

# National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



DCA23FA149

## **METEOROLOGY**

Specialist's Factual Report

May 4, 2023

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## **A. INCIDENT**

Location: Austin, Texas  
Date: February 4, 2023  
Time: 0640 central standard time (CST)  
1240 universal coordinated time (UTC)  
Airplane 1: FedEx flight 1432, Boeing 767-32LH; Registration: N297FE  
Airplane 2: Southwest Airlines flight 708, Boeing B737-79P; Registration: 7827A

## **B. METEOROLOGY INVESTIGATOR**

Donald Eick  
Senior Meteorologist  
Operational Factors (AS-30)  
National Transportation Safety Board  
Washington, DC

## **C. SUMMARY**

On February 4, 2023, at about 0640 central standard time (CST), Federal Express flight 1432 (FDX1432), a Boeing 767-32LF, and Southwest Airlines flight 708 (SWA708) a Boeing 737-79P were involved in a runway incursion with overflight that resulted in a loss of separation and near midair collision (NMAC) at the Austin-Bergstrom International Airport (AUS), Austin, Texas. There were no injuries reported to the 128 passengers and crew onboard the SWA airplane or to the 3 crew members onboard the FedEx airplane. SWA flight 708 was a regularly scheduled international passenger flight operating under the provisions of 14 Code of Federal Regulations (CFR) Part 121 from AUS to the Cancún International Airport (CUN), Cancun, Mexico. FedEx flight 1432 was a regularly scheduled domestic cargo flight operating under the provisions of 14 CFR Part 121 from Memphis International Airport (MEM), Memphis, Tennessee to AUS.

## **D. DETAILS OF THE INVESTIGATION**

The National Transportation Safety Board's Senior Meteorologist was not on scene for this investigation and conducted the meteorology phase of the investigation remotely, collecting data from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the Weather Prediction Center (WPC) and the National Center for Environmental Information (NCEI). This report documents the general weather products and forecasts over the region during the period and the pertinent meteorological parameters related

to the incident. All times are reported as CST based upon the 24-hour clock, local time is -6 hours from UTC, and UTC=Z. NWS airport and weather 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. Directions are referenced to true north and distances in nautical miles. Heights are in feet (ft) above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles.

## **E. FACTUAL INFORMATION**

### **1.0 Synoptic Conditions**

The synoptic or large-scale migratory weather systems influencing the area were documented using standard NWS charts issued by the National Center for Environmental Prediction (NCEP) and the WPC located in College Park, Maryland. These are the base products used in describing weather features and in the creation of forecasts and warnings. Reference to these charts can be found in the Federal Aviation Administration (FAA) "Aviation Weather Handbook", FAA-H-8083-28<sup>1</sup>.

### **1.1 Surface Analysis chart**

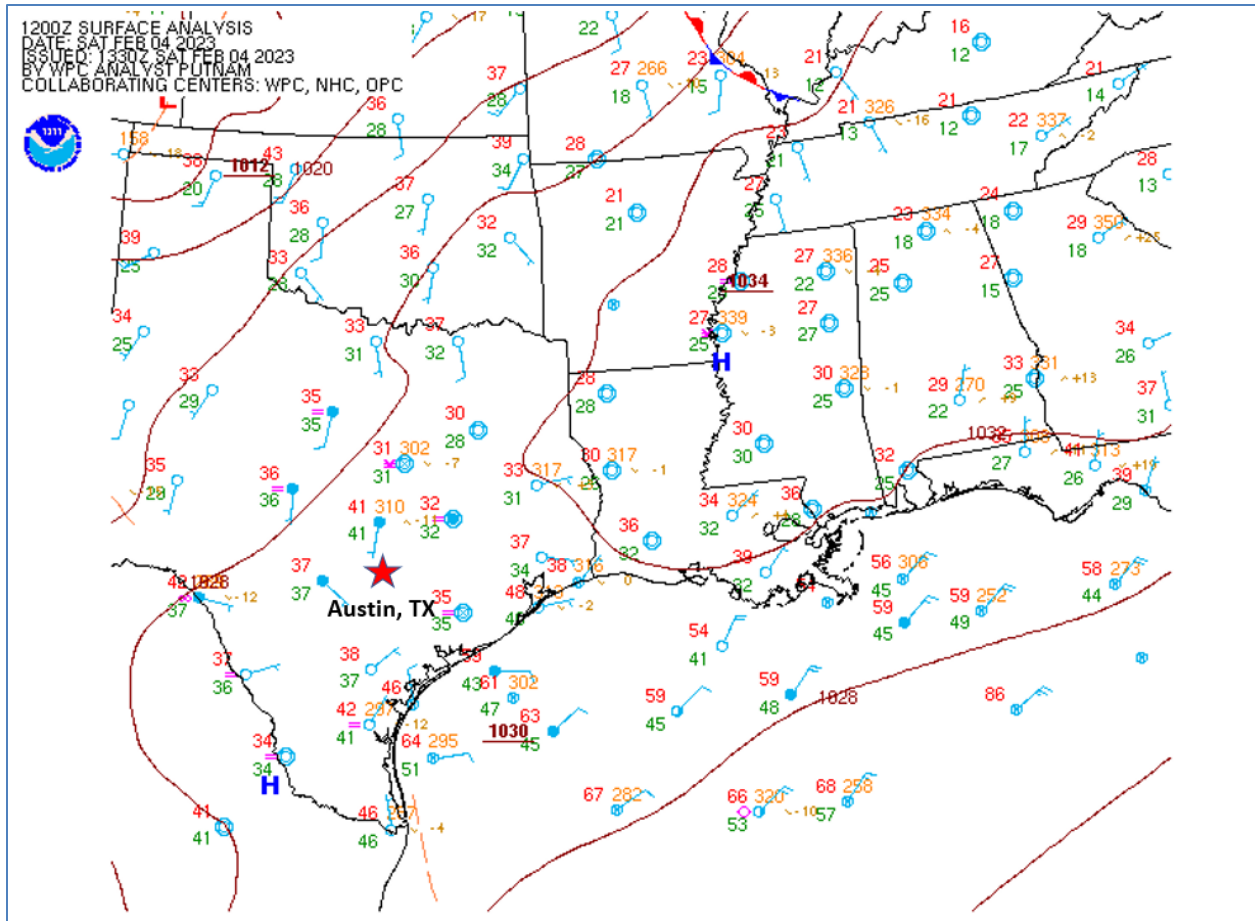
The NWS south central Surface Analysis Chart for 0600 CST is included as figure 1, with the approximate location of Austin, Texas, marked by the red star. The chart depicted a high-pressure system at 1034-hectopascals (hPa)<sup>2</sup> over the Louisiana, Mississippi, and Arkansas borders with a ridge extending westward over Texas and dominating over central Texas. The chart depicted calm to light southerly winds of 5 knots or less over the area with clear to obscured conditions in mist<sup>3</sup> and fog, with temperatures in the 30's to low 40's °F, with dew point temperatures within 2° F or less of the temperature over southern and central Texas.

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<sup>1</sup><https://www.faa.gov/regulationspolicies/handbooksmanuals/aviation/faq-h-8083-28-aviation-weather-handbook>

<sup>2</sup> Hectopascals are the standard units for reporting sea-level pressure and is interchangeable with the former term millibar (mb) with the same unit. The standard atmosphere is based on a sea-level pressure is 1013.25-hPa and a temperature of 15° Celsius (C), or 59° Fahrenheit (F).

