



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
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Weather Study

METEOROLOGY

CEN18FA358

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A. ACCIDENT

Location: Fort Walton Beach, Florida
Date: August 30, 2018
Time: About 1030 central daylight time
About 1530 Universal Coordinated Time (UTC)
Airplane: Beechcraft BE-60; Registration: N1876L

B. METEOROLOGIST

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C. SUMMARY

On August 30, 2018, about 1030 central daylight time, a Beechcraft BE-60 airplane, N1876L, impacted terrain during an approach to the Destin Executive Airport (KDTs), Destin, Florida, Texas. The commercial rated pilot and three passengers were fatally injured, and the airplane was destroyed. The airplane was registered to and operated by Henry Leasing Company, LLC, as a Title 14 *Code of Federal Regulations* Part 91 cross-country flight. The flight departed the Toledo Executive airport (KTOL) about 0747 en route to KDTs, and an instrument flight plan had been filed.

D. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's Senior Meteorologist was not on scene for this investigation and conducted the meteorology phase of the investigation from the Washington D.C. office, collecting data from official National Weather Service (NWS) sources including the Weather Prediction Center (WPC) and the National Center for Environmental Information (NCEI). All times are central daylight time (CDT) based upon the 24-hour clock, local time is -5 hours from UTC, and UTC=Z. NWS airport and station identifiers use the standard International Civil Aviation Organization 4-letter station identifiers versus the International Air Transport Association 3-letter identifiers, which deletes the initial country code designator "K" for U.S. airports. Directions are referenced to true north and distances in nautical miles. Heights are in feet (ft) above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles.

The accident site was located at latitude 30.494722° N and longitude 86.574444° W, at an elevation of approximately 100 ft.

E. WEATHER INFORMATION

1.0 Synoptic Conditions

The synoptic or large scale migratory weather systems influencing the area were documented using standard NWS charts issued by the National Center for Environmental Prediction (NCEP) located in College Park, Maryland. These are the base products used in describing weather features and in the creation of forecasts and warnings. Reference to these charts can be found in the joint NWS and Federal Aviation Administration (FAA) Advisory Circular “Aviation Weather Services”, AC 00-45H change 1.

1.1 Surface Analysis Chart

The eastern section of the NWS Surface Analysis Chart for 1000 CDT is included as figure 1 with the accident site located within the red circle. The chart depicted a low pressure system over southern Ohio at 1019-hectopascals (hPa) along a stationary front which stretched across West Virginia, extreme southern Ohio, Kentucky, and into Tennessee where another low-pressure system at 1019-hPa was located. The Azores-Bermuda high-pressure system was located off the North Carolina coast with a ridge of high pressure extending southwestward across northern Florida.

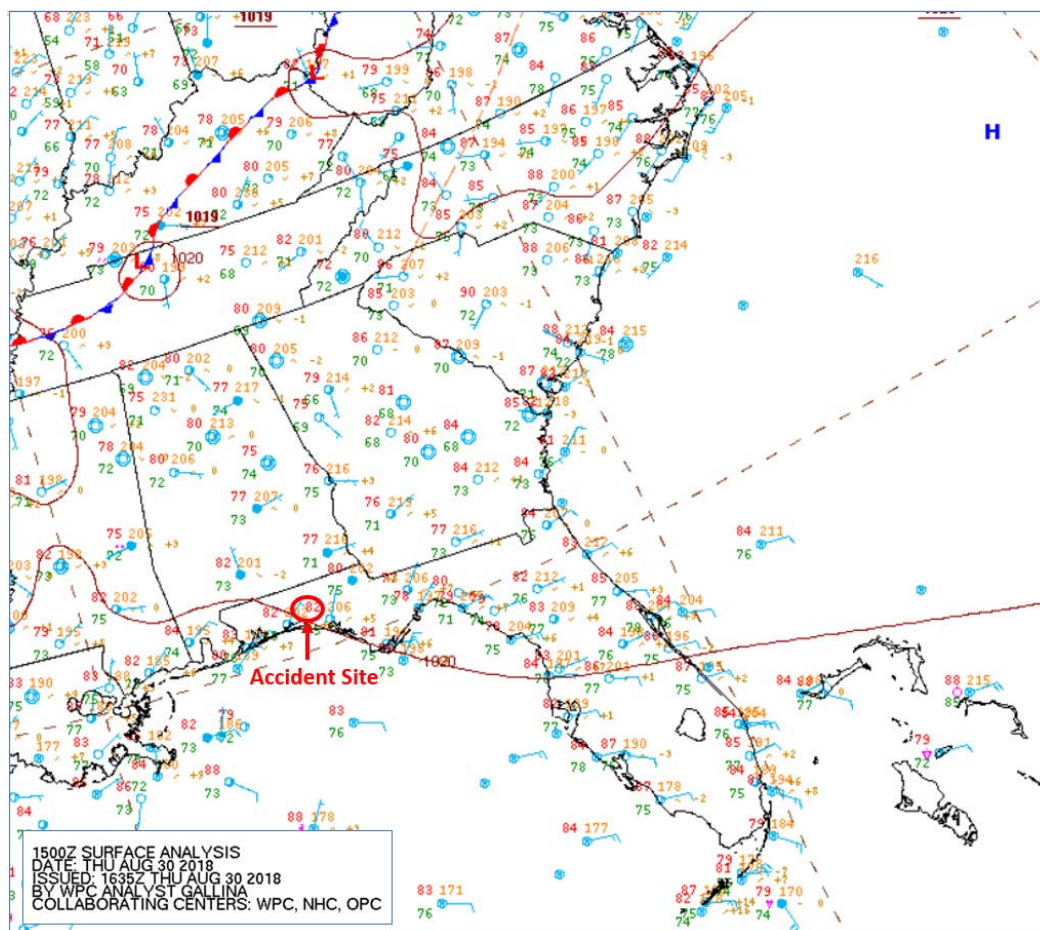


Figure 1 - Eastern section of the NWS Surface Analysis Chart for 1000 CDT

The chart depicted a weak pressure gradient across the Florida panhandle. The closest station model depicted a northeast wind of about 5 knots, scattered to broken cloud cover, with a temperature of 82° Fahrenheit (F), with a dew point temperature of 75° F.

1.2 National Composite Radar Mosaic

The southcentral display of the National Composite Radar Mosaic for 1030 CDT is included as figure 2 which depicted numerous heavy to extreme intensity echoes off the Louisiana, Mississippi, Alabama, and Florida Gulf Coast, with a few moderate to extreme cells over southern Alabama west of the flight route. A short band of echoes were also depicted reaching the coastal section from Pensacola eastward towards Destin, Florida.

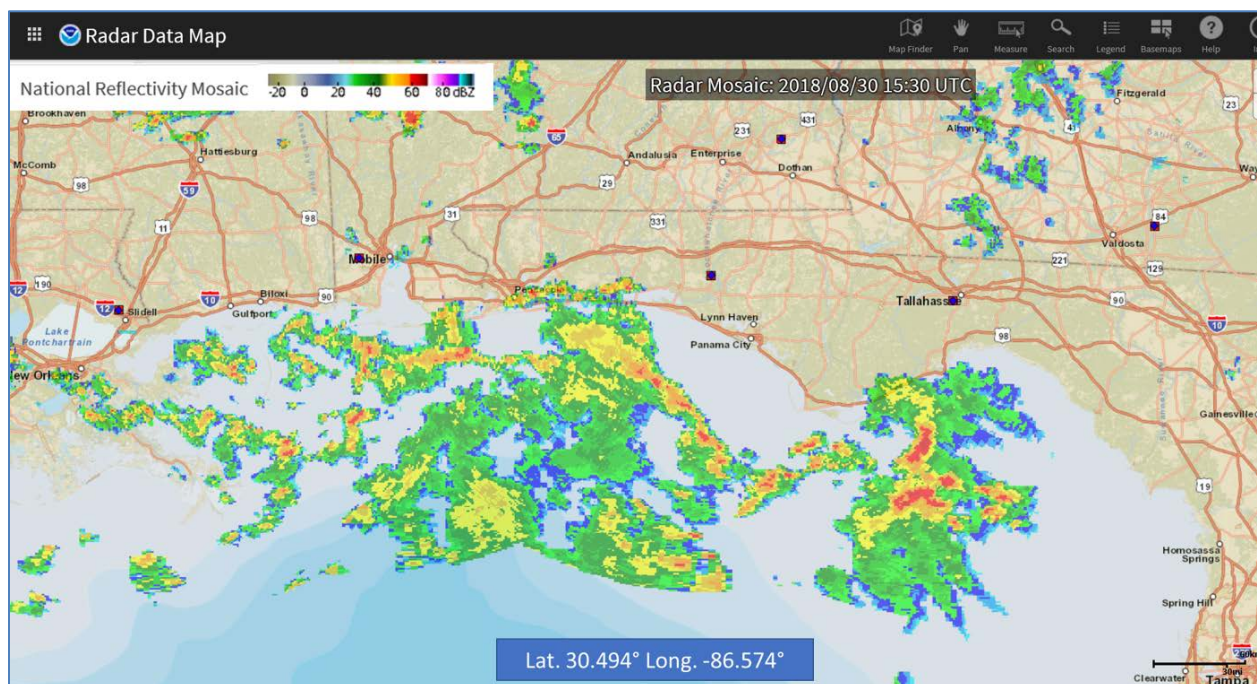


Figure 2 – Southcentral section of the National Composite Radar Mosaic for 1030 CDT

