



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

March 12, 2021

Specialist's Factual Report

METEOROLOGY

ERA20LA315

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A. ACCIDENT

Location: Steinhatchee, Florida
Date: September 13, 2020
Time: 1215 eastern daylight time
1615 Coordinated Universal Time (UTC)
Airplane: Van's-RV-9A; Registration: N4889R

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 official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the National Centers for Environmental Information (NCEI). In addition, the NTSB Meteorologist participated on the NTSB Air Traffic Control (ATC) workgroup during this investigation. All times are eastern daylight time (EDT) on September 13, 2020, and are based upon the 24-hour clock, where local time is -4 hours from UTC, and UTC=Z. 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. 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.

The last ATC point was at latitude 29.68547° N, Longitude 83.5048° W, with an approximate pressure altitude¹ of 5,725 feet (ft). The accident site was located within 2 miles of the last ATC point.

¹ Pressure altitude is the height above a standard datum plane (SDP), which is a theoretical level where the weight of the atmosphere is 29.92 "Hg (1,013.2 mb) as measured by a barometer. An altimeter is essentially a sensitive barometer calibrated to indicate altitude in the standard atmosphere.

D. FACTUAL 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 (FAA) Advisory Circular “Aviation Weather Services”, AC 00-45H.²

1.1 Surface Analysis Chart

The southeastern section of the NWS Surface Analysis Chart for 1100 EDT is provided as figure 1 with the approximate location of the accident site marked within the red circle. The chart identified Tropical Storm Sally in the eastern Gulf of Mexico with a pressure of 998-hectopascals (hPa). No surface frontal boundaries were located near the accident site.

The station models around the accident site depicted air temperatures in the low 80’s degrees Fahrenheit (°F), dew point temperatures in the mid 70’s °F with temperature-dew point spreads of 6°F or less, an east wind of 10 to 20 knots, and partly cloudy sky cover.

²

https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/1030235

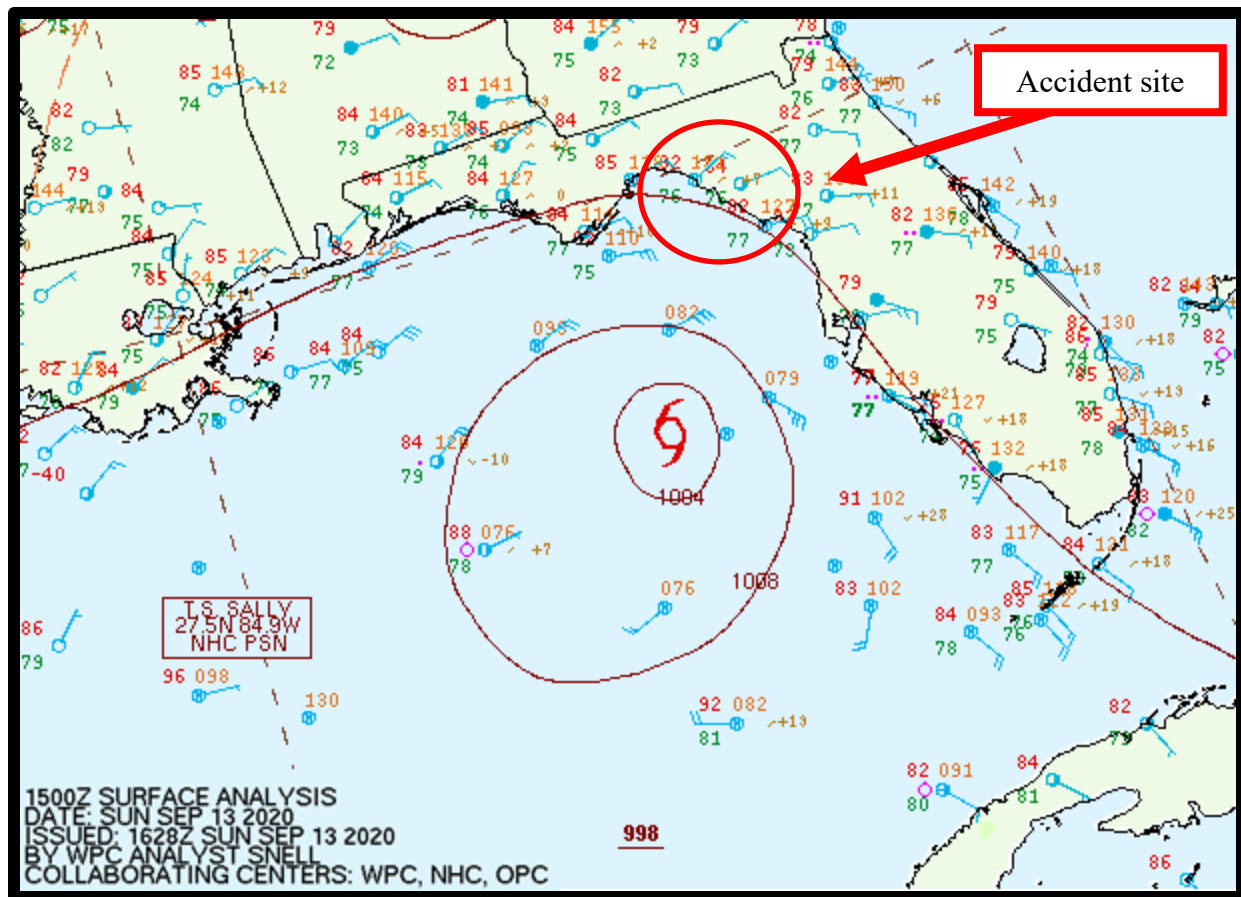


Figure 1 – NWS Surface Analysis Chart for 1100 EDT

1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 0800 EDT at 925-, 850-, 700-, 500-hPa are presented in figures 2 through 5. The low pressure center associated with Tropical Storm Sally was directly south of the accident site (figures 2, 3, and 4). Low pressure centers can act as lifting mechanisms to help produce clouds and precipitation if sufficient moisture is present. There was an east wind of 30 knots at 925-hPa above the accident site with the wind remaining easterly through 700-hPa (figure 4). The wind became southeasterly at 25 knots by 500-hPa (figure 5).

