



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

August 4, 2017

Weather Study

METEOROLOGY

CEN17FA100

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A. ACCIDENT

Location: Near Galveston, Texas
Date: February 6, 2017
Time: 1909 central standard time
0109 Coordinated Universal Time (UTC) on February 7, 2017
Airplane: Bell 206B-III, N978RH

B. METEOROLOGIST

Paul Suffern
Senior Meteorologist
Operational Factors Division (AS-30)
National Transportation Safety Board

C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's (NTSB) Meteorologist did not travel for this investigation and gathered the weather data for this investigation from the NTSB's Washington D.C. office and from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the National Centers for Environmental Information (NCEI). All times are central standard time (CST) on February 6, 2017, and are based upon the 24-hour clock, where local time is -6 hours from UTC, and UTC=Z (unless otherwise noted). Directions are referenced to true north and distances in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles.

The accident site was located at latitude 29.2397° N, longitude 94.9906° W, at sea level.

D. WEATHER INFORMATION

1.0 Synoptic Situation

The synoptic or large scale migratory weather systems influencing the area were documented using standard NWS charts issued by the National Center for Environmental Prediction and the Weather Prediction Center, located in College Park, Maryland. These are the base products used in describing synoptic weather features and in the creation of forecasts and warnings for the NWS. Reference to these charts can be found in the joint NWS and Federal Aviation Administration Advisory Circular "Aviation Weather Services", AC 00-45H.

1.1 Surface Analysis Chart

The NWS Surface Analysis Chart for 1800 CST is provided as figure 1 with the approximate location of the accident site marked by the red circle. The chart depicted no frontal boundaries or surface low or high pressure centers in the area of the accident site at the accident time. The station models around the accident site depicted air temperatures in the upper 60's to low 70's degrees Fahrenheit (°F), with temperature-dew point spreads of 2° F or less, a southeast wind of 10 to 15 knots, cloudy skies, and fog. Many of the surface observation points in the northwestern Gulf of Mexico reported fog and with the surface wind from the southeast, the fog and low clouds were likely to move onshore with time with no other frontal or surface low or high pressure features to influence the local weather pattern.

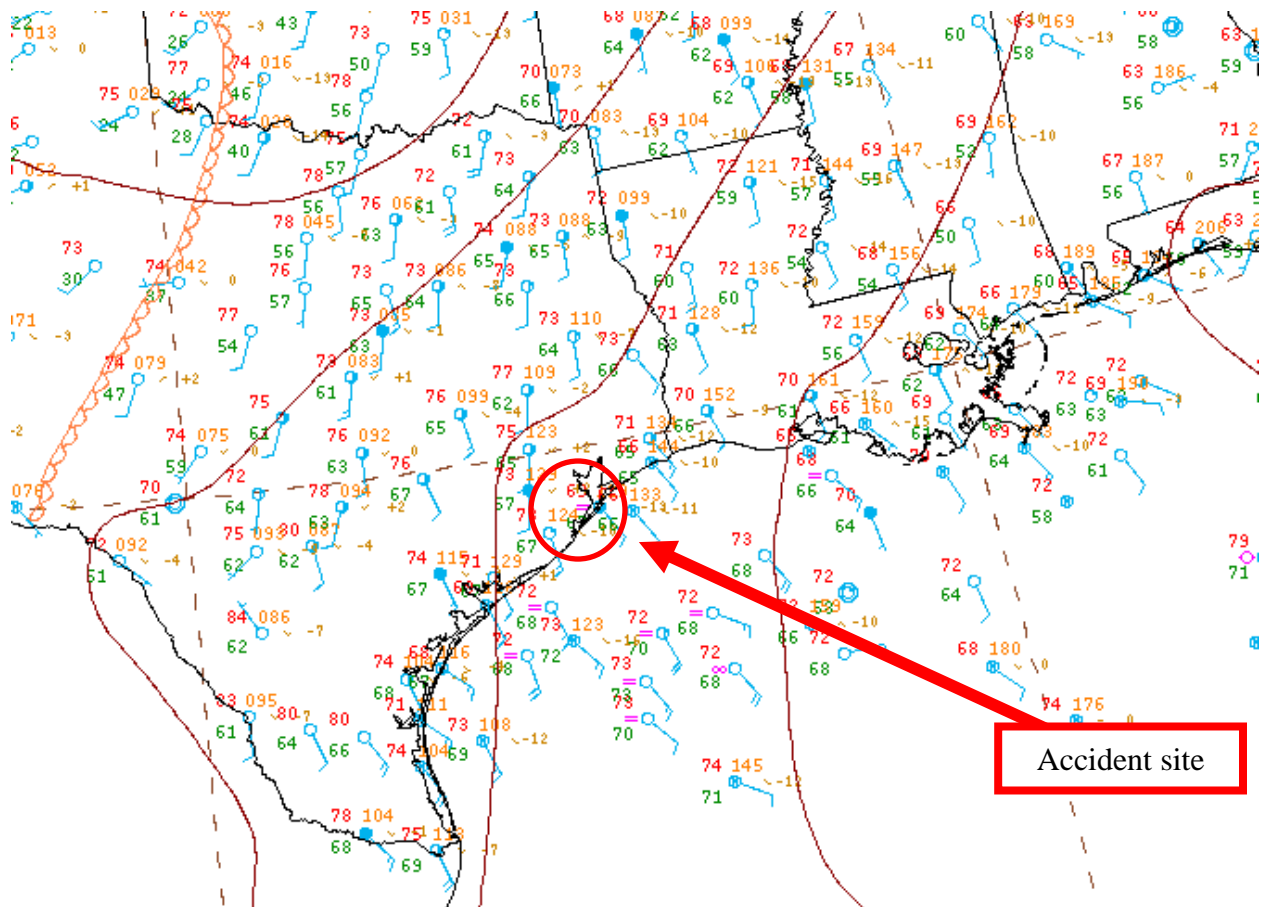


Figure 1 – NWS Surface Analysis Chart for 1800 CST

1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 1800 CST at 925-, 850-, 700-, 500-, and 300-hectopascals (hPa) are presented in figures 2 through 6. The 850-hPa chart depicted a low-level trough¹ in western Texas (figure 3) and the 700-hPa chart depicted a mid-level trough in western Texas (figure 4). Troughs typically act as lifting mechanisms where enhanced lift, gusty winds, fronts, clouds, and precipitation can occur, however the troughs mentioned above were too far away from the accident site to directly influence the weather conditions. The main influence on the weather conditions in the area of the accident site was the southeasterly surface wind and the fog and low clouds in the northwestern Gulf of Mexico moving onshore (section 1.1). There was a southerly wind of about 25 knots at 925-hPa (figure 2) with the wind becoming southwesterly by 700-hPa (figure 4). The 25-knot southwesterly wind at 700-hPa became a 40-knot west-southwest wind by 300-hPa (figure 6).

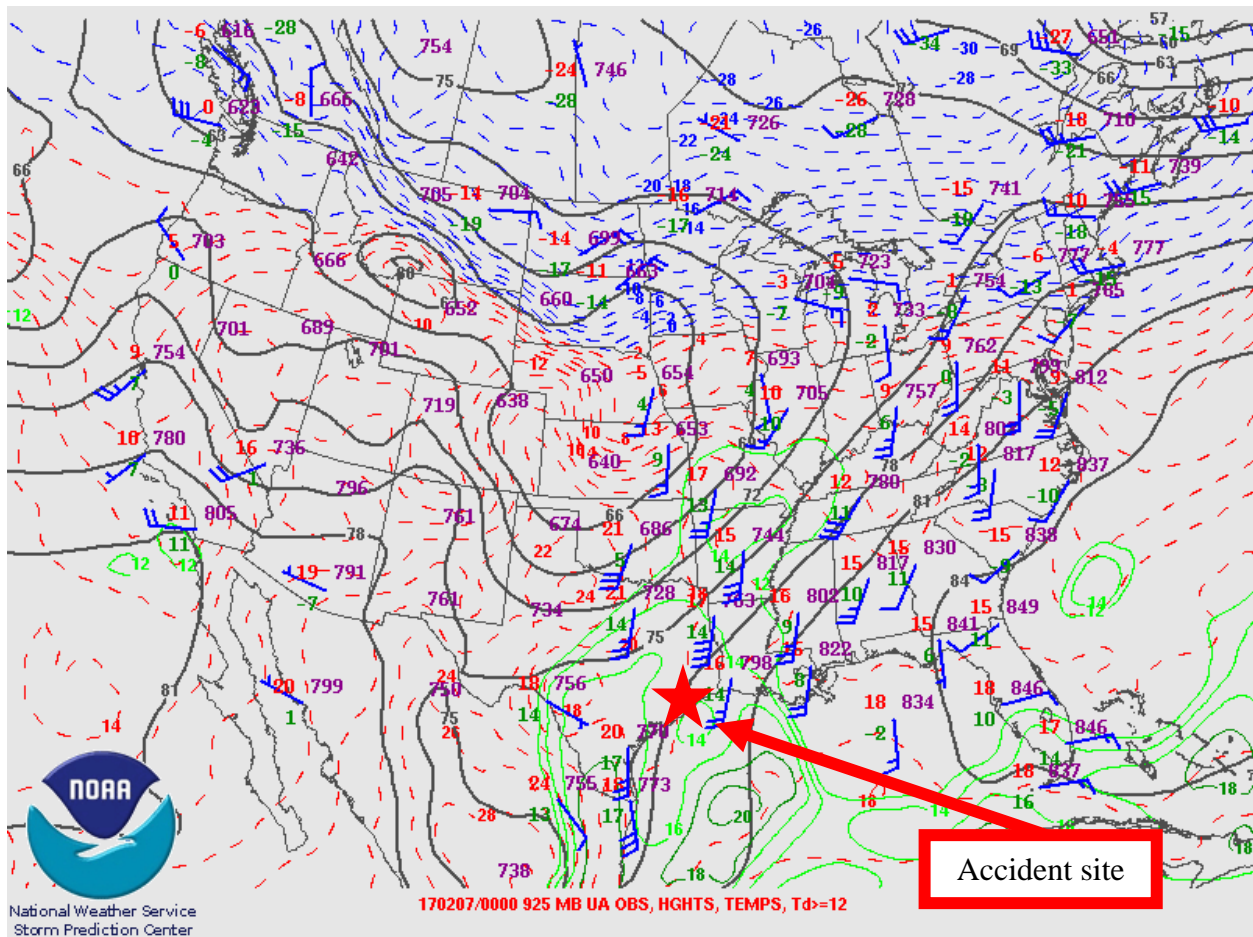


Figure 2 – 925-hPa Constant Pressure Chart for 1800 CST

¹ Trough – An elongated area of relatively low atmospheric pressure or heights.

