



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

January 27, 2017

Weather Study

METEOROLOGY

CEN16FA361

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A. ACCIDENT

Location: Chariton, Iowa
Date: September 7, 2016
Time: 1219 central daylight time (1719 UTC)¹
Airplane: Piper PA-46-310P; N465JM

B. METEOROLOGIST

Mike Richards
Senior Meteorologist
Operational Factors Division (AS-30)
National Transportation Safety Board

C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's meteorological specialist did not travel in support of this accident investigation and gathered all weather data remotely. Unless otherwise noted, all times are in central daylight time (CDT) for September 7, 2016 (based upon the 24-hour clock), directions are referenced to true north, distances are in nautical miles and heights are above mean sea level (msl).

Coordinates used for the accident location (approximate accident location): 41.090278° north latitude, 93.108611° west longitude, at an elevation of about 1,000 feet.

D. WEATHER INFORMATION

1.0 Synoptic Conditions

The National Weather Service (NWS) Surface Analysis Chart for 1300 CDT is presented in figure 1. The surface analysis chart identified a low pressure center in northeast Iowa, with a trough² extending southwest through the accident region and into northern Missouri. A WSR-88D regional radar composite reflectivity mosaic obtained from the National Centers for Environmental Information (NCEI) for 1220 CDT (figure 2) identified light to heavy values of reflectivity across much of the southwestern position of the state, including the accident area.

¹ UTC – abbreviation for Coordinated Universal Time

² Trough - An elongated area of relatively low atmospheric pressure, usually not associated with a closed circulation, and thus used to distinguish from a closed low. The opposite of ridge.

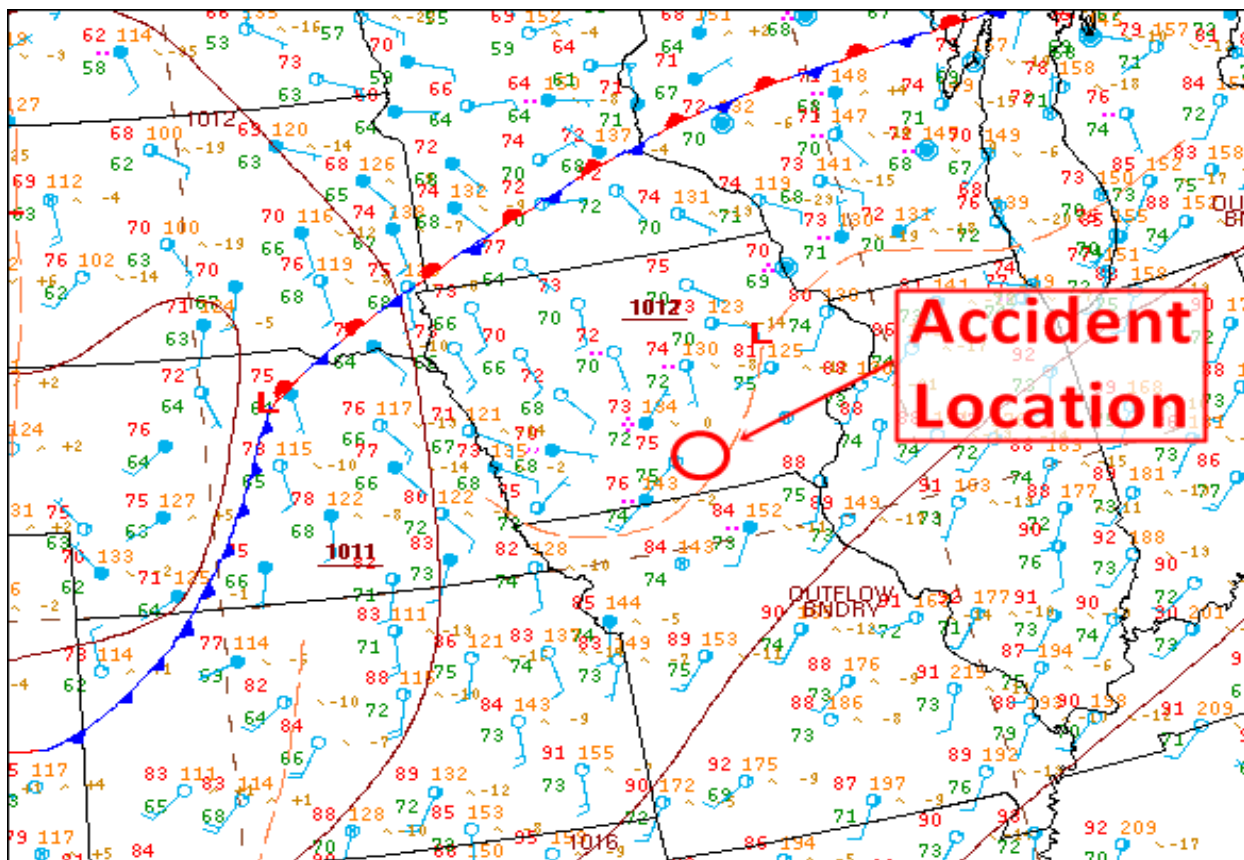


Figure 1 - NWS Surface Analysis Chart for 1300 CDT.

