

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



CEN23FA220

METEOROLOGY

Specialist's Factual Report

June 27, 2023

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A. ACCIDENT

Location: Gibbon, Nebraska

Date: 2 June 2023

Time: 0907 central daylight time (1407 UTC¹)

Aircraft: Type - Vans RV7; Registration - N977RV

B. METEOROLOGY INVESTIGATOR

Mike Richards

Senior Meteorologist

Office of Aviation Safety

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 for 2 June 2023 (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). The accident site was located at about: 40.693375° north latitude; 98.876512° west longitude at an elevation of about 2,070 feet.

This report provides information on weather conditions and forecasts applicable to the accident flight.

D. WEATHER INFORMATION

1.0 Weather Radar

WSR-88D² Level-II base reflectivity weather radar imagery from the Hastings, Nebraska, site (KUEX) is presented in Figures 1-3. KUEX was located approximately 30 miles southeast of the accident location with an antenna elevation of about 2,060 feet. Assuming standard refraction and considering the 0.95° beam width³ for the WSR-88D

¹ UTC - abbreviation for Coordinated Universal Time

² Weather Surveillance Radar 88 Doppler (WSR-88D)

³ Here we define the angular width of the radar beam as the region of transmitted energy that is bounded by one-half the maximum power. The maximum power lies along the beam centerline and decreases outward from the radar antenna.

radar beam, the KUEX 0.525° and 4.007° tilts would have “seen” altitudes above the accident location of between about 2,800 and 5,800 feet, and between about 13,900 and 16,900 feet, respectively. A vertical cross-section of the Level-II base reflectivity weather radar imagery along the final portion of the accident aircraft’s flight track⁴ is presented in Figure 3. Light to extreme values of reflectivity were seen along the accident aircraft’s flight path in the lower tilt, and light to moderate values of reflectivity were seen along the flight path in the higher tilt.

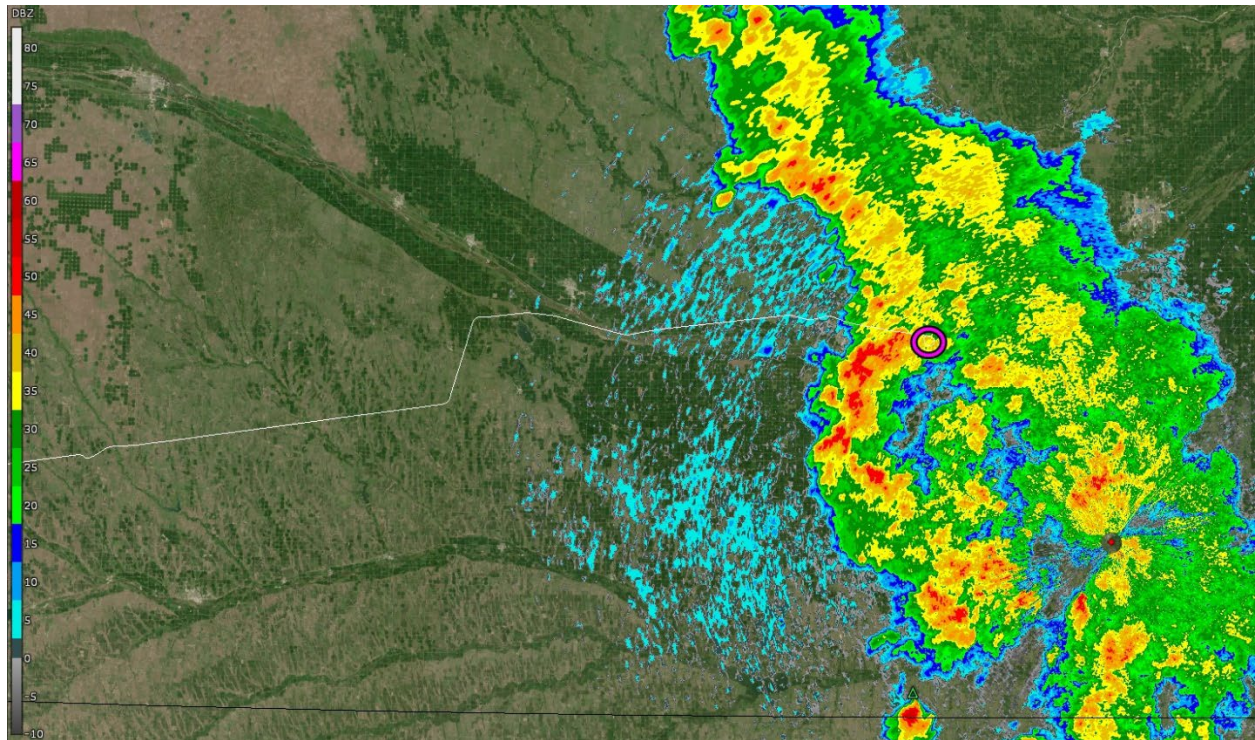


Figure 1 - KUEX 0.525° Level-II base reflectivity product from a sweep initiated at 0907:41. The accident location is denoted by the purple circle.