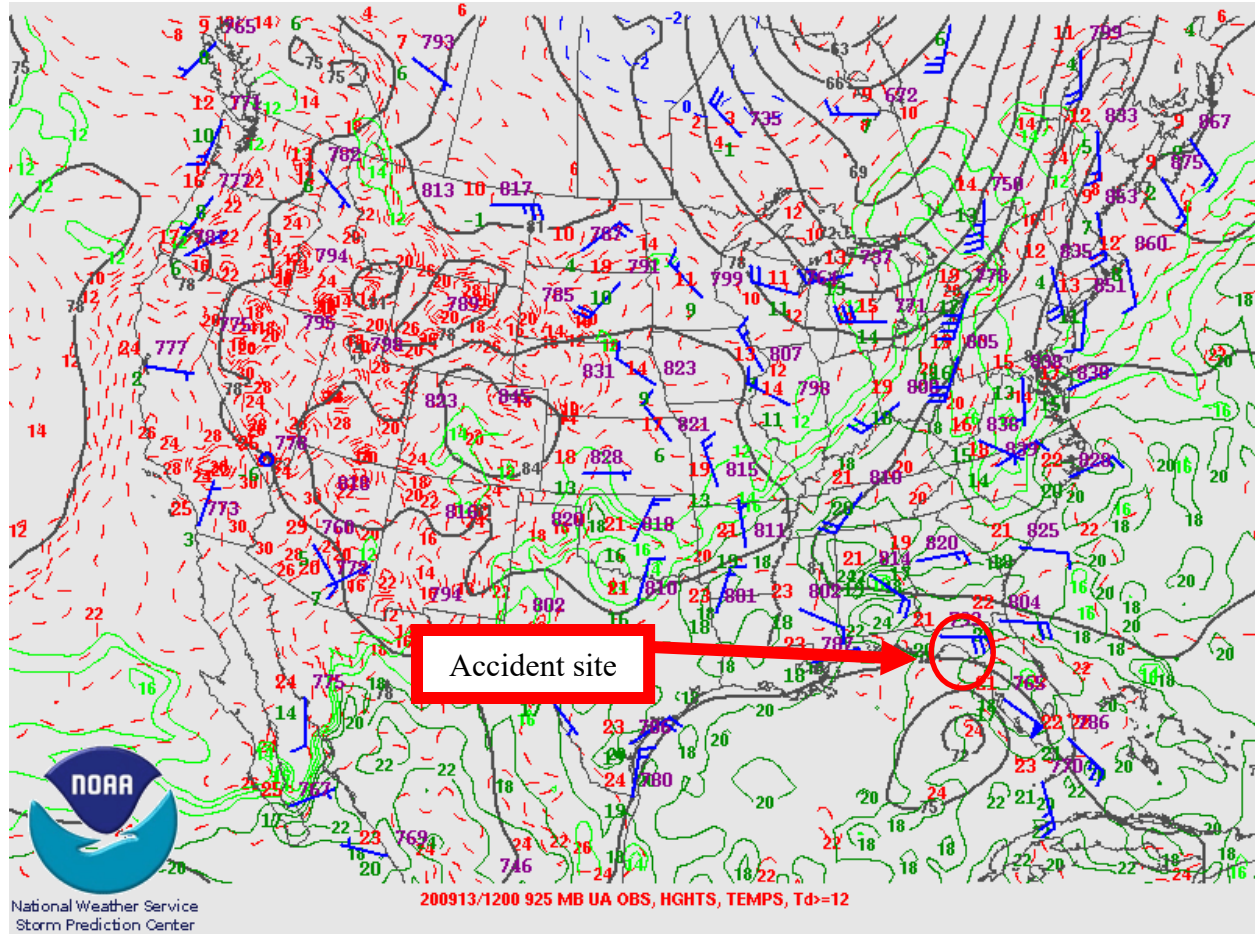


Figure 2 – 925-hPa Constant Pressure Chart for 0800 EDT

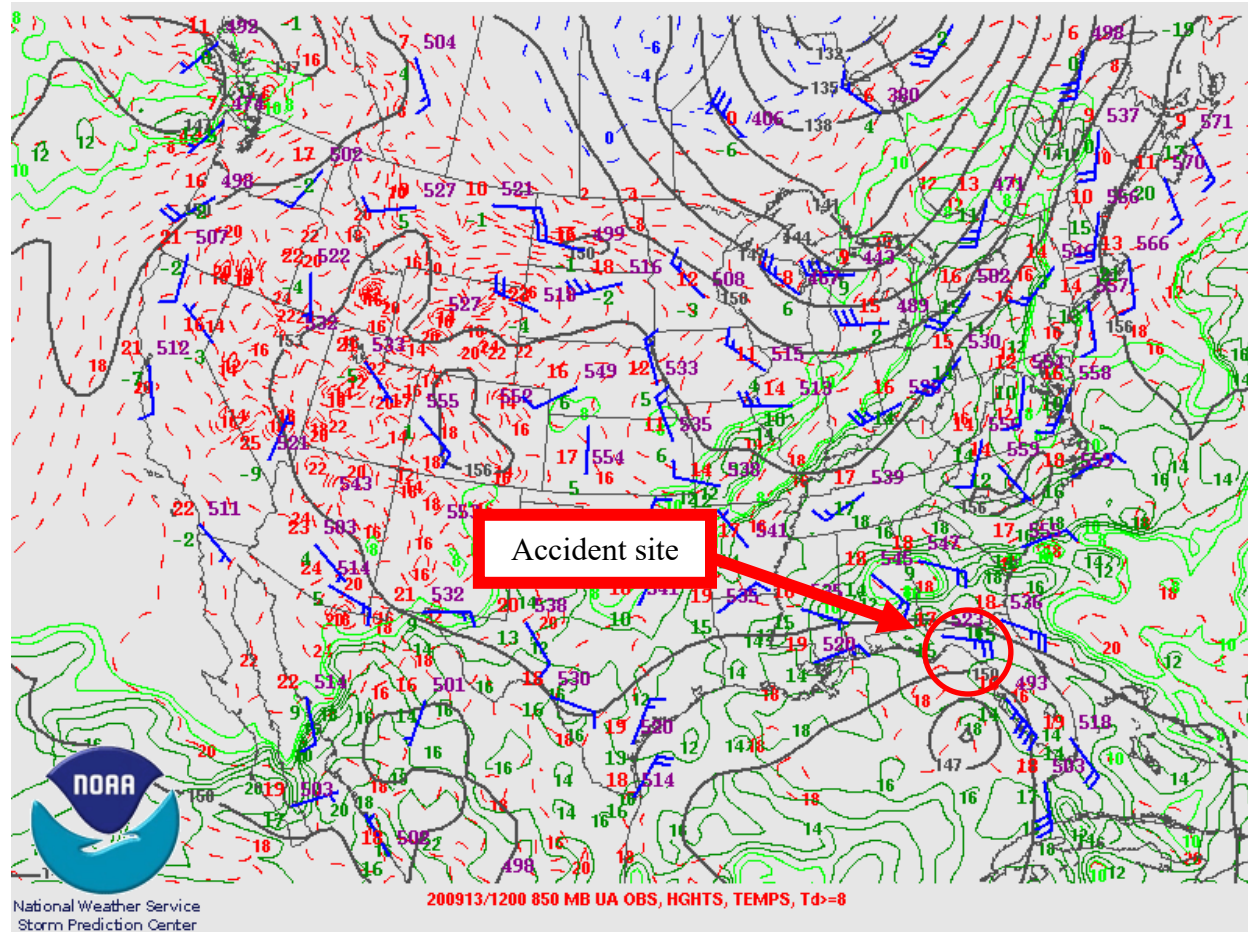


Figure 3 – 850-hPa Constant Pressure Chart for 0800 EDT

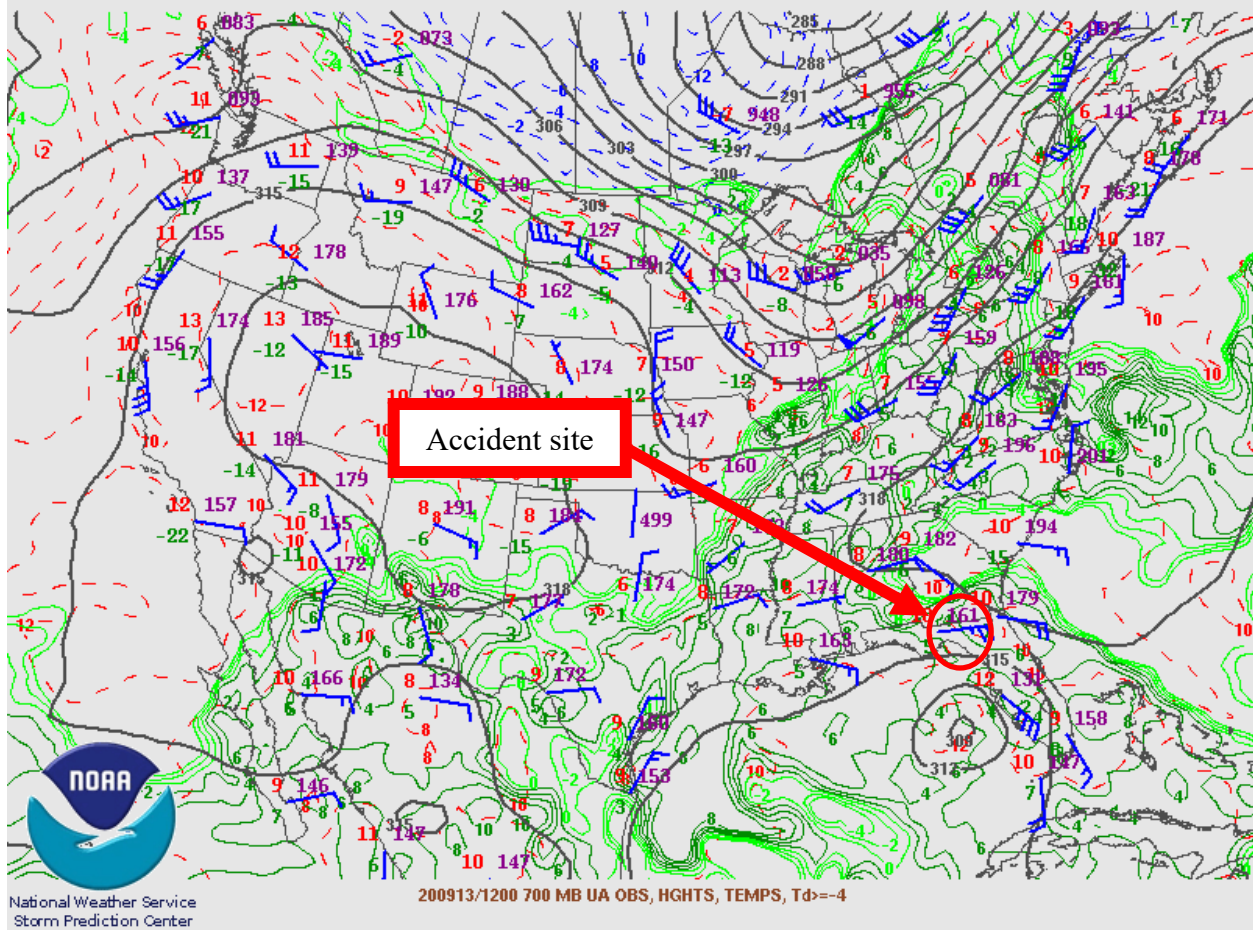


Figure 4 – 700-hPa Constant Pressure Chart for 0800 EDT

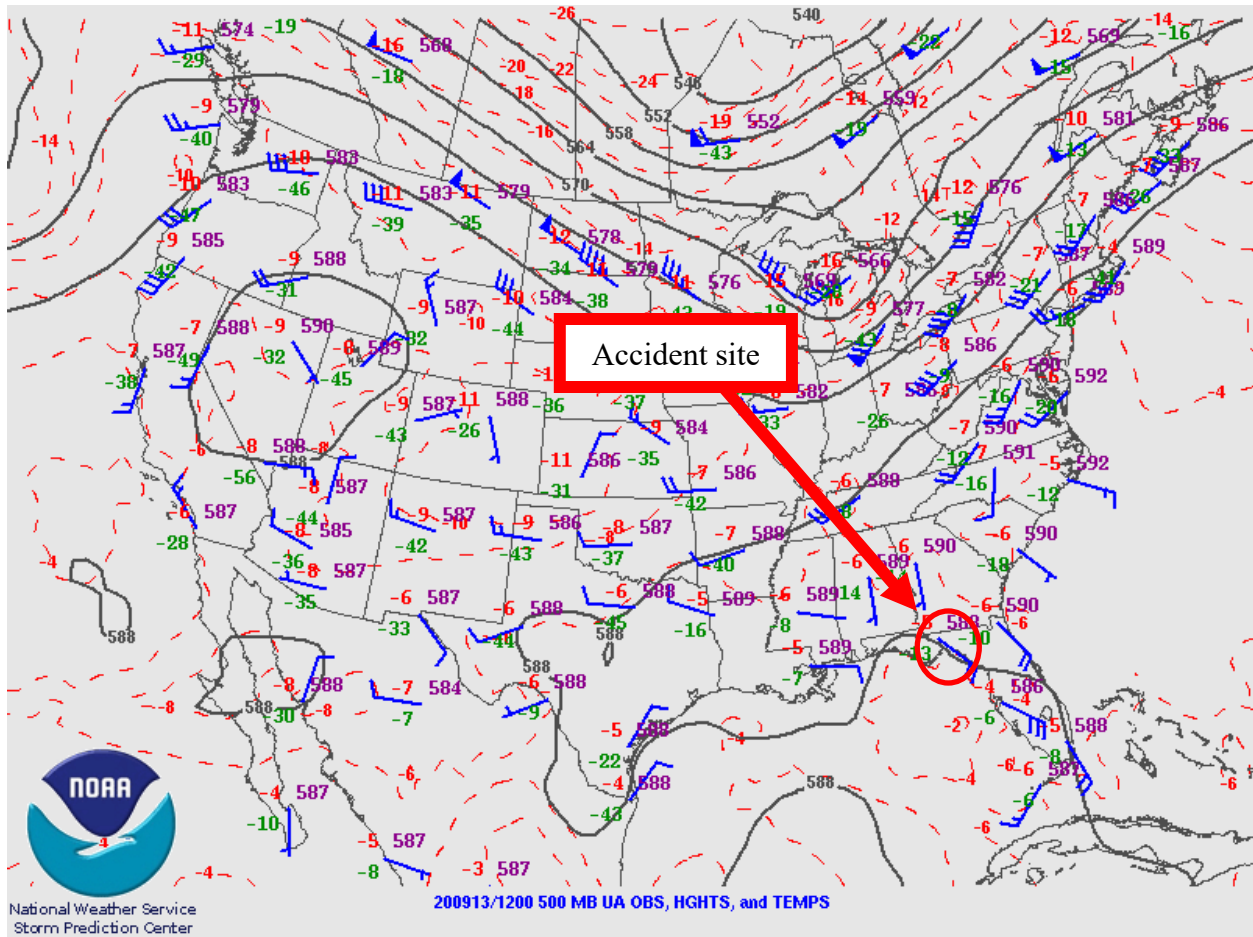


Figure 5 – 500-hPa Constant Pressure Chart for 0800 EDT

2.0 SPC Convective Outlook

SPC issued the following Day 1 Convective Outlook at 0852 EDT (figure 6) with areas of general thunderstorms forecast for the accident site. SPC defines the “TSTM” area as an area that encloses where a 10% or higher probability of thunderstorms is forecast during the valid period. The SPC Day 1 Convective Outlook text follows figure 6.

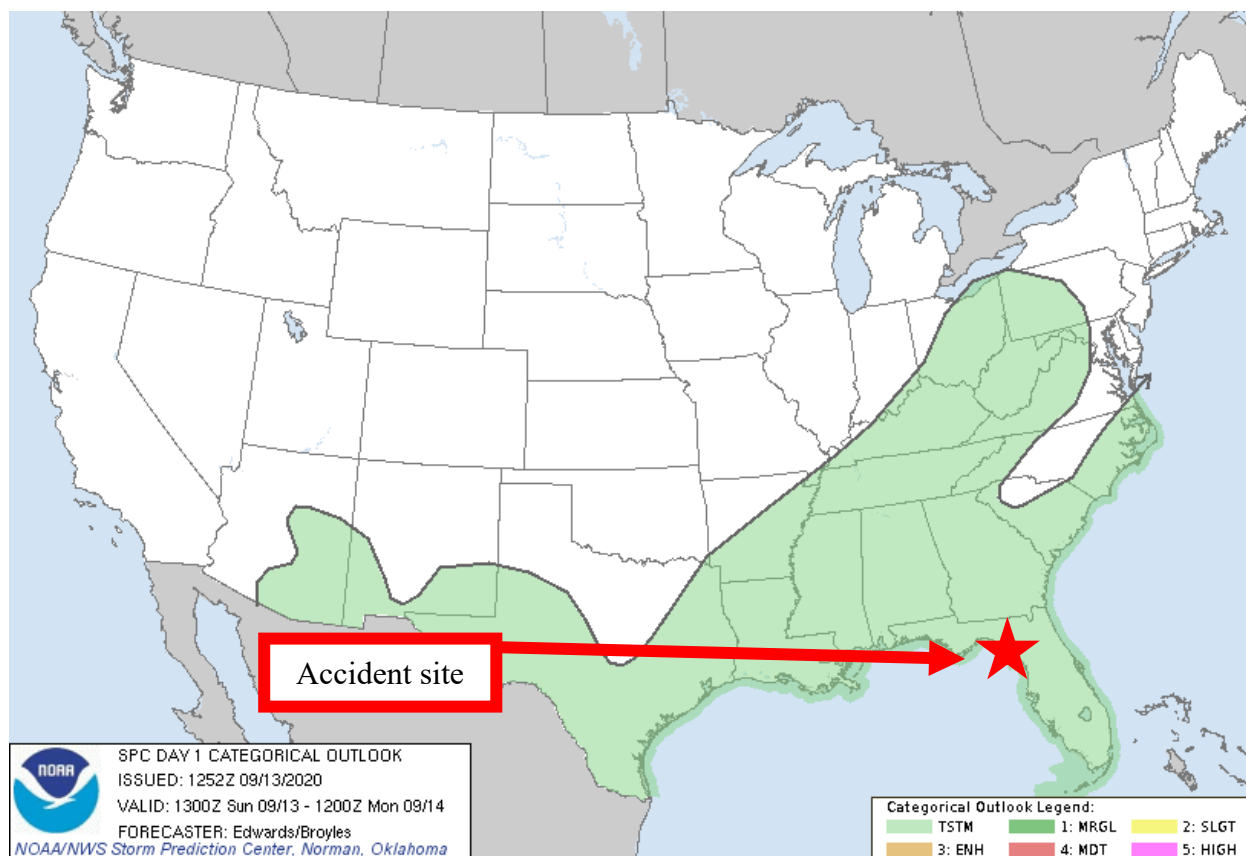


Figure 6 – SPC day 1 Convective Outlook valid at the time of the accident

SPC AC 131252

Day 1 Convective Outlook
NWS Storm Prediction Center Norman OK
0752 AM CDT Sun Sep 13 2020

Valid 131300Z - 141200Z

...NO SEVERE THUNDERSTORM AREAS FORECAST...

...SUMMARY...

Organized severe thunderstorms are unlikely across the contiguous United States today.

...Synopsis...

In mid/upper levels, ridging will remain over the Great Basin. A weak, lengthy, positively tilted vorticity ribbon will be left from the Ohio Valley across northern OK to AZ, behind a departing shortwave trough now located over the upper Great Lakes. To its east, ridging will extend nearly zonally across the southeastern CONUS, then east-northeastward to between Bermuda and Nova Scotia.

At the surface, 11Z analysis showed a cold front from southern ON across central/southern IN, and northern AR, to northwest TX. By 00Z the cold front should reach western portions of NY/PA, central KY and north TX. The boundary should reach Cape Cod, the Delmarva

Peninsula, and northern TN by 12Z, while becoming quasistationary from the MO Bootheel region to northeast TX overnight, and losing definition farther west. General thunderstorms are possible near and equatorward of this front through the period, most commonly diurnally from the upper Ohio Valley across much of the South and parts of the Southwest.

...Coastal FL Panhandle overnight...

The center of what now is Tropical Storm Sally is forecast by NHC to proceed west-northwestward across the northeastern Gulf through the period, while remaining offshore -- with the potential to become a hurricane during the SPC day-2 outlook period, before reaching southeastern Louisiana. In the meantime, outer bands or cells orbiting the northeastern quadrant, within a radius of increasing low-level shear supporting enlarged hodographs, may affect the near-coastal, southward-extending portion of the central FL Panhandle overnight.

Intensification of this system -- related to relaxation of the northwesterly deep shear -- still is very uncertain on timing and extent, as noted in the last NHC forecast discussion. That also relates to:

1. Potential for strengthening/expansion of peripheral wind fields that could form larger hodographs, and
2. Development of supercells in such an environment, at sufficient distance northeast of center to affect the coast, in order to offer at least a marginal tornado threat.

Guidance is mixed on both counts. Given these uncertainties, we will refrain from an unconditional/categorical late-period line inland for now. However, one may be added in a subsequent outlook, should the system intensify/expand more than presently predicted, or confidence otherwise increases in the more-favorable mesoscale scenario.

Please refer to the latest NHC advisories for forecast track/intensity information regarding Sally.

..Edwards/Broyles.. 09/13/2020

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NOTE: THE NEXT DAY 1 OUTLOOK IS SCHEDULED BY 1630Z

3.0 Surface Observations

The area surrounding the accident site was documented using official Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). The following observations were taken from standard code and are provided in plain language. Figure 7 is a local sectional chart with the accident site and the closest weather reporting location marked.

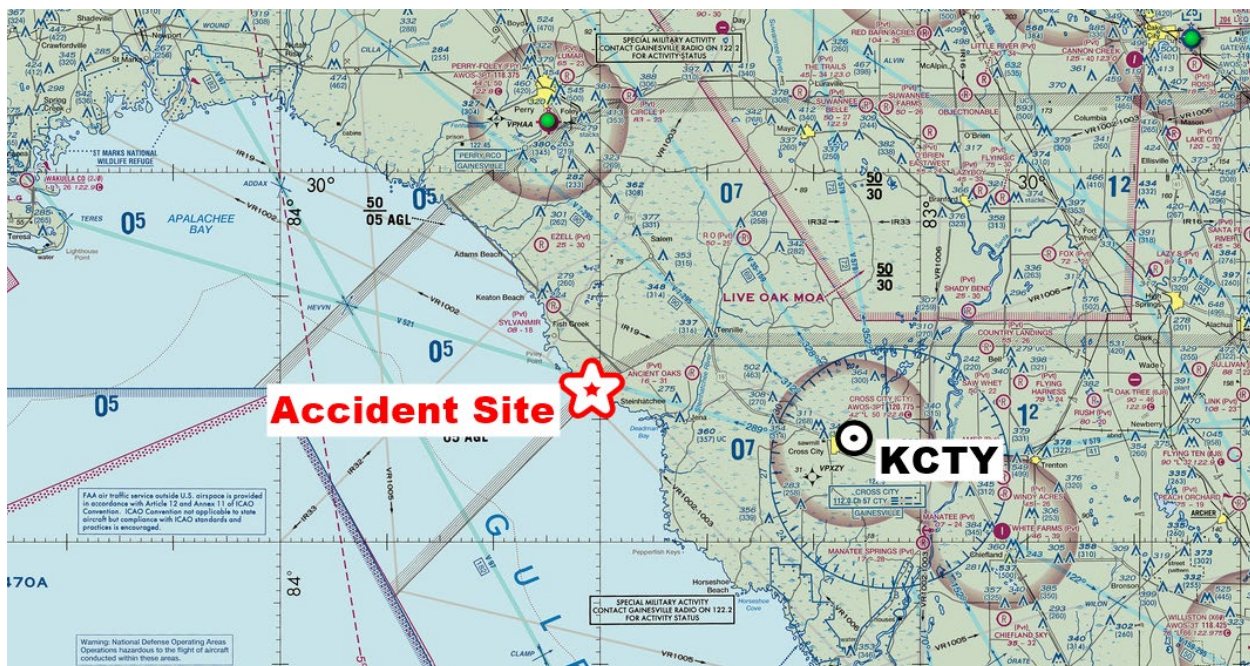


Figure 7 – Sectional map of the accident area with the location of the accident site and surface observation site

Cross City Airport (KCTY) had the closest official weather station to the accident site. KCTY had an Automated Weather Observing System (AWOS³) whose reports were not supplemented. KCTY AWOS site was located 22 miles east of the accident site, at an elevation of 42 ft, and had a 6° westerly magnetic variation⁴. The following observations were taken and disseminated during the times surrounding the accident:⁵

- [1055 EDT] METAR KCTY 131455Z AUTO 09011G18KT 10SM BKN022 BKN033 29/24 A2992 RMK AO2 T02900244=
- [1115 EDT] METAR KCTY 131515Z AUTO 11007G15KT 060V130 10SM SCT023 SCT029 SCT036 30/25 A2992 RMK AO2 T02970246=
- [1135 EDT] METAR KCTY 131535Z AUTO 09007KT 060V120 10SM BKN024 BKN032 29/25 A2992 RMK AO2 LTG DSNT E T02950246=
- [1155 EDT] METAR KCTY 131555Z AUTO 09006KT 10SM -RA SCT024 BKN033 OVC046 29/25 A2992 RMK AO2 LTG DSNT NE T02870249=

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 12,000 feet, and altimeter setting.

