National Transportation Safety Board
Office of Aviation Safety
Washington, DC 20594

DCA23FM007

METEOROLOGY

Specialist's Factual Report

March 14, 2023

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A. ACCIDENT

Location: 80 miles southeast of Lake Charles, Louisiana, in the open waters of the Gulf of Mexico
Date: November 20, 2022
Time: 1256 central standard time
1856 coordinated universal time (UTC)
Vessel: *L/B Robert*

B. METEOROLOGY SPECIALIST

Paul Suffern
National Transportation Safety Board
Washington, DC

C. 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), the Ocean Prediction Center (OPC), 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 central standard time (CST) and are based upon the 24-hour clock, where local time is -6 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 an approximate latitude 28.273965° N, longitude 92.104128°.

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 Charts

The WPC Surface Analysis Chart centered over the southern United States for 1200 CST is provided as figure 1 with the location of the accident site within the black circle. The chart depicted a low-pressure system over the central Gulf of Mexico with a pressure of 1014-hectopascals (hPa). A trough[2] was oriented north-to-south over eastern Texas. The accident site was located northwest of the low-pressure center on the cool side of the low-pressure system.

The closest station model near the accident site depicted mostly clear skies, a northeasterly wind at 20 to 35 knots, air temperatures in the low 60s° Fahrenheit (°F) and dew point temperatures in the mid-50s°F.

The OPC Atlantic Surface Analysis Chart is provided as figure 2 with the 1014-hPa low-pressure system indicated as a gale force[3] low in the central Gulf of Mexico. Frontal boundaries stretched from the low-pressure center in the central Gulf of Mexico across Florida into the western Atlantic Ocean.

[1] FAA-H-8083-28
[2] Trough – An elongated area of relatively low atmospheric pressure or heights.
[3] Gale force wind – An extratropical low or an area of sustained winds of 34 to 47 knots, inclusive: NOAA's National Weather Service - Glossary

