

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



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METEOROLOGY

Specialist's Factual Report

January 2, 2024

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A. ACCIDENT

Location: Micanopy, Florida
Date: November 14, 2023
Time: 1409 eastern standard time
1909 coordinated universal time (UTC)
Airplane: Piper PA28-180; Registration: N77806W

B. METEOROLOGY SPECIALIST

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National Transportation Safety Board
Washington, DC

C. SUMMARY

On November 14, 2023, at 1409 eastern standard time, a Piper PA-28-180, N7806W, was destroyed when it was involved in an accident near Micanopy, Florida. The private pilot was fatally injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight. The aircraft had departed from Kissimmee Gateway Airport (KISM) about 1245 with the planned destination of Sanders Ranch Airport (39FA). According to Federal Aviation Administration records, the pilot held a private pilot certificate. He did not hold an instrument rating.

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 remotely, collecting data 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 report documents the general weather products and forecasts over the region during the period and documents the pertinent meteorological parameters to the accident. All times are reported as eastern standard time (EST) based upon the 24-hour clock, local time is -5 hours from UTC, and UTC=Z. Airport and 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. continental 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 29.525833° N and longitude 82.283056° W.

E. FACTUAL 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) and the WPC 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 and other products can be found in the Federal Aviation Administration (FAA) "Aviation Weather Handbook", FAA-H-8083-28¹.

1.1 Surface Analysis Chart

The NWS Aviation Weather Center's (AWC) website² depiction of the surface pressure systems, fronts, and other boundaries, along with the radar and surface observation for 1400 EST are included as figure 1. The figure depicted a low-pressure system with a central pressure of 999-hectopascals (hPa)³ located off Louisiana in the Gulf of Mexico and associated with a frontal wave. A cold front extended southward from the low-pressure system and a warm front extended to the east which turned into a stationary front which extended southeastward across southern Florida. A large band of precipitation was noted north of the warm front in the Gulf of Mexico along the coastal sections of Louisiana, Mississippi, Alabama, and southwest Georgia, and scattered across central and northern Florida. An area of precipitation was noted over the accident site and over the Gainesville area at the time. The station models depicted a cyclonic (counterclockwise) circulation in the winds into the low-pressure system, with winds from the east and east-northeast over central and northern Florida in the vicinity of the accident site. MVFR conditions⁴ due to visibility restricted in rain and ceilings overcast at 1,800 ft agl were reported in the vicinity of the accident site.

¹ <https://www.faa.gov/regulationspolicies/handbooksmanuals/aviation/faq-h-8083-28-aviation-weather-handbook>

² <https://aviationweather.gov/>

³ Hectopascal (hPa) is the standard for reporting sea-level pressure and is interchangeable with the former term millibar (mb) with the same units. The international standard atmosphere and aircraft performance is based on a sea-level pressure of 1013.25-hPa at 15° Celsius (C) or 59° Fahrenheit (F).

⁴ Marginal Visual Flight Rules (MVFR) is defined as a ceiling between 1,000 ft and 3,000 ft agl and/or visibility between 3 and 5 miles inclusive.

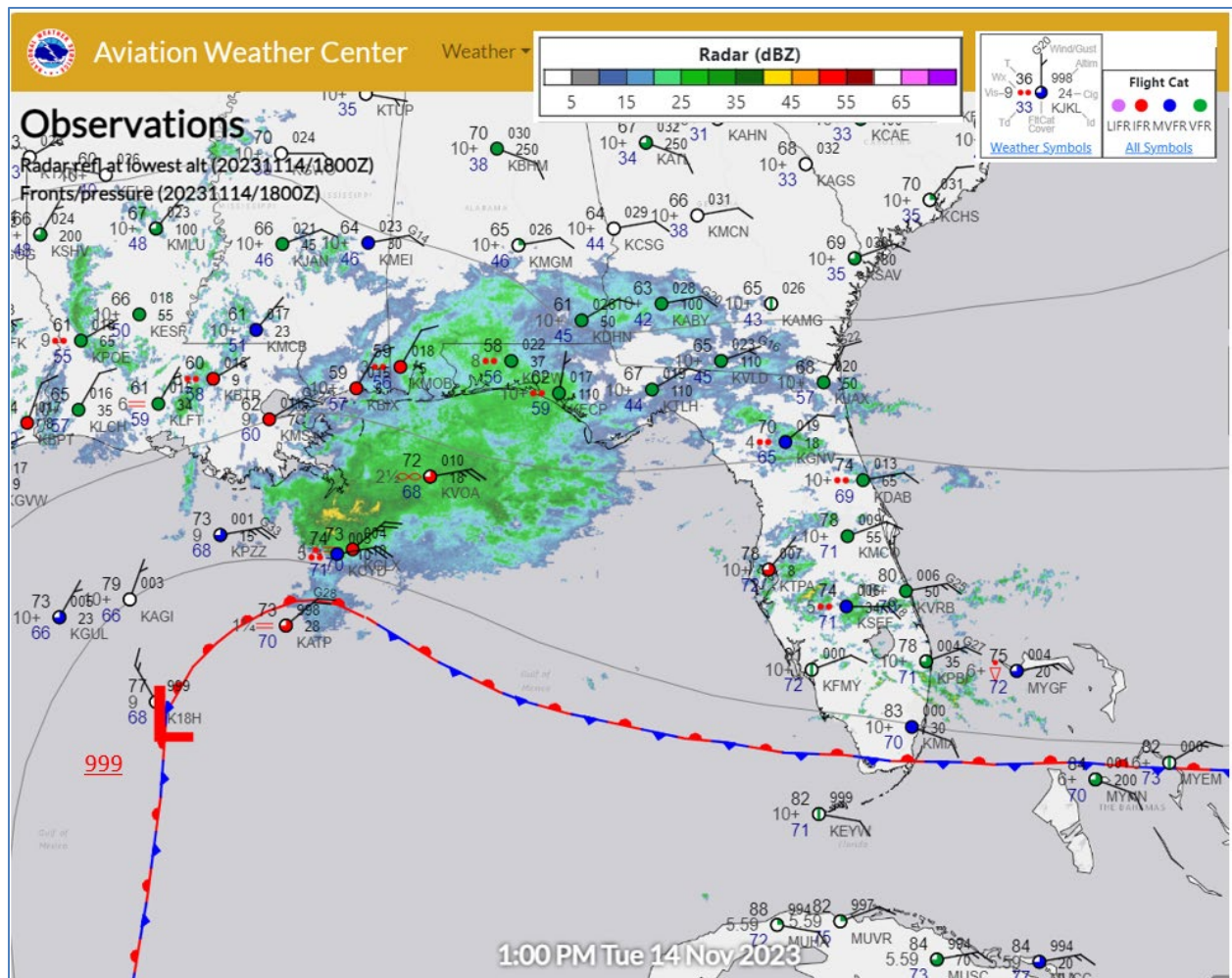


Figure 1 - NWS Surface Analysis Chart and station models and radar imagery for 1300 EST.

1.2 NWS Surface Prognostic Chart

The NWS 6-hour Surface Prognostic Chart valid for 1300 EST during the period is included as figure 2. The chart depicted the two low-pressure systems in the Gulf of Mexico associated with the developing frontal wave with the stationary front extending across south Florida. The chart depicted a large band of rain expected along and north of the front over the gulf coastal states with rain likely or with a probability over 60% over Louisiana, southern Mississippi and Alabama, and into the Florida panhandle. A chance of rain extended over the rest of Florida and over the accident site with a probability of 30-50%. The chart also indicated that there was a chance of thunderstorms expected over southern Florida.