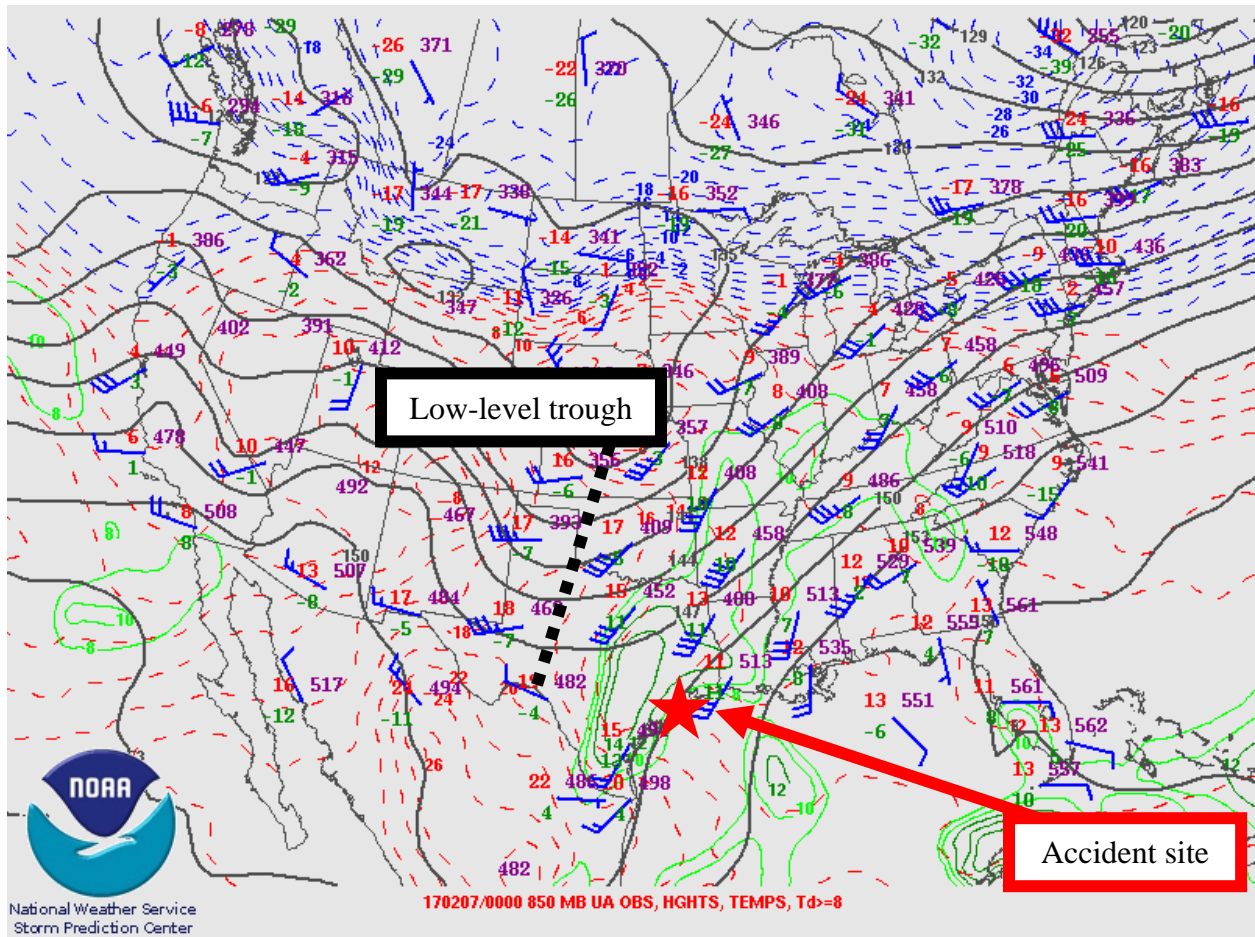


Figure 3 – 850-hPa Constant Pressure Chart for 1800 CST

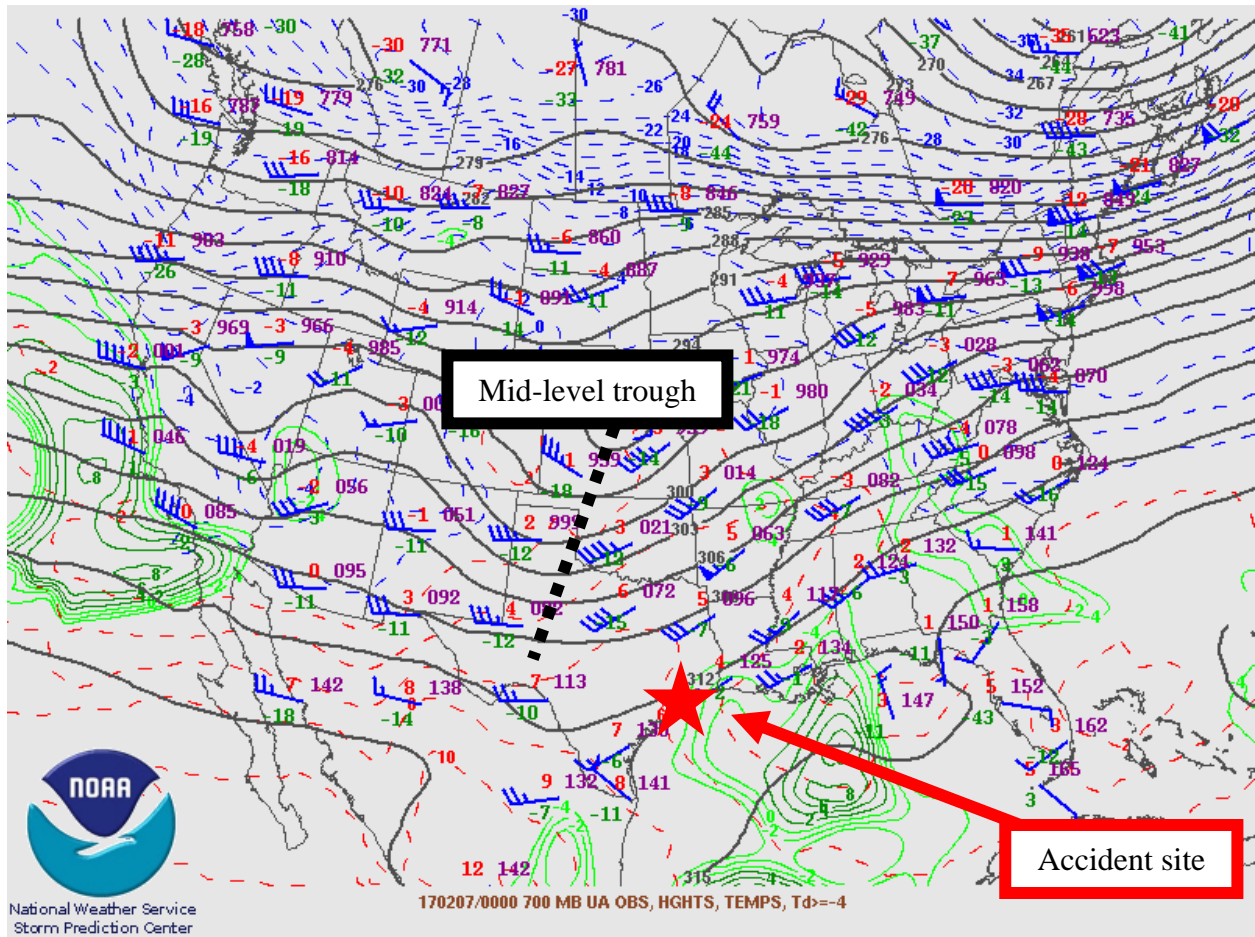


Figure 4 – 700-hPa Constant Pressure Chart for 1800 CST

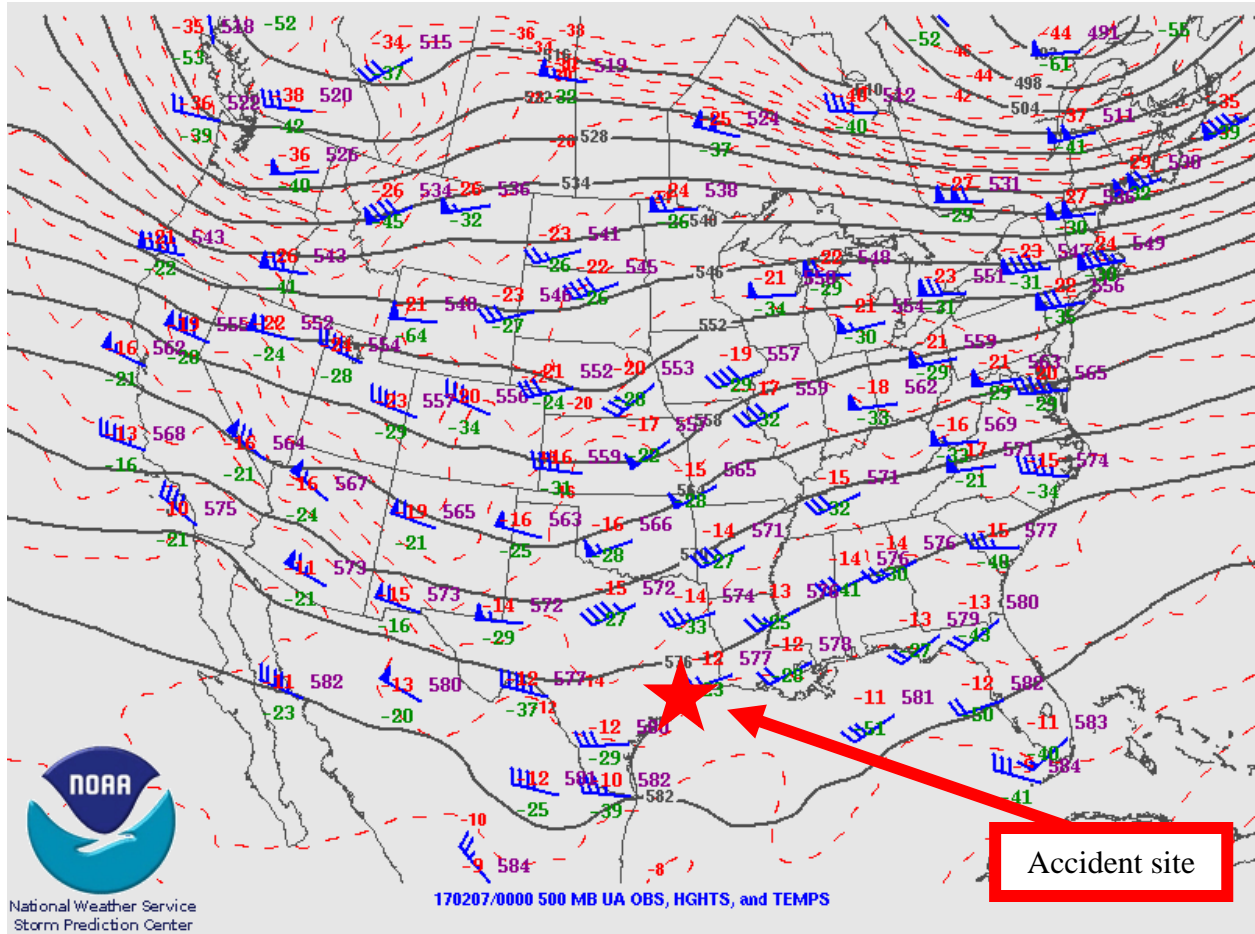


Figure 5 – 500-hPa Constant Pressure Chart for 1800 CST

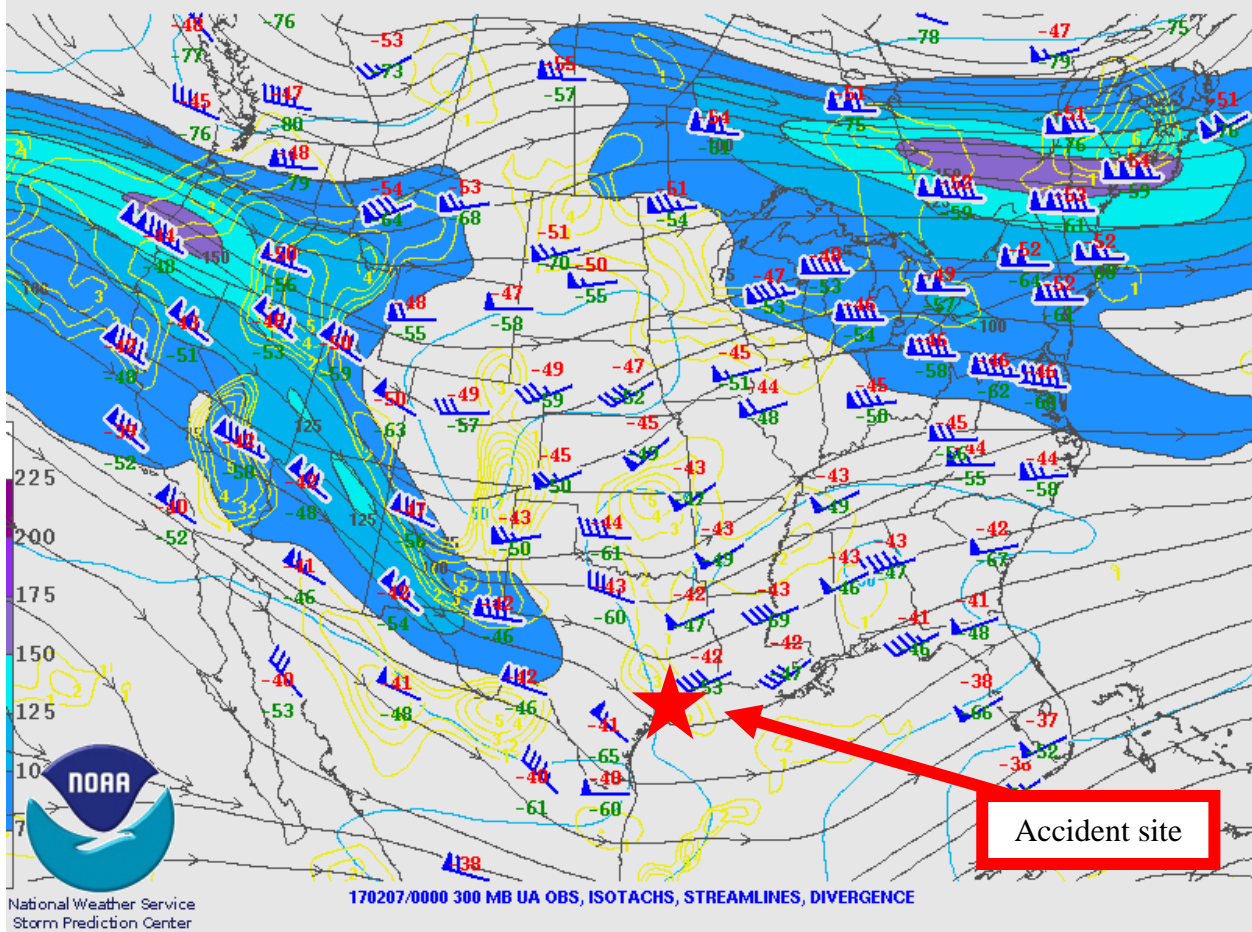


Figure 6 – 300-hPa Constant Pressure Chart for 1800 CST

2.0 Storm Prediction Center Products

