

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



ERA23FA164

METEOROLOGY

Specialist's Factual Report

July 21, 2023

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A. ACCIDENT

Location: Johns Island, South Carolina
Date: March 25, 2023
Time: 1252 eastern daylight time
1652 coordinated universal time (UTC)
Airplane: Piper PA-28-161; Registration: N21480

B. METEOROLOGY SPECIALIST

Paul Suffern
National Transportation Safety Board
Washington, DC

C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's Senior Meteorologist did not travel for this investigation but gathered all data remotely. Data for this investigation were collected from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the Weather Prediction Center (WPC) and the National Center for Environmental Information (NCEI). This Specialist's Factual Report contains the meteorological factors pertinent to the weather surrounding the accident time. All times are eastern daylight time (EDT) and are based upon the 24-hour clock, where local time is -4 hours from UTC. Directions are referenced to true north and distances are in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles. NWS 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 accident site was located at approximate latitude 32.669302° N, longitude 80.010379° W, and elevation of 5 feet (ft).

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 WPC, 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 Federal Aviation Administration (FAA) "Aviation Weather Handbook", FAA-H-8083-28.¹

1.1 Surface Analysis Chart

The NWS Surface Analysis Chart centered over the northcentral United States for 1400 EDT is provided as figure 1 with the location of the accident site within the black circle. The chart depicted a high-pressure system at 1014-hectopascals (hPa) located in northeastern Arkansas. Several front boundaries stretched from southwest to northeast through the Tennessee Valley into the Mid-Atlantic region. Near the accident site at 1400 EDT an outflow boundary² was indicated. The accident site was located just east of the outflow boundary. Outflow boundaries and fronts can act as lifting mechanisms to help produce clouds and precipitation if sufficient moisture is present.

The station model closest to the accident site depicted an air temperature of 75 degrees Fahrenheit (°F), dew point temperature of 65°F, mostly cloudy skies, and a southeast wind at 10 knots. Station models to the west of the outflow boundary indicated cloudy skies and light rain with a variable wind around 10 knots.

¹ [FAA-H-8083-28](#)

² Outflow Boundary - A storm-scale or mesoscale boundary separating thunderstorm-cooled air (outflow) from the surrounding air; similar in effect to a cold front, with passage marked by a wind shift and usually a drop in temperature. Outflow boundaries may persist for 24 hours or more after the thunderstorms that generated them dissipate, and may travel hundreds of miles from their area of origin.

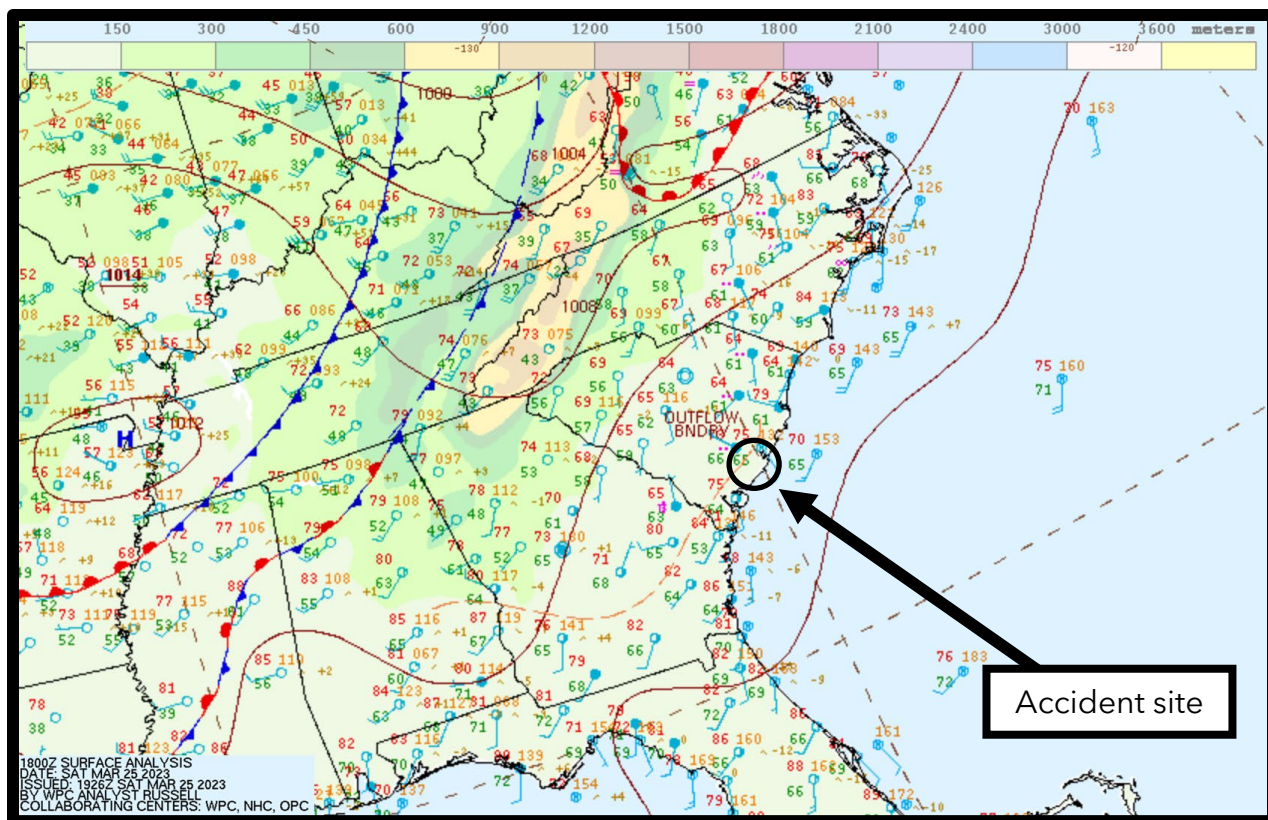


Figure 1. NWS Surface Analysis Chart for 1400 EDT.

1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 0800 EDT at 925-, 850-, and 700-hPa are presented in figures 2 through 4. The charts indicated a vertically stacked low-pressure system over the Great Lakes region with a trough³ west of the accident site at 925- and 850-hPa over the southeastern United States. The 925-hPa constant pressure chart depicted a southwest wind around 25 knots (figure 2) increasing to 35 knots by 700-hPa (figure 4).

³ Trough - An elongated area of relatively low atmospheric pressure or heights.