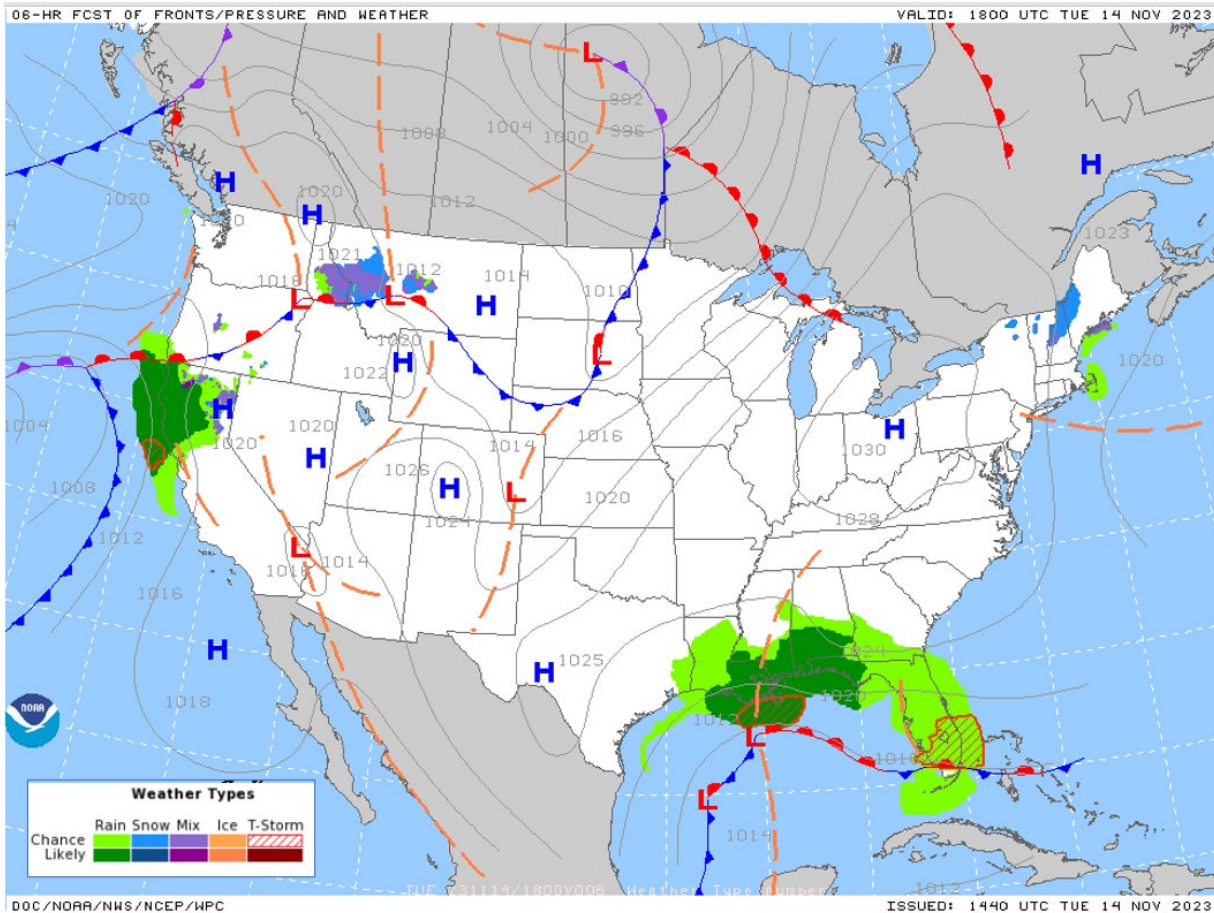


Figure 2 - NWS 6-hour Surface Prognostic Chart valid for 1300 EST with expected precipitation.

2.0 Surface Observations

The area surrounding the accident site was documented using official Aviation Routine Weather Reports (METAR) and Aviation Selected Special Weather Reports (SPECI). Cloud heights are reported above ground level (agl) in the following section. The magnetic variation over the area was estimated at 6° West based on the latest sectional chart for the area.

2.1 Gainesville, FL

The closest weather reporting station to the accident site was from Gainesville Regional Airport (KGNV), Gainesville, FL, located about 10 miles north of the accident site at an elevation of 151 ft. The airport had an Automated Surface Observation System (ASOS) and its reports were augmented by air traffic controllers during normal operating hours. The following conditions were reported surrounding the time of the accident.

Weather observation for KGNV at 1353 EST, wind from 040° at 11 knots gusting to 18 knots, visibility 2 miles in light rain and mist, a few clouds at 1,300 ft agl, ceiling broken at 1,800 ft, overcast at 3,600 ft, temperature 20°C, dew point temperature 18°C, altimeter 30.18 inches of mercury (inHg). Remarks: automated observation station with a precipitation discriminator, rain ended at 1318 and began at 1340 EST, sea level pressure 1021.7-hPa, hourly precipitation 0.03 inches, temperature 20.0°C, dew point temperature 18.3°C.

Special weather observation for KGNV at 1412 EST, wind from 040° at 10 knots, visibility 2 miles in moderate rain and mist, a few clouds at 1,600 ft agl, ceiling broken at 4,500 ft, overcast at 9,000 ft, temperature 19°C, dew point temperature 18°C, altimeter 30.17 inHg. Remarks: automated observation station with a precipitation discriminator, hourly precipitation 0.04 inches since 1353, temperature 19.4°C, dew point temperature 18.3°C.

The general flight categories⁵ (color coded) and longline disseminated observations from KGNV from about 1000 through 1600 EST were as follows. The observation in bold print is the decoded observation above.

MVFR METAR KGNV 141453Z 04009G19KT 10SM OVC012 21/18 A3022 RMK AO2 SLP232 T02110178 53012=

MVFR METAR KGNV 141553Z 04009G19KT 10SM OVC011 21/18 A3022 RMK AO2 SLP232 T02110178=

MVFR METAR KGNV 141653Z 05014G22KT 10SM OVC011 22/18 A3020 RMK AO2 SLP224 T02220178=

MVFR SPECI KGNV 141700Z 05014KT 10SM BKN019 BKN070 OVC085 22/18 A3020 RMK AO2 T02220178=

VFR SPECI KGNV 141709Z 05011KT 10SM SCT019 OVC075 22/18 A3020 RMK AO2 T02220178=

MVFR SPECI KGNV 141719Z 05014G22KT 10SM BKN019 OVC075 22/18 A3020 RMK AO2 T02220178=

MVFR METAR KGNV 141753Z 05011KT 4SM -RA BKN018 OVC030 21/18 A3019 RMK AO2 RAB40 SLP221 P0001 60001 T02110183 10228 20178 58011=

⁵ 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 subcategory of IFR. ** While MVFR is a subpart of VFR conditions.

Departed KISM 1825Z

VFR SPECI KGNV 141830Z 03009KT 8SM SCT020 OVC060 21/18 A3018 RMK AO2 RAE18 P0001
T02060183=

MVFR SPECI KGNV 141837Z 03008KT 7SM BKN020 OVC060 21/18 A3018 RMK AO2 RAE18 P0001
T02060183=

**IFR METAR KGNV 141853Z 04011G18KT 2SM -RA BR FEW013 BKN018 OVC036 20/18 A3018
RMK AO2 RAE18B40 SLP217 P0003 T02000183=**

Accident 1909Z

**IFR SPECI KGNV 141912Z 04010KT 2SM RA BR FEW016 BKN045 OVC090 19/18 A3017 RMK
AO2 P0004 T01940183=**

IFR SPECI KGNV 141934Z 03010KT 1 3/4SM RA BR FEW036 BKN048 OVC090 19/18 A3017 RMK
AO2 P0012 T01940178=

MVFR SPECI KGNV 141941Z 04012KT 3SM -RA BR SCT049 BKN080 OVC090 19/18 A3017 RMK AO2
P0014 T01940178=

IFR METAR KGNV 141953Z 03012G19KT 2SM RA BR FEW008 BKN046 OVC085 19/18 A3017 RMK
AO2 SLP216 P0015 T01940178=

IFR SPECI KGNV 142033Z 03010KT 2SM -RA BR BKN010 BKN036 OVC070 19/18 A3018 RMK AO2
P0004 T01890178=

IFR SPECI KGNV 142041Z 03011KT 2SM -RA BR BKN009 OVC037 19/18 A3018 RMK AO2 P0005
T01890178=

IFR METAR KGNV 142053Z 03009G16KT 5SM -RA BR OVC009 19/18 A3018 RMK AO2 CIG 006V010
SLP218 P0005 60023 T01890178 53001=

IFR SPECI KGNV 142105Z 02009KT 2 1/2SM -RA BR OVC008 19/18 A3018 RMK AO2 CIG 005V010
P0001 T01890178=

2.2 Melrose, FL

The planned destination of Sanders Ranch Airport (39FA), Melrose, Florida, did not have any weather reporting capability and was located about 14 miles east of the accident site at an elevation of 150 ft.

2.3 Williston, FL

The next closest airport to the accident site with weather reporting capability was Williston Municipal Airport (KX60), located about 16 miles southwest of the accident site at an elevation of 76 ft. The airport had an AWOS whose reports were not

augmented by any human observers and issued observations every 20-minutes. At the approximate time of the accident the following conditions were reported.