⁴ Magnetic variation – The angle (at a particular location) between magnetic north and true north. Latest measurement taken from <https://skyvector.com/>

⁵ The bold sections in this NWS product and the rest of the products in this report are intended to highlight the sections that directly reference the weather conditions that affected the accident location around the accident time. The local times in this section next to the METARs are provided for quick reference between UTC and local times around the accident time.

***[1215 EDT] METAR KCTY 131615Z AUTO 12007KT 10SM SCT025 SCT031 SCT046
31/25 A2991 RMK AO2 T03070246=***

ACCIDENT TIME 1215 EDT

***[1235 EDT] METAR KCTY 131635Z AUTO 12007G19KT 070V160 10SM SCT030 SCT038
SCT046 31/24 A2991 RMK AO2 LTG DSNT NE T03050242=***

**[1255 EDT] METAR KCTY 131655Z AUTO 10009G14KT 060V120 10SM SCT032 SCT038
BKN046 31/24 A2990 RMK AO2 LTG DSNT NE T03110242=**

KCTY weather at 1215 EDT, automated, wind from 120° at 7 knots, visibility 10 miles or greater, scattered clouds at 2,500 ft above ground level (agl), scattered clouds at 3,100 ft agl, scattered clouds at 4,600 ft agl, temperature of 31°Celsius (C), dew point temperature of 25°C, and an altimeter setting of 29.91 inches of mercury (inHg). Remarks: automated station with a precipitation discriminator, temperature 30.7°C, dew point temperature 24.6°C.

KCTY weather at 1235 EDT, automated, wind from 120° at 7 knots with gusts to 19 knots, wind varying between 070° and 160°, visibility 10 miles or greater, scattered clouds at 3,000 ft agl, scattered clouds at 3,800 ft agl, scattered clouds at 4,600 ft agl, temperature of 31°C, dew point temperature of 24°C, and an altimeter setting of 29.91 inHg. Remarks: automated station with a precipitation discriminator, lightning distant⁶ northeast, temperature 30.5°C, dew point temperature 24.2°C.

The observations from KCTY surrounding the accident time indicated VFR⁷ conditions with gusty and variable surface winds and lightning distant to the northeast.

⁶ Distant indicated that the lightning was beyond 10 miles but less than 30 miles from the center of the airport (or airport location point, [ALP]).

⁷ 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.

4.0 Upper Air Data

A High-Resolution Rapid Refresh (HRRR)⁸ model sounding was created for the accident site for 1200 EDT with station elevation of 0 ft.⁹ The 1200 EDT HRRR sounding was plotted on a standard Skew-T Log P diagram¹⁰ with the derived stability parameters included in figure 8 with data from the surface to 600-hPa (or approximately 14,000 ft msl). This data was analyzed using the RAOB software¹¹ package. The sounding depicted the lifted condensation level (LCL)¹² and the level of free convection (LFC)¹³ at 1,440 ft agl, and the convective condensation level (CCL)¹⁴ at 2,118 ft agl. The freezing level was located at 16,044 ft msl. The precipitable water value was 2.33 inches. The mean storm motion was from 144° at 23 knots.

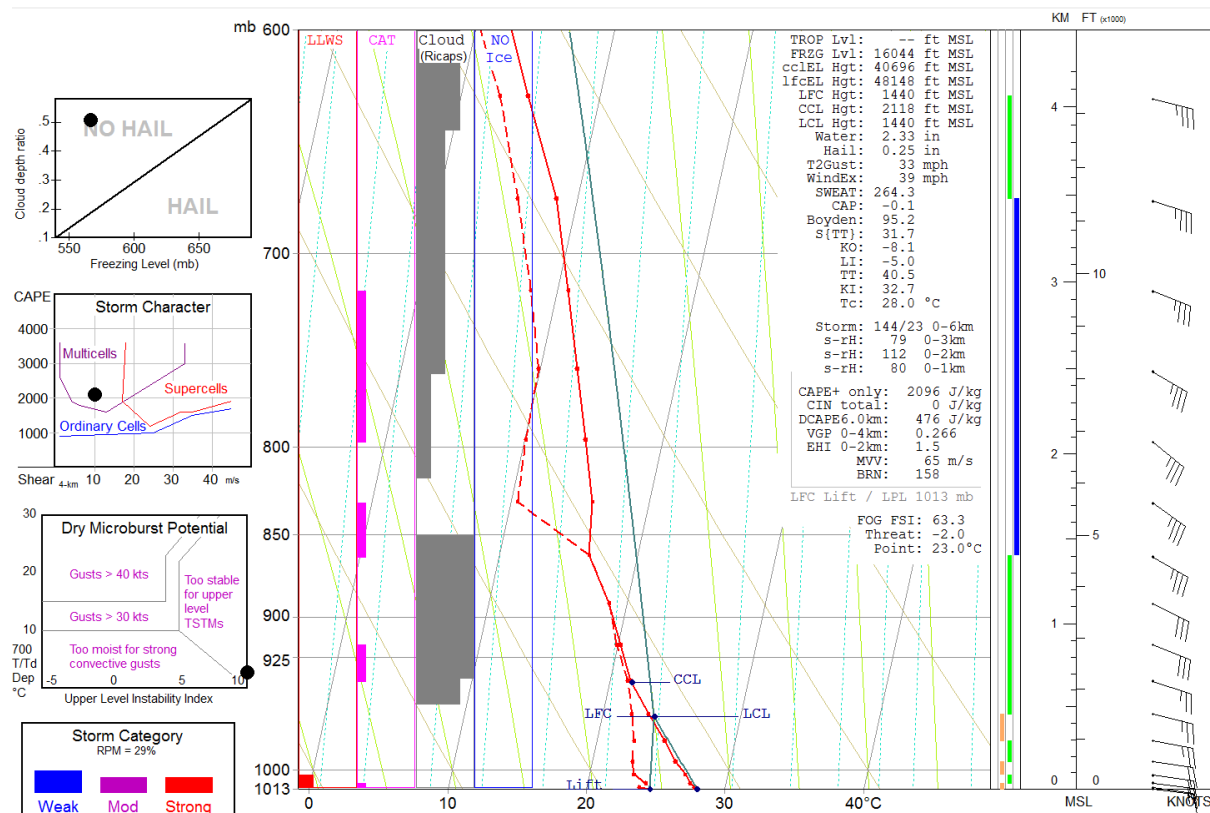


Figure 8 – 1200 EDT HRRR sounding

⁸ 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.

⁹ HRRR sounding was created using NOAA Air Resource Laboratory: <https://ready.arl.noaa.gov/READYamet.php>

¹⁰ 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.

¹¹ RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamoras, Pennsylvania.

¹² LCL - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

¹³ 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.

¹⁴ 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.

The 1200 EDT HRRR sounding for the accident site indicated an unstable atmosphere based on the Lifted Index of -5 and the Convective Available Potential Energy (CAPE)¹⁵ of 2,096 Joules/kilogram (J/kg), with the maximum vertical velocity (MVV) for this atmosphere was calculated as 65 meters/second (about 12,795 ft per minute).¹⁶ Given the environment, RAOB indicated the potential for multicell thunderstorms and rain shower development was possible. Downdraft CAPE (DCAPE; 6 kilometers agl)¹⁷ was measured at 476 J/kg. If rain showers or thunderstorms formed in this environment, the 1200 EDT HRRR sounding indicated that the strongest wind speeds possible at the surface (due to, for example, a microburst, outflow boundary, or gust front) would have been 39 mph (34 knots) according to the WindEx parameter. Outside of rain shower activity RAOB indicated cloud cover from 2,000 through 14,000 ft above msl.

The 1200 EDT HRRR sounding wind profile indicated a near surface wind from 098° at 14 knots with the wind remaining easterly through 14,000 ft. The wind speed increased to 30 knots by 3,000 ft msl. RAOB algorithm indicated the possibility of light low-level wind shear (LLWS) outside of a rain shower or thunderstorm activity between the surface and 500 ft msl. RAOB indicated that a chance of light clear-air turbulence existed in several layers outside of rain shower or thunderstorm activity between the surface and 14,000 ft. At the accident airplane's altitude before descent (and accident time)¹⁸ around 5,700 ft msl, the sounding indicated a southeast wind at 34 knots with a temperature of 15.9°C and a relative humidity of 70%.

5.0 Satellite Data

The Geostationary Operational Environmental Satellite number 16 (GOES-16) visible and infrared imagery 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 software. Visible and infrared imagery (GOES-16 bands 2 and 13) at wavelengths of 0.64 microns (μm) and 10.3 μm, respectively, were retrieved for the period from 1000 EDT through 1300 EDT and reviewed, and the closest images to the time of the accident were documented.

Figures 9 and 10 present the GOES-16 visible imagery at 1210 and 1220 EDT at 2X magnification with the accident site highlighted with a red square. The visible imagery indicated an extensive layer of cloud cover with cumuliform cloud cover closest to the ground and cirriform cloud cover above. The cloud cover moving from southeast to northwest (attachment 1) with the cumuliform cloud cover growing and expanding in areal extent through the accident time.

¹⁵ 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.

¹⁶ MVV is not usually considered a realistic estimate for maximum vertical velocity in a storm. Anecdotes suggest considering a value of MVV/2, however it is not well understood when or where such a half-value should be applied.

¹⁷ The DCAPE can be used to estimate the potential strength of rain-cooled downdrafts within thunderstorm convection, and is similar to CAPE. Larger DCAPE values are associated with stronger downdrafts.

¹⁸ For more information please see the NTSB ATC information in the docket for this accident.

Figure 11 presents the GOES-16 infrared imagery from 1640 EDT at 6X magnification with the accident site highlighted with a red square. The lower brightness temperatures (blue and green colors; higher cloud tops) were located to the southwest through east of the accident site. Based on the brightness temperatures above the accident site and the vertical temperature profile provided by the 1200 EDT HRRR sounding, the approximate cloud-top heights over the accident site were 13,000 ft at 1220 EDT (278 Kelvin). It should be noted these figures have not been corrected for any parallax error.

