National Transportation Safety Board

Office of Aviation Safety

Washington, D.C. 20594-2000

May 15, 2012

WEATHER STUDY

CEN12FA108

A. Accident

Location: Approximately 22 miles north of Bryan, Texas
Date: December 19, 2011
Time: approximately 2144 central standard time (0344 UTC[1] on December 20th)
Aircraft: Piper PA-32-260, N3590T

B. Meteorological Specialist

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C. Summary

On December 19, 2011, about 2144 central standard time, a Piper PA-32-260, N3590T, collided with terrain following an in-flight breakup near Bryan, Texas. The instrument rated private pilot and four passengers were fatally injured. The airplane was registered to and operated by the pilot under the provisions of 14 Code of Federal Regulations Part 91 as a personal flight. Instrument meteorological conditions prevailed and an instrument flight rules (IFR) flight plan had been filed for the personal flight. The cross-country flight had originated from the Clayton County Airport (4A7), Hampton, Georgia, approximately 1345. After a planed fuel stop at the Jackson-Evers International Airport (JAN), Jackson, Mississippi, the flight departed about 1750 for the TSTC Waco Airport (CNW), Waco, Texas.

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[1] UTC – is an abbreviation for Coordinated Universal Time.

D. Details of Investigation

The National Transportation Safety Board's (NTSB) Meteorologist was not on scene for this investigation and gathered all relevant weather data from the Washington D.C. office from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the National Climatic Data Center (NCDC). All times are central standard time (CST) on December 19, 2011, and are based upon the 24-hour clock, where local time is -6 hours from UTC, and UTC=Z. Directions are referenced to true north and distances are in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles.

The accident site was located at latitude 30.95° N, longitude 96.27° W; elevation: 300 feet.

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 (NCEP) located in Camp Springs, 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 joint NWS and Federal Aviation Administration (FAA) Advisory Circular "Aviation Weather Services", AC-0045G CHG 1.

1.1 Surface Analysis Chart

The NWS Surface Analysis Chart for 2100 CST is provided as figure 1, with the approximate location of the accident site marked. The chart depicted an outflow boundary just northwest of the accident site stretching northeastward from the accident site into northeast Texas. A low pressure system was located in the Texas Panhandle at 1005 hectopascals (hPa) with an occluded front stretching northeastward into Oklahoma before becoming a stationary front and stretching southward through central Texas. The station models north and west of the accident site depicted temperatures in the mid 50's to low 60's Fahrenheit (F), with temperature-dew point spreads of 3° F or less, a variable wind at 5 knots, cloudy skies, and light rain. Station models to the south and east of the accident site had temperatures in the low 60's to low 70's F, temperature-dew point spreads of 5° F or less, a south to southeast wind of 5 to 15 knots, and cloudy skies with moderate rain.

The accident site was located in a region of relatively flat terrain with warm moist air located throughout eastern Texas. With an outflow boundary, and its ability to be a lifting mechanism and lift the warm moist air located near the accident site, thunderstorms, rain showers, and associated turbulence would be expected near the accident site at the accident time.

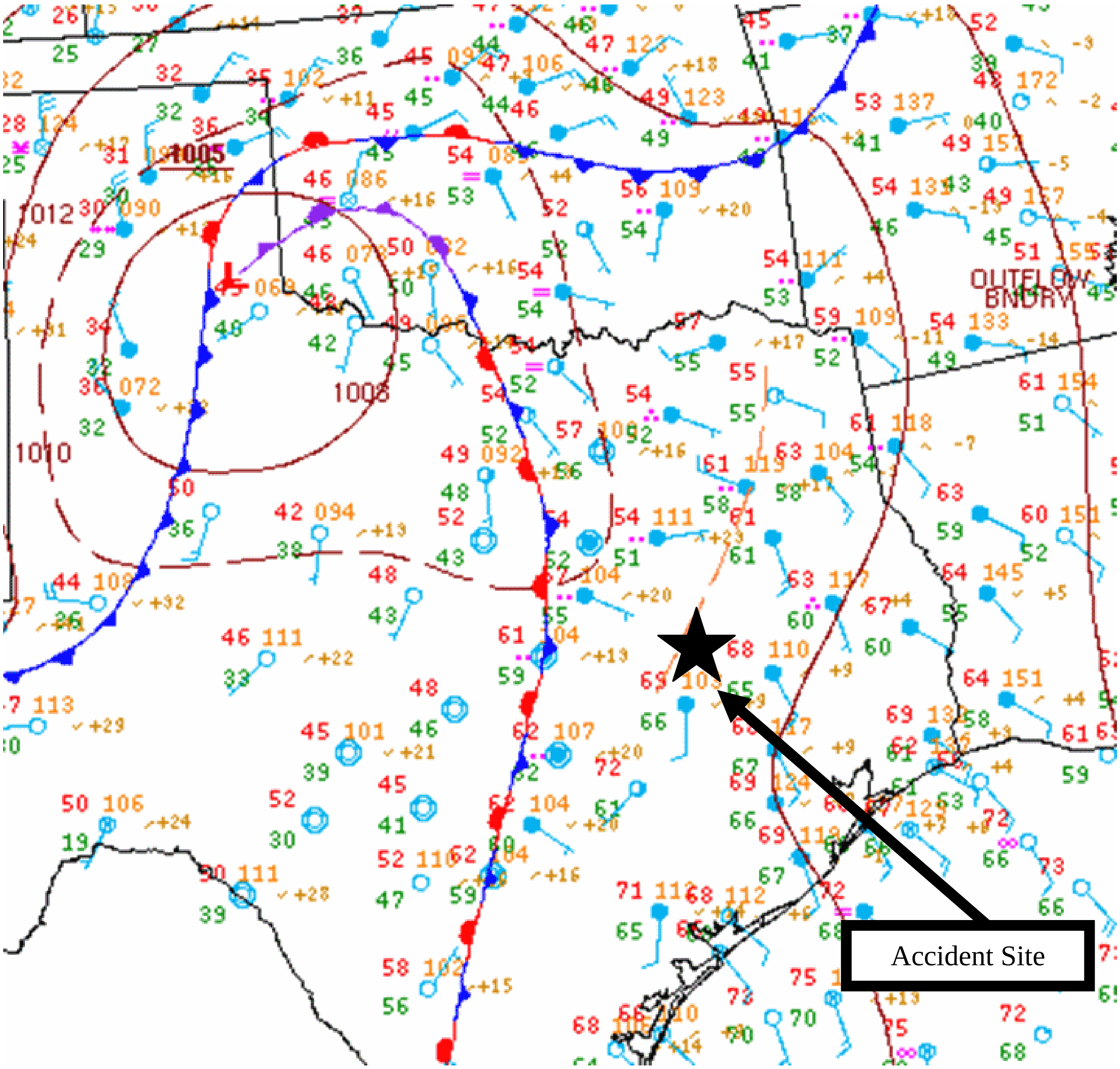

Figure 1 – NWS Surface Analysis Chart for 2100 CST

1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) archive Constant Pressure Charts for 1800 CST are presented for 925-, 850-, 700-, and 500-hPa in figures 2 through 5. The charts depicted a mid-level trough[2] at 500-hPa southwest of the accident site at 1800 CST and this mid-level trough acted as a lifting mechanism to help in the formation of clouds, showers, and thunderstorms in central, northern, and eastern Texas. The wind at 925- and 850-hPa was southerly between 20 and 35 knots near the accident site at 1800 CST bringing warm moist air from the Gulf of Mexico northward, with the wind increasing to between 50 and 60 knots out of the southwest at 700- and 500-hPa.

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

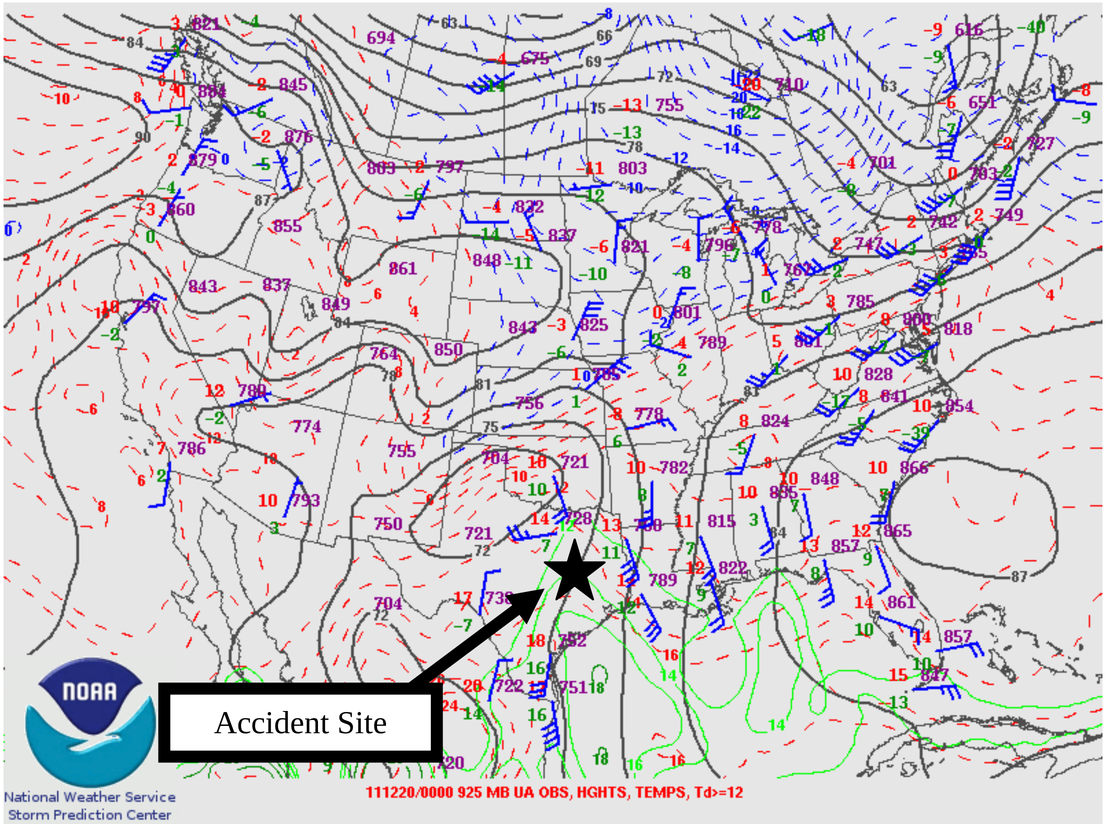

Figure 2 – 925-hPa Constant Pressure Chart for 1800 CST

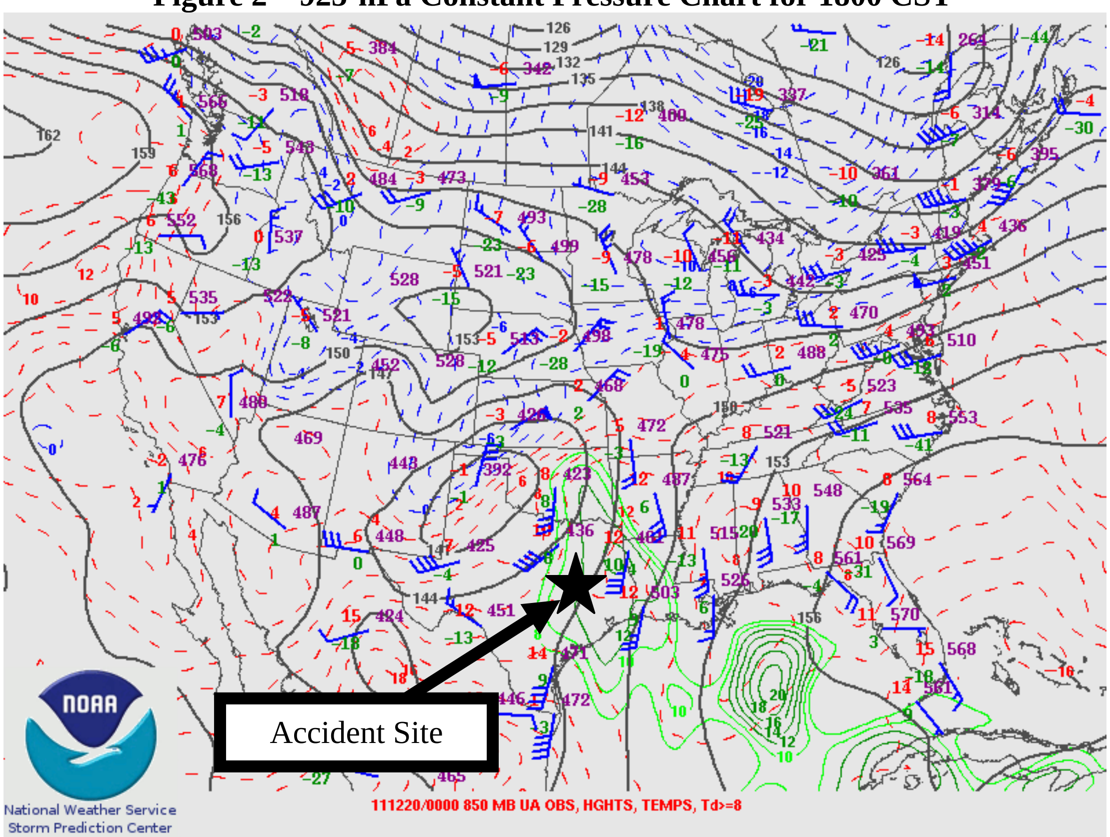

Figure 3 – 850-hPa Constant Pressure Chart for 1800 CST

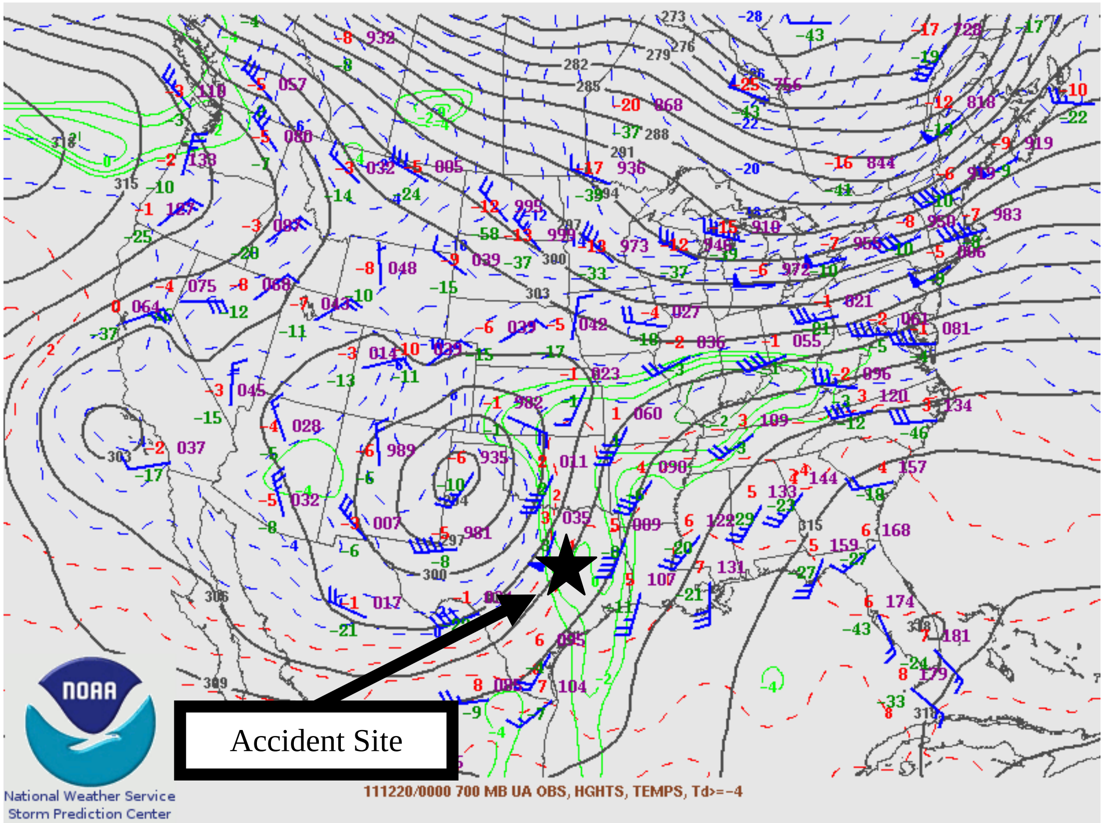

Figure 4 – 700-hPa Constant Pressure Chart for 1800 CST

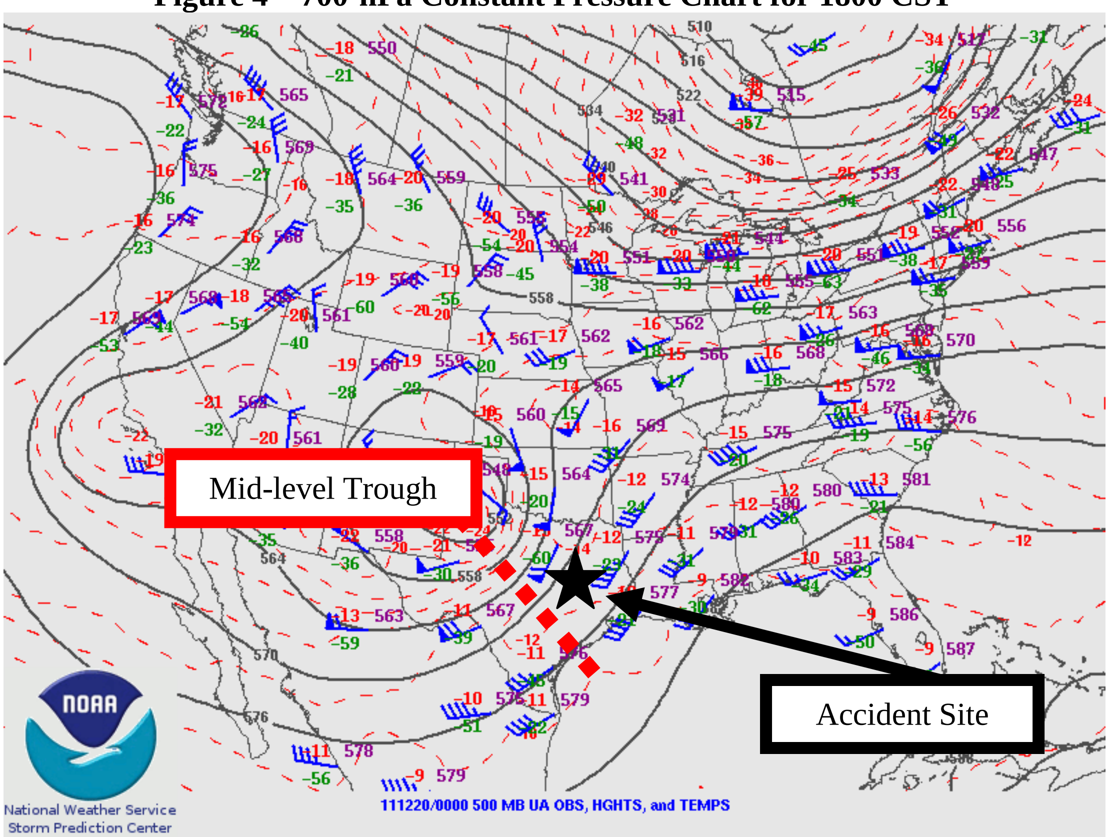

Figure 5 – 500-hPa Constant Pressure Chart for 1800 CST

2.0 Surface Observations

The area surrounding the accident site was documented utilizing official NWS Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). The following observations were taken from standard code and are provided in plain language, with cloud heights reported above ground level (agl).

The closest weather reporting to the accident site was from an Automated Weather Observing System (AWOS[3]) located at Hearne Municipal Airport (KLHB) 1 mile southwest of Hearne, Texas. These observations were taken from automated equipment and were not supplemented by a human observer. KLHB was 19 miles west-southwest of the accident site, had at an elevation of 285 feet, and had a 4° easterly magnetic variation[4] (figure 6). The following observations were disseminated around the time of the accident[5]:

[3] AWOS – Automated Weather Observing System is equipped with meteorological instruments to observe and report temperature, dewpoint, wind speed and direction, visibility, cloud coverage and ceiling up to twelve thousand feet, and altimeter setting.

[4] Magnetic variation – The angle (at a particular location) between magnetic north and true north.

[5] The bold sections in this NWS product and the rest of products in the weather study report are to highlight the individual sections that directly reference the weather conditions that are or will affect the accident location around the accident time.