Weather observation for KX60 at 1355 EST, automated, wind from 060° at 8 knots, visibility 10 miles or more, ceiling overcast at 700 ft agl, temperature 21°C, dew point temperature 20°C, altimeter 30.14 inHg. Remarks: automated observation station with a precipitation discriminator, temperature 20.5°C, dew point temperature 19.7°C.

The general flight categories and observations were reported surrounding the period.

MVFR METAR KX60 141655Z AUTO 07006KT 5SM BR OVC015 21/20 A3017 RMK AO2 T02100197=

MVFR METAR KX60 141715Z AUTO 06006KT 5SM BR BKN013 BKN025 OVC040 21/20 A3017 RMK AO2 P0001 T02090201=

MVFR METAR KX60 141735Z AUTO 05008KT 5SM BR SCT007 BKN026 OVC050 21/20 A3015 RMK AO2 P0006 T02080201=

VFR METAR KX60 141755Z AUTO 04010KT 7SM SCT007 BKN045 OVC060 21/20 A3015 RMK AO2 P0007 T02070201 10226 20182 60007=

VFR METAR KX60 141815Z AUTO 05009KT 10SM SCT007 BKN037 OVC070 21/20 A3014 RMK AO2 T02060199=

IFR METAR KX60 141835Z AUTO 05008G15KT 010V070 10SM BKN007 BKN030 OVC039 21/20 A3014 RMK AO2 T02070199=

IFR **METAR KX60 141855Z AUTO 06008KT 10SM OVC007 21/20 A3014 RMK AO2 T02050197=**

Accident 1909Z

IFR METAR KX60 141915Z AUTO 04008KT 10SM BKN007 OVC012 21/20 A3013 RMK AO2 T02070200=

MVFR METAR KX60 141935Z AUTO 04008KT 10SM OVC010 21/20 A3014 RMK AO2 T02070196=

IFR METAR KX60 141955Z AUTO 04008KT 7SM OVC008 20/19 A3014 RMK AO2 T02030194=

IFR METAR KX60 142035Z AUTO 05008G17KT 5SM BR BKN007 BKN014 OVC070 20/19 A3014 RMK AO2 P0003 T01990190=

IFR METAR KX60 142055Z AUTO 04011KT 4SM BR BKN006 BKN024 OVC060 19/19 A3014 RMK AO2 P0012 T01930188 60012=

MVFR METAR KX60 142115Z AUTO 03013G17KT 5SM BR SCT006 BKN049 OVC060 19/19 A3014 RMK AO2 P0006 T01920187=

IFR METAR KX60 142135Z AUTO 04010KT 10SM BKN006 BKN037 OVC080 19/19 A3014 RMK AO2

2.4 Orlando, FL

The accident airplane departed from Kissimmee Gateway Airport (KISM), Orlando, FL, which lists an elevation of 82 ft. The airport had an AWOS and its reports were augmented by air traffic controllers during normal operating hours. The following conditions were reported at the time of departure.

Weather observation for KISM at 1256 EST, wind from 060° at 9 knots, visibility 10 miles or more, ceiling overcast at 5,500 ft agl, temperature 23°C, dew point temperature 22°C, altimeter setting 30.10 inHg. Remarks: automated station with a precipitation discriminator, rain ended at 1218 EST, sea-level pressure 1019.3-hPa, hourly precipitation less than 0.01 inches⁶, 6-hour precipitation 0.22 inches, temperature 23.3°C, dew point 22.2°C, 6-hour maximum temperature 23.3°C, 6-hour minimum temperature 21.7°C, 3-hour pressure tendency fallen 1.6-hPa, maintenance indicator on (\$).

The general flight categories and observations were reported surrounding the period.

IFR METAR KISM 141556Z 08014KT 2SM RA BR BKN008 BKN012 OVC022 22/22 A3014 RMK AO2
VIS 1 3/4V4 CIG 007V011 SLP206 P0016 T02220217 \$=

IFR SPECI KISM 141640Z 07010KT 4SM -RA BR BKN008 BKN012 OVC035 22/22 A3013 RMK AO2
CIG 005V011 P0006 \$=

IFR METAR KISM 141656Z 07009KT 6SM -RA BR BKN008 OVC014 22/22 A3013 RMK AO2 CIG
006V010 SLP203 P0006 T02220217 \$=

VFR SPECI KISM 141724Z 06010KT 10SM SCT008 BKN043 OVC060 23/22 A3011 RMK AO2 RAE18
P0000 \$=

**VFR METAR KISM 141756Z 06009KT 10SM OVC055 23/22 A3010 RMK AO2 RAE18 SLP193
P0000 60022 T02330222 10233 20217 58016 \$=**

Departed 1825Z

MVFR METAR KISM 141856Z 09014G20KT 10SM BKN028 BKN055 26/21 A3008 RMK AO2 SLP185
P0001 T02560206 \$=

MVFR SPECI KISM 141929Z 09018G23KT 10SM BKN030 BKN085 26/19 A3008 RMK AO2 \$=

MVFR SPECI KISM 141940Z 09018G22KT 10SM BKN028 OVC040 26/19 A3008 RMK AO2 \$=

⁶ Precipitation less than 0.01 inches is also referred to as a trace.

3.0 Sounding

A High Resolution Rapid Refresh (HRRR) numerical model⁷ data was obtained from the NOAA Air Resource Laboratory for 1400 EST for the closest grid point to the accident site. The data was then plotted on a standard Skew T log P diagram⁸ using the RAOB Analysis software⁹. Figure 4 is the HRRR sounding over the approximate accident site.

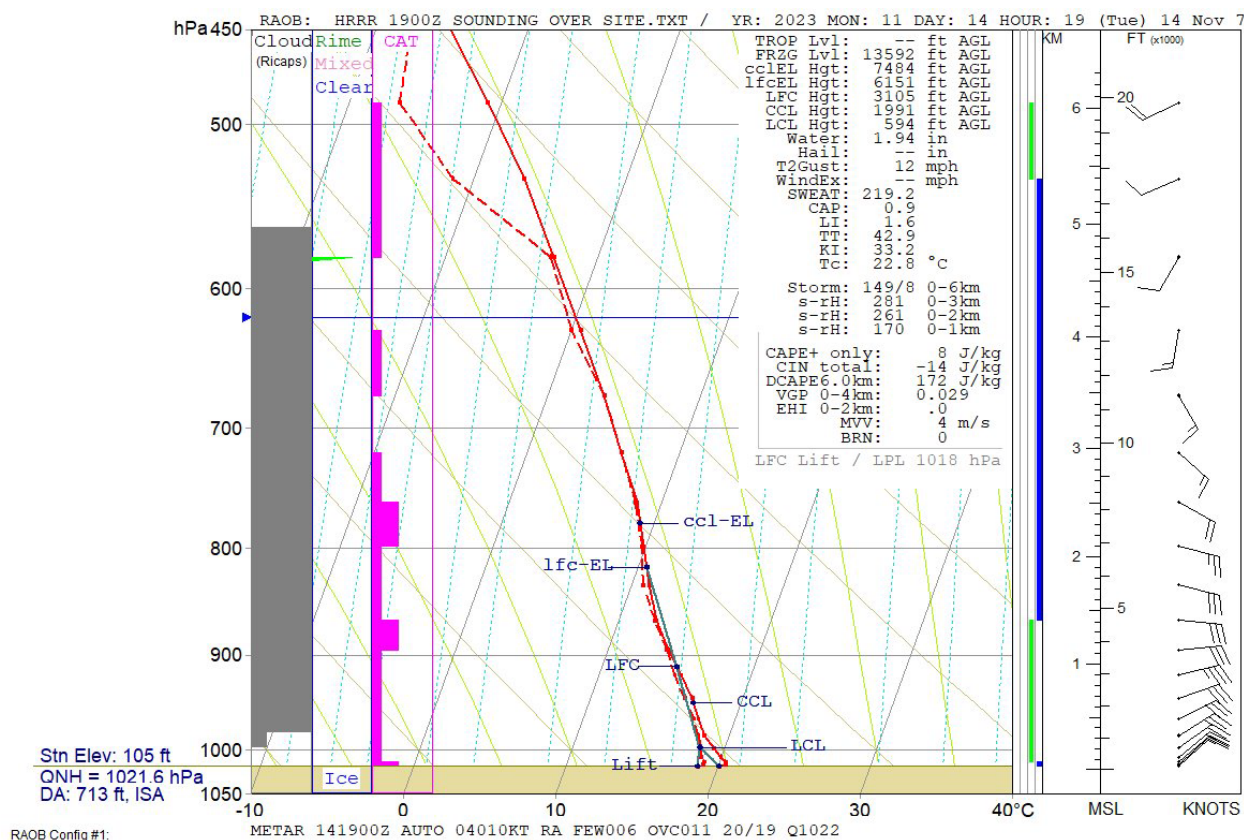


Figure 4 - HRRR Model sounding over the approximate accident site for 1400 EST.