The NWS SPC did not forecast any thunderstorms for the accident site at the accident time.

3.0 Surface Observations

The area surrounding the accident site was documented using official NWS Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). Figure 7 is a sectional map of the region with the accident site and the closest weather reporting location marked.

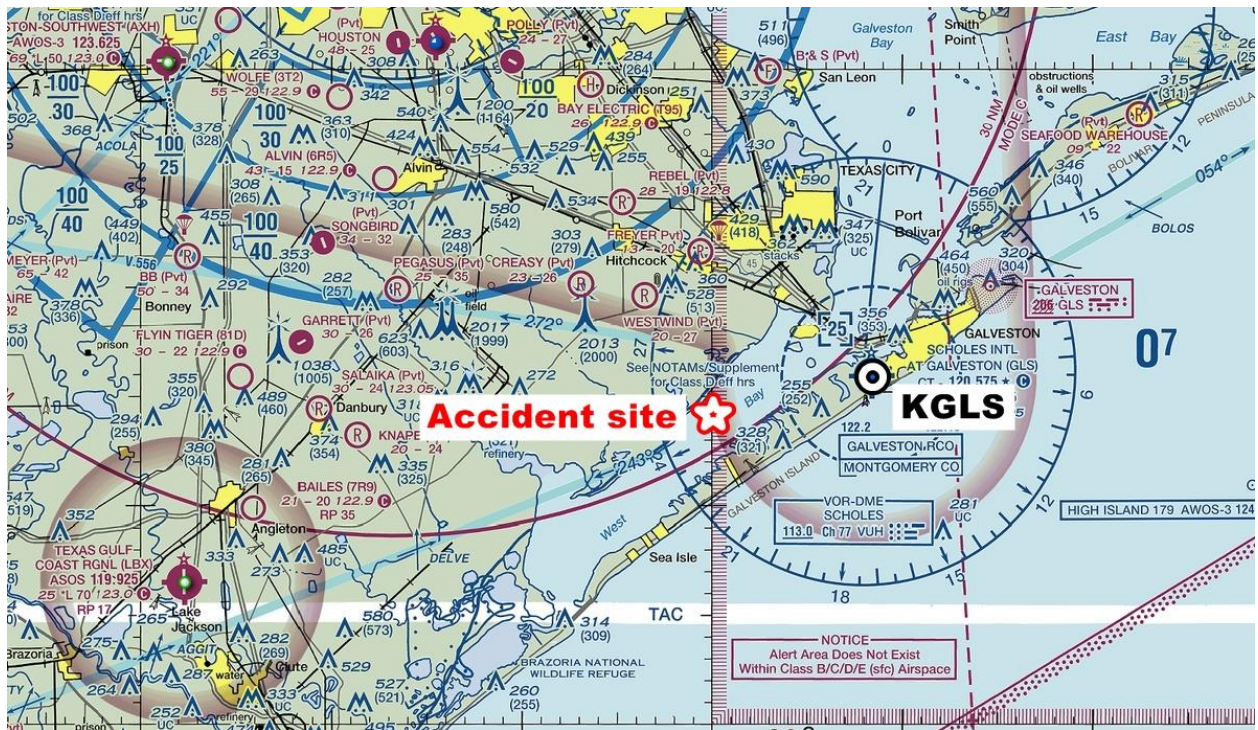


Figure 7 – Sectional Chart with the location of the accident site and surface observation site