Figure 3 is a close up of the 1030 CDT radar mosaic with the approximate accident site marked by a red star. The composite radar mosaic depicted a small line of several discrete heavy intensity echoes extending from near the coast of Pensacola eastward to the Valparaiso and Destin, Florida, with another larger area of echoes further south in the Gulf of Mexico. The accident site was located under one of the heavy echoes in the line.

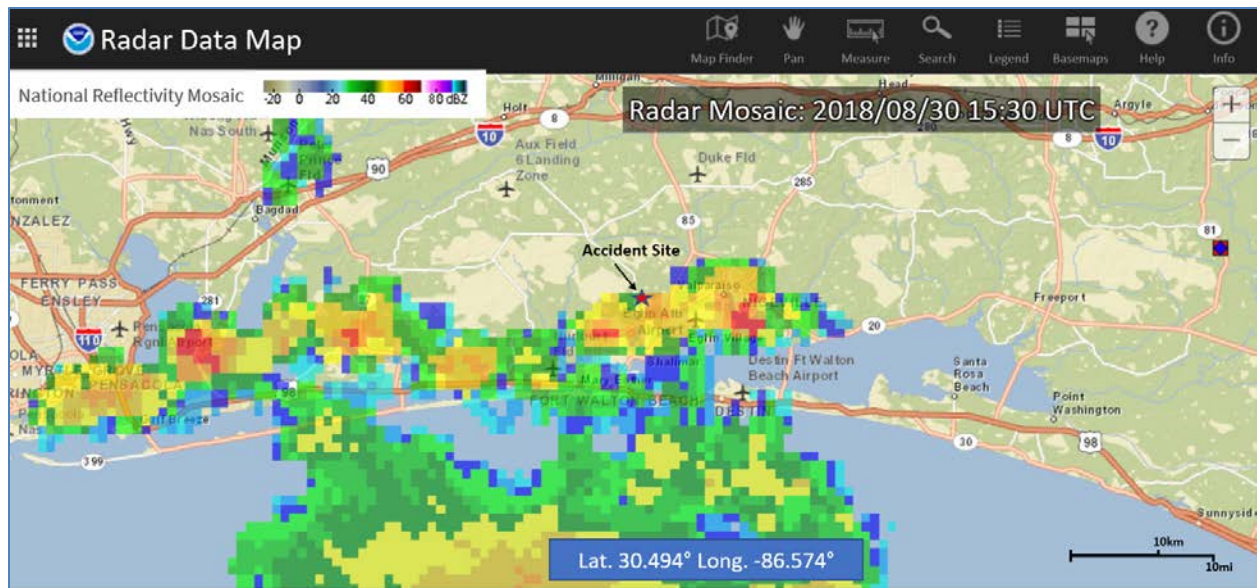


Figure 3 – Enlarged image of the Composite Radar Mosaic for 1030 CDT with the accident site marked

Based on the potential for echoes over the flight path the closest weather surveillance radar is documented in section 5.0 of this report.

1.3 Convective Outlook

The NWS Storm Prediction Center (SPC) Convective Outlook issued at approximately 0800 CDT is included as figure 4. The intent of the chart is to identify to users like NWS forecasters, emergency managers, media, and pilots where the NWS SPC expects organized thunderstorms and severe thunderstorms¹ to form. On the day of the accident the outlook expected a slight risk of organized severe thunderstorms over Missouri and northern Arkansas, with general airmass type thunderstorms over the general route of flight and over the accident site during the period.

¹ A severe thunderstorm is one that produces a tornado, large hail over 1.0 inch in diameter, or outflow winds greater than 50 knots. While all thunderstorms imply the likelihood of severe turbulence, a severe thunderstorm implies a high likelihood of severe to extreme turbulence, wind shear, and a high probability of encountering hail.

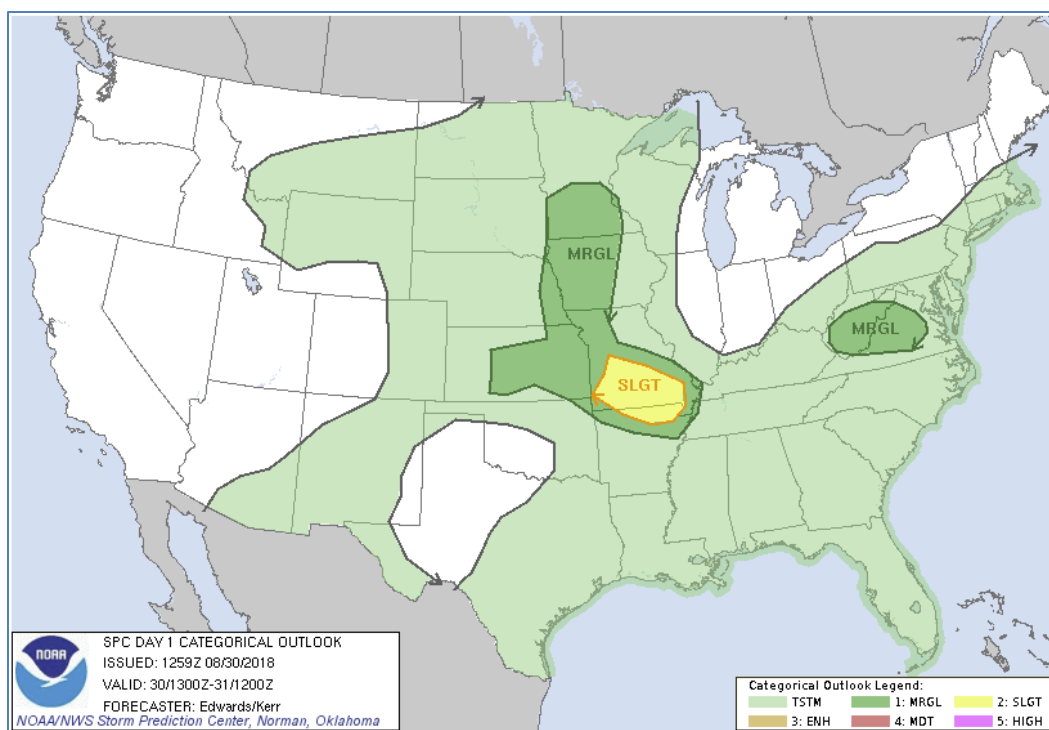


Figure 4 - Convective Outlook issued at approximately 0800 CDT

2.0 Observations

The official observations issued surrounding the accident site were documented using standard meteorological aerodrome reports (METARs) and specials (SPECI). Cloud heights are reported above ground level (agl) in the following section, and the magnetic variation was estimated at 3° west based on the latest sectional chart for the area.

2.1 Eglin Air Force Base/Destin-Fort Walton Beach Airport

The closest weather reporting location to the accident site was from Eglin Air Force Base/Destin-Fort Walton Beach Airport (KVPS), a joint military and civilian airport located 2 miles southeast of the accident site in Valparaiso, Florida, at an elevation of 84 ft. The airport had a military FMQ-22 automated weather observation system which was augmented by Air Force weather observers. The following conditions were reported immediately surrounding the time of the accident.