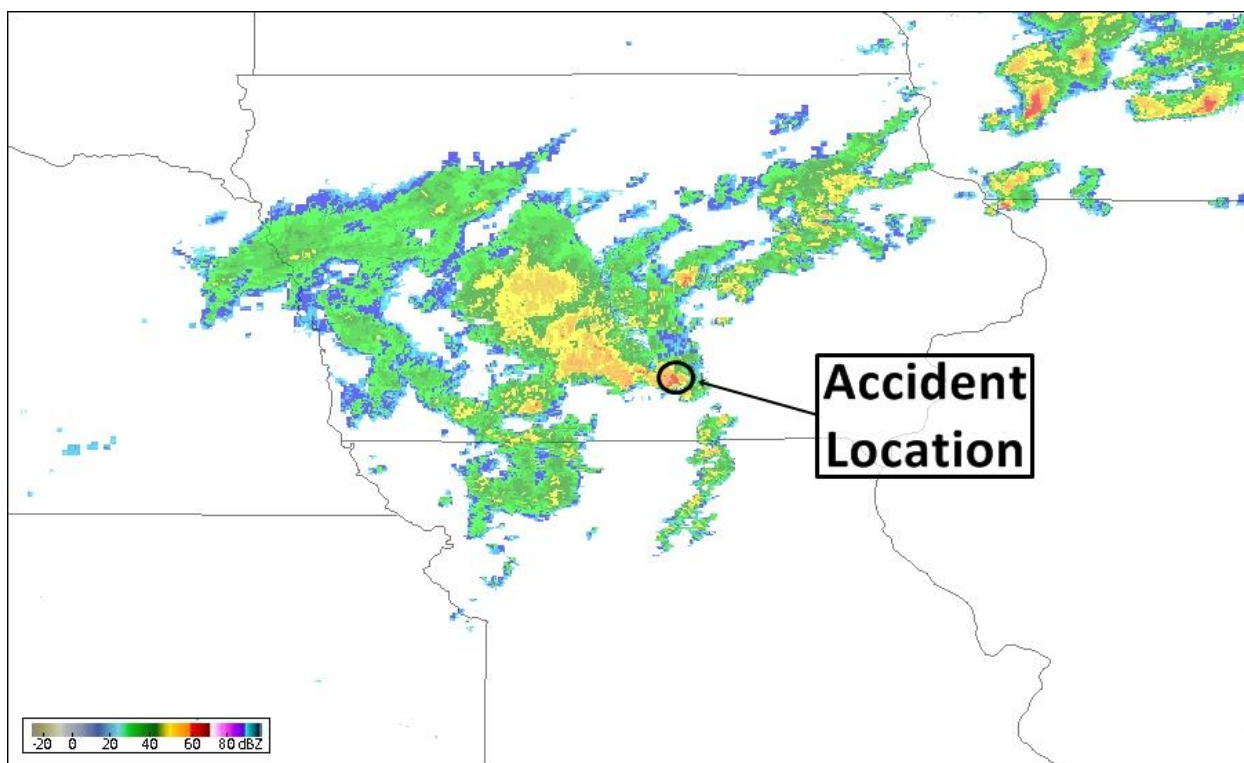


Figure 2 – NCEI WSR-88D mosaic from 1220 CDT.

2.0 Surface Observations

An Automated Weather Observing System was located at Chariton Municipal Airport (CNC)³ in Chariton, Iowa, and was located about 12 miles west-southwest of the accident location at an elevation of 1,050 feet. Automated reports from CNC during the times surrounding the accident time are presented here:

[1115 CDT] METAR KCNC 071615Z AUTO 23006KT 10SM 27/23 A2996 RMK AO2=

[1135 CDT] METAR KCNC 071635Z AUTO 23007KT 10SM 26/23 A2996 RMK AO2=

[1155 CDT] METAR KCNC 071655Z AUTO 25009KT 4SM -RA 25/23 A2995 RMK
AO2 P0004=

**[1215 CDT] METAR KCNC 071715Z AUTO 22009G17KT 1 1/4SM -RA 24/23 A2996
RMK AO2=**

[1235 CDT] METAR KCNC 071735Z AUTO 26007G13KT 4SM BR 24/23 A2997 RMK
AO2=

At 1215 CDT, CNC reported⁴ a wind at from 220° at 9 knots with gusts to 17 knots, visibility of one and one-quarter miles, light rain, temperature of 24° Celsius (C) and a dew point temperature of 23°C, altimeter setting of 29.96 inches of mercury; remarks included: station with a precipitation discriminator.

3.0 Weather Radar

WSR-88D Level-II weather radar imagery from Des Moines, Iowa (KDMX), are presented in figures 3-5. KDMX was located approximately 47 miles north-northwest of the accident site at an elevation of about 870 feet. Assuming standard refraction and considering the 0.95° beam width for the WSR-88D radar beam, the KDMX 2.4° tilt would have “seen” altitudes above the accident location of between about 11,900 and 16,650 feet msl. The KDMX imagery surrounding the accident time identified reflectivity features consistent with convection coincident with the accident location at the accident time. In the 10 minutes leading to the accident time, KDMX-detected maximum estimated hail diameter within the convective region close to the accident location was about one inch.

³ The National Weather Service (NWS) uses the 4-digit International Civil Aviation Organization (ICAO) format for station identifiers (as seen in the body of some formatted weather observations). This report uses the 3-digit International Air Transport Association format for station identification, which does not use the geographic designating digit (“K” for stations in the continental U.S. and “P” for U.S. stations in Alaska and the Pacific region) as found in the ICAO format.