The HRRR sounding depicted an elevation of 105 ft, with a near surface temperature of 20.1°C, a dew point temperature of 18.7°C, and a relative humidity of

⁷ 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.

⁸ 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.

⁹ RAOB - The Universal RAOBsonde OBServation program is an interactive sounding analysis program developed by Eosonde Research Services (ERS) previously known as Environmental Research Services, The Villages, Florida.

92%. The lifted condensation level (LCL)¹⁰ was identified at 594 ft agl and represented the approximate base of a layer of stratus clouds, with an overcast layer of nimbostratus clouds at 1,000 ft agl with tops to near 16,200 ft, and another higher level of altostratus type clouds between 21,000 ft and 26,000 ft. The Lifted Index (LI)¹¹ was 1.6, the K-index¹² was 33.2, and the convective available potential energy (CAPE)¹³ was 8 Joules/kilogram, which indicated a general conditionally unstable atmosphere. The precipitable water content was 1.94 inches. The freezing level was identified at about 13,600 ft msl. The wind profile indicated a surface wind from 040° at 10 knots with winds veering to the east through 5,000 ft, and gradually veering to the west-southwest above 18,000 ft. The mean 0 to 6 kilometer (or 18,000 ft) mean wind was from 120° at 11 knots.

A table of the HRRR sounding parameters of height, pressure, temperature (T), dew point temperature (Td), relative humidity (RH), wind direction and speed, and the RAOB derived clear air turbulence (CAT), Low-Level Wind Shear (LLWS), and Icing potential through 12,000 ft is included below.

Height (ft-msl)	Pres (hPa)	T (°C)	Td (°C)	RH (%)	Wind (dir kts) (FAA)	CAT (FAA)	LLWS (USAF)	Icing
105	1018	20.1	18.7	92	045/ 10			
161	1016	20.5	19.0	91	045/ 9	MDT	MODRT	
245	1013	20.4	19.0	92	047/ 15LGT	LIGHT		
386	1008	20.0	18.7	92	048/ 18LGT	LIGHT		
669	998	19.3	18.5	95	051/ 22LGT			
1069	984	18.4	18.0	98	055/ 25LGT			
1590	966	17.6	17.3	98	061/ 29LGT			
2238	944	16.7	16.2	97	070/ 32LGT			
2959	920	15.4	15.0	97	076/ 33LGT			
3726	895	14.0	13.9	99	084/ 31MDT			
4638	866	12.5	12.4	99	096/ 32LGT			
5709	833	11.2	10.8	97	105/ 31LGT			
6886	798	9.9	9.8	99	106/ 25MDT			
8217	760	8.4	8.3	99	121/ 18LGT			
9719	719	6.2	6.2	100	136/ 16			
11415	675	3.7	3.7	100	153/ 15LGT			

¹⁰ Lifted Condensation Level (LCL) - the level at which a lifted parcel becomes saturated. The LCL height corresponds to cloud base height for forced ascent.

¹¹ 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 or approximately 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.

¹² K-Index - The measure of thunderstorm potential based on the vertical temperature lapse rate, the moisture content of the lower atmosphere and the vertical extent of the moist layer. The higher the K-Index value the greater the probability of air mass type thunderstorm development across the region.

¹³ Convective Available Potential Energy (CAPE) - is a measure of the amount of energy available for convection. CAPE is directly related to the maximum potential vertical speed within an updraft; thus, higher values indicate greater potential for severe weather.

4.0 Satellite Imagery

The NOAA Geostationary Operational Environmental Satellite number 16 (GOES-16) infrared and visible imagery were obtained from an archive at the Space Science Engineering Center (SSEC) at the University of Wisconsin-Madison in Madison, Wisconsin, and processed using the Man-computer Interactive Data Access System (McIDAS) software. The infrared band 13 at a wavelength of 10.3 microns (μm) provided a resolution of 2 kilometers (km) with radiative cloud top temperatures, and the visible band 2 imagery at a wavelength of 0.64 μm provided a resolution of 0.5 km.

Figure 5 is the GOES-16 infrared image for 1406 EST at 4X magnification which depicted an extensive area of low and mid-level clouds with a radiative cloud top temperature of 251 kelvin or -22°C over the accident site, which corresponded to cloud tops near 26,000 ft based on the HRRR sounding. Figure 6 is the GOES-16 visible image for the same period at 2X magnification which depicted the extensive area of low and mid-level stratiform type clouds obscuring the accident site.

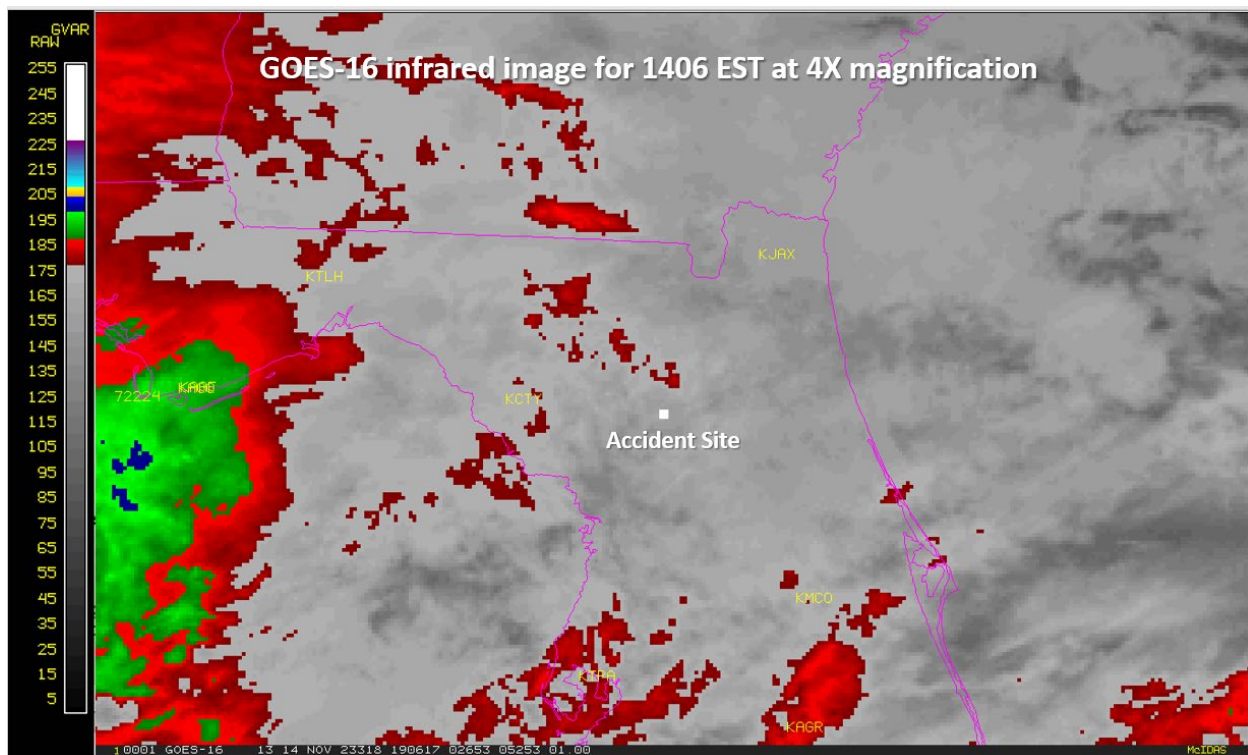


Figure 5 - GOES-16 infrared image for 1406 EST at 4X magnification with the accident site marked by the white square.

