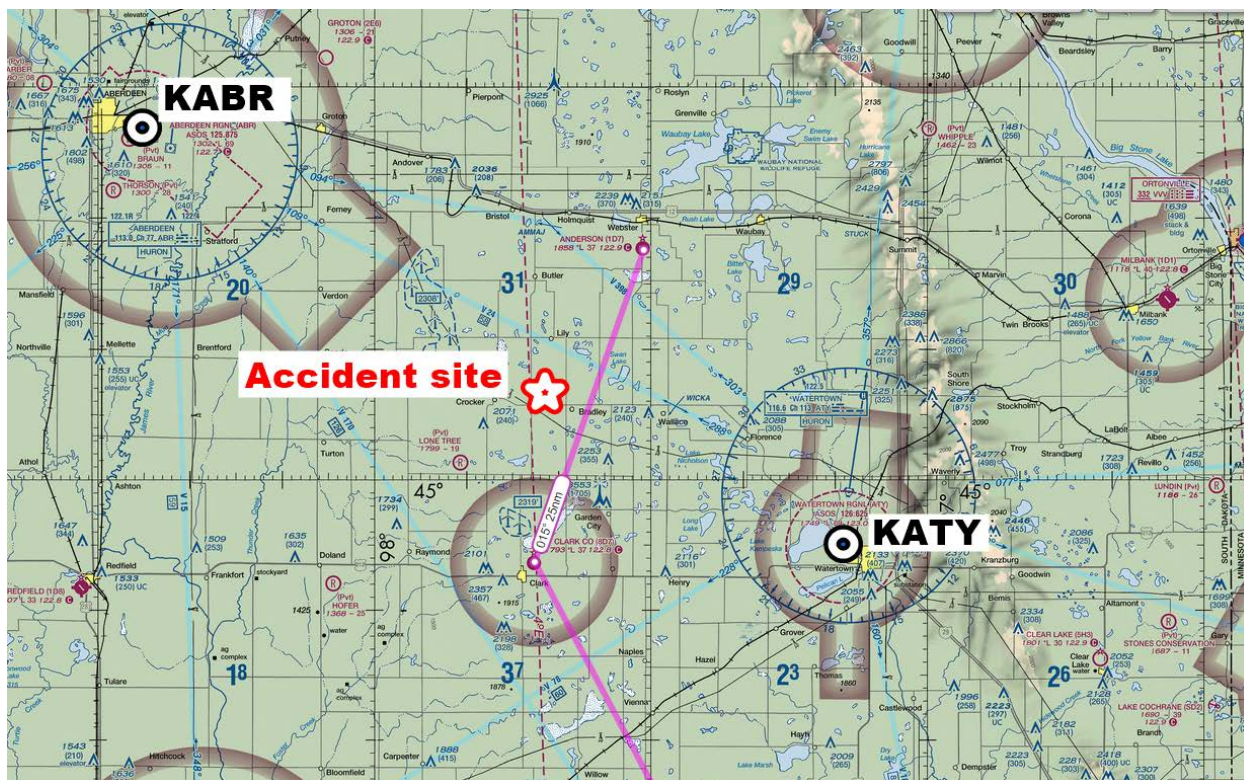


Figure 7 – Sectional chart of accident area with the location of the accident site and the closest surface observation sites and the intended route of flight (pink line)

Watertown Regional Airport (KATY) had the closest official weather observation point to the accident site, and was located 2 miles northwest of Watertown, South Dakota. KATY had an Automated Surface Observing System (ASOS³) whose reports were not supplemented. KATY was located 26 miles east-southeast of the accident site, at an elevation of 1,749 ft, and had a 4° easterly magnetic variation⁴ (figure 7). The following observations were taken and disseminated during the times surrounding the accident:⁵

[0753 CDT] METAR KATY 021253Z AUTO 06004KT 7SM BKN022 OVC030 03/02 A2986
RMK AO2 SLP124 T00280022=

[0821 CDT] SPECI KATY 021321Z AUTO 09004KT 8SM SCT008 BKN022 OVC030
03/02 A2986 RMK AO2 T00280022=

[0832 CDT] SPECI KATY 021332Z AUTO 07007KT 7SM BKN006 OVC022 03/02 A2987
RMK AO2 T00280022=

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

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

⁵ Bolded sections in this report highlight information that directly reference the weather conditions that affected the accident location around the accident time.

[0853 CDT] METAR KATY 021353Z AUTO 07004KT 8SM OVC006 03/02 A2987 RMK AO2 SLP128 T00280017=

ACCIDENT AIRCRAFT DEPARTED KFSD 0853 CDT

ACCIDENT AIRCRAFT LANDED AT 8D7 0940 CDT

[0953 CDT] METAR KATY 021453Z AUTO 08005KT 10SM OVC007 02/02 A2989 RMK AO2 CIG 006V011 SLP134 T00220017 53010=

[1053 CDT] METAR KATY 021553Z AUTO 06006KT 10SM OVC006 02/02 A2990 RMK AO2 SLP137 T00220017=

ACCIDENT AIRCRAFT DEPARTED 8D7 1108 CDT

ACCIDENT TIME 1130 CDT

[1153 CDT] METAR KATY 021653Z AUTO 09006KT 10SM SCT006 OVC019 03/02 A2989 RMK AO2 SLP133 T00280017=

[1253 CDT] METAR KATY 021753Z AUTO 11006KT 10SM FEW008 OVC020 03/02 A2988 RMK AO2 SLP131 T00330022 10033 20022 58004=

[1353 CDT] METAR KATY 021853Z AUTO 13005KT 10SM FEW009 OVC018 03/02 A2986 RMK AO2 SLP124 T00330022=

[1405 CDT] SPECI KATY 021905Z AUTO 13005KT 10SM BKN008 OVC018 03/02 A2986 RMK AO2 T00280022=

KATY weather at 0953 CDT, automated, wind from 080° at 5 knots, 10 miles visibility or greater, overcast ceiling at 700 ft above ground level (agl), temperature of 2° Celsius (C), dew point temperature of 2° C, and an altimeter setting of 29.89 inches of mercury. Remarks: automated station with a precipitation discriminator, ceiling varying between 600 and 1,100 ft agl, sea level pressure 1013.4 hPa, temperature 2.2° C, dew point temperature 1.7° C, 3-hourly pressure increase of 1.0 hPa.

KATY weather at 1053 CDT, automated, wind from 060° at 6 knots, 10 miles visibility or greater, overcast ceiling at 600 ft agl, temperature of 2° C, dew point temperature of 2° C, and an altimeter setting of 29.90 inches of mercury. Remarks: automated station with a precipitation discriminator, sea level pressure 1013.7 hPa, temperature 2.2° C, dew point temperature 1.7° C.

KATY weather at 1153 CDT, automated, wind from 090° at 6 knots, 10 miles visibility or greater, scattered clouds at 600 ft agl, overcast ceiling at 1,900 ft agl, temperature of 3° C, dew point temperature of 2° C, and an altimeter setting of 29.89 inches of mercury. Remarks: automated station with a precipitation discriminator, sea level pressure 1013.3 hPa, temperature 2.8° C, dew point temperature 1.7° C.

KATY weather at 1253 CDT, automated, wind from 110° at 6 knots, 10 miles visibility or greater, few clouds at 800 ft agl, overcast ceiling at 2,000 ft agl, temperature of 3° C, dew point temperature of 2° C, and an altimeter setting of 29.88 inches of mercury. Remarks: automated station with a precipitation discriminator, sea level pressure 1013.1 hPa, temperature 3.3° C, dew point temperature 2.2° C, 6-hourly maximum temperature of 3.3° C, 6-hourly minimum temperature of 2.2° C, 3-hourly pressure decrease of 0.4 hPa.