⁴ Sky conditions were missing from the CNC reports.

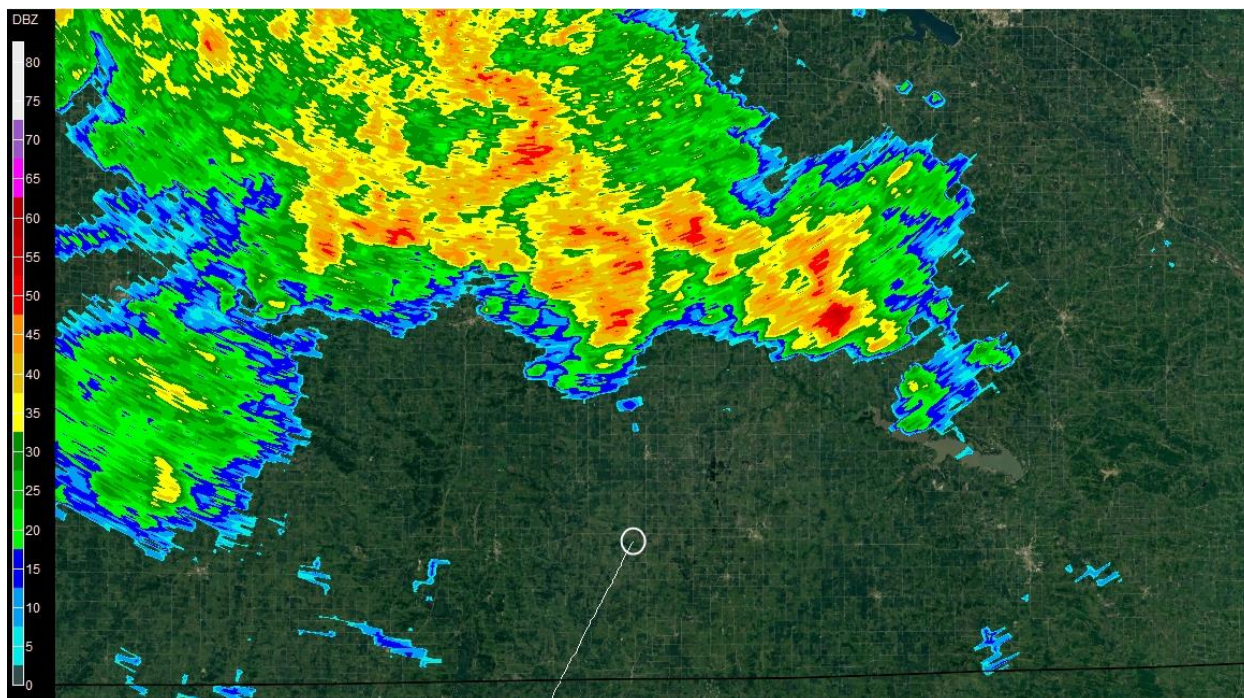


Figure 3 – KDMX 2.4° Level-II reflectivity product from a sweep initiated at 1210:07 CDT. Accident flight path denoted by white line with aircraft location at white circle at 1210:08 CDT.

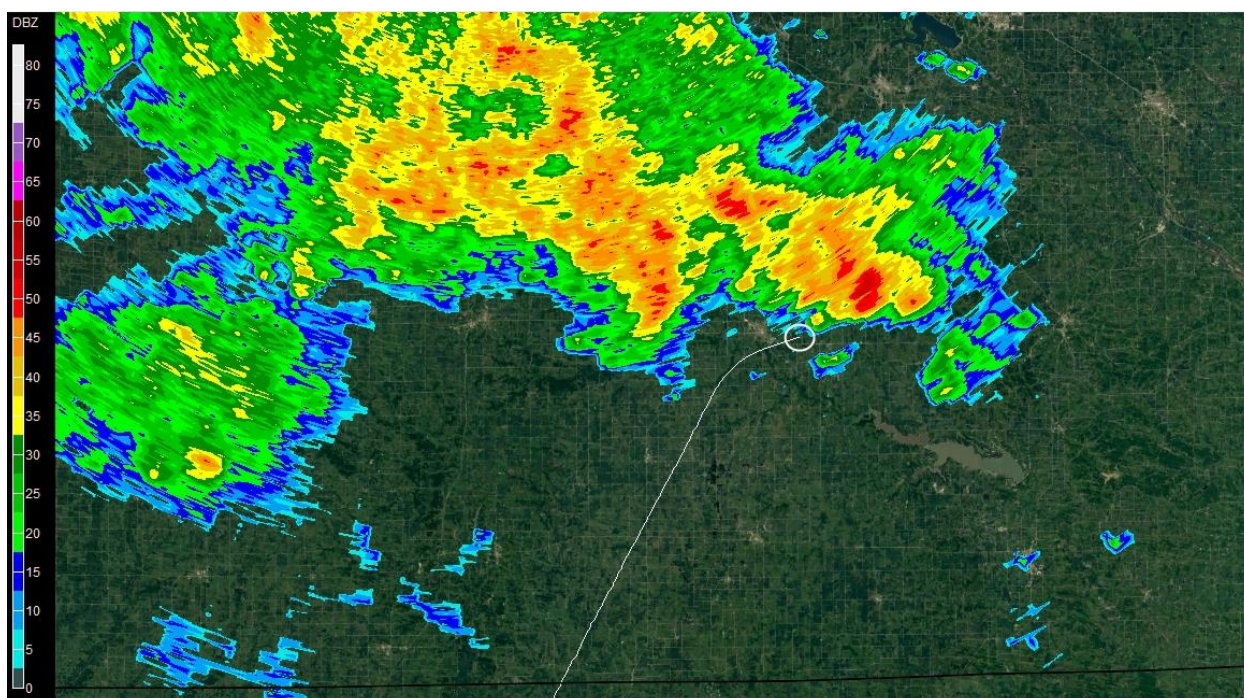


Figure 4 – KDMX 2.4° Level-II reflectivity product from a sweep initiated at 1215:35 CDT. Accident flight path denoted by white line with aircraft location at white circle at 1215:35 CDT.