KVPS special weather observation at 1023 CDT, wind from 060° at 5 knots, visibility 10 miles or more, thunderstorm, scattered clouds at 1,600 ft agl, ceiling broken at 3,000 ft in cumulonimbus clouds, broken clouds at 10,000 ft, temperature 28° Celsius (C), dew point temperature 23° C, altimeter 30.11 inches of mercury (Hg). Remarks: automated station with a precipitation discriminator augmented by observer, visibility north through northeast 2 miles, thunderstorm 2 miles east and 4 miles west, moving north, maintenance indicator.

KVPS special weather observation at 1039 CDT, wind from 070° at 11 knots, visibility 10 miles or more, scattered clouds at 2,000 ft agl, ceiling broken at 3,500 ft in cumulonimbus clouds, broken clouds at 10,000 ft, temperature 27° C, dew point temperature 21° C, altimeter 30.10 inches of Hg. Remarks: automated station with a precipitation discriminator augmented by observer, visibility north 2 miles, cumulonimbus cloud overhead moving north, sea-level pressure 1019.8-hPa, maintenance indicator, Observation corrected at 1044 CDT.

The general flight categories² and raw observations from approximately 0700 through 1400 CDT were as follows:

VFR METAR KVPS 301155Z 04005KT 10SM FEW025 SCT170 SCT250 23/21 A3009 RMK AO2A SLP195 70023 T02320213 10245 20232 53005 \$

VFR METAR KVPS 301255Z 05006KT 10SM FEW025 SCT170 BKN250 25/22 A3009 RMK AO2A LTG DSNT SW TS 25SW STNRY SLP195 T02490218 \$

VFR METAR KVPS 301355Z 06003KT 10SM SCT025 SCT150 BKN250 27/23 A3010 RMK AO2A LTG DSNT SW TS 25SW STNRY SLP198 T02710225 \$

VFR METAR KVPS 301455Z 05004KT 10SM SCT016 SCT030 BKN100 BKN200 28/23 A3011 RMK AO2A LTG DSNT S TS 20S STNRY SLP202 T02800227 52006 \$

MVFR SPECI KVPS 301523Z 06005KT 10SM TS SCT016 BKN030CB BKN0100 28/23 A3011 RMK AO2A VIS N-NE 2 TS 2E AND 4W MOV N \$

Accident 1530Z

VFR SPECI KVPS 301539Z COR 07011KT 10SM SCT020 BKN035CB BKN100 27/21 A3010 RMK AO2A VIS N 2 CB OHD MOV N SLP198 \$ COR 1544

VFR METAR KVPS 301555Z 06009KT 10SM BKN035 BKN050 26/22 A3011 RMK AO2A VIS N-NE 2 1/2 SLP202 T02620222 \$

MVFR METAR KVPS 301655Z 03003KT 10SM FEW016 BKN026 BKN050 26/22 A3011 RMK AO2A SLP202 T02640218 \$

VFR METAR KVPS 301755Z 04003KT 10SM SCT013 SCT025 BKN050 26/22 A3010 RMK AO2A SLP199 T02620222 10283 20233 58002 \$

² As defined by the NWS and the FAA Aeronautical Information Manual (AIM) section 7-1-7 defines the following general flight categories:

- Low Instrument Flight Rules (LIFR*) – ceiling below 500 ft above ground level (agl) and/or visibility less than 1 statute mile.
- Instrument Flight Rules (IFR) – ceiling between 500 to below 1,000 feet agl and/or visibility 1 to less than 3 miles.
- Marginal Visual Flight Rules (MVFR**) – ceiling from 1,000 to 3,000 ft agl and/or visibility 3 to 5 miles.
- Visual Flight Rules (VFR) – ceiling greater 3,000 ft agl and visibility greater than 5 miles.

* By definition, IFR is a ceiling less than 1,000 ft agl and/or visibility less than 3 miles while LIFR is a sub-category of IFR.

**By definition, VFR is a ceiling greater than or equal to 3,000 ft agl and visibility greater than 5 miles while MVFR is a sub-category of VFR.

A review of the observations from KVPS indicated that lightning was first observed in the distance south of the airport at 0855 through 1023 CDT when a thunderstorm was reported in the terminal area. During the thunderstorms passage over the field between 1023 and 1039 CDT only MVFR conditions were reported; however, the remarks section indicated that visibility was estimated at 2 miles in likely heavy rain showers to the north and northeast, with defined thunderstorm cells noted 2 miles east and 4 miles west of the station moving northward. The location of the restricted visibility was in the general direction of the accident site. No strong gusting winds were noted during the period to indicate any strong gust front or microburst type activity from the convective activity moving across the airport.

2.2 Hurlburt Field Airport

The next closest weather reporting location was from Hurlburt Field Airport (KHRT), a military restricted field located approximately 8 ½ miles southwest of the accident site in Mary Esther, Florida, at an elevation of 38 ft. The airport had an FMQ-22 automated weather observation system which was augmented by Air Force weather observers. The following conditions were reported at the approximate time of the accident.

KHRT special weather observation at 1026 CDT, wind from 190° at 9 knots, visibility 10 miles or more, light rain, scattered clouds at 1,600 ft, ceiling broken at 2,300 ft, temperature 27° C, dew point temperature 19° C, altimeter 30.10 inches of Hg. Remarks: automated station with a precipitation discriminator augmented by observer, rain began at 1026 CDT, ceiling 1,600 ft variable 2,300 ft, broken variable overcast, ceiling 1,800 ft over runway 18, sea level pressure 1019.4-hPa, maintenance required on system.

The general flight conditions and raw observers reported surrounding the period were as follows.

VFR METAR KHRT 301156Z 04003KT 10SM SCT055 23/21 A3008 RMK AO2A SLP188 60000 75539
T02290206 10236 20225 53007 \$

VFR METAR KHRT 301256Z 05005KT 10SM FEW095 25/21 A3009 RMK AO2A SLP191 T02460207 \$

VFR METAR KHRT 301356Z 06006KT 10SM SCT020 SCT250 27/21 A3009 RMK AO2A LTG DSNT SW SLP191
T02720207 \$

VFR METAR KHRT 301456Z 12007KT 10SM SCT017 29/21 A3010 RMK AO2A SLP194 T02850205 52005 \$

MVFR SPECI KHRT 301506Z 19010KT 10SM BKN016 28/20 A3010 RMK AO2A SLP194 \$

MVFR SPECI KHRT 301526Z 19009KT 10SM -RA SCT016 BKN023 27/19 A3010 RMK AO2A RAB26 CIG
016V023 BKN V OVC CIG 018 RWY18 SLP194 \$

Accident 1530Z

VFR METAR KHRT 301556Z 18009KT 10SM -RA FEW007 SCT029 BKN045 BKN070 26/21 A3010 RMK AO2A
RAB26 SLP194 P0002 T02630208 \$

VFR SPECI KHRT 301559Z 18009KT 10SM VCSH SCT029 BKN045 BKN070 26/21 A3010 RMK AO2A RAE59
SLP194 \$

VFR METAR KHRT 301656Z 19005KT 10SM BKN034 OVC085 26/18 A3010 RMK AO2A RAE1559 SLP194
P0000 T02600181 \$

VFR METAR KHRT 301756Z 00000KT 10SM SCT034 BKN075 BKN150 27/20 A3009 RMK AO2A SLP191 60002
T02650198 10290 20230 58004 \$

MVFR METAR KHRT 301856Z 00000KT 10SM VCSH BKN019 BKN075 BKN140 27/20 A3006 RMK AO2A
SLP181 T02730199 \$

A review of the observations for KHRT also indicated MVFR conditions as the line of showers moved across the region between 1026 and 1059 CDT, with only light rain recorded during the period with broken to overcast ceilings near 1,500 ft. No lightning activity was reported at the station during the period, which was inconsistent with that being reported at KVPS during the period.

2.3 Destin Executive Airport

The planned destination was Destin Executive Airport (KDTs) was located approximately 9 miles southeast of the accident site in Destin, Florida, at an elevation of 22 ft. The airport had an ASOS and was augmented by human observers during the period. The following conditions were reported at the approximate time of the accident.

KDTs special weather observation at 1025 CDT, wind from 200° at 6 knots, visibility 10 miles or more, ceiling broken at 1,500 ft, broken clouds at 2,000 ft, and broken clouds at 4,400 ft, temperature 26° C, dew point temperature 22° C, altimeter 30.11 inches of Hg. Remarks: automated station with a precipitation discriminator, lightning distant south, temperature 26.1° C, dew point temperature 21.7° C.