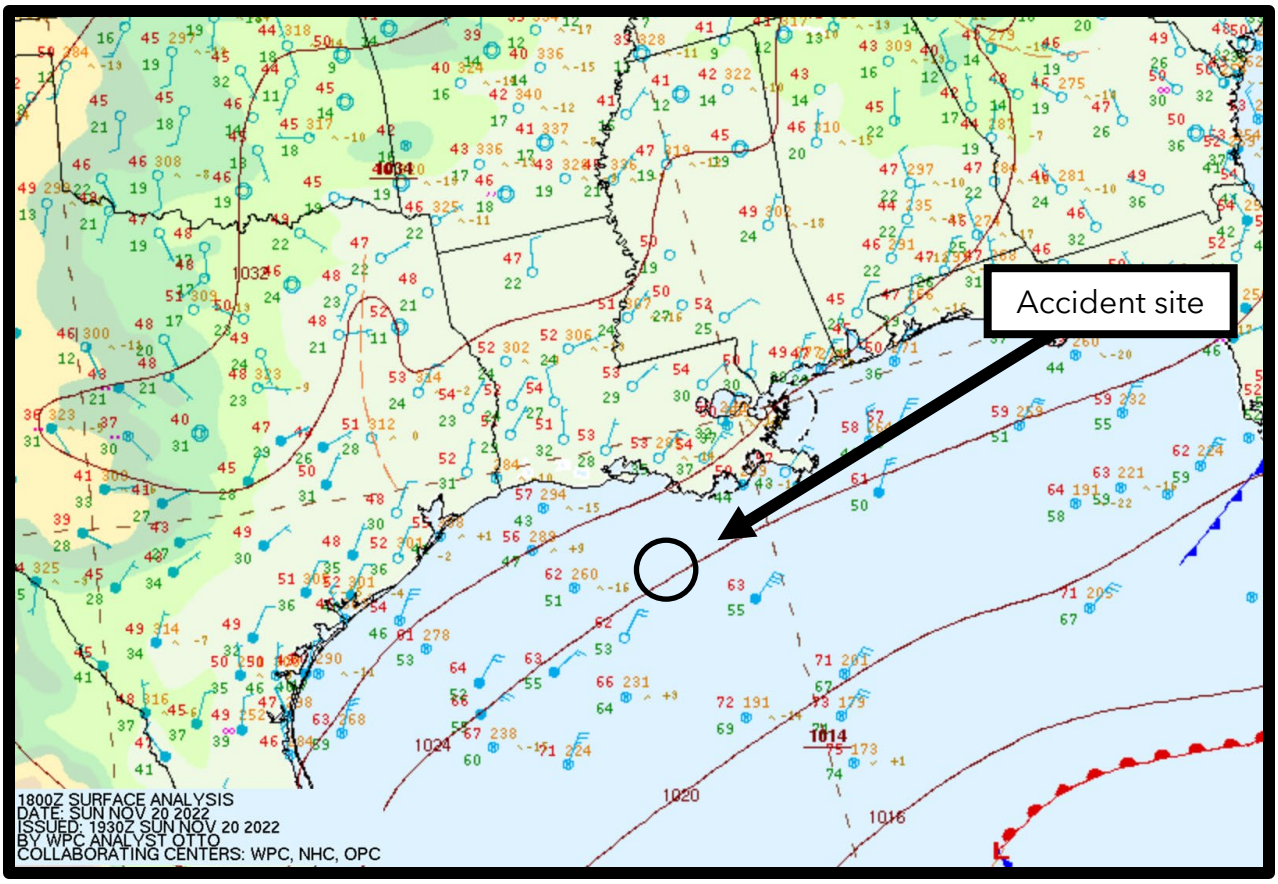

Figure 1. WPC Surface Analysis Chart for 1200 CST.