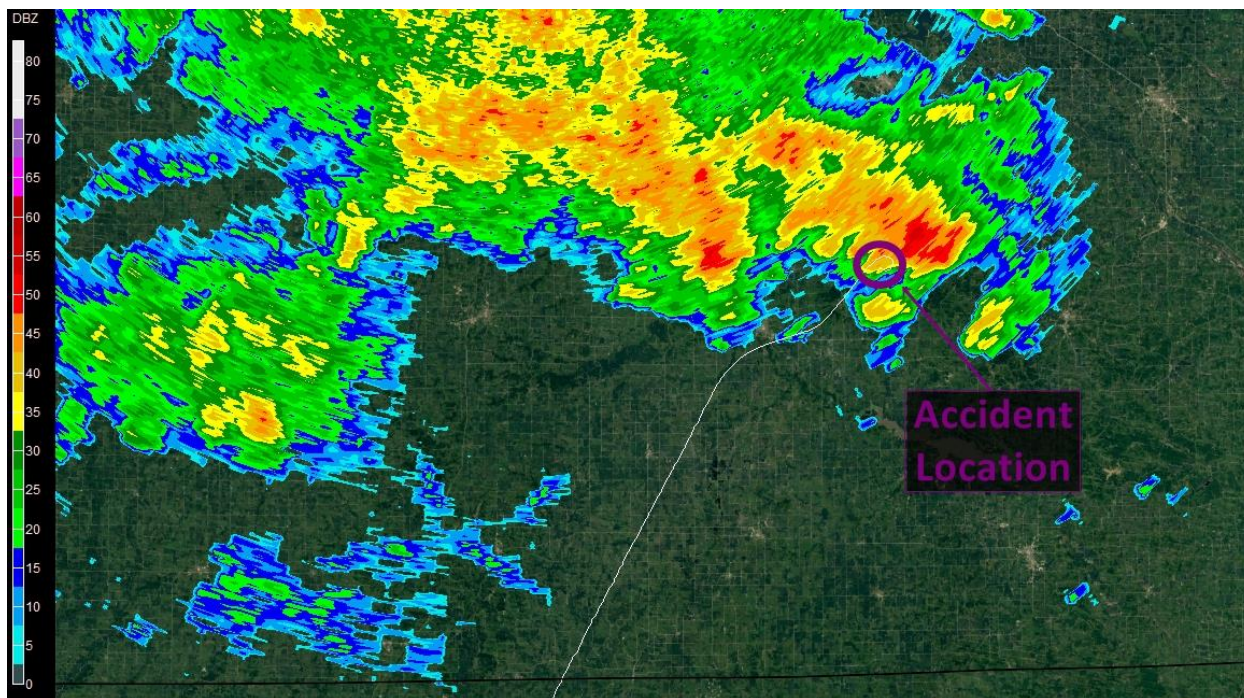


Figure 5 - KDMX 2.4° Level-II reflectivity product from a sweep initiated at 1223:06 CDT. Accident flight path through the accident time denoted by white line with accident location marked.

4.0 Lightning

Figure 6 depicts the total lightning activity detected by the Earth Networks Total Lightning Network (ENTLN) in the accident region between 1210 and 1220 CDT (inclusive).