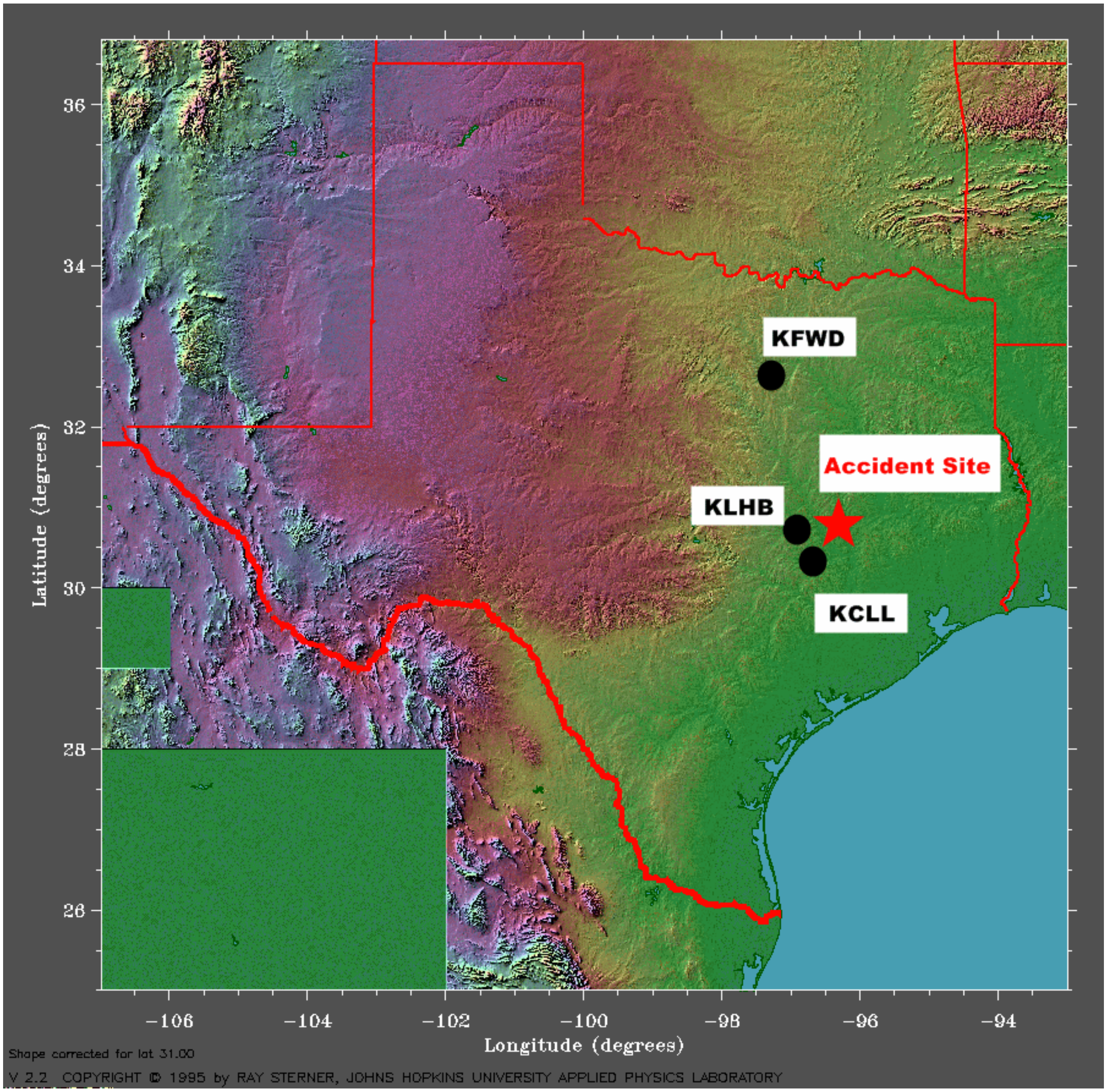

Figure 6 – Topography with NWS METAR sites and upper air sounding site

[1955 CST] KLHB 200155Z AUTO 19008KT 10SM OVC011 20/18 A2983 RMK AO2 LTG DSNT NE=

[2015 CST] KLHB 200215Z AUTO 29007KT 10SM OVC011 20/18 A2985 RMK AO2 LTG DSNT N=

[2035 CST] KLHB 200235Z AUTO 29006KT 10SM BKN011 OVC015 18/16 A2986 RMK AO2 LTG DSNT N=

[2055 CST] KLHB 200255Z AUTO 29005KT 10SM RA BKN014 OVC020 17/15 A2987 RMK AO2 LTG DSNT N P0002=

[2115 CST] KLHB 200315Z AUTO 00000KT 7SM RA SCT016 BKN025 OVC032 16/15 A2988 RMK AO2 P0014=

[2135 CST] ***KLHB 200335Z AUTO 00000KT 5SM -RA BKN027 OVC034 16/15 A2988 RMK AO2 P0019=***

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[2155 CST] ***KLHB 200355Z AUTO 00000KT 10SM BKN027 OVC032 16/15 A2988 RMK AO2 LTG DSNT NE P0022=***
[2215 CST] ***KLHB 200415Z AUTO 00000KT 10SM OVC030 16/15 A2988 RMK AO2 LTG DSNT E=***
[2235 CST] KLHB 200435Z AUTO 00000KT 10SM OVC032 16/15 A2988 RMK AO2 LTG DSNT NW=

KLHB weather at 2135 CST, wind calm, 5 miles visibility and light rain, a broken ceiling at 2,700 feet agl, overcast skies at 3,400 feet, temperature of 16° Celsius (C), dew point temperature of 15° C, altimeter setting of 29.88 inches of mercury. Remarks: automated weather observation station with a precipitation discriminator, one-hourly precipitation of 0.19 inches.

KLHB weather at 2155 CST, wind calm, 10 miles visibility, a broken ceiling at 2,700 feet agl, overcast skies at 3,200 feet, temperature of 16° C, dew point temperature of 15° C, altimeter setting of 29.88 inches of mercury. Remarks: automated weather observation station with a precipitation discriminator, lightning distant[6] northeast, one-hourly precipitation of 0.22 inches.

KLHB weather at 2215 CST, wind calm, 10 miles visibility, an overcast ceiling at 3,000 feet agl, temperature of 16° C, dew point temperature of 15° C, altimeter setting of 29.88 inches of mercury. Remarks: automated weather observation station with a precipitation discriminator, lightning distant east.

The observations from KLHB indicated that rain and lightning were present near the accident site around the time of the accident.

An Automated Surface Observing System[7] (ASOS) reported the weather around the time of the accident from Easterwood Field Airport (KCLL) located 3 miles southwest of College Station, Texas, and located 22 miles southwest of the accident site (figure 6). These observations were taken from automated equipment and were augmented by the air traffic control tower. KCLL had at an elevation of 320 feet and had a 6° easterly magnetic variation. The following observations were disseminated around the time of the accident:

[1953 CST] KCLL 200153Z 17012KT 10SM SCT012 BKN085 20/19 A2983 RMK AO2 SLP097 T02000189
[2053 CST] KCLL 200253Z 19009KT 10SM FEW065 OVC080 21/19 A2984 RMK AO2 SLP103 60000 T02060189 53009

[6] Lightning distant means lightning was detected by the automated system beyond 10 miles but less than 30 miles from the airport location point.
[7] ASOS – Automated Surface Observing System is equipped with meteorological instruments to observe and report wind, visibility, ceiling, temperature, dewpoint, altimeter, and barometric pressure.

[2134 CST] ***KCLL 200334Z AUTO 20005KT 10SM BKN020 OVC060 21/19 A2987 RMK AO2***

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[2153 CST] ***KCLL 200353Z AUTO 20005KT 10SM BKN020 OVC085 20/19 A2986 RMK AO2 LTG DSNT E SLP108 T02000189***

[2213 CST] ***KCLL 200413Z AUTO 22005KT 10SM SCT020 BKN060 OVC080 20/18 A2986 RMK AO2***

[2253 CST] KCLL 200453Z AUTO 21006KT 10SM FEW033 20/18 A2986 RMK AO2 SLP109 T02000183

KCLL weather at 2134 CST, wind from 200° at 5 knots, 10 miles visibility, a broken ceiling at 2,000 feet agl, overcast skies at 6,000 feet, temperature of 21° C, dew point temperature of 19° C, altimeter setting of 29.87 inches of mercury. Remarks: automated weather observation station with a precipitation discriminator.

KCLL weather at 2153 CST, wind from 200° at 5 knots, 10 miles visibility, a broken ceiling at 2,000 feet agl, overcast skies at 8,500 feet, temperature of 20° C, dew point temperature of 19° C, altimeter setting of 29.86 inches of mercury. Remarks: automated weather observation station with a precipitation discriminator, lightning distant east, sea-level pressure 1010.8 hPa, temperature of 20.0° C, dew point temperature of 18.9° C.

KCLL weather at 2213 CST, wind from 210° at 6 knots, 10 miles visibility, scattered clouds at 2,000 feet agl, a broken ceiling at 6,000 feet, overcast skies at 8,000 feet, temperature of 20° C, dew point temperature of 18° C, altimeter setting of 29.86 inches of mercury. Remarks: automated weather observation station with a precipitation discriminator.

3.0 Upper Air Sounding Data

The closest upper air sounding to the accident site was from Fort Worth, Texas (KFWD), site number 72249 with a station elevation of 643 feet and KFWD was located approximately 123 miles northwest of the accident site. The 1800 CST sounding from KFWD was plotted on a standard Skew-T log P diagram[8] with the derived stability parameters included in figure 7 (with data from the surface to 600-hPa, or 14,000 feet msl). These data were analyzed utilizing the RAOB[9] software package. The sounding depicted a conditionally unstable vertical environment with the Lifted Condensation Level (LCL)[10] at 726 feet msl and a Convective Condensation Level (CCL)[11] of 8,892 feet. The sounding had a relative humidity of 80 percent or more from the surface to 1,500 feet, then again from 4,500 feet to 13,000 feet. The freezing level was identified at 11,414 feet. The precipitable water value was 1.13 inches.

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[8] 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.

[9] RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamopras, Pennsylvania.

[10] Lifting Condensation Level (LCL) - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

[11] 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.

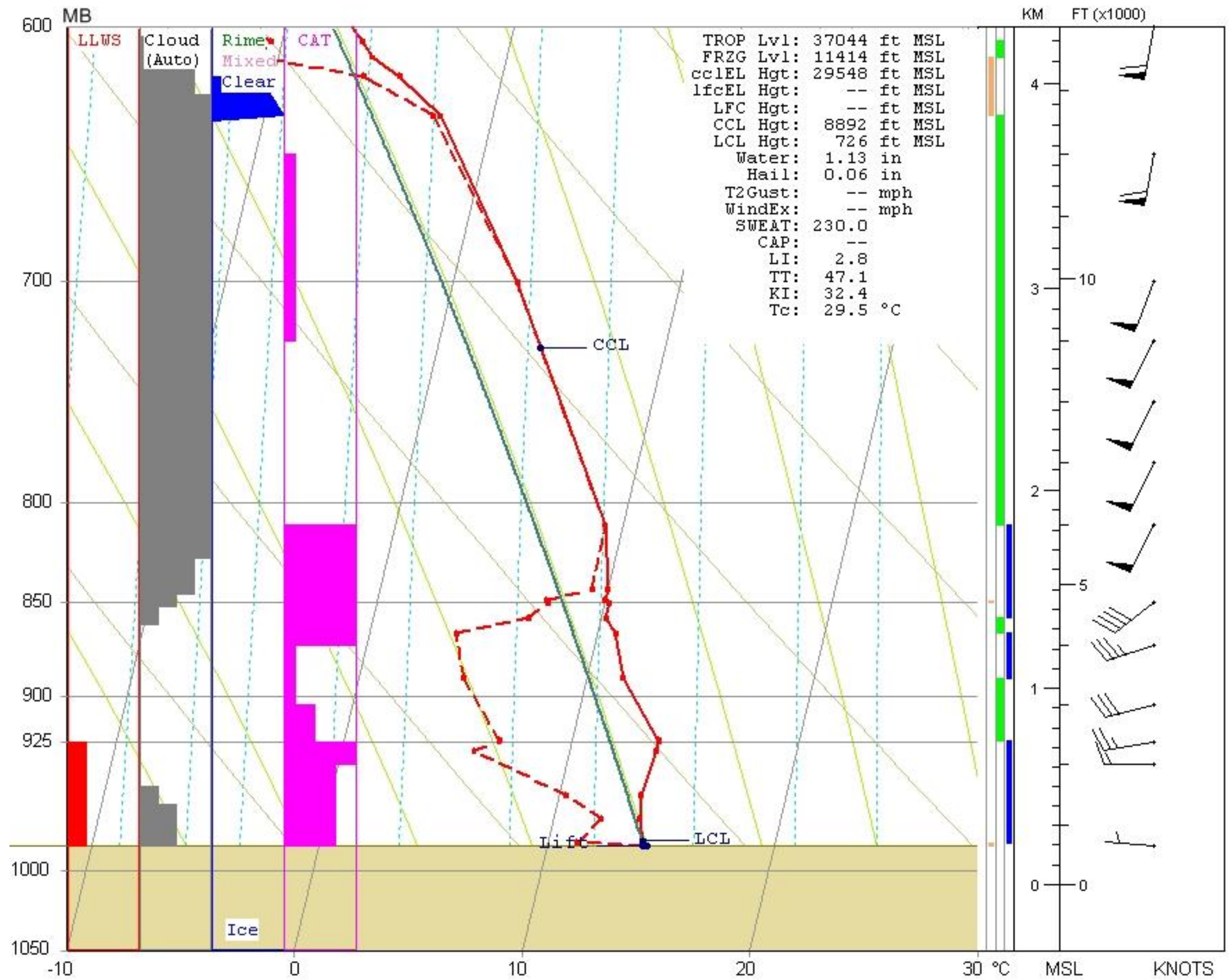


Figure 7 – 1800 CST KFWD sounding

The KFWD sounding indicated a moist conditionally unstable environment considered favorable for the development of clouds and precipitation from the surface through 14,000 feet. The potential for clouds was indicated by RAOB between the surface and 1,500 feet, then again from 4,500 feet through 14,000 feet. Icing conditions were indicated by RAOB around 13,000 feet.

The sounding wind profile indicated a surface wind from 275° at 3 knots that increased to 40 knots by 4,000 feet with the wind out of the southwest. The wind backed[12] to the south from 4,000 feet through 14,000 feet while increasing in speed to 60 knots. Low-level wind shear (LLWS) was identified by RAOB between the surface and 2,000 feet. RAOB detected the potential for clear air turbulence in several layers between the surface and 14,000 feet.

[12] Backing wind – Wind which changes in a counter-clockwise direction with time at a given location, or which changes direction in a counter-clockwise sense with height.

A computer model generated upper air sounding was made for the accident site. The 2100 CST model sounding was plotted on a standard Skew-T log P diagram with the derived stability parameters included in figure 8 (with data from the surface to 600-hPa, or 14,000 feet msl). These data were analyzed utilizing the RAOB software package. The sounding depicted a conditionally unstable vertical environment with the LCL at 703 feet, a CCL of 2,089 feet, and a Level of Free Convection (LFC)[13] at 3,511 feet. The sounding had a relative humidity of 80 percent or more from the surface to 8,000 feet. The freezing level was identified at 11,662 feet. The precipitable water value was 1.38 inches.

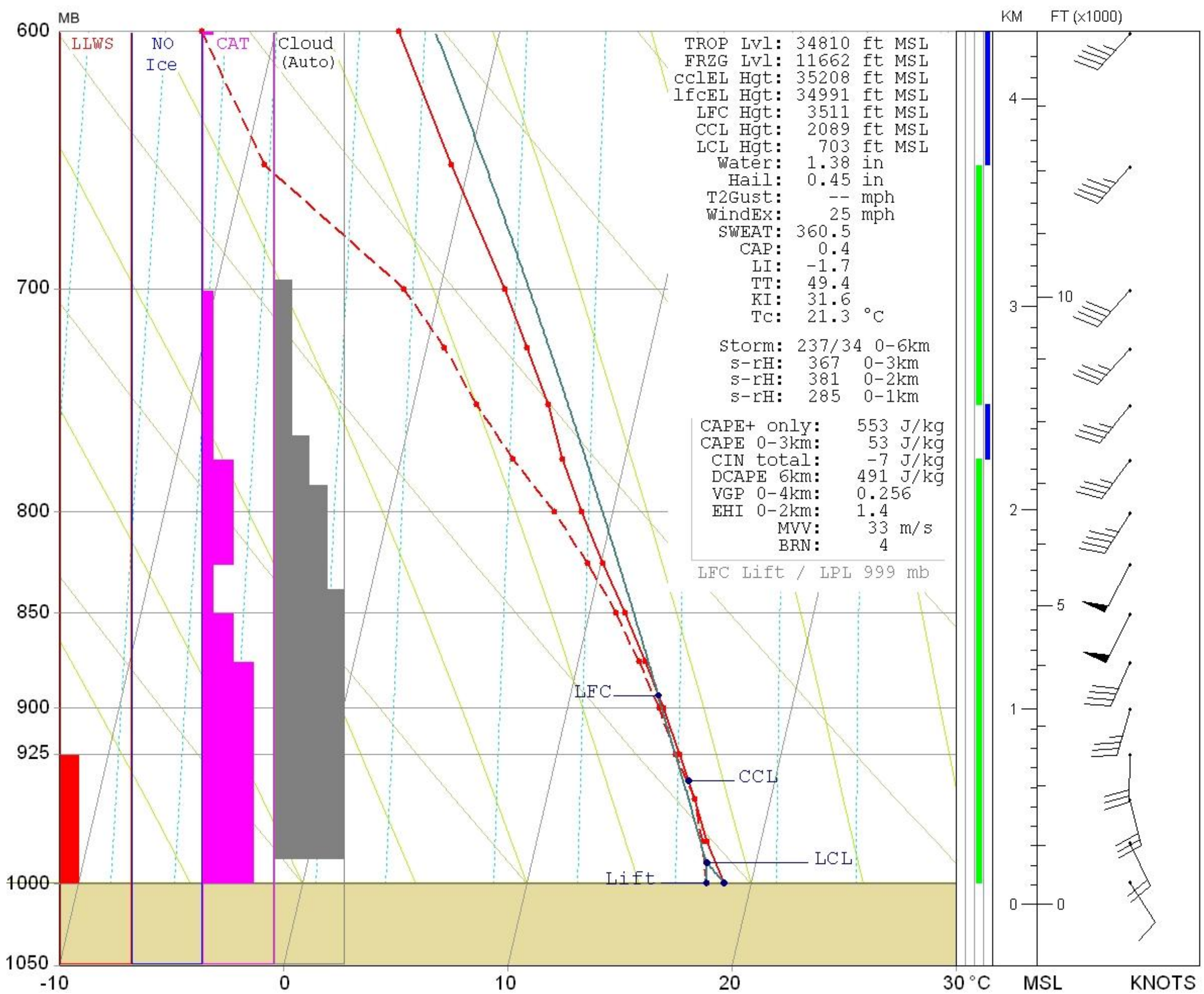


Figure 8 – 2100 CST model sounding

[13] Level of Free Convection (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.

The model sounding indicated a moist conditionally unstable environment with 553 J/kg of CAPE[14]. This environment would have been supportive of cloud formation, rain showers, and thunderstorms. The maximum vertical velocity (MVV) possible with rain showers or thunderstorm updrafts was 33 meters per second (m/s) or 64 knots given the model sounding environment. The potential for clouds was indicated by RAOB between 1,000 and 10,000 feet. No icing conditions were indicated by RAOB below 14,000 feet.

The model sounding wind profile indicated a surface wind from 149° at 9 knots that increased to 50 knots by 4,000 feet with the wind veering[15] to the southwest. The wind remained at 45 knots while out of the southwest through 14,000 feet. LLWS was identified by RAOB between the surface and 2,500 feet. RAOB detected the potential for clear air turbulence between the surface and 10,000 feet.

4.0 Satellite Data

Infrared data from the Geostationary Operational Environmental Satellite number 13 (GOES-13) data was obtained from the NCDC and processed with the NTSB's Man-computer Interactive Data Access System (McIDAS) workstation. Infrared imagery (GOES-13 band 4), at a wavelength of 10.7 microns (μm) retrieved brightness temperatures for the scene. Satellite imagery surrounding the time of the accident, from 1800 CST through 2300 CST at approximately 15-minute intervals, were reviewed and the closest images to the time of the accident are documented here.

Figures 9 through 11 present the GOES-13 infrared imagery from 2140, 2145, and 2202 CST at 8X magnification with the accident site highlighted with a blue square. From 2140 to 2202 CST a narrow enhanced (colder cloud tops) band of clouds moved eastward over the accident site. The GOES-13 10.7μm brightness temperature over the accident site was retrieved from 2145 CST as -8° C, which, when considering the 2100 CST model sounding, indicated cloud-top heights of approximately 16,000 feet.

[14] Convective Available Potential Energy (CAPE) – CAPE is a measure of the amount of energy available for convection and is directly related to the maximum potential vertical speed within an updraft.
[15] Veering wind – Wind which changes in a clockwise direction with time at a given location, or which changes direction in a clockwise sense with height.