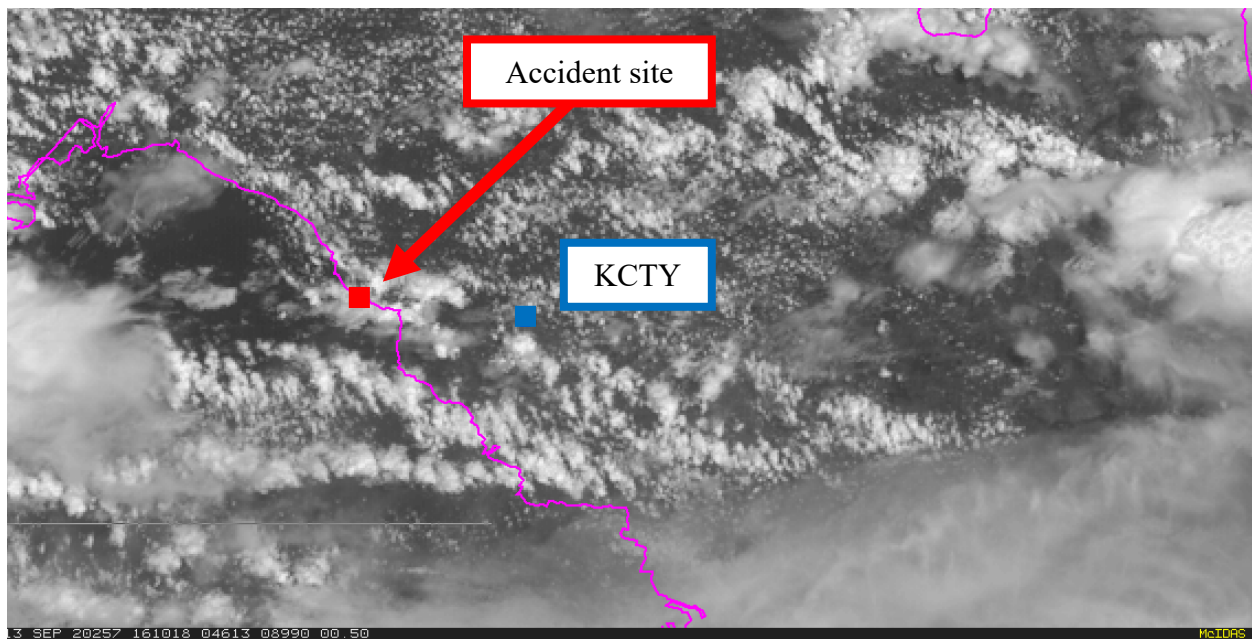


Figure 9 – GOES-16 visible image at 1210 EDT

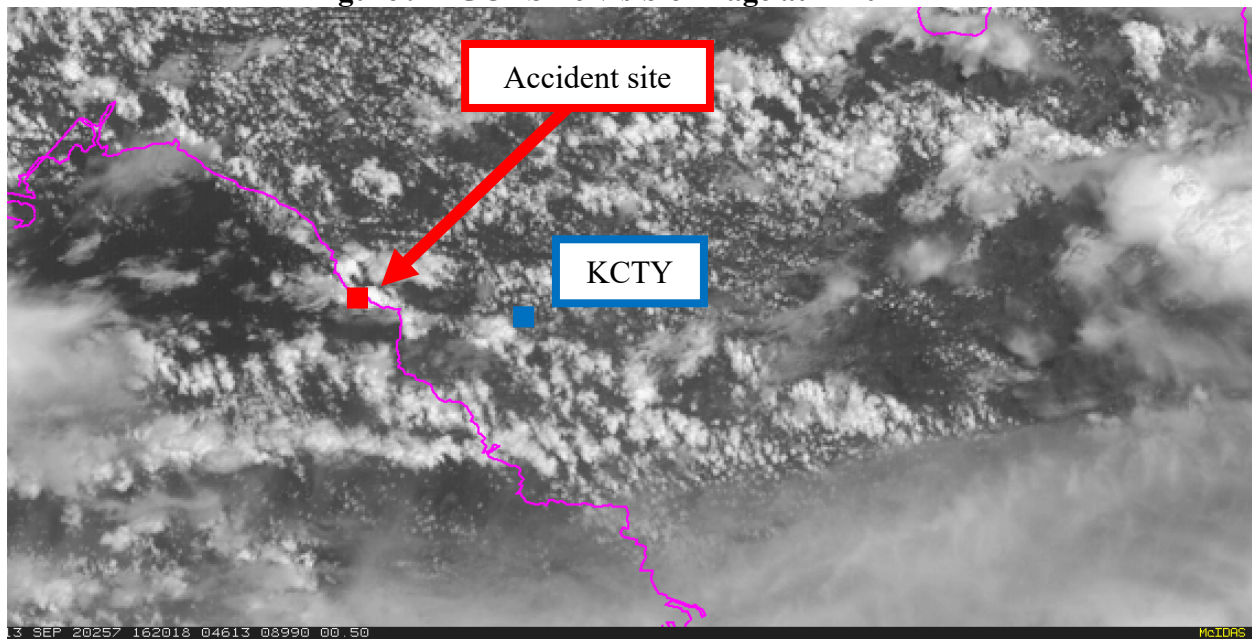


Figure 10 – GOES-16 visible image at 1220 EDT

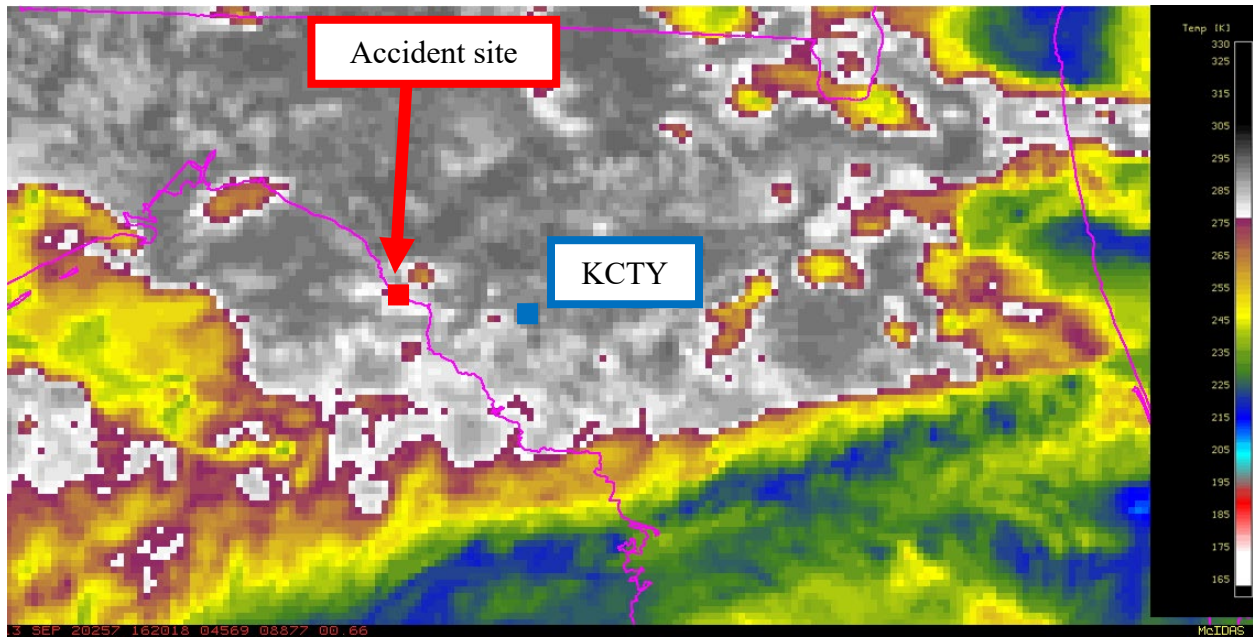


Figure 11 – GOES-16 infrared image at 1220 EDT

6.0 Regional Radar Imagery Information

A regional view of the NWS national composite radar mosaic is included as figure 12 for 1215 EDT with the approximate location of the accident site marked within a red circle. The image depicted echoes from 20 to 45 decibels (dBZ¹⁹) above the accident site.

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.

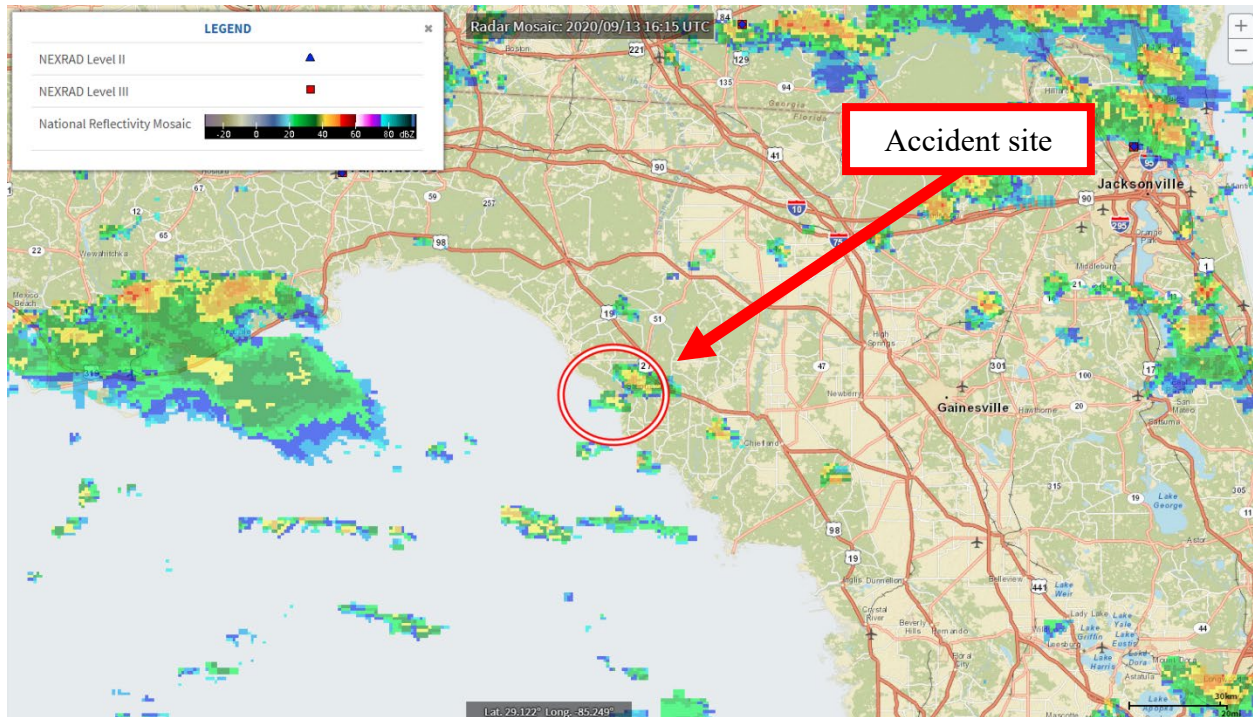


Figure 12 – Regional Composite Reflectivity image for 1215 EDT

7.0 Radar Imagery Information

The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D)²⁰ to the accident site was Tallahassee, Florida (KTLH) located 59 miles northwest of the accident site. Level II archive radar data was obtained from the NCEI utilizing the NEXRAD Data Inventory Search and displayed using the NOAA's Weather and Climate Toolkit software.

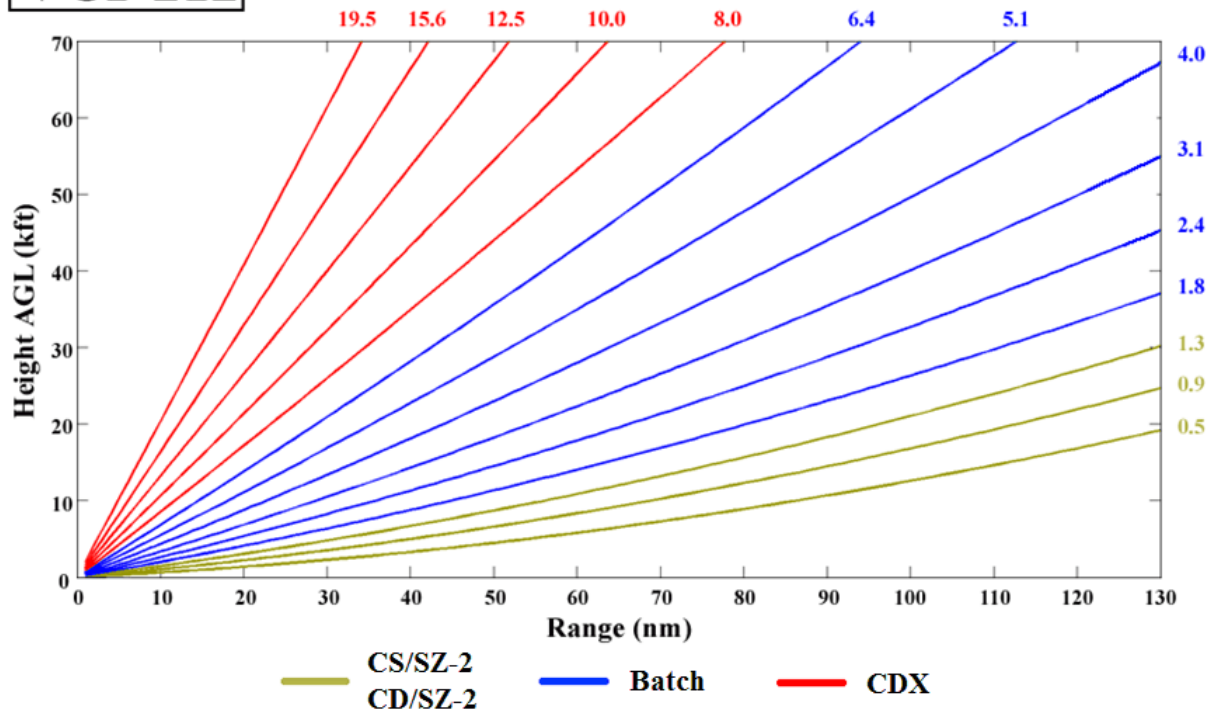
7.1 Volume Scan Strategy

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. Products that require data from multiple elevation scans are not available until the end of the five to ten minute volume scan.

The WSR-88D operates in several different scanning modes, identified as Mode A and Mode B. Mode A is the precipitation scan and has three common scanning strategies. The most common is where the radar makes 14 elevation scans from 0.5° to 19.5° every four and a half minutes. This particular scanning strategy is documented as volume coverage pattern 212 (VCP-212). 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 KTLH WSR-88D radar was operating in the precipitation mode VCP-212. 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.

²⁰ 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.

VCP 212



VCP-212 Precipitation Mode Scan Strategy²¹

7.2 Beam Height Calculation

Assuming standard refraction²² of the KTLH WSR-88D radar beam with the antenna elevation at 176 ft, and considering a beamwidth²³ of 0.95°, the following table shows the approximate heights for the radar beam center, top and base for antenna elevations over the accident site. These heights have been rounded to the nearest 10 ft.

ANTENNA ELEVATION	BEAM CENTER	BEAM BASE	BEAM TOP
KTLH 0.5°	5,830 ft	2,920 ft	8,740 ft

²¹ Contiguous Surveillance (CS)--The low Pulse Repetition Frequency (PRF) scan of the split cut. Gives a high R_{max} value to determine proper target location and intensity, but a low V_{max} value limits the velocities that can be measured. Contiguous Doppler (CD)--The high PRF scan of the split cut. Gives a low R_{max} value causing more range folded (multiple trip) echoes, but a high V_{max} value to get higher, more accurate velocity values.

Batch Mode – Uses alternating low and high PRFs on each radial for one full rotation at each elevation angle. The two resulting data sets (low PRF and high PRF) are combined to resolve range ambiguity. Used in the middle elevation angles.

W – With range unfolding (W)

WO – Without range unfolding (WO)

²² Standard Refraction in the atmosphere is when the temperature and humidity distributions are approximately average, and values set at the standard atmosphere.

²³ Beamwidth - the angular separation between the half power points on the antenna radiation pattern, where the gain is one half the maximum value.

Based on the radar height calculations, the elevation scans from KTLH listed in the above table depicted the conditions between 2,920 ft and 8,740 ft above msl over the accident site and these scans “saw” the closest altitudes to the accident aircraft’s flight level before the descent in altitude.^{24,25}

7.3 Reflectivity

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors²⁶ 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 dBZ and is a general measure of echo intensity. FAA Advisory Circular AC 00-24C²⁷, “Thunderstorms,” dated February 19, 2013, also defines the echo intensity levels and weather radar echo intensity terminology associated with those levels. For dBZ values less than 30 the weather radar echo intensity terminology should be “light.” For dBZ values between 30 and 40, the terminology should be “moderate.” “Heavy” terminology is used for dBZ values greater than 40 dBZ but less than 50 dBZ, inclusive. Finally, any dBZ values above 50 dBZ shall be described as “extreme.”

²⁴ 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 standard 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.

²⁵ For more information please see ATC data located in the docket of this accident.

²⁶ 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.

²⁷

https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/1020774

7.4 Base Reflectivity and Lightning Data

Figures 13 through 19 present the KTLH WSR-88D base reflectivity images for the 0.5° elevation scans initiated at 1155:25, 1208:43, 1213:08, 1215:17, 1218:10, 1223:00, and 1227:49 EDT, respectively, with a resolution of 0.5° X 250 m. Reflectivity values between 35 and 47 dBZ were located above the accident site at the accident time and indicative of moderate to heavy rainfall (section 7.3). The band of rain showers was moving from southeast to northwest with time (attachment 2).

There were no lightning flashes²⁸ near the accident site at the accident time.²⁹

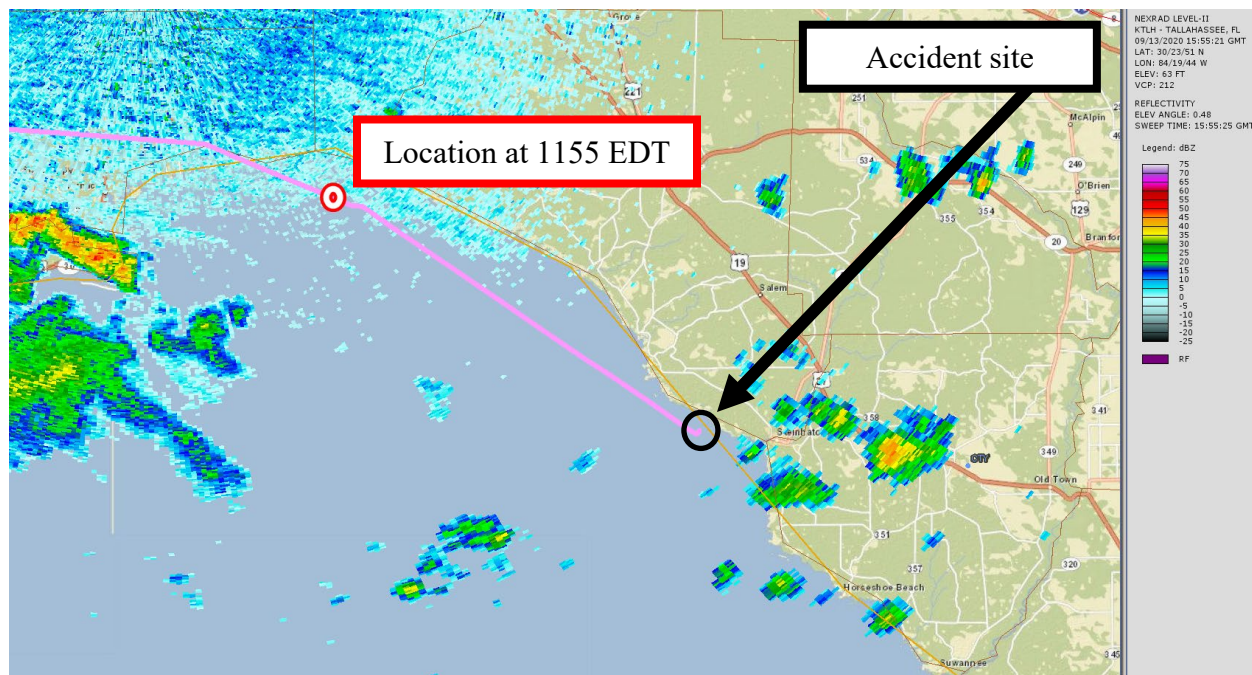


Figure 13 – KTLH WSR-88D reflectivity for the 0.5° elevation scan initiated at 1155:25 EDT with the accident site marked with black circle and the accident flight track in pink

²⁸ Lightning Flash – This is one contiguous conducting channel and all the current strokes/pulses that flow through it. There are two types of flashes: ground flashes and cloud flashes.