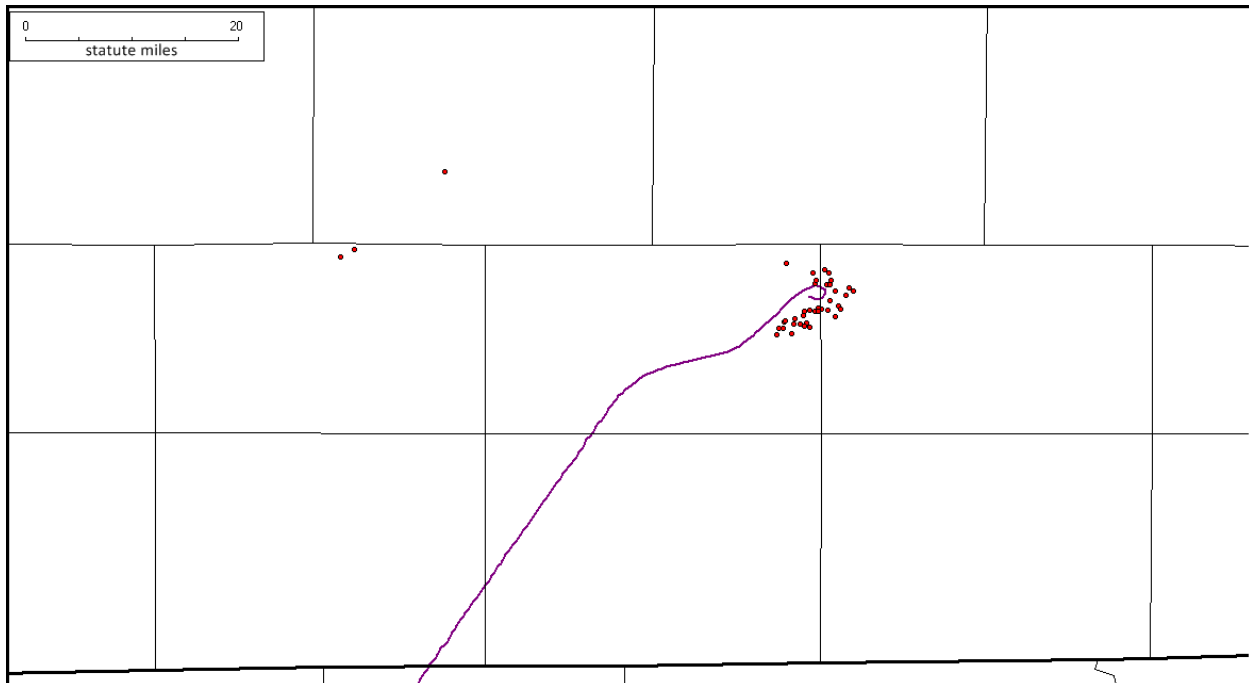


Figure 6 - Total lightning activity (red dots) detected by the ENTNLN between 1210 and 1220 CDT (inclusive). Accident aircraft flight path through accident time is shown as a purple line.

5.0 Pilot Reports

There were no publicly disseminated pilot reports⁵ made within two hours of the accident time near the accident site below FL200⁶.

6.0 Upper Air Data

A High-Resolution Rapid Refresh (HRRR) model⁷ sounding (figure 7) for the accident location at 1200 CDT was retrieved from the National Oceanic and Atmospheric Administration's (NOAA) Air Resources Laboratory. The wind was from the southwest in the entire column with magnitudes of about 10 knots near the surface, 35 knots near 9,500 feet, and 25 knots near 13,500 feet. Calculations made by the Rawinsonde OBservation Program did not yield any significant areas of non-convective turbulence for this atmosphere. The freezing level was at about 16,400 feet.

⁵ Only pilot reports with the WMO header UBIA** were considered.

⁶ Flight Level - a standard nominal altitude of an aircraft, in hundreds of feet. This altitude is calculated from the International standard pressure datum of 1013.25 hPa (29.92 in Hg), the average sea-level pressure, and therefore is not necessarily the same as the aircraft's true altitude either above msl or agl.

⁷ 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.

The most-unstable Convective Available Potential Energy (CAPE)⁸ parameter was 1,479 Joules/kilogram (from 978 hPa). The Lifting Condensation Level⁹ (LCL) and Level of Free Convection¹⁰ (LFC) were calculated to be 3,081 feet. Maximum vertical velocity (MVV) for this atmosphere was calculated as 54 meters/second (about 10,630 feet per minute). Downdraft CAPE (DCAPE; 6 kilometers agl)¹¹ was measured at 527 Joules/kilogram.