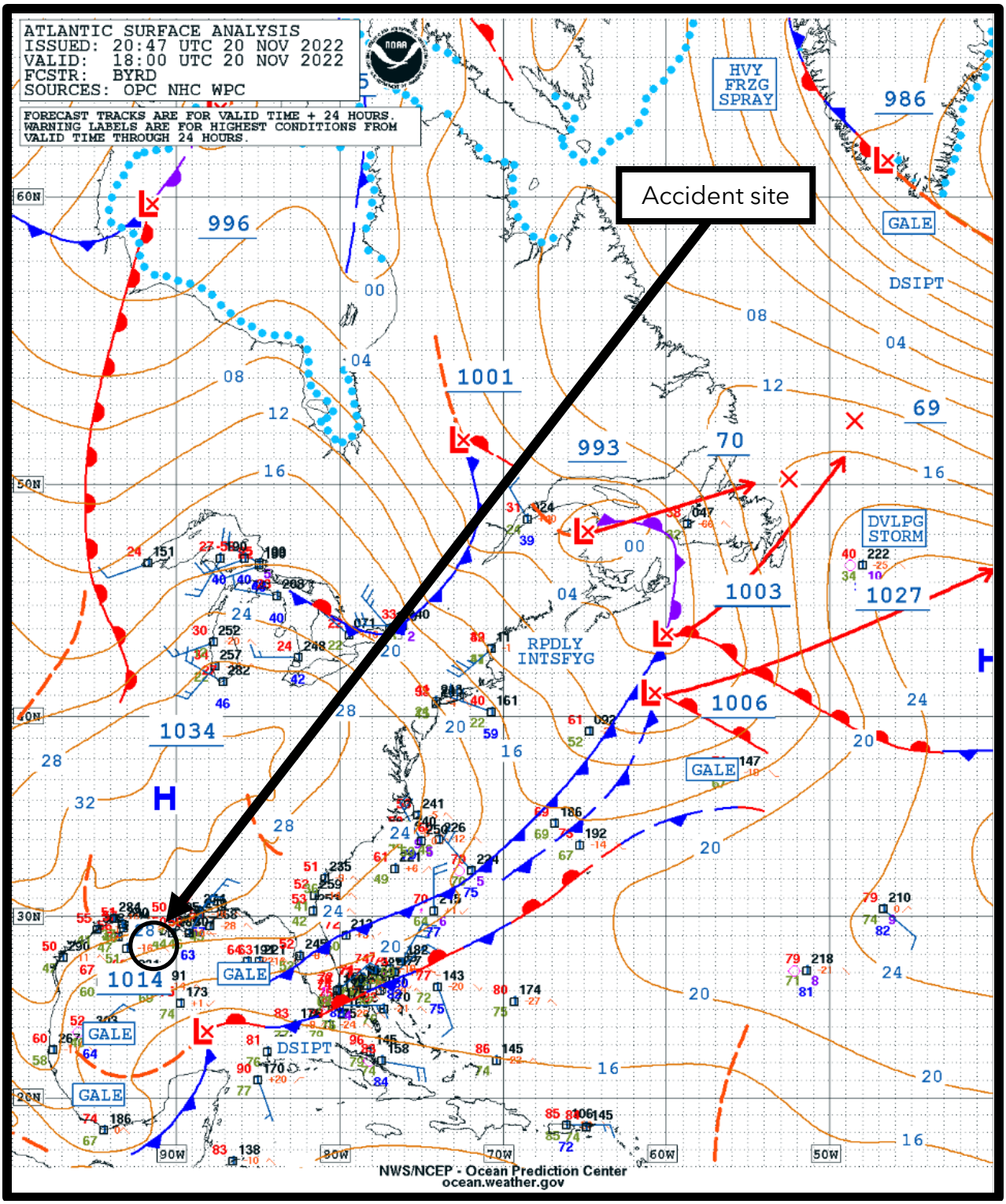

Figure 2. OPC Surface Analysis Chart for 1200 CST.

2.0 Surface Observations

The area surrounding the accident site was documented using official Aviation Routine Weather Reports (METARs) and Special Reports (SPECIs) where available. The following observations were taken from standard code and are provided in plain language. Figure 3 is a Google Earth map with the accident site and the closest weather reporting locations marked. There was a magnetic variation[4] of 0.5° east over the area.