²⁹ A review of Earth Networks Total Lightning network was done.

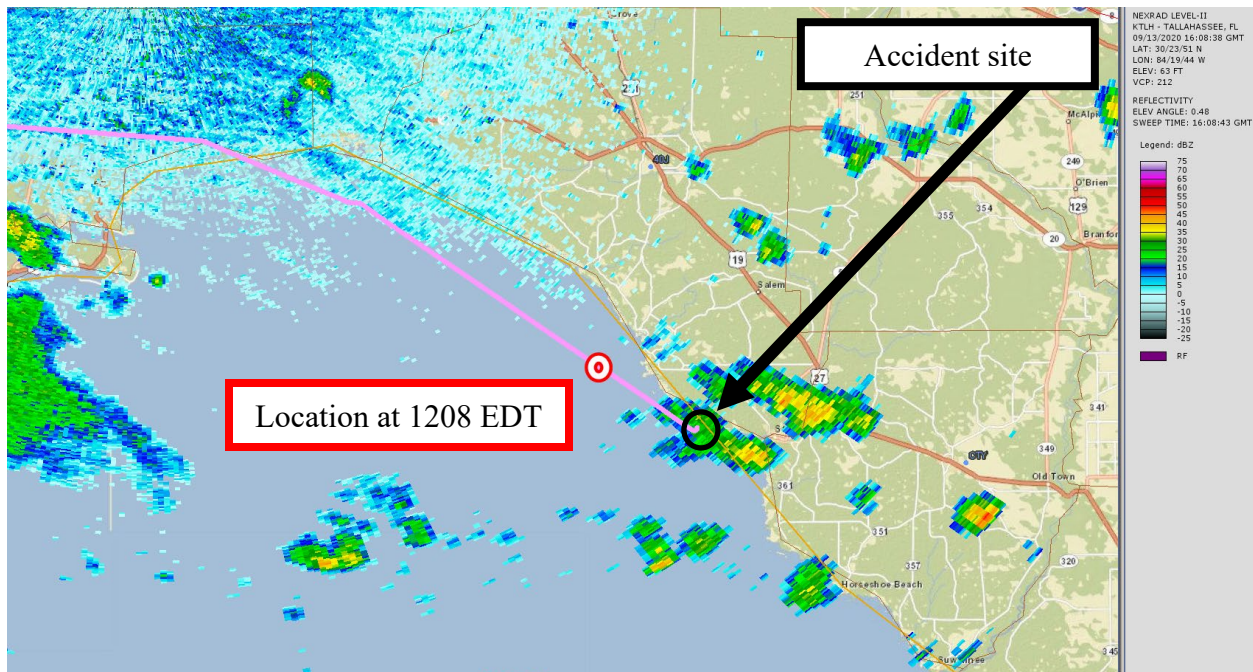


Figure 14 – KTLH WSR-88D reflectivity for the 0.5° elevation scan initiated at 1208:43 EDT with the accident site marked with black circle and the accident flight track in pink

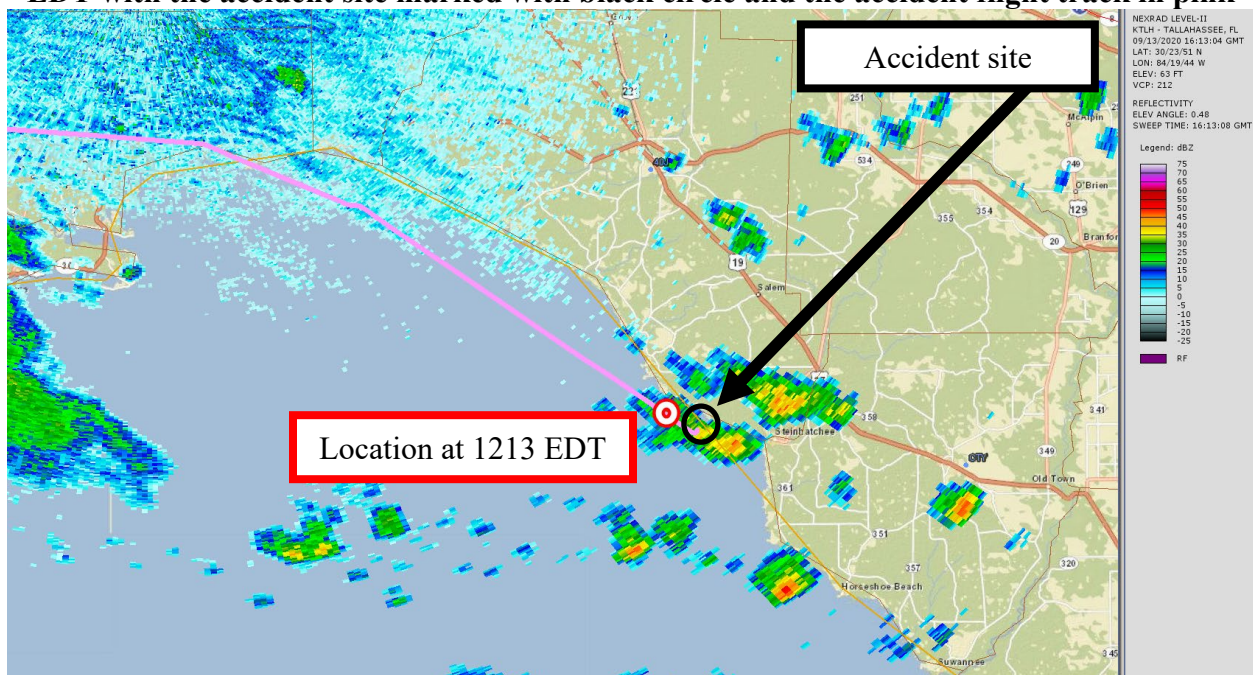


Figure 15 – KTLH WSR-88D reflectivity for the 0.5° elevation scan initiated at 1213:08 EDT with the accident site marked with black circle and the accident flight track in pink

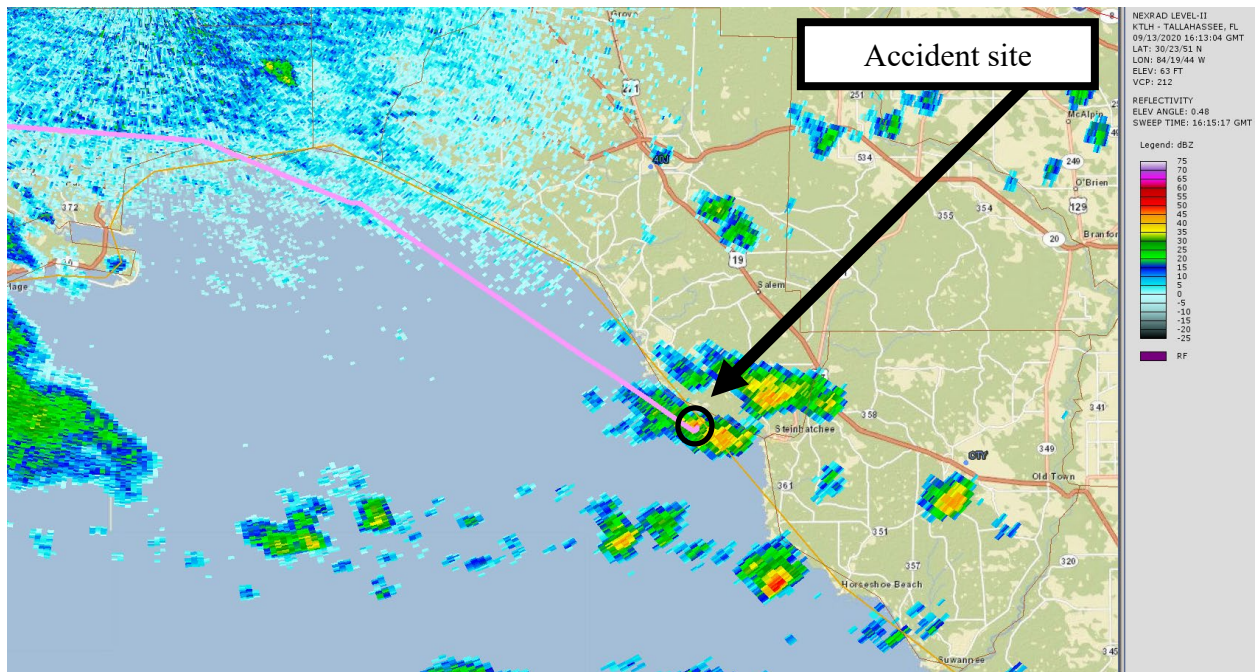


Figure 16 – KTLH WSR-88D reflectivity for the 0.5° elevation scan initiated at 1215:17 EDT with the accident site marked with black circle and the accident flight track in pink

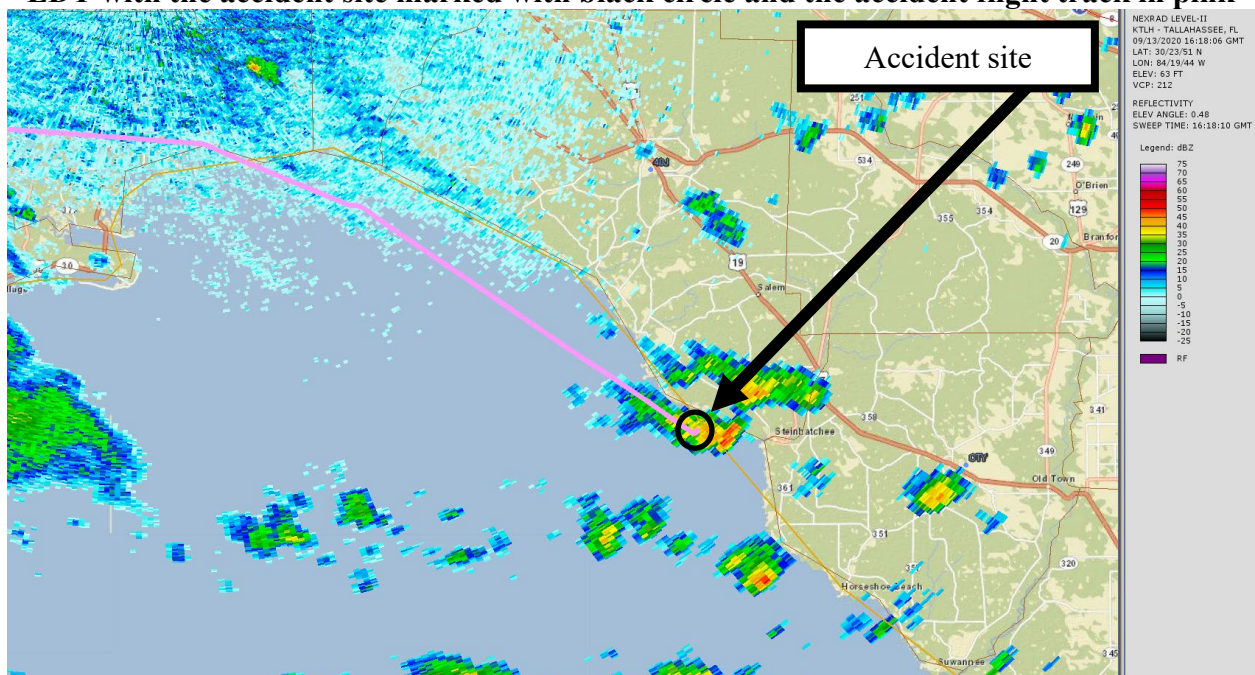


Figure 17 – KTLH WSR-88D reflectivity for the 0.5° elevation scan initiated at 1218:10 EDT with the accident site marked with black circle and the accident flight track in pink

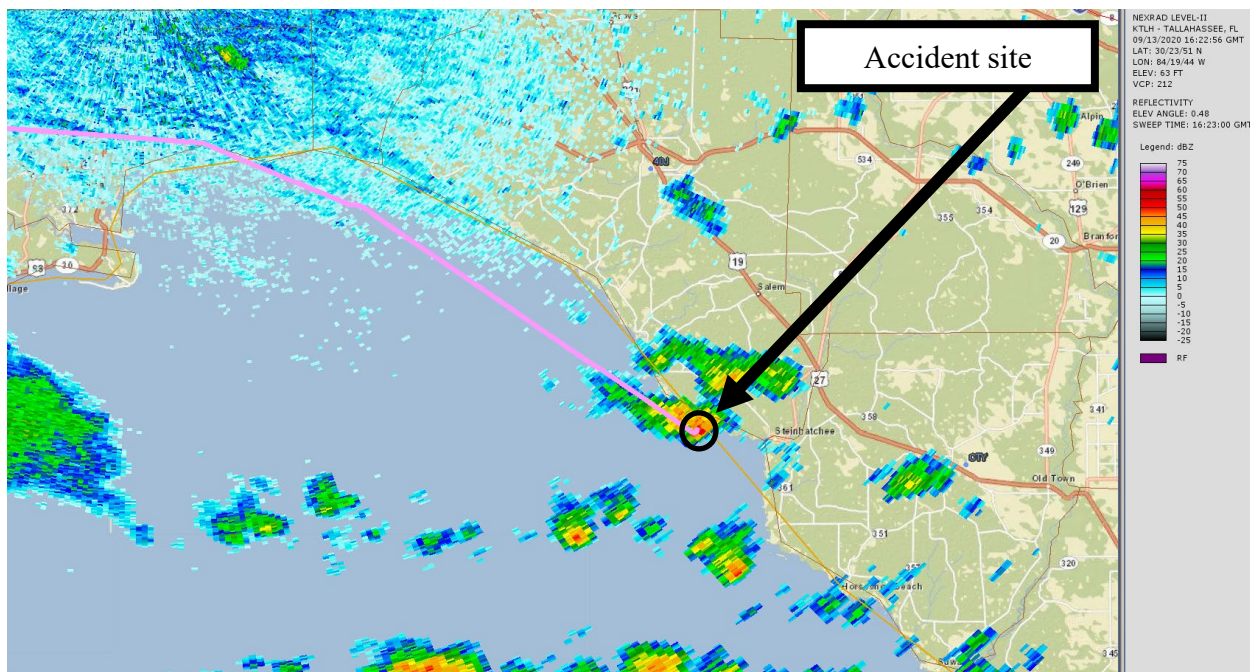


Figure 18 – KTLH WSR-88D reflectivity for the 0.5° elevation scan initiated at 1223:00 EDT with the accident site marked with black circle and the accident flight track in pink