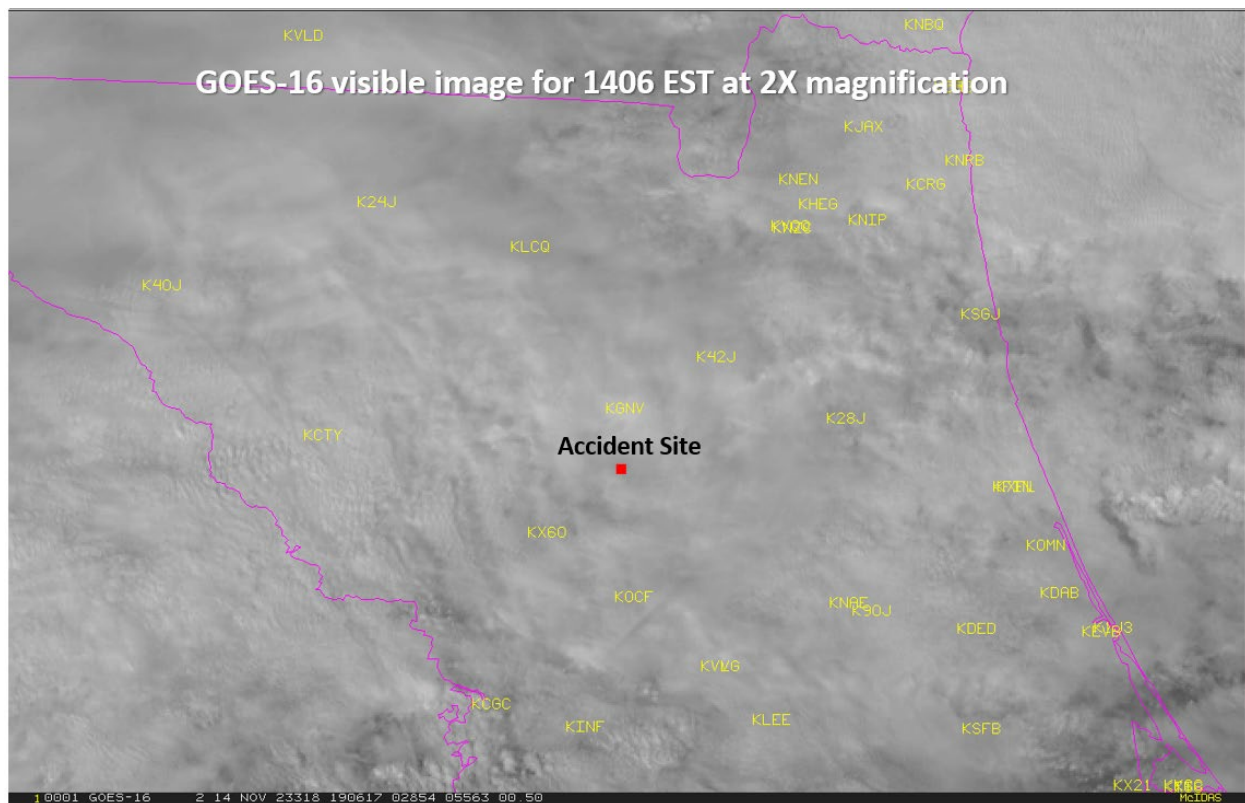


Figure 6 - GOES-16 visible image for 1406 EST at 2X magnification with the accident site marked by the red square.

5.0 Weather Radar Imagery

The NWS Jacksonville (KJAX) Weather Surveillance Radar 1988 Doppler (WSR-88D)¹⁴ was located about 65 miles north-northeast of the accident site. The level II archive radar data were obtained from the NCEI using the Hierarchical Data Storage System and displayed using the NWS NEXRAD Interactive Viewer and Data Exporter software¹⁵. The accident aircraft's ADS-B flight track data were obtained and overlaid on the radar imagery. During the period, the KJAX WSR-88D was operating in the precipitation mode identified as volume scanning pattern 215 (VCP-215), where the radar makes 15 different elevation scans during a 6 minute scan. This scan is typically used in general precipitation situations and provides the most vertical resolution of any other scanning strategies.

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors¹⁶, it is a function of the drop size

¹⁴ The WSR-88D is a S-band 10-centimeter wavelength radar with a power output of 750,000 watts, with a 28-foot parabolic antenna concentrating the energy into a 0.95° beam width. The radar produces three basic types of products reflectivity, radial velocity, and spectral width.

¹⁵ <https://www.ncdc.noaa.gov/wct/>

¹⁶ Hydrometeors are any product of condensation or sublimation of atmospheric water vapor, whether

distribution, number of particles per unit volume, physical state (ice or water), shape, and aspect. Reflectivity is normally displayed in decibels (dBZ)¹⁷ and is a general measure of echo intensity. The FAA Aviation Weather Handbook¹⁸ 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 as shown in the following table. Light rain is typically reported at the surface when reflectivities reach 20 dBZ, while air traffic control weather displays typically do not display echoes less than 30 dBZ or light intensity echoes on their weather displays or disseminate alerts of any such echoes.

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

Figure 7 is the KJAX WSR-88D 0.5° base reflectivity for 1409 EST with the flight track overlaid in magenta. Based on the distance of 65 miles from the radar with an antenna height of 160 ft, the center of the 0.53° elevation scan was centered near 6,610 ft and the radar was scanning the altitudes between 3,340 and 9,890 ft. The accident aircraft is observed operating under an area of light intensity echoes around 1330 EST and then turning westerly while remaining under light intensity echoes of 10 to 30 dBZ.

formed in the free atmosphere or at 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.

¹⁷ dBZ - Nondimensional "unit" of radar reflectivity which represents a logarithmic power ratio (in decibels, or dB) with respect to radar reflectivity factor, Z.

¹⁸ FAA Aviation Weather Handbook - WSR-88D Radar Precipitation Intensity Terminology (Table 24-8).

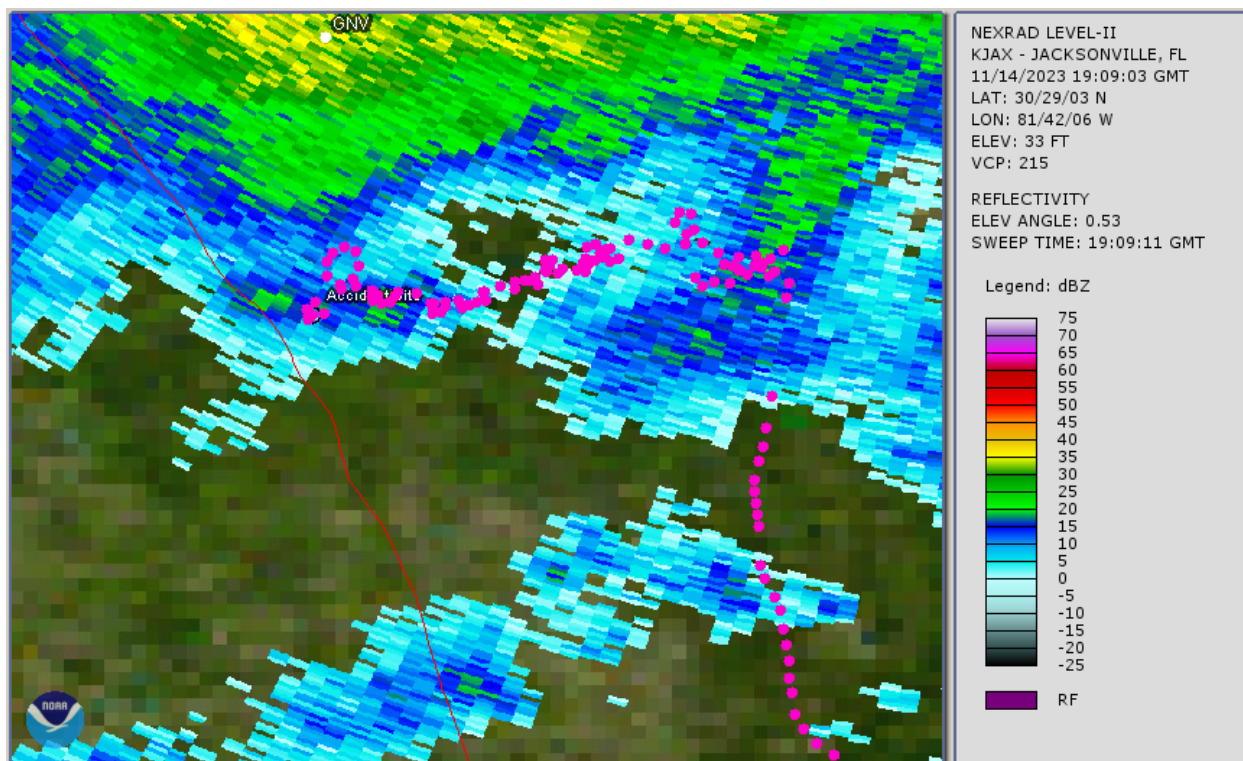


Figure 7 - NWS KJAX WSR-88D 0.5° base reflectivity image for 1409 EST with the flight track overlaid in magenta.