⁴ End points for the vertical cross section are: 40.756737°N, 99.253174°W and 40.646645°N, 98.620628°W

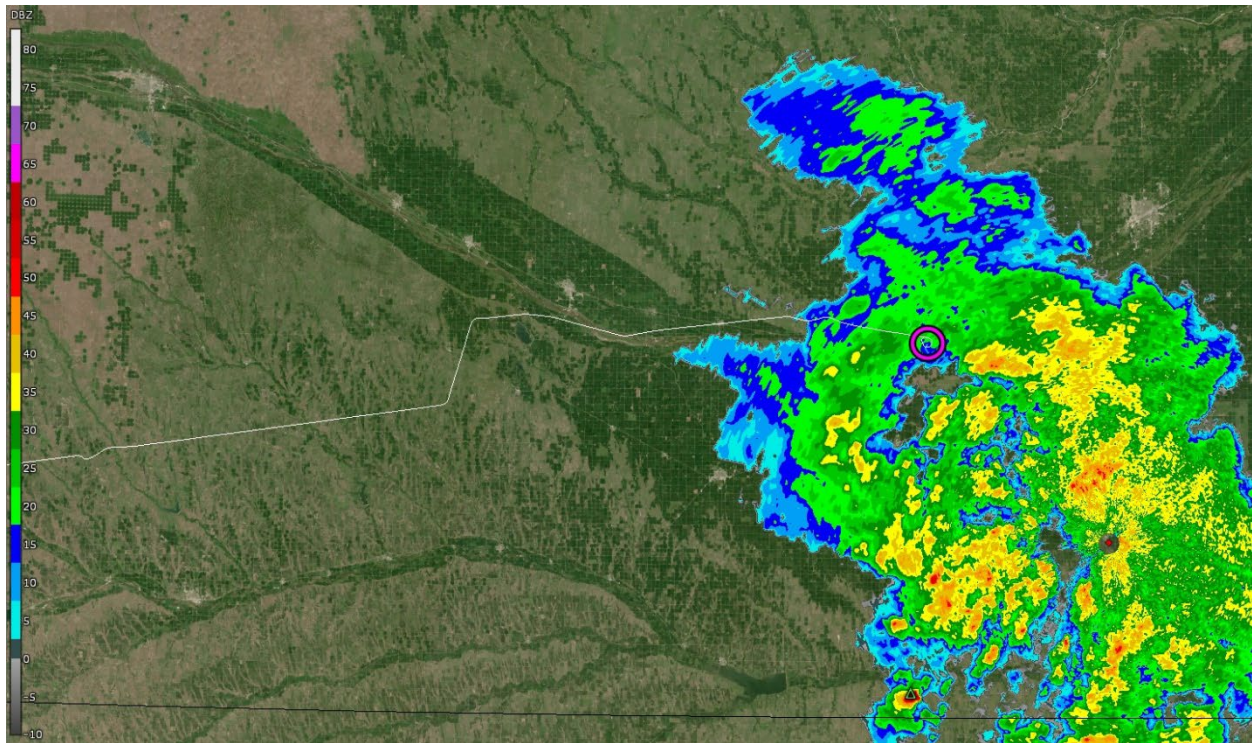


Figure 2 - KUEX 4.007° Level-II base reflectivity product from a sweep initiated at 0911:12. The accident location is denoted by the purple circle.

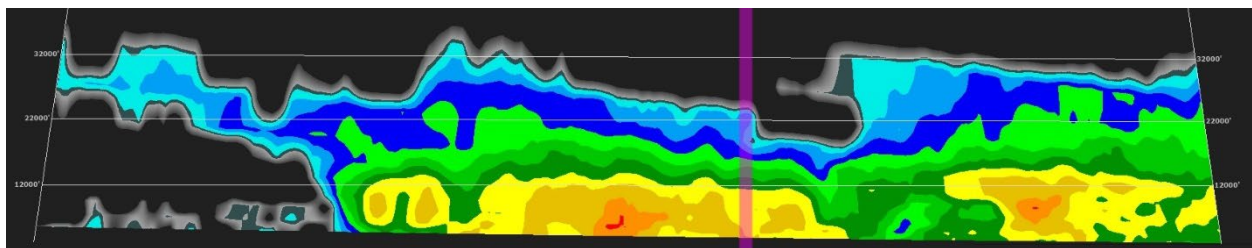


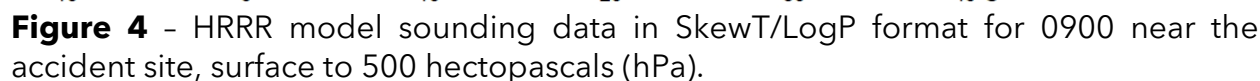
Figure 3 - Vertical cross-section of the KUEX Level-II base reflectivity weather radar imagery for the volume scan initiated at 0907:41 along the final portion of the accident aircraft's flight path. Height scale is approximate to within about 100 feet. Pink bar approximates the accident location along the vertical pane.

2.0 Lightning

A review of the Earth Networks Total Lightning Network (ENTLN) lightning database for a region surrounding the accident location⁵ revealed no flash total lightning activity between 0855 and 0910 within 10 miles of the accident location inside that region.

⁵ The ENTLN was queried for a geographic area bounded by latitudes 41.0876°N and 40.2942°N, and longitudes 99.5938°W and 98.5007°W.

A High-Resolution Rapid Refresh (HRRR) model⁶ sounding (Figure 4) for near the accident site⁷ at 0900 with an elevation of 2,070 feet was retrieved from the National Oceanic and Atmospheric Administration's (NOAA) Air Resources Laboratory and analyzed by the RAwinsonde OBservation (RAOB) program. Scattered to overcast clouds were identified by RAOB between about 8,000 to above 17,000 feet. The freezing level was at 12,575 feet, and RAOB identified the potential for light rime icing between about 18,400 and 24,200 feet. A trace of rime icing was noted at about 12,700 feet. No turbulence severities above "light" were identified between 5,000 and 35,000 feet. The wind near 10,000 feet was generally from the south at about 20 knots, and the wind remained generally from the south between about 20 and 25 knots through 20,000 feet.



⁷ Coordinates used for the model were latitude: 40.69; longitude: -98.88.