The general flight conditions and raw observers reported surrounding the period were as follows.

VFR METAR KDTs 301153Z 08005KT 10SM CLR 24/23 A3009 RMK AO2 SLP190 70010 T02440233 10250
20239 53006

VFR SPECI KDTs 301231Z 06008KT 10SM FEW007 26/23 A3009 RMK AO2 LTG DSNT SW AND W
T02560233

VFR METAR KDTs 301253Z 08006KT 10SM SCT007 25/23 A3010 RMK AO2 LTG DSNT SW SLP192
T02500233

VFR METAR KDTs 301353Z 08005KT 10SM FEW006 27/24 A3010 RMK AO2 LTG DSNT S AND SW SLP193
T02670239

VFR METAR KDTs 301453Z 05005KT 10SM FEW041 28/24 A3011 RMK AO2 LTG DSNT S SLP197
T02780239 53007

MVFR SPECI KDTs 301517Z 19006KT 10SM BKN014 BKN020 27/23 A3011 RMK AO2

MVFR SPECI KDTs 301525Z 20006KT 10SM BKN015 BKN020 BKN044 26/22 A3011 RMK AO2 LTG DSNT
S T02610217

Accident 1530Z

VFR *SPECI KDTS 301545Z 20006KT 10SM FEW015 BKN035 OVC049 26/22 A3011 RMK AO2*

VFR *METAR KDTS 301553Z VRB06KT 10SM FEW029 BKN050 OVC060 26/22 A3011 RMK AO2 LTG DSNT
S SLP196 T02560217*

VFR *METAR KDTS 301653Z VRB05KT 10SM FEW047 BKN060 OVC075 26/22 A3011 RMK AO2
RAB1555E12 SLP196 P0000 T02610217*

VFR *METAR KDTS 301753Z 13005KT 10SM -RA SCT032 BKN070 OVC085 25/23 A3011 RMK AO2 RAB01
SLP195 P0002 60002 T02500228 10283 20244 58002*

VFR *METAR KDTS 301853Z 00000KT 10SM -RA FEW060 FEW075 OVC100 26/22 A3008 RMK AO2 SLP184
P0003 T02560222*

The observations for KDTS also noted lightning in the distance south and southwest from 0731 through the time of the accident. At the time of the accident a short period of MVFR conditions were being reported due to ceilings broken at 1,500 ft agl. Only light precipitation was reported after the accident and no strong outflow winds or gusts were reported.

3.0 Sounding

To determine the vertical structure and state of the atmosphere over the accident site a High-Resolution Rapid Refresh (HRRR)³ numerical model data was retrieved from archive data from the NOAA Air Resources Laboratory for 1000 CDT on August 30, 2018. The model data was then plotted on a standard Skew T log P diagram⁴ using the complete Rawinsonde Observation RAOB program software⁵ from the surface to 450-hPa or approximately 21,000 ft. Figure 5 is the 1000 CDT HRRR model sounding which depicted the elevation as 105 ft, with a near-surface temperature of 28° C, a dew point temperature of 22° C, with an approximate relative humidity of 80%. The precipitable water content was 2.04 inches. The lifted condensation level (LCL)⁶ and the level of free convection (LFC)⁷ were identified at approximately 2,500 ft agl, with the

³ The HRRR is a National Oceanic and Atmospheric Administration (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.

⁴ Skew T log P diagram – is a standard meteorological plot or thermodynamic diagram using temperature and the logarithmic of pressure as coordinates, used to display winds, temperature, dew point, and various indices used to define the vertical structure of the atmosphere.

⁵ RAOB software – The complete RAwinsonde OBservation program is an interactive sounding analysis program developed by Environmental Research Services, Matamoras, Pennsylvania, for plotting and analyzing upper air data.

⁶ Lifting Condensation Level (LCL) - the level at which a lifted parcel becomes saturated. The LCL height corresponds to cloud base height for forced ascent.

⁷ Level of Free Convection (LFC) - the last level where a parcel becomes buoyant, or "warmer" than the environmental temperature at the same level. The LFC represents the bottom of the layer containing CAPE.

convective condensation level (CCL)⁸ at approximately 3,300 ft agl. The freezing level was identified above 15,000 ft. The sounding was characterized as conditionally unstable with a Lifted Index (LI)⁹ of -3, a Convective Available Potential Energy (CAPE)¹⁰ of 1,656 Joules/kilogram, and a K-index of 31.6, which indicated a probability of 60% of airmass type convection. The CAPE and vertical wind shear support ordinary non-severe airmass type convection, with the maximum potential outflow winds (T2Gust) estimated at 35 knots (40 mph). The maximum vertical velocity (MVV) of the updrafts was estimated at 58 meters/second or 116 knots.

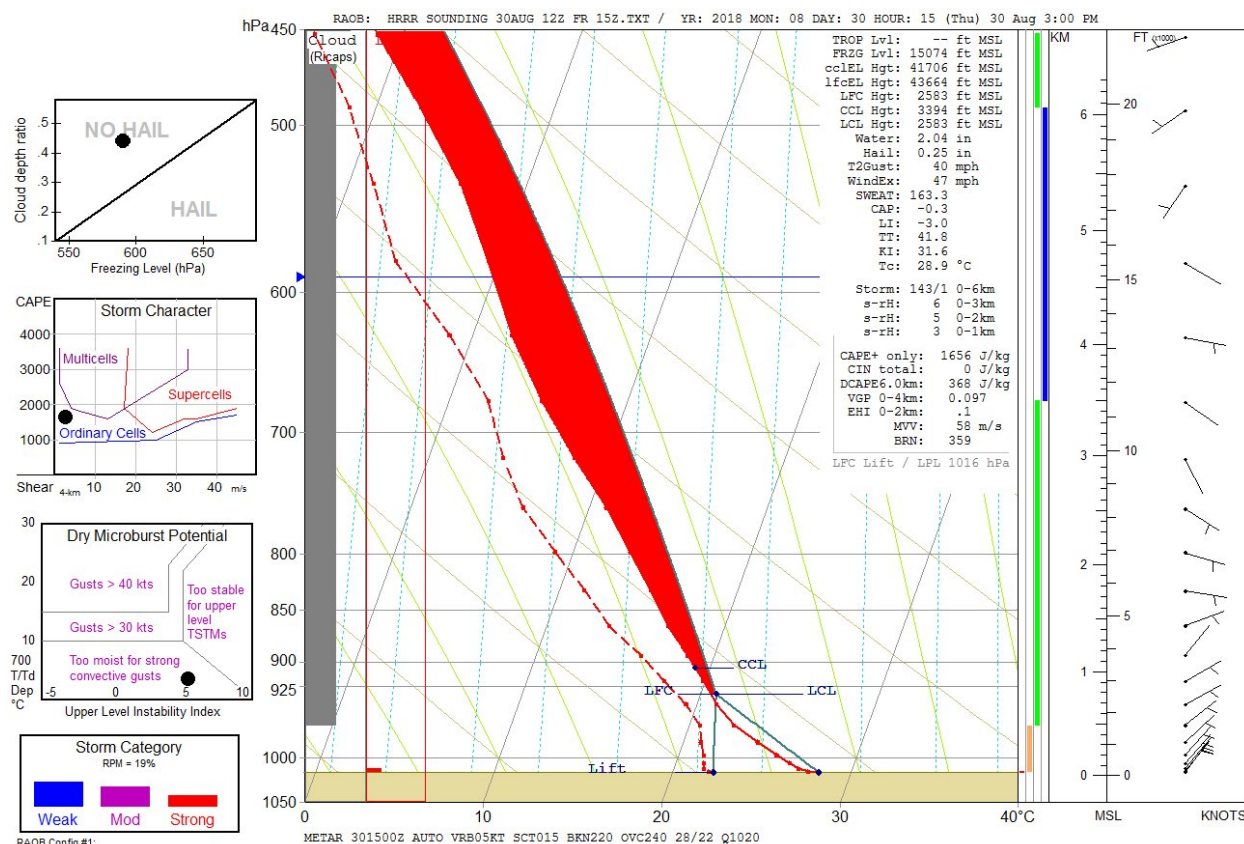


Figure 5 - HRRR numerical model sounding for 1000 CDT over the accident site

The HRRR wind profile indicated a near-surface wind from the northeast at 5 knots with wind direction veering to the east through 15,000 ft with wind speeds under 10 knots. The wind shifted

⁸ Convective Condensation Level (CCL) - is the height of cloud bases resulting from air rising from the surface due to positive buoyancy alone.