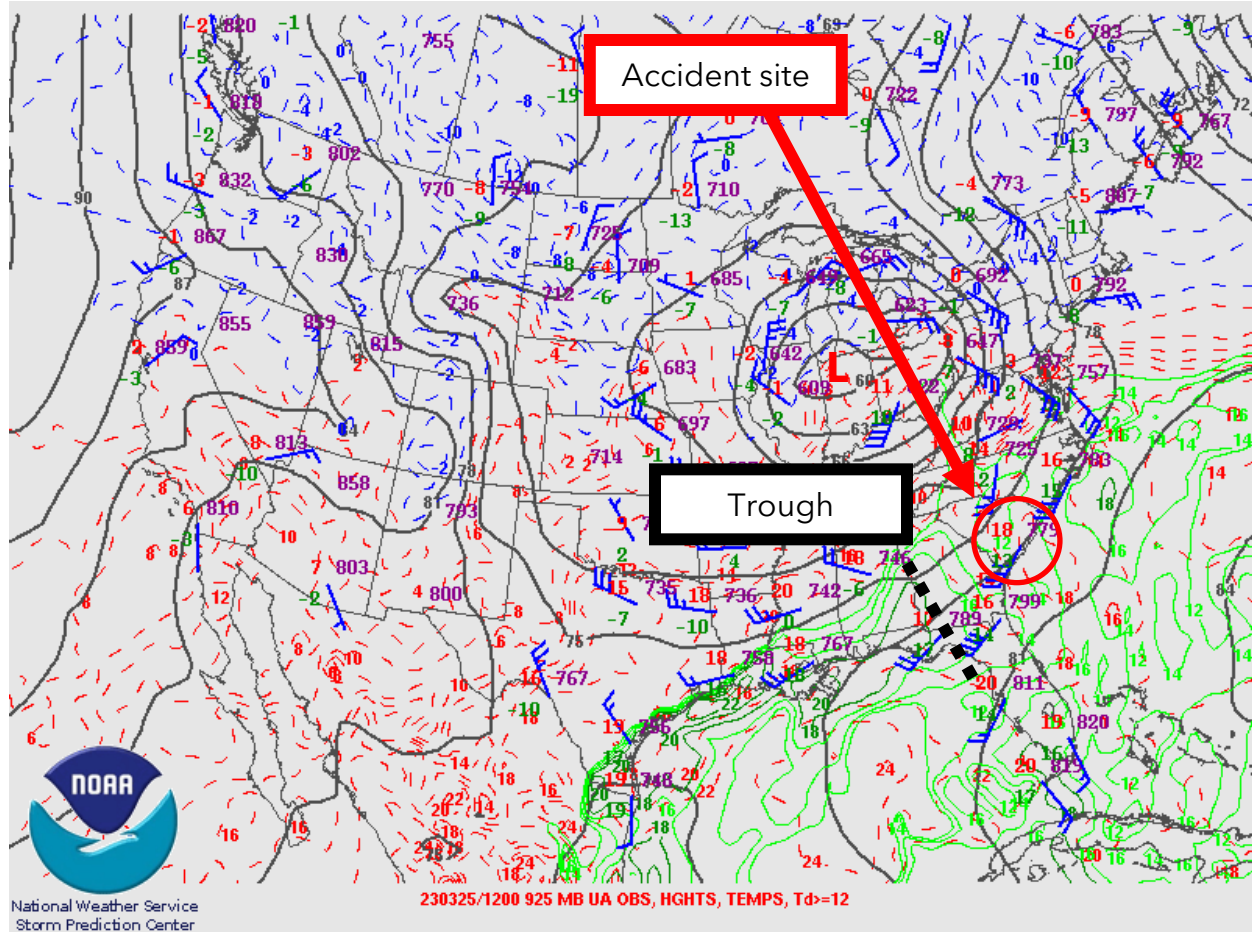


Figure 2. 925-hPa Constant Pressure Chart for 0800 EDT.

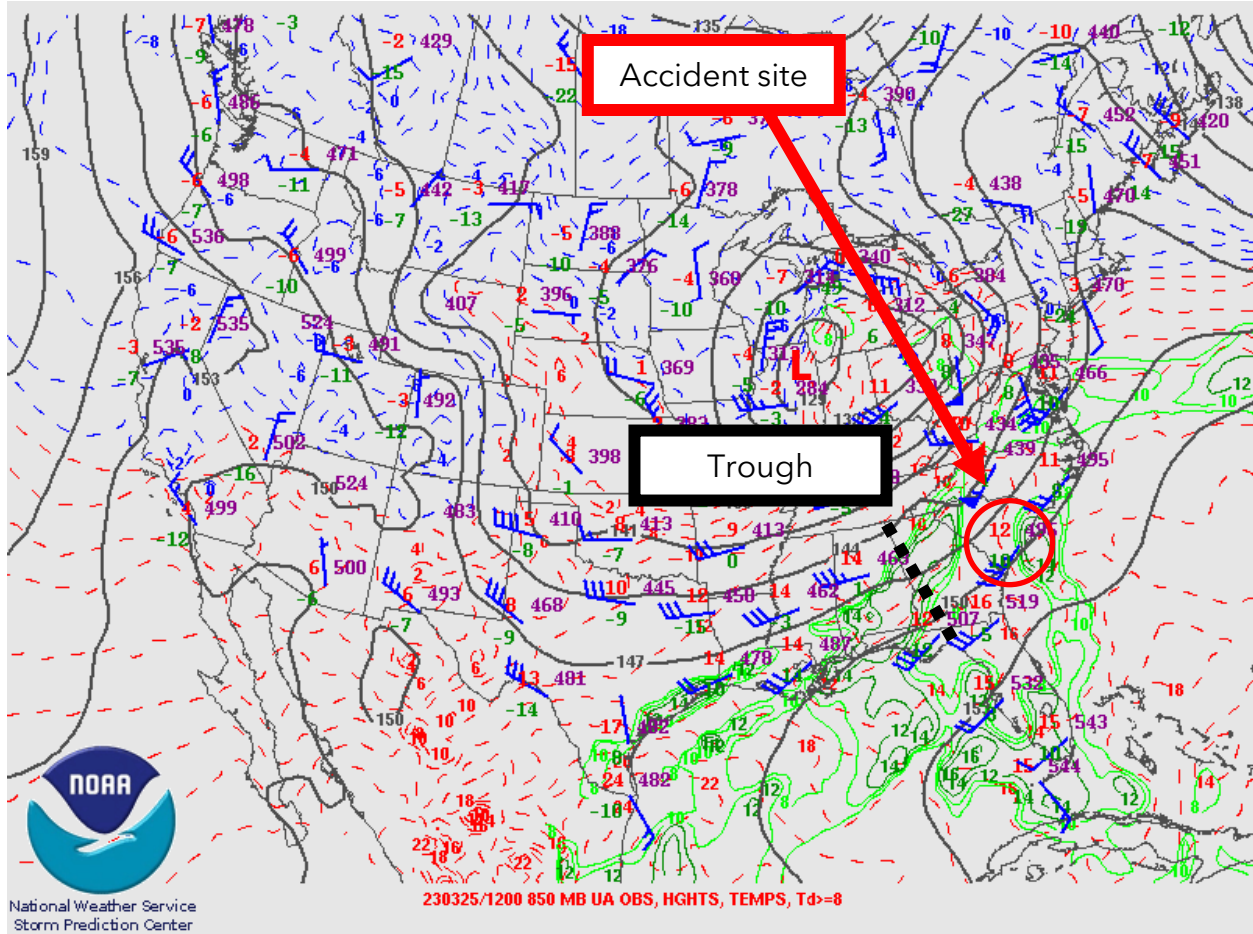


Figure 3. 850-hPa Constant Pressure Chart for 0800 EDT.

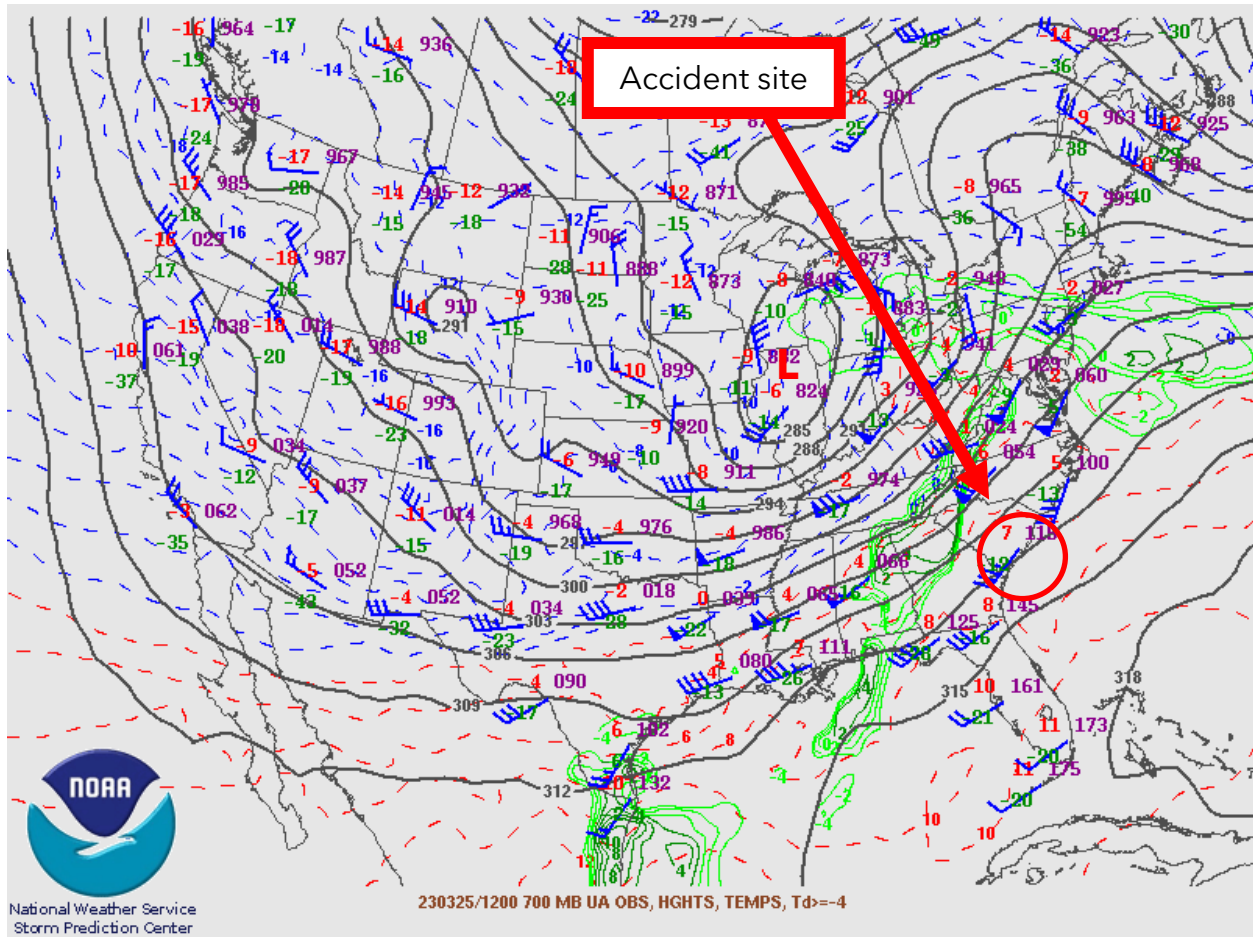


Figure 4. 700-hPa Constant Pressure Chart for 0800 EDT.