Aberdeen Regional Airport (KABR) was the next closest official weather observation point to the accident site, and was located 2 miles east of Aberdeen, South Dakota. KABR had an ASOS whose reports were not supplemented. KABR was located 37 miles northwest of the accident site at an elevation of 1,302 ft (figure 7). The following observations were taken and disseminated during the times surrounding the accident:

[0753 CDT] METAR KABR 021253Z AUTO 01005KT 4SM -RA BR FEW005 BKN016
OVC030 04/04 A2989 RMK AO2 RAB17E45B50 SLP130 P0002 T00440039=

[0835 CDT] SPECI KABR 021335Z AUTO 34006KT 4SM -RA BR BKN006 BKN013
OVC018 04/04 A2990 RMK AO2 P0002 T00440039=

[0853 CDT] METAR KABR 021353Z AUTO 36005KT 5SM BR OVC006 04/04 A2990
RMK AO2 RAE40 SLP133 P0002 T00440039=

ACCIDENT AIRCRAFT DEPARTED KFSD 0853 CDT

[0920 CDT] SPECI KABR 021420Z AUTO 01005KT 3SM BR OVC004 04/04 A2991
RMK AO2 T00440039=

ACCIDENT AIRCRAFT LANDED AT 8D7 0940 CDT

***[0953 CDT] METAR KABR 021453Z AUTO 02004KT 4SM BR OVC005 04/04 A2991
RMK AO2 SLP138 60004 T00440039 53008=***

***[1053 CDT] METAR KABR 021553Z AUTO 00000KT 4SM BR OVC005 05/04 A2991
RMK AO2 SLP136 T00500039=***

ACCIDENT AIRCRAFT DEPARTED 8D7 1108 CDT

ACCIDENT TIME 1130 CDT

***[1153 CDT] METAR KABR 021653Z AUTO 00000KT 5SM BR OVC005 06/04 A2990
RMK AO2 SLP133 T00560039=***

***[1253 CDT] METAR KABR 021753Z AUTO 04003KT 7SM OVC009 06/04 A2989 RMK
AO2 SLP130 60004 T00560039 10061 20044 58008=***

[1353 CDT] METAR KABR 021853Z AUTO 00000KT 6SM BR OVC008 06/04 A2987
RMK AO2 SLP124 T00560039=

[1453 CDT] METAR KABR 021953Z AUTO 25004KT 6SM BR OVC009 06/04 A2986
RMK AO2 SLP120 T00560039=

KABR weather at 0953 CDT, automated, wind from 020° at 4 knots, 4 miles visibility, mist, overcast ceiling at 500 ft agl, temperature of 4° C, dew point temperature of 4° C, and an altimeter setting of 29.91 inches of mercury. Remarks: automated station with a precipitation discriminator, sea level pressure 1013.8 hPa, 6-hourly precipitation of 0.04 inches, temperature 4.4° C, dew point temperature 3.9° C, 3-hourly pressure increase of 0.8 hPa.

KABR weather at 1053 CDT, automated, wind calm, 4 miles visibility, mist, overcast ceiling at 500 ft agl, temperature of 5° C, dew point temperature of 4° C, and an altimeter setting of 29.91 inches of mercury. Remarks: automated station with a precipitation discriminator, sea level pressure 1013.6 hPa, temperature 5.0° C, dew point temperature 3.9° C.

KABR weather at 1153 CDT, automated, wind calm, 5 miles visibility, mist, overcast ceiling at 500 ft agl, temperature of 6° C, dew point temperature of 4° C, and an altimeter setting of 29.90 inches of mercury. Remarks: automated station with a precipitation discriminator, sea level pressure 1013.3 hPa, temperature 5.6° C, dew point temperature 3.9° C.

KABR weather at 1253 CDT, automated, wind from 040° at 3 knots, 7 miles visibility, overcast ceiling at 900 ft agl, temperature of 6° C, dew point temperature of 4° C, and an altimeter setting of 29.89 inches of mercury. Remarks: automated station with a precipitation discriminator, sea level pressure 1013.0 hPa, temperature 5.6° C, dew point temperature 3.9° C, 6-hourly maximum temperature of 6.1° C, 6-hourly minimum temperature of 4.4° C, 3-hourly pressure decrease of 0.8 hPa.

The accident aircraft departed KFSD around 0853 CDT and landed at 8D7 around 0940 CDT. KFSD had an ASOS whose reports were supplemented by a certified weather observer. KFSD was located 100 miles south-southeast of the accident site at an elevation of 1,430 ft. The following observations were taken and disseminated during the times surrounding the accident:

[0656 CDT] METAR KFSD 021156Z 03005KT 6SM BR OVC049 05/04 A2983 RMK
AO2 SLP107 60025 70029 T00500039 10067 20050 51011=

[0756 CDT] METAR KFSD 021256Z 01004KT 7SM OVC035 05/04 A2984 RMK AO2
SLP113 T00500039=

[0833 CDT] ***SPECI KFSD 021333Z 36004KT 8SM BKN023 OVC033 05/03 A2986
RMK AO2 T00500033=***

ACCIDENT AIRCRAFT DEPARTED KFSD 0853 CDT

[0856 CDT] ***METAR KFSD 021356Z 36005KT 7SM OVC024 05/03 A2987 RMK AO2***

SLP120 T00500033=

ACCIDENT AIRCRAFT LANDED AT 8D7 0940 CDT

- [0956 CDT] ***METAR KFSD 021456Z 03005KT 6SM BR OVC025 05/03 A2988 RMK AO2 SLP125 T00500033 51017=***
- [1023 CDT] SPECI KFSD 021523Z 03005KT 2 1/2SM BR FEW007 OVC022 04/03 A2989 RMK AO2 TWR VIS 3 T00440028=
- [1037 CDT] SPECI KFSD 021537Z 03006KT 1 3/4SM BR FEW007 FEW012 OVC022 04/03 A2989 RMK AO2 TWR VIS 2 T00440033=
- [1043 CDT] SPECI KFSD 021543Z 02006KT 2SM BR FEW007 BKN012 OVC022 04/03 A2989 RMK AO2 T00440033=
- [1056 CDT] METAR KFSD 021556Z 02005KT 2SM BR SCT007 BKN012 OVC022 04/03 A2989 RMK AO2 SLP131 T00440033=

ACCIDENT AIRCRAFT DEPARTED 8D7 1108 CDT

- [1115 CDT] SPECI KFSD 021615Z 02006KT 2SM BR BKN007 BKN012 OVC023 04/03 A2989 RMK AO2 SFC VIS 2 1/2 T00440033=

ACCIDENT TIME 1130 CDT

- [1156 CDT] METAR KFSD 021656Z 01004KT 6SM BR BKN007 OVC012 04/03 A2990 RMK AO2 CIG 005V010 SLP133 T00440033=
- [1256 CDT] METAR KFSD 021756Z 04004KT 10SM OVC009 06/03 A2988 RMK AO2 CIG 008V012 SLP128 T00560033 10061 20044 50000=
- [1304 CDT] SPECI KFSD 021804Z 03003KT 10SM OVC010 06/03 A2988 RMK AO2 T00610028=
- [1356 CDT] METAR KFSD 021856Z 36004KT 10SM OVC012 06/03 A2987 RMK AO2 SLP123 T00610028=

KFSD weather at 0833 CDT, wind from 360° at 4 knots, 8 miles visibility, broken ceiling at 2,300 ft agl, overcast skies at 3,300 ft agl, temperature of 5° C, dew point temperature of 3° C, and an altimeter setting of 29.86 inches of mercury. Remarks: automated station with a precipitation discriminator, temperature 5.0° C, dew point temperature 3.3° C.

KFSD weather at 0856 CDT, wind from 360° at 5 knots, 7 miles visibility, overcast ceiling at 2,400 ft agl, temperature of 5° C, dew point temperature of 3° C, and an altimeter setting of 29.87

inches of mercury. Remarks: automated station with a precipitation discriminator, sea level pressure 1012.0 hPa, temperature 5.0° C, dew point temperature 3.3° C.

KFSD weather at 0956 CDT, wind from 030° at 5 knots, 6 miles visibility, mist, overcast ceiling at 2,500 ft agl, temperature of 5° C, dew point temperature of 3° C, and an altimeter setting of 29.88 inches of mercury. Remarks: automated station with a precipitation discriminator, sea level pressure 1012.5 hPa, temperature 5.0° C, dew point temperature 3.3° C, 3-hourly pressure increase of 1.7 hPa.