4.0 Satellite Imagery

Geostationary Operational Environmental Satellite (GOES)-16 visible ($0.64\mu\text{m}$) and infrared ($10.3\mu\text{m}$) data were obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison. Imagery from these data are presented in Figures 5 and 6. The visible imagery depicts cloudy conditions over the accident region. Brightness temperatures over the accident location were about -35°C , which, when considering the 0900 HRRR sounding, corresponded to cloud top heights of about 30,000 feet.

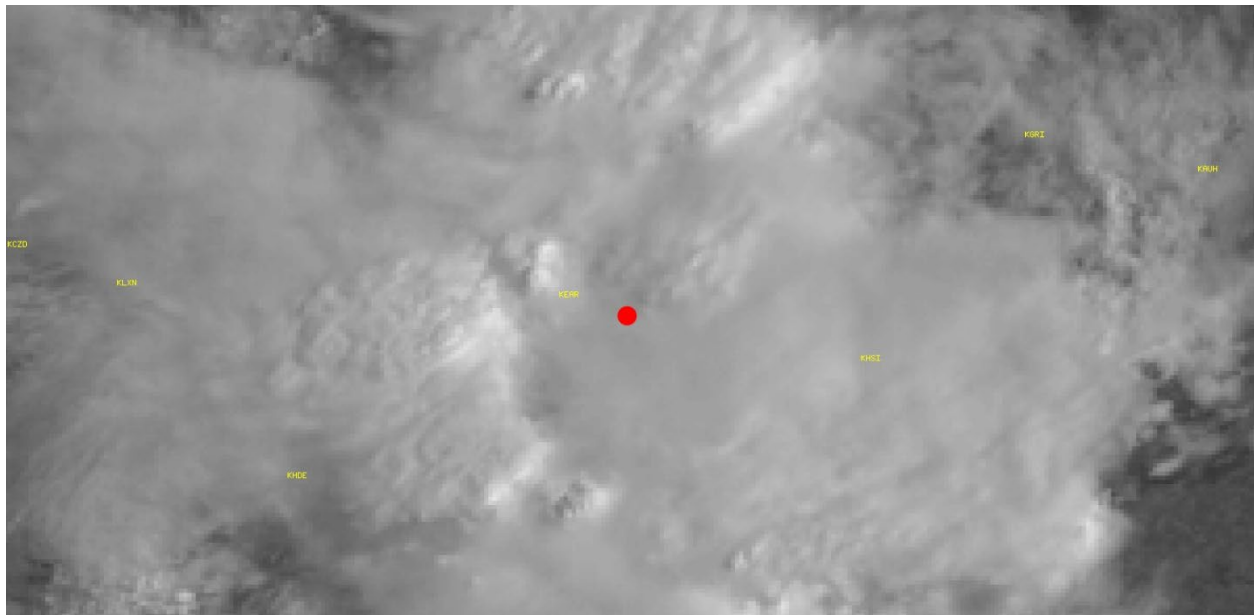


Figure 5 - GOES-16 visible imagery from 0906. Accident location denoted by the red dot. Image is not corrected for parallax error.

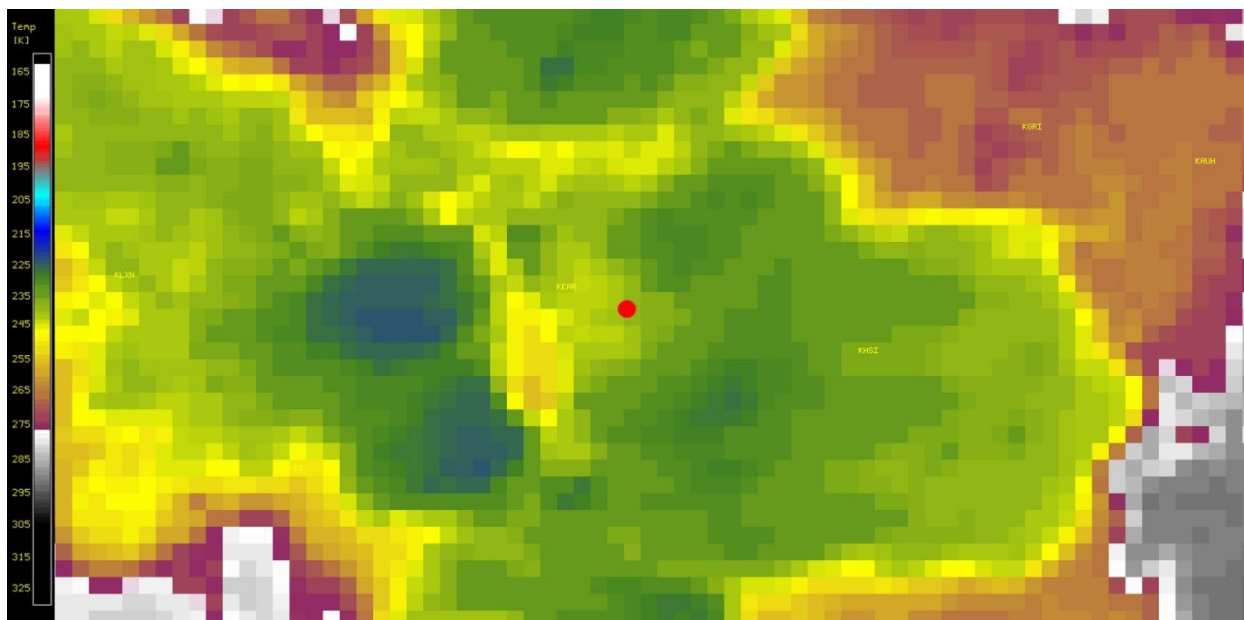


Figure 6 - GOES-16 infrared imagery from 0906. Accident location denoted by the red dot. Image is not corrected for parallax error.

5.0 Pilot Reports

The following are the longline-disseminated pilot reports⁸ (PIREPs) reported between 0700 and 1100 within 100 miles of the accident location below FL200⁹ (or at an unknown altitude).