Scholes International Airport (KGLS) was the closest airport with official weather observations and was located 3 miles southwest of Galveston, Texas. KGLS had an Automated Surface Observing System (ASOS²) whose reports were supplemented by air traffic control (ATC), during hours of local ATC operation. KGLS was located 7 miles east-northeast of the accident site, at an elevation of 6 feet (ft), and had a 2° easterly magnetic variation³ (figure 7). The following observations were taken and disseminated during the times surrounding the accident:⁴

- [1352 CST] METAR KGLS 061952Z 16017KT 10SM CLR 23/19 A2998 RMK AO2 SLP151 T02280194=
- [1452 CST] METAR KGLS 062052Z 16014KT 10SM CLR 23/19 A2995 RMK AO2 SLP143 T02280194 56034=
- [1552 CST] METAR KGLS 062152Z 16014KT 9SM BKN037 22/20 A2994 RMK AO2 SLP139 T02220200=

² ASOS – Automated Surface Observing System is equipped with meteorological instruments to observe and report wind, visibility, ceiling, temperature, dewpoint, altimeter, and barometric pressure.
³ Magnetic variation – The angle (at a particular location) between magnetic north and true north. 2015, latest measurement taken from <http://www.airnav.com/airport/KGLS>
⁴ Bolded sections in this report highlight information that directly reference the weather conditions that affected the accident location around the accident time.

[1652 CST] METAR KGLS 062252Z 15014KT 8SM CLR 21/19 A2994 RMK AO2 SLP137 T02110194=

[1734 CST] SPECI KGLS 062334Z 15014KT 6SM BR FEW004 SCT014 21/19 A2992 RMK AO2 T02060194=

[1752 CST] METAR KGLS 062352Z 15013KT 5SM BR SCT003 BKN014 21/19 A2991 RMK AO2 SLP129 T02060194 10239 20206 58013=

[1759 CST] SPECI KGLS 062359Z AUTO 14014KT 5SM BR BKN003 OVC014 21/19 A2991 RMK AO2 T02060194=

[1852 CST] METAR KGLS 070052Z AUTO 16009KT 5SM BR OVC004 20/19 A2995 RMK AO2 PRESRR SLP140 T02000194=

ACCIDENT TIME 1909 CST

[1947 CST] SPECI KGLS 070147Z AUTO 14014KT 2 1/2SM BR OVC003 20/19 A2991 RMK AO2=

[1952 CST] METAR KGLS 070152Z AUTO 14013KT 2SM BR OVC002 20/19 A2991 RMK AO2 SLP128 T02000194=

[2000 CST] SPECI KGLS 070200Z AUTO 15012KT 1 1/4SM BR OVC002 20/20 A2991 RMK AO2 T02000200=

[2033 CST] SPECI KGLS 070233Z AUTO 16011KT 2 1/2SM BR OVC002 20/19 A2994 RMK AO2 T02000194=

KGLS weather at 1759 CST, automated, wind from 140° at 14 knots, 5 miles visibility, mist, broken ceiling 300 ft above ground level (agl), overcast skies at 1,400 ft agl, temperature of 21° Celsius (C), dew point temperature of 19° C, and an altimeter setting of 29.91 inches of mercury. Remarks: automated station with a precipitation discriminator, temperature of 20.6° C, dew point temperature of 19.4° C.

KGLS weather at 1852 CST, automated, wind from 160° at 9 knots, 5 miles visibility, mist, an overcast ceiling at 400 ft agl, temperature of 20° C, dew point temperature of 19° C, and altimeter setting of 29.95 inches of mercury. Remarks: automated station with a precipitation discriminator, pressure rising rapidly, sea level pressure 1014.0 hPa, temperature 20.0° C, dew point temperature 19.4° C.

KGLS weather at 1947 CST, automated, wind from 140° at 14 knots, 2 and a half miles visibility, mist, an overcast ceiling at 300 ft agl, temperature of 20° C, dew point temperature of 19° C, and altimeter setting of 29.91 inches of mercury. Remarks: automated station with a precipitation discriminator.

KGLS weather at 1952 CST, automated, wind from 140° at 13 knots, 2 miles visibility, mist, an overcast ceiling at 200 ft agl, temperature of 20° C, dew point temperature of 19° C, and altimeter setting of 29.91 inches of mercury. Remarks: automated station with a precipitation discriminator, sea level pressure 1012.8 hPa, temperature 20.0° C, dew point temperature 19.4° C.

The observations from KGLS surrounding the accident time indicated LIFR⁵ conditions due to ceilings, with restrictions to the visibility due to mist. Restrictions to visibility began as early as 1552 CST with decreased ceiling conditions by 1752 CST, and LIFR conditions by 1759 CST.

4.0 Upper Air Data

A High-Resolution Rapid Refresh (HRRR)⁶ model sounding was created for the accident site for 1900 CST. The 1900 CST sounding was plotted on a standard Skew-T log P diagram⁷ with the derived stability parameters included in figure 8 (with data from the surface to 700-hPa, or 10,000 ft msl.) This sounding data was analyzed utilizing the RAOB⁸ software package. The sounding depicted the lifted condensation level (LCL)⁹ at 84 ft, a convective condensation level (CCL)¹⁰ of 1,626 ft, and a level of free convection (LFC)¹¹ at 8,673 ft. The freezing level was located at 10,322 ft. The precipitable water value was 0.97 inches.

⁵ Low Instrument Flight Rules (LIFR) – Refers to the general weather conditions pilots can expect at the surface. LIFR criteria means a ceiling below 500 ft agl and/or less than 1 miles visibility.

⁶ 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.

⁷ 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.

⁸ RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamoras, Pennsylvania.

⁹ Lifting Condensation Level (LCL) - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

¹⁰ 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.

¹¹ 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.

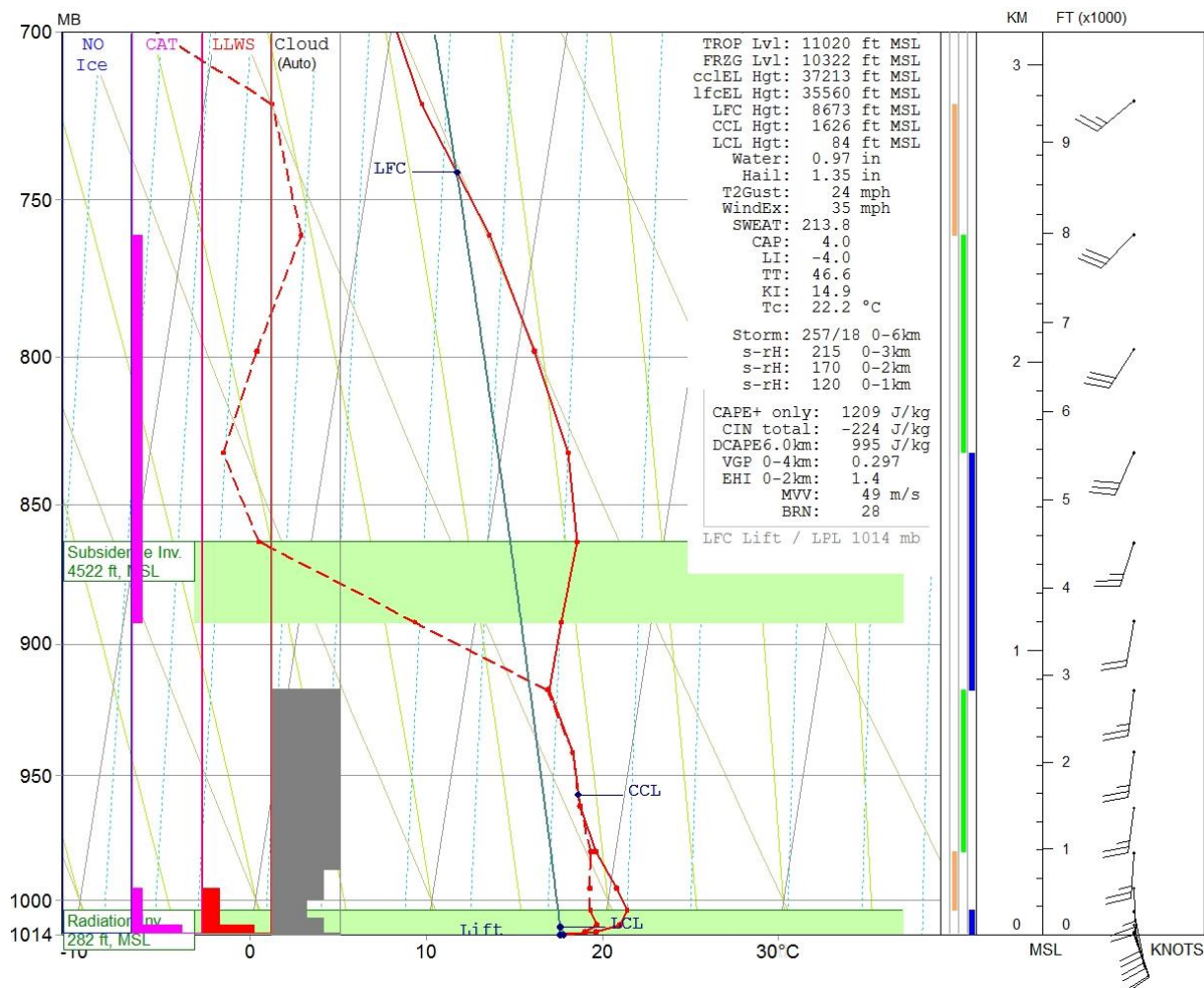


Figure 8 – 1900 CST HRRR sounding for the accident site

The 1900 CST HRRR sounding indicated a stable layer between the surface and 300 ft msl with an unstable and conditionally unstable layer between 300 and 3,000 ft. The HRRR sounding identified two inversions; the first inversion¹² was at 282 ft and the second inversion was at 4,522 ft. These inversions would have helped the fog and low clouds remain in place with time. RAOB identified the possibility of clouds from the surface through 3,000 ft. No areas of icing were indicated by RAOB for below 10,000 ft.