<sup>3</sup> Mist - is a visible aggregate of minute water particles suspended in the atmosphere that reduces visibility to less than 7 statute miles, but greater than or equal to 5/8 statute miles. It does not reduce visibility as much as fog and is often confused with drizzle.



**Figure 1 - NWS south central section of Surface Analysis Chart for 0600 CST with the approximate location of Austin, Texas noted by the red star.**

## 2.0 Surface Observations

The area was documented using official Aviation Routine Weather Reports (METAR<sup>4</sup>) and Aviation Selected Special Weather Reports (SPECI) that were disseminated long-line<sup>5</sup> surrounding the period. Cloud heights are reported above ground level (agl) in the following section, and the latest sectional chart for the area indicated a magnetic variation of 3.5° E over the area. While the Automated Terminal Information Service (ATIS) and air traffic controllers broadcast the latest weather observation to pilots with wind referenced to magnetic north, there was no significant difference in the magnetic variation and the true wind direction reported in this case.

<sup>4</sup> METAR - an abbreviation for METeoro logical Aerodrome Report.

<sup>5</sup> Long-line - refers to the dissemination or transmission of the weather observation with the intent that they are available in near real-time to the national database and available to users and are also archived. This does not include observations which may have been broadcast locally by the station on very high frequency (VHR) line-of-sight radio or by telephone.

## 2.1 Austin, Texas

The incident occurred at Austin-Bergstrom International Airport (KAUS), Austin, TX, which lists an elevation of 542 ft and had a federally installed and maintained Automated Surface Observation System (ASOS) that was augmented by contract weather observers, who were located on the second floor of the control tower in a window less office at the time of the event. Surrounding the time of the runway incursion the following reports were disseminated long-line to users.

*KAUS special weather observation at 0618 CST (1218Z), wind calm, visibility 1/4 mile, runway 36R runway visual<sup>6</sup> range 1800 variable 2400 ft, freezing fog, vertical visibility 200 ft agl, temperature -1° C, dew point temperature -1° C, and altimeter 30.43 inches of mercury (inHg). Remarks: automated station with a precipitation discriminator, temperature -0.6° C, dew point temperature -0.6° C.*

### **Runway incursion 0640 CST**

*KAUS special weather observation at 0647 CST (1247Z), wind calm, visibility 1/8 mile, runway 36R runway visual range 1800 variable 2400 ft, freezing fog, vertical visibility 200 ft agl, temperature -1° C, dew point temperature -1° C, and altimeter 30.43 inHg. Remarks: automated station with a precipitation discriminator.*

According to air traffic controllers in the tower during the period, they were above the fog at the tower level at about 300 ft agl and had unlimited visibility on top but were unable to see the surface due to the fog and the time of day.

As visibility begins to decrease it is often first reported as restricted in mist. The NWS defines mist (BR) as a visible aggregate of minute water particles suspended in the atmosphere that reduces visibility to less than 7 statute miles, but greater than or equal to 5/8 statute miles. It does not reduce visibility as much as fog and is often confused with drizzle. While fog (FG) is also water droplets suspended in the air at the Earth's surface and is reported when visibility is less than 5/8 mile, unlike drizzle, it does not fall to the ground. Fog is often considered hazardous for transportation when visibility is reduced to 1/4 mile or less and is defined as dense fog. Freezing Fog (FZFG)

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<sup>6</sup> Runway Visual Range (RVR) - is an estimate of the maximum distance at which the runway, or the specified lights or markers delineating it, can be seen from a position above a specific point on its centerline. This value is normally determined by visibility sensors or transmissometers located alongside and higher than the center line of the runway. RVR is used operationally to assess whether visibility conditions are good enough to allow a particular operation, such as an instrument landing. The RVR reported in surface observations and disseminated long-line is the highest RVR achievable for the measured visibility at the touchdown zone of a specified runway. Typically, this is the RVR calculated for the highest and lowest values of visibility over the previous 10 minutes at runway light intensity step five. This is an automated report.



is defined as a fog where the droplets freeze upon contact with exposed objects and form a coating of rime and/or glaze. In METAR reports freezing fog is reported when visibility is reported less than 5/8 of a mile and the temperature is reported below the freezing or 0° C, and the dew point depression is less than 2° C. The FAA definition of freezing fog<sup>7</sup> is similar to the NWS's but does not imply icing conditions are occurring.

The location of the primary ASOS sensors was west of the touchdown zone for runway 36L, with the ASOS back-up station near the touchdown zone of runway 18R, which are depicted in figure 2. The elevation of the primary ASOS equipment was approximately 484 ft and located in the lowest section of the airport. The location of the primary ASOS was also about 1/2 mile north of Onion Creek, a small waterway that was south of the airport. According to NWS local climatology data<sup>8</sup> for the airport, the location of the ASOS is in a low-lying area in the drainage basin of the Onion Creek. Because of this, the overnight low temperature in the wintertime under clear skies can sometimes be 10° F colder at KAUS than at Austin-Mabry Army Reserve Heliport, a distance of only 10 miles away.



**Figure 2 - Location of the main ASOS equipment and backup sensor arrays at KAUS.**

The general flight categories<sup>9</sup> and the observations that were disseminated long-line from 0053 through 0800 CST were as follows.

<sup>7</sup> As defined in JO 7900.5E section 9.3. Obscurations, H. Freezing Fog (FZFG).

<sup>8</sup> <https://www.weather.gov/media/ewx/climate/ClimateSummary-ewx-Austin.pdf>

<sup>9</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.

VFR METAR KAUS 040653Z 0000KT 7SM FEW015 02/02 A3049 RMK AO2 SLP330 T00170017=

MVFR METAR KAUS 040753Z 0000KT 3SM R36R/1400V3500FT BR FEW015 00/00 A3047 RMK AO2 SLP326  
T00000000=

IFR SPECI KAUS 040814Z 0000KT 2SM R36R/3500VP6000FT BR SCT002 M01/M01 A3047 RMK AO2  
T10111011=

IFR SPECI KAUS 040841Z 0000KT 1SM R36R/P6000FT BR SCT002 M02/M02 A3046 RMK AO2 T10171022=

LIFR METAR KAUS 040853Z 0000KT 3/4SM R36R/1400VP6000FT BR SCT002 01/M01 A3046 RMK AO2 SLP320  
T00111006 58012=

LIFR SPECI KAUS 040926Z 0000KT 3/4SM R36R/1400V2200FT BR SCT002 01/M01 A3045 RMK AO2  
T00111006=

LIFR SPECI KAUS 040938Z 0000KT 3/4SM R36R/2000V2400FT BR SCT002 01/M01 A3045 RMK AO2  
T00111006=

LIFR METAR KAUS 040953Z 0000KT 3/4SM R36R/1200V1800FT BR SCT002 02/M01 A3044 RMK AO2 SLP314  
T00221006=

LIFR SPECI KAUS 041008Z 0000KT 3/4SM R36R/1800V2400FT BR SCT002 02/M01 A3044 RMK AO2  
T00221006=

LIFR METAR KAUS 041053Z 0000KT 1/2SM R36R/1800V2400FT FG SCT002 02/M01 A3043 RMK AO2 SLP308  
T00221006=

LIFR SPECI KAUS 041133Z 0000KT 1/4SM R36R/1800V2400FT FG SCT002 02/M01 A3043 RMK AO2  
T00171006=

LIFR METAR KAUS 041153Z 0000KT 1/4SM R36R/1800V2400FT FG SCT002 02/M01 A3043 RMK AO2 SLP309  
T00171011 10028 21022 56011=