EAR UA /OV EAR/TM 1232/FL040/TP B190/SK B040

EAR UA /OV EAR /TM 1254 /FLUNKN /TP C208 /WX -RA /TB LGT CHOP /RM
ON FINAL

MCK UA /OV MCK/TM 1405/FL038/TP C208/SK BASE 038/WX BR/IC NEG/RM
ZDV

OLU UA /OV OBH270025/TM 1503/FL110/TP C182/WX -RA/TA UNKN/TB
LGT CHOP/IC NEG

⁸ These do not include pilot reports only broadcast via radio.

⁹ Flight Level (FL) - 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 inches of mercury), the average sea-level pressure, and therefore is not necessarily the same as the aircraft's true altitude either above msl or agl.

6.0 Surface Observations

An Automated Weather Observing Station (AWOS) was located at Kearney Regional Airport (EAR¹⁰) in Kearney, Nebraska, which was located about 6 miles west-northwest of the accident site at an elevation of about 2,130 feet. It had a magnetic variation of about 5° east. Automated longline¹¹ reports from the EAR AWOS during the times surrounding the accident time are presented here, and the observations closest in time to the accident time are highlighted with bold text.

- [0756] METAR KEAR 021256Z AUTO 15009KT 8SM -RA FEW040 SCT060 OVC080 17/16 A3000 RMK AO2 LTG DSNT SE AND S RAB08 SLP145 P0012 T01670156=
- [0805] SPECI KEAR 021305Z AUTO 16006KT 7SM VCTS -RA FEW055 OVC075 17/16 A3000 RMK AO2 LTG DSNT SE TSB1259 P0001=
- [0829] SPECI KEAR 021329Z AUTO 14008KT 1 3/4SM +TSRA BR FEW021 BKN046 OVC070 17/16 A3000 RMK AO2 VIS 1 1/2V3 TSB1259 P0025=
- [0837] SPECI KEAR 021337Z AUTO 09009KT 3SM TSRA BR FEW021 BKN046 OVC055 16/16 A2999 RMK AO2 LTG DSNT S TSB1259 P0030=
- [0856] METAR KEAR 021356Z AUTO 09009KT 4SM VCTS +RA BR FEW019 BKN034 OVC044 17/16 A3000 RMK AO2 LTG DSNT SE AND S AND NW TSB1259 SLP147 P0040 T01670156=**
- [0919] SPECI KEAR 021419Z AUTO 12011KT 2 1/2SM VCTS +RA BR FEW020 BKN027 OVC037 17/16 A3002 RMK AO2 VIS 2V5 LTG DSNT SE AND S P0014=**
- [0923] SPECI KEAR 021423Z AUTO 12010KT 2 1/2SM +RA BR FEW018 BKN034 OVC050 17/16 A3002 RMK AO2 VIS 2V5 LTG DSNT SE AND S TSE23 P0016=

At 0856, the EAR AWOS reported a wind from 090° at 9 knots, visibility 4 statute miles, thunderstorms in the vicinity¹², heavy rain, mist, few clouds at 1,900 feet above ground

¹⁰ This report uses the 3-digit International Air Transport Association format for airport identification, which does not use the geographic designating digit (e.g., "K" for stations in the continental U.S. and "P" for U.S. stations in Alaska and the Pacific region) as found in the 4-digit International Civil Aviation Organization (ICAO) identifier format. Weather observations from airports in this report are referenced by their reporting station's identifier (using ICAO format that includes the geographic designating digit), not by the airport at which the reporting station is located.

¹¹ "Longline" refers to the dissemination of weather observations with the intent that they are available in near-real time to national databases (effectively, the whole world) and accessible to the general global public from a large number of vendors. This does not include public accessibility to observations from a reporting station's Very High Frequency (VHF; line-of-site) or telephone broadcast, where applicable. Longline-dissemination of weather observations is the primary vehicle through which the general global public has access to surface weather observations, particularly outside of the aviation community.

¹² "In the vicinity" means 5 to 10 statute miles from the point of observation (e.g., in a METAR) or from

level (agl), ceiling broken at 3,400 feet agl, overcast clouds at 4,400 feet agl, temperature of 17° Celsius (C) and dew point temperature of 16°C, altimeter setting of 30.00 inches of mercury; Remarks: automated station with a precipitation discriminator, lightning distant¹³ to the southeast and south and northwest, thunderstorm began at 0759, sea level pressure of 1014.7 hPa, temperature of 16.7°C and dew point temperature of 15.6°C.

At 1919, the EAR AWOS reported a wind from 120° at 11 knots, visibility 2 and 1/2 statute miles, thunderstorms in the vicinity, heavy rain, mist, few clouds at 2,000 feet agl, ceiling broken at 2,700 feet agl, overcast clouds at 3,700 feet agl, temperature of 17°C and dew point temperature of 16°C, altimeter setting of 30.02 inches of mercury; Remarks: automated station with a precipitation discriminator, visibility variable between 2 and 5 statute miles, lightning distant to the southeast and south, 0.14 inches of liquid equivalent precipitation since 0856.