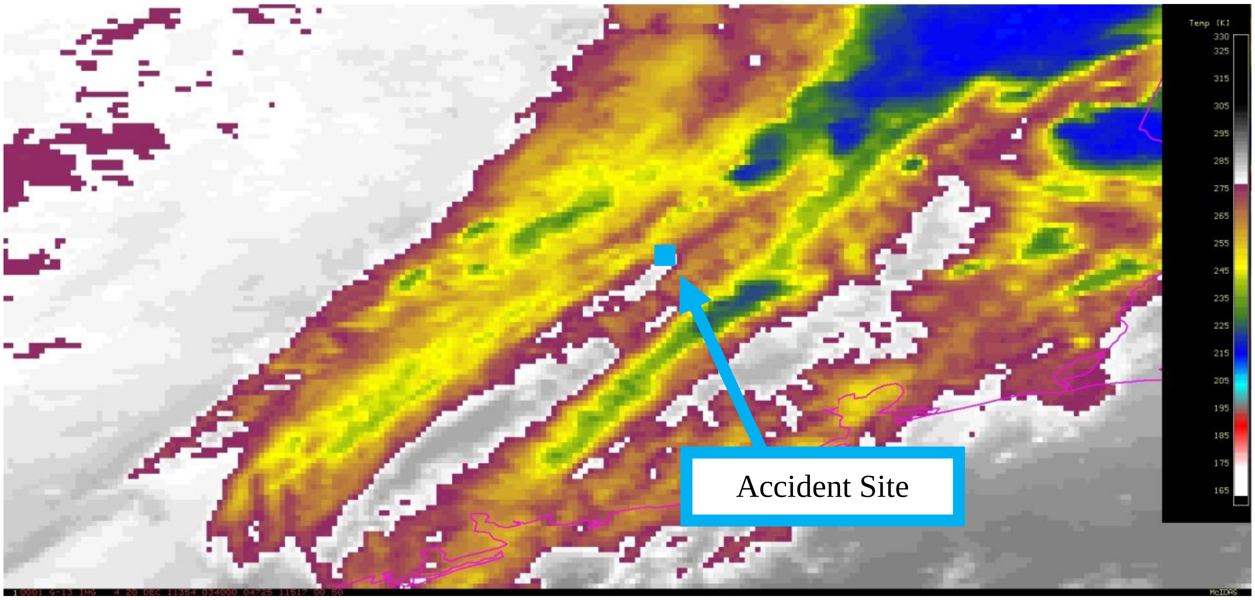


Figure 9 – GOES-13 infrared image at 2140 CST

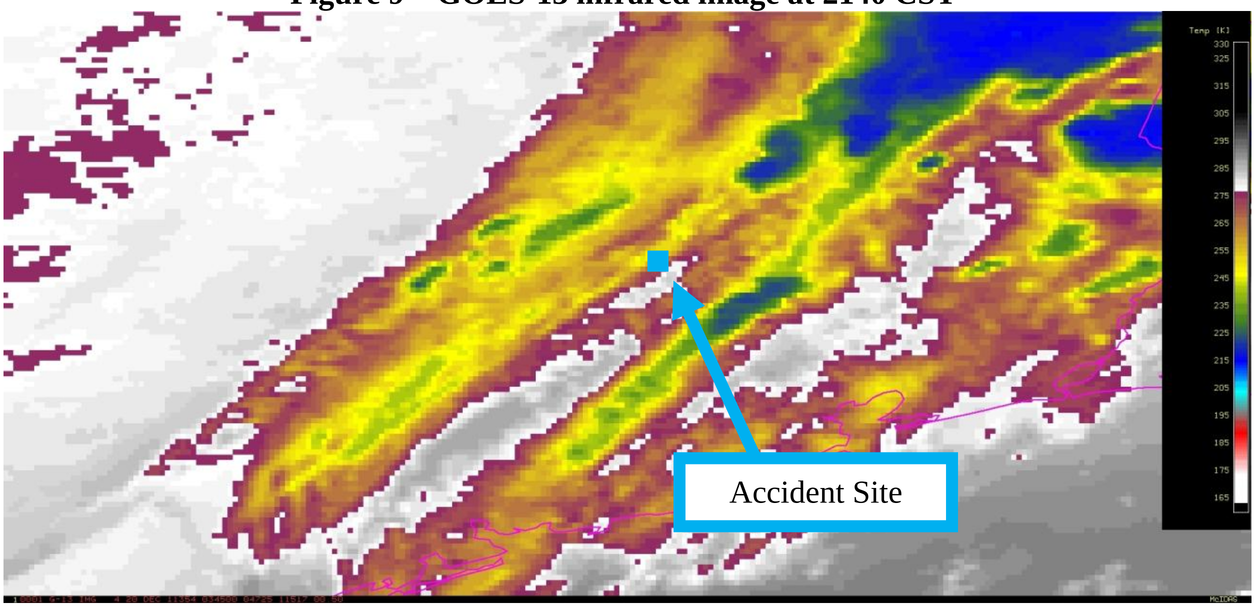


Figure 10 – GOES-13 infrared image at 2145 CST

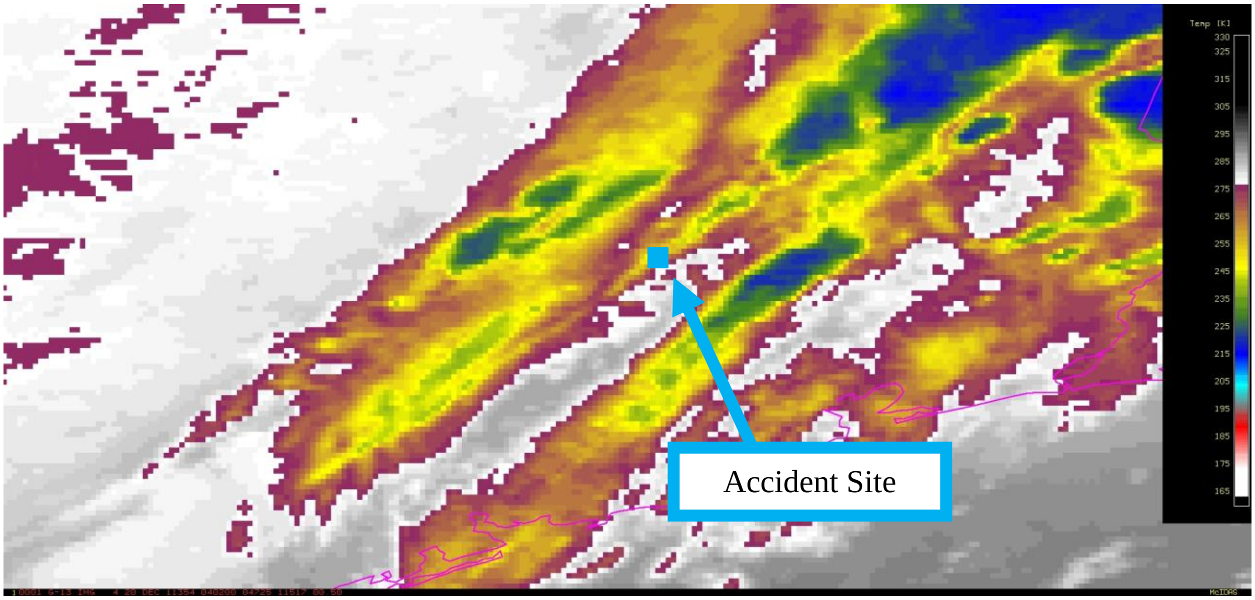


Figure 11 – GOES-13 infrared image at 2202 CST

5.0 Radar Imagery

The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D) was KGRK, located in Granger, Texas, approximately 60 miles west-southwest of the accident site at an elevation of 538 feet. Level II archive radar data was obtained from the NCDC utilizing the Hierarchical Data Storage System (HDSS) and displayed using the NWS NEXRAD Interactive Viewer and Data Exporter software.

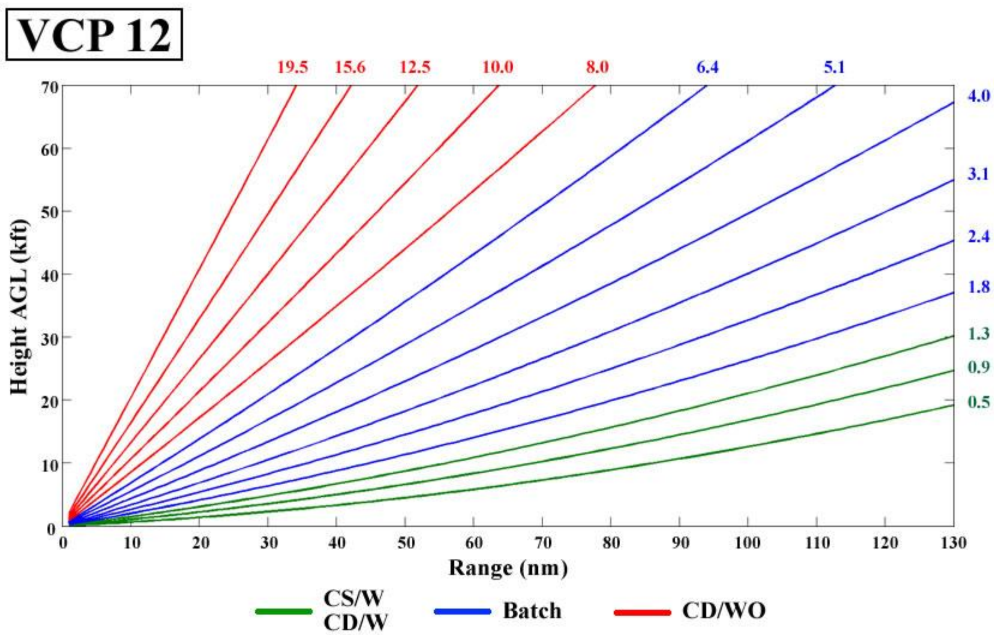
The WSR-88D is an S-band 10-centimeter wavelength radar with a power output of 750,000 watts, and with a 28-foot parabolic antenna that concentrates the energy into a 0.95° beam width[16]. The radar produces three basic types of products: base reflectivity, base radial velocity, and base spectral width.

5.1 Volume Scan Strategy

The WSR-88D is a computer controlled radar system, which automatically creates a complete series of specific scans in a specific sequence known as a volume scan. Individual elevation scans are immediately available on the WSR-88D's Principle Users Processor (PUP). Products that require data from multiple elevation scans are not available until the end of the five to ten minute volume scan.

[16] Beam width – A measure of the angular width of a radar beam.

The WSR-88D operates in several different scanning modes, identified as Mode A and Mode B. Mode A is the precipitation scan and has two common scanning strategies. The most common is where the radar makes 14 elevation scans from 0.5° to 19.5° every four minutes. This particular scanning strategy is documented as volume coverage pattern 12 (VCP-12). Mode B is the clear-air mode, where the radar makes 5 elevation scans during a ten minute period. During the period surrounding the accident, the KGRK WSR-88D radar was operating in the normal precipitation mode (Mode A, VCP-12). The following chart provides an indication of the different elevation angles in this VCP, and the approximate height and width of the radar beam with distance from the radar site.



VCP-12 Precipitation Mode Scan Strategy

5.2 Beam Height Calculation

Assuming standard refraction[17] of the WSR-88D 0.95° wide radar beam, the following table shows the approximate beam height and width information of the radar display over the site of the accident. The heights have been rounded to the nearest 10 feet.

ANTENNA ELEVATION	BEAM CENTER	BEAM BASE	BEAM TOP	BEAM WIDTH
0.5°	6,330 feet	3,370 feet	9,290 feet	5,920 feet
0.9°	8,870 feet	5,910 feet	11,830 feet	5,920 feet
1.4°	11,400 feet	8,440 feet	14,360 feet	5,920 feet

[17] Standard Refraction in the atmosphere is when the temperature and humidity distributions are approximately average, and values set at the standard atmosphere.

Based on the radar height calculations, the 0.5° elevation scan depicted the conditions between 3,370 to 9,290 feet above msl over the accident site, the 0.9° elevation scan depicted the conditions between 5,910 to 11,830 feet above msl over the accident site, and the 1.4° elevation scan depicted the conditions between 8,440 to 14,360 feet above msl over the accident site.

5.3 Reflectivity

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors[18] it is a function of the drop size distribution, number of particles per unit volume, physical state (ice or water), shape, and aspect. Reflectivity is normally displayed in decibels (dBZ[19]), and is a general measure of echo intensity. The chart below relates the NWS video integrator and processor (VIP) intensity levels versus the WSR-88D's display levels, precipitation mode reflectivity in decibels, and rainfall rates.

NWS VIP/DBZ CONVERSION TABLE

NWS VIP	WSR-88D LEVEL	PREC MODE DBZ	RAINFALL
0	0 1 2	< 5 5 to 9 10 to 14	
1 Very Light	3 4 5	15 to 19 20 to 24 25 to 29	.01 in/hr .02 in/hr .04 in/hr
2 Light to Moderate	6 7	30 to 34 35 to 39	.09 in/hr .21 in/hr
3 Strong	8	40 to 44	.48 in/hr
4 Very Strong	9	45 to 49	1.10 in/hr
5 Intense	10	50 to 54	2.49 in/hr
6 Extreme	11 12 13 14 15	55 to 59 60 to 64 65 to 69 70 to 74 > 75	>5.67 in/hr

[18] Hydrometeors are any product of condensation or sublimation of atmospheric water vapor, whether formed in the free atmosphere or at the earth's surface; also, any water particles blown by the wind from the earth's surface. Hydrometeors are classified as; (a) Liquid or solid water particles suspended in the air: cloud, water droplets, mist or fog. (b) Liquid precipitation: drizzle and rain. (c) Freezing precipitation: freezing drizzle and freezing rain. (d) Solid (frozen) precipitation: ice pellets, hail, snow, snow pellets, and ice crystals. (e) Falling particles that evaporate before reaching the ground: virga. (f) Liquid or solid water particles lifted by the wind from the earth's surface: drifting snow, blowing snow, blowing spray. (g) Liquid or solid deposits on exposed objects: dew, frost, rime, and glazed ice.

[19] dBZ – A non-dimensional "unit" of radar reflectivity which represents a logarithmic power ratio (in decibels , or dB) with respect to radar reflectivity factor, Z.

5.4 Base Reflectivity

Figures 12, 13, and 14 present the KGRK WSR-88D base reflectivity image for the 0.5°, 0.9°, and 1.4° elevation scans initiated at 2136 CST with a resolution of 0.5° X 250 meters (m). The images depicted a line of strong to intense echoes west of the accident site corresponding to a line of heavy rain showers. A new area of echoes can be seen southwest of the accident site on the 0.9° and 1.4° degree elevation scans (figures 13 and 14). This new area of echoes intensified by the 0.5°, 0.9°, and 1.4° elevation scans from 2141 CST indicative of a new rain shower forming along the south side of the line of rain showers (figures 15, 16, and 17). By the 0.5°, 0.9°, and 1.4° elevation scans from 2145 CST the strong to intense echoes have continued to move northeastward and are above the accident site (figures 18, 19, and 20).

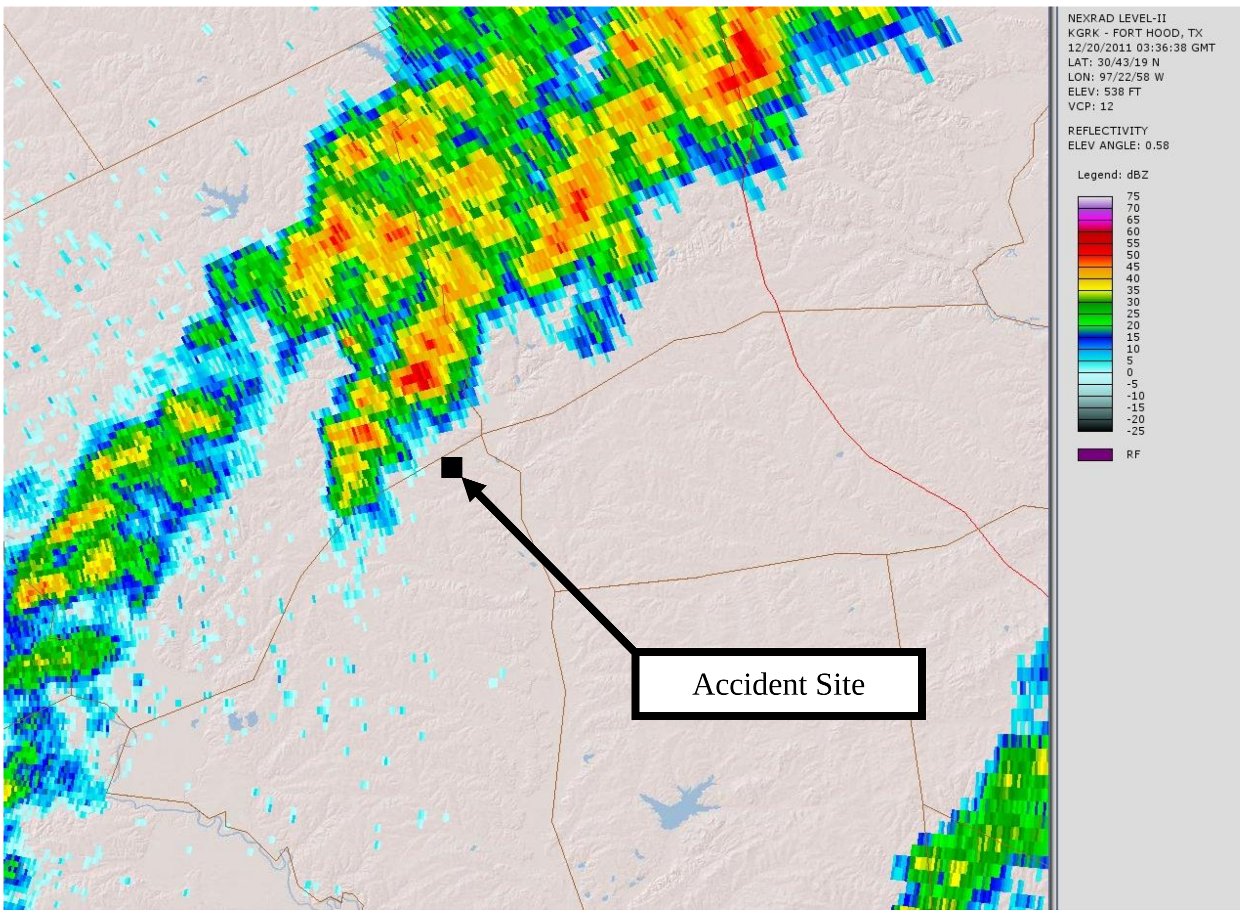


Figure 12 – KGRK WSR-88D base reflectivity 0.5° elevation scan initiated at 2136 CST

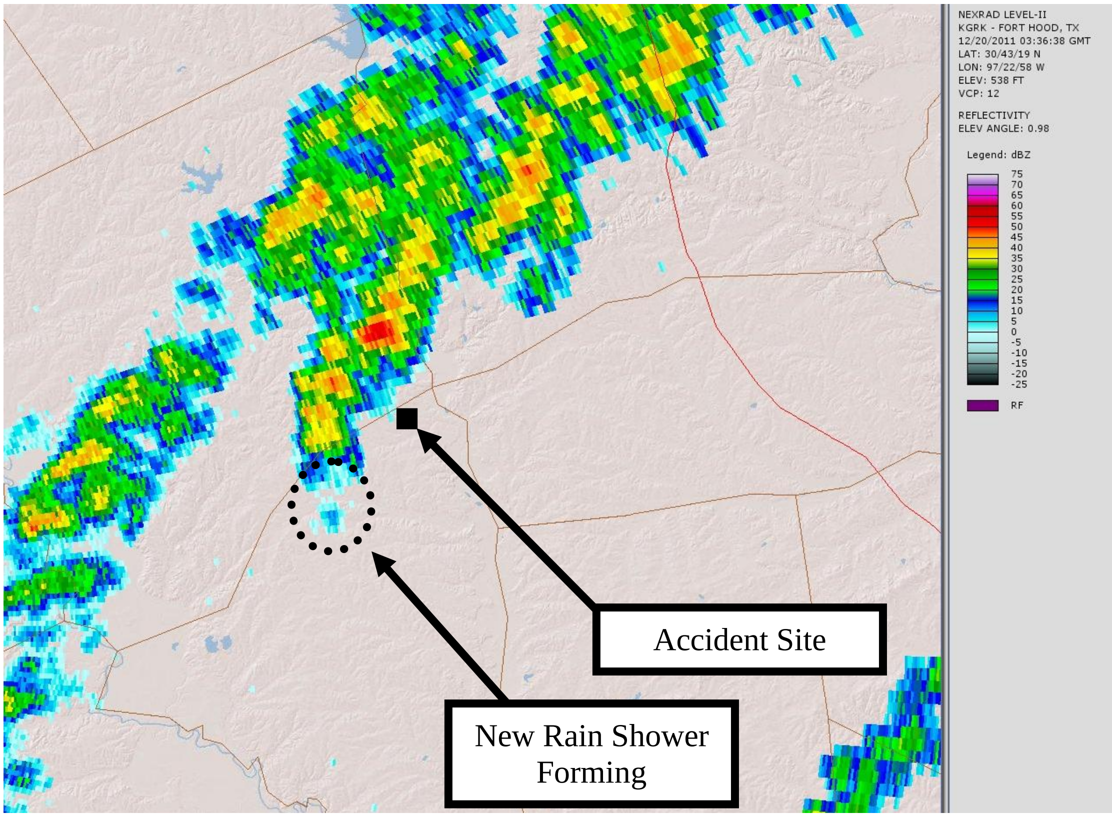


Figure 13 – KGRK WSR-88D base reflectivity 0.9° elevation scan initiated at 2136 CST

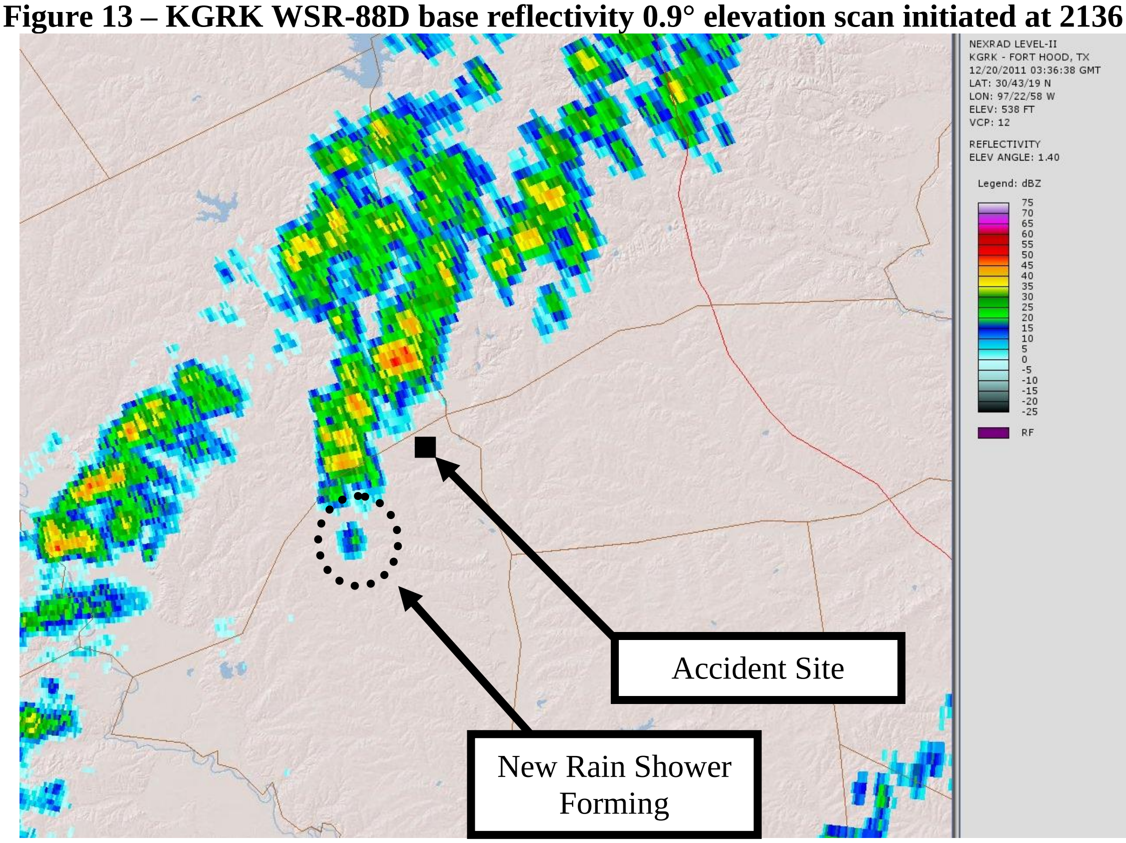


Figure 14 – KGRK WSR-88D base reflectivity 1.4° elevation scan initiated at 2136 CST