The 1900 CST HRRR sounding wind profile indicated a surface wind from 162° at 9 knots with the wind increasing to 19 knots by 100 ft and increasing to 25 knots by 500 ft. The southerly wind present from the surface to 5,000 ft became southwesterly by 10,000 ft. Between 500 ft and 10,000 ft the wind remained between 20 to 30 knots. The possibility of light low-level wind shear was indicated by RAOB between the surface and 500 ft. Two layers of possible clear-air turbulence were identified between the surface and 10,000 ft.

¹² Inversion – Warming of temperature with height.

5.0 Satellite Data

Visible and infrared data from the Geostationary Operational Environmental Satellite number 13 (GOES-13) data was obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison in Madison, Wisconsin, and processed using the NTSB's Man-computer Interactive Data Access System software. Visible and infrared imagery (GOES-13 band 1 and 4) at wavelengths of 0.65 microns (μm) and 10.7 μm , respectively, were retrieved for the period. Satellite imagery surrounding the time of the accident, from 1700 CST through 2100 CST at approximately 15-minute intervals were reviewed, and the closest images to the time of the accident are documented here.

Figures 9 and 10 present the GOES-13 infrared imagery from 1907 and 1915 CST at 4X magnification with the accident site highlighted with a red square. The infrared imagery indicated cooler brightness temperatures and higher cloud tops (green and blue colors) located over western Texas with a few mid-level clouds (yellow colors) near the accident site moving eastward. Based on the brightness temperatures above the accident site and the vertical temperature profile provided by the 1900 CST HRRR sounding, the approximate cloud-top heights over the accident site were 3,000 ft at 1907 CST. It should be noted these figures have not been corrected for any parallax error.

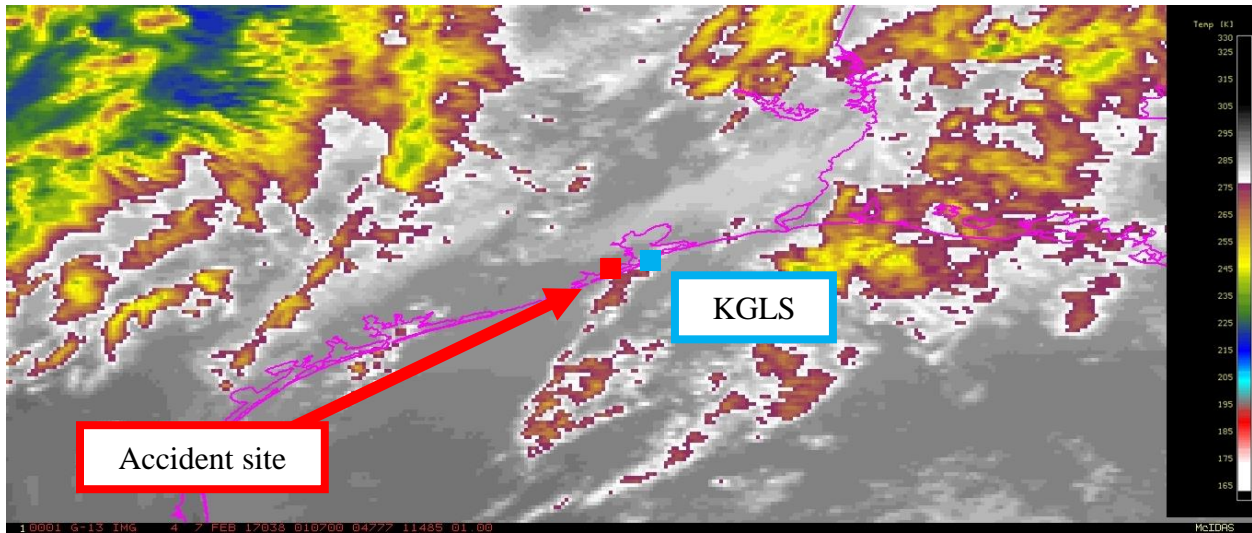


Figure 9 – GOES-13 infrared image at 1907 CST

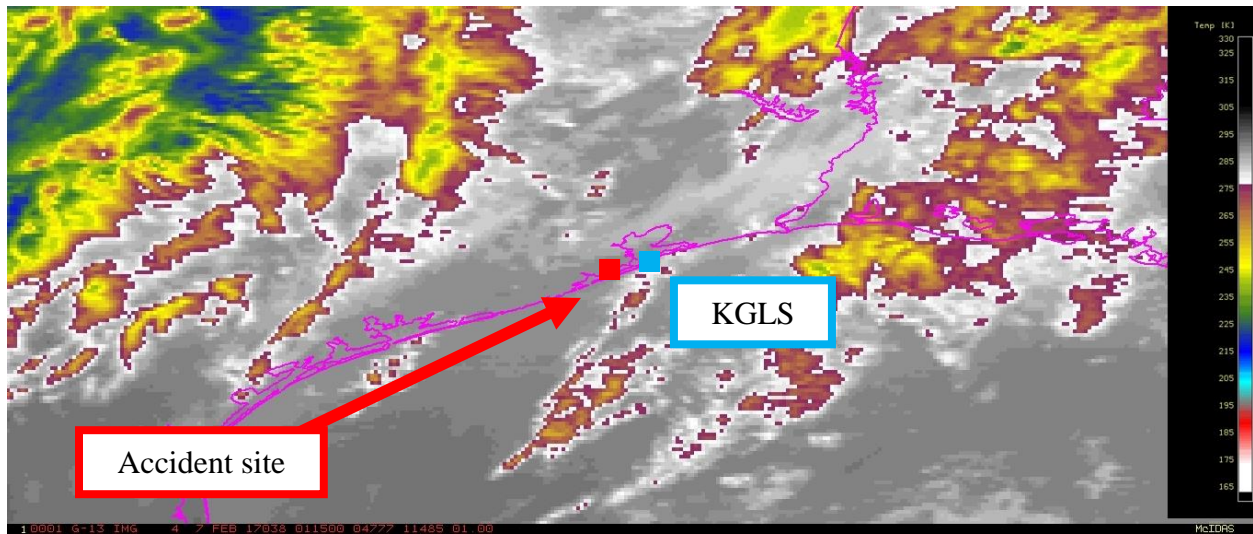


Figure 10 – GOES-13 infrared image at 1915 CST

6.0 Radar Imagery Information

The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D)¹³ to the accident site was the Houston, Texas, radar (KHGX), which was located 14 miles north of the accident site at an elevation of 16 ft. Level II and III archive radar data were obtained from the NCEI utilizing the NEXRAD Data Inventory Search and displayed using the NOAA’s Weather and Climate Toolkit software. No precipitation targets were located near the accident site at the accident time.

7.0 Pilot Reports¹⁴

All pilot reports (PIREPs) within 200 miles of the accident site from about two hours prior to the accident time to about two hours after the accident time for below FL180¹⁵ are provided below:

CXO UA /OV IAH360005/TM 2320/FL060/TP B737/SK BASES 021 TOPS 057/RM BASES RAGGED

HOU UA /OV HOU225020/TM 2332/FL035/TP PA46/SK BASES 020 TOPS .35/RM CLEAR ABOVE

IAH UA /OV 40 W IAH/TM 0010/FL060/TP B350/SK BASES 045 TOPS 055

EFD UA /OV EFD135003/TM 0040/FL2000/TP H25B/SK BASES BKN012

IAH UA /OV IAH090008/TM 0121/FL030/TP E175/SK BASES 015 TOPS 030

KIAH UA /OV 3NM EAST IAH/TM 0147/FL020/TP E145/SK SCT020

¹³ The WSR-88D is an S-band 10-centimeter wavelength radar with a power output of 750,000 watts, and with a 28-foot parabolic antenna that concentrates the energy between a 0.87° and 0.96° beam width. The radar produces three basic types of products: base reflectivity, base radial velocity, and base spectral width.

¹⁴ Only pilot reports with the WMO header UBTX** identifier were considered.

¹⁵ Flight Level – A Flight Level (FL) is a standard nominal altitude of an aircraft, in hundreds of ft. This altitude is calculated from the International standard pressure datum of 1013.25 hPa (29.92 inHg), the average sea-level pressure, and therefore is not necessarily the same as the aircraft’s true altitude either above mean sea level or above ground level.

HOU UA /OV HOU225004/TM 0200/FL040/TP B737/SK BKN LAYERS BASE 010 TOP 023 BASE 031 TOP 040

IAH UA /OV IAH360005/TM 0222/FL050/TP B737/SK TOP048

KIAH UA /OV 10NM N IAH/TM 0224/FL050/TP E145/SK SCT014 TOPS 048

Routine pilot report (UA); 5 miles from Houston, Texas, on the 360° radial; Time – 1720 CST (2320Z); Altitude – 6,000 ft; Type aircraft – Boeing B737-700; Sky – Bases at 2,100 ft with tops at 5,700 ft; Remarks – Bases ragged.

Routine pilot report (UA); 20 miles from Houston, Texas, on the 225° radial; Time – 1732 CST (2332Z); Altitude – 3,500 ft; Type aircraft – Piper PA-46; Sky – Bases at 2,000 ft with tops at 3,500 ft; Remarks – Clear above.

Routine pilot report (UA); 40 miles west of Houston, Texas; Time – 1810 CST (0010Z); Altitude – 6,000 ft; Type aircraft – Beechcraft Super King Air 350; Sky – Bases at 4,500 ft with tops at 5,500 ft.