LIFR SPECI KAUS 041200Z 0000KT 1/4SM R36R/1800V2400FT FZFG SCT002 M01/M01 A3042 RMK AO2  
T10061006=

LIFR **SPECI KAUS 041218Z 0000KT 1/4SM R36R/1800V2400FT FZFG VV002 M01/M01 A3043 RMK AO2  
T10061006=**

**Incident 1240Z**

LIFR **SPECI KAUS 041247Z 0000KT 1/8SM R36R/1800V2400FT FZFG VV002 M01/M01 A3043 RMK AO2=**

LIFR METAR KAUS 041253Z 0000KT 1/8SM R36R/1800V2400FT FZFG VV002 M01/M01 A3043 RMK AO2  
SLP309 T10061006=

LIFR SPECI KAUS 041323Z 0000KT 1/8SM R36R/1000FT FZFG VV002 00/00 A3043 RMK AO2 T00000000=

LIFR SPECI KAUS 041341Z 0000KT 1/8SM R36R/1000V1200FT FG VV002 01/01 A3043 RMK AO2 T00060006=

LIFR METAR KAUS 041353Z 0000KT 1/8SM R36R/0800V1000FT FG VV002 01/01 A3044 RMK AO2 SLP314  
T00060006=

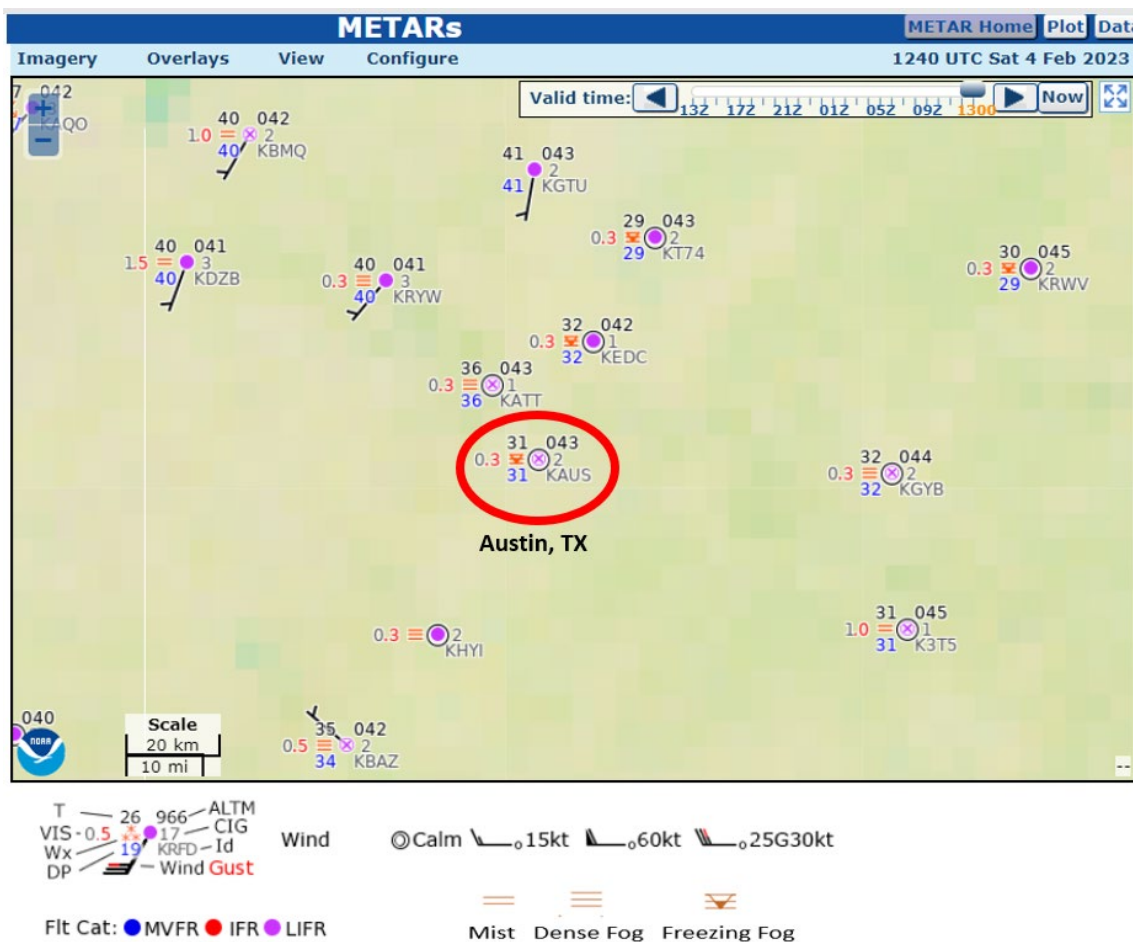
Attachment 1 is a review of the KAUS weather conditions of significant events of IFR to LIFR conditions, or periods of significant weather that impacted the airport during the previous 45 days.

- 
- 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.



## 2.2 NWS METAR Display

A display of the conditions from the NWS Aviation Weather Center's (AWC) METAR display<sup>10</sup> at 0640 CST centered over Austin is included as figure 3. The image depicts the general flight categories as colored station models according to the legend, and the observations being reported at the time, with the regional radar mosaic overlaid for the period. The image depicts an extensive area of LIFR conditions over the region with visibility restrictions of 1 ½ miles or less and ceilings between 200 to 300 ft agl over the area with no precipitation echoes. Four stations, including KAUS were reporting freezing fog with visibility of 0.3 mile (or ¼ mile), with temperatures at 32° F or below at the time, while other stations immediately northwest and north reported warmer temperatures.



**Figure 3 - NWS Aviation Weather Center's METAR display at 0640 CST with a red circle over the Austin-Bergstrom International Airport (KAUS). The station color depicts the general flight conditions. Note the legend at the bottom of the image depicts the symbols for mist, dense fog, and freezing fog.**

<sup>10</sup> <https://www.aviationweather.gov/metar>

## 2.3 High resolution ASOS Data

The 5-minute ASOS observation for KAUS decoded at the time of the incident was as follows.

*KAUS weather observation at 0640 CST, automated, wind calm, visibility 1/4 mile in freezing fog, vertical visibility 200 ft agl, temperature 0° C, dew point temperature 0° C, altimeter 30.43 inHg, pressure altitude 80 ft, relative humidity 100%, density altitude -1700 ft, magnetic wind 000°/00 kt.*

The 5-minute observations surrounding the period from 0600 through 0700 CST with the other disseminated observations (blue type) issued during the period are included below. The local time has been added to the report for reference. The second line of the observations includes the pressure altitude, relative humidity, density altitude, magnetic wind direction and wind speed. The 5-minute observations do not include the remarks section of the report (as depicted in section 1.1 above).