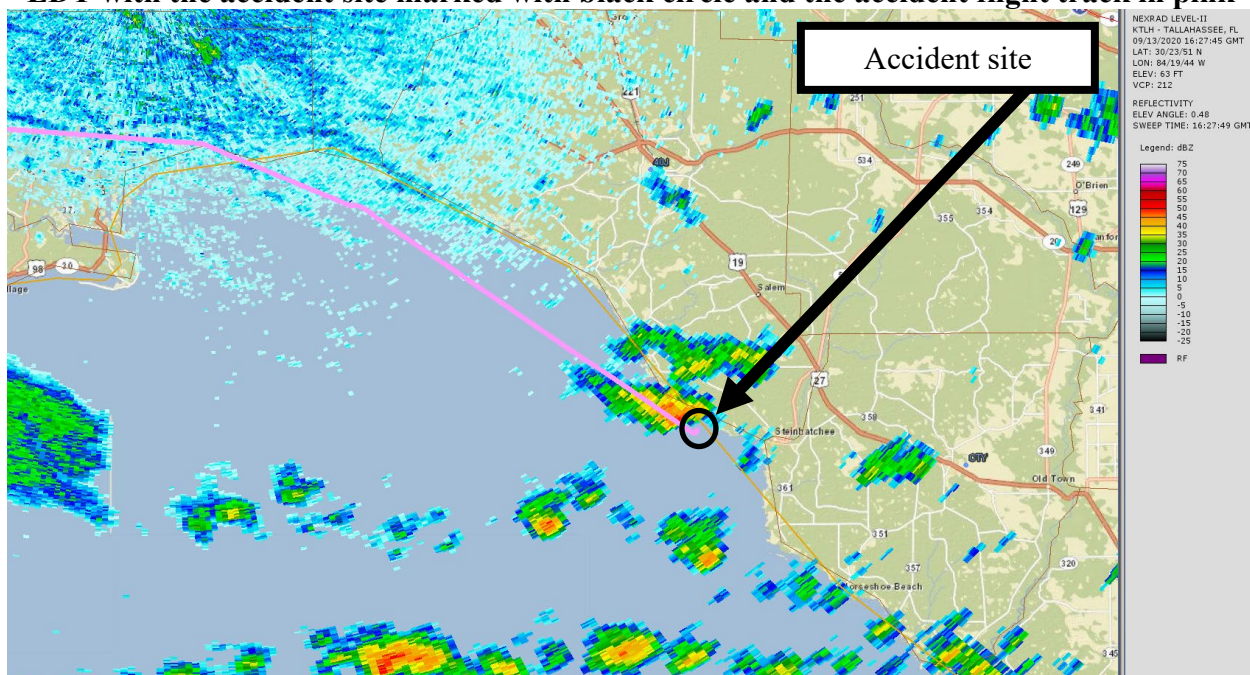


Figure 19 – KTLH WSR-88D reflectivity for the 0.5° elevation scan initiated at 1227:49 EDT with the accident site marked with black circle and the accident flight track in pink

8.0 Pilot Reports³⁰

There were three pilot reports (PIREPs) distributed into the national airspace within 100 miles of the accident site between 1015 and 1415 EDT below 18,000 ft msl. The ATC personnel in contact with the accident aircraft from Jacksonville Air Route Traffic Control Center (ZJX ARTCC) did not request nor receive PIREPs (ride reports) throughout the accident timeframe.³¹

BKV UA /OV KBKV/TM 1550/FL012/TP C550/SK SCT019 BKV035/WX FV10SM/RM BASES 012. BKN LAYER ABOVE

JAX UA /OV OCF/TM 1723/FLFNL/TP F2TH/SK BASE 020

JAX UA /OV OCF/TM 1737/FLDURGD/TP GALX/SK OVC023

9.0 SIGMET

There were no convective or non-convective Significant Meteorological Information (SIGMET) advisories valid for the accident site at the accident time.

10.0 CWSU Advisories

The ZJX Center Weather Service Unit (CWSU) was responsible for the region. The ZJX CWSU issued no Meteorological Impact Statements (MIS) for the area prior to the accident. ZJX CWSU issued had Center Weather Advisory (CWA) 204 at 1051 EDT valid until 1300 EDT. The CWA 204 warned of an area of scattered rain showers and thunderstorms with tops to FL420 with moderate to heavy precipitation. The forecast box was expected to move from 150° at 15 knots and it was expected that the rain shower and thunderstorm coverage and intensity would increase between 1051 and 1300 EDT.

At 1159 EDT, the CWSU issued CWA 205, which was valid for the accident area through 1400 EDT. The advisory warned of an area of scattered rain showers and thunderstorms with tops to FL420 with moderate to heavy precipitation. The forecast box was expected to move from 160° at 15 knots and it was expected that the rain shower and thunderstorm coverage and intensity would increase between 1159 and 1400 EDT:

FAUS22 KZJX 131451
ZJX2 CWA 131500
ZJX CWA 204 VALID UNTIL 131700
FROM 20NNE AMG-70NE CRG-100NNE TRV-10E ORL-100SW SZW-20NNE AMG
**AREA SCT SHRA/TS MOV FM 15015KT. TOPS FL420. MOD
TO HVY PCPN. EXP GRAD INCR IN CVRG/INTST OVR
GA/FL/ADJ ATLC WATERS THRU PD.**

=

FAUS22 KZJX 131559

³⁰ Only pilot reports with the World Meteorological Organization headers UBFL**, UBGA**, and UBAL** were considered.

³¹ For more information please see the ATC factual located in the docket for this accident.

ZJX2 CWA 131600
ZJX CWA 205 VALID UNTIL 131800
FROM 40NW SAV-80E OMN-25SW ORL-145ESE SJI-40NW SAV
**AREA SCT SHRA/TS MOV FM 16015KT. TOPS FL420. MOD
TO HVY PCPN. EXP GRAD INCR IN CVRG/INTST OVR
GA/FL/ADJ ATLC WATERS THRU PD.**

=

11.0 AIRMETs

Airmen's Meteorological Information (AIRMET) advisory Tango was valid for the accident site at the accident time. The AIRMET warned of moderate turbulence conditions below 12,000 ft:

WAUS42 KKCI 131445
WA2T
-MIAT WA 131445
AIRMET TANGO UPDT 2 FOR TURB AND STG SFC WNDS VALID UNTIL 132100
.
AIRMET TURB...GA FL AND CSTL WTRS
FROM 50S SAV TO 210SE CHS TO 180E PBI TO 70ENE PBI TO 150SE MIA
TO 80WSW EYW TO 90WSW PIE TO 210S CEW TO 70SW TLH TO 50S SAV
MOD TURB BTN FL240 AND FL400. CONDS CONTG BYD 21Z THRU 03Z.
.
**AIRMET TURB...FL AND CSTL WTRS
FROM 60WNW TLH TO 20N CTY TO 20WNW ORL TO 40NE RSW TO 50S RSW TO
80WSW RSW TO 90WSW SRQ TO 150WSW SRQ TO 140SE LEV TO 30ESE SJI
TO 60WNW TLH
MOD TURB BLW 120. CONDS CONTG BYD 21Z THRU 03Z.**
.
AIRMET STG SFC WNDS...FL CSTL WTRS
FROM 100SSW TLH TO 70SW CTY TO 30W PIE TO 40WSW SRQ TO 100SW SRQ
TO 90WSW PIE TO 210S CEW TO 110S CEW TO 100SSW TLH
SUSTAINED SURFACE WINDS GTR THAN 30KT EXP. CONDS CONTG BYD 21Z
THRU 03Z.
....

12.0 Graphical Forecasts for Aviation

The Graphical Forecasts for Aviation (GFA) products made available before the accident flight and valid at 1100 EDT are shown in attachment 3. The GFA surface forecast products indicated VFR surface visibilities with scattered (between 30 and 50 percent chance) thunderstorm activity and a surface wind from the east at 10 to 15 knots. The GFA cloud forecast valid before departure for around the accident time indicated few clouds at 2,200 to 2,900 ft msl, with cirrus clouds above. For more information please see attachment 3.

13.0 Terminal Aerodrome Forecast

There were no NWS Terminal Aerodrome Forecast (TAF) valid within 30 miles of the accident site.

14.0 NWS Area Forecast Discussion

The NWS office in Tallahassee, Florida, issued the following Area Forecast Discussion (AFD) at 0929 EDT (closest AFD to the accident time). The aviation section of the AFD discussed the IFR to MVFR ceilings with rain showers and thunderstorms by the afternoon:

FXUS62 KTAE 131329
AFDTAE

Area Forecast Discussion
National Weather Service Tallahassee FL
929 AM EDT Sun Sep 13 2020

.UPDATE...

No significant changes to the previous forecast appear necessary this morning. Several breaks in the cloud cover are noted on visible imagery this morning with fairly strong low level flow just above the surface on the 12z KTAE sounding. Daytime heating will allow for gusty winds later this morning into the afternoon, particularly with afternoon convection that is expected to develop. Locally heavy rain is also expected with any convective banding that occurs.

&&

.PREV DISCUSSION [630 AM EDT]...

.NEAR TERM [Through Tonight]...

Tropical Storm Sally will continue moving westward across the Eastern Gulf of Mexico today per the official forecast from NHC. A deep easterly flow will remain across the region, with tropical moisture advection, as shown in Precipitable Water values (PW) approaching 2.4 inches! The main concern late this morning into the evening is heavy rainfall, especially near an axis along Cross City-Tallahassee-Geneva. There will be an instability gradient that is expected to focus convection, with the potential for cells to move repeatedly across the same area. A Flash Flood Watch is in effect from Franklin County northwestward to Walton County. Otherwise, thunderstorms could produce gusty winds.

.SHORT TERM [Monday Through Thursday]...

Sally is expected to make landfall as a hurricane along the north-central gulf coast by early this week. This will maintain a heavy rainfall potential across much of the area, with a drying trend beginning late on Thursday from south to north. The flash flood watch remains in effect through Tuesday for the heaviest rainfall closer to the coast, but minor flooding will be possible thereafter. Will also have to watch thunderstorm/potential for a brief tornado through mid-week as well.

.LONG TERM [Tuesday through Sunday]...

The remnants of Sally will slide east of the region at the start of the long term, though some lingering moisture will allow for chance PoPs into the weekend. Highs will be in the 80s and at least a couple degrees below normal while lows will range from the mid 60s to mid 70s.

.AVIATION...

[Through 12Z Monday]

IFR to MVFR conditions have developed across the majority of the terminals this morning. Cigs should improve by mid morning. Rain showers will begin to develop more and move from east to west across the terminals with TSRA expected by afternoon. With the influence of Tropical Storm Sally, convection will persist into tonight.

.MARINE...

Tropical Storm Sally, located off the southwest coast of Florida this morning, will track west northwest across the Gulf of Mexico through early this week and bring increased winds and seas through Tuesday. A Tropical Storm Warning remains in effect for the offshore waters from Apalachicola westward with a Tropical Storm Watch in effect for the remainder of the marine area, except for the eastern nearshore waters. In addition to the strong winds and high seas, an enhanced potential for waterspouts exists through Monday due to the impacts from Sally. Showers and thunderstorms are expected each day.

.FIRE WEATHER...

Red Flag conditions are not expected over the next several days.

.HYDROLOGY...

Chances for precipitation will be at above normal levels through Tuesday roughly southeast of the Flint River and I-10. From Wednesday through the end of the week, the entire region will see above average precip chances. Average precipitation amounts are expected to range from up to 2 inches in Dixie County tapering down northwestward to around one half of an inch in the Wiregrass Region. Saturated areas, such as the Steinhatchee Basin, could have minor flooding issues if locally higher rainfall occurs over a short period of time. Otherwise, the anomalously moist air mass and slow storm motions may lead to isolated urban and low-lying/poor drainage flooding from midweek through the weekend.

For more detailed information on specific river stages and forecasts, visit: <http://water.weather.gov/ahps2/index.php?wfo=tae>.

.SPOTTER INFORMATION STATEMENT...

Spotter activation is not requested. However, spotters are always encouraged to safely report significant weather conditions when they occur (while following all local, state, and CDC guidelines) by calling the office or tweeting us @NWSTallahassee.

&&

.PRELIMINARY POINT TEMPS/POPS...

Tallahassee 89 73 85 73 83 / 80 60 80 60 70
Panama City 89 75 83 75 83 / 70 70 100 70 90
Dothan 89 73 84 71 80 / 70 50 80 50 80
Albany 88 73 88 74 82 / 70 40 50 40 70
Valdosta 89 73 88 73 84 / 70 40 60 40 70
Cross City 88 73 88 73 87 / 80 50 90 60 70
Apalachicola 86 76 83 76 83 / 70 80 90 80 90

&&

.TAE WATCHES/WARNINGS/ADVISORIES...

FL...Flash Flood Watch through Tuesday evening for Calhoun-Central
Walton-Coastal Bay-Coastal Franklin-Coastal Gulf-Coastal
Wakulla-Holmes-Inland Bay-Inland Franklin-Inland Gulf-
Inland Wakulla-Jackson-Liberty-North Walton-South Walton-
Washington.

High Rip Current Risk through Tuesday evening for Coastal Bay-
Coastal Franklin-Coastal Gulf-South Walton.

High Surf Advisory from 8 PM EDT /7 PM CDT/ this evening to 8 PM
EDT /7 PM CDT/ Monday for Coastal Bay-Coastal Gulf-South
Walton.

Tropical Storm Warning for Coastal Bay-Coastal Gulf-South
Walton.

Coastal Flood Advisory from 8 PM EDT /7 PM CDT/ this evening to
2 AM EDT /1 AM CDT/ Tuesday for Coastal Bay-Coastal Dixie-
Coastal Franklin-Coastal Gulf-Coastal Jefferson-Coastal
Taylor-Coastal Wakulla-South Walton.

High Surf Advisory until 8 AM EDT Monday for Coastal Franklin.

Tropical Storm Watch for Coastal Franklin.

GA...None.

AL...None.

GM...Flash Flood Watch through Tuesday evening for Apalachee Bay or
Coastal Waters From Keaton Beach to Ochlockonee River FL
out to 20 Nm-Coastal Waters From Ochlockonee River to
Apalachicola FL out to 20 Nm-Coastal waters from Mexico
Beach to Apalachicola FL out 20 NM-Coastal waters from
Mexico Beach to Okaloosa Walton County Line FL out 20 NM.

Tropical Storm Warning for Coastal waters from Mexico Beach to Apalachicola FL out 20 NM-Coastal waters from Mexico Beach to Okaloosa Walton County Line FL out 20 NM-Waters from Suwannee River to Apalachicola FL from 20 to 60 NM-Waters from Apalachicola to Mexico Beach FL from 20 to 60 NM-Waters from Mexico Beach to Okaloosa Walton County Line FL from 20 to 60 NM.

Tropical Storm Watch for Coastal Waters From Ochlockonee River to Apalachicola Fl out to 20 Nm.

&&

\$\$

15.0 Winds and Temperature Aloft Forecast

The NWS 0955 EDT Winds and Temperature Aloft forecast valid for the closest point to the accident site is included below:

FBUS31 KWNO 131355
FD1US1
DATA BASED ON 131200Z
VALID 131800Z FOR USE 1400-2100Z. TEMPS NEG ABV 24000

FT	3000	6000	9000	12000	18000	24000	30000	34000	39000
TLH	0918	1228+16	1230+12	1225+07	1115-05	0716-15	021229	361039	281251

The accident site was located closest to the Tallahassee, Florida, (TLH) forecast point. The 0955 EDT TLH forecast for use between 1000 EDT and 1700 EDT indicated a wind at 3,000 ft from 090° at 18 knots, a wind at 6,000 ft from 120° at 28 knots with a temperature of 16°C, and a wind at 9,000 ft from 120° at 30 knots with a temperature of 12°C.

16.0 Pilot Weather Briefing

The accident pilot did not request a weather briefing from Leidos.