6.0 Pilot Reports

The following pilot reports or PIREPs were reported¹⁹ within 100 miles of KGNV below 12,500 ft from 1030 through 1500 EST.

ISM UA /OV ISM/TM 1530/FLDURGD/TP TTX/SK OVC004
SFB UA /OV SFB/TM 1601/FL010/TP E55P/SK BKN012
JAX UA /OV FHB/TM 1601/FL030/TP BE20/SK B030
BKV UA /OV /OV BKV/TM 1601/FL010/TP CL60/SK OVC011
MCO UA /OV MCO180003/TM 1602/FLDURD/TP B753/RM BASE OVC012 DURD RWY36L
ISM UA /OV ISM/TM 1602/FL020/TP C240/SK BASE005
EVB UA /OV EVB250003/TM 1603/FL013/TP C25/SK OVC013/RM DURD
MCO UA /OV MCO180002/TM 1604/FLDURD/TP B752/RM BASE OVC010 LGT PRECIP DURD RWY35R
JAX UA /OV OCF/TM 1614/FLDURGD/TP BE33/SK B030
MCO UA /OV MCO330010/TM 1615/FL095/TP A320/TB POCKETS MOD TURB/RM DURD
DAB UA /OV DAB340005/TM 1618/FL030/TP UH60/SK SCT030
JAX UA /OV CRG270008/TM 1623/FL030/TP C172/SK OVC030
JAX UA /OV JAX/TM 1624/FL050/TP B737/SK B030 OVC T034
JAX UA /OV JAX270005/TM 1629/FLDURGD/TP HDJT/SK BASES040
ORL UA /OV ORL/TM 1634/FL011/TP C172/SK BKN030/RM LT CHOP
ORL UA /OV ORL/TM 1700/FL020/TP B737/SK OVC039-TOP125/WX RA

¹⁹ Includes PIREPs disseminated longline and may not include "ride reports" or other reports made on radio frequency to air traffic control.

MCO UA /OV MCO/TM 1701/FL010/TP A321/SK OVC035/WX RA
 MCO UA /OV MCO180002/TM 1704/FLDURGD/TP B739/RM SMOOTH RIDE DURD RWY36L
 SFB UA /OV 6NM W OF SFB/TM 1706/FL016/TP DA42/SK SCT023
 JAX UA /OV NIP/TM 1714/FLDURGD/TP B738/SK BASES030
 LCQ UA /OV LCQ264059/TM 1718/FL035/TP C172/SK TOP050/TB NEG
 DAB UA /OV FIN16005/TM 1719/FL065/TP PA34/TB SMOOTH/RM BASE BKN065
 ORL UA /OV ORL25004/TM 1722/FL015/TP LJ35/SK BKN022
 JAX UA /OV OCF/TM 1744/FL010/TP C172/SK BASE012
 BKV UA /OV BKV/TM 1748/FL007/TP C525/SK OVC007-TOP050/WX FV05SM BR
 MCO UA /OV MCO/TM 1800/FL030/TP B757/SK OVC016
 ISM UA /OV 09009/TM 1801/FL016/TP B737/SK OVC029/WV 090037
 ORL UA /OV ORL/TM 1804/FL015/TP P28A/SK SCT020/WX FV10SM
 JAX UA /OV JAX/TM 1809/FL050/TP C550/SK BKN040
 DAB UA /OV OMN/TM 1819/FL047/TP DA40/SK BKN047/RM TOPS BKN050
 SFB UA /OV SFB270005/TM 1837/FL011/TP P28A/SK OVC025
 MCO UA /OV MCO180003/TM 1858/FLDURGD/TP A21N/RM SMOOTH RIDE DURD RWY36L
OCF UA /OV OCF/TM 1859/FL008/TP PC12/SK OVC008

Accident 1909Z

SFB UA /OV SFB270005/TM 1902/FL016/TP C172/SK OVC025/WX FV10SM/TB NEG
 ORL UA /OV ORL34001/TM 1903/FL009/TP DA40/RM LIGHT CHOP
 DAB UA /OV 5 W OF OMN/TM 1907/FL020/TP C172/SK OVC050
CTY UA /OV CTY/TM 1908/FL110/TP AT76/SK IMC/TA 11/TB LGT CHOP
 MCO UA /OV MCO/TM 1920/FL020/TP DA40/SK BASES 030-035/WX FV10SM/WV 30KTS WIND
 MCO UA /OV MCO180004/TM 1923/FLDURGD/TP B738/RM BASE BKN030 SMOOTH RIDE DURD
 RWY35R

The majority of the PIREPs recorded surrounding the period were reporting sky cover, the amount of which varied with time and location. Of 32 reports of sky conditions, 19 reported cloud bases below 3,000 ft suggesting MVFR conditions and 4 reports of IFR to LIFR conditions. One of the reports immediately prior to the accident over Ocala (OCF) approximately 24 miles south of the accident site, reported overcast clouds at 800 ft. A few aircraft reported cloud tops near 5,000 ft, while one aircraft about 40 miles west of the accident site reported being in instrument meteorological conditions at 11,000 ft at the time of the accident. Both of those reports are in bold blue text. There was only a single report of moderate turbulence near 9,500 ft, and no significant reports of any low-level wind shear over the area.

7.0 NWS Forecasts

The NWS Jacksonville (KJAX), FL, Weather Forecast Office (WFO) was responsible for the issuance of the local forecasts and weather warnings over the area. The NWS AWC located in Kansas City, MO, was responsible for the aviation graphic products and advisories documented below.

7.1 Terminal Aerodrome Forecast

The NWS KJAX WFO does not issue a Terminal Aerodrome Forecast (TAF) for the planned destination of 39FA. The closest TAF to the accident site was from KGNV. A TAF is a concise forecast of wind, clouds, weather for a period of general 24-hours, and is valid for a 5 statute mile radius of the airports center point. The TAF current at the time of the accident was issued at 1240 EST and was as follows.

*TAF KGNV 141740Z 1418/1518 05014G22KT 6SM -RA BR BKN015 OVC070
TEMPO 1418/1422 4SM SHRA BR BKN010 OVC030
FM150000 06011KT P6SM VCSH SCT025 OVC070
FM151400 07011G18KT P6SM -RA SCT020 BKN045 OVC060=*

The forecast for KGNV expected from 1300 EST winds from 050 at 14 knots gusting to 22 knots, visibility better than 6 miles in light rain and mist, ceiling broken at 1,500 ft agl, overcast at 7,000 ft, with a temporary²⁰ period between 1300 and 1700 EST of visibility 4 miles in moderate rain showers and mist, ceiling broken at 1,000 ft agl, and overcast at 3,000 ft. Beyond 1900 EST, VFR conditions were expected with rain showers in the vicinity.

7.2 Area Forecast Discussion

The NWS Area Forecast Discussions (AFD) are issued by each 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 and provide 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 NWS KJAX WFO issued the AFD at 1258 EST for the period which was as follows.

*FXUS62 KJAX 141758
AFDJAX*

*Area Forecast Discussion
National Weather Service Jacksonville FL
1258 PM EST Tue Nov 14 2023*

...New AVIATION...

*.UPDATE...
Issued at 1000 AM EST Tue Nov 14 2023*

For the latest NE FL and SE GA Daily Key Messages please visit:

²⁰ Temporarily - Indicator of temporary fluctuations to forecast conditions which are expected to last less than an hour in each instance and, in the aggregate, to cover less than half of the indicated period.

<https://www.weather.gov/media/jax/briefings/nws-jax-briefing.pdf>

The forecast is generally on track. The main change was to increase the rain chances across northeast FL as the trough of low pressure near the coast and overrunning conditions support at least 20-30 percent changes, with some 50 percent probabilities especially southeast zones and the northeast FL coast. Gusty northeast winds at the coast will continue with temps only slightly moderating through the day due to the abundant cloud cover. Though guidance shows some 10-20 percent thunderstorm chance across the south zones today and marine waters, there will not be enough instability to support a mention of t-storm.

Little change in the marine forecast but may need to extend the high surf advisory for northeast FL beaches. The tide levels along the coast and the St Johns River are generally peaking in the action stage, but one or two sites may be to meet minor coastal flooding. The guidance at the coast fell short of the observations by about 0.1 to 0.2 feet with the morning high tide.

.NEAR TERM...(Today and Tonight)

As of 3 AM, light and shallow showers are being generated along a coastal trough axis over the waters and have advanced into the coast for areas generally south of Mayport. Due to unsupportive conditions further inland, this activity will diminish and not likely push beyond the I-95 corridor through the remaining predawn hours. Meanwhile, aloft weak isentropic upglide has thickened a layer of mid level clouds and lead to occasional drizzle for inland areas.