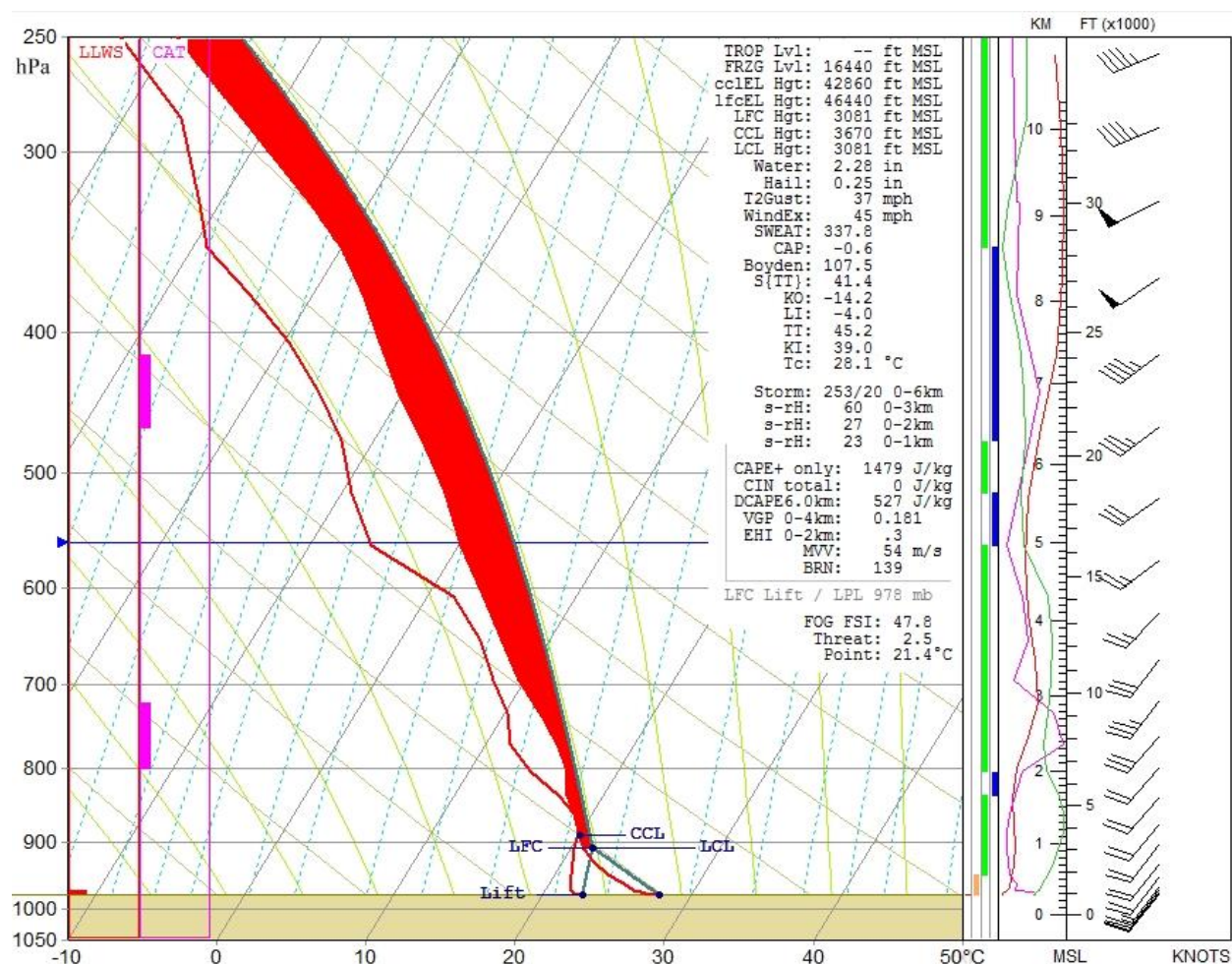


Figure 7 – HRRR model sounding data in SkewT/LogP format for 1200 CDT at the accident site, surface to 250 hPa.

⁸ Convective Available Potential Energy - A measure of the amount of energy available for convection. CAPE is directly related to the maximum potential vertical speed within an updraft; thus, higher values indicate greater potential for severe weather. 1,479 Joules/kilogram would be considered a moderate value.

⁹ Lifting Condensation Level - The level at which a parcel of moist air lifted dry-adiabatically would become saturated.

¹⁰ Level of Free Convection - The level at which a parcel of air lifted dry-adiabatically until saturated and saturation-adiabatically thereafter would first become warmer than its surroundings in a conditionally unstable atmosphere. On a thermodynamic diagram the level of free convection is given by the point of intersection of the process curve, representing the process followed by the ascending parcel, and the sounding curve, representing the lapse rate of temperature in the environment.

¹¹ The DCAPE can be used to estimate the potential strength of rain-cooled downdrafts within thunderstorm convection, and is similar to CAPE. Larger DCAPE values are associated with stronger downdrafts. 527 Joules/kilogram would be considered a relatively weak value.

7.0 Satellite Imagery

Geostationary Operational Environmental Satellite (GOES)-13 visible ($0.63\mu\text{m}$) and infrared ($10.7\mu\text{m}$) data were obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison. Imagery from 1215 CDT is presented in figures 8 and 9. The GOES-13 infrared cloud-top temperatures varied significantly in the area around the accident time. Figure 9 has estimated cloud top heights (considering the HRRR model sounding) labelled for several areas of the scene. It should be noted these figures have not been corrected for any parallax error.