A search of archived ForeFlight information indicated that the accident pilot did request weather information for a flight at 9,000 ft via ForeFlight Mobile (attachment 4) at 0730 EDT with a planned departure of 0930 EDT. The 0730 EDT weather briefing information contained all the standard weather information valid at 0730 EDT, including Convective SIGMET information valid along the route of flight, AIRMETs, CWA, a surface analysis chart, current METARs valid along the route of flight, PIREPs, a GFA forecast, TAFs, turbulence cross section information, and the winds aloft information. The accident pilot did not access any weather imagery via ForeFlight mobile prior to the accident flight on the accident day. For more information please see attachment 4. There is no record of the accident pilot receiving or retrieving any other weather information before or during the accident flight.

17.0 ZTL CWSU Information

ZJX CWSU provided a pre-duty weather briefing at 0500 and 1200 EDT the day of the accident for ATC working at ZJX with the weather briefing containing all the standard weather information (attachments 5 and 6).

18.0 Consolidated Storm Prediction for Aviation Data

The Consolidated Storm Prediction for Aviation (CoSPA)³² images were retrieved for 1200, 1205, 1210, 1215, and 1220 EDT and provided in figures 20 through 24 with the accident site marked. The CoSPA, along with depicting NWS weather radar VIP levels, lightning data, weather satellite, and storm motion, forecast areas of likely rain shower or thunderstorm growth (orange hatched areas) and areas of likely rain shower or thunderstorm dissipation (blue hatched areas). The rain shower activity was moving from southeast to northwest with time and growing in areal coverage. In addition, the accident site located in an of projected rain shower or thunderstorm growth from 1210 EDT onward (orange hatched area). For more information please see attachment 7.

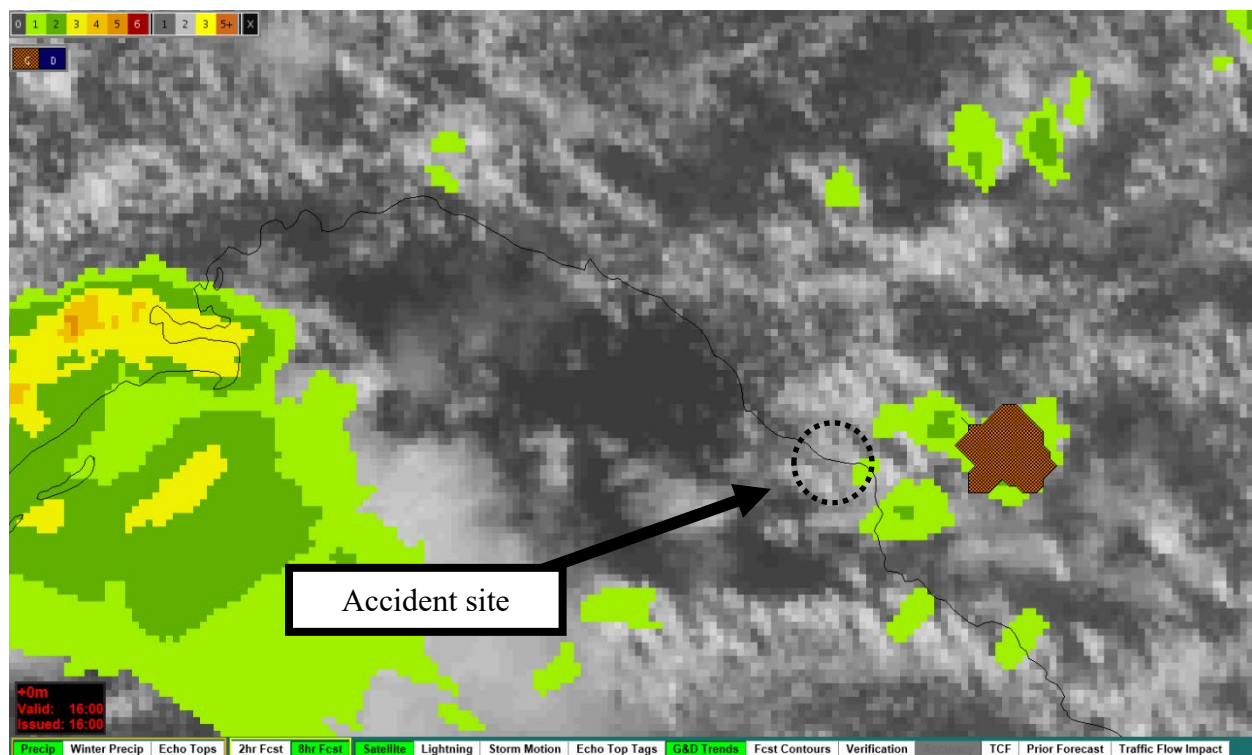


Figure 20 – CoSPA image from 1200 EDT with the accident site marked

³² <https://cospa.wx.ll.mit.edu/>
<https://ral.ucar.edu/projects/CoSPA/index.php>
<https://ral.ucar.edu/solutions/products/consolidated-storm-prediction-aviation-cospa>