Today ---

Rain chances will mainly be associated with the inverted coastal trough that is progged to propagate inland through the day. Dry air intruding into areas north of I-10 will generally keep shower chances below mentionable. Whereas a bit more moisture and very marginal instability should allow for mostly light showers with a few embedded moderate rain showers across north-central FL through the afternoon.

Between strong high pressure to the north and the inverted coastal trough, breezy conditions will continue today with gusts at the coast nearing 30-35 mph at times and 20-25 mph inland, especially across NE FL. Coastal hazards will continue with frequent rip currents, high surf, minor beach erosion and elevated high tides.

Given the thick multi-layered cloud cover, temperatures will struggle to warm again today but less low clouds should promote a warmer day than yesterday with highs in the low 70s for portions of NE FL. In SE GA, warming will also be restricted by cloudiness with highs only reaching the low/mid 60s.

.AVIATION...

(18Z TAFS)

Issued at 1255 PM EST Tue Nov 14 2023

VFR to MVFR ceilings with occasional patches of rain expected for the northeast FL terminals into Wednesday morning. The chance for any IFR conditions seems low probability/low confidence at this time, even given the abundant cloud cover over the area. A couple of brief moderate to briefly heavy shower activity is possible at times over northeast FL TAFs as well. Otherwise, sfc winds will be northeast 10-15 kt gusting to near 25 kt and slowly diminish tonight, and become more easterly on Wednesday.

7.3 Graphic Forecast for Aviation

The NWS Graphic Forecast for Aviation (GFA) is a graphical depiction of surface wind, thunderstorms, precipitation, color-coded general flight categories, and cloud cover bases and tops reported in msl heights, from graphical output from the NWS National Digital Forecast Database (NDFD) with the Graphic-Airmen's Meteorological Information (G-AIRMET) for IFR conditions, mountain obscuration, icing conditions, and strong surface wind overlaid. The GFA provides a forecast for the enroute phase of flight and for locations without a TAF. The GFA is available at the NWS AWC website and through other weather briefing services.

The GFA surface ceiling and visibility, precipitation, and cloud display at 1300 EST or at the approximate time of departure are included as figure 8 through 10. The images depicted general MVFR conditions expected over the route of flight and accident site with rain showers expected, while the cloud forecast depicted broken clouds with bases at 1,600 to 4,000 ft with tops to 26,000 ft. The Graphic-AIRMET for IFR conditions was depicted over a portion of the route.

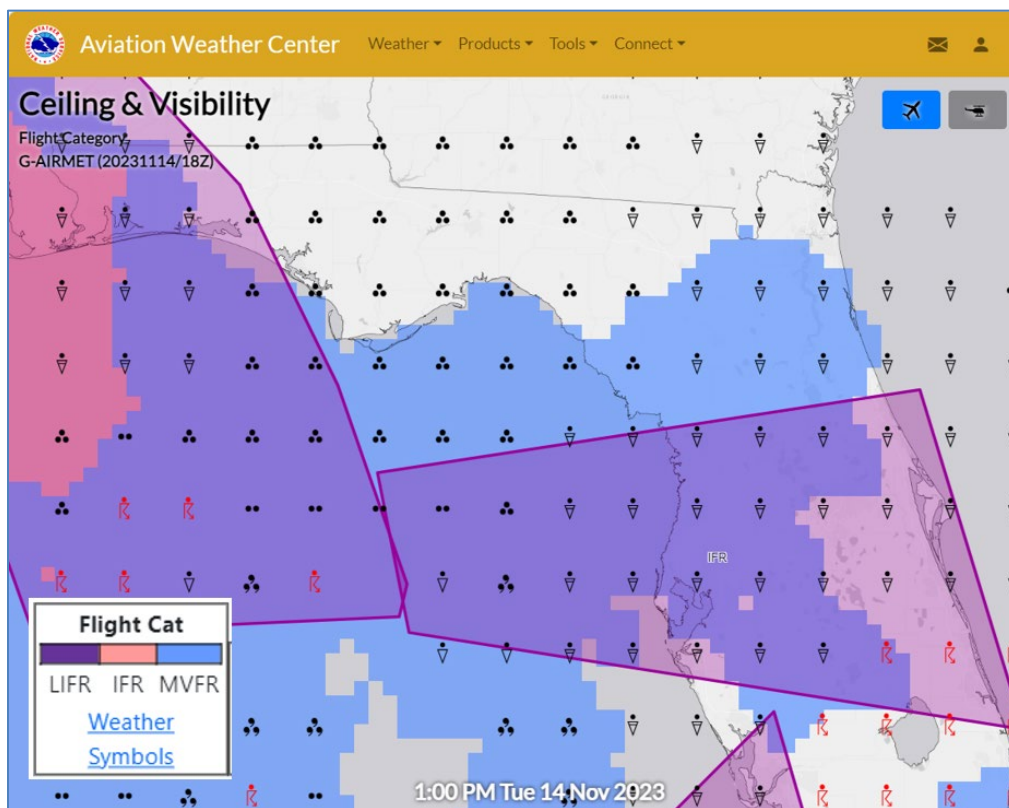


Figure 8 - Graphic Forecast for Aviation Ceiling and Visibility Categories for 1300 EST.

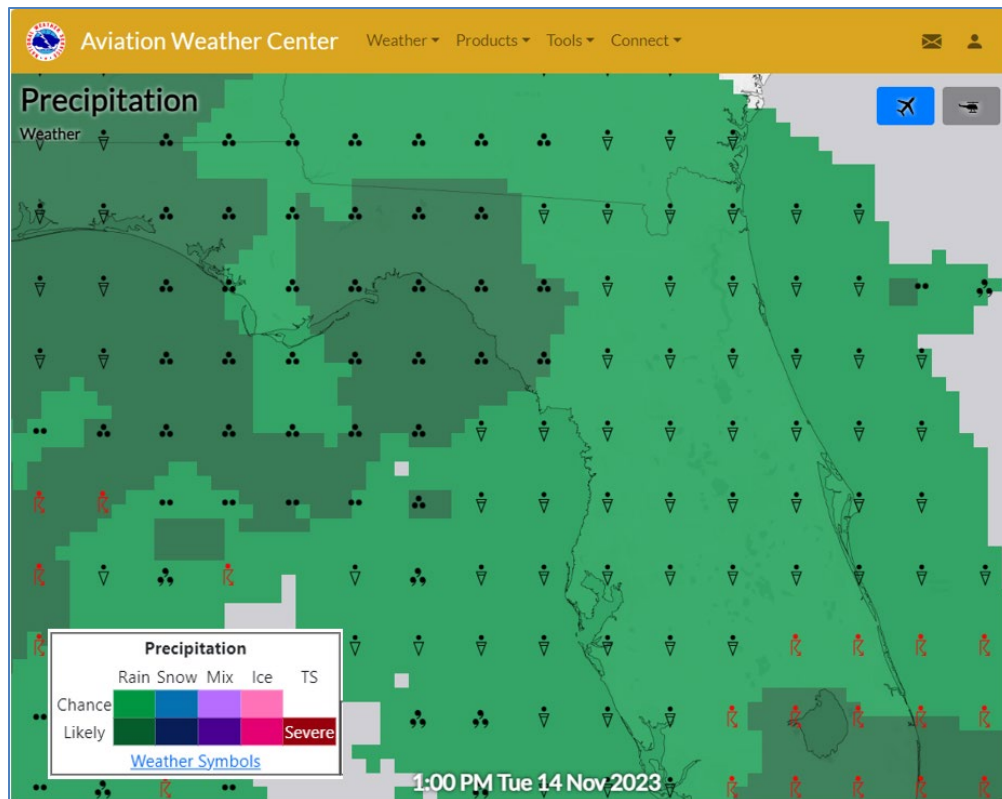


Figure 9 - Graphic Forecast for Aviation Precipitation Forecast for 1300 EST.