*[0600 CST] 5-MIN KAUS 041200Z AUTO 00000KT 1/4SM FZFG SCT002 M01/M01 A3042  
80 100 -1700 000/00*

*[0605 CST] 5-MIN KAUS 041205Z AUTO 00000KT 1/4SM FZFG SCT002 M01/M01 A3043  
80 100 -1700 000/00*

*[0610 CST] 5-MIN KAUS 041210Z AUTO 00000KT 1/4SM FZFG SCT002 M01/M01 A3042  
80 100 -1700 000/00*

*[0615 CST] 5-MIN KAUS 041215Z AUTO 00000KT 1/4SM FZFG SCT002 M01/M01 A3043  
80 100 -1700 000/00*

*[0618 CST] SPECI KAUS 041218Z 00000KT 1/4SM R36R/1800V2400FT FZFG VV002 M01/M01  
A3043*

*[0620 CST] 5-MIN KAUS 041220Z AUTO 00000KT 1/4SM FZFG VV002 M01/M01 A3043  
80 100 -1700 000/00*

*[0625 CST] 5-MIN KAUS 041225Z AUTO 00000KT 1/4SM FZFG VV002 M01/M01 A3043  
80 100 -1700 000/00*

*[0630 CST] 5-MIN KAUS 041230Z AUTO 00000KT 1/4SM FZFG VV002 M01/M01 A3042  
80 100 -1700 000/00*

*[0635 CST] 5-MIN KAUS 041235Z AUTO 00000KT 1/4SM FZFG VV002 00/00 A3043  
80 100 -1700 000/00*

***[0640 CST] 5-MIN KAUS 041240Z AUTO 00000KT 1/4SM FZFG VV002 00/00 A3043  
80 100 -1700 000/00***

***Incident [0640 CST] or 1240Z***

[0645 CST] 5-MIN KAUS 041245Z AUTO 00000KT 1/4SM FZFG VV002 00/00 A3043  
80 100 -1700 000/00

[0647 CST] SPECI KAUS 041247Z 00000KT 1/8SM R36R/1800V2400FT FZFG VV002 M01/M01  
A3043

[0650 CST] 5-MIN KAUS 041250Z AUTO 00000KT M1/4SM FZFG VV002 M01/M01 A3043  
80 100 -1700 000/00

[0653 CST] METAR KAUS 041253Z 00000KT 1/8SM R36R/1800V2400FT FZFG VV002 M01/M01  
A3043 RMK AO2 SLP309 T10061006

[0655 CST] 5-MIN KAUS 041255Z AUTO 00000KT M1/4SM FZFG VV002 M01/M01 A3043  
80 100 -1700 000/00

[0700 CST] 5-MIN KAUS 041300Z AUTO 00000KT M1/4SM FZFG VV002 M01/M01 A3043  
80 100 -1700 000/00

### 3.0 Pilot Weather Reports

A search for pilot weather reports or PIREPs in the national database<sup>11</sup> within 100 miles of KAUS, during the period from 0400 through 0800 CST did not yield any results.

### 4.0 Sounding

To determine the vertical structure and state of the atmosphere over the incident site a High-Resolution Rapid Refresh (HRRR) numerical model<sup>12</sup> sounding was obtained from the NOAA Air Resource Laboratory's website for the closest grid point to KAUS for 0700 CST. The sounding was then plotted on a standard skew-T log P diagram<sup>13</sup> utilizing the RAOB Analysis software<sup>14</sup> from the surface to 700-hPa (approximately 10,000 ft) and is included as figure 4.

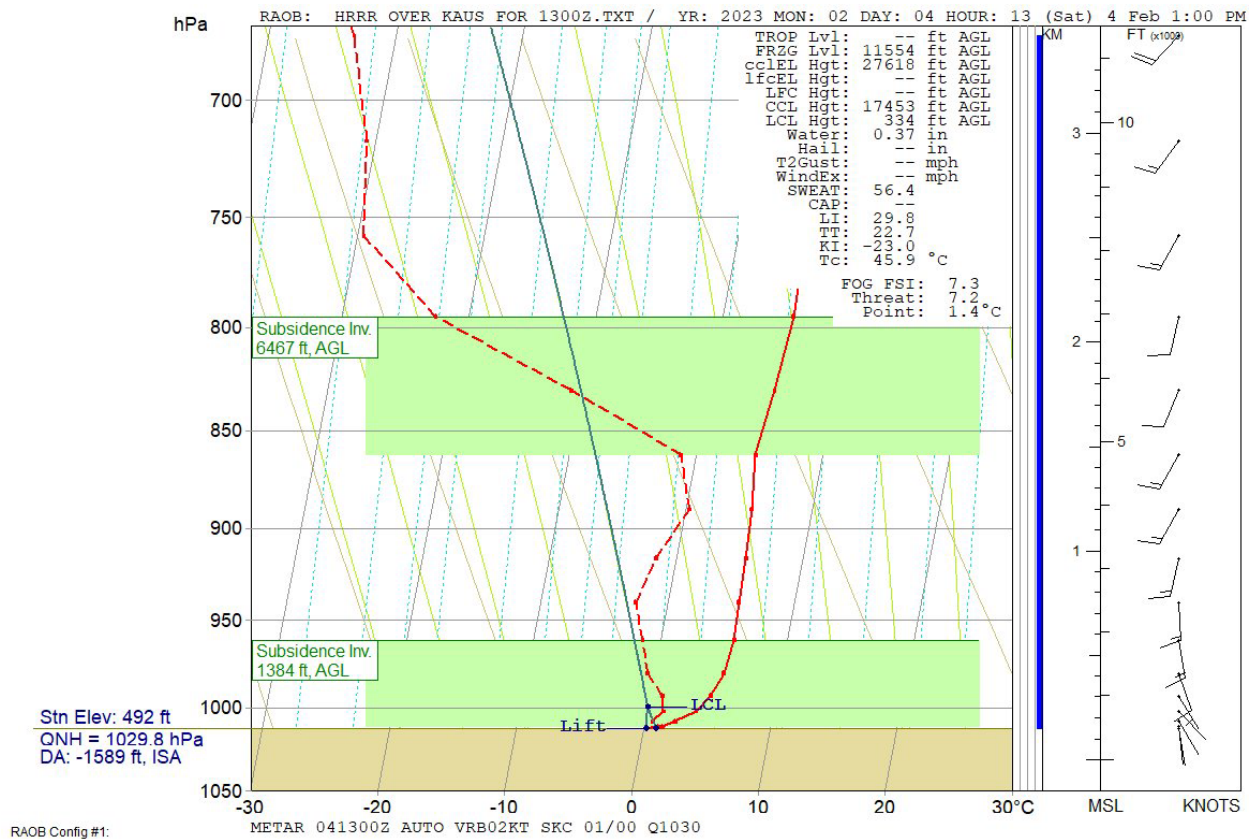
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<sup>11</sup> Includes only the reports official recorded and disseminated as a PIREP and may not include "ride reports" broadcasted or other conditions solicited by air traffic controllers and not entered in the formal PIREP format coding. These reports are available to user's in near real-time.

<sup>12</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>13</sup> Skew T log P diagram - is a standard meteorological plot or thermodynamic diagram using temperature and the logarithmic of pressure as coordinates, used to display winds, temperature, dew point, and various indices used to define the vertical structure of the atmosphere.