⁹ Lifted Index (LI) - A common measure of atmospheric instability. Its value is obtained by computing the temperature that air near the ground would have if it were lifted to 500-hPa (around 18,000 feet) and comparing that temperature to the actual temperature at that level. Negative values indicate instability - the more negative, the more unstable the air is, and the stronger the updrafts are likely to be with any developing thunderstorms.

¹⁰ Convective Available Potential Energy (CAPE) - is the amount of energy a given mass of air would have if lifted vertically in the atmosphere. CAPE is effectively the positive buoyancy of an air parcel (red shaded area on sounding) and is an indicator of atmospheric stability and the potential updraft strength of thunderstorms.

to the southwest above 17,000 ft. The wind profile did not depict any strong vertical shears supporting any significant layers of moderate or greater turbulence outside of convective clouds.

The Geostationary Operational Environmental Satellite number 16 (GOES-16) data were obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison in Madison, Wisconsin, and processed using the Man-computer Interactive Data Access System (McIDAS) software. The infrared long wave and visible imagery were obtained surrounding the time of the accident, with the images closest to the time of the accident documented below. The infrared long wave imagery (band 13) at a wavelength of 10.3 microns (μm) provided radiative cloud top temperatures with a nominal spatial resolution of 2 km. The visible (band 2) at a wavelength of 0.64 μm images at a resolution of 0.5 km.

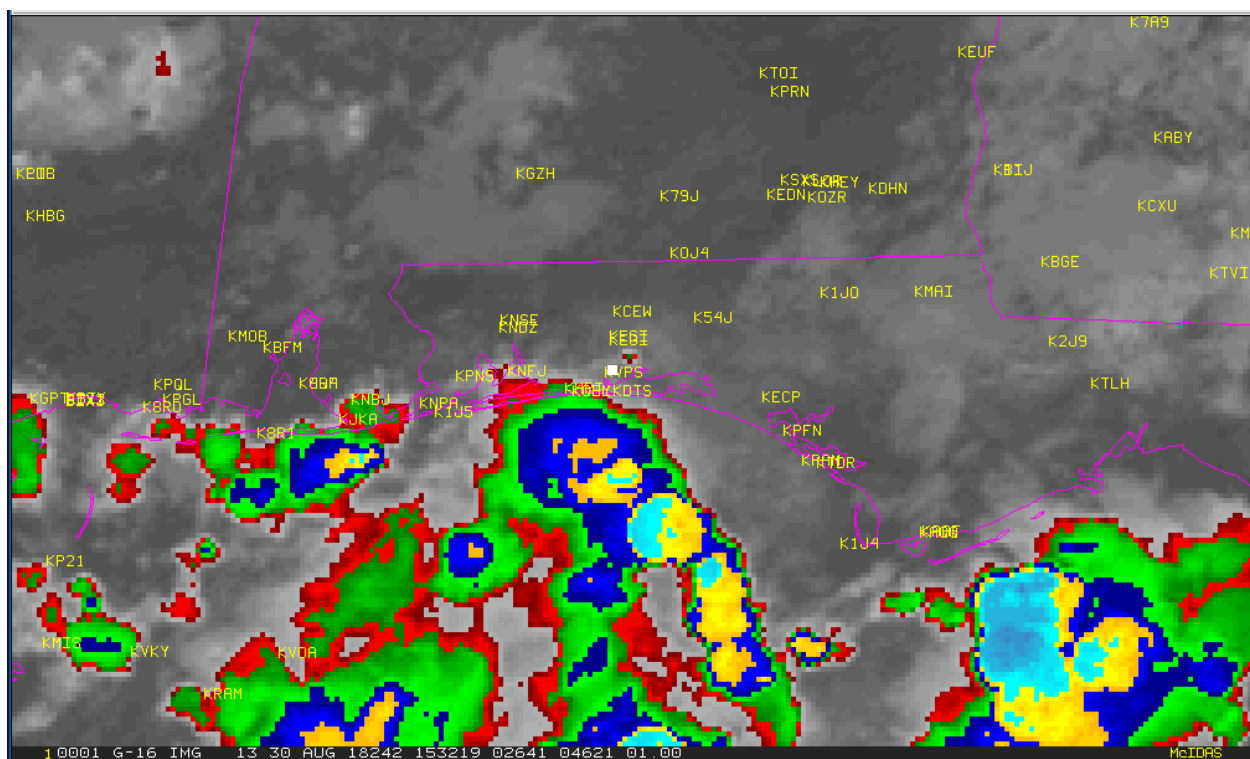


Figure 7 is the GOES-16 visible image for 1032 CDT at 2X magnification and depicted a band of cumulus congestus type clouds extending west-to-east along the Florida panhandle and the accident site. Off the Alabama and Florida coast multiple large cumulonimbus cloud systems can be observed with extensive anvils and overshooting cloud tops. The cumulus congestus clouds over the accident site did not display any extensive anvil and were of limited size as compared to the well-defined cumulonimbus cloud systems in the Gulf of Mexico to the south of the accident site.

Figure 7 - GOES-16 visible image at 2X magnification at 1032 CDT

The closest Weather Surveillance Radar 1988 Doppler (WSR-88D) was from the Department of Defense Northwest Florida/Eglin AFB (KEVX) site located approximately 34 miles east of the accident site in Red Bay, Florida. The level II archive data was obtained from the NCEI using the Hierarchical Data Storage System and displayed using the NWS NEXRAD Interactive Viewer and Data Exporter software.

5.1 Volume Scanning Strategies

During the period the KEVX WSR-88D was operating in the precipitation mode volume scan pattern 212 (VCP-212), where the radar makes 14 different elevation scans in 4 ½ minutes. Assuming standard refraction¹¹ of the WSR-88D radar beam with the antenna elevation at 221 ft with a beam width¹² of 0.95°, the following table shows the antenna elevation angle and the approximate heights of the center of the radar beam, base, top, and width over the accident site. These heights have been rounded to the nearest 10 ft.

Antenna Elevation	Beam Center	Base of Beam	Top of beam	Beam Width
0.54°	2,930 ft	1,220 ft	4,650 ft	3,430 ft

Based on the radar height calculations, the 0.54° elevation scan depicted the conditions between 1,220 ft and 4,650 ft msl over the accident site.

5.2 Reflectivity

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors, 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 (dBZ¹³) and is a general measure of echo intensity. The following table shows the NWS former VIP¹⁴ Levels of intensity from 1-6 to the WSR-88D levels, reflectivity, and convective rainfall rates. Light rain typically occurs with echoes of 20-34 dBZ (0.10"/hr), moderate rain with echoes of 35-40 dBZ (0.11" to 0.30"/hr), heavy rain with echoes 40-60 dBZ (>0.30"/hr), values greater than 55 dBZ are typically associated with hail.

¹¹ Standard Refraction in the atmosphere is when the temperature and humidity distributions are approximately average, and values set at the standard atmosphere.

¹² Beam width - the angular separation between the half power points on the antenna radiation pattern, where the gain is one half the maximum value.

¹³ dBZ - 10 log Ze

¹⁴ Video Integrated Processor

NWS VIP/DBZ CONVERSION TABLE

NWS VIP	WSR-88D LEVEL	PREC MODE DBZ	RAINFALL
0	0	< 5	
	1	5 to 9	
	2	10 to 14	
1 Very Light	3	15 to 19	.01 in/hr
	4	20 to 24	.02 in/hr
	5	25 to 29	.04 in/hr
2 Light to Moderate	6	30 to 34	.09 in/hr
	7	35 to 39	.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	55 to 59	>5.67 in/hr
	12	60 to 64	
	13	65 to 69	
	14	70 to 74	
	15	> 75	

The FAA defines the reflectivity (dBZ) ranges or intensity levels to pilots in Advisory Circular AC 00-24C - “Thunderstorm”. That AC further defines echoes less than 30 dBZ as “light” in intensity, “moderate” echoes 30-40 dBZ, “heavy” with echoes of >40-50 dBZ, and “extreme” intensity with echoes above >50 dBZ. These are the new standard radio phraseology terms used by air traffic controllers to describe weather conditions to pilots.