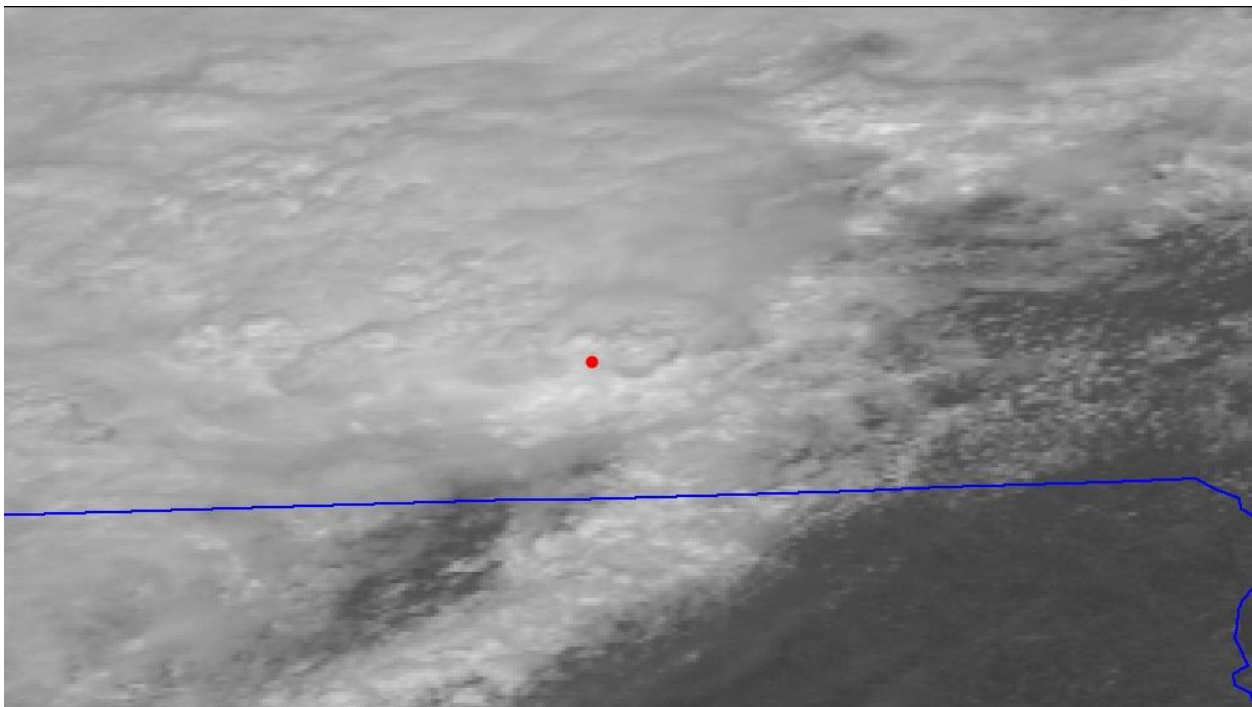


Figure 8 – GOES-13 visible imagery from 1215 CDT. Accident location denoted by red dot.

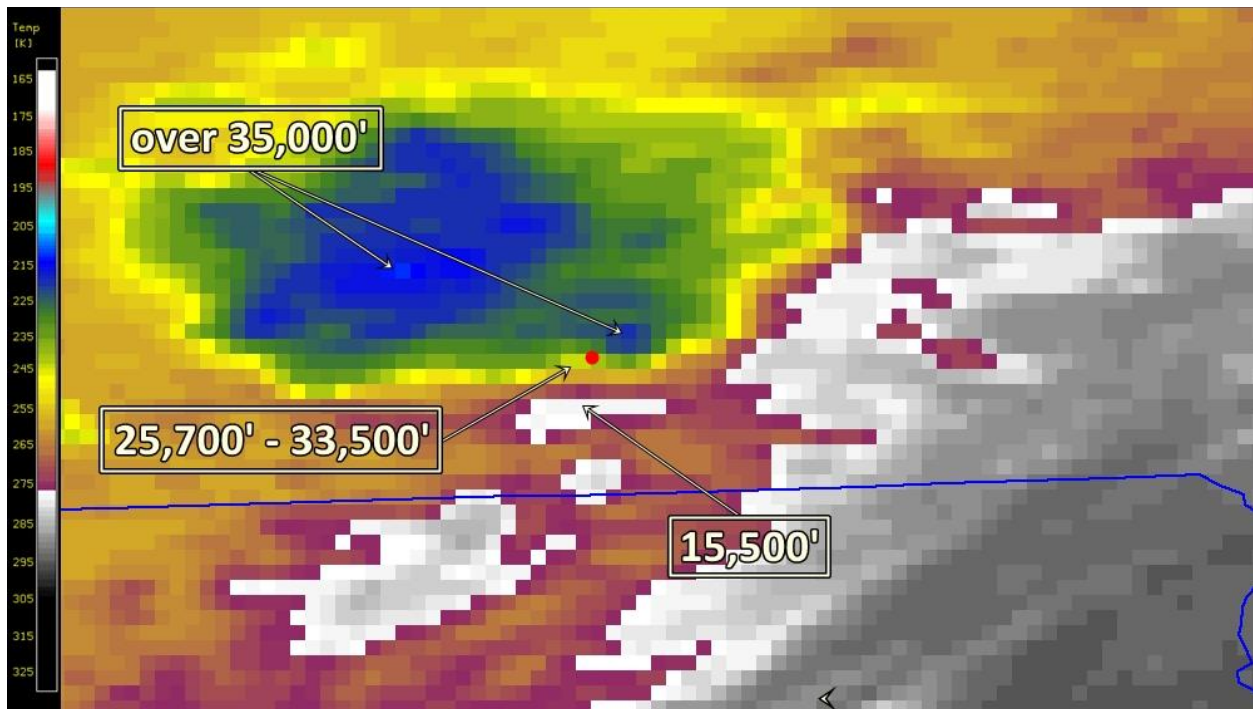


Figure 9 – GOES-13 infrared imagery from 1215 CDT. Accident location denoted by red dot. Estimated cloud top heights (in feet) are identified for several areas in the scene.

8.0 Area Forecast

An Area Forecast that included the state of Iowa was issued at 0445 CDT by the Aviation Weather Center (AWC) in Kansas City, Missouri. Cloud heights are above msl. The portion of the Area Forecast directed toward the southern half of Iowa forecasted for the accident time: broken clouds at 5,000 feet and scattered moderate rain showers.

FAUS43 KKKI 070945

FA3W

_CHIC FA 070945

SYNOPSIS AND VFR CLDS/WX

SYNOPSIS VALID UNTIL 080400

CLDS/WX VALID UNTIL 072200...OTLK VALID 072200-080400

ND SD NE KS MN IA MO WI LM LS MI LH IL IN KY

.
SEE AIRMET SIERRA FOR IFR CONDS AND MTN OBSCN.
TS IMPLY SEV OR GTR TURB SEV ICE LLWS AND IFR CONDS.
NON MSL HGTS DENOTED BY AGL OR CIG.

.
SYNOPSIS...FRONTAL BNDRY ERN UPR MI-CNTRL WI-SE MN-NW IA-ERN
NE-NW KS WILL REMAIN NEARLY STNR. AFT 21Z STN FNT WILL MOV SEWD
AS COLD FNT TO CNTRL LWR MI-SRN WI-CNTRL IA-CNTRL KS BY 04Z.