2.0 Storm Prediction Center Convective Outlook

SPC issued a Day 1 Convective Outlook at 1223 EDT (figure 5) with the accident site located in an area of “marginal” risk for severe thunderstorms (a level 1 out of 5 risk). In addition, the accident location was in a 5 percent risk probability area of damaging thunderstorms winds or wind gusts of 50 knots or higher within 25 miles of a point (figure 6). The text of the SPC Day 1 Convective Outlook follows figure 6.

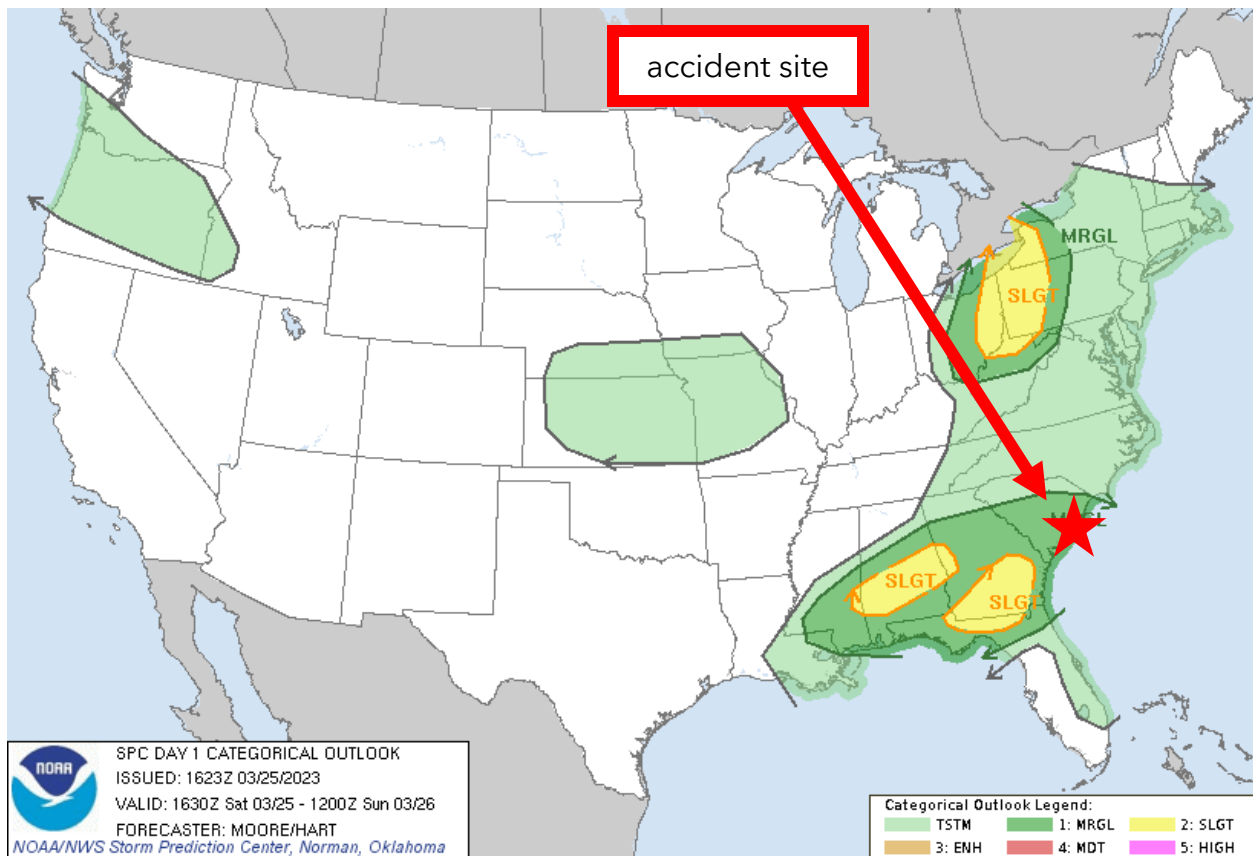


Figure 5. SPC day 1 Convective Outlook valid at the time of the accident.

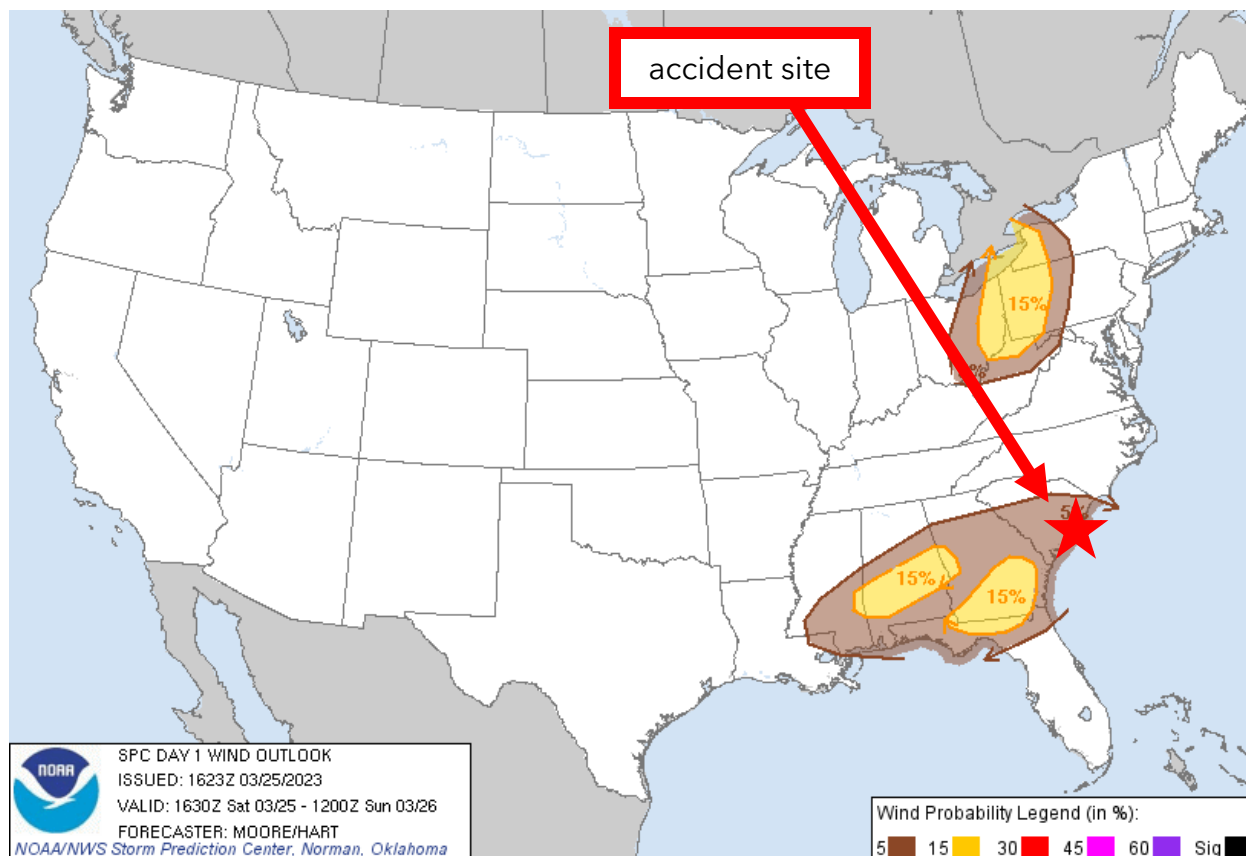


Figure 6. SPC day 1 Wind Outlook valid at the time of the accident.

SPC AC 251623

Day 1 Convective Outlook
 NWS Storm Prediction Center Norman OK
 1123 AM CDT Sat Mar 25 2023

Valid 251630Z - 261200Z

...THERE IS A SLIGHT RISK OF SEVERE THUNDERSTORMS FOR THE UPPER OHIO RIVER VALLEY...SOUTHEAST GEORGIA AND NORTHERN FLORIDA...AND ALABAMA...

...SUMMARY...