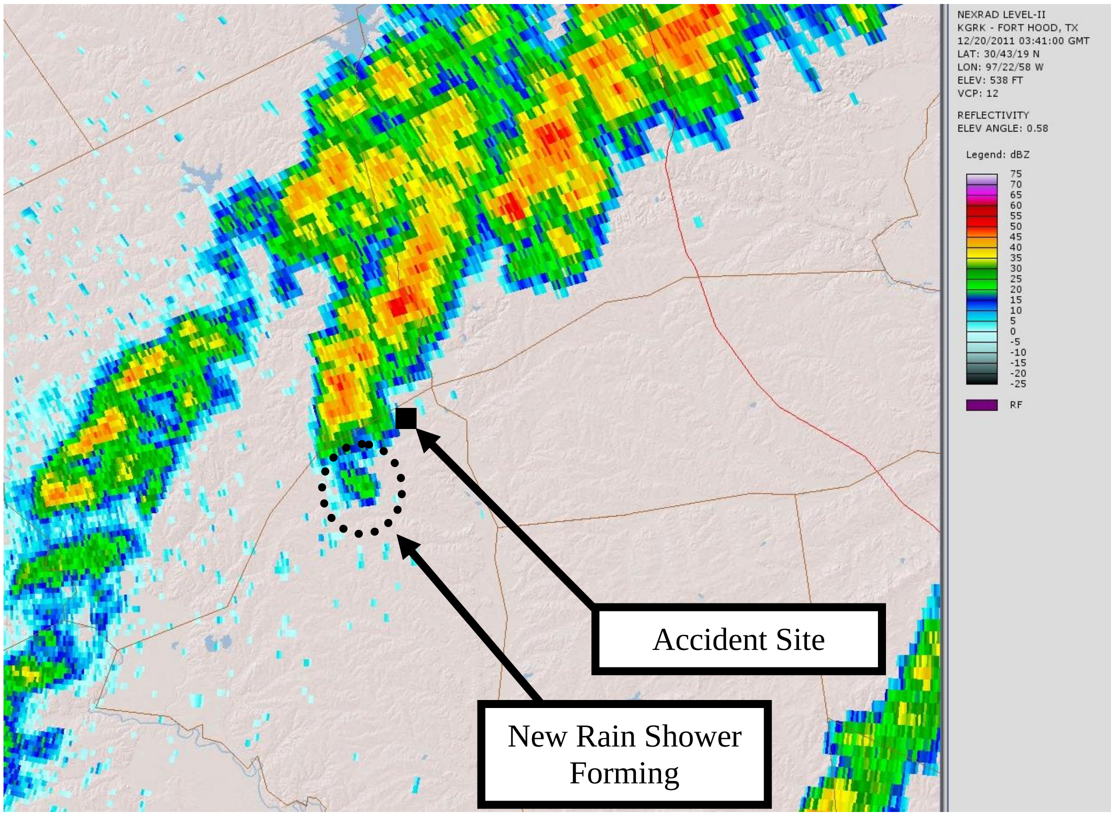


Figure 15 – KGRK WSR-88D base reflectivity 0.5° elevation scan initiated at 2141 CST

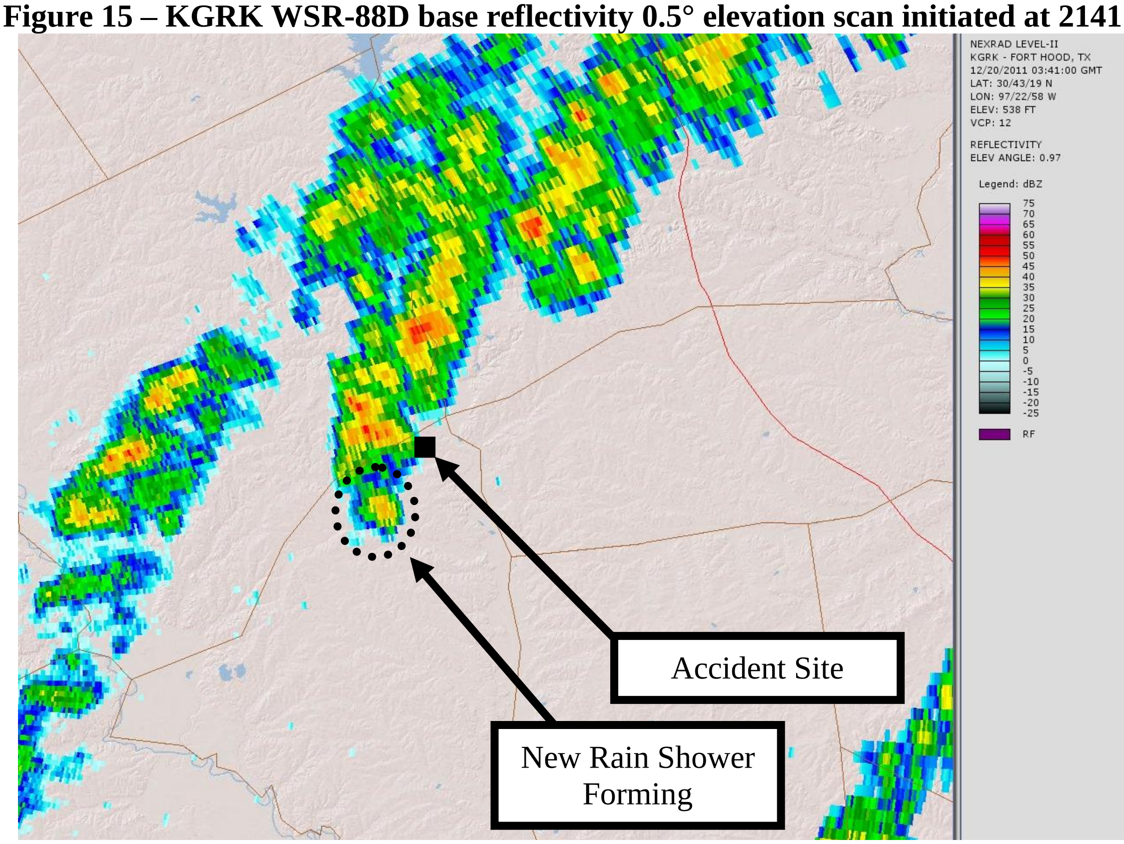


Figure 16 – KGRK WSR-88D base reflectivity 0.9° elevation scan initiated at 2141 CST

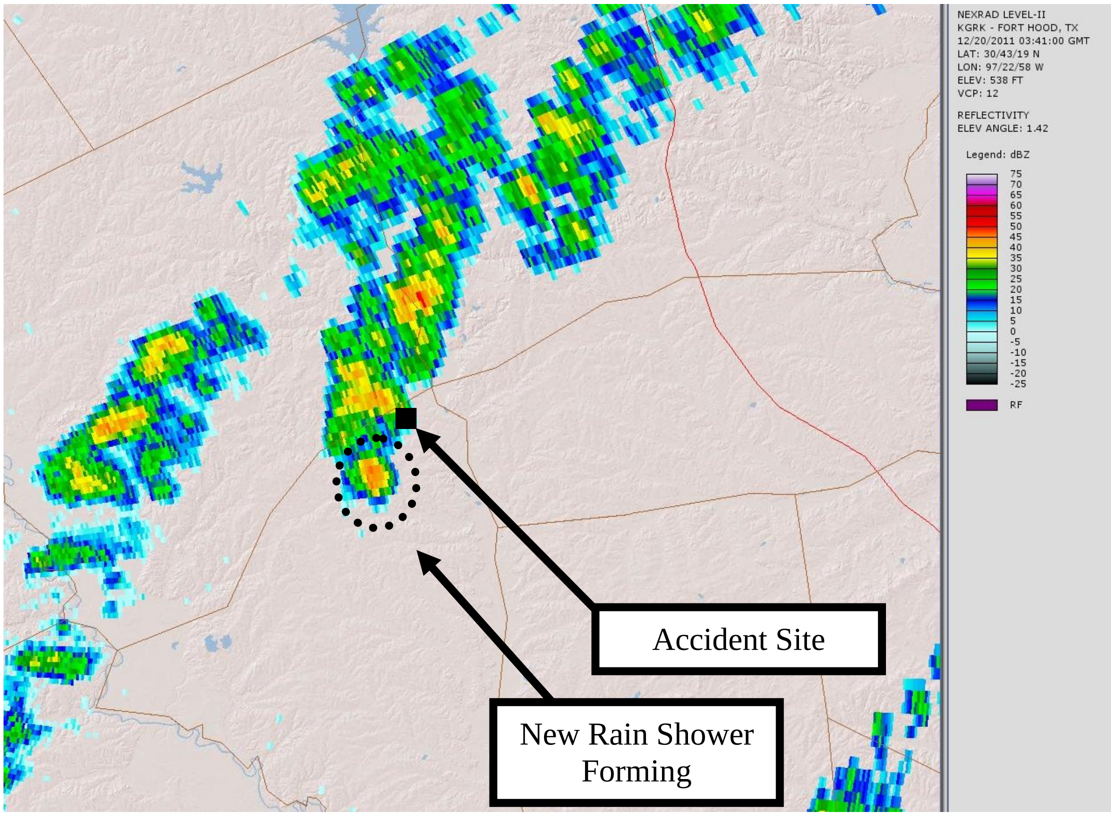


Figure 17 – KGRK WSR-88D base reflectivity 1.4° elevation scan initiated at 2141 CST

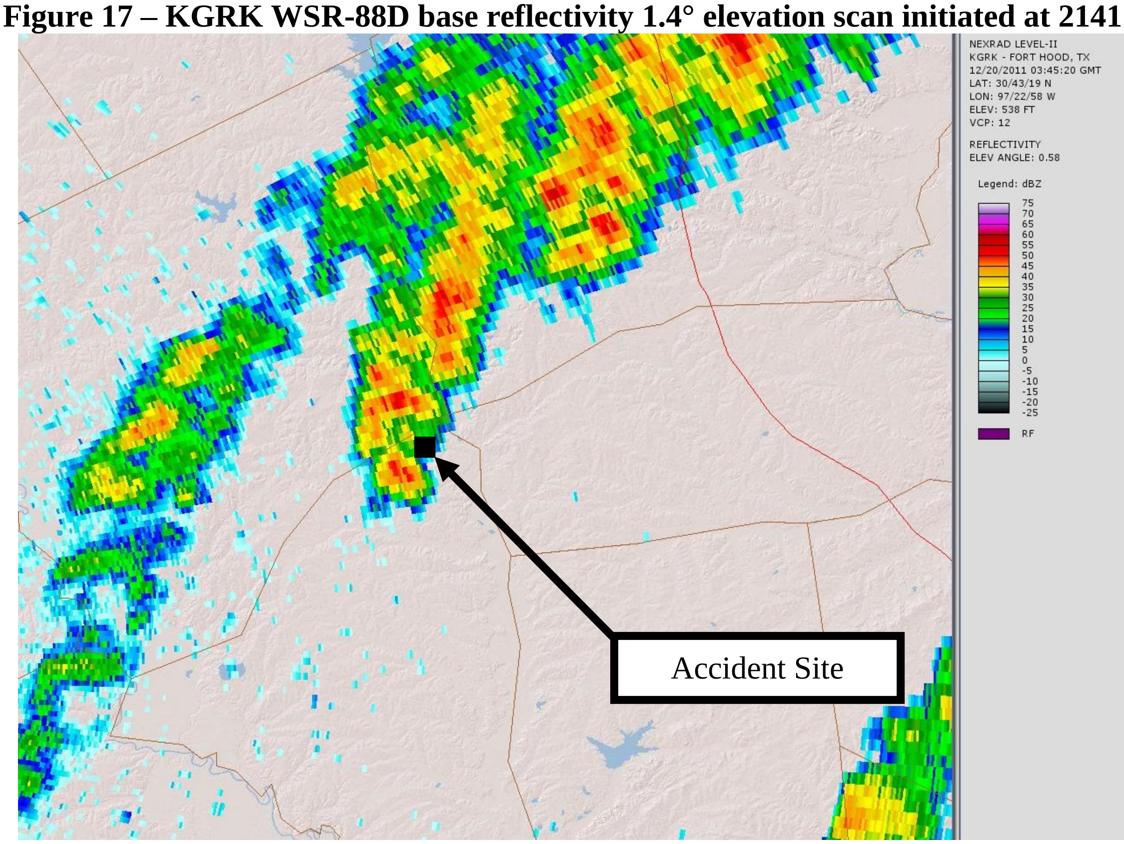


Figure 18 – KGRK WSR-88D base reflectivity 0.5° elevation scan initiated at 2145 CST

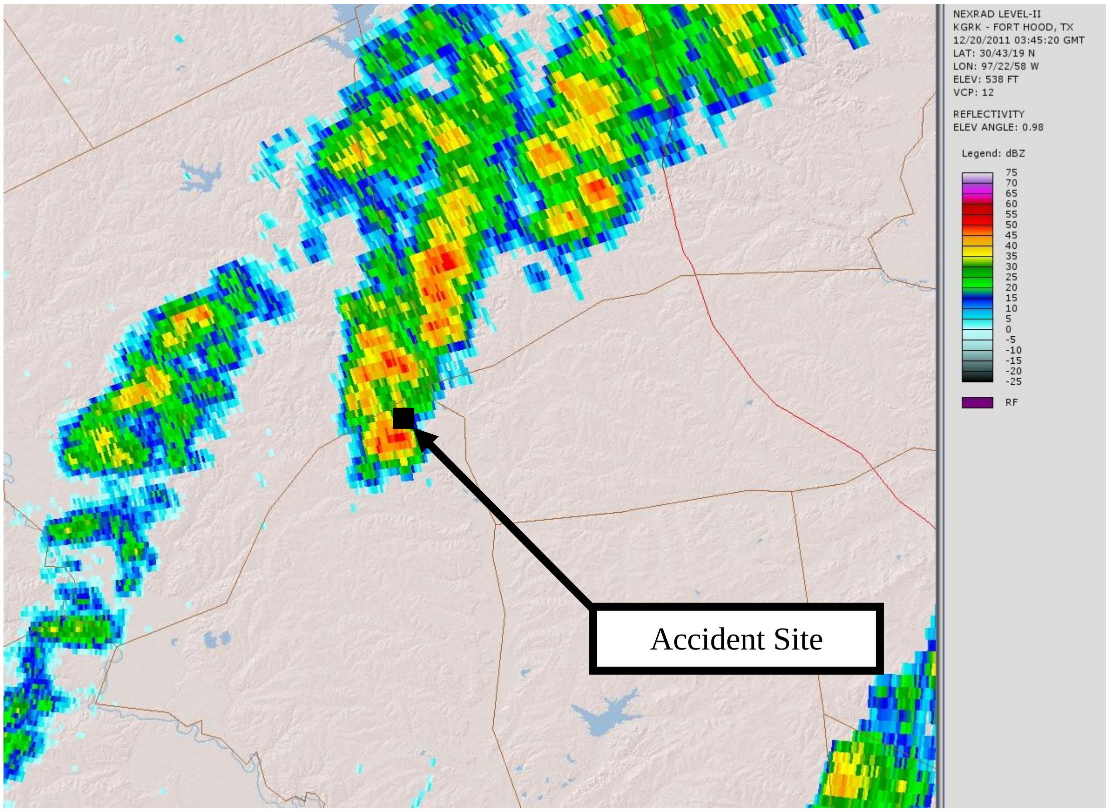


Figure 19 – KGRK WSR-88D base reflectivity 0.9° elevation scan initiated at 2145 CST

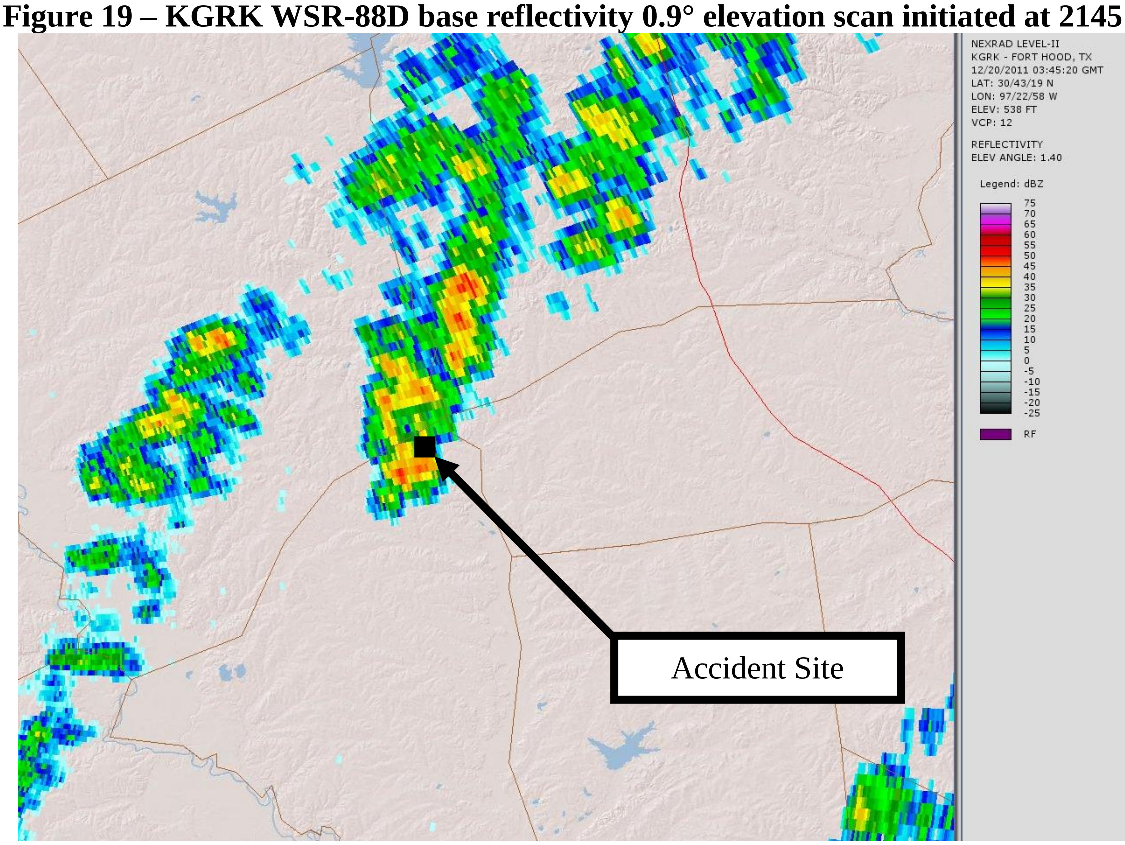


Figure 20 – KGRK WSR-88D base reflectivity 1.4° elevation scan initiated at 2145 CST

5.5 ATC Flight Track with Radar Reflectivity Data

Figure 21 presents the KGRK WSR-88D base reflectivity image for the 0.9° elevation scan initiated at 2136 CST with a resolution of 0.5° X 250 m. The accident airplane's flight track was obtained from Air Traffic Controller (ATC) and the flight track was overlaid on the base reflectivity from 0.9° for a time comparison. The accident airplane's altitude was at 8,200 feet msl between 2136 CST and 2142 CST and so the 0.9° base reflectivity is used for comparison due to the 0.9° central beam height at 8,870 feet msl. At 2136 CST the accident airplane was moving southwest with very strong to intense echoes just to the west of the accident airplane's location (figure 21). By 2141 CST the accident airplane had entered light echoes with strong to very strong echoes just to the southwest of the airplane along the current flight direction (figure 22). At 2145 CST, the 0.9° base reflectivity showed very strong to intense echoes above the accident site and the last part of the accident airplane's flight track and these very strong to intense echoes are indicative of a strong rain shower.

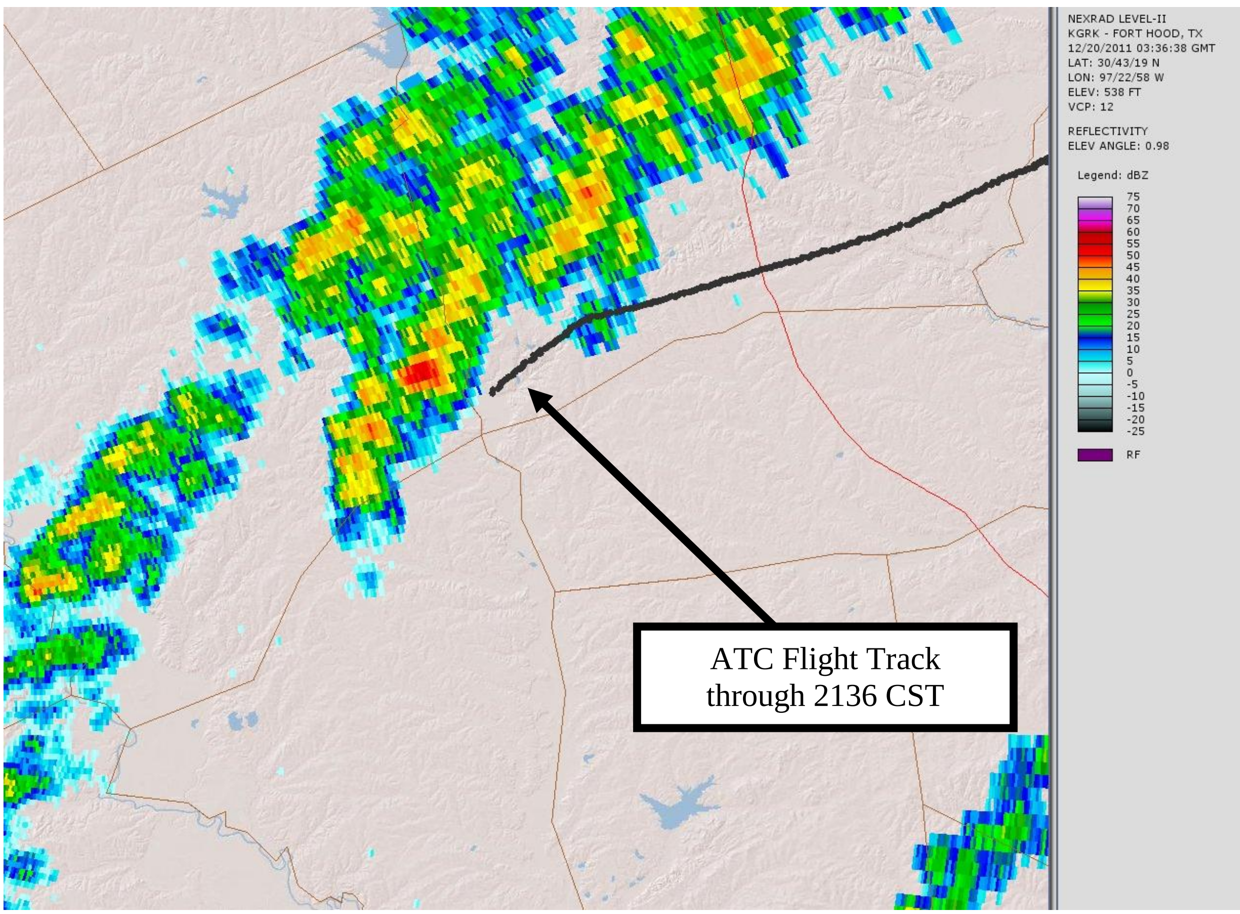


Figure 21 – KGRK WSR-88D base reflectivity 0.9° elevation scan initiated at 2136 CST with ATC Flight Track