7.0 Terminal Aerodrome Forecasts

At 0620 a Terminal Aerodrome Forecasts (TAF) was issued for EAR that forecasted for the accident time: a wind from 140° at 10 knots, visibility of greater than 6 statute miles, thunderstorms in the vicinity, scattered clouds at 6,000 feet agl and ceiling broken at 9,000 feet agl with clouds of cumulonimbus type. According to National Weather Service (NWS) Instruction 10-813: "A NWS TAF consists of the expected meteorological conditions significant to aviation at an airport for a specified time period. For the U.S., this is the area within five (5) statute miles (SM) of the center of an airport's runway complex."¹⁴

TAF

KEAR 021120Z 0212/0312 **14010KT P6SM VCTS SCT060 BKN090CB**

TEMPO 0213/0214 -TSRA BKN050CB

FM021500 15012G17KT P6SM SCT060 BKN090

FM022000 13014G19KT P6SM VCTS BKN050CB

FM030100 10008KT P6SM SCT050=

At 0851 an amended TAF was issued for EAR. One minute later, at 0852, a corrected TAF was issued for EAR that forecasted for the accident time: a wind from 140° at 10 knots, visibility of greater than 6 statute miles, thunderstorms in the vicinity, scattered clouds at 6,000 feet agl and ceiling broken at 9,000 feet agl with clouds of

the center of the airport's runway complex (e.g., in a Terminal Aerodrome Forecast).

¹³ "Distant" means beyond 10 statute miles from the point of observation.

¹⁴ www.nws.noaa.gov/directives/sym/pd01008013curr.pdf

cumulonimbus type. There were temporary conditions¹⁵ forecasted between 0900 and 1000 visibility of 3 statute miles, thunderstorms with light rain and ceiling broken at 4,000 feet with clouds of cumulonimbus type.

TAF AMD

KEAR 021351Z 0214/0312 14010KT P6SM VCTS SCT060 BKN090CB
TEMPO 0214/0215 -TSRA BKN050CB
FM021500 15012G17KT P6SM VCSH SCT060 BKN090
FM022000 13014G19KT P6SM VCTS BKN050CB
FM030100 10008KT P6SM SCT050=

TAF COR

KEAR 021352Z 0214/0312 **14010KT P6SM VCTS SCT060 BKN090CB**
TEMPO 0214/0215 **3SM -TSRA BKN040CB**
FM021500 15012G17KT P6SM VCSH SCT060 BKN090
FM022000 13014G19KT P6SM VCTS BKN050CB
FM030100 10008KT P6SM SCT050=

8.0 Area Forecast Discussion

The NWS Hastings, Nebraska, Weather Forecast Office issued the following Aviation section of an Area Forecast Discussion at 0618, applicable for a region that included the accident location.

FXUS63 KGID 021118

AFDGID

AREA FORECAST DISCUSSION

National Weather Service Hastings NE

618 AM CDT Fri Jun 2 2023

.AVIATION...(For the 12Z KGRI/KEAR TAFS through 12Z Saturday)

Issued at 615 AM CDT Fri Jun 2 2023

Overall confidence remains on the low side through this TAF period. Currently have VFR conditions forecast, but am a little concerned that ceilings could flirt with the top end of MVFR conditions at times. An area of scattered showers/storms are making their way north toward the terminal areas, look to potentially impact them through mid-morning. Another chance for storms may come this afternoon, but confidence in timing is not high. Otherwise, expecting

¹⁵ Temporary conditions - fluctuations to forecast conditions which are expected to last less than one hour in each instance and, in the aggregate, to cover less than half of the indicated period.

generally southeasterly winds through the period, can't rule out some gusts near 20 MPH through the late morning and afternoon hours.

9.0 Current Icing Potential and Forecast Icing Potential

The Current Icing Potential (CIP) and Forecast Icing Potential (FIP) imagery provides information on expected icing severity as five categories: none, trace, light, moderate, and heavy. The severity estimates are roughly based on the accretion rate of ice on an airplane, and the levels are determined by the time it would take for an airfoil to accrete 1/4 of an inch of ice: trace = 1 hour; light = 15 minutes to 1 hour; moderate = 5 to 15 minutes; severe = less than 5 minutes.¹⁶

The images presented in this report show data from the National Center for Atmospheric Research's (NCAR) prototype CIP and FIP algorithms and were generated using NCAR's visualization software. These algorithms differ in various ways from the operational CIP and FIP that provided data used to generate the publicly available images accessible through the NWS Aviation Weather Center on the accident day. NCAR's prototype CIP and FIP represent the latest research and development conducted by their team of in-flight icing scientists and have passed internal validation exercises using voice PIREPs of icing conditions and scientific airborne research observations of in-flight icing (when available).

Images presenting output from the CIP and 1-hour and 2-hour FIP valid for 0900 for altitudes from 10,000 feet to 16,000 feet for the accident region were provided by the NCAR¹⁷ and are presented in Attachment 1. CIP output identified up to moderate and heavy icing severities, high icing probabilities and high supercooled large droplet potential in the accident region.

10.0 SIGMETs

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

At 0755, the NWS' Aviation Weather Center (AWC) issued Convective SIGMET 61C that was active for the accident location and valid until 0955. It warned of an area of embedded thunderstorms with tops to FL340. The Convective SIGMETs polygon was

¹⁶ These are general values. Users should always consider the icing susceptibility of their airframe and availability of icing protection provided by their aircraft. Different aircraft and different flight configurations (airspeed, angle of attack, etc.) will experience variations in accretion rate.

¹⁷ Courtesy of Mr. Daniel Adriaansen and Ms. Allyson Rugg, NCAR.

moving from 180° at 25 knots. Convective SIGEMTs imply severe or greater turbulence, severe icing, and low level wind shear.

*WSUS32 KPCI 021255
SIGC
-MKCC WST 021255
CONVECTIVE SIGMET 61C
VALID UNTIL 1455Z
KS NE
FROM 30NW ONL-60NE OBH-40ENE SLN-50WSW SLN-30E LBF-30NW ONL
AREA EMBD TS MOV FROM 18025KT. TOPS TO FL340.*

At 0855, the AWC issued Convective SIGMET 65C that superseded Convective SIGMET 61C and was active for the accident location and valid until 1055. It warned of an area of embedded thunderstorms with tops to FL340. The Convective SIGMETs polygon was moving from 180° at 20 knots.