Strong to severe thunderstorms capable of damaging winds, large hail, and brief tornadoes are possible across parts of the upper Ohio River Valley and southeast Georgia and northern Florida this afternoon. Another round of strong to severe storms is expected during the early morning Sunday hours across southern AL.

...Synopsis...

Latest water-vapor imagery shows a compact, well-organized upper low over the IL/IN region with a pronounced slot of dry air pushing north ahead of the main vorticity maximum. At the surface, a 994 mb surface low over southern lower MI is expected to gradually shift

east/northeast towards the Northeast over the next 12-24 hours in tandem with the upper wave. Strong flow and ascent associated with this feature is expected to overspread the upper OH river valley and lower Great Lakes region, which will support the potential for strong to severe thunderstorms through the late afternoon. Across the Southeast, ongoing convection along a residual outflow boundary is expected to persist into the mid/late afternoon and intensify to severe limits. A late-night round of strong to severe thunderstorms is expected during the early morning hours Sundays across parts of MS/AL as the outflow boundary advances north as an effective warm front tonight.

...Upper Ohio River Valley...

Considerable clearing is ongoing across parts of southern OH into far southwest PA as the aforementioned dry slot advances northward. This clearing has allowed temperatures to warm into the low to mid 60s ahead of an approaching cold front, which, as of 15:45 UTC, is slightly warmer than most 12 UTC guidance. Consequently, low-level lapse rates have already increased to around 7 C/km where warming has been maximized. The combination of warming surface temperatures, mid to upper 50s dewpoints, and cool temperatures aloft will support increasing buoyancy through the mid-afternoon hours. Shallow convection evident in visible imagery along the front across western OH is expected to intensify as it moves into the destabilizing air mass. Strong kinematic fields sampled by morning soundings and recent VWP observations will be favorable for organized convection, and the steep low-level lapse rates will allow for efficient mixing of 50+ knot boundary layer winds to the surface. As a result, damaging winds appear likely across eastern OH to western PA and portions of western NY, though a few instances of severe hail and perhaps a brief tornado are plausible.

...Southeast Georgia and northern Florida...

GOES IR imagery has shown a slow intensification of ongoing convection across portions of central/southern GA. Although this region will become increasingly displaced from synoptic ascent and stronger mid-level flow through the day, regional VWPs show sufficient deep-layer shear for organized convection through peak daytime heating. Furthermore, quality low-level moisture (sampled by the 12 UTC TLH and JAX soundings) will migrate northeastward ahead of the convection, allowing for MLCAPE values to increase to near 2000 J/kg. As a result, the recent intensification trend will likely continue through the day and regionally augment the potential for damaging winds and hail.

...Alabama...

The residual outflow boundary draped across the Southeast from prior convection over the past 24 hours is expected to gradually lift to the north through the day, eventually becoming draped from southeast LA into southern MS and central AL by late tonight. A weak mid-level perturbation is expected to move into the southern Plains/lower MS River Valley during the 00-12 UTC period, which will help strengthen southerly 850 mb flow and bolster isentropic ascent over the

boundary. Despite some nocturnal cooling, profiles are expected to be weakly capped with MLCAPE values near 1000-2000 J/kg during the overnight period. Elongated hodographs featuring around 50 knots of effective shear should support organized cells, including splitting supercells, that will pose a severe wind/hail risk (though storm motions along the boundary may limit individual cell longevity and promote upscale growth into clusters). Timing of this convection remains uncertain with recent CAMs showing spread in the onset of convective initiation, but the probability of CI prior to 12 UTC has increased sufficiently to introduce higher risk probabilities.

..Moore/Hart.. 03/25/2023

CLICK TO GET WUUS01 PTSDY1 PRODUCT

NOTE: THE NEXT DAY 1 OUTLOOK IS SCHEDULED BY 2000Z

3.0 Surface Observations

The area surrounding the accident site was documented using official Aviation Routine Weather Reports (METARs) and Special Reports (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. A magnetic variation⁴ of 8° west was indicated over the area.

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

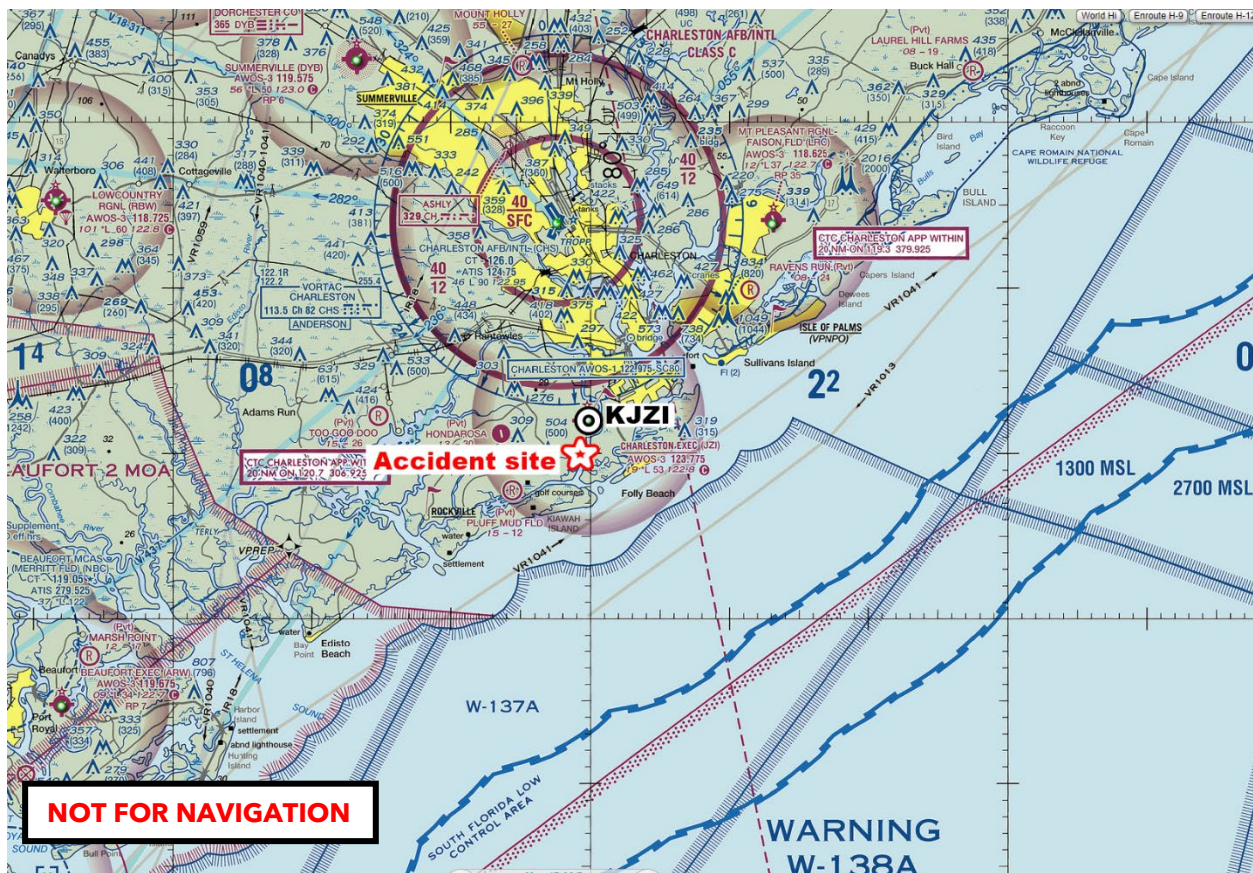


Figure 7. FAA sectional aeronautical chart of the accident area with the location of the accident site and surface observation site noted.

Charleston Executive Airport (KJZI) had the closest official weather station to the accident site. KJZI had an Automated Weather Observing System (AWOS⁵) and its longline⁶ reports were not augmented. The KJZI AWOS was located 2 miles north-northeast of the accident site (figure 7), at an elevation of 19 ft, and issued the following observations surrounding the period of the accident:⁷

⁵ AWOS - Automated Weather Observing System is equipped with meteorological instruments to typically observe and report temperature, dewpoint, wind speed and direction, visibility, cloud coverage and ceiling up to 12,000 feet, and altimeter setting. AWOS are maintained by the FAA. Certain AWOS may have different reporting or observational equipment.

⁶ "Longline" refers to the dissemination of weather observations with the intent that they are available in near-real time to national databases and accessible to the general global public from a large number of vendors. This does not include public accessibility to observations from a reporting station's Very High Frequency (VHF; line-of-site) or telephone broadcast, where applicable. Longline dissemination of weather observations is the primary vehicle through which the weather observations are distributed.