Reflectivity (dBZ) Ranges	Weather Radar Echo Intensity Terminology
< 30 dBZ	Light
30 – 40 dBZ	Moderate
>40 – 50 dBZ	Heavy
>50 dBZ	Extreme

5.3 Base Reflectivity Images

Figure 8 is the KEVX WSR-88D 0.54° base reflectivity image for 1033 CDT with the flight track of N1876L overlaid. The flight track is observed operating under a cell with maximum reflectivity of 56.0 dBZ or an extreme intensity echo. The echo tops product indicated that the maximum height of the echo was to 24,000 ft at that time.

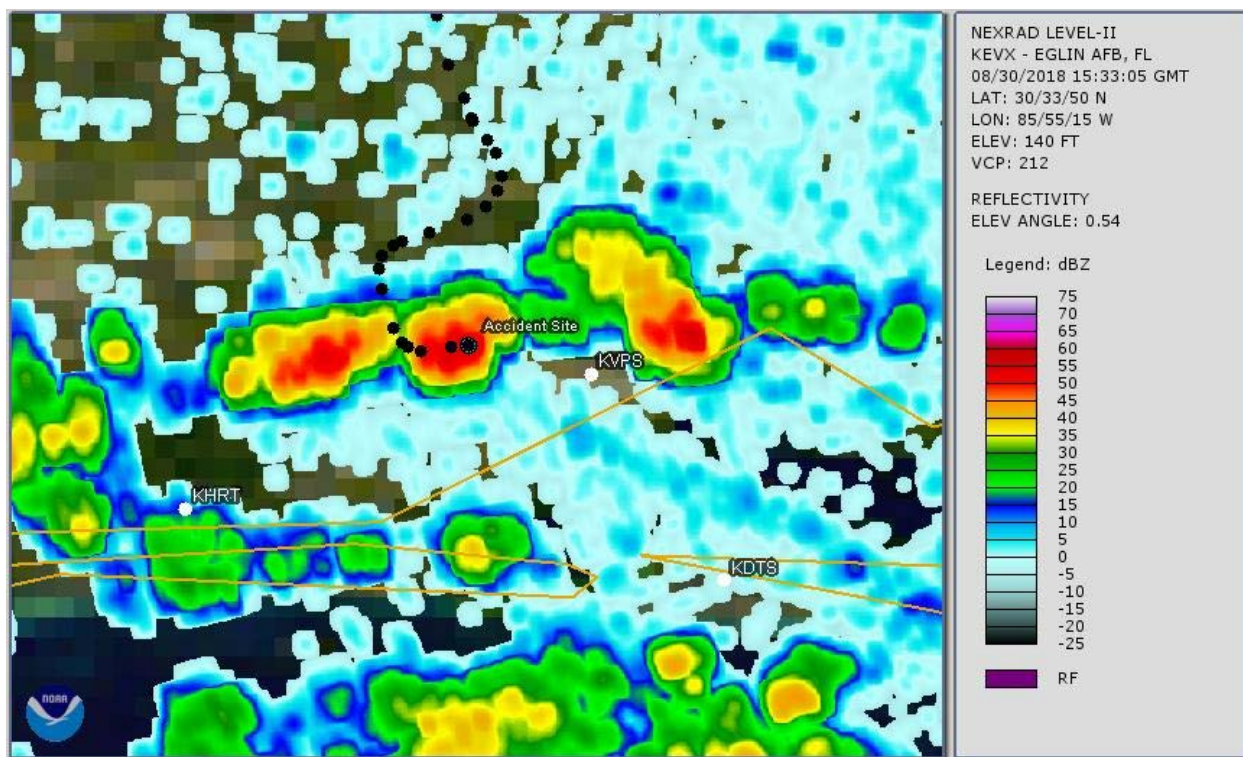


Figure 8 - KEVX 0.54° Base Reflectivity image for 1033 CDT with flight track overlaid

The KEVX WSR-88D image also shows that at 1033 CDT the surrounding airports KVPS and KDTs were outside of any strong reflectivity echoes, while KHRT bordered an echo 30 dBZ and was reporting light rain. KVPS was between extreme intensity echoes of 50 dBZ which were located approximately 2 miles east and 4 miles west. This corresponds to the KVPS SPECI observation at 1023 CDT included in section 2.1 of this report.

5.4 Cross Section

The GR2Analysis Radar software¹⁵ was also used to examine the echoes in the vicinity of the accident site. Figure 9 is a cross section along the approximate flight track as the accident aircraft turned eastward and was descending between 1,200 and 500 ft, and shows the echoes at 1025, 1029, 1033, and 1036 CDT. The image shows an echo of 50.0 dBZ develop at 10,000 ft at 1025 CDT, and by 1029 CDT was well-defined with the echo of 50 dBZ reaching 12,000 ft with another large area of echoes from 50-64 dBZ between 5,800 and 10,000 ft. At 1033 CDT the heavy precipitation core of 50 dBZ is descending below 5,300 ft to the surface, at 1036 CDT the general shape and the depth of the high precipitation core continues to collapse. The cross section indicated the cell developing or building with predominate updrafts at 1025 and 1029 CDT, with the high precipitation core reaching its greatest height and collapsing, with predominate downdrafts, between 1029 through 1036 CDT. The heaviest low-level precipitation was occurring near the 1033 CDT period with echoes of 50 dBZ below 5,400 ft.

¹⁵ GR2Analysis was created by Gibson Ridge Software, LLC, Suwanee, GA, and is an advanced Nexrad Level II analysis application to display weather radar data.

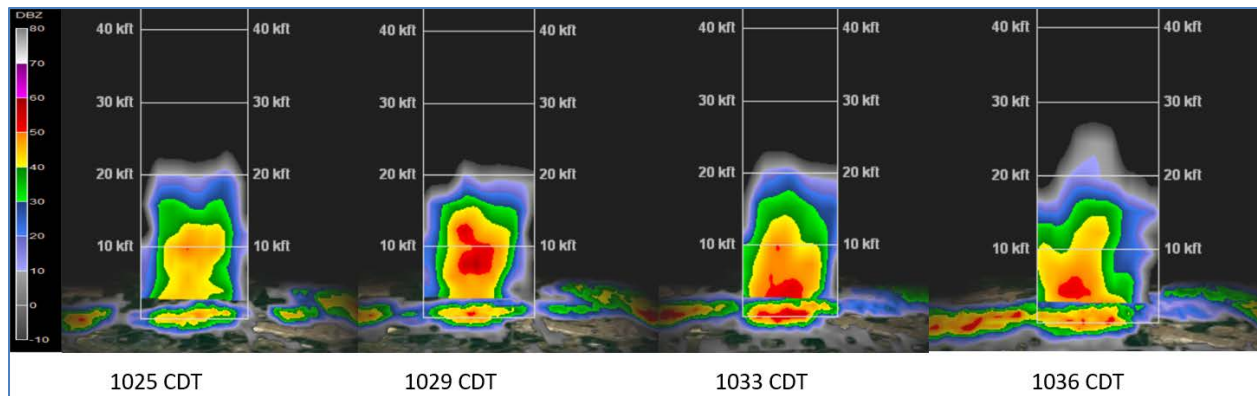


Figure 9 – Cross-section analysis of the echoes between 1025 and 1036 CDT over the flight track

A KEVX WSR-88D radial velocity imagery was also examined surrounding the period of the accident for any signs of any divergent cores associated with any microburst activity and strong outflow winds and none were identified in the vicinity of the accident site.

5.5 FAA Weather Display

The Federal Aviation Administration (FAA) Consolidated Storm Prediction for Aviation (CoSPA) display of composite weather radar data for 1035 CDT over the area is included as figure 10 with the approximate accident site marked by the red star. The image depicts the Vertical Integrated Liquid Water (VIL) levels similar to reflectivity values, lightning, echo tops, and storm movement which available to Air Traffic Control (ATC) managers and other users. The image depicted the west-to-east band of echoes over the Florida coastal sections with tops between 30,000 ft and 32,000 ft immediately west and east of the accident site. No lightning activity was detected in the band along the coast surrounding the period. The intense echoes off the coast indicated in brown and reds were depicted producing significant lightning during the period with tops as high as 47,000 ft and were moving northward at 5 knots.