Routine pilot report (UA); 3 miles from Houston, Texas, on the 135° radial; Time – 1840 CST (0040Z); Altitude – 2,000 ft; Type aircraft – Hawker 800; Sky – Bases broken at 1,200 ft.

Routine pilot report (UA); 8 miles from Houston, Texas, on the 090° radial; Time – 1921 CST (0121Z); Altitude – 3,000 ft; Type aircraft – Embraer E175; Sky – Bases at 1,500 ft with tops at 3,000 ft.

Routine pilot report (UA); 3 miles east of Houston, Texas; Time – 1947 CST (0147Z); Altitude – 2,000 ft; Type aircraft – Embraer E145; Sky – Scattered at 2,000 ft.

Routine pilot report (UA); 4 miles from Houston, Texas, on the 225° radial; Time – 2000 CST (0200Z); Altitude – 4,000 ft; Type aircraft – Boeing B737-700; Sky – Broken layer base at 1,000 ft with tops at 2,300 ft and another cloud layer base at 3,100 ft with tops at 4,000 ft.

Routine pilot report (UA); 5 miles from Houston, Texas, on the 360° radial; Time – 2022 CST (0222Z); Altitude – 5,000 ft; Type aircraft – Boeing B737-700; Sky – Tops at 4,800 ft.

Routine pilot report (UA); 10 miles north of Houston, Texas; Time – 2024 CST (0224Z); Altitude – 5,000 ft; Type aircraft – Embraer E145; Sky – Scattered clouds at 1,400 ft with tops at 4,800 ft.

8.0 SIGMET and CWSU Advisories

There were no Significant Meteorological Information (SIGMET) advisories valid for the accident site at the accident time for below FL180.

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

9.0 AIRMETS

Airmen's Meteorological Information (AIRMET) advisory Sierra was issued at 1445 CST (well before the accident flight's departure time) and valid at the accident time for the accident site (figures 11 through 14). AIRMET Sierra forecast instrument flight rules (IFR) conditions due to mist and the IFR conditions were forecast to develop between 1500 and 1800 CST:

108

WAUS44 KPCI 062045

WA4S

-DFWS WA 062045

AIRMET SIERRA UPDT 4 FOR IFR AND MTN OBSCN VALID UNTIL 070300

.
AIRMET IFR...TX LA

FROM 40WNW AEX TO 60SSW LSU TO 30WSW LCH TO 30ESE CRP TO 20NNW BRO TO 20ENE SAT TO LFK TO 40WNW AEX

CIG BLW 010/VIS BLW 3SM BR. CONDS DVLPG 21-00Z. CONDS CONTG BYD 03Z THRU 09Z.

.
AIRMET IFR...AR TN MS AL NE KS IA MO WI LM MI IL IN KY

FROM 30NW MKG TO FWA TO CVG TO 20NW HNN TO 20NNW HMV TO GQO TO 20SSW LGC TO 20WNW LIT TO 20WSW BUM TO 40SSE OVR TO 40WSW DLL TO 30NW MKG

CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 03Z THRU 09Z.

.
AIRMET MTN OBSCN...TN KY

FROM HNN TO HMV TO GQO TO LOZ TO HNN

MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 03Z THRU 09Z.

.
OTLK VALID 0300-0900Z

AREA 1...IFR TX AR LA MS AL

BOUNDED BY 20W SQS-20SSE LGC-50SW PZD-30WNW CEW-50SE SJI-20SW LEV-40SW LCH-30ESE CRP-20ESE BRO-30S LRD-30SW CWK-30S EIC-20W SQS
CIG BLW 010/VIS BLW 3SM BR. CONDS CONTG THRU 09Z.

.
AREA 2...IFR OK AR TN MS AL SD NE KS MN IA MO WI LM MI LH IL IN
KY

BOUNDED BY 30N ASP-50SSW YVV-30SE ECK-FWA-CVG-HNN-HMV-GQO-30SSE LGC-30NW TXK-40S UIN-20SW BUM-80S FSD-30NE MCW-30N ASP
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG THRU 09Z.

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Aviation Weather Overview

INFO

METARs

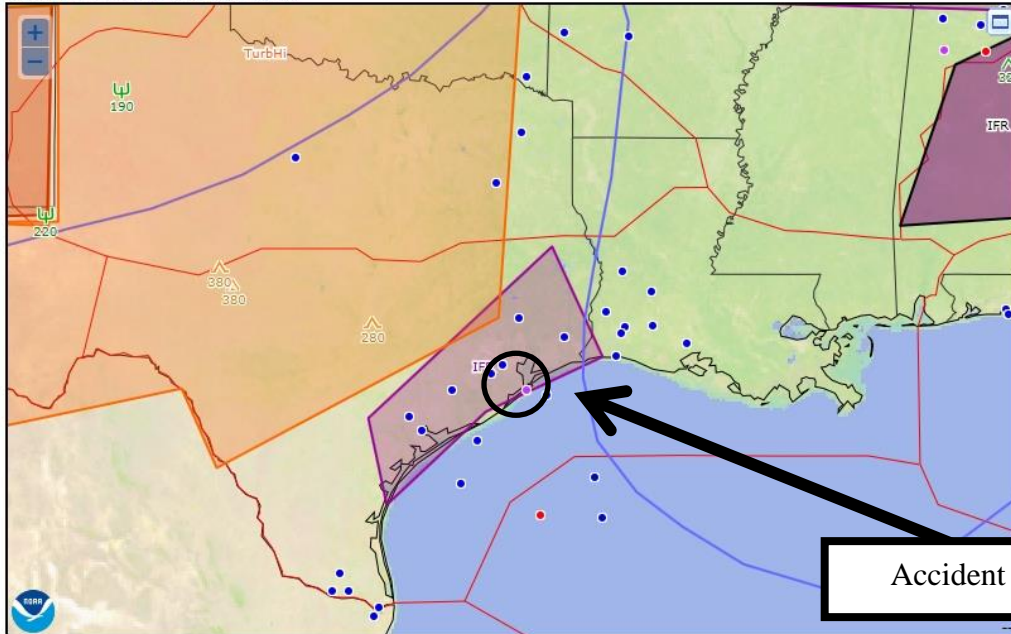
TAFs

AIR/PIREPs

SIGMETs

G-AIRMETs

Valid at 0000 UTC 7 Feb 2017



Sat VisFog Radar METAR FltCat SIGMET
 CWA Highways Jetroutes FIRs
 G-AIRMET PIREP-Ice PIREP-Turb Hover

SIGMET CWA G-AIRMET TurbHI TurbLO Icing Steward Icing IFR IFR-LO

Flt Cat: ● MVFR ● IFR ● LIFR PIREP Turb: ▲ LGT ▲ MOD ▲ SEV PIREP Ice: ☁ LGT ☁ MOD ☁ SEV

Disclaimer: International SIGMET locations approximated. Please refer to SIGMET text for full details

Figure 12 – AWC SIGMET, CWA, and AIRMET graphic valid for 1800 CST



AVIATION WEATHER CENTER

NOAA NATIONAL WEATHER SERVICE

Local Forecast

Go

HOME ADVISORIES FORECASTS OBSERVATIONS TOOLS NEWS SEARCH ABOUT USER

Aviation Weather Overview

INFO

METARs

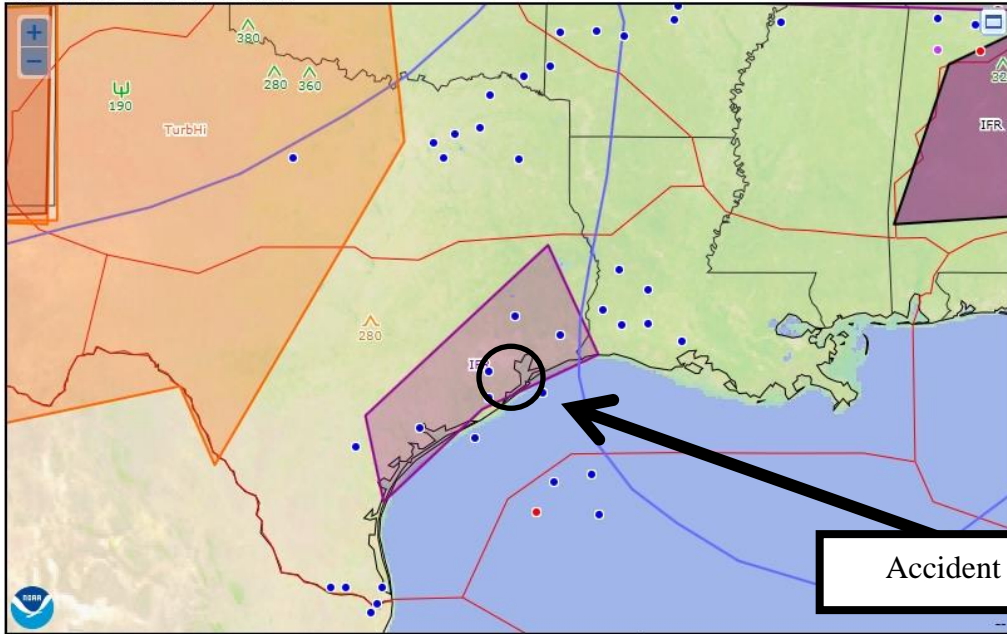
TAFs

AIR/PIREPs

SIGMETs

G-AIRMETS

Valid at 2300 UTC 6 Feb 2017



Sat VisFog Radar METAR FltCat SIGMET
 Highways Jetroutes FIRs
 CWA Hover
 G-AIRMET PIREP-Ice PIREP-Turb

SIGMET CWA G-AIRMET

Flt Cat: ● MVFR ● IFR ● LIFR PIREP Turb: ▲ LGT ▲ MOD ▲ SEV PIREP Ice: ☄ LGT ☄ MOD ☄ SEV

Disclaimer: International SIGMET locations approximated. Please refer to SIGMET text for full details