<sup>14</sup> RAOB -The Complete RAOBsonde OBServation program is an interactive sounding analysis program developed by Eosonde Research Services (ERS) previously known as Environmental Research Services, The Villages, Florida.



**Figure 4 - High Resolution Rapid Refresh (HRRR) model sounding over KAUS for 0700 CST.**

The HRRR 0700 CST sounding depicted an elevation of 492 ft over the grid point<sup>15</sup> with a near surface temperature of 1.0° C (33.8° F), a dew point temperature of 0.2° C (32.4° F), with a relative humidity of 94%. The sounding depicted a surface-based temperature inversion due to subsidence to 1,384 ft agl, with another inversion from about 5,000 ft through 7,000 ft (green shaded area horizontal across diagram). The lifted condensation level (LCL)<sup>16</sup> was at 334 ft agl, with the convective condensation level (CCL)<sup>17</sup> was at 17,945 ft. The precipitable water content was 0.37 inches. The Lifted Index (LI)<sup>18</sup> was 29.8 and indicated a stable atmosphere. The fog indices on the top right section of the diagram indicated a Fog FSI<sup>19</sup> was calculated as 7.3, which

<sup>15</sup> Closest grid point generated for the sounding was latitude 30.19° N and longitude 97.67° W.

<sup>16</sup> Lifted Condensation Level (LCL) - the level at which a lifted parcel becomes saturated. The LCL height corresponds to cloud base height for forced ascent.

<sup>17</sup> Convective Condensation Level (CCL) - the level in the atmosphere to which an air parcel, if heated from below, will rise dry adiabatically, without becoming colder than its environment just before the parcel becomes saturated.

<sup>18</sup> Lifted Index (LI) - A common measure of atmospheric instability. Its value is obtained by computing the temperature that air near the ground would have if it were lifted to 500-hPa or approximately 18,000 feet and comparing that temperature to the actual temperature at that level. Negative values indicate instability - the more negative, the more unstable the air is, and the stronger the updrafts are likely to be with any developing thunderstorms.

<sup>19</sup> Fog Stability Index (FSI) was developed by the U.S. Air Force Weather Service for use in Germany but can be applied to similar climates. Reference USAF publication 2WW/TN-79/008 and is designed to

indicated a high potential for radiation fog formation. The fog point temperature was 1.4° C, which indicated the temperature required for radiation fog to form. The Fog Threat index of 7.2 indicated a low likelihood of radiation fog formation. The freezing level was identified at about 12,050 ft.

The HRRR wind profile indicated a surface wind from 170° at 2 knots, with the wind veering to the west with height and increasing in speed. The mean 0 to 6 kilometer (18,000 ft) “steering” wind was from 230° at 17 knots. The RAOB Analysis program indicated a threat of light w-Level Wind Shear (LLWS) below 1,000 ft agl.

A summary list of the sounding parameters of height, pressure, temperature, dew point temperature, relative humidity, wind, and derived clear air turbulence (CAT), LLWS, and icing potential from the surface to about 7,000 ft are included below.

Height (ft msl)	Pres (hPa)	T (°C)	Td (°C)	RH (%)	Wind (dir-kts)	CAT (FAA)	LLWS (FAA)	Icing AFGWC
492	1012	1.0	0.2	94	172/ 2			None
518	1011	1.5	1.1	97	174/ 2			
597	1008	2.4	0.6	88	152/ 2			
756	1002	3.9	1.3	83	140/ 2			
997	993	4.8	1.0	76	151/ 3	MDT	LIGHT	
1350	980	5.5	-0.5	65	162/ 10	LGT	LIGHT	
1876	961	5.8	-1.4	60	171/ 15			
2469	940	5.6	-2.5	56	177/ 15	LGT		
3163	916	5.5	-1.6	60	192/ 15	LGT		
3936	890	5.2	0.3	71	207/ 16			
4792	862	4.7	-1.2	66	208/ 15	LGT		
5805	830	5.2	-10.8	30	201/ 11			
6959	795	5.6	-22.6	11	193/ 10	LGT		

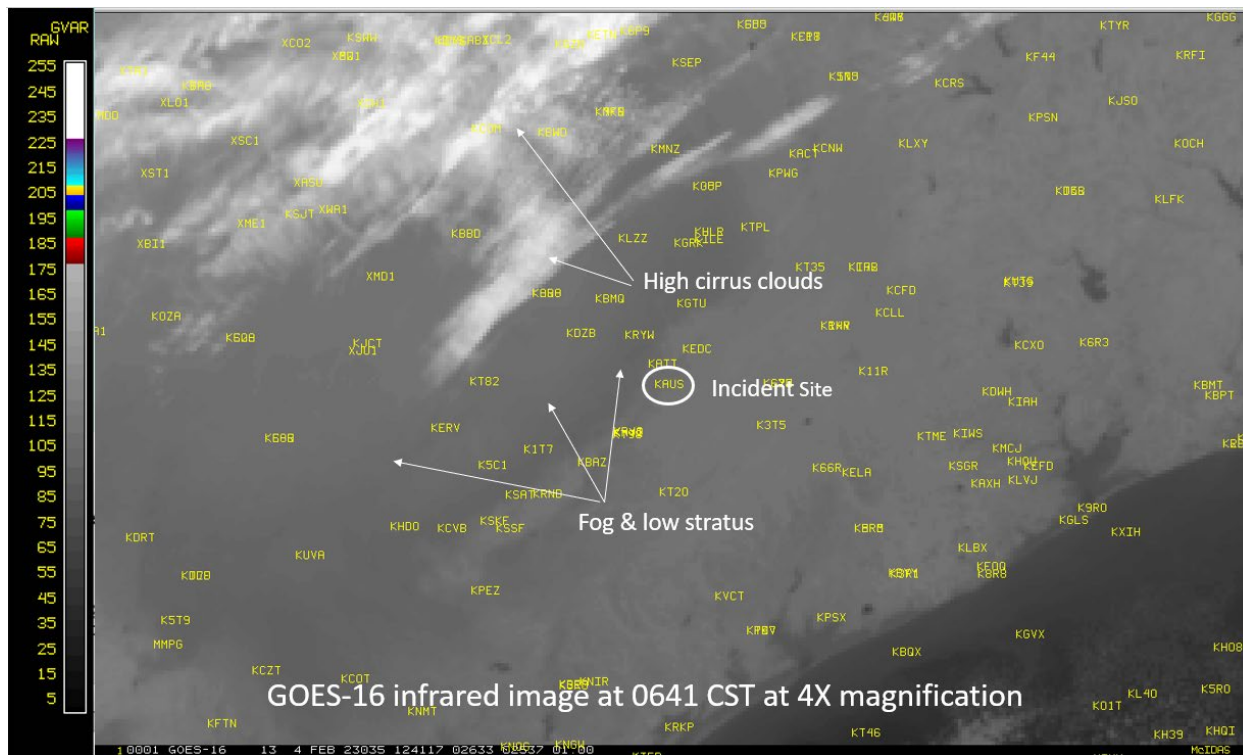
## 5.0 Satellite Imagery

NOAA Geostationary Operational Environmental Satellite number 16 (GOES-16) infrared imagery was obtained from an archive at the Space Science Engineering Center (SSEC) at the University of Wisconsin-Madison in Madison, Wisconsin, and processed using the Man-computer Interactive Data Access System (McIDAS) software. The infrared band 13 at a wavelength of 10.3 microns (µm) provided a resolution of 2 kilometers (km) with radiative cloud top temperatures. At the time of the incident, the visible band imagery was not useful due to the low sun angle.