⁷ The bold sections of products in this report are intended to highlight the text that directly reference the weather conditions that affected the accident region around the accident time. The local times in this section next to the METARs are provided for quick reference between UTC and local times.

[1115 EDT] METAR KJZI 251515Z AUTO 21012G18KT 10SM FEW024
22/17 A2998 RMK AO2

[1135 EDT] METAR KJZI 251535Z AUTO 20012G19KT 10SM CLR 22/18
A2997 RMK AO2

[1155 EDT] METAR KJZI 251555Z AUTO 21013G18KT 10SM SCT013
22/18 A2997 RMK AO2

[1215 EDT] METAR KJZI 251615Z AUTO 21012KT 10SM BKN013 22/18
A2997 RMK AO2

**[1235 EDT] METAR KJZI 251635Z AUTO 23012KT 10SM BKN013
BKN017 22/18 A2998 RMK AO2**

ACCIDENT TIME 1252 EDT

**[1255 EDT] METAR KJZI 251655Z AUTO 20012G18KT 180V240
10SM OVC013 22/18 A2998 RMK AO2**

[1315 EDT] METAR KJZI 251715Z AUTO 20012G17KT 10SM OVC013
22/18 A2998 RMK AO2

The bold type observations decoded in plain language were as follows:

KJZI weather at 1235 EDT, automated, wind from 230° at 12 knots, visibility 10 miles or greater, broken ceiling at 1,300 ft above ground level (agl), broken skies at 1,700 ft agl, temperature of 22° Celsius (C), dew point temperature of 18°C, and an altimeter setting of 29.98 inches of mercury (inHg). Remarks, automated station with a precipitation discriminator.

KJZI weather at 1255 EDT, automated, wind from 200° at 12 knots with gusts to 18 knots, wind varying between 180° and 240°, visibility 10 miles or greater, overcast ceiling at 1,300 ft agl, temperature of 22°C, dew point temperature of 18°C, and an altimeter setting of 29.98 inHg. Remarks, automated station with a precipitation discriminator.

The observations from the KJZI AWOS around the accident time identified MVFR⁸ conditions with winds gusting as high as 18 knots.

⁸ 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

4.0 Upper Air Sounding

A High-Resolution Rapid Refresh (HRRR)⁹ model sounding was created¹⁰ for the approximate accident site coordinates for 1300 EDT. The HRRR sounding was plotted on a standard Skew-T Log P diagram¹¹ from the surface to 700-hPa (or approximately 10,000 ft) using the RAOB¹² software package and is included as figure 8. The sounding depicted an elevation of sea level over the grid point with a near surface temperature of 23.3°C, a dew point temperature of 17.7°C, and a relative humidity of 71%. The sounding depicted the lifted condensation level (LCL)¹³ at 2,333 ft, the level of free convection (LFC)¹⁴ at 3,626 ft, and the convective condensation level (CCL)¹⁵ at 4,355 ft. The freezing level was located at 13,130 ft. The precipitable water value was 1.12 inches.

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.

⁹ 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.

¹⁰ HRRR sounding was created using NOAA Air Resource Laboratory: [READY Archived Meteorology \(noaa.gov\)](https://ready.noaa.gov).

¹¹ 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.

¹² RAOB - (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Esonde Research Services, The Villages, Florida.

¹³ LCL - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

¹⁴ 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.

¹⁵ CCL - The level in the atmosphere to which an air parcel, if heated from below, will rise dry adiabatically, without becoming colder than its environment just before the parcel becomes saturated.

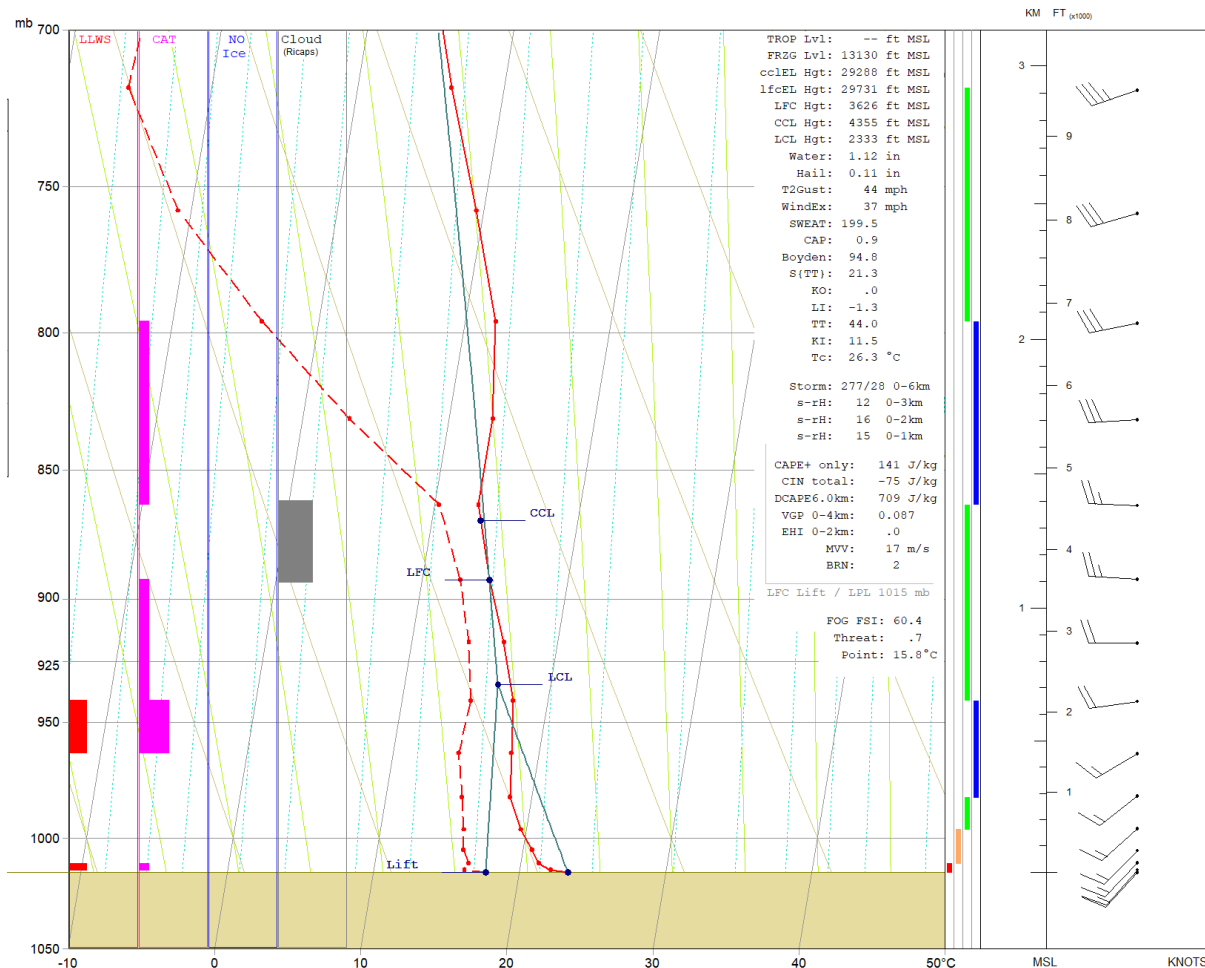


Figure 8. 1300 EDT HRRR sounding.

The 1300 EDT HRRR sounding indicated alternating layers of conditionally unstable and unstable environments from the surface through 1,000 ft, then a stable layer from 1,000 ft to 2,000 ft. Another conditionally unstable layer was noted between 2,000 and 4,700 ft. RAOB indicated there was a cloud layer between 4,000 and 5,000 ft. No icing was indicated below 10,000 ft.

The 1300 EDT HRRR sounding wind profile indicated a near surface wind from 221° at 13 knots with the wind becoming westerly through 10,000 ft. The wind speed increased to 20 knots by 2,000 ft agl and to 35 knots by 10,000 ft. RAOB indicated the possibility of light low-level wind shear (LLWS) and light clear air turbulence (CAT) between the surface and 200 ft agl, then another layer of light LLWS and CAT between 1,500 and 3,000 ft.

5.0 Satellite Data

Geostationary Operational Environmental Satellite number 16 (GOES-16) visible and infrared 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 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 0900 EDT through 1400 EDT and reviewed, and the closest images to the time of the accident were documented.