Figure 13 – AWC SIGMET, CWA, and AIRMET graphic valid for 1700 CST

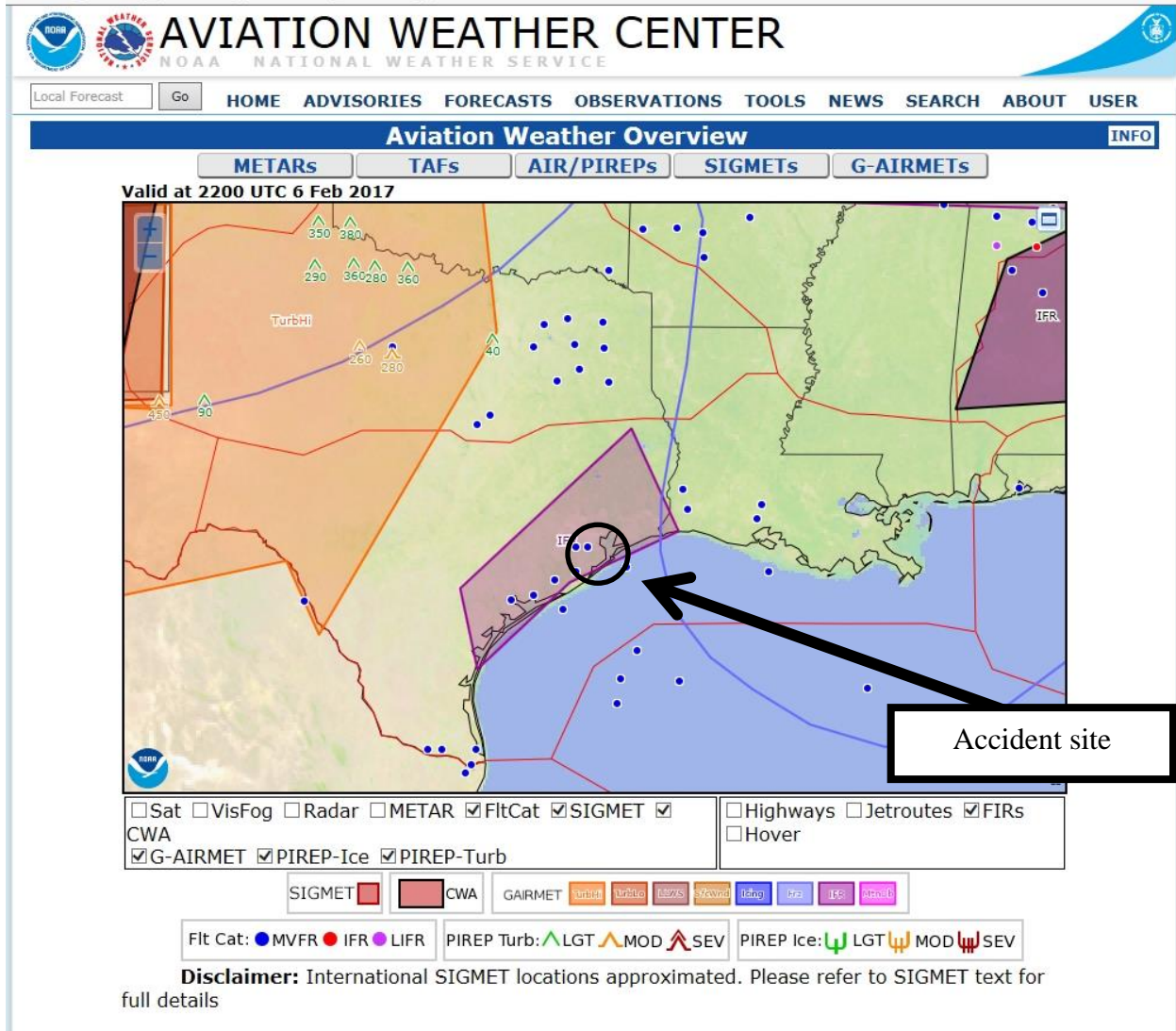


Figure 14 – AWC SIGMET, CWA, and AIRMET graphic valid for 1600 CST

10.0 Area Forecast

The Area Forecast issued at 1345 CST, valid at the accident time (and departure time), forecasted for the accident site a broken ceiling at 2,000 ft with tops at 5,000 ft. Between 1700 and 1900 CST the ceiling was forecast to drop to 1,000 ft msl overcast with visibilities between 3 and 5 miles in mist:

018
 FAUS44 KPCI 061945
 FA4W
 -DFWC FA 061945
 SYNOPSIS AND VFR CLDS/WX
 SYNOPSIS VALID UNTIL 071400
 CLDS/WX VALID UNTIL 070800...OTLK VALID 070800-071400
 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...LOW PRES SERN SD WITH WRMFNT SWRN MN-NRN IL-E CNTRL
IN. CDFNT FM LOW PRES TO SWRN SD. LOW PRES SWRN WITH WRMFNT EWD
TO SWRN MO. DRYLINE WRN OK TO SWRN TX. 06Z LOW PRES SERN NE WITH
QSTNRY FNT EWD TO EXTRM NRN IN...LTL CHG THRU PD. LOW PRES W
CNTRL MO WITH WRMFNT TO SERN MO. WK CDFNT SERN KS TO SWRN MO.
DRYLINE SERN OK TO SRN TX. 14Z CDFNT NERN MO-NERN OK-SWRN OK.
DRYLINE SERN OK TO SWRN TX.

.
OK
PNHDL-W...SCT CI. TIL 01Z WND SW G30KT. OTLK...VFR.
E...BKN030 TOP 060. 00Z SCT030 BKN CI. OTLK...VFR.

.
NWRN TX
PNHDL...SCT CI. WND W G30KT. OTLK...VFR TIL 10Z WND.
RMNDR...SCT CI. OTLK...VFR.

.
SWRN TX
MTNS WWD...SCT CI. TIL 01Z WND W G30KT. OTLK...VFR.
RMNDR...SCT CI. OTLK...VFR.

.
N CNTRL TX
W HLF...SCT CI. OTLK...VFR.
E HLF...SCT030 SCT CI. 03Z SCT CI. OTLK...VFR.

.
NERN TX
BKN025 TOP 070. 02Z OVC015. OTLK...IFR CIG.

.
SERN TX
BKN020 TOP 050. BECMG 2301 OVC010. VIS 3-5SM BR. OTLK...IFR CIG
BR.

.
S CNTRL TX
HILL COUNTRY...BKN030 TOP 060. 23Z SCT CI. BECMG 0305 BKN030.
OTLK...MVFR CIG.
CSTL PLAIN...BKN020 TOP 050. 23Z BKN-OVC010. VIS 3-5SM BR.
OTLK...IFR CIG BR.
RMNDR...
W HLF...SCT030. OTLK...VFR 09Z MVFR CIG 11Z IFR CIG.
E HLF...SCT040 BKN CI. BECMG 0305 OVC010 TOP 050. VIS 3-5SM BR.
OTLK...IFR CIG BR.

.
AR
NW...BKN030 TOP 060. OTLK...MVFR CIG 11Z SHRA TSRA.
NERN...BKN-OVC010 TOP 070. OTLK...IFR CIG 11Z SHRA TSRA.
S HLF...BKN030 TOP 070. OTLK...MVFR CIG 11Z SHRA TSRA.

.
LA
NRN...BKN025 TOP 050. 04Z OVC010. OTLK...IFR CIG 12Z SHRA TSRA.
SW...BKN015 TOP 050. 01Z OVC010. VIS 3-5SM BR. OTLK...IFR CIG BR.
SE...SCT130 BKN CI. OTLK...VFR BECMG 1214 MVFR CIG SHRA TSRA.

.
TN

W...OVC015 TOP 080. OTLK...IFR CIG 12Z SHRA TSRA.
MID...OVC020 TOP 090. OTLK...IFR CIG 14Z SHRA TSRA.
E...OVC040 TOP 120. TIL 01Z -RA. 04Z BKN050. OTLK...VFR.

.
MS

N HLF...SCT025. 00Z SCT CI. OTLK...VFR 11Z MVFR CIG SHRA TSRA.
S HLF...SCT CI. 06Z OVC010 TOP 040. OTLK...IFR CIG 14Z SHRA TSRA.

.
AL

N HLF...OVC010-015 TOP 100. OTLK...IFR CIG.
S HLF...SCT060 SCT CI. 07Z BKN015 BKN 100 TOP 160. OTLK...MVFR
CIG 09Z IFR CIG.

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11.0 Terminal Aerodrome Forecast

KGLS was the closest site to the accident site with a Terminal Aerodrome Forecast (TAF). The TAF valid at the time of the accident was issued at 1906 CST and was valid for a 23-hour period beginning at 1900 CST. The TAF for KGLS was as follows:

KGLS 070106Z 0701/0724 **15010KT 5SM BR OVC004**
FM070300 16010KT 1SM BR OVC003
FM071500 20010KT 4SM BR BKN008
FM072000 20012KT 6SM HZ SCT020=

The 1906 CST forecast expected a wind from 150° at 10 knots, 5 statute miles visibility, mist, and an overcast ceiling at 400 ft agl.

The KGLS TAF valid before the departure time was issued at 1726 CST and was valid for a 24-hour period beginning at 1800 CST. The 1726 CST TAF for KGLS was as follows:

TAF KGLS 062326Z 0700/0724 **15014KT 6SM HZ SCT010**
FM070200 16010KT 1SM BR OVC003
FM071500 20010KT 4SM BR BKN008
FM072000 20012KT 6SM HZ SCT020=

The 1726 CST forecast expected a wind from 150° at 14 knots, 6 statute miles visibility, haze, scattered clouds at 1,000 ft agl. The 1726 CST KGLS TAF did not forecast LIFR conditions until 2000 CST.