.
IA
NW...BKN020 LYRD FL280. SCT TSRA. CB TOP FL400. 15Z BKN040. WDLY
SCT SHRA. OTLK...VFR.
NE...SCT020 BKN050 LYRD FL280. TIL 15Z SCT SHRA. WDLY SCT -TSRA. CB
TOP FL350. OTLK...VFR TSRA BECMG 2301 VFR.
S HLF...SCT060 BKN100 TOP FL250. 15Z BKN050. SCT SHRA.
OTLK...VFR. TIL 00Z TSRA.

9.0 SIGMETs

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

At 1055 CDT, the AWC issued the following convective SIGMET, which was valid for two hours (also see figure 10). It advised of an area of embedded thunderstorms moving from 230° at 25 knots, with tops above FL450.

WSUS32 KKCI 071555
SIGC
_MKCC WST 071555
CONVECTIVE SIGMET 62C
VALID UNTIL 1755Z
MO IA NE
FROM 20W DSM-60NNE MCI-30NE PWE-10NNW OVR-20W DSM
AREA EMBD TS MOV FROM 23025KT. TOPS ABV FL450.

At 1155 CDT, the AWC issued the following convective SIGMET, which was valid for two hours (also see figure 10). It advised of an area of embedded thunderstorms moving from 230° at 25 knots, with tops above FL450.

WSUS32 KKCI 071655
SIGC
_MKCC WST 071655
CONVECTIVE SIGMET 67C
VALID UNTIL 1855Z
MO IA
FROM 40NE OVR-10NNW DSM-40NW IRK-50SE OVR-40NE OVR
AREA EMBD TS MOV FROM 23025KT. TOPS ABV FL450.

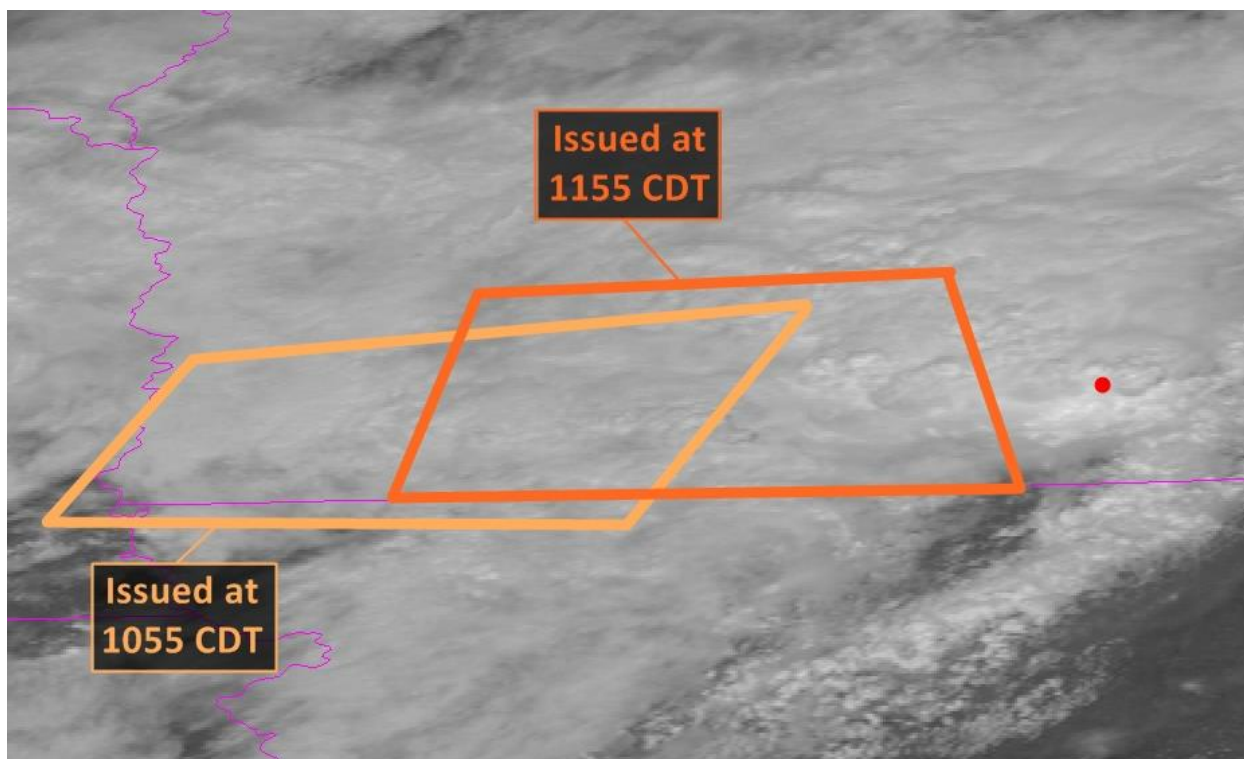


Figure 10 – Boundaries of convective SIGMETs. Red dot denotes accident location.

10.0 CWSU Products

There were no Center Weather Advisories or Meteorological Impact Statements issued by the Center Weather Service Unit (CWSU) at the Chicago Air Route Traffic Control Center that were active for the accident site at the accident time.

Submitted by:

Mike Richards
Senior Meteorologist

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