The observations from KATY and KABR surrounding the accident time indicated IFR⁶ conditions with mist and temperatures just 2° above 0° C at KATY. At KFSD at the time of departure (0853 CDT) conditions were MVFR⁷ with ceilings dropping to IFR by the accident time.

4.0 Upper Air Data

A High-Resolution Rapid Refresh (HRRR)⁸ model sounding was created for KFSD for 0900 CDT using a station elevation of 1,440 ft.⁹ The 0900 CDT HRRR sounding was plotted on a standard Skew-T Log P diagram¹⁰ with the derived stability parameters included in figure 8 (with data from the surface to 600-hPa (or approximately 14,000 ft msl). This data was analyzed using the RAOB¹¹ software package. The sounding depicted the lifted condensation level (LCL)¹² at 577 ft agl (2,017 ft msl), the level of free convection (LFC)¹³ at 619 ft agl (2,059 ft msl), and the convective condensation level (CCL)¹⁴ at 1,985 ft agl (3,425 ft msl). The sounding had a greater than 90 percent relative humidity from the surface through 7,000 ft. The freezing level was located at 4,237 ft msl. The precipitable water value was 0.48 inches.

⁶ Instrument Flight Rules (IFR) – Refers to the general weather conditions pilots can expect at the surface. IFR criteria means a ceiling below 1,000 ft agl and/or less than 3 miles visibility.

⁷ Marginal Visual Flight Rules – Refers to the general weather conditions pilots can expect at the surface. MVFR criteria means a ceiling 1,000 to 3,000 ft agl and/or 3 to 5 miles visibility.

⁸ 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.

⁹ HRRR sounding was created using NOAA Air Resource Laboratory: <https://ready.arl.noaa.gov/READYamet.php>

¹⁰ 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.

¹¹ RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamoras, Pennsylvania.

¹² LCL - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

¹³ 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.

¹⁴ 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.

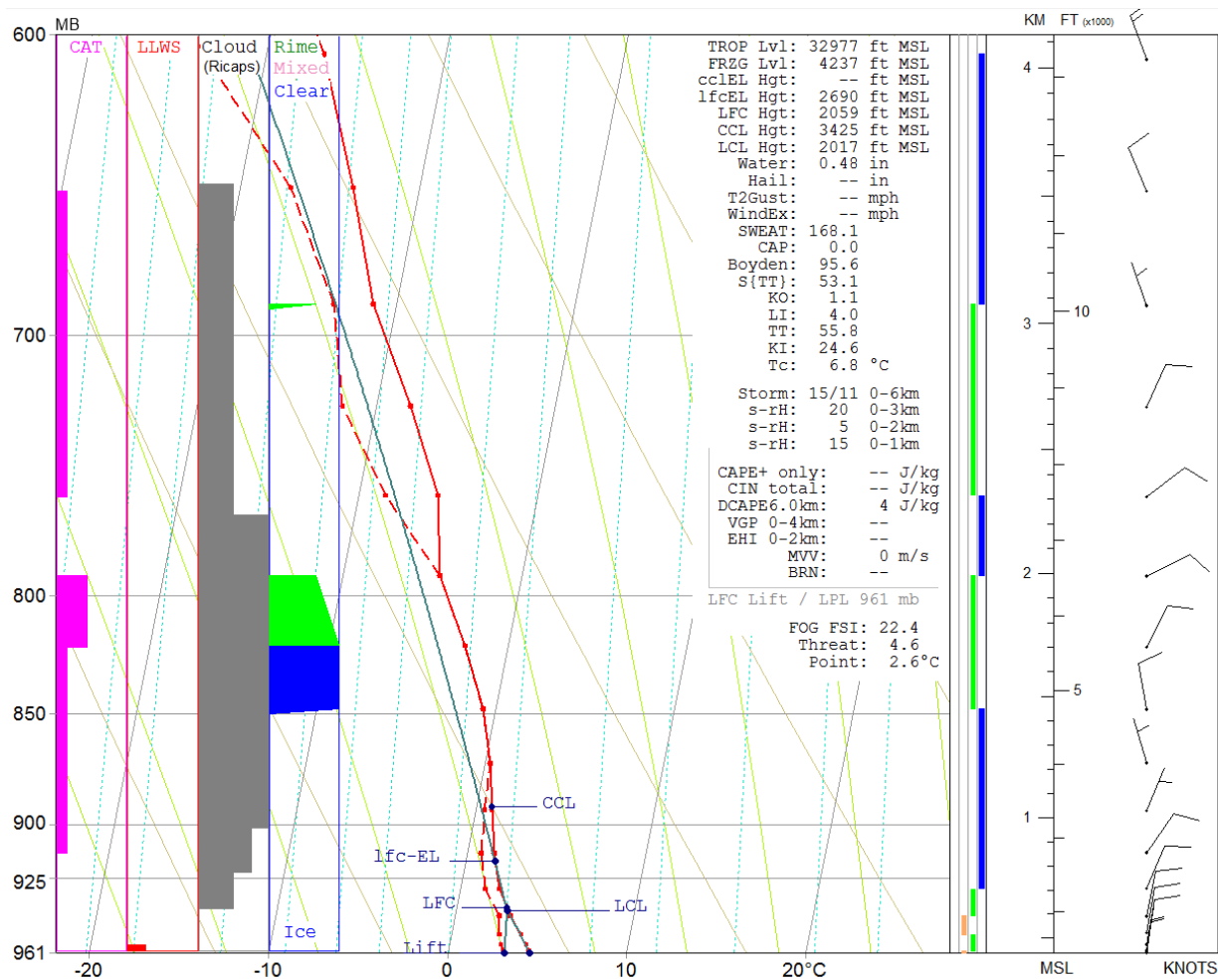


Figure 8 – 0900 CDT HRRR sounding for KFSD

The 0900 CDT HRRR sounding for KFSD indicated a conditionally unstable environment from the surface through 10,000 ft, except for two stable layers between 2,500 and 5,000 ft and between 6,500 and 7,500 ft. RAOB identified the possibility of clouds from 2,000 ft msl (~560 ft agl) through 11,500 ft msl. RAOB indicated moderate or greater rime or clear ice icing conditions between 5,000 ft and 6,500 ft msl.

The 0900 CDT HRRR sounding wind profile indicated a surface wind from 008° at 6 knots with the wind remaining between 5 and 10 knots through 10,000 ft. The wind direction remained between the north to northeast from the surface through 10,000 ft. RAOB indicated a small chance of very light low-level wind shear (LLWS) between the surface and 1,700 ft msl. RAOB indicated that a small chance of clear-air turbulence existed in several layers between the surface and 12,000 ft.

Another HRRR model sounding was created for the accident site for 1200 CDT using a station elevation of 1,785 ft. The 1200 CDT HRRR sounding was plotted on a standard Skew-T Log P diagram with the derived stability parameters included in figure 9. The sounding depicted the LCL at 781 ft agl (2,566 ft msl), the LFC at 781 ft agl (2,566 ft msl), and the CCL at 2,025 ft agl (3,810 ft msl). The sounding had a greater than 88 percent relative humidity from the surface through 9,000 ft. The freezing level was located at 3,692 ft msl. The precipitable water value was 0.41 inches.