12.0 NWS Area Forecast Discussion

The NWS Office in Houston/Galveston, Texas, issued the following Area Forecast Discussion (AFD) at 1739 CST (closest AFD to the accident time). The aviation section of the AFD discussed that the lower cloud cover was not expected until the night time inversion developed. The weather forecaster on duty thought that the weather models were being too pessimistic with the LIFR ceilings and visibilities across the entire Houston, Texas, region. The sea fog threat for the northwestern Gulf of Mexico area was discussed in the marine section of the AFD:

691

FXUS64 KHGX 062339
AFDHGX

Area Forecast Discussion
National Weather Service Houston/Galveston TX
539 PM CST Mon Feb 6 2017

.AVIATION...

Surface analysis shows a decent pressure gradient over much of the area allowing for gusty southerly winds and VFR ceilings. The expectation is for VFR ceilings to continue for a couple more hours until the night time inversion begins to develop and the boundary layer saturates. Models again look to be way too pessimistic with LIFR ceilings and visibility. Since winds will remain above 5 kts for much of the night and a 30 kt LLJ, ceiling are more likely to remain IFR to MVFR for the area. IFR may develop 05-07Z tonight and continue through the morning with heights ranging from 700-1200ft. Tomorrow winds veer to the SW as a Pacific front approaches the area. There should be enough mixing to allow for ceilings to rise late morning and become VFR in the afternoon. There may be another set up for IFR again tomorrow night as shallow moisture continues in the boundary layer.

Overpeck

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.PREV DISCUSSION... /ISSUED 311 PM CST Mon Feb 6 2017/

DISCUSSION...

Another unseasonably warm day across SE TX with high temperatures at 80 degrees across much of the area. Sfc analysis shows high pressure over the northern Gulf and low pressure over the western high plains. The pressure gradient has tightened and south winds have increased to 15 to 20 mph and gusty. Winds are not expected to decouple overnight and clouds will hang around too so expecting another warm night with min temps only cooling into the upper 60s. A well defined short wave will approach SE TX later tonight and the region will lie in a LFQ of a 110 knot jet. PW values are around 1.30 inches so would expect some increase in shower activity overnight, especially over the eastern half of the CWA. The warm dew points moving over slightly cooler shelf waters will also be somewhat favorable for sea fog but warming Gulf waters coupled with a S-SW sfc wind making sea fog less of a threat.

The short wave will exit the region early Tuesday and any remaining showers will end by 15-16z. Forecast soundings show clouds eroding by 18z, quite a bit of mid level dry air and warming at 850 mb. Some of this dry air will mix to the surface and have lowered sfc dew pts a bit below the superblend. RH values will fall to near 30 percent over the north. Winds are not expected to be as strong as today but parts of the north will need to be monitored for elevated fire weather conditions. Warm 850 temps and dry air will translate into very warm sfc temperatures with highs warming into the lower and possibly mid 80s on Tuesday. 850 temps warm even more on Wednesday with even slightly warmer

temps possible on Wednesday. Records for Tue/Wed are below:

	TUE	WED
CLL	83/1999	82/1994
IAH	80/1957	82/1932
HOU	82/1950	83/1962
GLS	76/1904	76/1950

A weak cold front will cross the area Wednesday night with cooler temperatures on Thursday and Friday. Onshore winds return by Friday so the cool down will be brief as warmer temperatures return by next weekend. Upper level riding over the eastern Gulf will amplify into East Texas over the weekend as a deep upper low over NV drops south into AZ. Temps over the weekend will once again warm to near 80. A cold front will move into Texas Sunday night and stall somewhere over east Texas. Rain chances will start to increase as the upper low shifts east early next week. Some timing differences with the frontal passage between the GFS and the ECMWF but the latest consensus brings the front through next Tuesday. 43

MARINE...

Moderate onshore winds will persist the next couple of days. Slightly stronger winds are possible over the offshore waters, and caution flags might be needed at times. Sea fog development will also remain possible the next few days. With the passage of the next front, the fog threat will come to an end and winds will become northwest Wednesday night and then northeast on Thursday. Caution flags and/or advisories are possible in the wake of the front. South to southeast winds return to the area at the end of the week and persist over the weekend. Caution flags might be needed for increasing winds and building seas. 42

&&

.PRELIMINARY POINT TEMPS/POPS...

College Station (CLL)	66	84	61	84	51	/	20	10	0	0	0
Houston (IAH)	67	83	65	85	55	/	20	10	10	0	0
Galveston (GLS)	65	76	65	77	60	/	20	10	10	10	0

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.HGX WATCHES/WARNINGS/ADVISORIES...

TX...NONE.

GM...NONE.

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Discussion...40

Aviation/Marine...39

13.0 NWS Hazardous Weather Outlook

The NWS Office in Houston/Galveston, Texas, issued the following Hazardous Weather Outlook (HWO) at 0724 CST. The coastal section and marine waters of the HWO (including the accident site and Galveston, Texas) mentioned that areas of sea fog were expected to develop during the “today” and “tonight” time periods on the accident day reducing visibilities below one nautical mile at times:

503
FLUS44 KHGX 061324
HWOHGX

HAZARDOUS WEATHER OUTLOOK
NATIONAL WEATHER SERVICE HOUSTON/GALVESTON TX
724 AM CST MON FEB 6 2017

GMZ370-375-TXZ163-164-176>179-195>200-210>213-226-227-235-071330-
AUSTIN-BRAZOS-BURLESON-COLORADO-FORT BEND-GRIMES-HARRIS-HOUSTON-
JACKSON-LIBERTY-MADISON-MONTGOMERY-POLK-SAN JACINTO-TRINITY-
WALKER-WALLER-WASHINGTON-
WATERS FROM FREEPORT TO THE MATAGORDA SHIP CHANNEL FROM 20 TO
60 NM-WATERS FROM HIGH ISLAND TO FREEPORT FROM 20 TO 60 NM-
WHARTON-
724 AM CST MON FEB 6 2017

THIS HAZARDOUS WEATHER OUTLOOK IS FOR PORTIONS OF SOUTHEAST TEXAS..

.DAY ONE...TODAY AND TONIGHT

NO HAZARDOUS WEATHER IS EXPECTED AT THIS TIME.

.DAYS TWO THROUGH SEVEN...TUESDAY THROUGH SUNDAY

WE WILL BE MONITORING FIRE WEATHER CONDITIONS TUESDAY AND
WEDNESDAY, GENERALLY NORTH OF HIGHWAY 59, WHERE WARM TEMPERATURES
AND LOW HUMIDITIES ARE EXPECTED.

.SPOTTER INFORMATION STATEMENT...

SPOTTER ACTIVATION WILL NOT BE NEEDED.

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GMZ330-335-350-355-TXZ214-236>238-071330-
BRAZORIA-CHAMBERS-
COASTAL WATERS FROM FREEPORT TO THE MATAGORDA SHIP CHANNEL OUT
20 NM-COASTAL WATERS FROM HIGH ISLAND TO FREEPORT OUT 20 NM-
GALVESTON-GALVESTON BAY-MATAGORDA-MATAGORDA BAY-
724 AM CST MON FEB 6 2017

THIS HAZARDOUS WEATHER OUTLOOK IS FOR PORTIONS OF SOUTHEAST TEXAS..

.DAY ONE...TODAY AND TONIGHT

AREAS OF SEA FOG WILL REDUCE VISIBILITIES BELOW 1 MILE AT TIMES.

.DAYS TWO THROUGH SEVEN...TUESDAY THROUGH SUNDAY

AREAS OF SEA FOG WILL PERSIST THROUGH WEDNESDAY. A COLD FRONT WILL PUSH OFF THE COAST WEDNESDAY NIGHT. A SMALL CRAFT ADVISORY MAY BE REQUIRED IN ITS WAKE.

.SPOTTER INFORMATION STATEMENT...

SPOTTER ACTIVATION WILL NOT BE NEEDED.

14.0 Winds and Temperature Aloft Forecast

The NWS 1400 CST Winds and Temperature Aloft forecast valid for the accident flight are included below:

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334
FBUS31 KWNO 062000
FD1US1
- DATA BASED ON 061800Z
VALID 070000Z FOR USE 2000-0300Z. TEMPS NEG ABV 24000

FT 3000 6000 9000 12000 18000 24000 30000 34000 39000

HOU 1925 2130+14 2325+09 2414+01 2533-13 2544-27 254642 255052 255359
```

The closest forecast point was Houston, Texas, (HOU). The 1400 CST HOU forecast indicated a wind at 3,000 ft from 190° at 25 knots and a wind at 6,000 ft from 210° at 30 knots with a temperature of 14° C.

15.0 Pilot Weather Briefing and Information

A search of official weather briefing sources, such as Leidos and Direct User Access Terminal Service (DUATS), revealed that the accident pilot did not contact Leidos or DUATS. It is unknown if the accident pilot checked or received additional weather information before or during the accident flight.

16.0 Astronomical Data

The astronomical data obtained from the United States Naval Observatory for the accident site on February 6, 2017, indicated the following:

SUN	
Begin civil twilight	0641 CST
Sunrise	0706 CST
Sun transit	1234 CST
Sunset	1803 CST
End civil twilight	1827 CST

MOON

Moonset	0258 CST
Moonrise	1402 CST
Moon transit	2100 CST
Moonset	0400 CST on following day (February 7)

The phase of the Moon was Waxing Gibbous with 78% of the Moon's visible disk illuminated. The moonlight would have likely been visible above the cloud tops. Below 3,000 ft (sections 4.0 and 5.0) near the accident site at the accident time would have been instrument meteorological conditions with no moonlight visible.

Submitted by:

Paul Suffern
Senior Meteorologist

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