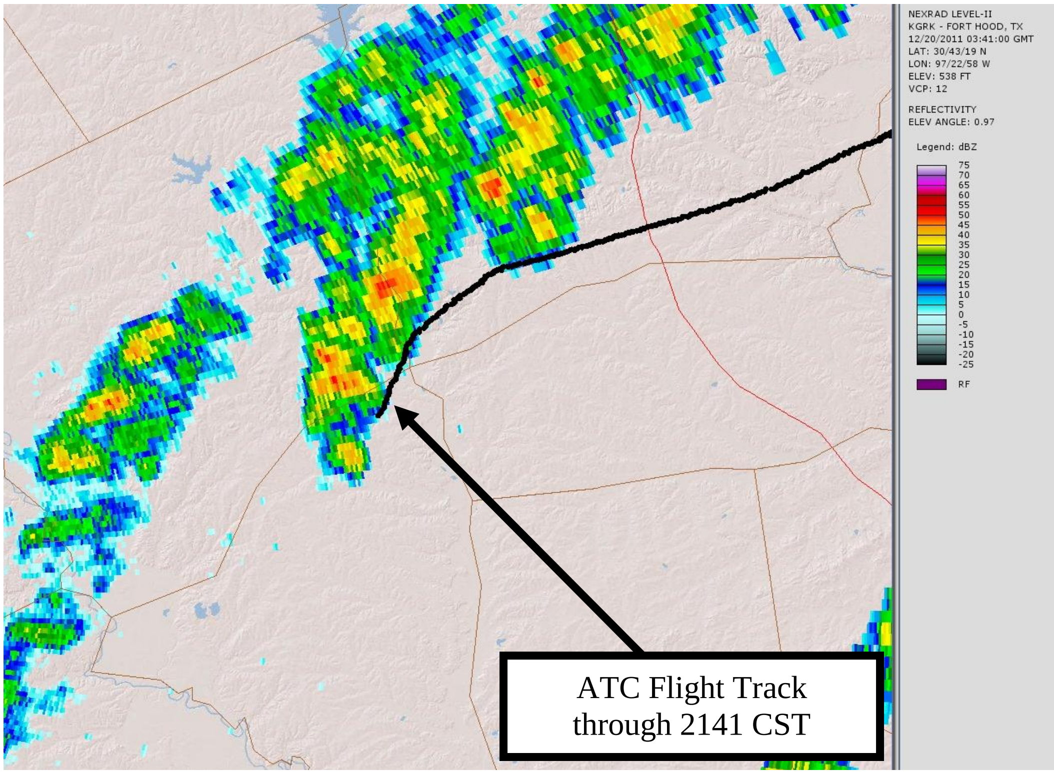


Figure 22 – KGRK WSR-88D base reflectivity 0.9° elevation scan initiated at 2141 CST with ATC Flight Track

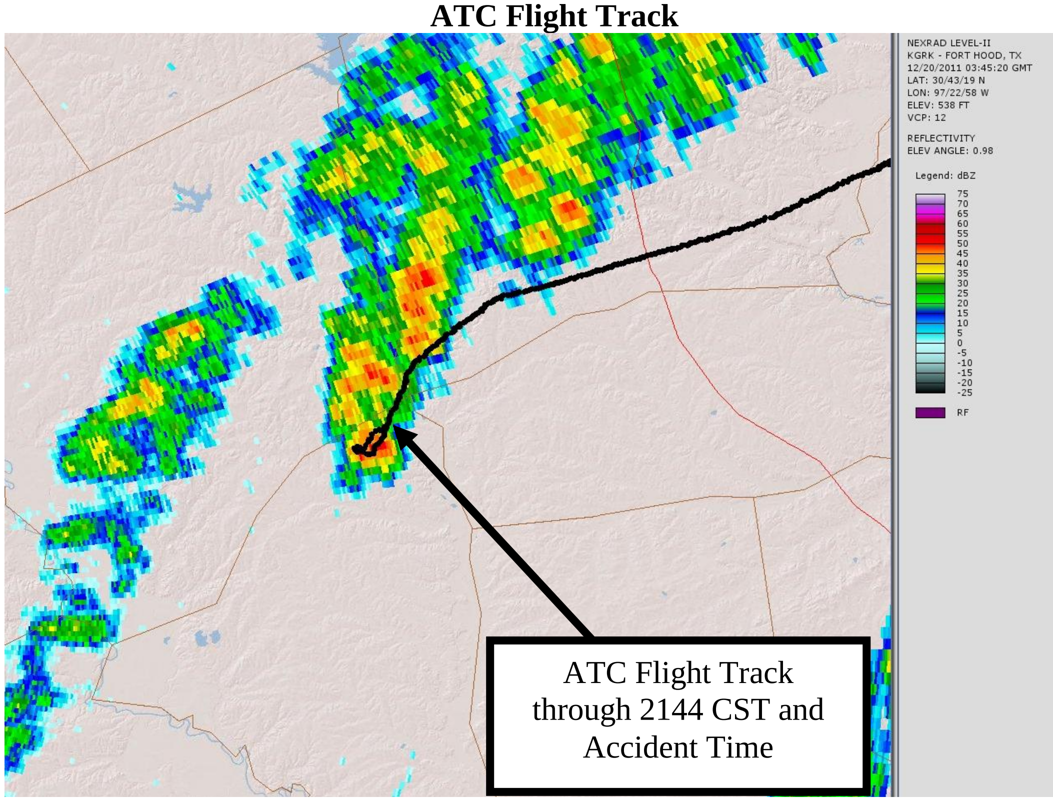


Figure 23 – KGRK WSR-88D base reflectivity 0.9° elevation scan initiated at 2145 CST with ATC Flight Track

5.6 3-Dimensional Radar Reflectivity Data

Figures 24 through 27 present a 3-dimensional view of the KGRK WSR-88D base reflectivity for elevation scans initiated at 2132, 2136, 2141, and 2145 CST, respectively. The accident airplane's flight track obtained from Air Traffic Controller was also plotted on the Google Earth image for a time comparison with the base reflectivity images. The images show the accident flight encountering a line of developing rain showers by 2141 CST with the accident flight's flight track becoming more erratic after 2141 CST. Figures 28 through 30 present the 3-dimensional base reflectivity data from the KGRK WSR-88D within Google Earth as an image facing southwestward along the accident airplane's route of flight from 2132, 2136, and 2141 CST. From 2132 and 2136 CST, the accident airplane remains east of the line of rain showers with all the base reflectivity echoes west of the flight track (figures 28 and 29). By 2141 CST, the accident airplane has encountered a developing rain shower and the flight track direction has changed significantly (figure 30).

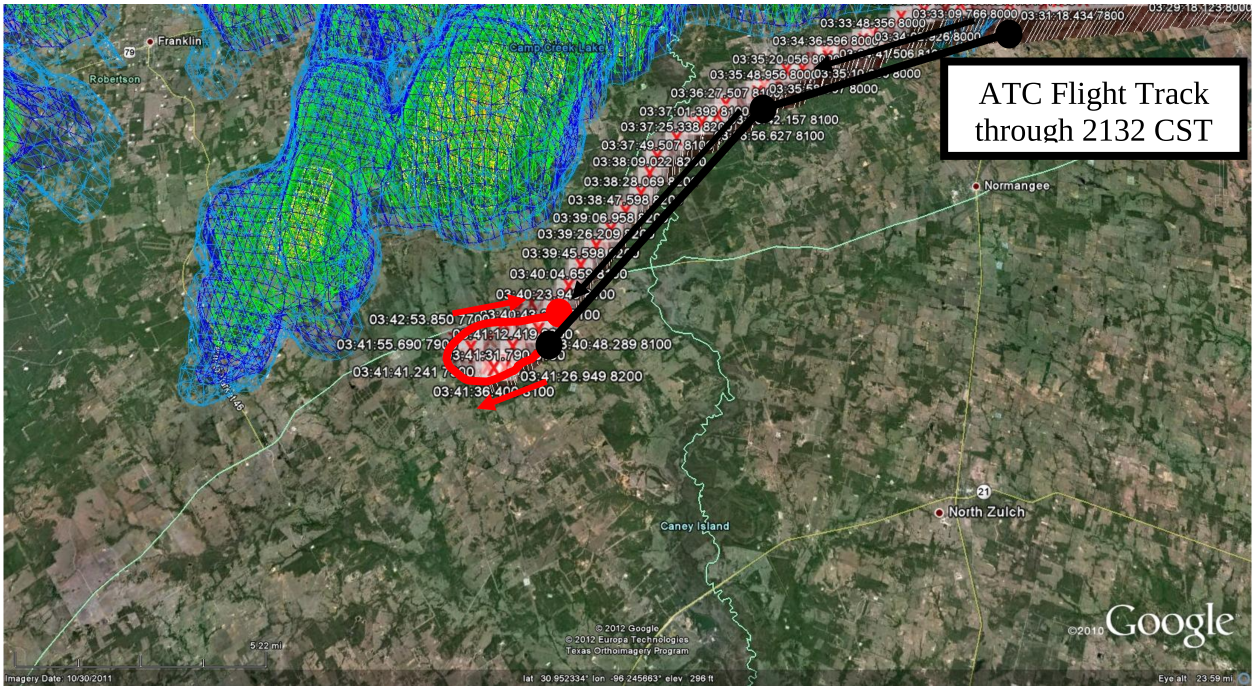


Figure 24 – 3-dimensional KGRK WSR-88D base reflectivity from the scan initiated at 2132 CST and the ATC Flight Track

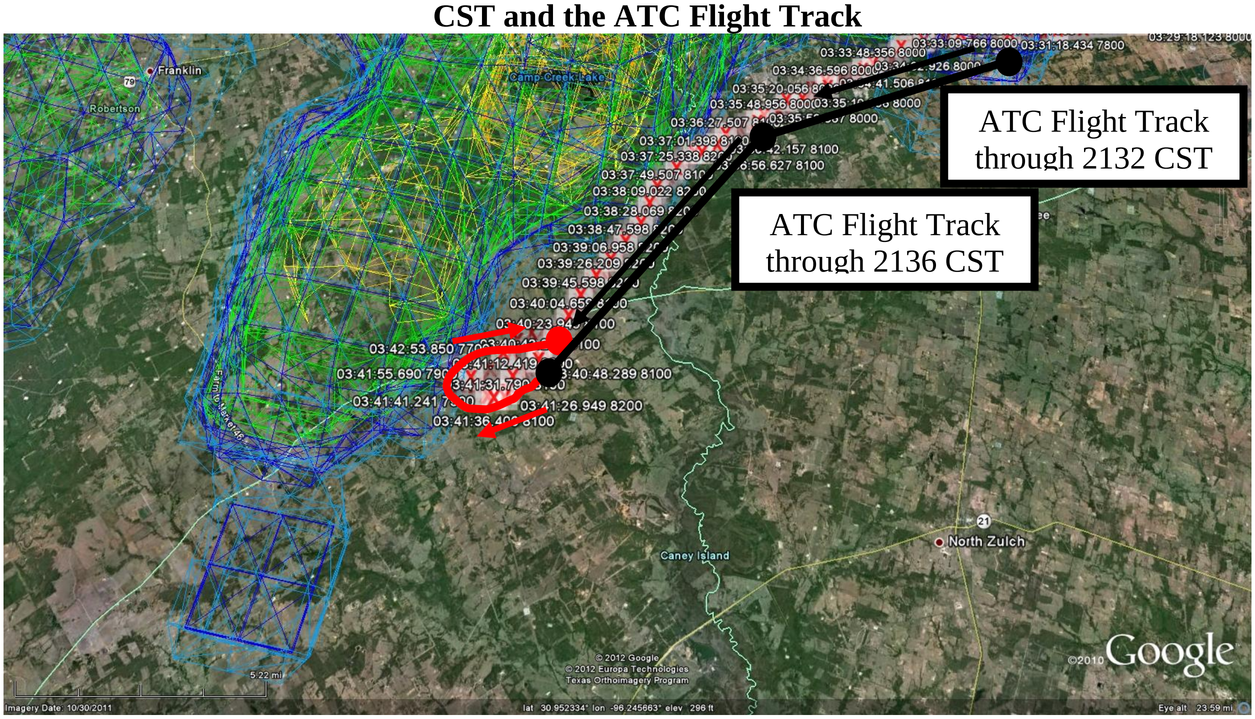


Figure 25 – 3-dimensional KGRK WSR-88D base reflectivity from the scan initiated at 2136 CST and the ATC Flight Track

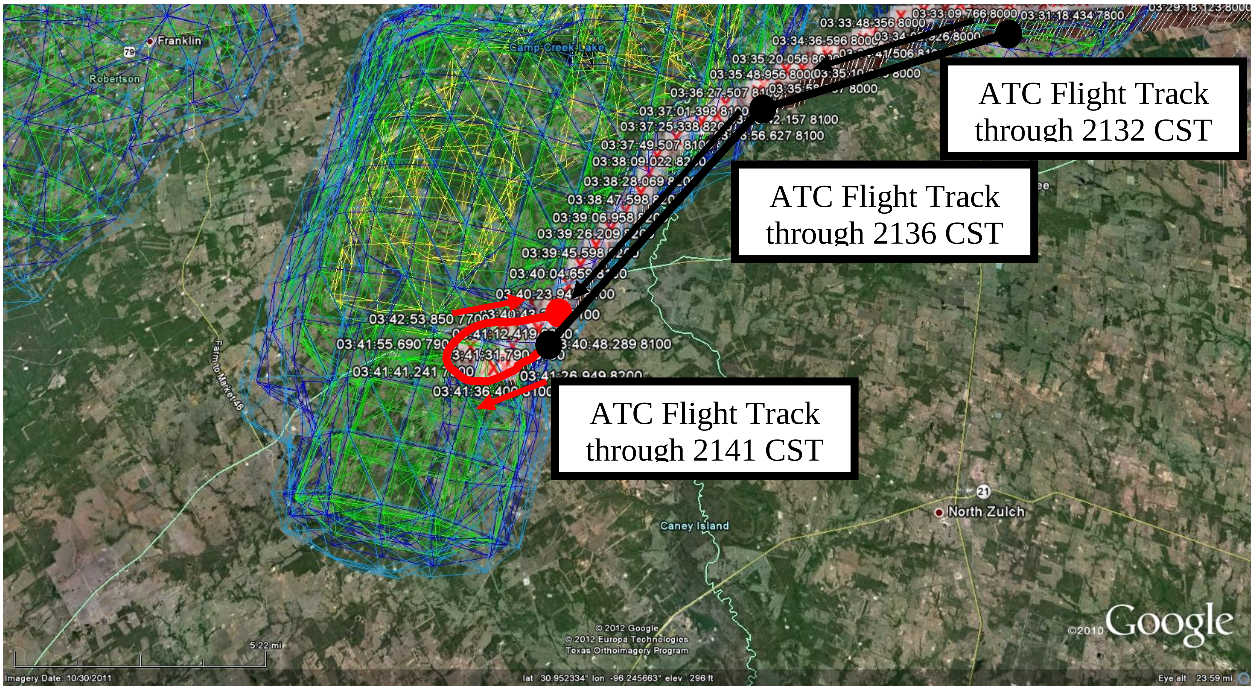


Figure 26 – 3-dimensional KGRK WSR-88D base reflectivity from the scan initiated at 2141 CST and the ATC Flight Track

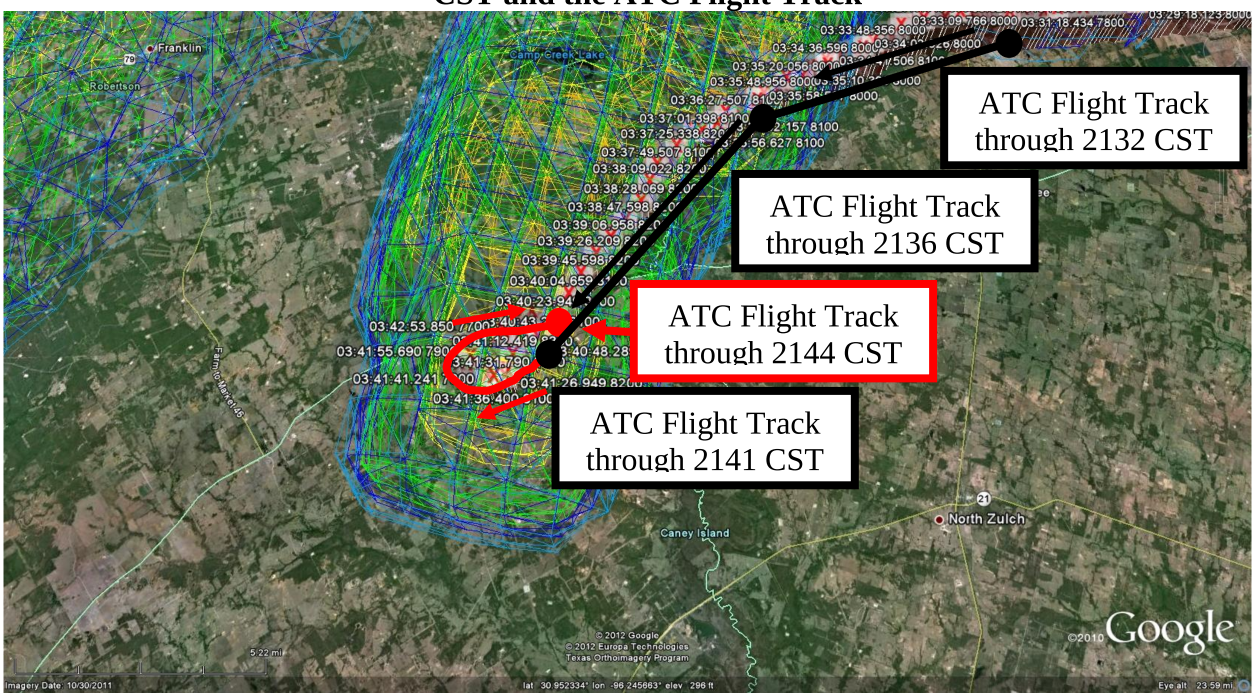


Figure 27 – 3-dimensional KGRK WSR-88D base reflectivity from the scan initiated at 2145 CST and the ATC Flight Track

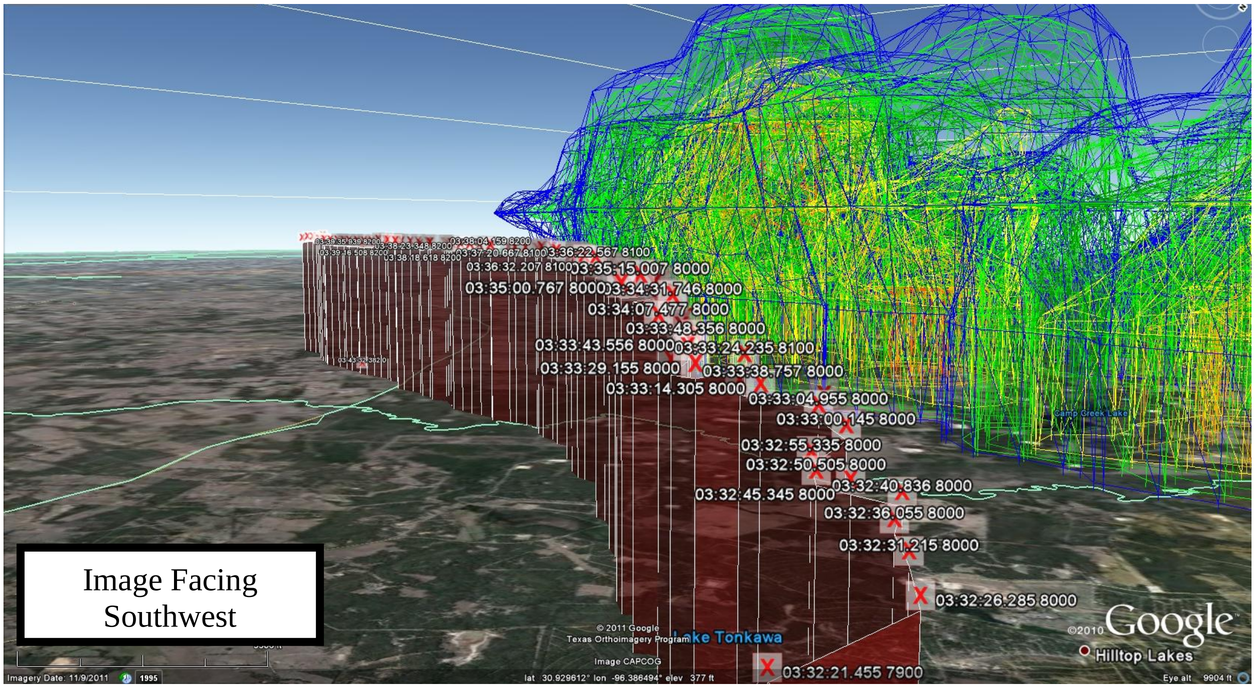


Figure 28 – 3-dimensional KGRK WSR-88D base reflectivity from the scan initiated at 2132 CST and the ATC Flight Track from 2132 CST onward

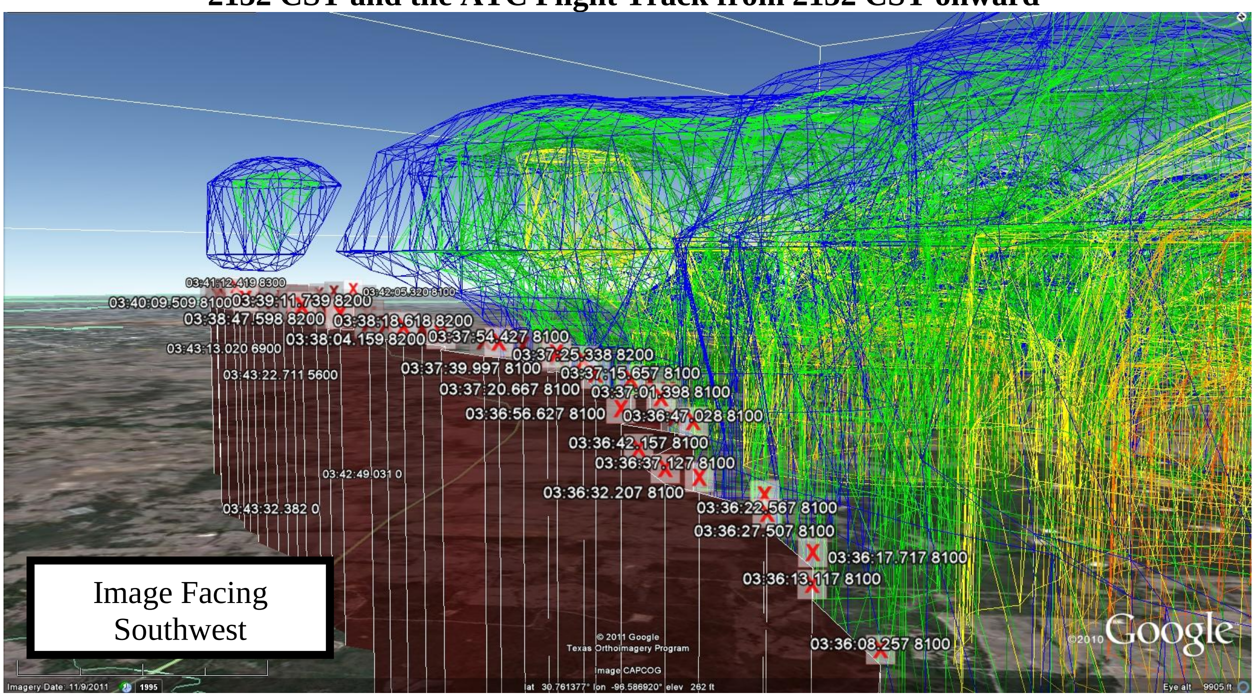


Figure 29 – 3-dimensional KGRK WSR-88D base reflectivity from the scan initiated at 2136 CST and the ATC Flight Track from 2136 CST onward