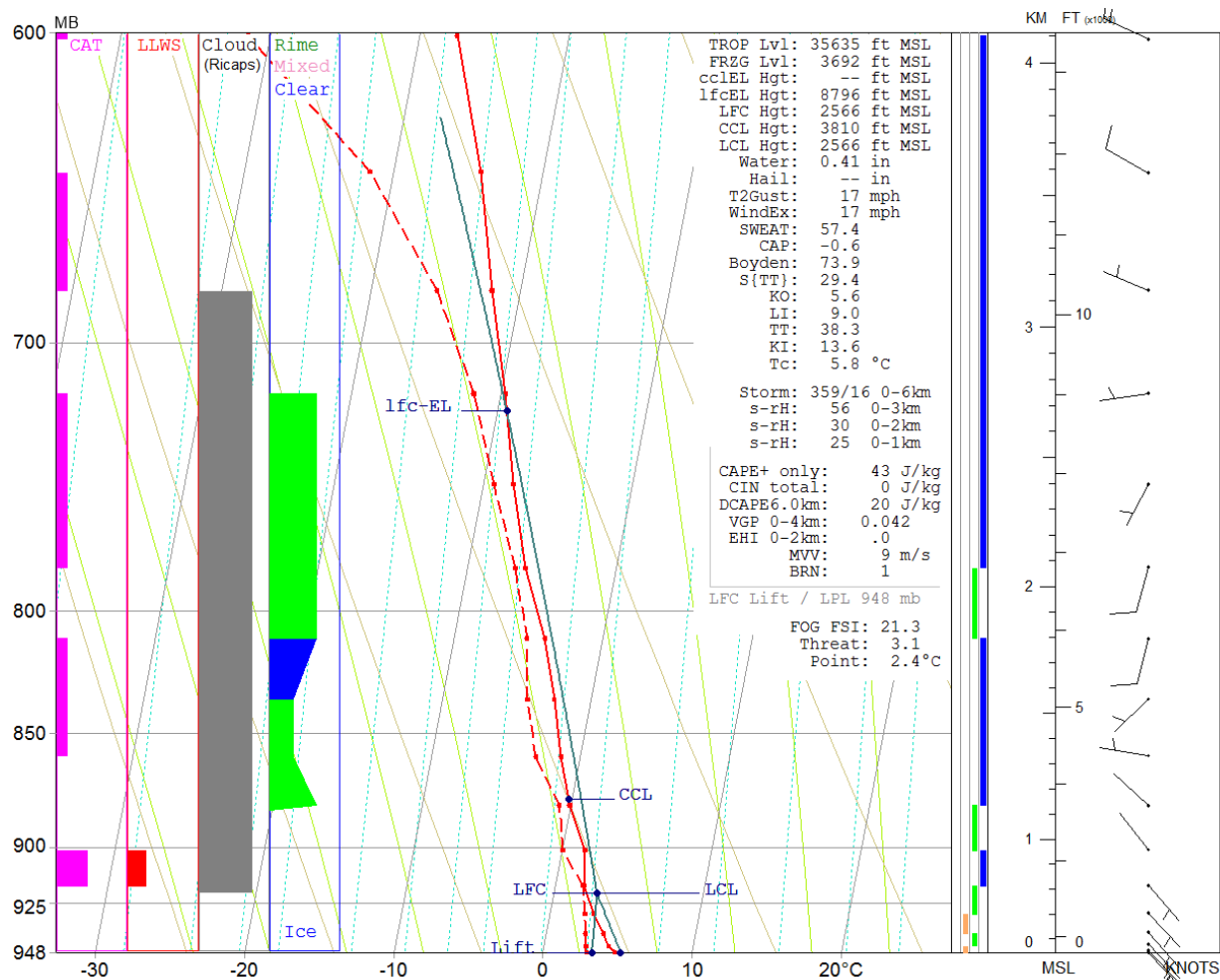


Figure 9 – 1200 CDT HRRR sounding for the accident site

The 1200 CDT HRRR sounding for the accident site indicated alternating conditionally unstable and stable environments from the surface through 7,000 ft. Above 7,000 ft the environment was stable. RAOB identified the possibility of clouds between 2,500 ft msl (~715 ft agl) through 11,500 ft msl. RAOB indicated moderate or greater rime or clear ice icing conditions between 3,500 ft and 9,000 ft msl.

The 1200 CDT HRRR sounding wind profile indicated a surface wind from 139° at 5 knots with the wind remaining between 5 and 10 knots through 10,000 ft. The wind direction was highly variable between the surface and 14,000 ft. RAOB indicated a small chance of very light LLWS between 2,750 and 3,250 ft msl. RAOB indicated a small chance of clear-air turbulence existed in several layers between the surface and 14,000 ft.

5.0 Satellite Data

Data from the Geostationary Operational Environmental Satellite number 16 (GOES-16) data was 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 (bands 2 and 13) imagery at a wavelength of 0.64 microns (μm) and 10.3 μm were retrieved for the period. Satellite imagery surrounding the time of the accident, from 0800 CDT through 1300 CDT at approximately 5-minute intervals were reviewed, and the closest images to the time of the accident are documented here.

Figure 10 presents the GOES-16 visible imagery from 1130 CDT at 2X magnification with the accident site highlighted with a red square. Inspection of the visible imagery indicated cloud cover over the accident site at the accident time. The lower cloud cover remained relatively stationary between 1017 and 1217 CDT (attachment 1). Figure 11 presents the GOES-16 infrared imagery from 1130 CDT 5X magnification with the accident site highlighted with a red square. Inspection of the infrared imagery indicated cloud cover over the accident site. The lower brightness temperatures (bright yellow and green colors; higher cloud tops) were located to the west of the accident site over western South Dakota. Based on the brightness temperatures above the accident site (268° Kelvin) and the vertical temperature profile provided by the 1200 CDT HRRR sounding, the approximate cloud-top heights over the accident site were 6,500 ft at 1130 CDT. It should be noted these figures have not been corrected for any parallax error.

Attachment 2 is an animation of visible imagery from 0852 to 0932 CDT with the air traffic control (ATC) flight data points (yellow dots) for each visible image time, with the blue dots being the airport locations similar to figure 10 and the blue dot of KFSD added at the southeastern portion of South Dakota. During the flight from KFSD to 8D7 earlier in the day, there was overcast cloud cover from KFSD through 8D7 (attachment 2). The approximate cloud-top heights over KFSD were 11,500 ft at 0853 CDT with approximate cloud-top heights of 10,000 ft at 0940 CDT over 8D7.