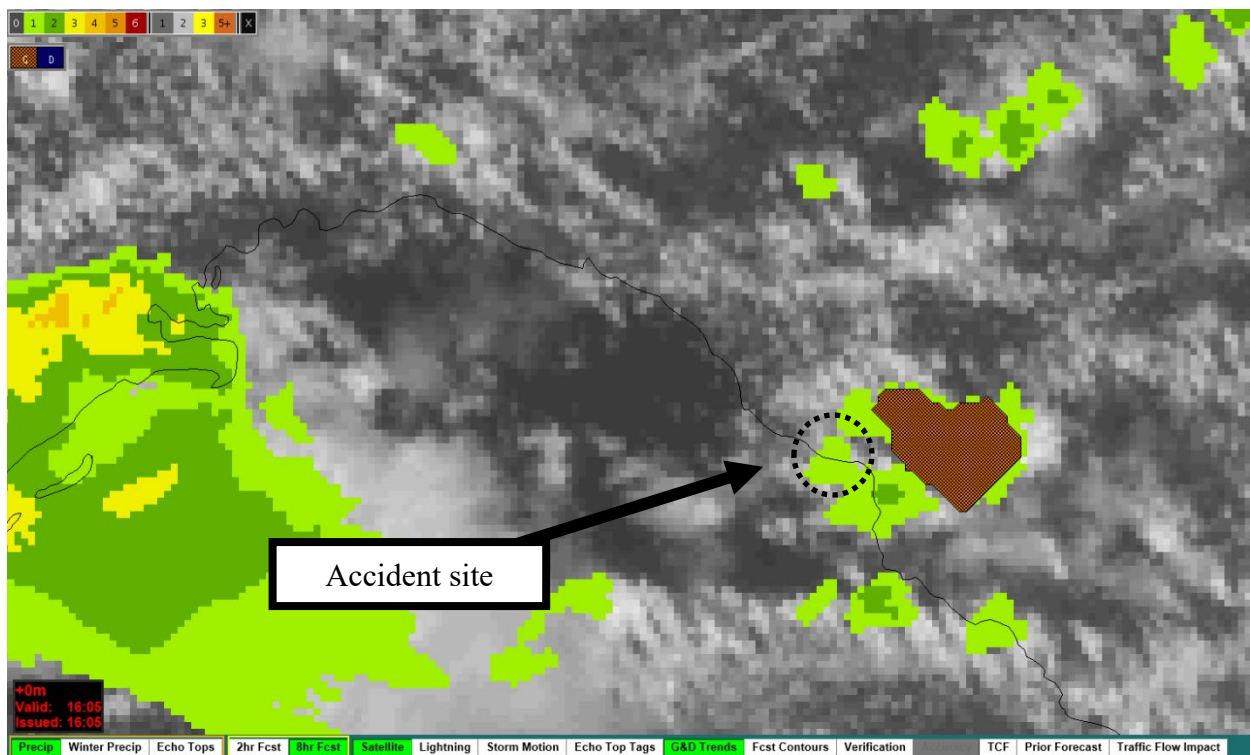


Figure 21 – CoSPA image from 1205 EDT with the accident site marked

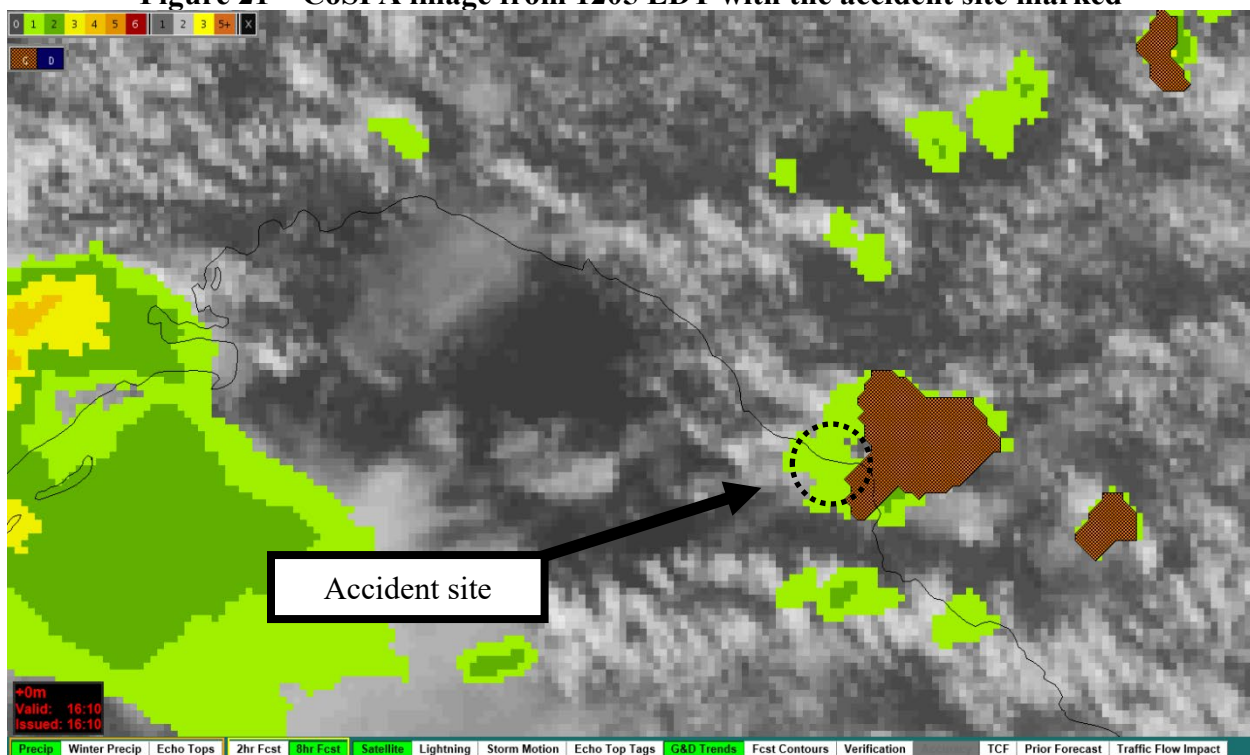


Figure 22 – CoSPA image from 1210 EDT with the accident site marked

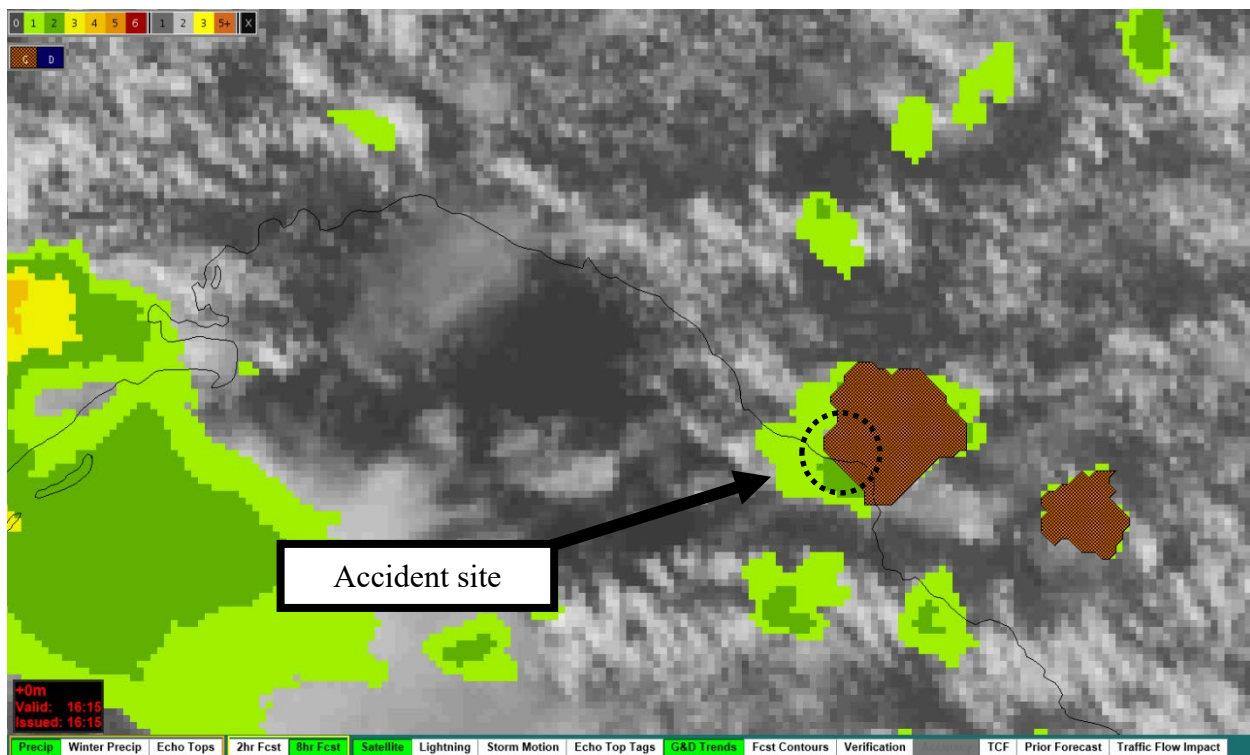


Figure 23 – CoSPA image from 1215 EDT with the accident site marked

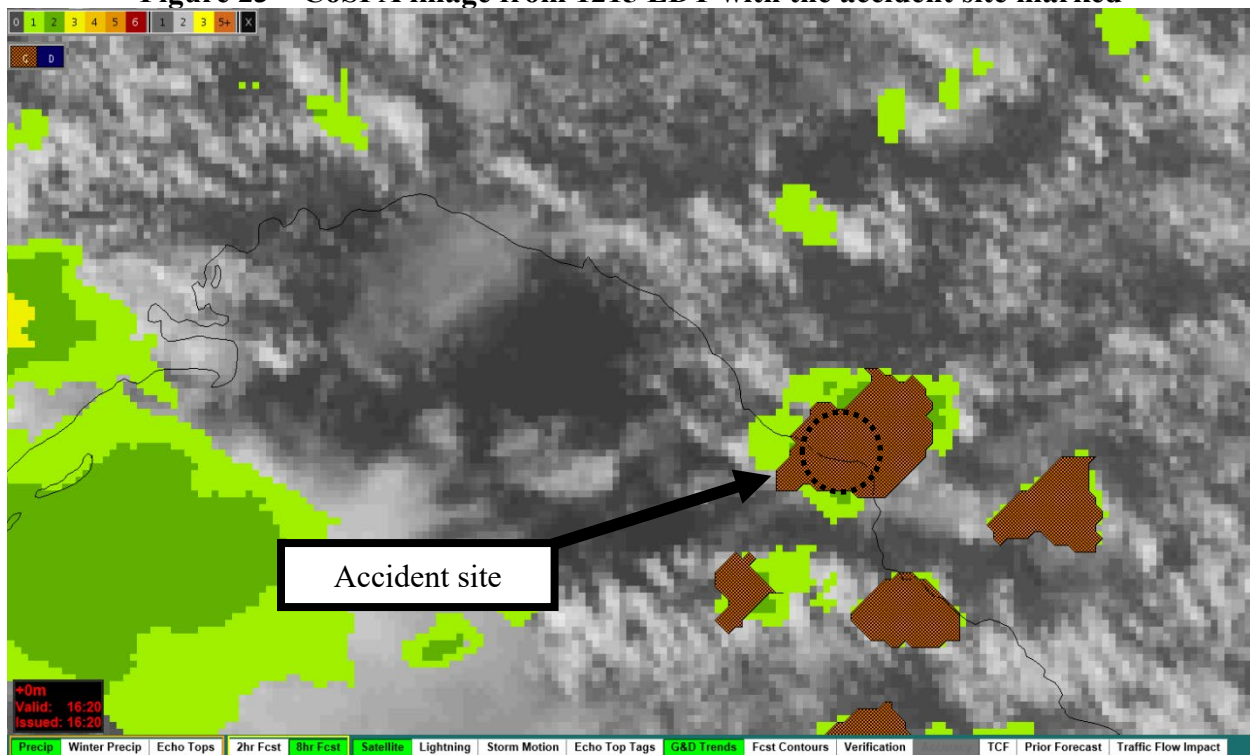


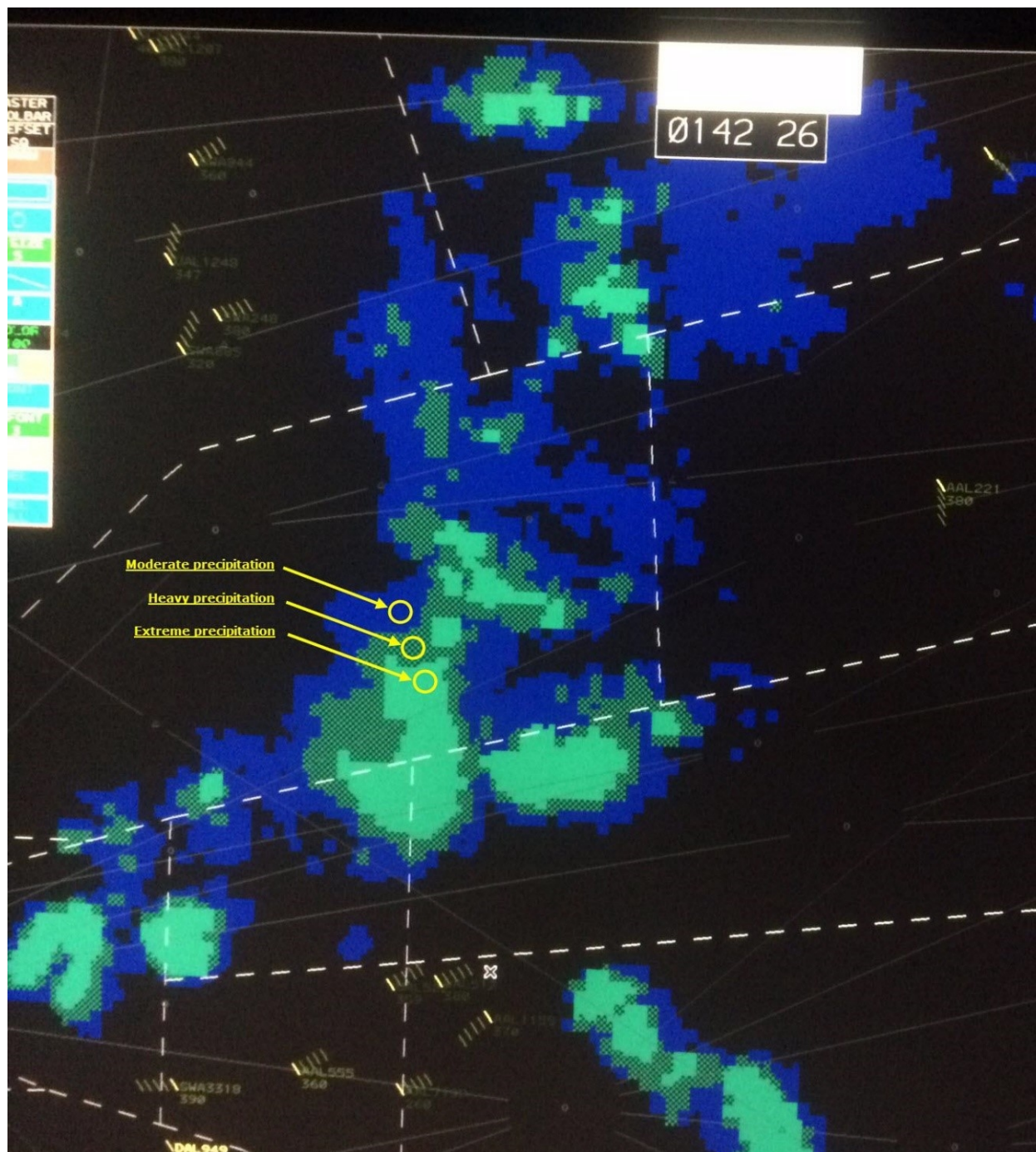
Figure 24 – CoSPA image from 1220 EDT with the accident site marked

19.0 Display of sector 13 ERAM Imagery

The ATC workgroup conducted a review of facility documents and an En Route Automation Modernization (ERAM) replay of the accident controller's display. The ERAM system processes flight and surveillance data, provides communications, and generates display data to air traffic controllers. ERAM has increased flexibility in routing around congestion, bad weather and other airspace restrictions. After the accident, the FAA secured the sector 13 ERAM replay showing the sector 13 controller preference settings and intensities.

Figure 25 provides an exemplar display of ERAM displayed precipitation. Figures 26 through 31 show the sector 13 ERAM displayed precipitation at 1154:50, 1204:50, 1209:50, 1211:50, 1213:50, and 1214:50 EDT. The accident aircraft entered moderate precipitation between 1213:50 and 1214:50 EDT. For more ERAM³³ imagery please see attachment 8.

³³ Additional ATC information can be found in the docket for this accident.



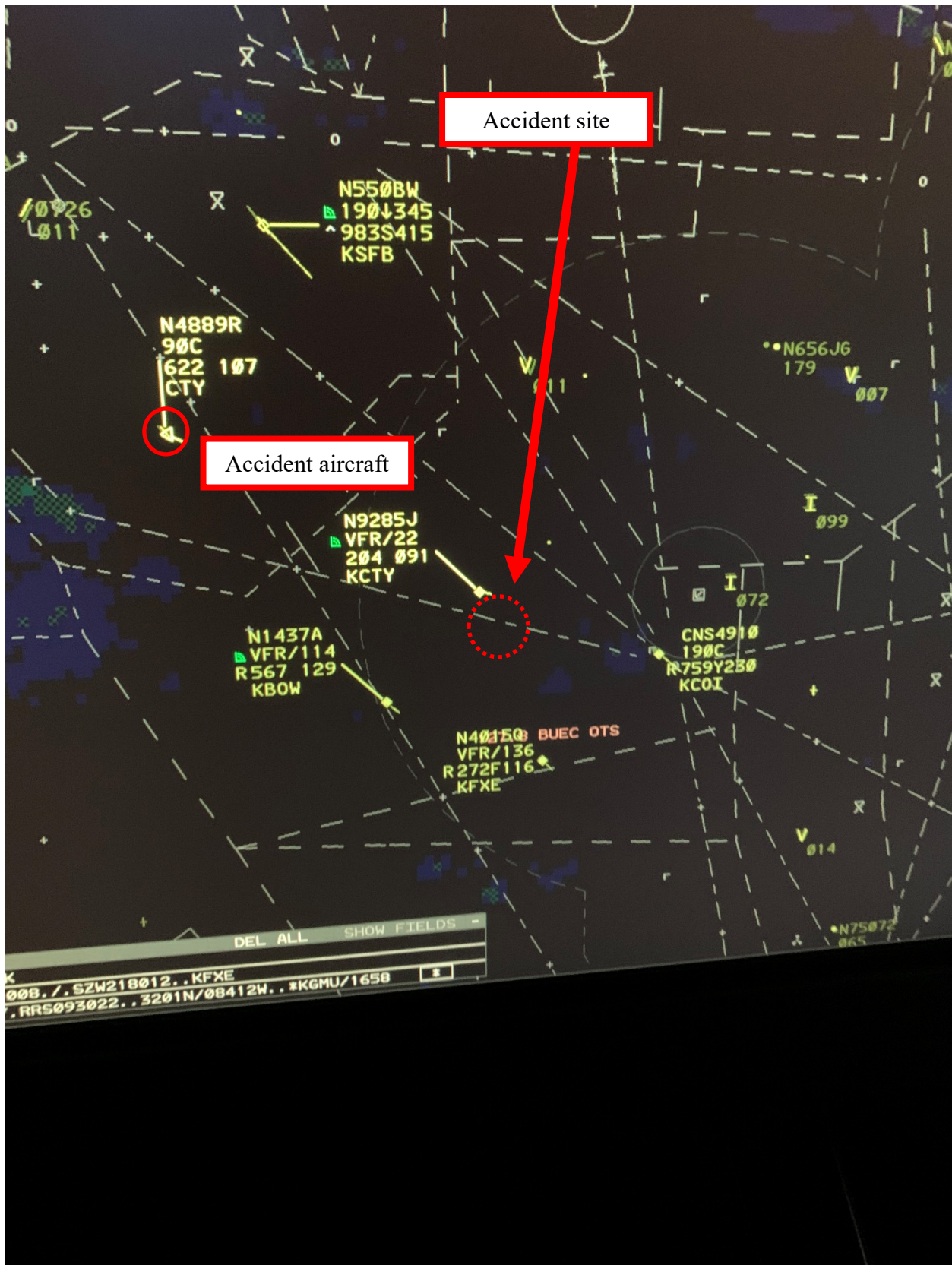


Figure 26 – Screenshot of the sector 13 ERAM displayed precipitation from 1154:50 EDT



Figure 27 – Screenshot of the sector 13 ERAM displayed precipitation from 1204:50 EDT



Figure 28 – Screenshot of the sector 13 ERAM displayed precipitation from 1209:50 EDT



Figure 29 – Screenshot of the sector 13 ERAM displayed precipitation from 1211:50 EDT

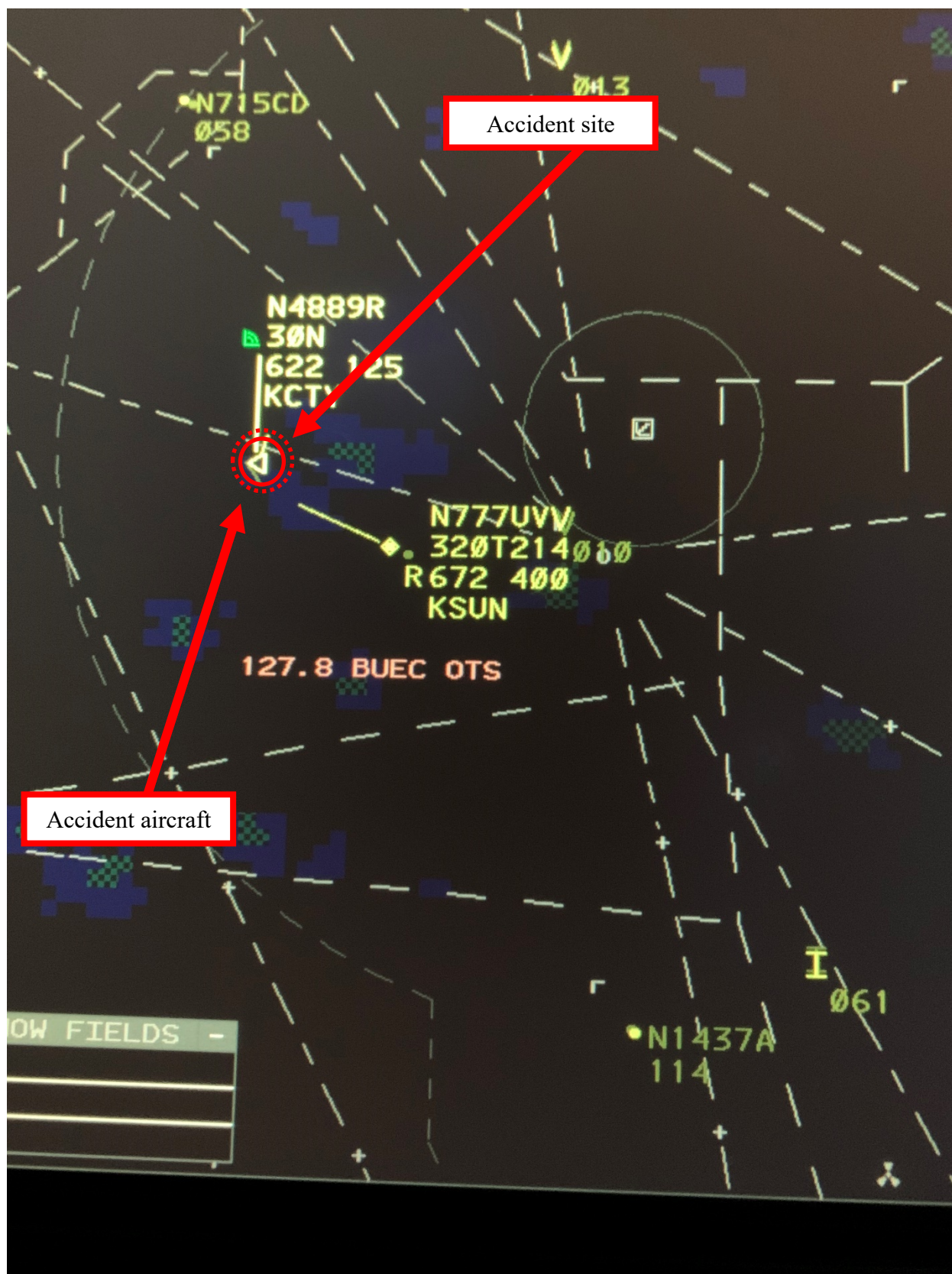


Figure 31 – Screenshot of the sector 13 ERAM displayed precipitation from 1214:50 EDT

20.0 Astronomical Data

The astronomical data obtained for the accident site on September 13, 2020, indicated the following:

SUN	
Begin civil twilight	0654 EDT
Sunrise	0718 EDT
Accident time	1215 EDT³⁴
Sun transit	1330 EDT
Sunset	1941 EDT
End civil twilight	2005 EDT

E. LIST OF ATTACHMENTS

Attachment 1 – GOES-16 Visible animation from 1131 to 1301 EDT

Attachment 2 – KTLH WSR-88D level 2 base reflectivity animation for the 0.5° elevation scans from 1151 to 1241 EDT

Attachment 3 – GFA products valid for the accident flight

Attachment 4 – ForeFlight correspondence

Attachment 5 – ZJX CWSU pre-duty weather briefing from 0500 EDT

Attachment 6 – ZJX CWSU pre-duty weather briefing from 1200 EDT

Attachment 7 – CIWS/CoSPA reference sheet

Attachment 8 – ERAM imagery from accident flight

Submitted by:

Paul Suffern
Senior Meteorologist

³⁴ Inserted accident time for reference and context.