Figure 9 presents the GOES-16 visible image at 1251 EDT at 3X magnification with the accident site highlighted with a red square. The image depicted cloud cover over the accident site with the lower cloud cover remaining in place above the accident site and along the coast south of KJZI (attachment 1). GOES-16 visible imagery from 1231 through 1256 EDT was overlaid with the accident airplane's Automatic Dependent Surveillance-Broadcast (ADS-B)¹⁶ track data showing the flight's path into the cloud cover (attachment 2). Figure 10 presents the GOES-16 infrared image at 1251 EDT at 8X magnification with the accident site highlighted with a red square. The lower brightness temperatures (green and yellow colors; higher cloud tops) were located west and north of the accident site at the accident time. The brightness temperature of 288 Kelvin above the accident site would have been near 3,500 ft based on the vertical temperature profile provided by the 1300 EDT HRRR sounding. It should be noted these figures have not been corrected for any parallax error.

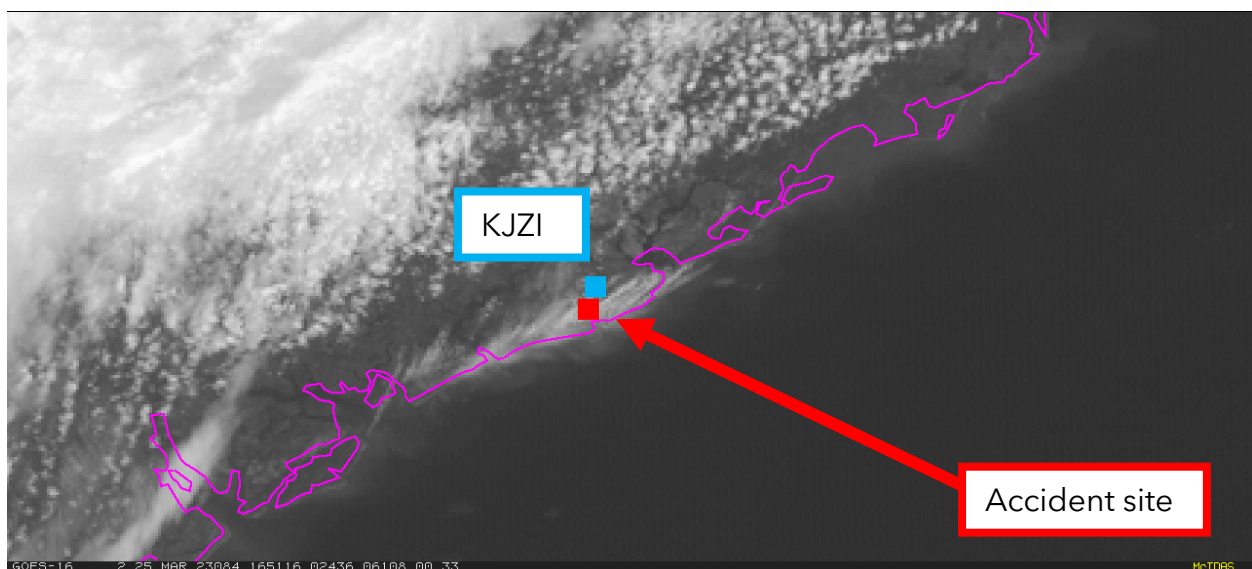


Figure 9. GOES-16 visible image at 1251 EDT.

¹⁶ ADS-B - [Automatic Dependent Surveillance-Broadcast \(ADS-B\) | Federal Aviation Administration \(faa.gov\)](https://www.faa.gov/ats/adsb/)

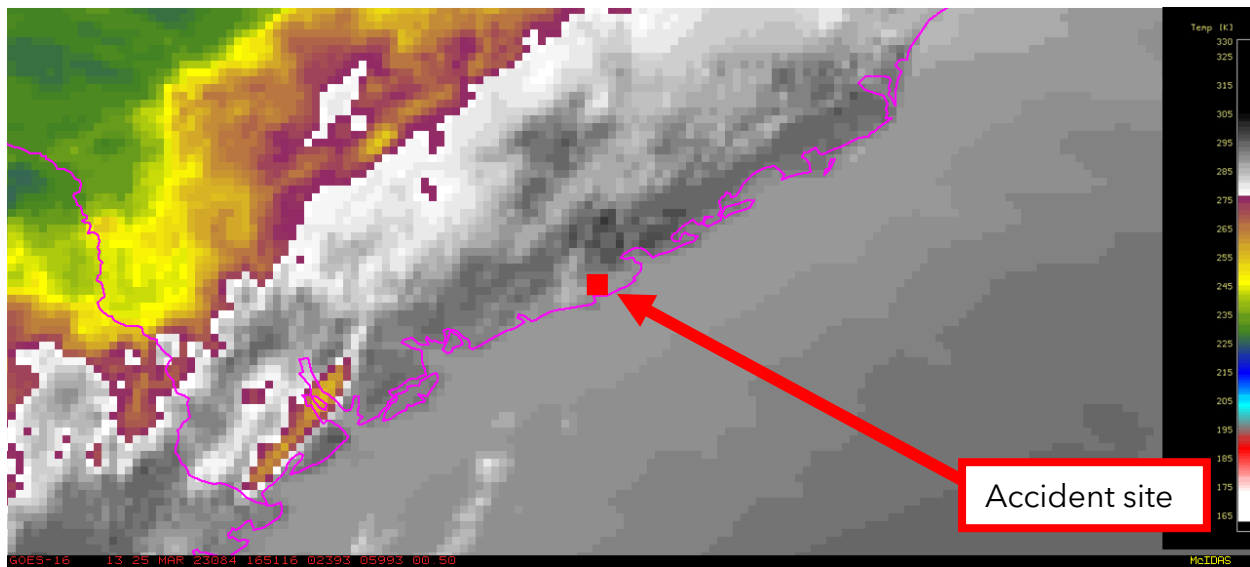


Figure 10. GOES-16 infrared image at 1251 EDT.

6.0 National Radar Imagery

A regional view of the NWS National Reflectivity Mosaic is included as figure 11 for 1255 EDT with the approximate location of the accident site marked by a red circle. The image depicted no echoes above the accident site.

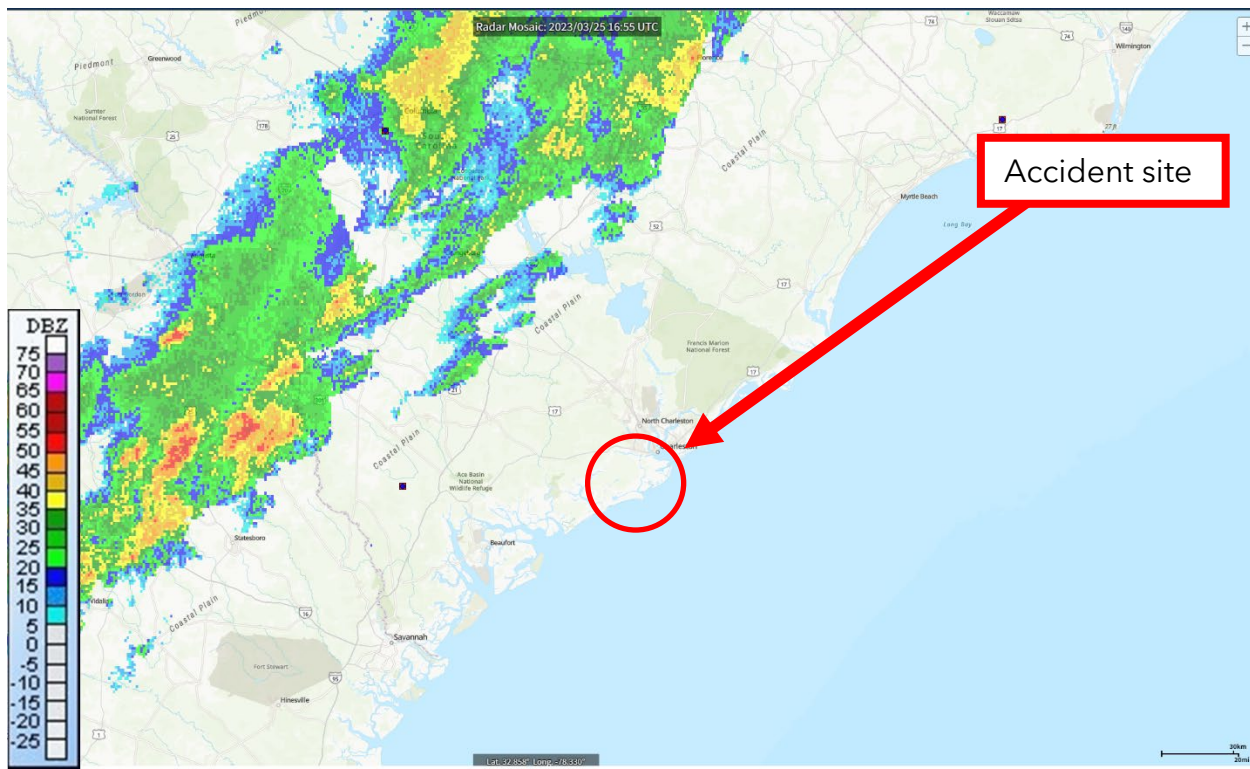


Figure 11. National Reflectivity Mosaic for 1255 EDT.