*WSUS32 KPCI 021355
SIGC
-MKCC WST 021355
CONVECTIVE SIGMET 65C
VALID UNTIL 1555Z
KS NE
FROM 30NW ONL-30E OBH-30N SLN-60WNW SLN-30E LBF-30NW ONL
AREA EMBD TS MOV FROM 18020KT. TOPS TO FL340.*

11.0 CWSU Products

There were no Center Weather Advisories or Meteorological Impact Statements issued by the Center Weather Service Units (CWSU) at the Denver and Minneapolis Air Route Traffic Control Centers that were active for the accident flight.

12.0 G-AIRMETS

There were no G-AIRMET advisories active for the accident location and valid at 0700 and 1000.

13.0 Graphical Forecasts for Aviation

The Graphical Forecasts for Aviation (GFA) are intended to provide the necessary aviation weather information to give users a complete picture of the weather that might impact flight in the continental United States. Hourly model data and forecasts, including information on clouds, flight category, precipitation, icing, turbulence, wind, and other output from the NWS are available, however only certain imagery are archived by the NWS.

Figures 7-10 depict GFA forecast information on sky condition, icing, mountain obscuration, IFR condition and surface wind G-AIRMET advisories, surface visibility, surface wind, precipitation, and other obscurations and hazards, valid for times near the accident time. These GFA forecast imagery depict broken and overcast sky conditions in the immediate accident region with points near the accident location identifying bases below 5,000 feet and tops above FL250 for both 0700 and 1000 (Figures 7 and 8). The GFA surface forecasts (Figures 9 and 10) depicted scattered thunderstorms across the region with visibilities greater than 5 statute miles.

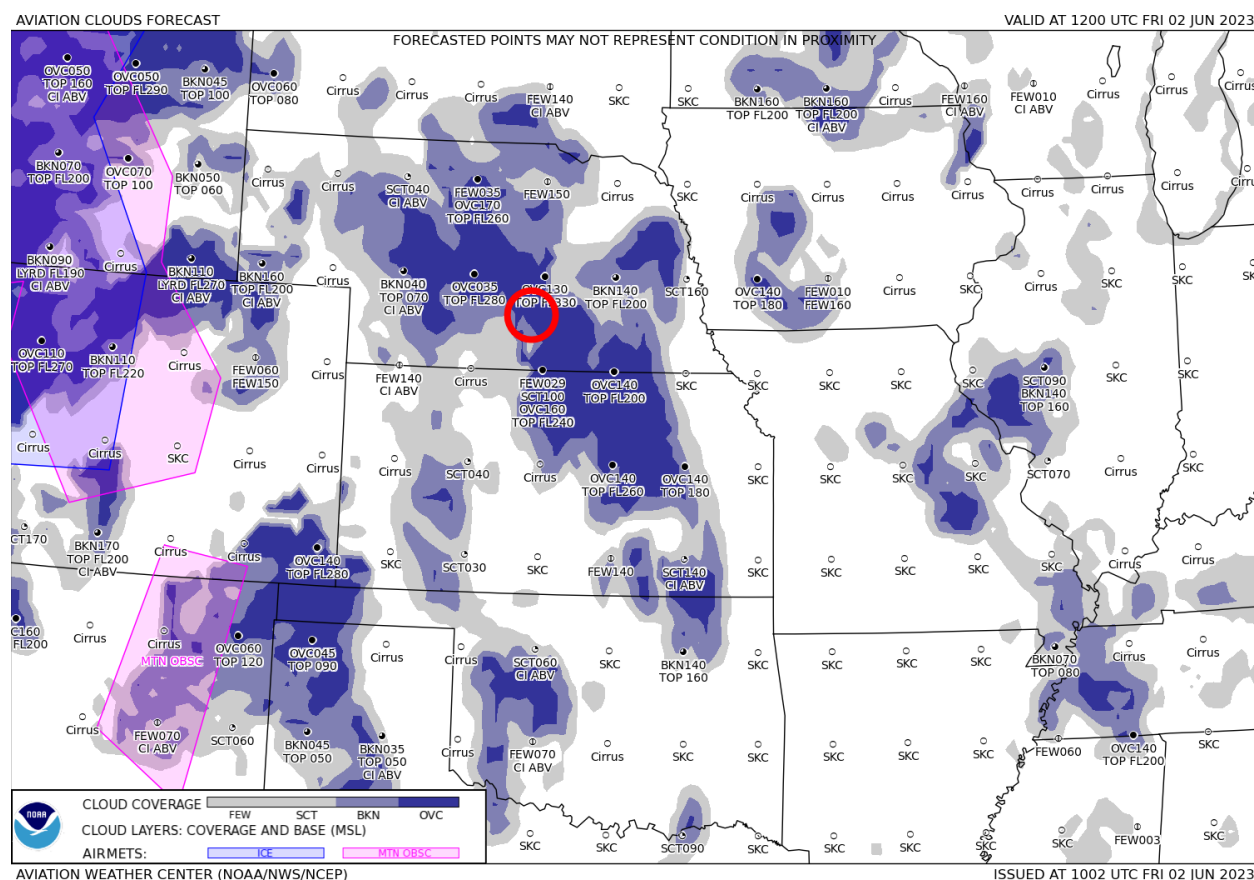


Figure 7 - GFA forecast imagery depicting sky condition and icing and mountain obscuration G-AIRMETS issued about 0500 and valid for 0700. The accident location is located within the red circle.