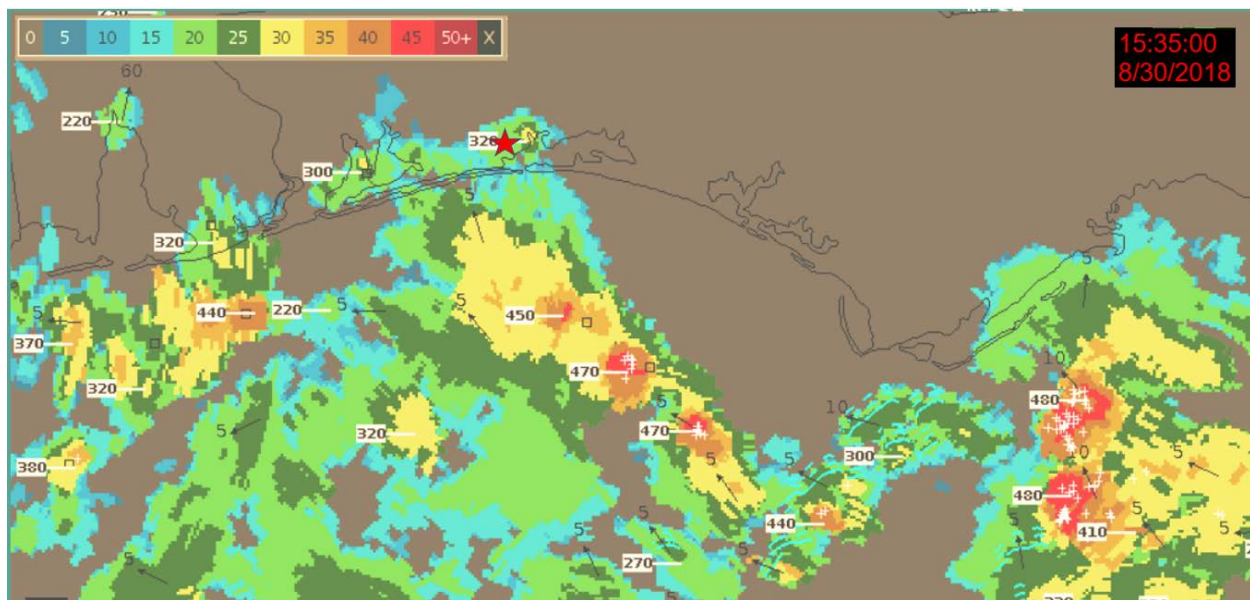


Figure 10 - FAA CoSPA radar composite image for 1035 CDT with lightning, cloud tops, and movement

6.0 Pilot Reports

The following pilot reports or PIREPs were recorded within 50 miles of the accident site between 0500 EDT through 1200 EDT. The reports are in standard code and abbreviations with time referenced to UTC. The reports were as follows.

PNS UA /OV PNS350002/TM 1054/FLDURGD/TP A306/SK BKN005

PNS UA /OV PNS080001/TM 1123/FLDURGC/TP E170/SK BKN004-BKN010/RM SCT-BKN

NPA UA /OV NPA180007/TM 1458/FL017/TP HAWK/SK SCT017

PNS UA /OV PNS330004/TM 1530/FL013/TP ST75/SK SCT013

KHRT UA /OV KHRT360003/TM 1531/FL018-018/TP PC12/SK BKN018

KHRT UA /OV KHRT180002/TM 1533/FL018-018/TP PC12/SK BKN018

PNS UA /OV PNS260005/TM 1547/FLDURGD/TP BE9L/SK BKN015

Most of the reports were from pilots arriving into and departing from Pensacola (KPNS) who reported sky cover broken between 500 ft and 1,500 ft, while two pilots reported in the vicinity of KHRT and reported a broken ceiling at 1,800 ft. This was also noted in the KHRT SPECI at 1026 CDT in section 2.2 above. There were no reports of any significant turbulence, wind shear, or icing conditions reported during the period in the area.

7.0 NWS Forecasts

The following forecast products were reviewed and documented.

7.1 Terminal Aerodrome Forecasts

A Terminal Aerodrome Forecast (TAF) is a concise statement of the expected meteorological conditions at an airport during a specified period, usually 24 hours. TAFs are valid for a 5 mile radius around an airport's center point. The forecasts issued surrounding the period relevant to the preflight planning and the time of the accident was as follows.

The NWS Mobile/Pensacola (KMOB) Weather Forecast Office (WFO), located in Mobile, Alabama, was responsible for advisories and forecasts for the region. The NWS does not issue a forecast for KDTS. The closest TAFs to the destination and the accident site were issued by the U.S. Air Force for KVPS. The following forecasts were issued during the period.

*TAF KVPS 300900Z 3009/3115 06004KT 9999 FEW020 BKN160 BKN250 QNH3006INS
BECMG 3011/3012 10006KT 9000 VCTS SCT025CB BKN160 BKN250 QNH3008INS
TEMPO 3012/3015 10012G18KT 4800 -TSRA BKN025CB
BECMG 3014/3015 11009KT 9999 NSW FEW020 SCT150 BKN250 QNH3005INS
TEMPO 3018/3021 13012G20KT 6000 -TSRA BKN035CB
BECMG 3022/3023 11006KT 9999 FEW020 SCT150 BKN200 QNH3001INS
BECMG 3111/3112 11006KT 9000 -SHRA BKN018 BKN150 QNH3003INS TX31/3018Z TN23/3012Z*

*TAF AMD KVPS 301305Z 3013/3115 06004KT 9999 FEW020 SCT160 BKN250 QNH3006INS
BECMG 3014/3015 11009KT 9999 FEW020 SCT150 BKN250 QNH3005INS
TEMPO 3018/3021 13012G20KT 6000 -TSRA BKN035CB
BECMG 3022/3023 11006KT 9999 FEW020 SCT150 BKN200 QNH3001INS
BECMG 3111/3112 11006KT 9000 -SHRA BKN018 BKN150 QNH3003INS TX31/3018Z TN23/3112Z*

*TAF AMD KVPS 301545Z 3015/3115 06004KT 9999 VCTS FEW020CB SCT160 BKN250 QNH3006INS
TEMPO 3015/3022 13012G20KT 6000 -TSRA BKN035CB
BECMG 3022/3023 11006KT 9999 NSW FEW020 SCT150 BKN200 QNH3001INS
BECMG 3111/3112 11006KT 9000 -SHRA BKN018 BKN150 QNH3003INS TX31/3018Z TN23/3112Z*

The initial forecast issued at about 0400 CDT expected thunderstorms in the vicinity and temporarily over the airport prior to the flights estimated time of arrival, the forecast for the flights arrival was for wind from 110° at 9 knots, visibility of 10 kilometers or more (unrestricted of 6 miles or more), no significant weather, with a few clouds at 2,000 ft agl, scattered clouds at 15,000 ft, and ceiling broken at 25,000 ft, with a forecast minimum altimeter of 30.05 inches of Hg. The forecast was amended at 0805 CDT taking the thunderstorms out of the forecast until after 1500 CDT. The forecast was amended again immediately after the accident at 1045 CDT to include thunderstorms in the vicinity of and at the station after 1000 CDT.

7.2 Area Forecast Discussion

The NWS Area Forecast Discussions (AFD) are issued by each NWS WFO to describe the short term weather conditions within their region with an aviation section that includes the general conditions as it relates to the creation of the TAF. These are useful for additional aviation-related issues that cannot be encoded into the TAF. The discussion also gives some reasoning behind the

forecast. These are generated roughly every 6 hours and corresponds to the release of the latest TAFs for that office. The following AFD was issued by the KMOB WFO at 0628 CDT discussion the conditions over the area. Only the short term forecast and aviation discussions are included.

*FXUS64 KMOB 301128 AAA
AFDMOB
Area Forecast Discussion...UPDATED
National Weather Service Mobile AL
628 AM CDT Thu Aug 30 2018*

.DISCUSSION...Updated for latest aviation discussion below.

.AVIATION...

12Z issuance...Showers and thunderstorms will increase in coverage through the morning and afternoon hours. IFR/MVFR conditions will be possible in and around showers and thunderstorms.