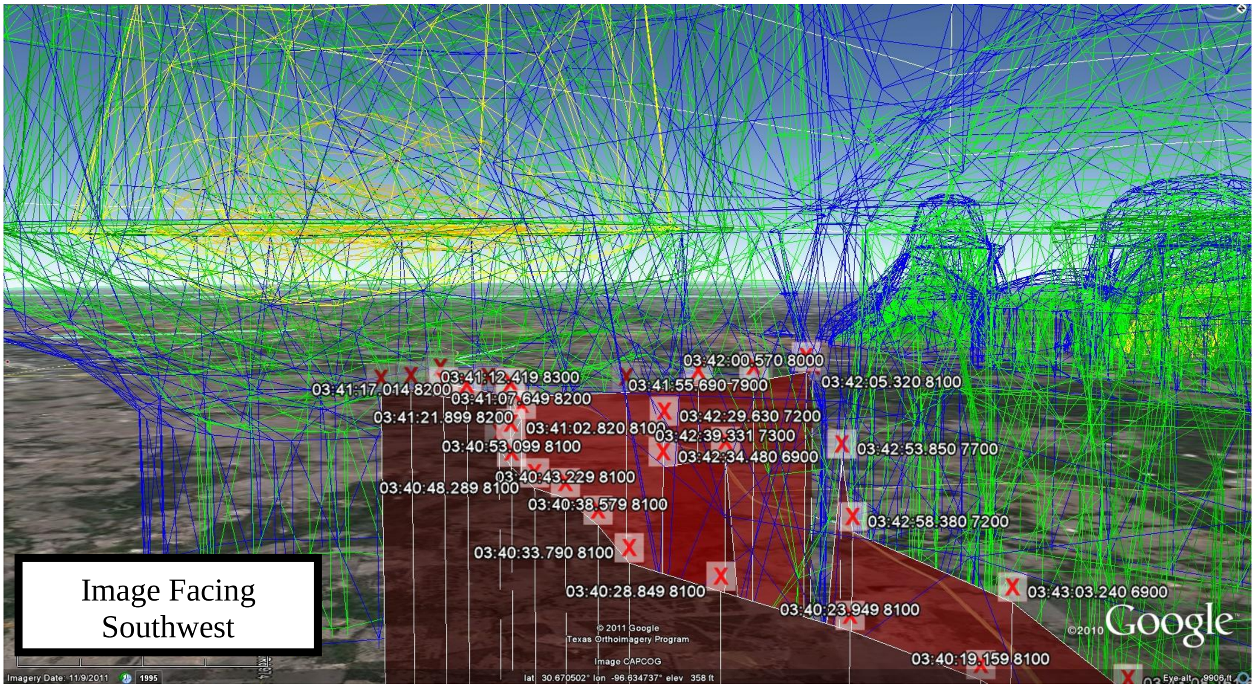


Figure 30 – 3-dimensional KGRK WSR-88D base reflectivity from the scan initiated at 2141 CST and the ATC Flight Track from 2140 CST onward

5.7 Onboard Radar and National Weather Service Base Reflectivity Time and Data Comparison

A time and data comparison was done between the KGRK WSR-88D base reflectivity images and the XM Sirius satellite weather NEXRAD[20] data (XM data). The accident pilot described using NEXRAD data[21], had a valid subscription to XM data, and a Garmin 696 was found in the accident aircraft which would support XM data. The XM data was a weather radar service provided by XM Sirius and displayed on the Garmin 696 within the accident airplane. The XM data was provided to the Garmin 696 via satellite using multiple sources at a nominal update rate. The Garmin GPSMAP 695/696 Owner's Manual specifically mentions that the NEXRAD weather data should be used for "long-range planning purposes only", not to "penetrate hazardous weather", as the "NEXRAD data is not real-time." The XM data and images provided below are not the actual images that the Garmin 696 displayed in the accident airplane, but they are a representation of what the XM data would have looked like based on the timing from archived ground logs[22].

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[20] NEXRAD - NEXt-generation RADar

[21] ATC Factual Report.

[22] We do not have the images as generated by the pilot's Garmin 696 (due to the various individualized settings, color schemes, scales, etc… the pilot could have used), but the XM data and images in this report are based on the most up to date XM data that would have been available to the accident pilot.

The closest matching base reflectivity image to the 2130 CST XM data[23] was the 1.4° elevation scan base reflectivity which began at 21:24:40 CST and this gives the 2130 CST XM data a time latency[24] of 5 minutes and 20 seconds (figure 31). There was an addition 1 minute and 4 seconds for the XM data to be created[25] so that it could be displayed in the cockpit and so the total approximate time latency of the 2130 CST XM data was 6 minutes and 24 seconds. The XM data age indicator in the cockpit should have indicated that the XM data was 1 minute old (the time it took for the XM data to be created and sent to the accident airplane). The ATC flight track is provided for reference. Figure 32 provides the closest available 1.4° elevation scan base reflectivity from the KGRK WSR-88D, which began at 21:29:01 CST, to the 2130 CST XM data time stamp. The ATC flight track is also updated through 21:29:01 CST with the accident flight much closer to the line developing rain showers in the KGRK WSR-88D base reflectivity data from 21:29:01 CST (figure 32a), than was indicated by the XM data with the time stamp at 2130 CST (figure 32b).

The closest matching base reflectivity image to the 2135 CST XM data was the 1.4° elevation scan base reflectivity which began at 21:29:01 CST and this gives the 2135 CST XM data a time latency of 5 minutes and 59 seconds (figure 33). There was an addition 1 minute and 13 seconds for the XM data to be created[26] so that it could be displayed in the cockpit and so the total approximate time latency of the 2135 CST XM data was 7 minutes and 12 seconds. The XM data age indicator in the cockpit should have indicated that the XM data was 1 minute old (the time it took for the XM data to be created and sent to the accident airplane). The ATC flight track is provided for reference. Figure 34 provides the closest available 1.4° elevation scan base reflectivity from the KGRK WSR-88D, which began at 21:37:42 CST, to the 2135 CST XM data time stamp. The ATC flight track is also updated through 21:37:42 CST with the accident flight at the edge of the line of rain showers as the accident flight moved southwestward in the KGRK WSR-88D base reflectivity data from 21:37:42 CST (figure 34a). In the 2135 CST XM data the accident flight remained 2 to 3 miles east of the line of rain showers (figure 34b) with the southwesterly flight track continuing to remain east of the line of rain showers.

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[23] The radar image dBz values and color scales are different for both the KGRK WSR-88D and XM data and a legend is provided in each figure.

[24] Latency is defined as the time difference between the "actual conditions" as defined by the WSR-88D base reflectivity data, and the time of the XM data.

[25] An unsmoothed and smoothed radar images are made with several other difference data sources being pulled in to make the actual XM data and so in this case even though the XM data said 2130 CST, the XM data would not be available in the cockpit until at least 21:31:04 CST based on the archived XM ground logs.

[26] An unsmoothed and smoothed radar images are made with several other difference data sources being pulled in to make the actual XM data and so in this case even though the XM data said 2135 CST, the XM data would not be available in the cockpit until at least 21:36:13 CST based on the archived XM ground logs.

The closest matching base reflectivity image to the 2140 CST XM data was the 1.4° elevation scan base reflectivity which began at 21:33:22 CST and this gives the 2140 CST XM data a time latency of 6 minutes and 48 seconds (figure 35). There was an addition 1 minute and 12 seconds for the XM data to be created[27] so that it could be displayed in the cockpit and so the total approximate time latency of the 2140 CST XM data was 8 minutes. The XM data age indicator in the cockpit should have indicated that the XM data was 1 minute old (the time it took for the XM data to be created and sent to the accident airplane). The ATC flight track is provided for reference. Figure 36 provides the closest available 1.4° elevation scan base reflectivity from the KGRK WSR-88D, which began at 21:42:04 CST, to the 2140 CST XM data time stamp. The ATC flight track is also updated through 21:42:04 CST with the accident flight within the developing line of rain showers southwest of the accident site in the KGRK WSR-88D base reflectivity data from 21:42:04 CST (figure 36a). In the 2140 CST XM data the accident flight remained southeast of the line of rain showers (figure 36b) with no rapidly developing rain showers along the south side of the line of showers as seen in the KGRK WSR-88D base reflectivity data (figures 32a, 34a, and 36a).

The closest matching base reflectivity image to the 2145 CST XM data was the 1.4° elevation scan base reflectivity which began at 21:37:42 CST and this gives the 2145 CST XM data a time latency of 7 minutes and 18 seconds (figure 37). There was an addition 1 minute and 4 seconds for the XM data to be created[28] so that it could be displayed in the cockpit and so the total approximate time latency of the 2145 CST XM data was 8 minutes and 22 seconds. The XM data age indicator in the cockpit should have indicated that the XM data was 1 minute old (the time it took for the XM data to be created and sent to the accident airplane). The ATC flight track is provided for reference. Figure 38 provides the closest available 1.4° elevation scan base reflectivity from the KGRK WSR-88D, which began at 21:46:24 CST, to the 2145 CST XM data time stamp. The ATC flight track is also updated through the accident time of 2144 CST with a very strong rain shower directly above the accident site in the KGRK WSR-88D base reflectivity data from 21:46:24 CST (figure 38a). In the 2145 CST XM data the accident flight remained 1 mile east of the line of rain showers (figure 38b).

[27] An unsmoothed and smoothed radar images are made with several other difference data sources being pulled in to make the actual XM data and so in this case even though the XM data said 2140 CST, the XM data would not be available in the cockpit until at least 21:41:12 CST based on the archived XM ground logs.

[28] An unsmoothed and smoothed radar images are made with several other difference data sources being pulled in to make the actual XM data and so in this case even though the XM data said 2145 CST, the XM data would not be available in the cockpit until at least 21:46:04 CST based on the archived XM ground logs.

The accident flight departed their southwesterly heading at 21:41:26 and made a sharp right turn[29]. Before this turn the accident flight could have had access to the 2130, 2135, and the 2140 CST XM data. Figure 39 provides the 2135 and 2140 CST XM data with the ATC flight track through 21:41:26 CST and this figure approximates what the accident pilot could have seen on his Garmin 696[30]. The 2135 CST XM data after the unsmoothed and smoothed radar data images were gathered, along with several other difference data sources pulled together to make the actual XM data, would have been available to the accident pilot in the cockpit by 21:36:17 CST giving the accident pilot approximately 5 minutes and 9 seconds to review the 2135 CST XM data before he made the sharp right turn. The 2140 CST XM data after the unsmoothed and smoothed radar data images were gathered, along with several other difference data sources pulled together to make the actual XM data, would have been available to the accident pilot in the cockpit by 21:41:04 CST giving the accident pilot approximately 22 seconds to review the 2140 CST XM data before he made the sharp right turn.

[29] ATC Factual Report.
[30] We do not have the XM data that the accident pilot was actual looking at and what scale his map was set to, but the XM data and images in this report are based on the archived ground logs that show the most up to date XM data that would have been available to the accident pilot.

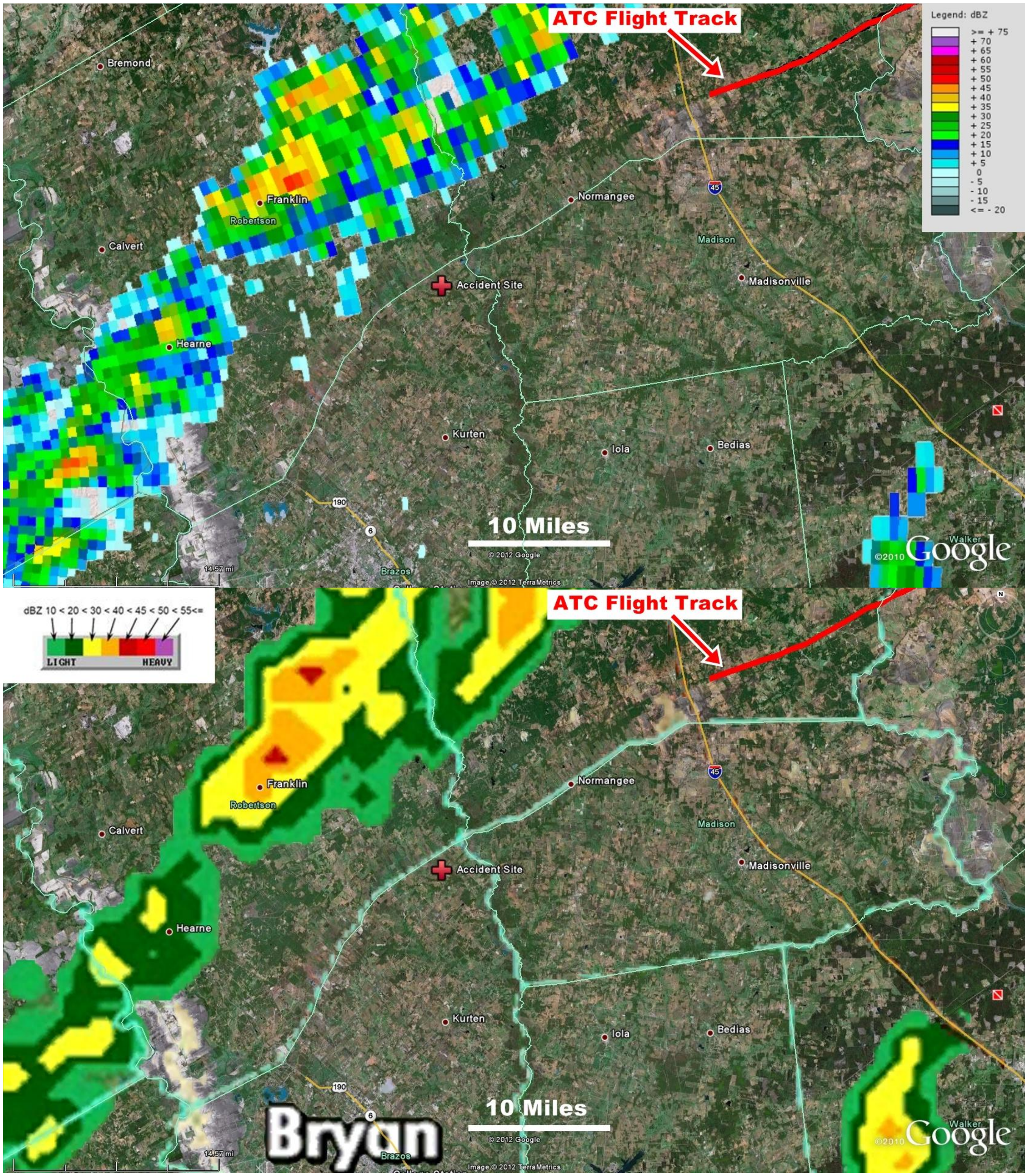

Figure 31 – (a) KGRK WSR-88D level III base reflectivity 1.4° elevation scan which began at 21:24:40 CST with accident flight ATC flight track through 21:24:40 CST and corresponding (b) XM radar mosaic data at time stamped 2130 CST with accident flight ATC flight track through 21:24:40 CST

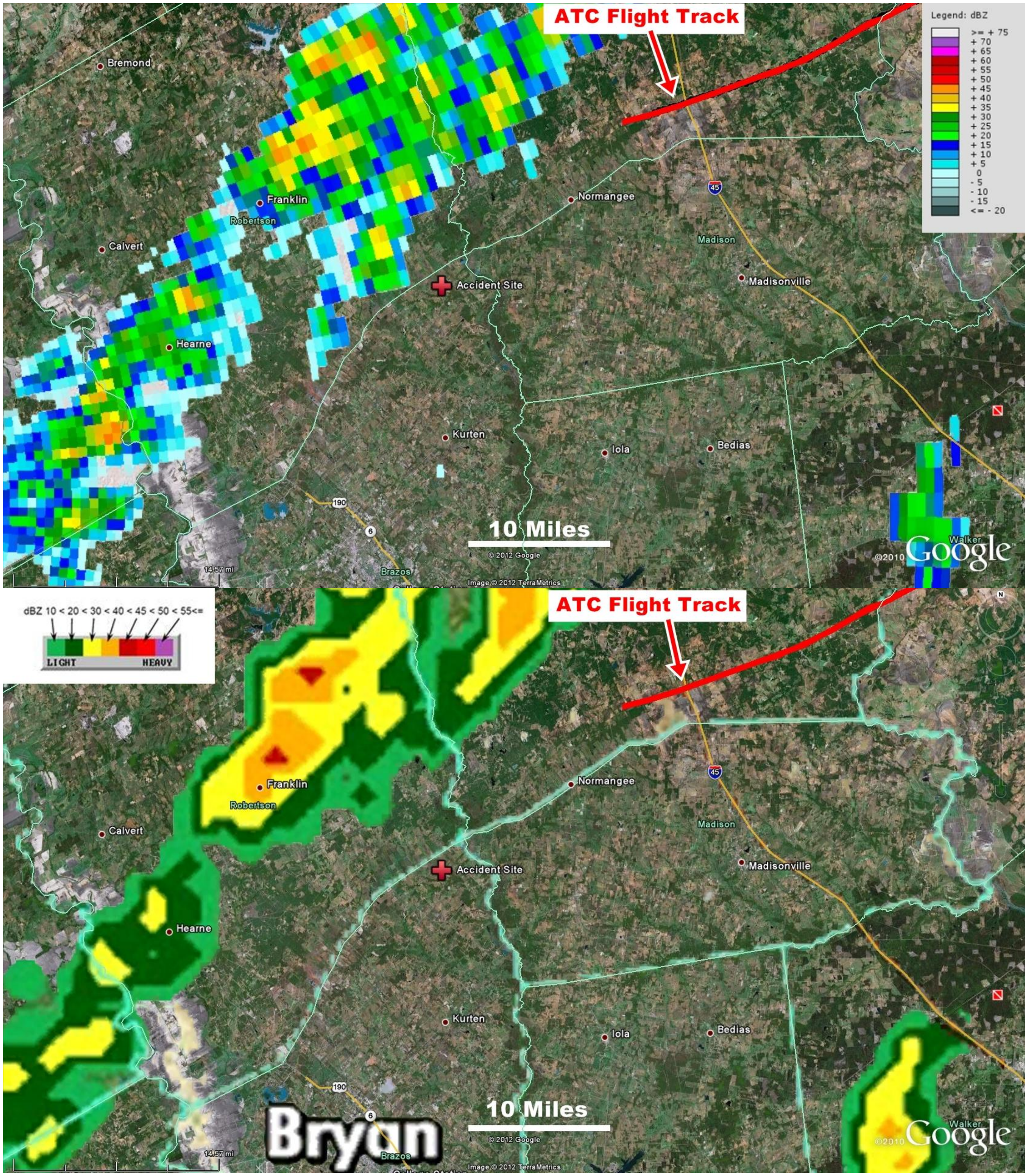

Figure 32 – (a) KGRK WSR-88D level III base reflectivity 1.4° elevation scan which began at 21:29:01 CST with accident flight ATC flight track through 21:29:01 CST (b) XM radar mosaic data at time stamped 2130 CST with accident flight ATC flight track through 21:29:01 CST

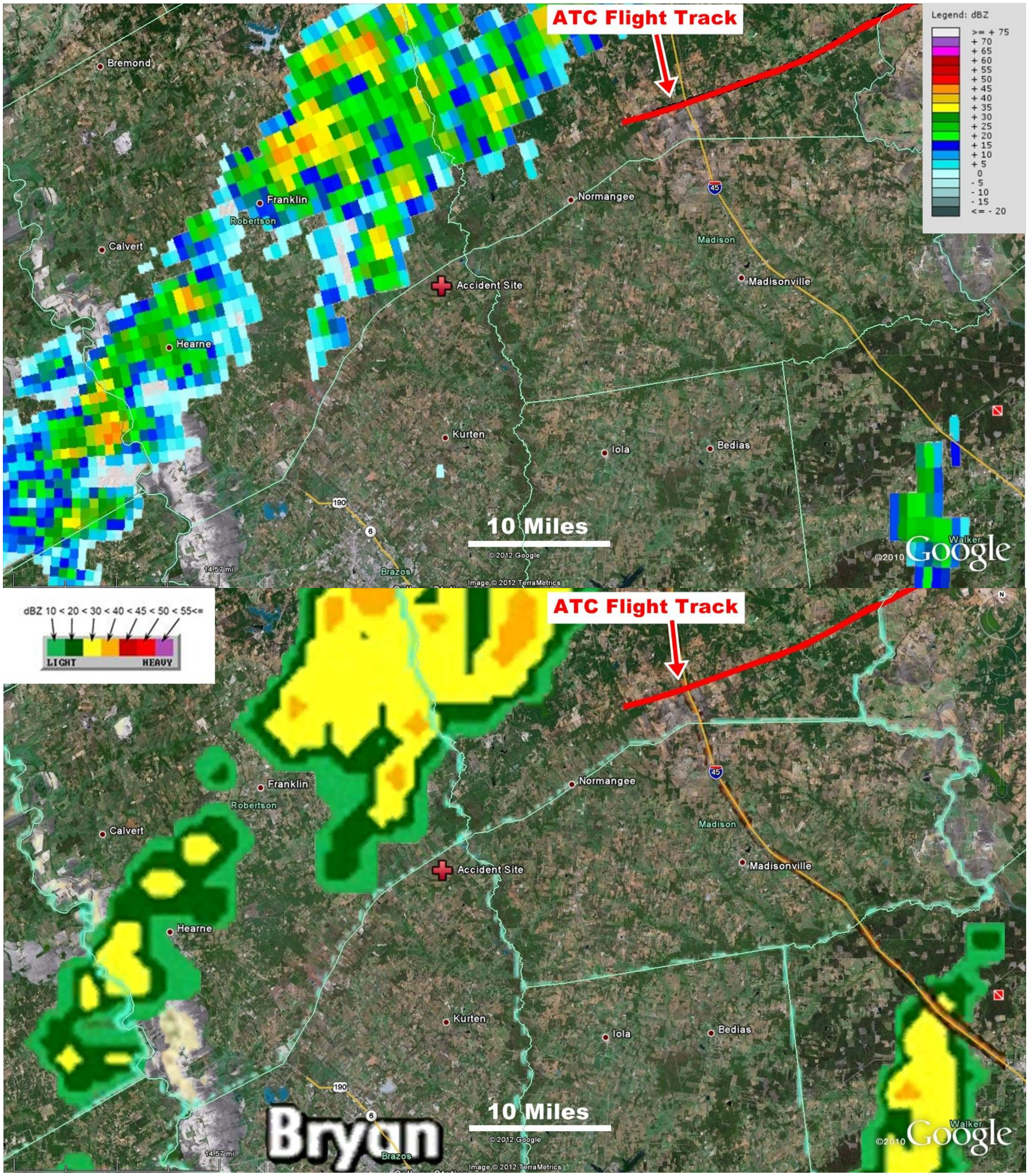

Figure 33 – (a) KGRK WSR-88D level III base reflectivity 1.4° elevation scan which began at 21:29:01 CST with accident flight ATC flight track through 21:29:01 CST and corresponding (b) XM radar mosaic data at time stamped 2135 CST with accident flight ATC flight track through 21:29:01 CST