7.0 Pilot Reports

The longline-disseminated pilot reports¹⁷ (PIREPs) distributed into the national airspace system (NAS) within two hours before and after the accident time and within 100 miles of the accident site at altitudes below 18,000 ft are shown here:

CHS UA /OV CHS210003/TM 1610/FL020/TP GLF6/SK BASES 015 TOPS 020
MYR UA /OV MYR040012/TM 1611/FL030/TP CRJ9/SK BKN035
SAV UA /OV SAV090013/TM 1634/FLDURGD/TP CRJ9/SK SCT033/RM BASES 035/
TOPS 050
SAV UA /OV SAV/TM 1642/FLDURGD/TP CL30/SK SCT036/TB LIGHT CHOP/RM
BASES 035 TOPS 050
CHS UA /OV CHS330005/TM 1752/FL035/TP CRJ9/SK BASES 035
MYR UA /OV MYE230010/TM 1754/FL025/TP C172/SK OVC030/WX -RA/TB SMOOTH
SAV UA /OV 5N/TM 1755/FL035/TP E190
SAV UA /OV SAV10010/TM 1810/FL035/TP P28A/SK BASES BKN035
SAV UA /OV 5S/TM 1811/FL025/TP P28A/TB LIGHT
CHS UA /OV CHS040010/TM 1817/FL065/TP A320/SK BASES 028
MYR UA /OV MYR315015/TM 1837/FL030/TP C172/SK BASES 026
KCHS UA /OV CHS314013/TM 1852/FL090/TP BE95/SK BKN095/TB LT TO MOD

8.0 Significant Meteorological Information

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

9.0 Center Weather Service Advisories

The Jacksonville (ZJX) Air Route Traffic Control Center (ARTCC) Center Weather Service Unit (CWSU) was responsible for the accident region. There was no Center Weather Advisory (CWA) valid for the accident site at the accident time.

¹⁷ Only PIREPs with the World Meteorological Organization headers UBSC**, UBNC**, and UBGA** were considered. These do not include pilot reports only broadcast via radio.

10.0 Airmen's Meteorological Information

The NWS Aviation Weather Center had text Airmen's Meteorological Information (AIRMET) advisory Tango valid for the accident site at the accident time. The text AIRMET Tango was issued at 1045 EDT and forecast moderate turbulence below 18,000 ft:

WAUS42 KPCI 251445

WA2T

-MIAT WA 251445

AIRMET TANGO UPDT 2 FOR TURB STG WNDZ AND LLWS VALID UNTIL 252100

.
**AIRMET TURB...NC SC GA ME NH VT MA RI CT NY LO NJ PA OH LE WV MD
DC DE VA AND CSTL WTRS
FROM YOW TO 80NE MPV TO 90NE ACK TO 200SE ACK TO 160SE SIE TO
190ESE ECG TO 20E SAV TO 30S VXV TO HNV TO HNN TO CVG TO FWA TO
30SE ECK TO YOW
MOD TURB BLW FL180. CONDS CONTG BYD 21Z THRU 03Z.**

.
AIRMET TURB...NC SC GA FL AND CSTL WTRS
FROM 30S VXV TO 20E SAV TO 190ESE ECG TO 130SSE ILM TO 60ENE CRG
TO 20NNW OMN TO 30SSW CTY TO 70SW TLH TO 40W CEW TO 50SW PZD TO
GQO TO 30S VXV
MOD TURB BLW 090. CONDS CONTG BYD 21Z THRU 03Z.

.
AIRMET TURB...NC SC GA FL AND CSTL WTRS
FROM 160SE SIE TO 190E ECG TO 90ESE CHS TO 40W CRG TO 50W CTY TO
90SW TLH TO 20W CEW TO 50SW PZD TO GQO TO HNV TO 20NE ECG TO
160SE SIE
MOD TURB BTN FL180 AND FL420. CONDS CONTG BYD 21Z THRU 03Z.

.
AIRMET STG SFC WNDZ...NC SC AND CSTL WTRS
FROM 160SE SIE TO 160ESE ECG TO 130SSE ILM TO 110ESE CHS TO
50ESE ILM TO 80E ECG TO 160SE SIE
SUSTAINED SURFACE WINDS GTR THAN 30KT EXP. CONDS DVLPG 15-18Z.
CONDS CONTG BYD 21Z THRU 03Z.

.
LLWS POTENTIAL...NC SC NH VT MA CT NY LO NJ PA OH LE WV MD DC DE
VA AND CSTL WTRS
BOUNDED BY 30ESE YOW-50NNE MPV-20E HTO-40SSE SBY-20ESE ORF-30N
FLO-40SSW LYH-30SW PSK-40ESE APE-30N CVG-FWA-30SE ECK-60SSW YOW-
30ESE YOW
LLWS EXP. CONDS CONTG BYD 21Z THRU 03Z.

.
OTLK VALID 2100-0300Z
AREA 1...TURB NC SC GA FL AND CSTL WTRS
BOUNDED BY 160SE SIE-190ESE ECG-130SSE ILM-20SW CRG-60SW TLH-
50SSE MGM-50SW PZD-LGC-20N ATL-40WSW GQO-GQO-HNV-20NE ECG-160SE
SIE
MOD TURB BTN FL180 AND FL420. CONDS CONTG THRU 03Z.

.
AREA 2...TURB NC ME NH VT MA RI CT NY LO NJ PA OH LE WV MD DC DE

VA AND CSTL WTRS
BOUNDED BY 70NW PQI-60NE PQI-200SE ACK-160SE SIE-200ESE ECG-70S
ECG-HMV-HNN-CVG-FWA-30SE ECK-YOW-80S YQB-70NW PQI
MOD TURB BLW FL180. CONDS CONTG THRU 03Z.

.
AREA 3...TURB NC SC GA FL AND CSTL WTRS
BOUNDED BY HMV-70S ECG-200ESE ECG-130SSE ILM-40ENE CTY-30S PZD-
40ESE MCN-20ESE ODF-50SSW VXV-HMV
MOD TURB BLW 090. CONDS CONTG THRU 03Z.

....

11.0 Graphical Forecasts for Aviation

The Graphical Forecasts for Aviation (GFA) products issued by the Aviation Weather Center (AWC) before the accident flight and valid from 1100 until 1700 EDT are shown in attachment 3. The GFA surface forecasts applicable to the accident site that were valid before the accident flight's departure from 1100 until 1700 EDT indicated VFR conditions with a southwest wind of 10 knots and gusts to 20 knots by 1400 EDT. In addition, scattered (between 30 and 50 percent chance of) thunderstorms were forecast to be over the accident site between 1400 and 1700 EDT. The GFA cloud forecast applicable to the accident site that was valid from 1100 until 1700 EDT indicated overcast clouds at the accident site with bases at 2,100 ft and tops near 3,500 ft at 1100 EDT with the cloud layer becoming few to scattered by 1400 to 1700 EDT. The Graphical AIRMET¹⁸ (G-AIRMET) Tango valid for the accident site at 1000 EDT is located in figure 12. The only human-generated information reflected in the two GFA products were the G-AIRMETs.

¹⁸ Graphical AIRMETs (G-AIRMETs), found on the Aviation Weather Center webpage at <http://aviationweather.gov>, are graphical forecasts of en-route weather hazards valid at discrete times no more than 3 hours apart for a period of up to 12 hours into the future (for example, 00, 03, 06, 09, and 12 hours). G-AIRMETs are snap shots at discrete time intervals as defined above. The text AIRMET is the result of the production of the G-AIRMET but provided in a time smear for a 6hr valid period.

12.0 Terminal Aerodrome Forecast

KJZI was the closest site with an NWS Terminal Aerodrome Forecast¹⁹ (TAF) current at the time of the accident. The KJZI TAF valid at the accident time was issued at 0726 EDT and was valid for a 24-hour period beginning at 0800 EDT. The 0726 EDT TAF for KJZI was as follows:

FTUS42 KCHS 251126
TAFJZI
TAF
KJZI 251126Z 2512/2612 21010G18KT P6SM FEW008 SCT012
TEMPO 2512/2514 BKN008
FM251500 21014G22KT P6SM BKN250
FM251900 20010KT P6SM VCSH SCT025 BKN060
FM252200 18007KT P6SM BKN250=

Between 1100 and 1500 EDT the KJZI forecast expected a wind from 210° at 14 knots with gusts to 22 knots, 6 miles visibility or greater, and a broken ceiling at 25,000 ft agl.