Figure 5 is the GOES-16 infrared image at 0641 CST at 4X magnification. The image depicted warm stratiform type clouds over central Texas with the KAUS area on the eastern border. Colder cloud tops associated with cirriform clouds were noted northwest of the area. Over KAUS the radiative cloud top temperature was 274 Kelvin

indicate the potential for radiation fog.

or 0.8° C, which corresponded to near surface temperatures based on the HRRR sounding.



**Figure 5 - GOES-16 infrared image at 0641 CST at 4X magnification.**

## 6.0 NWS Forecasts and Advisories

The NWS Austin/San Antonio (KEWX) Weather Forecast Office (WFO) located in New Braunfels, Texas, was responsible for the weather alerts and warnings for the local area, while the NWS AWC in Kansas City, Missouri, was responsible for the aviation products. The relevant forecasts during the period are included below.

### 6.1 Terminal Aerodrome Forecast

The NWS Terminal Aerodrome Forecast (TAF) is a concise statement of the expected meteorological conditions significant to aviation for a specified time period, usually 24-hours and within 5 statute miles of the center of the airport's runway complex (terminal). The TAFs issued by the NWS KEWX WFO at 0246, 0552, and 0619 CST are below. Cloud heights are agl. The forecast valid at the time of the incident is in bold blue type.

AMD TAF KAUS 040846Z 0409/0512 VRB02KT 1SM BR SCT003  
**FM041100 VRB02KT 1/2SM FG BKN002**  
 FM041600 18006KT 3SM BR BKN010



FM041800 18011KT P6SM BKN040=

**TAF KAUS 041152Z 0412/0518 VRB02KT 1/2SM FG SCT002**

**TEMPO 0412/0414 BKN002**

FM041600 18006KT 3SM BR BKN010

FM041800 18012G22KT P6SM SCT035 SCT250

FM050000 16010KT P6SM SKC

FM051000 19005KT 4SM BR SCT005=

**AMD TAF KAUS 041219Z 0412/0518 VRB02KT 1/2SM FG SCT002**

**TEMPO 0412/0414 1/4SM FG BKN002**

FM041600 18006KT 3SM BR BKN010

FM041800 18012G22KT P6SM SCT035 SCT250

FM050000 16010KT P6SM SKC

FM051000 19005KT 4SM BR SCT005=

The initial amended forecast for KAUS issued at 0246 CST expected light and variable winds, visibility 1/2 mile in fog with ceiling broken at 200 ft agl. The next scheduled TAF issued at 0552 CST, continued to expect light and variable winds at 2 knots, visibility 1/2 mile in fog with scattered clouds at 200 ft, with a temporary<sup>20</sup> period between 0600 and 0800 CST with ceiling broken at 200 ft. That TAF was amended at 0619 CST and expected light and variable winds, visibility 1/2 mile in fog, scattered clouds at 200 ft, with a temporary condition between 0600 and 0800 CST of visibility 1/4 mile in fog, ceiling broken at 200 ft.

## 6.2 Area Forecast Discussion

The NWS Area Forecast Discussions (AFD) are issued by each WFO to describe the short-term weather conditions within their region with an aviation section that includes the general conditions as they relate to the creation of the TAF. These are useful for additional aviation-related issues that cannot be encoded into the TAF and provide some reasoning behind the forecast. These are generated roughly every 6 hours and correspond to the release of the latest TAFs for that office. The NWS KEWX WFO AFD short term forecast, aviation, and warning sections issued at 0349 CST were as follows. The KAUS airport is located with Travis County, Texas.

*FXUS64 KEWX 040949*

*AFDEWX*

*Area Forecast Discussion*

*National Weather Service Austin/San Antonio TX*

*349 AM CST Sat Feb 4 2023*

*.SHORT TERM...*

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<sup>20</sup> Temporary is used when conditions are expected to last less than an hour at a time and less than half the time period indicated.

(Today through Sunday)  
Issued at 332 AM CST Sat Feb 4 2023

Morning satellite data and observations show an area of low clouds and patchy fog from the Hill Country eastward to near the Interstate 35 corridor. In addition, clear skies, light winds and wet ground from near Interstate 35 east to the Highway 77 corridor has allowed fog to develop. Current temperatures across the region are mainly in the mid 30s to lower 40s. A few spots in the Hill Country to I-35 corridor near Austin are at or just below freezing.

**The main concern for this morning will be patchy dense fog across the Hill Country, southern Edwards Plateau and along and east of the I-35/I-37 corridor. Given current observations and expected trends through the morning hours, we have issued a Dense Fog Advisory for the above mentioned areas through 10 AM this morning. A few spots of freezing fog from the Hill Country eastward to I-35 near Austin may allow for some light ice accumulation on bridges and overpasses.** Otherwise, look for dry weather along with afternoon highs in the mid 50s to lower 60s for most areas. Clear skies this evening will give way to increasing low cloudiness after midnight from the coastal plains northward into the I-35 corridor. Some patchy fog development can also be expected in the coastal plains region tonight. Lows tonight range from the mid 30s in the Hill Country to upper 40s in the coastal plains. Temperatures warm into the mid 60s to mid 70s on Sunday.

.AVIATION...  
(06Z TAFS)  
Issued at 1043 PM CST Fri Feb 3 2023

**IFR to MVFR ceilings prevail across portions of the Hill Country and into the I-35 corridor near BAZ and HYI.** We still anticipate low ceilings and fog to develop overnight and into Saturday morning across much of the region, producing LIFR to IFR conditions. These conditions are expected to continue to gradually develop through the Hill Country and portions of the I-35 corridor between 06Z-12Z and then expand out into the Rio Grande Plains 11Z-14Z. In addition, there is a possibility freezing fog could develop through portions of the Hill Country early Saturday morning. The low stratus and fog is forecast to gradually erode 16Z-20Z with VFR conditions thereafter.

.EWX WATCHES/WARNINGS/ADVISORIES...  
**Dense Fog Advisory until 10 AM CST this morning** for Bandera-Bastrop-Bexar-Blanco-Burnet-Caldwell-Comal-Edwards-Fayette-Gillespie-Gonzales-Guadalupe-Hays-Kendall-Kerr-Kinney-Lee-Llano-Medina-Real-**Travis**-Uvalde-Williamson-Wilson.

Short-Term...Platt  
Aviation...Platt

The NWS KEWX WFO updated the Aviation Weather Discussion at 0624 CST and was as follows.

FXUS64 KEWX 041224 AAA  
AFDEWX

Area Forecast Discussion...UPDATED  
National Weather Service Austin/San Antonio TX

624 AM CST Sat Feb 4 2023

...New AVIATION...

**.AVIATION...**

(12Z TAFS)

Issued at 611 AM CST Sat Feb 4 2023

**Fog and low clouds along I-35 continue to expand westward into the Rio Grande plains this morning. Flight conditions will remain poorest at AUS, where IFR and even some LIFR are in store this morning.** The remaining TAF sites should remain IFR due to low clouds and fog. Conditions begin to improve between 15-16Z, with all sites trending back to VFR 17-19Z. VFR is then expected to continue through the evening before another round of fog and low clouds develops early Sunday morning.