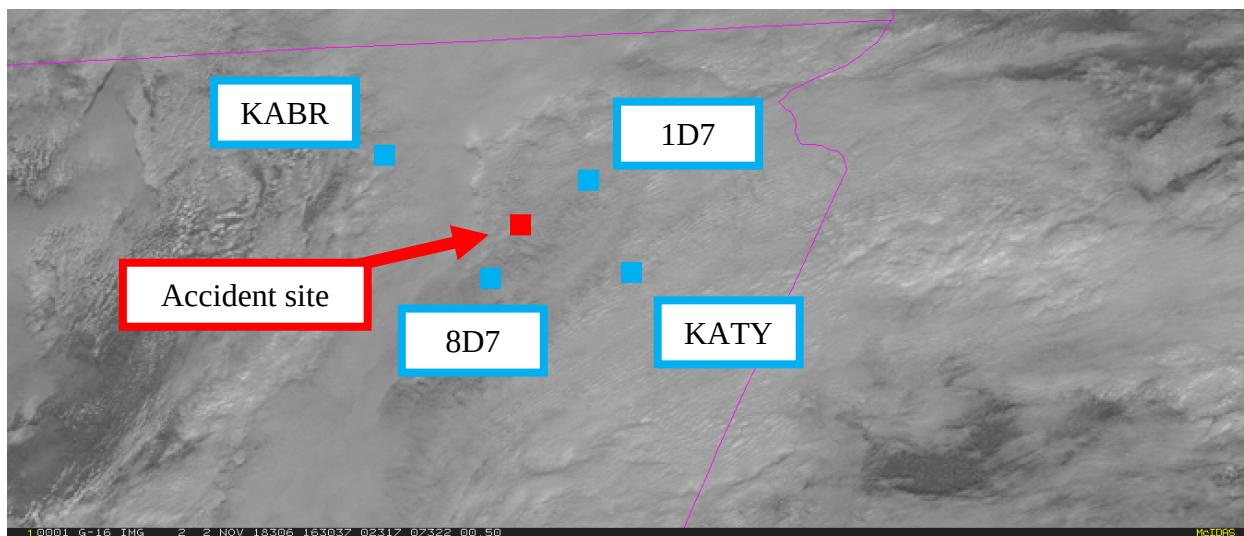


Figure 10 – GOES-16 visible image at 1130 CDT

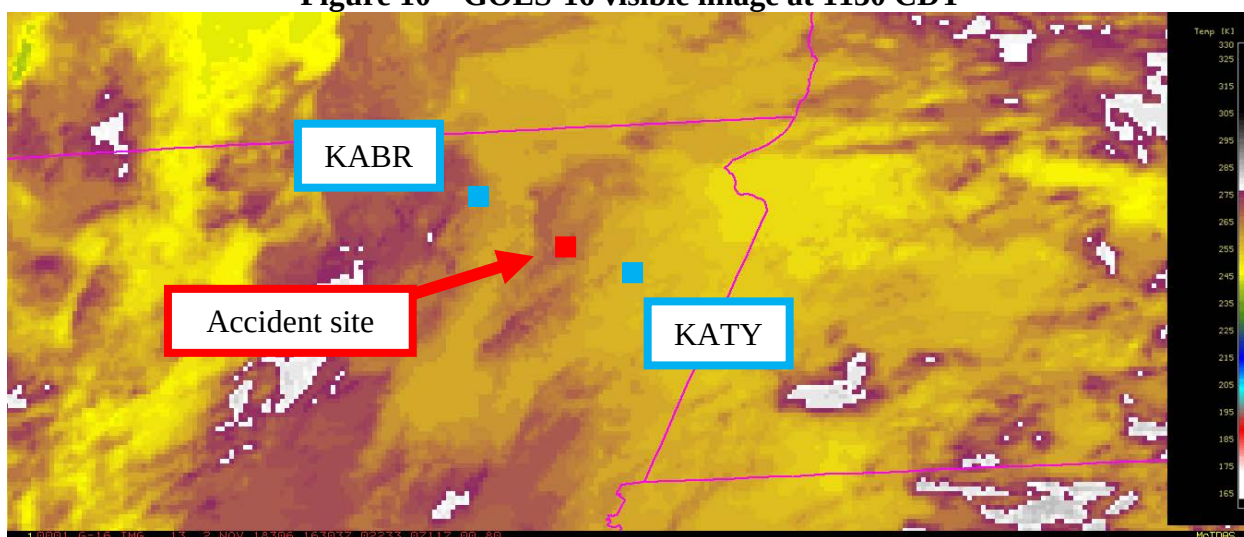


Figure 11 – GOES-16 infrared image at 1130 CDT

6.0 Radar Imagery Information

The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D)¹⁵ to the accident site was KABR. Level II archive radar data was obtained from the NCEI utilizing the NEXRAD Data Inventory Search and displayed using the NOAA's Weather and Climate Toolkit software. No precipitation targets were noted above the accident site around the accident time. A regional view of the NWS national composite radar mosaic is included as figure 12 for 1130 CDT with the approximate accident site marked by a red circle. The image depicted no echoes above the accident site, but light to moderate intensity echoes were depicted east of KATY and in western Minnesota.

¹⁵ The WSR-88D is an S-band 10-centimeter wavelength radar with a power output of 750,000 watts, and with a 28-foot parabolic antenna that concentrates the energy between a 0.87° and 0.96° beam width. The radar produces three basic types of products: base reflectivity, base radial velocity, and base spectral width.

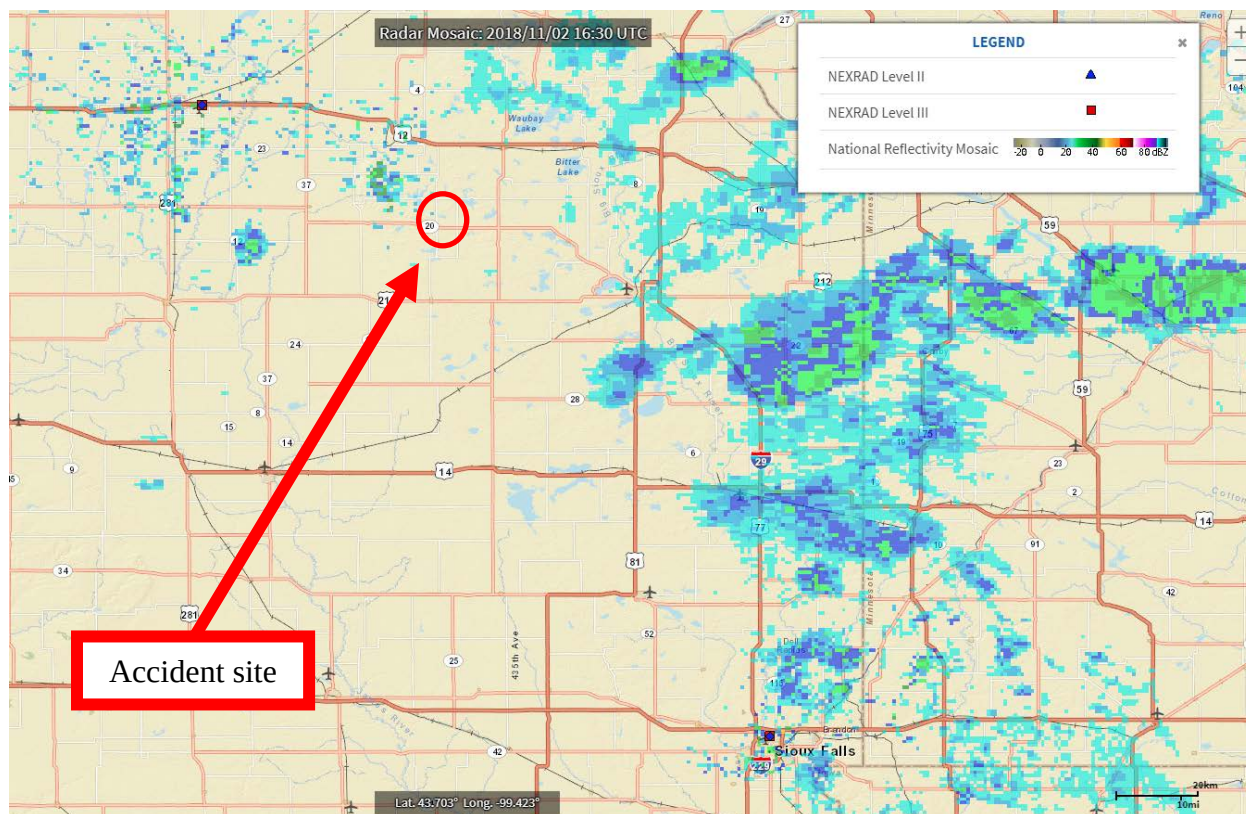


Figure 12 – Regional Composite Reflectivity image for 1130 CDT

7.0 Pilot Reports¹⁶

All PIREPs within 100 miles of the accident site from about four hour prior to the accident time to about two hours after the accident time were reviewed. Only PIREPs for below FL200¹⁷ are provided below:

FSD UA /OV FSD320005/TM 1235/FL060/TP BE9L/SK 060OVC065/TA M02/IC LGT CLR

ABR UA /OV ABR225045/TM 1253/FL080/TP PA31/SK TOP093/TA M10/IC MOD MX

FSD UA /OV FSD030010/TM 1318/FL078/TP BE20/TA M04/IC LGT RIME

FSD UA /OV FSD270010/TM 1350/FLDURC/TP BE9L/SK OVC036-TOP075/IC NEG ICE/RM HIGHER LAYERS ABOVE

FSD UA /OV FSD150015/TM 1507/FL040/TP CRJ7/SK OVC040-TOP125/IC TRACE RIME AOT 1

FSD UA /OV FSD045010/TM 1640/FLDURGC/TP C510/SK 020 OVC 095/TA M05/IC LGT MX

¹⁶ Only pilot reports with the World Meteorological Organization (WMO) headers UBSD**, UBMN**, and UBND** identifier were considered.

¹⁷ Flight Level – A Flight Level (FL) is a standard nominal altitude of an aircraft, in hundreds of ft. This altitude is calculated from the International standard pressure datum of 1013.25 hPa (29.92 inHg), the average sea-level pressure, and therefore is not necessarily the same as the aircraft's true altitude either above mean sea level or above ground level.