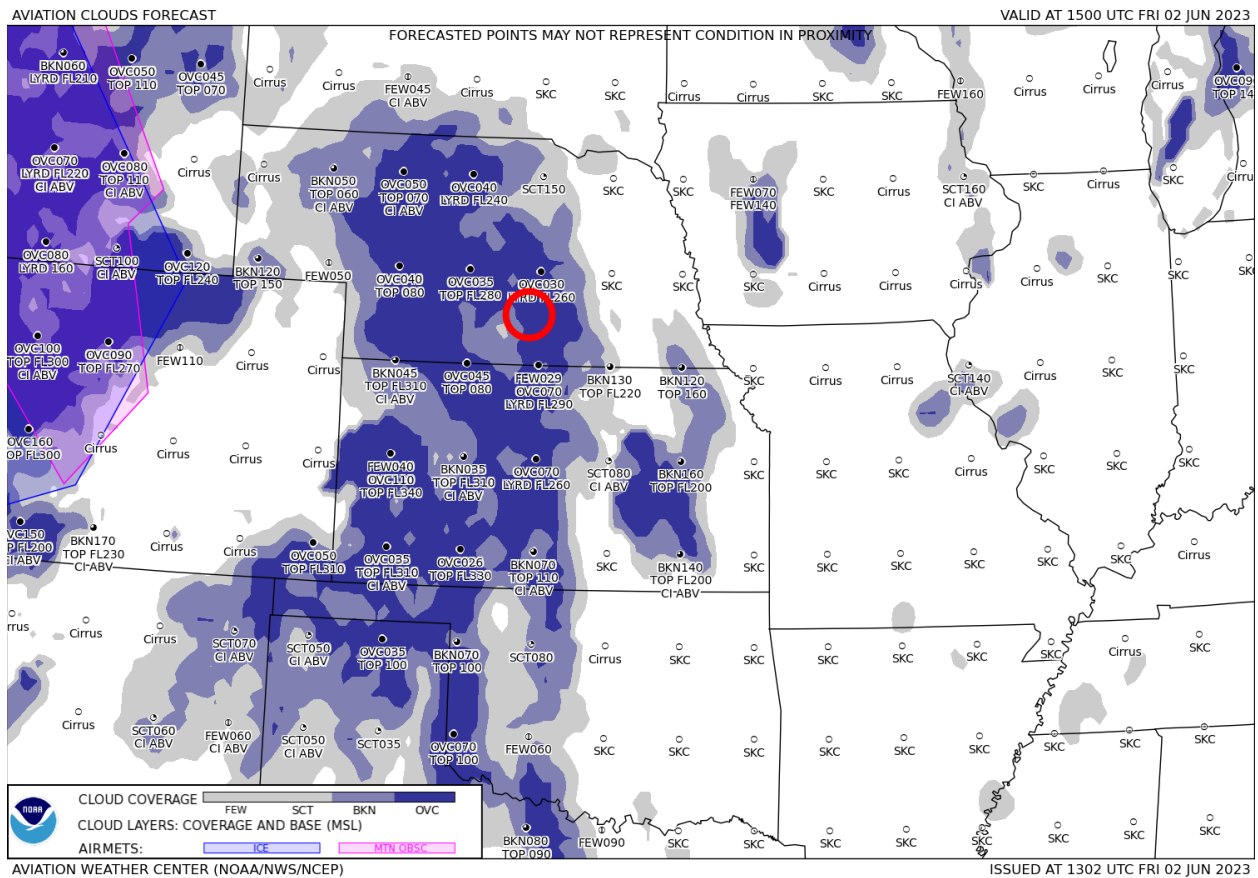


Figure 8 – GFA forecast imagery depicting sky condition and icing and mountain obscuration G-AIRMETS issued about 0800 and valid for 1000. The accident location is located within the red circle.