.EWX WATCHES/WARNINGS/ADVISORIES...

**Dense Fog Advisory until 10 AM CST** this morning for Bandera-Bastrop-Bexar-Blanco-Burnet-Caldwell-Comal-Edwards-Fayette-Gillespie-Gonzales-Guadalupe-Hays-Kendall-Kerr-Kinney-Lee-Llano-Medina-Real-**Travis**-Uvalde-Williamson-Wilson.

Short-Term...Platt

Aviation...Platt

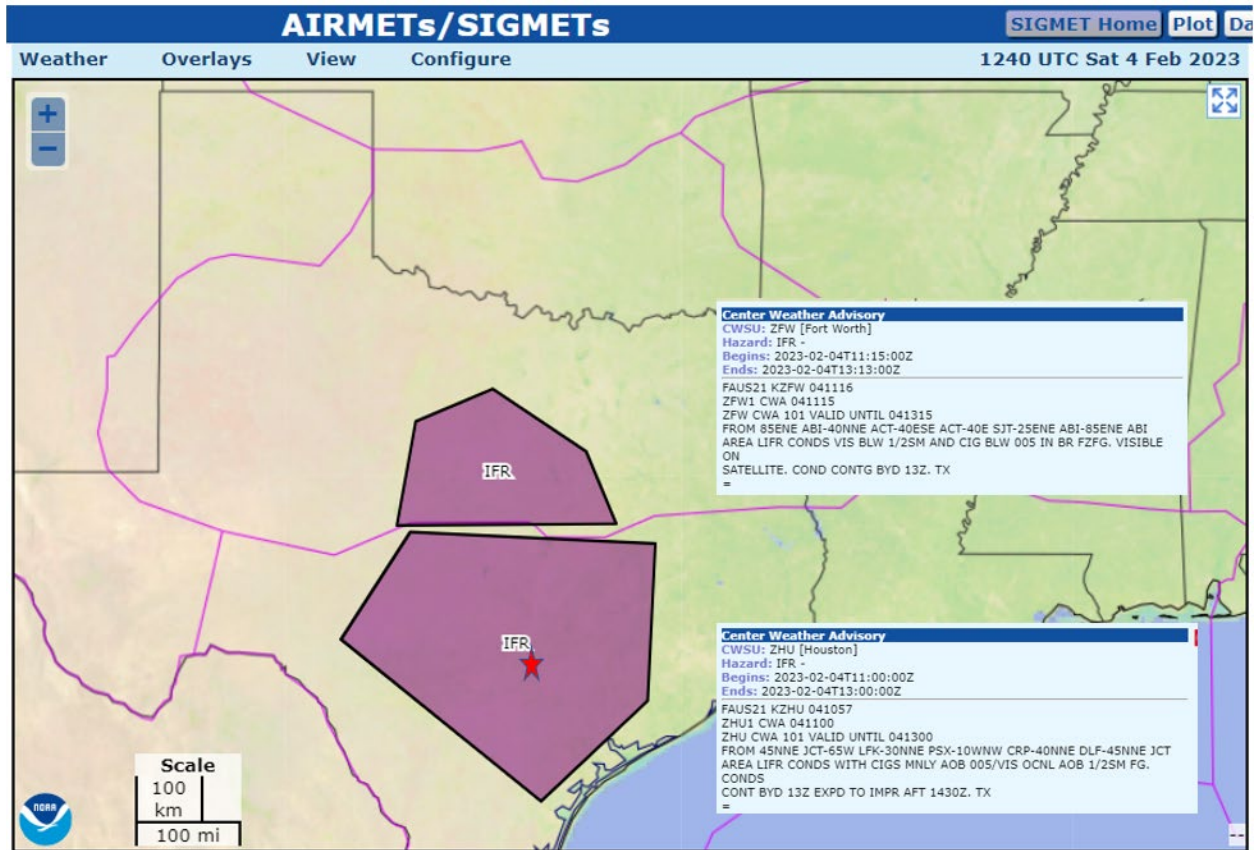
### 6.3 In-flight Weather Advisories

In-flight Aviation Weather Advisories are forecasts that advise en route aircraft of the development of potentially hazardous weather. Inflight aviation weather advisories in the conterminous U.S. are issued by the NWS AWC, as well as from the Center Weather Service Units (CWSU) at the various Air Route Traffic Control Centers (ARTCCs). There are four basic types of inflight aviation weather advisories: the Significant Meteorological Information (SIGMET), the Convective SIGMET, the Graphic - Airmen's Meteorological Information (G-AIRMET), and the Center Weather Advisory (CWA). Inflight advisories serve to notify en-route pilots of the possibility of encountering hazardous flying conditions that may not have been forecast at the time of the preflight briefing. Whether or not the condition described is potentially hazardous to a particular flight is for the pilot to evaluate based on experience and the operational limits of the aircraft. Once issued they are broadcast by FAA air traffic controllers upon issuance and available on inflight weather broadcasts.

At the time of the incident the NWS did not have any SIGMETs, Convective SIGMETs current for the area. The NWS did have CWA and G-AIRMET advisories current for the area which are documented below.

### 6.3.1 Center Weather Advisories

The NWS Houston (KZHU) CWSU issued CWA #101 at 0457 CST, which was valid through 0700 CST for LIFR conditions over the region with ceilings below 500 ft agl, and visibilities at or below 1/2 mile in fog. The CWA advisories current are depicted in figure 6. The NWS Dallas (KZFW) CWSU also had a CWA current for their respected area for LIFR conditions, which is also depicted in figure 6.