13.0 National Weather Service Area Forecast Discussion

The NWS weather forecast office in Charleston, South Carolina, (WFO CHS) was responsible for the public forecast in the region of the accident site. WFO CHS issued the following Area Forecast Discussion (AFD) at 1027 EDT, the closest AFD to the accident time with an aviation section:

FXUS62 KCHS 251427
AFDCHS

Area Forecast Discussion
National Weather Service Charleston SC
1027 AM EDT Sat Mar 25 2023

.SYNOPSIS...

A cold front will approach from the west today, before stalling over the region through early next week. High pressure is expected to return on Wednesday and persist into late week.

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.NEAR TERM /THROUGH TONIGHT/...

The forecast area will remain well into the warm sector ahead of an

¹⁹ According to NWS Instruction 10-813: "An NWS TAF consists of the expected meteorological conditions significant to aviation at an airport for a specified time period. For the U.S., this is the area within five (5) statute miles (SM) of the center of an airport's runway complex."
www.nws.noaa.gov/directives/sym/pd01008013curr.pdf

approaching cold front today. Focus for the day will be on the upstream line of convection and how much it sustains itself or intensifies as it moves through this afternoon. Best forcing is removed from the area, and models remain a bit mixed on coverage. The environment ahead of the line will be characterized by ample deep layer shear on the order of 40-50 kt and CAPE around 1000-1500 J/kg. This could support a few strong to severe thunderstorms through the afternoon, with the higher chance being across southeast Georgia where the better instability resides. The primary threat would be damaging wind gusts, however an isolated tornado cannot be ruled out.

It will be a gusty and warm day. High temperatures should again peak in the 80s across most locations away from the locally cooler coastline.

Tonight: Shower/tstm activity will quickly wind down along the Georgia coast this evening. The cold front will remain to the west keeping the entire area in the warm sector. Increasing isentropic ascent early Sunday morning could support shower activity across the interior. The CAMs are all over the place with both timing and coverage with the HREF forecasting a very wet early morning across far interior Southeast Georgia. Slight chance pops were introduced to account for possible shower activity late, but further refinements will be needed in later forecast updates as additional model data are received and trends become more apparent. Lows will only drop into the mid 60s for most areas, although a few lower 60s will be possible, especially over parts of the Francis Marion National Forest.

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.SHORT TERM /SUNDAY THROUGH TUESDAY/...

Come daybreak Sunday, a cold front is expected to stall across or in the vicinity of the region and linger through the short-term. With the boundary, PWATs between 1-1.5" and ripples of shortwave energy, the period will be unsettled. Showers and thunderstorms are expected to develop along the boundary, leading to a couple of rainy days. Although, excessive rainfall is generally not expected. On the other hand, SPC has outlooked portions of inland SE GA/SC in a Slight Risk for Severe Thunderstorms on Sunday with other areas in a Marginal Risk. While confidence is quite low for widespread severe weather, isolated to scattered severe thunderstorms could occur, especially where instability is forecast in the 1500-1800 J/kg range. High temperatures will be in the 80s on Sunday then a few degrees cooler each day thereafter. Low temperatures will be in the 60s.

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.LONG TERM /TUESDAY NIGHT THROUGH FRIDAY/...

The aforementioned stalled front will finally make its way offshore overnight Tuesday as high pressure builds into the region. A few dry days are expected before another cold front approaches late week and

brings unsettled weather into the weekend. As of note, high temperatures on Wednesday will be in the 60s to low 70s with lows in the 40s on Tuesday and Wednesday nights. Thereafter, a warming trend will ensue.

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.AVIATION /14Z SATURDAY THROUGH WEDNESDAY/...

KCHS/KJZI: A small batch of stratus has recently developed over both terminals. These should begin to mix out after daybreak.

A weakening line of convection will move across the two terminals mid-late afternoon. Since this part of the line is expected to weaken, opted for a VCSH at this time. While a few tstms may be lurking about, the risk for tstms is too low to justify a mention for the 25/12z TAFs with the best tstm parameters expected to remain displaced to the south. Gusty winds will begin by mid- morning then last until the line pushes offshore.

KSAV: A fairly solid line of showers/tstms will approach from the west this morning and is progged to cross the terminal by mid-afternoon. VFR will prevail for much of the 25/12z TAF period, but a few hours of MVFR will accompany the line of convection. Incoming high-res data support for the continued prevailing TSRA 19-21z with a TEMPO group of 2SM TSRA to account for pockets of heavier convective rains.

Extended Aviation Outlook: Periodic flight restrictions will be possible during showers/thunderstorms and/or low clouds through late Tuesday. Prevailing VFR should return on Wednesday.

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.MARINE...

Today: A southerly wind regime will persist with high pressure centered well offshore. Winds will increase to 15-20 kt with gusts to 25 kt over the South Santee-Edisto Beach nearshore leg where a Small Craft Advisory remains in effect through tonight. Winds in the Charleston Harbor could get very close to advisory levels, but updated forecast holds winds just shy. Elsewhere winds will be a tad lower. Seas will average 3-5 ft over the South Santee-Edisto Beach and Georgia offshore legs with 2-4 ft elsewhere. Waves in Charleston Harbor will reach 1-2 ft.

Tonight: Southerly winds will persist, but speeds will diminish to 10-15 kt, except closer to 15 kt over the South Santee-Edisto Beach nearshore leg. Seas will average 2-4 ft.

Sunday through Thursday: Before a cold front pushes offshore late Tuesday, southwest winds will prevail. Once the front passes, north to northeast winds will return. Winds will be less than 10 knots on Sunday and Monday then pick up late Tuesday. Seas will generally be less than 4 feet for the first half of the week then increase to 4

to 6 feet. Small Craft Advisories could eventually be needed.

Rip Currents: A moderate risk for rip currents continues today for the beaches of south coastal South Carolina. Slightly lower swells will keep the risk in the low category for the Georgia beaches.

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.CHS WATCHES/WARNINGS/ADVISORIES...

GA...None.

SC...None.

MARINE...Small Craft Advisory until 8 PM EDT this evening for AMZ350.

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14.0 Winds and Temperature Aloft Forecast

The NWS 0958 EDT Winds and Temperature Aloft forecast valid for the closest point to the accident site is included below:

FBUS31 KWNO 251358

FD1US1

DATA BASED ON 251200Z

VALID 251800Z FOR USE 1400-2100Z. TEMPS NEG ABV 24000

FT 3000 6000 9000 12000 18000 24000 30000 34000 39000

CHS 2523 2629+13 2537+08 2542+03 2454-12 2460-24 248238 248747 259754

The closest forecast point to the accident site was the Charleston, South Carolina (CHS). The 0958 EDT forecast was for use between 1000 EDT and 1700 EDT.

15.0 Pilot Weather Information

Title 14 CFR 91.103 states that “Each pilot in command shall, before beginning a flight, become familiar with all available information concerning that flight.” FAA AC 91-92 “Pilot’s Guide to a Preflight Planning” (dated March 15, 2021) provided pilot guidance on preflight self-briefings, including planning, weather interpretation, and risk identification/mitigation skills. The AC further stated in part:

Pilots adopting these guidelines will be better prepared to interpret and utilize real-time weather information before departure and en route, in the cockpit, via technology like Automatic Dependent Surveillance-Broadcast (ADS-B) and via third-party providers.²⁰

A search of archived information indicated that the accident pilot did not request weather information from Leidos Flight Service. The accident pilot did have an account with ForeFlight and updated the route string around 1129 to 1130 EDT on the accident day (attachment 4), but the accident pilot did not file a flight plan through ForeFlight nor did they request a weather briefing. It is unknown what additional weather information, if any, the accident pilot checked or received before or during the accident flight.

16.0 Astronomical Data

The astronomical data obtained for the accident site on March 25, 2023, indicated the following:

SUN

Begin civil twilight 0653 EDT

Sunrise 0717 EDT

Accident time 1252 EDT²¹

Sun transit 1326 EDT

Sunset 1935 EDT

End civil twilight 2000 EDT

At the time of the accident the Sun was located at an altitude of 58.22° and azimuth of 163.70°.

²⁰ https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_91-92.pdf. The AC also listed multiple online FAA resources for aviation flight planning services for adverse weather.

²¹ Inserted accident time for reference and context.

E. LIST OF ATTACHMENTS

Attachment 1 - GOES-16 visible imagery animation from 1201 to 1316 EDT

Attachment 2 - GOES-16 visible imagery animation from 1231 to 1256 EDT
with track data

Attachment 3 - GFA information valid at the accident time

Attachment 4 - ForeFlight information

Submitted by:

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