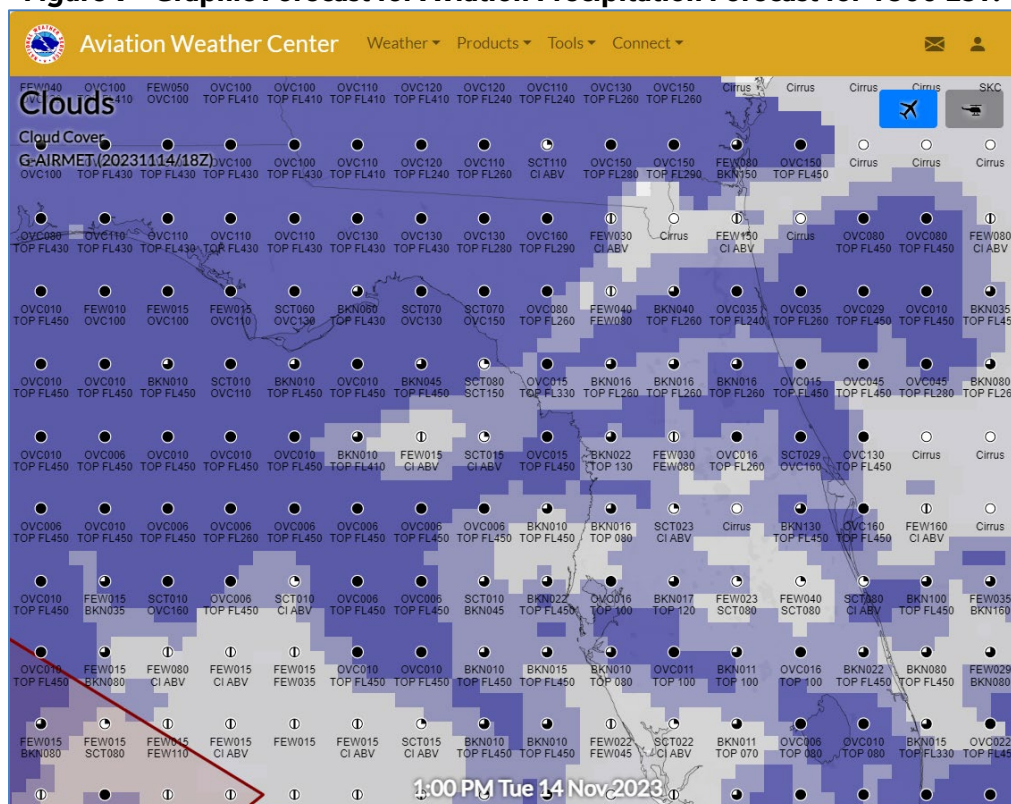


Figure 10 - Graphic Forecast for Aviation Cloud Forecast for 1300 EST.

8.0 NWS Weather Advisories

In-flight Aviation Weather Advisories are forecasts that 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) at the various Air Route Traffic Control Centers (ARTCCs). There are four basic types of inflight aviation weather advisories: the Significant Meteorological Information (SIGMET), the Convective SIGMET, the Graphic-AIRMET, and the Center Weather Advisory (CWA). Inflight advisories serve to notify en-route pilots of the possibility of encountering hazardous flying conditions that 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 based on experience and the operational limits of the aircraft. Once issued they are broadcast by FAA air traffic controllers upon issuance and available on inflight weather broadcasts.

At the time of departure, the NWS had a Graphic-AIRMET current for IFR conditions over central Florida, which extended along the general route of flight, with the northern boundary extending to the Ocala area or about 24 miles south of the accident site. The G-AIRMET is depicted with the observations and radar mosaic for 1300 EST and is included as attachment 11. The NWS also had a G-AIRMET Zulu current for icing conditions between the freezing level at 12,000 and 14,000 ft through 26,000 ft over northern and western Florida, which extended over the accident site at altitude. There were no SIGMETs, Convective SIGMETs, or CWAs current over the area at the time of the accident.

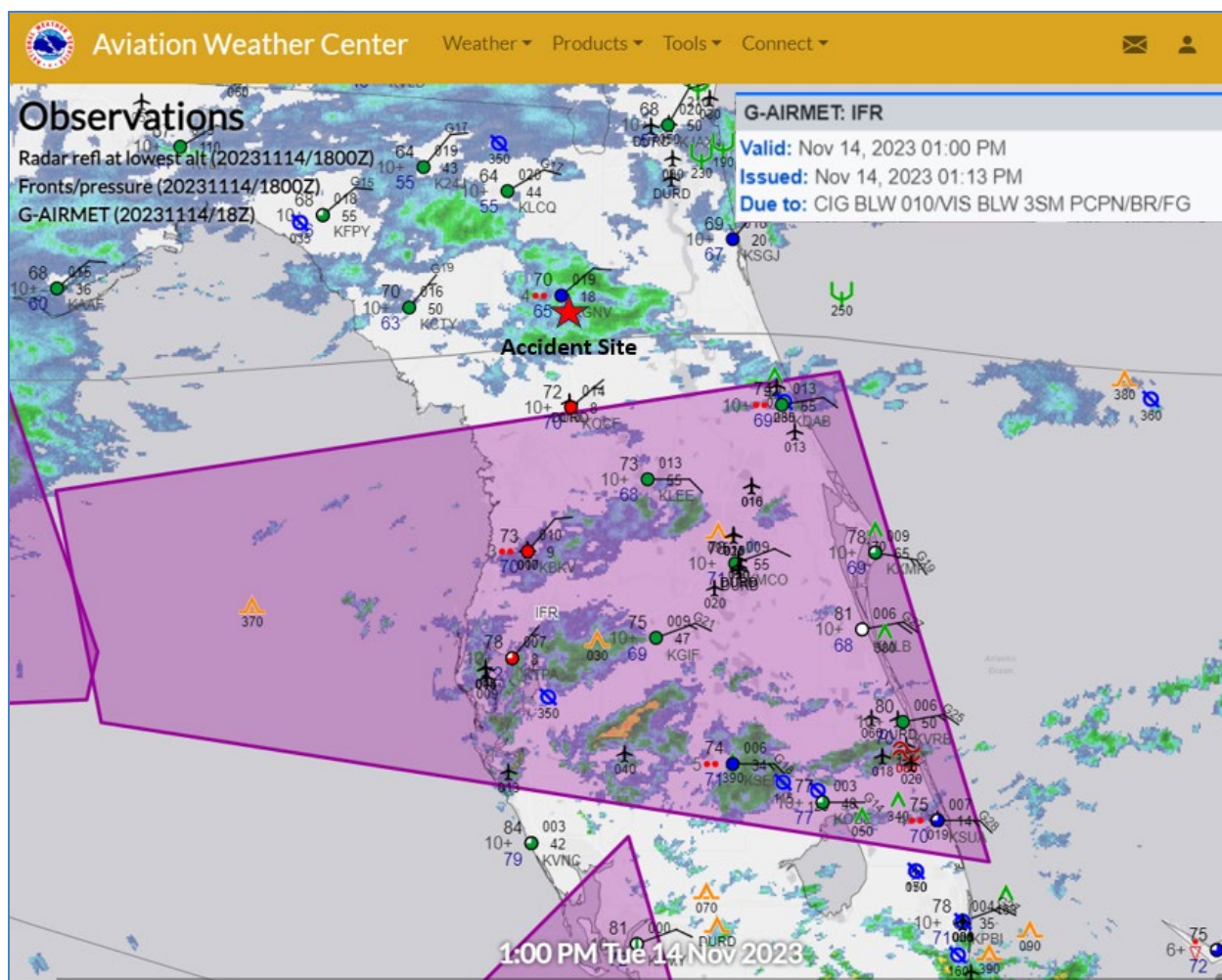


Figure 11 - NWS AWC depiction of the Graphic-AIRMET and observations and radar overlay for 1300 EST with the accident site marked by the red star.

After the accident at 1514 EST the NWS ZJAX CWSU issued a CWA for rain showers developing over the area.

FAUS21 KZJX 142014
 ZJX1 CWA 142015
 ZJX CWA 101 VALID UNTIL 142200
 FROM 25N CRG-20SSE OMN-45S CTY-30ESE SZW-25N CRG
 AREA NMRS SHRA MOV FM 17010KT. TOPS FL270. MOD TO HVY PCPN.
 EXP SLO INCR IN CVRG/INTST OVR SRN GA/FL PEN THRU PD. GA FL

9.0 Preflight Weather Briefing

The FAA contract Automated Flight Service Station (AFSS) provider Leidos and third party users of their system did not have any contact with the pilot on the day of

the accident. The NTSB contacted ForeFlight, who indicated that the accident pilot did have an account with them and had programmed the route of flight into the ForeFlight app but did not file any flight plans or review any weather on the day of the accident. Therefore, it is unknown what the pilot may have reviewed, if anything, prior to departure to familiarize himself with the weather conditions over the region.

Submitted by:

Donald Eick
Senior Meteorologist