The decoded PIREPs in plain language from standard code and abbreviation were as follows:

Routine pilot report (UA), KFSD; Over – 5 miles from KFSD on the 320° radial; Time – 0735 CDT (1235Z); Altitude – 6,000 ft; Type aircraft – Beech King Air 90; Sky – Overcast skies 6,000 to 6,500 ft; Temperature – -2° C; Icing – Light clear.

Routine pilot report (UA), KABR; Over – 45 miles from KABR on the 225° radial; Time – 0753 CDT (1253Z); Altitude – 8,000 ft; Type aircraft – Piper PA-31 Navajo; Sky – Tops at 9,300 ft; Temperature – -10° C; Icing – Moderate mixed.

Routine pilot report (UA), KFSD; Over – 10 miles from KFSD on the 030° radial; Time – 0818 CDT (1318Z); Altitude – 7,800 ft; Type aircraft – Beechcraft Super King Air; Temperature – -4° C; Icing – Light rime.

Routine pilot report (UA), KFSD; Over – 10 miles from KFSD on the 270° radial; Time – 0850 CDT (1350Z); Altitude – During climb; Type aircraft – Beech King Air 90; Sky – Overcast skies 3,600 ft with tops to 7,500 ft; Icing – Negative; Remarks – Higher layers above.

Routine pilot report (UA), KFSD; Over – 15 miles from KFSD on the 150° radial; Time – 1007 CDT (1507Z); Altitude – 4,000 ft; Type aircraft – Bombardier CRJ-700; Sky – Overcast skies 4,000 ft with tops at 12,500 ft; Icing – Trace rime outside air temperature 1° C.

Routine pilot report (UA), KFSD; Over – 10 miles from KFSD on the 045° radial; Time – 1140 CDT (1640Z); Altitude – During climb; Type aircraft – Cessna Citation Mustang; Sky – Overcast skies 2,000 ft to 9,500 ft; Temperature – -5° C; Icing – Light mixed.

8.0 SIGMET

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

9.0 CWSU Advisories

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

10.0 AIRMETs

There were Airmen's Meteorological Information (AIRMET) advisories Sierra and Zulu that were valid for the accident site at the accident time. The same AIRMETs Sierra and Zulu were also valid for 8D7 and points northward during the timeframe of the flight from 0853 to 0940 CDT from KFSD to 8D7. The 0345 CDT AIRMETs warned of IFR conditions due to mist and fog and warned of moderate icing conditions between the freezing level¹⁸ and FL180. The 0945 CDT AIRMETs warned of IFR conditions due to mist and fog and warned of moderate icing conditions between the freezing level¹⁹ and 15,000 ft:

WAUS43 KPCI 020845

WA3S

-CHIS WA 020845

AIRMET SIERRA UPDT 1 FOR IFR AND MTN OBSCN VALID UNTIL 021500

.
AIRMET IFR...KS IA MO IL OK TX AR LA
FROM 20WSW IOW TO 20E BDF TO 20SE AXC TO 40SSE FAM TO 30SSE EIC
TO 50WSW GGG TO 30SSE MLC TO 30NE BUM TO 20WSW IOW
CIG BLW 010/VIS BLW 3SM BR/FG. CONDS ENDG 12-15Z.

.
AIRMET IFR...MI LH IN KY
FROM 50SSW YVV TO 30SE ECK TO FWA TO 40ESE GRR TO 50SSW YVV
CIG BLW 010/VIS BLW 3SM PCPN/BR/FG. CONDS ENDG BY 12Z.

.
AIRMET IFR...KY TN AL
FROM 20S HNN TO HNV TO GQO TO 50SW PZD TO 40W CEW TO 30SSW MSL
TO 60SW LOZ TO 20S HNN
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 15Z ENDG BY 18Z.

.
AIRMET IFR...ND SD MN
FROM 70NE MOT TO 60S YWG TO 60SSW BJI TO 40WNW RWF TO 50NW ABR
TO 30NE DIK TO 50NNW ISN TO 70NE MOT
CIG BLW 010/VIS BLW 3SM BR/FG. CONDS CONTG BYD 15Z ENDG 18-21Z.

.
AIRMET MTN OBSCN...KY TN
FROM HNN TO HNV TO GQO TO 20WNW LOZ TO HNN
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 15Z THRU 21Z.

....

WAUS43 KPCI 021445

WA3S

-CHIS WA 021445

AIRMET SIERRA UPDT 2 FOR IFR AND MTN OBSCN VALID UNTIL 022100

.
AIRMET IFR...MO IL
FROM 20NE AXC TO 60SW TTH TO 20W PXV TO 40SE STL TO 40WSW STL TO
20NE AXC
CIG BLW 010/VIS BLW 3SM BR. CONDS ENDG 15-18Z.

.
AIRMET IFR...ND SD
FROM 90WSW YWG TO 40WNW FAR TO 20S FAR TO 60N FSD TO 50SSW DIK

¹⁸ Freezing level between the surface and 7,000 ft.

¹⁹ Freezing level between 1,000 and 3,000 ft.

**TO 40N ISN TO 90WSW YWG
CIG BLW 010/VIS BLW 3SM BR/FG. CONDS ENDG 18-21Z.**

.
AIRMET MTN OBSCN...KY TN
FROM HNN TO HNV TO GQO TO 30WSW LOZ TO HNN
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 21Z THRU 03Z.

.
OTLK VALID 2100-0300Z...IFR ND SD
BOUNDED BY 70NE MOT-30ENE DPR-100SE MLS-50NNW ISN-70NE MOT
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS DVLPG AFT 21Z. CONDS
CONTG THRU 03Z.

....

WAUS43 KPCI 020845
WA3Z
-CHIZ WA 020845
AIRMET ZULU UPDT 1 FOR ICE AND FRZLVL VALID UNTIL 021500

.
AIRMET ICE...ND SD NE KS OK TX
FROM 50NNW ISN TO 30ENE DIK TO DPR TO 20NNE MCK TO 20S TUL TO 40W
MLC TO 60SW END TO 50W LBL TO GLD TO BFF TO 70SW RAP TO 50NNW ISN
MOD ICE BTN FRZLVL AND FL220. FRZLVL SFC-100. CONDS CONTG BYD 15Z
THRU 21Z.

.
**AIRMET ICE...ND SD NE KS MN IA MO WI LS MI IL OK AR
FROM 70WNW INL TO 60WSW YQT TO 30N RHI TO 40E ODI TO BDF TO FAM
TO 40E ELD TO 40NW TXK TO 40ESE MLC TO 40W MLC TO 20SSW TUL TO
20NW PWE TO 70S ABR TO 20E BIS TO 40NNW MOT TO 70WNW INL
MOD ICE BTN FRZLVL AND FL180. FRZLVL SFC-070. CONDS CONTG BYD 15Z
THRU 21Z.**

.
AIRMET ICE...MO LM MI LH IL IN KY AR TN
FROM 60NW YVV TO YVV TO 30SE ECK TO FWA TO CVG TO 40E CVG TO BNA
TO ARG TO FAM TO 30NE STL TO ORD TO 30NNW ASP TO 60NW YVV
MOD ICE BTN FRZLVL AND FL200. FRZLVL 030-070. CONDS CONTG BYD 15Z
THRU 21Z.

.
AIRMET ICE...KY TN AL
FROM HNN TO HNV TO GQO TO HNN
MOD ICE BTN FRZLVL AND FL220. FRZLVL 030-120. CONDS ENDG BY 12Z.

.
OTLK VALID 1500-2100Z...ICE ND SD NE KS MN IA MO WI LS MI IL IN
KY OK AR TN MS AL
BOUNDED BY 70SW YWG-70WNW INL-60WSW YQT-30NNW RHI-40E ODI-20N
AXC-50S PXV-50WSW MSL-20SW SQS-40E ELD-40NW TXK-MCI-OVR-70S
ABR-50NNW MOT-70SW YWG
MOD ICE BTN FRZLVL AND FL180. FRZLVL 010-070. CONDS CONTG THRU
21Z.