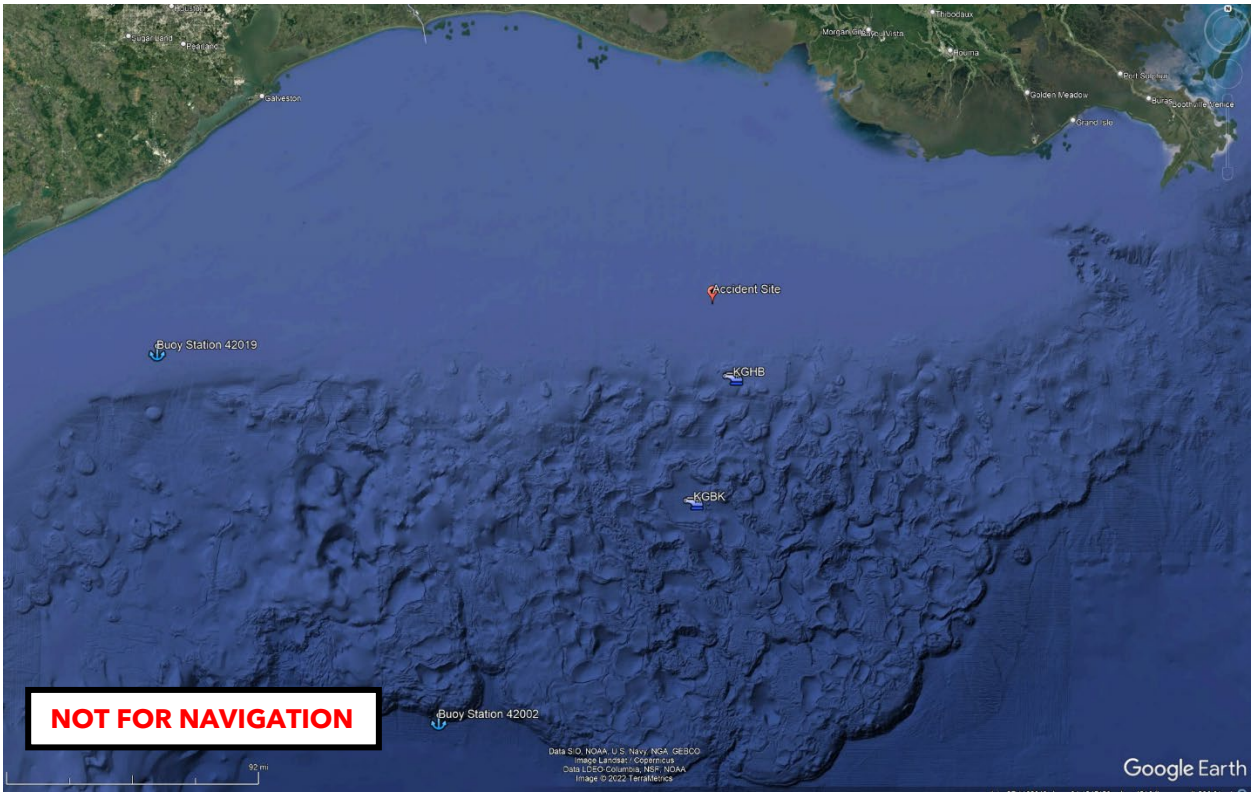

Figure 3. Google Earth map with the location of the accident site and surface observation sites.

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

The closest observation site was GB172/Salsa, Shell E-P, (KGHB[5]), and KGHB had the closest official weather station to the accident site (figure 3). KGHB had an Automated Weather Observing System (AWOS[6]) and longline[7] reports were not augmented. The KGHB AWOS was located 27 miles south of the accident site, at an elevation of about 68 ft (with the wind sensor elevation of 110 ft, attachment 10), and issued the following observations surrounding the period of the accident:[8]

[1040 CST] METAR KGHB 201640Z AUTO 03031G39KT 4SM HZ OVC022 16/12 A3031 RMK A01

[1100 CST] METAR KGHB 201700Z AUTO 04028G35KT 5SM HZ OVC021 16/12 A3031 RMK A01

[1120 CST] METAR KGHB 201720Z AUTO 04029G35KT 4SM HZ OVC021 16/12 A3031 RMK A01

[1140 CST] METAR KGHB 201740Z AUTO 04028G33KT 4SM HZ OVC020 16/12 A3030 RMK A01

[1200 CST] METAR KGHB 201800Z AUTO 03028KT 4SM HZ OVC020 16/12 A3029 RMK A01

[1220 CST] METAR KGHB 201820Z AUTO 03027KT 5SM HZ OVC020 16/12 A3028 RMK A01

[1240 CST] METAR KGHB 201840Z AUTO 04024G31KT 4SM HZ OVC019 16/12 A3028 RMK A01

ACCIDENT TIME 1256 CST

[5] MESOWEST STATION INTERFACE (utah.edu)

[6] 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.

[7] "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.

[8] The bold sections in this NWS product and the rest of the products in this report are intended to highlight the text 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.

[1300 CST] METAR KGHB 201900Z AUTO 04025G33KT 4SM HZ OVC019 16/12 A3026 RMK A01

[1320 CST] METAR KGHB 201920Z AUTO 04025G31KT 4SM HZ OVC019 16/13 A3025 RMK A01

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

KGHB weather at 1240 CST, automated, wind from 040° at 24 knots with gusts to 31 knots, 4 miles visibility, haze, overcast ceiling at 1,900 ft above ground level (agl), temperature of 16° Celsius (C), dew point temperature 12°C, and an altimeter setting of 30.28 inches of mercury (inHg). Remarks, automated station without a precipitation discriminator.

KGHB weather at 1300 CST, automated, wind from 040° at 25 knots with gusts to 33 knots, 4 miles visibility, haze, overcast ceiling at 1,900 ft agl, temperature of 16°C, dew point temperature 12°C, and an altimeter setting of 30.26 inHg. Remarks, automated station without a precipitation discriminator.

Additional weather information was available from the Magnolia Oil (KGBK)[9] AWOS located 65 miles south of the accident site (figure 3) and can be found in attachment 1 . Additional information from the KGHB AWOS can be found in attachment 2. The closest buoy with significant wave height information was Station 42002[10], which was owned and maintained by the National Data Buoy Center[11] (NDBC) and was located 157 miles southwest of the accident site (figure 3). Another NDBC buoy, Station 42019[12], was located 173 miles west of the accident site (figure 3). Weather and marine information from these two buoys can be found in attachments 3 and 4. Data from these buoys indicated significant wave heights as high as 6.89 meters (m) (~22.6 ft) early on the accident day at Station 42002 and significant wave heights to 4.9 m (~16.1 ft) at Station 42019 late on November 19. Winds gusted to gale force as early as 1330 CST on November 17 at Station 42002, as early as 2310 CST on November 18 at Station 42019, as early as 2320 CST on November 16 at KGHB and as early as 2335 CST on November 16 at KGBK. Winds gusted to storm force[13] by 1755 CST on November 19 at KGBK and by 2030 CST on November 19 at Station 42002 with no wind gusts higher than gale force at Station 42019 and KGHB from November 13 through the accident time.