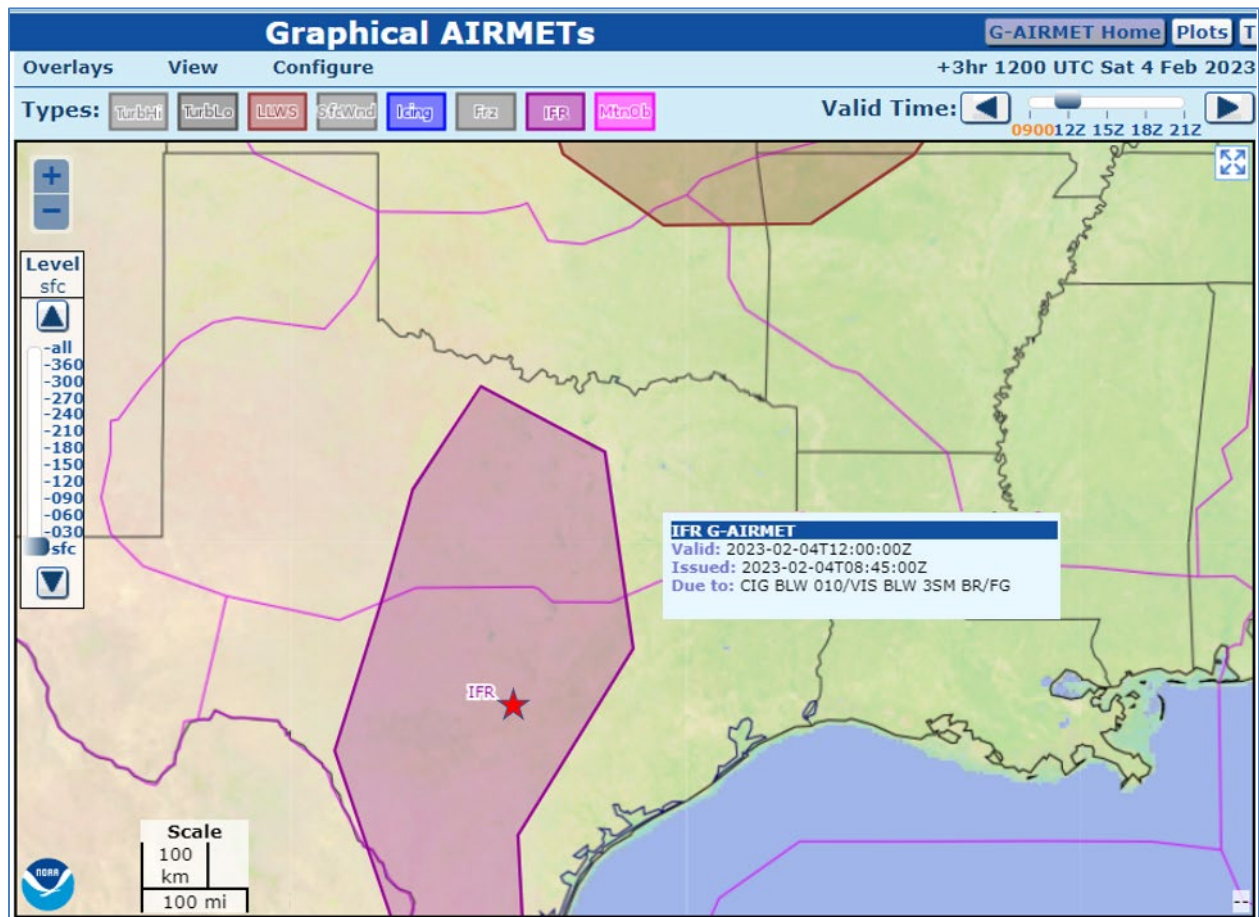
**Figure 6 - A depiction of the NWS CWSU Center Weather Advisories issued for LIFR conditions at 0640 CST, with the incident location KAUS marked by the red star.**

AUS21 KZHU 041057  
ZHU1 CWA 041100  
ZHU CWA 101 VALID UNTIL 041300  
FROM 45NNE JCT-65W LFK-30NNE PSX-10WNW CRP-40NNE DLF-45NNE JCT  
AREA LIFR CONDS WITH CIGS MNLY AOB 005/VIS OCNL AOB 1/2SM FG. CONDS  
CONT BYD 13Z EXPD TO IMPR AFT 1430Z. TX

### 6.3.2 Graphic-AIRMET

In addition, the NWS AWC also had a G-AIRMET current for the period for a large area of IFR conditions over Texas which also covered the incident location. Figure 7 is

a depiction of the NWS AWC G-AIRMET display<sup>21</sup> valid at 0640 CDT on February 4, 2023.



**Figure 7 - Depiction of the NWS Graphic-AIRMET for IFR conditions valid at 0640 CST with the incident location at KAUS marked by the red star.**

## 7.0 Astronomical Conditions

The United States Naval Observatory website<sup>22</sup> was used to determine the astronomical conditions for Auston, Texas, on February 4, 2023.

Sun	Time (CST)
<b>Runway Incursion</b>	<b>0640</b>
Begin civil twilight	0655
Sunrise	0720

<sup>21</sup> <https://www.aviationweather.gov/gairmet>

<sup>22</sup> <https://aa.usno.navy.mil/data/index>



<b>Moon</b>	<b>Time</b>
Moonrise	1717 CST on February 3, 2023
<b>Runway Incursion</b>	<b>0640</b>
Moonset	0657

At the time of the runway incursion the Sun was 9° below the horizon at an azimuth of 103°. The moon was 2.7° above the horizon at an azimuth of 296°. The phase of the moon was a waxing gibbous with 98% of the moon’s disk visible.

## **8.0 Weather Observer Program**

Please see the Air Traffic Control Factual Report for the Interview of the Contract Weather Observation Manager at KAUS.

The FAA Order JO 7900.5E “Surface Weather Observing” is the FAA’s guidance and provides the best practices and procedures for weather observations in the National Airspace System (NAS) and applies to all FAA and contract weather observers. A copy of the order is included as Attachment 2. The order complements, but does not change, the standards contained in the NWS Federal Meteorological Handbook Number 1 (FMH-1). The FMH-1 and that order state the requirement for a contract weather observer to maintain a Basic Weather Watch<sup>23</sup>, to monitor weather conditions and issue special reports as necessary. The conditions may be reported from a reliable source such as from the tower controller, that existing conditions differ from those reported in the last disseminated observation and issue a SPECI if criteria are met. As previously documented, at KAUS the contract weather observer’s office is located on the second floor of the control tower without windows, the facility also does not have a computer with access to the internet to check NWS WSR-88D, satellite imagery or other observations across the region. The location requires the observers to go down 2 flights of stairs and go outside the tower and to check the prevailing conditions from several points around the tower to make their observation. The observers also need to exit the tower or to use their iPhone’s to access the internet for basic weather data.

The order in section 3.11 states the criteria for SPECI observations and includes the following:

- a. *Wind Shift* - of 45° or more in less than 15 minutes, and the wind speed is 10 knots or more throughout the shift.

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<sup>23</sup> In contrast to a Continuous Weather Watch, where the observer must monitor weather conditions on a continuous basis. In addition to METAR observations, observers must take and disseminate observations as conditions meeting criteria for SPECI observations occur.



- b. **Visibility** - Visibility as reported in the body of the report decreases to less than, or if below, increases to equal or exceeds: 3-, 2-, 1-, 1/2-, 1/4 miles or the lowest standard instrument approach minimum as published.
- c. **Runway Visual Range** - The highest values of the designated RVR decreases to less than, or if below, increases to equal or exceeds 2,400 ft during the preceding 10 minutes.
- d. **Tornado, Funnel Cloud, or Waterspout** - Is observed, disappears from sight or ends.
- e. **Thunderstorm** - Begins or ends.
- f. **Precipitation** - Hail, freezing precipitation, ice pellets, or snow begins, ends, or changes intensity.
- g. **Squall** - Wind speed increases by at least 16 knots and is sustained at 22 knots or more for at least 1 minute.
- h. **Ceiling** - The height of the base of clouds covering 5/8 or more (broken or overcast) of the sky forms or dissipates below, decreases to less than or, if below, increases to equal or exceed: 3000 ft, 1500 ft, 1000 ft, 500 ft, or the lowest standard approach procedure minimum. If no published 200 ft.
- i. **Sky Condition** - A layer of clouds or obscuring phenomena aloft is present below 1,000 ft and none was reported in the preceding METAR or SPECI observation.
- j. **Volcanic Eruption** - When eruption is first noted.
- k. **Aircraft Mishap** - Upon notification of an aircraft mishap, unless there has been an intervening observation.

## **F. ATTACHMENTS**

Attachment 1 - KAUS Significant weather events in the previous 45 days.

Attachment 2 - FAA Order JO 7900.5E "Surface Weather Observing"

Submitted by:

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