.
FRZLVL...RANGING FROM SFC-105 ACRS AREA
MULT FRZLVL 040-100 BOUNDED BY CVG-HNN-40W BKW-GQO-40E MEI-
MCB-40SSW AEX-40WSW MLU-50W BNA-CVG
SFC ALG 90SW YWG-30NNE FAR-30SE BRD-40SSW DLH-70E INL-80E INL
040 ALG 70NW RAP-20NW OBH-40NW FSD-40N FSD-20NNW BDF-50W BWG-
20E CVG
080 ALG 40SSE LOZ-20S HNN

....

WAUS43 KPCI 021445

WA3Z

-CHIZ WA 021445

AIRMET ZULU UPDT 3 FOR ICE AND FRZLVL VALID UNTIL 022100

.

...SEE SIGMET WHISKEY SERIES...

.

AIRMET ICE...ND SD NE

FROM 50NNW ISN TO 50NE ISN TO 20SSW BIS TO 40ENE AKO TO BFF TO
70SW RAP TO 50NNW ISN

MOD ICE BTN FRZLVL AND FL200. FRZLVL SFC-060. CONDS DVLPG AFT
15Z. CONDS CONTG BYD 21Z THRU 03Z.

.

AIRMET ICE...SD KS MN IA MO WI IL IN KY AR TN MS AL

FROM 40SW BRD TO 20WNW DLL TO PXV TO MSL TO 20NW IGB TO 30NE TXK
TO 40S FSM TO 30E OVR TO 30N FSD TO 40SW BRD

MOD ICE BTN FRZLVL AND FL180. FRZLVL 030-070. CONDS CONTG BYD 21Z
THRU 03Z.

.

AIRMET ICE...MN MO WI LM LS MI LH IL IN KY TN

FROM YQT TO SSM TO YVV TO 30SE ECK TO FWA TO CVG TO 30W HNN TO
50WNW VXV TO 30ESE BNA TO 20N MSL TO 20NNW PXV TO 50SSW JOT TO
30NE BAE TO YQT

MOD ICE BTN 030 AND 120. CONDS CONTG BYD 21Z THRU 03Z.

.

AIRMET ICE...ND SD MN WI LS

**FROM 40NNE INL TO 30NNW DLH TO 40NNE EAU TO 20WNW DLL TO 40SW BRD
TO 40N FSD TO 20NE ABR TO 70NE MOT TO 40NNE INL**

**MOD ICE BTN FRZLVL AND 150. FRZLVL 010-030. CONDS CONTG BYD 21Z
THRU 03Z.**

.

OTLK VALID 2100-0300Z

AREA 1...ICE SD NE KS

BOUNDED BY 80SW DIK-40S PIR-30WNW OVR-70ESE SLN-20NNE ICT-20S
HLC-40ENE LAA-GLD-BFF-70SW RAP-80SW DIK

MOD ICE BTN FRZLVL AND FL220. FRZLVL 020-100. CONDS CONTG THRU
03Z.

.

AREA 2...ICE MI LH IL IN KY TN

BOUNDED BY 70NW YVV-YVV-30SE ECK-FWA-CVG-HNN-HMV-50SSW VXV-20ESE
BNA-40SW TTH-40WSW FWA-70NW YVV

MOD ICE BTN 040 AND 120. CONDS CONTG THRU 03Z.

.

AREA 3...ICE IA MO WI IL IN KY AR TN MS AL

BOUNDED BY 60SW BAE-40SE BDF-30ENE AXC-30ESE BNA-GQO-40W
VUZ-60ESE LIT-30WNW IRK-40SW FOD-30SW DBQ-60SW BAE

MOD ICE BTN FRZLVL AND FL180. FRZLVL 030-070. CONDS CONTG THRU
03Z.

.

AREA 4...ICE ND SD MN IA WI LS IL

BOUNDED BY 70SW YWG-30N INL-80WNW YQT-40N DLH-50SSE DLH-50SW
RHI-60SW BAE-30SW DBQ-40SW FOD-70SW YWG

MOD ICE BTN FRZLVL AND 150. FRZLVL 010-040. CONDS CONTG THRU 03Z.

.

AREA 5...ICE ND SD NE
BOUNDED BY 60NNW MOT-50NNE MOT-60E MOT-40SE ABR-30E ONL-80SW
DIK-50NNW ISN-60NNW MOT
MOD ICE BTN FRZLVL AND FL200. FRZLVL SFC-060. CONDS CONTG THRU
03Z.

.
FRZLVL...RANGING FROM 010-100 ACRS AREA
MULT FRZLVL 040-090 BOUNDED BY 70SSW ISN-60ESE LBF-20SSW MCK-
20NW GLD-BFF-70SW RAP-70SSW ISN
MULT FRZLVL 040-090 BOUNDED BY CVG-HNN-50WSW BKW-30SW V XV-
30SE BNA-CVG
MULT FRZLVL 050-100 BOUNDED BY GQO-LGC-MGM-30SW LCH-30NNE IAH-
30SW IGB-20NE MSL-GQO
040 ALG 80SW DIK-50S ANW-20NW OBH-20W FSD-50SE RWF-40E PXV-
60E CVG
080 ALG 40E LAA-20W GCK-30E LBL
....

11.0 Graphical Forecasts for Aviation

The Graphical Forecasts for Aviation (GFA) products made available before the flight from KFSD and 8D7, and before the accident flight are shown in attachment 3. The GFA surface forecast products showed the AIRMET Sierra (section 10.0) valid for the accident site and at 8D7 and points northward, but indicated mainly VFR²⁰ conditions across northeastern South Dakota with the IFR conditions located mainly in North Dakota and western Minnesota. However, the GFA cloud forecast products indicated consistently overcast ceilings at 2,000 ft msl with cloud tops between 7,000 and 9,000 ft msl near the accident site at the accident time. Overcast ceilings were forecast to be between 3,500 and 5,000 ft msl between 8D7 and KFSD. For more information please see attachment 3.

The reason for the differences between the GFA surface forecast and the GFA cloud forecast is the two are computed automatically by two different weather models. The Rapid Refresh (RAP) weather model is used for the cloud forecast and the Localized Aviation MOS²¹ Program (LAMP) weather model is used for the surface forecast charts, and both forecasts are issued with no human intervention. The only human-generated information reflected in the two GFA products are the AIRMETs. The GFA is “human-over-the-loop.”

²⁰ Visual Flight Rules – Refers to the general weather conditions pilots can expect at the surface. VFR criteria means a ceiling greater than 3,000 feet agl and greater than 6 miles visibility.

²¹ Model Output Statistics: https://www.weather.gov/mdl/mos_home

12.0 Terminal Aerodrome Forecast

KATY was the closest site with a NWS Terminal Aerodrome Forecast (TAF). The KATY TAF valid at the accident time (and valid at the time of the flight between KFSD and 8D7) was an amended TAF issued at 0736 CDT and was valid for a 23-hour period beginning at 0800 CDT. The 0736 CDT TAF for KATY was as follows:

KATY 021236Z 0213/0312 07004KT 6SM BR FEW007 OVC021
FM021600 VRB04KT P6SM OVC012
FM022000 13005KT P6SM OVC020
FM030900 12007KT 5SM -RA BR OVC008=

Between 1100 and 1500 CDT, the TAF expected a variable wind at 4 knots, greater than 6 miles visibility, and an overcast ceiling at 1,200 ft agl.

13.0 NWS Area Forecast Discussion

The NWS Office in Aberdeen, South Dakota, issued the following Area Forecast Discussion (AFD) at 0624 and 1025 CDT (closest AFD to the accident time with an aviation section). The aviation section of the AFD discussed a mix of ceiling conditions across the area with conditions expected to improve during the day. Another system was expected to move across the region that night and bring lower ceiling conditions again:

FXUS63 KABR 021124
AFDABR

Area Forecast Discussion
National Weather Service Aberdeen SD
624 AM CDT Fri Nov 2 2018

.SHORT TERM...(Today and Tonight)
Issued at 420 AM CDT Fri Nov 2 2018

Light precipitation, mainly rain/sprinkles continues across the far east of the state into western Minnesota this morning with stratus having encompassed much of the Dakotas (though with noticeable thinness and sporadic gaps). With the stratus in place all day, temperatures will struggle to warm much, though with the gaps and filtered sunshine - mid 40s seems achievable thanks to a lack of thermal advection.