.PREV DISCUSSION... /issued 452 AM CDT Thu Aug 30 2018/

NEAR TERM /Now Through Thursday night/...A weakness aloft continues over the region as the area remains between two upper levels ridges. The upper level weakness combined with a very moist airmass (PW values of 1.70 to 2 inches) and daytime heating will lead to the development of scattered to numerous showers and thunderstorms today. Convection has already started offshore and will develop and spread inland through the day. Thunderstorms today will produce heavy rain and frequent cloud to ground lightning. The coverage will decrease tonight, however scattered convection will likely continue offshore through the night. High temps today will be in the mid and upper 80s. Lows tonight will be in the low to mid 70s.

SHORT TERM /Friday Through Saturday night/...A deeply moist airmass will remain entrenched across our forecast area Friday as we remain situated underneath a mid level weakness between a pair of ridges located over the Desert Southwest/Southern Plains and across the Eastern Seaboard and western Atlantic. With precipitable water values averaging between 2.0" and 2.2" across our region and a weak mid to upper level inverted trough progressing westward over the area, we expect another round of scattered to numerous showers and thunderstorms to develop again during the day Friday. The best chance of showers and storms will initially be near the coast in the early morning, with increasing coverage over inland areas as the day progresses. We have kept POPs in the likely (60-70% chance) range over much of the area going into Friday afternoon. Some of the storms will be capable of producing heavy rainfall within a short period of time given the high precipitable water values. Coverage of showers and storms should tend to diminish through the evening hours, before becoming mostly focused offshore or near the immediate coast overnight Friday night.

The AFD discussed an upper level disturbance and the very moist airmass with high precipitable water content as the key reasons for the development of rain showers and thunderstorms over the region. The advisory indicated that the best chance of showers and thunderstorms will be near the coast in the early morning, with increasing coverage over inland areas as the day progresses. The probability of precipitation was in the range of 60-70%, and some of the storms will be capable of producing heavy rainfall within a short period of time given the high precipitable water values. The aviation discussion also mentioned that IFR/MVFR conditions would be possible in and around the developing rain showers and thunderstorms.

8.0 NWS Inflight Weather Advisories

Inflight Aviation Weather Advisories are forecasts to advise en route aircraft of the development of potentially hazardous weather. Inflight aviation weather advisories in the conterminous U.S. are issued by the NWS AWC, as well as from the Center Weather Service Units (CWSU) associated with FAA ARTCCs. There are four basic types of inflight aviation weather advisories: the Significant Meteorological Information (SIGMET), the Convective SIGMET, the AIRMET, and the Center Weather Advisory (CWA). Inflight advisories serve to notify en route pilots of the possibility of encountering hazardous flying conditions which may not have been forecast at the time of the preflight briefing. Whether or not the condition described is potentially hazardous to a particular flight is for the pilot to evaluate on the basis of his experience and the operational limits of the aircraft. The following advisories were current during the period.

During the period there were no domestic SIGMETs current for any severe turbulence or icing over the region. The NWS did issue a series of Convective SIGMETs, CWA's issued from the Jacksonville (KZJX) CWSU, and AIRMETs for IFR conditions which bordered or were active over the accident site, which are included below. The advisories in bold italic type below extended over the accident site.

Convective SIGMETs

WSUS31 KPCI 301355
SIGE
-MKCE WST 301355
CONVECTIVE SIGMET 33E
VALID UNTIL 1555Z
FL AND FL AL MS CSTL WTRS
FROM 20S CEW-90SW TLH-160W PIE-110ESE LEV-40SSE SJI-20S CEW
AREA TS MOV LTL. TOPS ABV FL450.

WSUS31 KPCI 301455
SIGE
-MKCE WST 301455
CONVECTIVE SIGMET 37E
VALID UNTIL 1655Z
FL AL MS LA AND CSTL WTRS
FROM 40ESE SJI-90SW TLH-190WSW PIE-10W HRV-40ESE SJI
AREA TS MOV LTL. TOPS ABV FL450.

The NWS AWC had two Convective SIGMETs current for areas of thunderstorms in the Gulf of Mexico south of the accident site.

AIRMETs

WAUS42 KPCI 301121 AAB
WA2S
-MIAS WA 301121 AMD
AIRMET SIERRA UPDT 4 FOR IFR VALID UNTIL 301500
.
AIRMET IFR...GA FL AND CSTL WTRS
FROM 30WSW ATL TO 20ESE MCN TO AMG TO 20W OMN TO 60SE CTY TO 20N
CTY TO 70SW TLH TO 30ESE CEW TO 40W CEW TO 50SW PZD TO 30WSW ATL

CIG BLW 010/VIS BLW 3SM BR/FG. CONDS CONTG BYD 15Z ENDG 15-18Z.

WAUS42 KPCI 301445

WA2S

-MIAS WA 301445

AIRMET SIERRA UPDT 5 FOR IFR VALID UNTIL 302100

.

AIRMET IFR...GA FL

FROM 40W CEW TO 20N TLH TO 40SE TLH TO 50SW CEW TO 40W CEW

CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS ENDG 15-18Z.

....

WAUS42 KPCI 301445

WA2T

-MIAT WA 301445

AIRMET TANGO UPDT 2 FOR TURB VALID UNTIL 302100

.

NO SGFNT TURB EXP OUTSIDE OF CNVT ACT.

....

WAUS42 KPCI 301445

WA2Z

-MIAZ WA 301445

AIRMET ZULU UPDT 3 FOR ICE AND FRZLVL VALID UNTIL 302100

.

AIRMET ICE...GA FL AND CSTL WTRS

FROM 40ENE ATL TO 20WSW CRG TO 20SE CTY TO 30S TLH TO 50SW PZD TO

40WNW ATL TO 40ENE ATL

MOD ICE BTN 160 AND FL240. CONDS ENDG 18-21Z.

.

FRZLVL...RANGING FROM 140-160 ACRS AREA

....

The NWS AWC had AIRMET Sierra current over the accident area due to IFR conditions due to low ceilings and mist, with conditions expected to end between 1000 and 1300 CDT. AIRMET Tango indicated no significant turbulence outside of convective activity was expected, and AIRMET Zulu was current for northern Florida and Georgia, east of the accident site for icing conditions between 16,000 through 24,000 ft.

CWA

FAUS22 KZJX 301225

ZJX2 CWA 301230

ZJX CWA 203 VALID UNTIL 301430

FROM 20E SJI-30E SZW-80SSW CTY-215SW CTY-185S SJI-20E SJI

AREA SCT SHRA/TS MOV FM 17010KT. TOPS FL450. MOD

TO HVY PCPN. EXP GRAD INCR IN CVRG/INTST OVR FL

PNHDL/ADJ GULF WATERS THRU PD.

FAUS21 KZJX 301353

ZJX1 CWA 301400

ZJX CWA 104 VALID UNTIL 301600

FROM 20N ABY-20SE TLH-20SW CEW-40N CEW-20N ABY

AREA LIFR CIGS BLW 005 AND VIS BLW 1/2SM IN FG.

CONDS SLOWLY IMPRG THRU PD.

FAUS22 KZJX 301559

ZJX2 CWA 301600

ZJX CWA 204 VALID UNTIL 301800

FROM 30ENE SJI-35E CEW-80SSE CEW-80SSW CEW-30ENE SJI

AREA SCT DVLPG SHRA/TS MOV FM 17010KT. TOPS FL450.

MOD TO HVY PCPN. EXP GRAD INCR IN CVRG/INTST OVR

FL PNHDL/ADJ GULF WATERS THRU PD.

The Jacksonville CWSU issued several advisories which impacted the area over the accident site. The first was CWA #203 which was issued at 0725 CDT and valid until 0830 CDT for an area of scattered rain showers and thunderstorms with moderate to heavy precipitation. The advisory was updated by CWA #204 immediately after the accident at 1059 CDT. CWA #104 was also current at the time of the accident for an area of IFR conditions with ceilings below 500 ft agl and visibility below 1/2 mile in fog, with conditions slowly improving through the period.

9.0 Preflight Weather Briefing

A search of the FAA contract Automated Flight Service Station (AFSS) provider Leidos indicated that they had no contact with the pilot or the flight on the day of the accident for any weather briefings or inflight contacts. A similar search of ForeFlight also indicated no weather or route briefings were obtained. It is therefore unknown what the pilot familiarized himself with prior to departure regarding the reported and forecast weather conditions.

Submitted by:

Don Eick
Senior Meteorologist