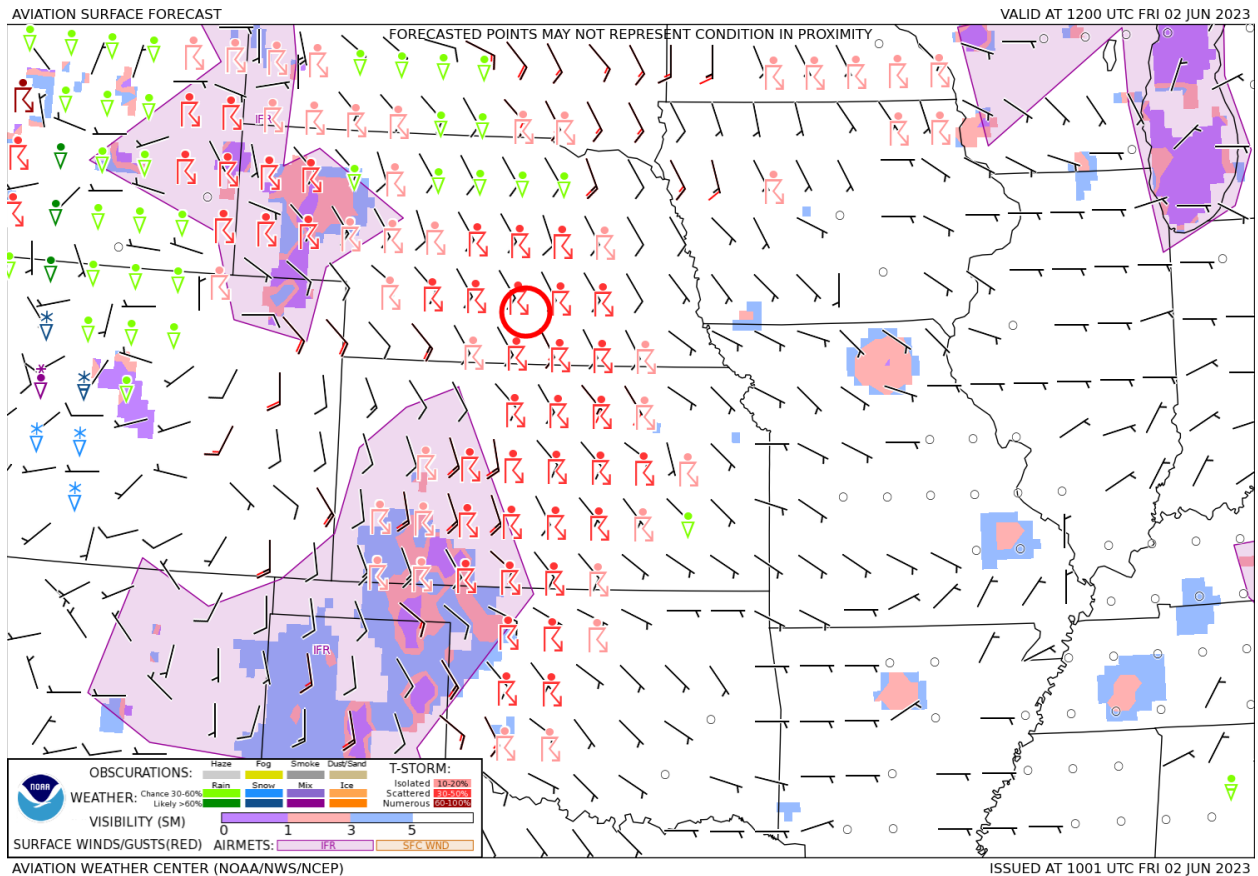


Figure 9 - GFA forecast imagery depicting IFR conditions and surface wind G-AIRMETs, surface visibility, surface wind, precipitation, and other obscurations and hazards. Issued about 0500 and valid for 0700. The accident location is located within the red circle.

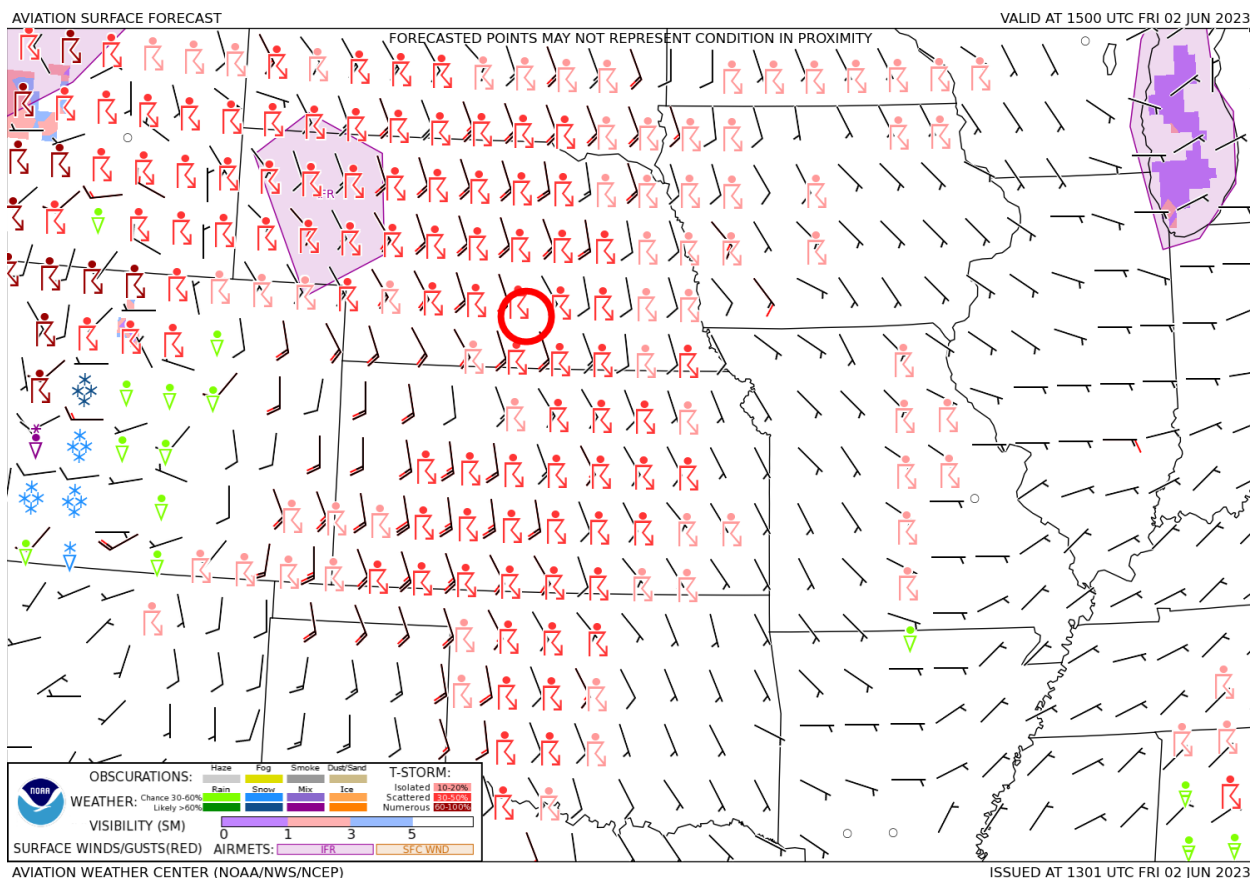


Figure 10 - GFA forecast imagery depicting IFR conditions and surface wind G-AIRMETs, surface visibility, surface wind, precipitation, and other obscurations and hazards. Issued about 0800 and valid for 1000. The accident location is located within the red circle.

E. LIST OF ATTACHMENTS

Attachment 1 - Images presenting output from the CIP and 1-hour and 2-hour FIP valid for 0900 for altitudes from 10,000 feet to 16,000 feet for the accident region.

Submitted by:

Mike Richards
Senior Meteorologist