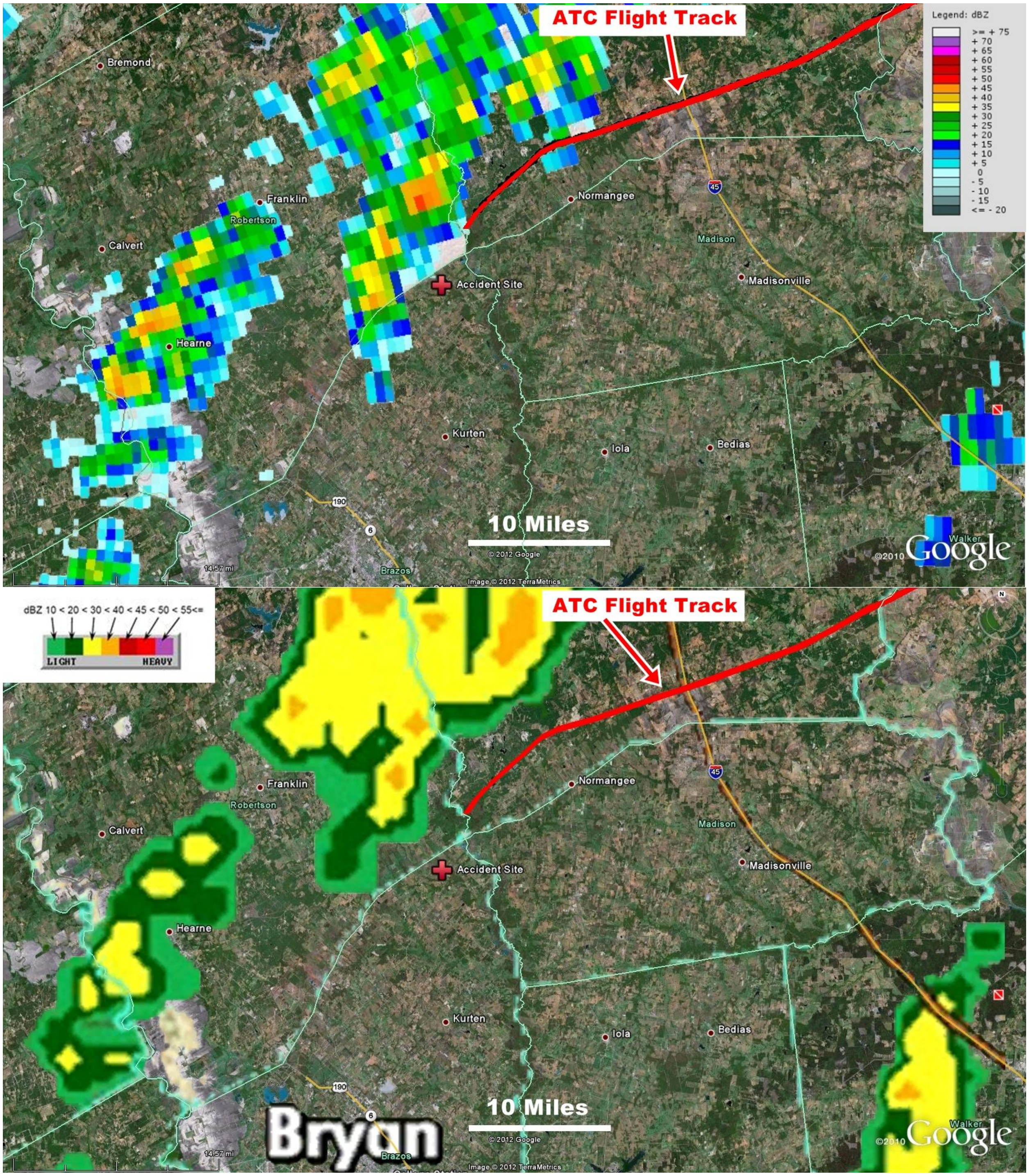

Figure 34 – (a) KGRK WSR-88D level III base reflectivity 1.4° elevation scan which began at 21:37:42 CST with accident flight ATC flight track through 21:37:42 CST (b) XM radar mosaic data at time stamped 2135 CST with accident flight ATC flight track through 21:37:42 CST

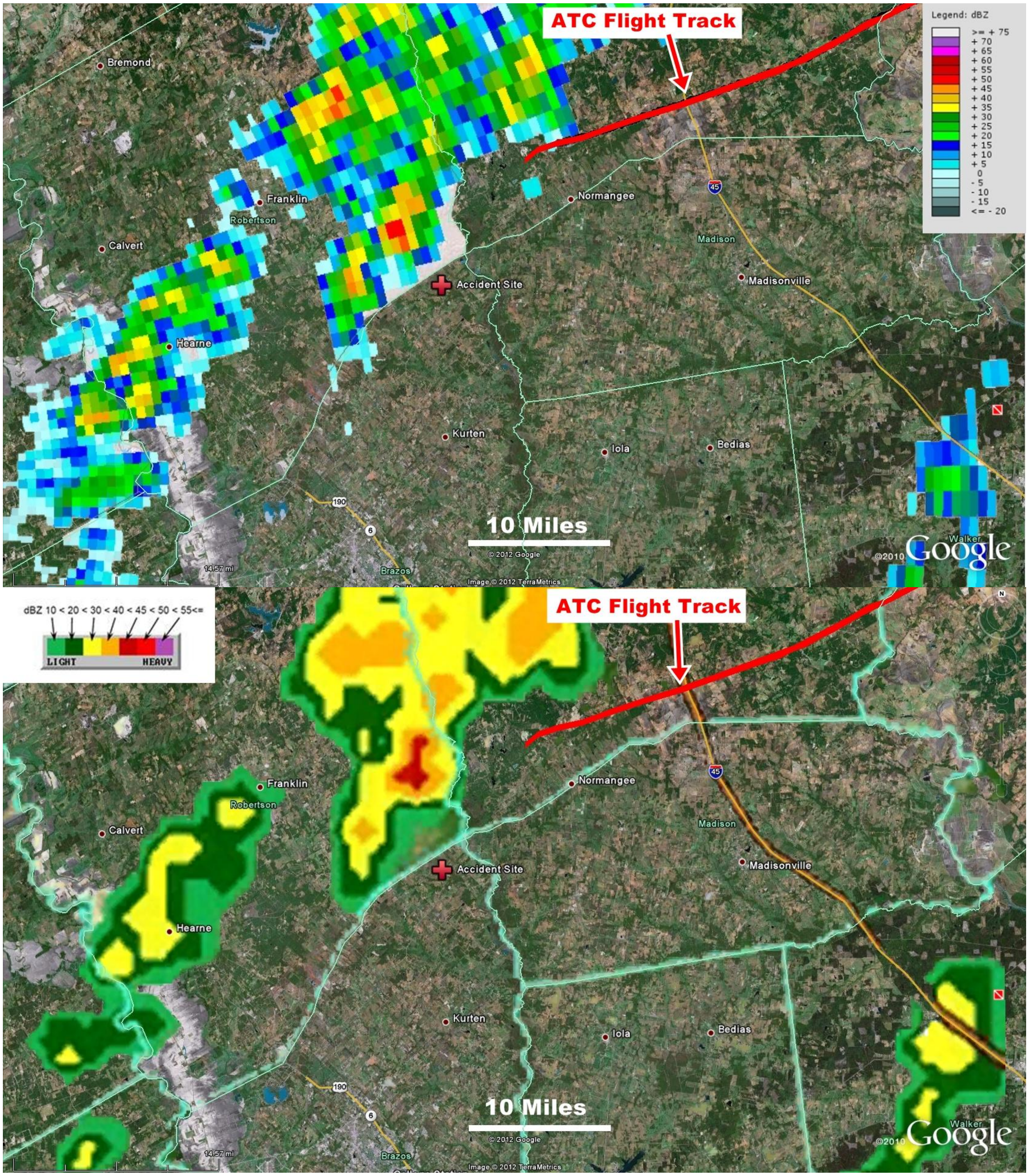

Figure 35 – (a) KGRK WSR-88D level III base reflectivity 1.4° elevation scan which began at 21:33:22 CST with accident flight ATC flight track through 21:33:22 CST and corresponding (b) XM radar mosaic data at time stamped 2140 CST with accident flight ATC flight track through 21:33:22 CST

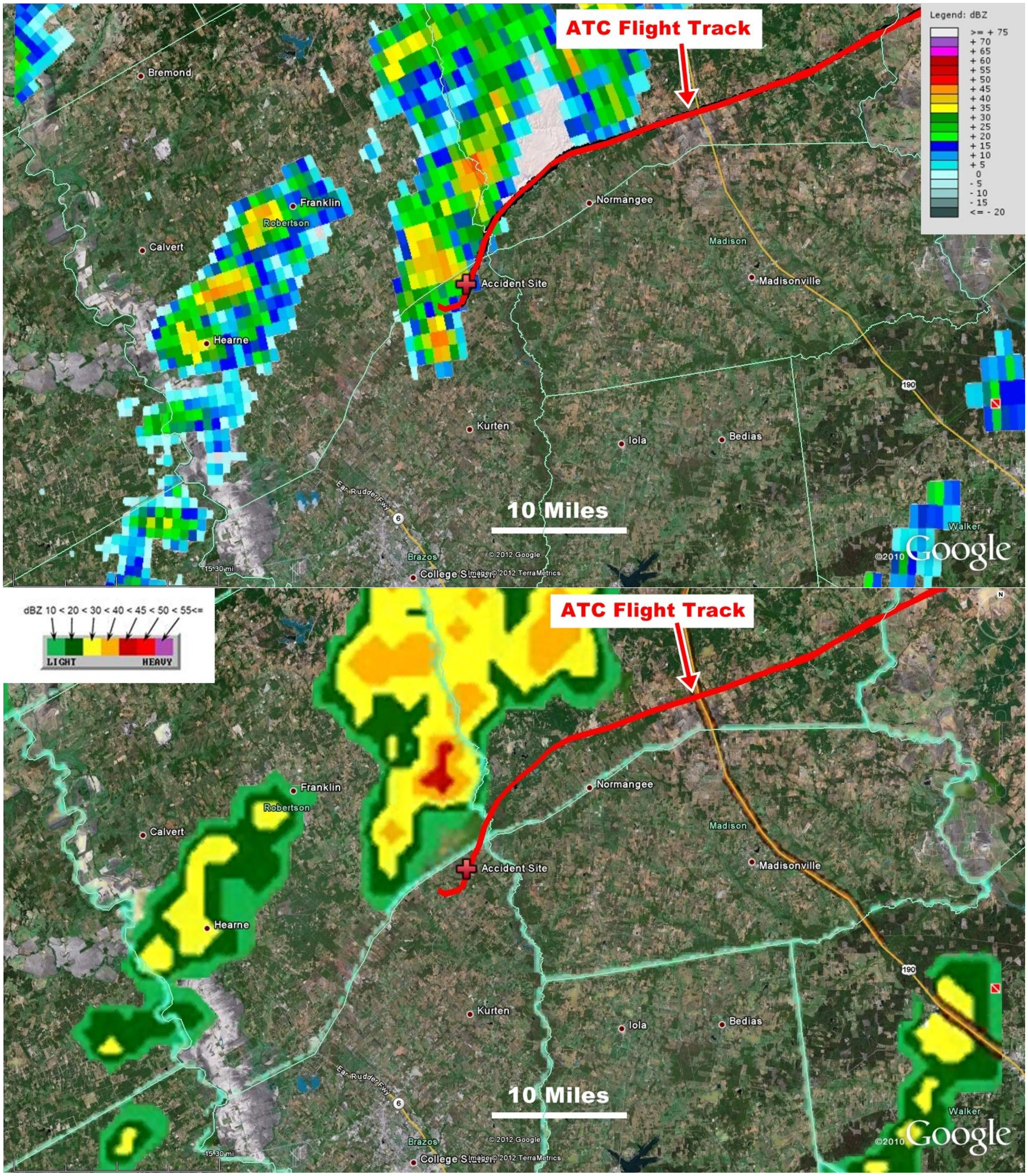

Figure 36 – (a) KGRK WSR-88D level III base reflectivity 1.4° elevation scan which began at 21:42:04 CST with accident flight ATC flight track through 21:42:04 CST (b) XM radar mosaic data at time stamped 2140 CST with accident flight ATC flight track through 21:42:04 CST

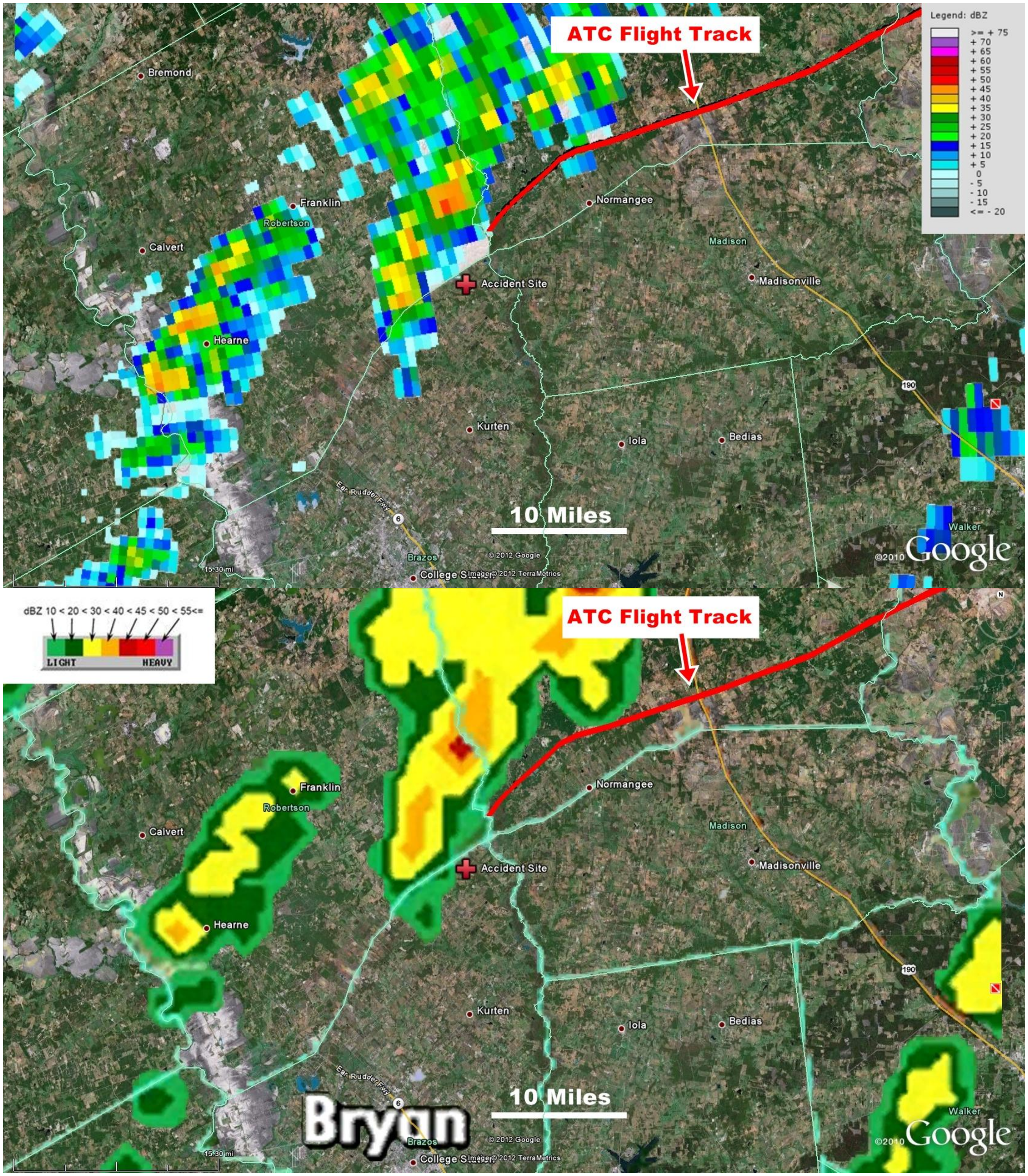

Figure 37 – (a) KGRK WSR-88D level III base reflectivity 1.4° elevation scan which began at 21:37:42 CST with accident flight ATC flight track through 21:37:42 CST and corresponding (b) XM radar mosaic data at time stamped 2145 CST with accident flight ATC flight track through 21:37:42 CST

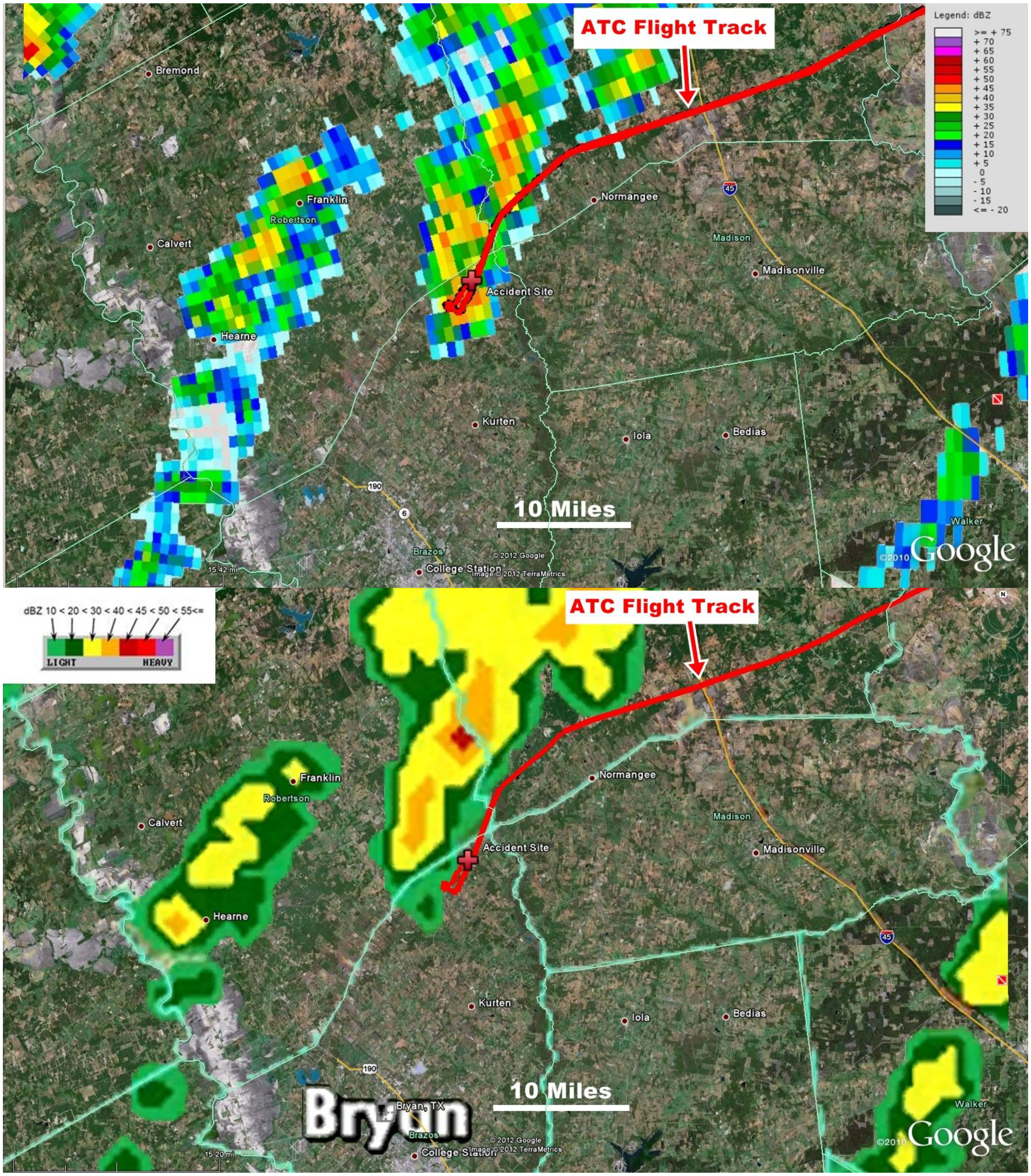

Figure 38 – (a) KGRK WSR-88D level III base reflectivity 1.4° elevation scan which began at 21:46:24 CST with accident flight ATC flight track through 2144 CST (b) XM radar mosaic data at time stamped 2145 CST with accident flight ATC flight track through 2144 CST

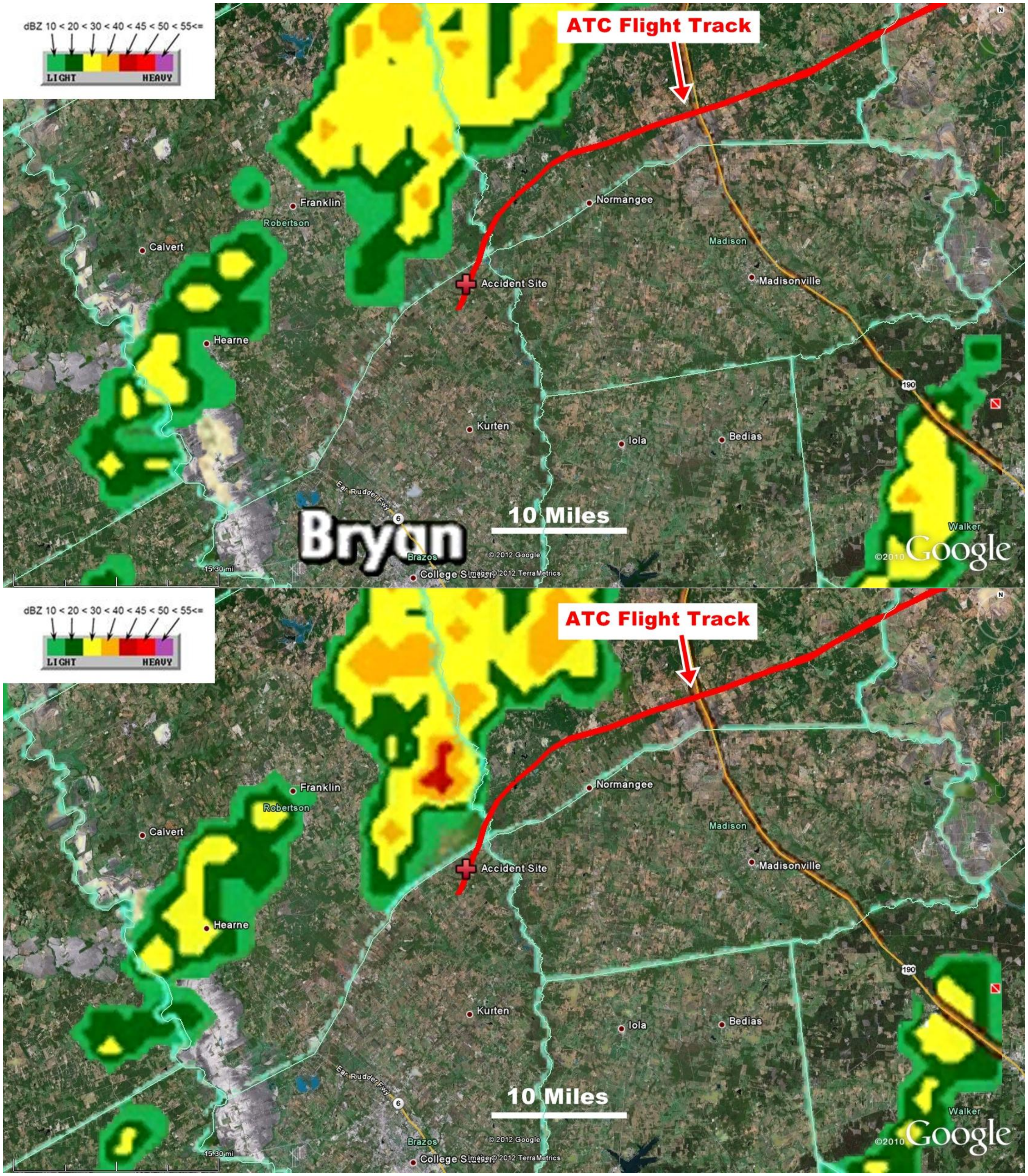

Figure 39 – (a) XM radar mosaic data at time stamped 2135 CST with accident flight ATC flight track through 21:41:26 CST (b) XM radar mosaic data at time stamped 2140 CST with accident flight ATC flight track through 21:41:26 CST

5.8 Lightning Data

Lightning data was also reviewed for the time and location of the accident and no lightning strikes were observed near the accident site around the time of the accident.