Adjusted timing in the onset of precipitation this afternoon/evening west river through the Missouri valley, and then overnight with the latest CAMS, though there isn't a real significant change with the system timing and expected outcome. Profiles support snow aloft, but with a 2-4kft thick above freezing layer, and cloud cover keeping ground temperatures above the freezing mark, its more than likely snow will be at a state of melting or have melted by the time it reaches the surface. SREF and GEFS plumes are in agreement, though KMBG seems to have the highest probability that some snow will exist as the predominant P-Type, though this is only ever as high as 20-30 percent. Still, cant rule out some accumulation for our minor

terrain, such as the ridges in Corson/Dewey counties and out towards the Leola hills and parts of the Missouri Coteau.

.LONG TERM...(Saturday through Thursday)
Issued at 420 AM CDT Fri Nov 2 2018

There are few chances for precip in the forecast between Saturday and Thursday. First, there's one precipitation event ongoing at the start of the period. Model soundings and gridded guidance supports mainly a rain event (system-relative warm conveyor belt/waa-forced), although the column (in higher terrain areas of the CWA) may end up cooling down enough for rain to mix with or change over to snow late in the event Saturday evening/overnight. Tough to say if drizzle potential will be around in between systems on Sunday as model soundings maintain a (deep enough?) stratus layer over pretty much the whole CWA heading into Sunday night/Monday when the next s/w trof rotates through the region. Again, model soundings Sunday night into Monday at/around potential precip onset have to re-saturate between "near surface" and 700hpa. For the most part, p-type in the soundings suggests a better chance for rain to be happening. But, gridded guidance this morning is showing a lack of ice present in the prob-ice field, some additional non-rain p-types ended up falling out of the collaborative process this morning for a few hours before p-type goes to all rain by mid/late morning on Monday. Beyond that, the most significant attention grabbers in the out periods is the continued nw flow pattern aloft and the potential to see 850hpa/925hpa air cold enough to prohibit high temps from getting out of the 20s next Thursday.

&&

.AVIATION...(For the 12Z TAFS through 12Z Saturday Morning)
Issued at 622 AM CDT Fri Nov 2 2018

A mix of CIGS across the region this morning due to stratus. CIGS will improve during the day, but another system tonight will bring us back down to a mix of MVFR/IFR with some mixed precipitation possible as well for KMBG/KABR.

&&

.ABR WATCHES/WARNINGS/ADVISORIES...
SD...None.
MN...None.
&&

\$\$

FXUS63 KABR 021525 AAA
AFDABR

Area Forecast Discussion...UPDATED
National Weather Service Aberdeen SD
1025 AM CDT Fri Nov 2 2018

.UPDATE...

Issued at 1024 AM CDT Fri Nov 2 2018

Upper level shear axis across the eastern dakotas late this morning will be pushing east through the day. As it does, the areas of light rain across the eastern cwa are expected to dissipate. Much of the east should stay cloudy today with more breaks showing up on satellite across the west this morning along with high level clouds streaming over. Highs in the lower to mid 40s still looks good for today. The winds should all become southeast into the evening as the inverted low pressure trough in the east dissipates.

&&

.SHORT TERM...(Today and Tonight)
Issued at 420 AM CDT Fri Nov 2 2018

Light precipitation, mainly rain/sprinkles continues across the far east of the state into western Minnesota this morning with stratus having encompassed much of the Dakotas (though with noticeable thinness and sporadic gaps). With the stratus in place all day, temperatures will struggle to warm much, though with the gaps and filtered sunshine - mid 40s seems achievable thanks to a lack of thermal advection.

Adjusted timing in the onset of precipitation this afternoon/evening west river through the Missouri valley, and then overnight with the latest CAMS, though there isn't a real significant change with the system timing and expected outcome. Profiles support snow aloft, but with a 2-4kft thick above freezing layer, and cloud cover keeping ground temperatures above the freezing mark, its more than likely snow will be at a state of melting or have melted by the time it reaches the surface. SREF and GEFS plumes are in agreement, though KMBG seems to have the highest probability that some snow will exist as the predominant P-Type, though this is only ever as high as 20-30 percent. Still, cant rule out some accumulation for our minor terrain, such as the ridges in Corson/Dewey counties and out towards the Leola hills and parts of the Missouri Coteau.

.LONG TERM...(Saturday through Thursday)
Issued at 420 AM CDT Fri Nov 2 2018

There are few chances for precip in the forecast between Saturday and Thursday. First, there's one precipitation event ongoing at the start of the period. Model soundings and gridded guidance supports mainly a rain event (system-relative warm conveyor belt/waa-forced), although the column (in higher terrain areas of the CWA) may end up cooling down enough for rain to mix with or change over to snow late in the event Saturday evening/overnight. Tough to say if drizzle potential will be around in between systems on Sunday as model soundings maintain a (deep enough?) stratus layer over pretty much the whole CWA heading into Sunday night/Monday when the next s/w trof rotates through the region. Again, model soundings Sunday night into Monday at/around potential precip onset have to re-saturate between "near surface" and 700hpa. For the most part, p-type in the soundings suggests a better chance for rain to be happening. But,

gridded guidance this morning is showing a lack of ice present in the prob-ice field, some additional non-rain p-types ended up falling out of the collaborative process this morning for a few hours before p-type goes to all rain by mid/late morning on Monday. Beyond that, the most significant attention grabbers in the out periods is the continued nw flow pattern aloft and the potential to see 850hpa/925hpa air cold enough to prohibit high temps from getting out of the 20s next Thursday.

&&

.AVIATION...(For the 12Z TAFS through 12Z Saturday Morning)
Issued at 622 AM CDT Fri Nov 2 2018

A mix of CIGS across the region this morning due to stratus. CIGS will improve during the day, but another system tonight will bring us back down to a mix of MVFR/IFR with some mixed precipitation possible as well for KMBG/KABR.

&&

.ABR WATCHES/WARNINGS/ADVISORIES...
SD...None.
MN...None.
&&

\$\$

14.0 Winds and Temperature Aloft Forecast

The NWS 0857 CDT Winds and Temperature Aloft forecast valid for the closest point to the accident site is included below:

FBUS31 KWN0 021357
FD1US1
DATA BASED ON 021200Z
VALID 021800Z FOR USE 1400-2100Z. TEMPS NEG ABV 24000

FT 3000 6000 9000 12000 18000 24000 30000 34000 39000

ABR 9900 9900-05 9900-10 3112-15 3447-21 3368-31 339947 338653 337554

The accident site was closest to the ABR forecast point. The 0857 CDT ABR forecast for use between 0900 and 1600 CDT indicated a calm wind at 3,000 ft, a calm wind at 6,000 ft with a temperature of -5° C, a calm wind at 9,000 ft with a temperature of -10° C, and a wind at 12,000 ft from 310° at 12 knots with a temperature of -15° C.

15.0 Pilot Weather Briefing

The accident pilot did not request a weather briefing through Leidos.

A search of archived ForeFlight information indicated that the accident pilot did not review or request any weather information from ForeFlight. It is unknown if the accident pilot checked or received additional weather information before or during the accident flight.

16.0 Astronomical Data

The astronomical data obtained from the United States Naval Observatory for the accident site on November 2, 2018, indicated the following:

SUN	
Begin civil twilight	0740 CDT
Sunrise	0811 CDT
Accident	1130 CDT²²
Sun transit	1314 CDT
Sunset	1817 CDT
End civil twilight	1848 CDT

E. LIST OF ATTACHMENTS

Attachment 1 – GOES-16 visible imagery animation from 1017 to 1217 CDT

Attachment 2 – GOES-16 visible imagery animation from 0852 to 0932 CDT

Attachment 3 – GFA products available before the accident flight for around the accident time

Submitted by:

Paul Suffern
Senior Meteorologist

²² Inserted accident time for reference and context.

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