6.0 Pilot Reports

Pilot reports (PIREPs) were reviewed from two hours prior to the accident time to two hours after the accident time and these PIREP was disseminated:

TYR UUA /OV UIM160015/TM 0238/FL041/TP C208/TB EXTRM/RM DURC
AWC-WEB:KZFW=

HYI UA /OV HYI /TM 0307 /FLUNKN /TP B737 /TB LGT-OCNL MOD 130-040
/RM DURD=

AFW UA /OV AFW /TM 0505 /FLUNKN /TP DC10 /RM SKC ABV 100 FEET AGL
GROUND FOG BLO=

Urgent pilot report (UUA); 15 miles from Quitman, Texas, on the 160° radial; Time – 2038 CST (0238Z); Altitude – 4,100 feet; Type aircraft – Cessna 208; Turbulence – Extreme; Remarks – During climb.

Routine pilot report (UA); Over San Macros, Texas; Time – 2107 CST (0307Z); Flight level[31] – Unknown; Type aircraft – Boeing 737; Turbulence – Light and occasional moderate from 4,000 feet through 13,000 feet msl; Remarks – During descent.

Routine pilot report (UA); Over Fort Worth, Texas; Time – 2305 CST (0505Z); Flight level – Unknown; Type aircraft – DC 10; Remarks – Sky clear above 100 feet agl with ground fog below.

7.0 SIGMETs and AIRMETs

Two SIGMETs were valid for just west of the accident site at the accident time. These SIGMETs advised of a line of moving from 200° at 45 knots with embedded severe thunderstorms. Thunderstorm tops were forecast above FL450 with wind gusts to 50 knots possible (figure 40):

[31] Flight Level – A Flight Level (FL) is 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 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.

CONVECTIVE SIGMET 5C
VALID UNTIL 0355Z
TX OK
FROM 60ESE ADM-60ESE TTT-30ENE ACT-30ENE CWK
LINE EMBD TS 30 NM WIDE MOV FROM 20045KT. TOPS TO FL440.

CONVECTIVE SIGMET 7C
VALID UNTIL 0455Z
TX
FROM 70ENE TTT-50W GGG-60E ACT-30ENE CWK
LINE SEV EMBD TS 30 NM WIDE MOV FROM 20045KT. TOPS ABV FL450.
WIND GUSTS TO 50KT POSS.

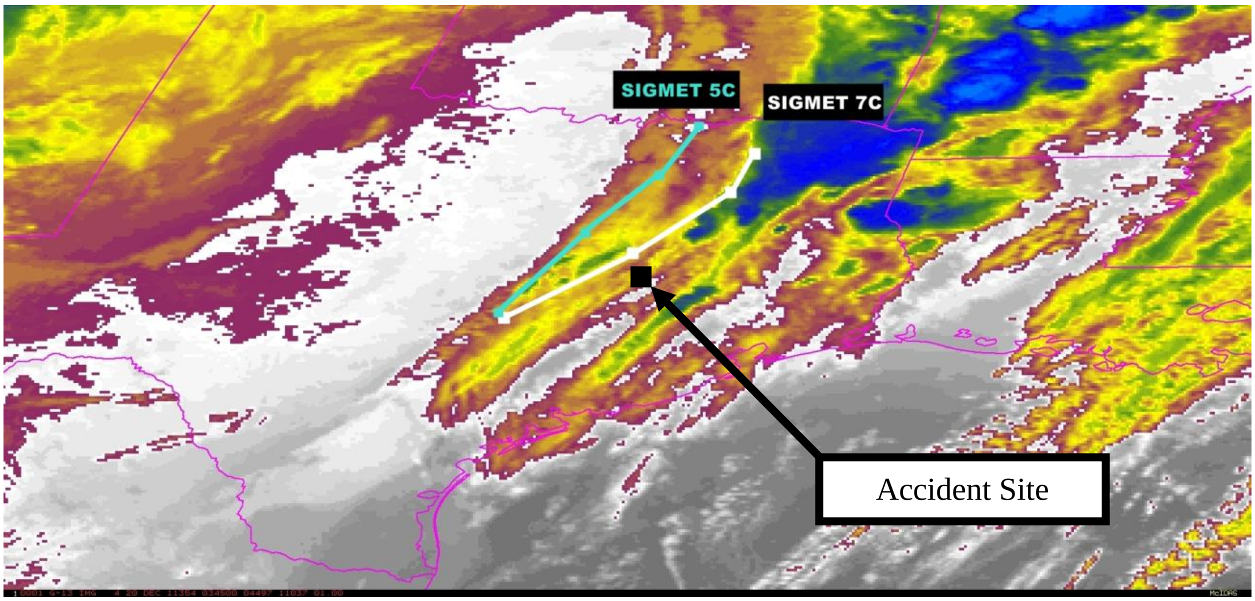

Figure 40 – SIGMET 5C and 7C valid at the time of the accident

No AIRMETs were active for the accident site at the accident time.

8.0 Terminal Aerodrome Forecast

KCLL (figure 6) is a National Weather Service Terminal Aerodrome Forecast[32] (TAF) site and the TAF obtained for the accident time was issued at 2112 CST and valid for a 21-hour period beginning at 2100 CST. The TAF forecast for KCLL was as follows:

TAF AMD KCLL 200312Z 2003/2024 **19009KT P6SM FEW070 OVC080**
FM200400 21008KT P6SM VCSH BKN025
FM200800 27008KT 4SM BR BKN070
FM201300 29009KT P6SM SKC
FM201700 30010G16KT P6SM SKC

[32] Terminal Aerodrome Forecast (TAF) – These forecasts apply to a five statute mile radius from the center of the airport runway complex where the TAF is valid.

The forecast valid at the accident time expected wind from 190° at 9 knots, visibility greater than 6 miles, few clouds at 7,000 feet agl, and an overcast ceiling at 8,000 feet. At 2200 CST wind from 210° at 8 knots, visibility greater than 6 miles, vicinity[33] showers, and a broken ceiling at 2,500 feet agl was forecasted.

9.0 Area Forecast

At 2045 CST the following Area Forecast was issued and discussed expected flying weather conditions across much of the South, including Texas. The Area Forecast for southeastern Texas, including the accident site, forecasted a broken ceiling of clouds from 1,000 to 2,000 feet msl, with clouds layered through FL250. Scattered thunderstorms were forecasted with cumulonimbus tops to FL400:

```
FAUS44 KKCI 200245
FA4W
_DFWC FA 200245
SYNOPSIS AND VFR CLDS/WX
SYNOPSIS VALID UNTIL 202100
CLDS/WX VALID UNTIL 201500...OTLK VALID 201500-202100
OK TX AR TN LA MS AL
.
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...CDFNT NERN OK-TX PNHDL-SERN NM FCST 21Z NWRN AR-NWRN
LA-SERN TX-NWRN GLFMEX. WRMFNT SWRN OK-CNTRL TX-NWRN GLFMEX FCST
21Z NWRN AR-NERN MS-SERN AL.
.
OK
PNHDL-NWRN...CIG OVC010 TOP FL250. WND N 20G30KT. VIS 3SM -SN
BLSN BR. OTLK...IFR CIG BR.
SWRN...SCT030 BKN080 LYRD FL250. VIS 3-5SM -RA BR. BECMG 0507
OVC030. VIS 3-5SM BR. OTLK...MVFR CIG 19Z VFR.
.
NWRN TX
OVC020 LYRD FL250. NMRS -TSRA. CB TOP FL410. 12Z BKN070.
OTLK...VFR.
.
SWRN TX
FAR WEST...BKN060 TOP 150. WDLY SCT -SHRA. OTLK...MVFR CIG 16Z
VFR.
BIG BEND...SKC. OTLK...VFR.
RMNDR...BKN070 TOP 150. WND W G25KT. 07Z SCT060 BKN120 LYRD
FL250. WND NW G25KT. OTLK...VFR.
.
N CNTRL TX
WRN PTNS...SKC. BECMG 0507 SCT-BKN070 LYRD FL250. WND NW G25KT.
OTLK...VFR.
ERN PTNS...BKN080 LYRD FL250. WDLY SCT -SHRA/-TSRA. CB TOP FL390.
```

[33] In the vicinity of the airport is defined as a weather phenomenon within 5-10 miles of the airfield, but not over the airfield.

04Z SCT CI. OTLK...VFR 16Z MVFR CIG.
.
NERN TX
OVC020 LYRD FL250. SCT -TSRA/-SHRA. CB TOP FL400. 13Z BKN070.
OTLK...VFR.
.
SERN TX
BKN010-020 LYRD FL250. SCT -TSRA. CB TOP FL400. 12Z BKN070.
OTLK...VFR.
.
S CNTRL TX
WRN PTNS...SKC TO SCT CI. OTLK...VFR.
ERN PTNS...SCT030 BKN050-060 TOP 150 BKN CI. WDLY SCT -SHRA. ISOL
-TSRA. CB TOP FL400. 06Z SCT-BKN070-090. OTLK...VFR.
.
AR
W HLF...BKN030 LYRD FL250. BKN CI. VIS 3-5SM -RA BR. WDLY SCT
-TSRA. CB TOP FL400. OTLK...IFR CIG RA BR.
E HLF...BKN060-070 LYRD FL250. 09Z OVC035. VIS 3SM BR. SCT -SHRA.
OTLK...IFR CIG SHRA BR.
.
LA
N HLF...BKN050-060 LYRD FL250. SCT -SHRA/-TSRA. CB TOP FL380. AFT
06Z OVC010-015. OTLK...MVFR CIG 18Z VFR.
SERN...BKN060 LYRD FL250. BKN CI. 08Z BKN015-025. VIS 3-5SM BR.
OTLK...MVFR CIG BR.
SWRN...OVC060 LYRD FL250. WDLY SCT -SHRA. 06Z OVC020. SCT
-SHRA/-TSRA. CB TOP FL400. OTLK...MVFR CIG SHRA BR.
.
TN
E HLF...BKN CI. OTLK...MVFR CIG SHRA.
W HLF...SCT080 BKN150 LYRD FL250. 10Z OVC070. 13Z OVC035. NMRS
-SHRA. ISOL -TSRA. CB TOP FL350. OTLK...IFR CIG SHRA BR.
.
MS
NWRN...SCT080 BKN150 LYRD FL250. 09Z OVC020. VIS 3-5SM BR. 12Z
BKN010-015. SCT -SHRA/-TSRA. CB TOP FL380. OTLK...MVFR CIG SHRA.
NERN...BKN CI. BECMG 1112 OVC015 LYRD FL250. OTLK...MVFR CIG
SHRA.
SWRN...OVC035 LYRD FL250. BECMG 0608 OVC020. VIS 3-5SM BR.
OTLK..MVFR CIG 18Z VFR SHRA.
SERN...BKN150 LYRD FL250. BKN CI. 08Z OVC010. VIS 5SM BR.
OTLK...MVFR CIG.
.
AL
N HLF...OVC CI. 10Z OVC015-020 LYRD FL250. OTLK...IFR CIG BR.
S HLF...OVC050 TOP 100 BKN CI. BECMG 0809 OVC015-020. OCNL VIS
3-5SM BR. OTLK...MVFR RA CIG.
....

10.0 Meteorological Impact Statement and Center Weather Advisory

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

11.0 National Weather Service Discussion

At 2027 CST, the NWS forecast office in Houston/Galveston, Texas, issued the following Area Forecast Discussion (AFD) for southeast Texas which included the accident site. The AFD discussed bands of showers continuing to develop across central and east Texas with the showers slowly moving southeastward into Tuesday morning:

FXUS64 KHGX 200327
AFDHGX

AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE HOUSTON/GALVESTON TX
927 PM CST MON DEC 19 2011

.DISCUSSION...
W/V IMAGERY SHOWS UPPER LOW CENTERED OVER THE TX PANHANDLE ON THE
MOVE TO THE ENE. BANDS OF SHRA CONTINUE TO DEVELOP ACROSS THE
EASTERN PERPIHERY ACROSS CNTL/EAST TX. EXPECT THESE BANDING
FEATURES TO CONTINUE INTO THE OVERNIGHT HOURS AND POSSIBLY
INCREASE IN COVERAGE ACROSS NRN HALF OF THE AREA AS LFQ OF
INCOMING JET NUDGES INTO THE REGION. THINK THESE BANDS WILL BECOME
MORE EAST-WEST ORIENTED WITH TIME (AS UPPER LOW MOVES FURTHER ENE)
AND MAY NOT MAKE IT ALL THE WAY OFF THE COAST UNTIL LATE TUE
MORNING WITH THE FRONT IF THE PAST FEW NAM12/WRF RUNS REMAIN ON TARGET.

THINK SEVERE WX POTENTIAL IS MARGINAL AND HAVE REMOVED THE MENTION FROM
THE ZFP WORDING. LLVL SHEAR IS STILL IMPRESSIVE BUT OVERALL INSTABILITY
IS NOT. CANNOT RULE OUT SOME ISOLATED STRONG ROTATING CELLS BUT
NOT CURRENTLY EXPECTING THAT TO BE THE NORM.

ADJUSTED GRIDS BASED ON THIS THINKING. ALSO TWEAKED LOW TEMPS TO
GIVE A LITTLE MORE WEIGHT TO THE NAM12/WRF WHICH SEEM TO HAVE A
DECENT HANDLE ON THE SITUATION. UPDATED PRODUCTS OUT SHORTLY. 47

&&

.PRELIMINARY POINT TEMPS/POPS...
COLLEGE STATION (CLL) 55 61 38 60 46 / 80 10 10 10 60
HOUSTON (IAH) 64 68 43 62 50 / 60 30 10 10 60
GALVESTON (GLS) 63 70 50 62 56 / 60 50 10 10 60

&&

.HGX WATCHES/WARNINGS/ADVISORIES...
TX...NONE.
GM...SMALL CRAFT ADVISORY UNTIL 6 AM CST TUESDAY FOR THE FOLLOWING
ZONES: WATERS FROM HIGH ISLAND TO FREEPORT 20 TO 60 NM.

SMALL CRAFT SHOULD EXERCISE CAUTION UNTIL MIDNIGHT CST TONIGHT
FOR THE FOLLOWING ZONES: GALVESTON BAY...WATERS FROM HIGH
ISLAND TO FREEPORT OUT 20 NM.

&&

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12.0 Storm Prediction Center Products

At 1844 CST, the Storm Prediction Center issued a day 1 convective outlook, valid from 1900 CST on September 19th to 0600 CST on September 20th, which forecasted thunderstorms, with an isolated wind damage threat, to continue to move from central Texas across east Texas through the evening hours (figure 41):

SPC AC 200044

DAY 1 CONVECTIVE OUTLOOK
NWS STORM PREDICTION CENTER NORMAN OK
0644 PM CST MON DEC 19 2011

VALID 200100Z - 201200Z

...NO SVR TSTM AREAS FORECAST...

...EAST TX...
A CONVECTIVE LINE JUST SOUTHEAST OF THE DALLAS METRO IS LOCATED
ALONG A COLD FRONT WHERE LOW-LEVEL CONVERGENCE IS ENHANCED. THE LINE
IS BEING SUPPORTED BY LIFT ON THE WRN EDGE OF A 45 TO 60 KT
LOW-LEVEL JET AND LARGE-SCALE ASCENT ASSOCIATED WITH AN UPPER-LEVEL
LOW OVER WEST TX. THE STRONG WIND FIELDS AND LINEAR NATURE OF THE
STORMS MAY RESULT IN AN ISOLATED WIND DAMAGE THREAT AS THE LINE
MOVES ACROSS THE REMAINDER OF EAST TX THIS EVENING. HOWEVER...THE
AIRMASS AHEAD OF THE STORMS IS WEAKLY UNSTABLE SUGGESTING ANY SEVERE
THREAT SHOULD REMAIN MARGINAL THIS EVENING.

..BROYLES.. 12/20/2011

CLICK TO GET WUUS01 PTSDY1 PRODUCT

NOTE: THE NEXT DAY 1 OUTLOOK IS SCHEDULED BY 0600Z

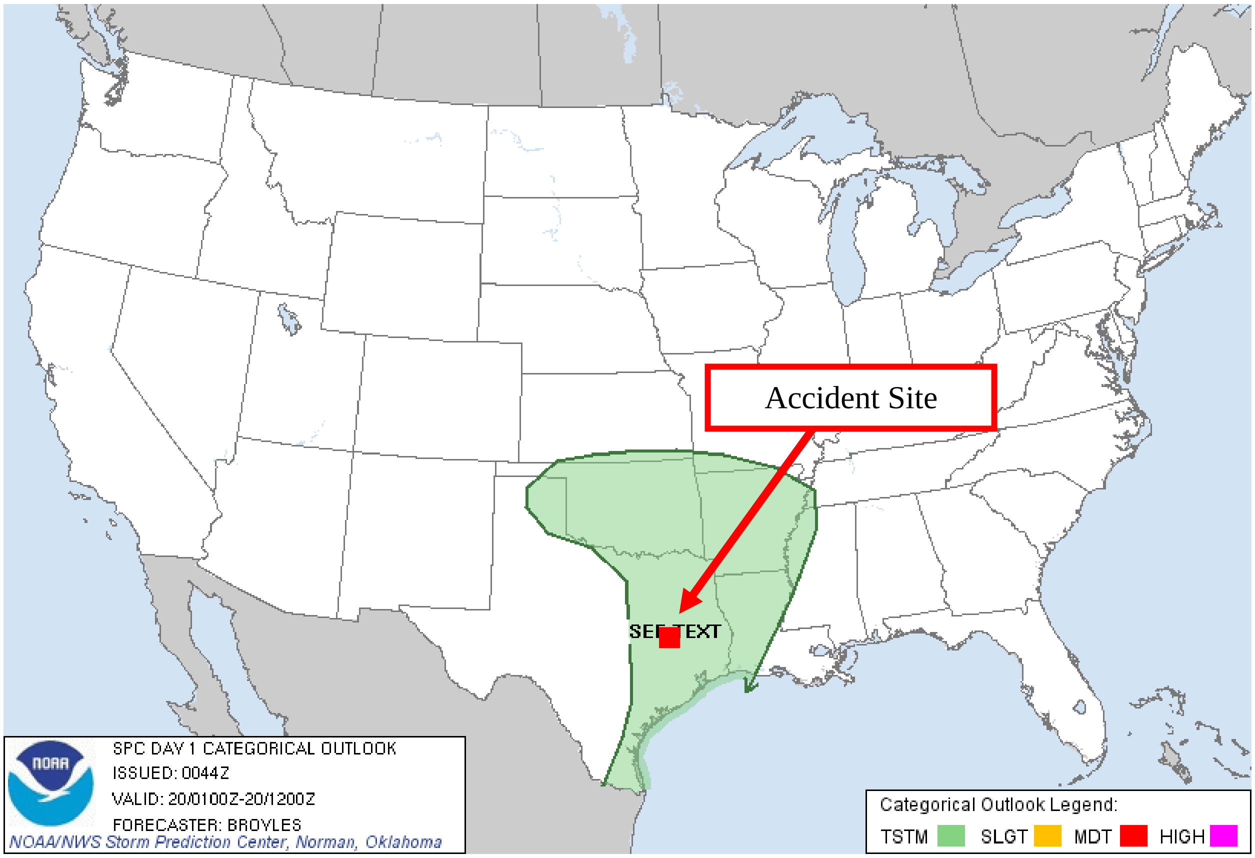

Figure 41 – Storm Prediction Center convective outlook valid at the time of the accident

13.0 Astronomical Data

The astronomical data obtained from the United States Naval Observatory for coordinates 30.95° N, 96.27° W on December 19, 2011, indicated the following for the accident location:

SUN	
Begin civil twilight	0651 CST
Sunrise	0718 CST
Sun transit	1222 CST
Sunset	1726 CST
End civil twilight	1753 CST

MOON

Moonset	1234 CST on the preceding day
Moonrise	0143 CST
Moon transit	0731 CST
Moonset	1313 CST
Moonrise	0250 CST on the following day

It was night at the time of the accident with the moon not yet risen.

Paul Suffern
NTSB Senior Meteorologist