[9] MESOWEST STATION INTERFACE (utah.edu)
[10] NDBC - Station 42002 Recent Data (noaa.gov)
[11] National Data Buoy Center (noaa.gov)
[12] NDBC - Station 42019 Recent Data (noaa.gov)
[13] Storm force wind – An extratropical low or an area of sustained winds of 48 to 63 knots, inclusive: pd01003003curr.pdf (noaa.gov)

3.0 Satellite Data

Geostationary Operational Environmental Satellite number 16 (GOES-16) visible 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 imagery (GOES-16 band 2) at a wavelength of 0.64 microns (μm) was retrieved for the period from 1100 CST through 1500 CST and reviewed, and the closest images to the time of the accident were documented.

Figure 4 presents the GOES-16 visible imagery from 1256 CST at -1X magnification with the accident site highlighted with a red square. Cloud cover was observed above the accident site. It should be noted that this figure has not been corrected for any parallax error.

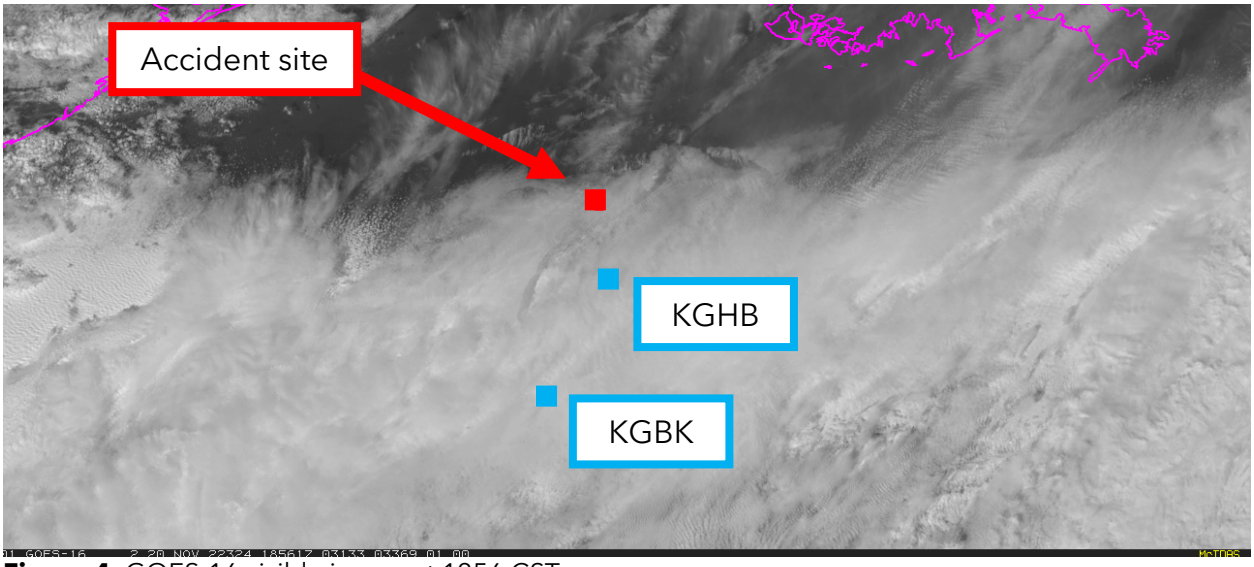

Figure 4. GOES-16 visible image at 1256 CST.

4.0 National Radar Imagery

A regional view of the NWS National Reflectivity Mosaic is included as figure 5 for 1255 CST with the approximate location of the accident site marked by a black circle. The image depicted no precipitation echoes above the accident site.

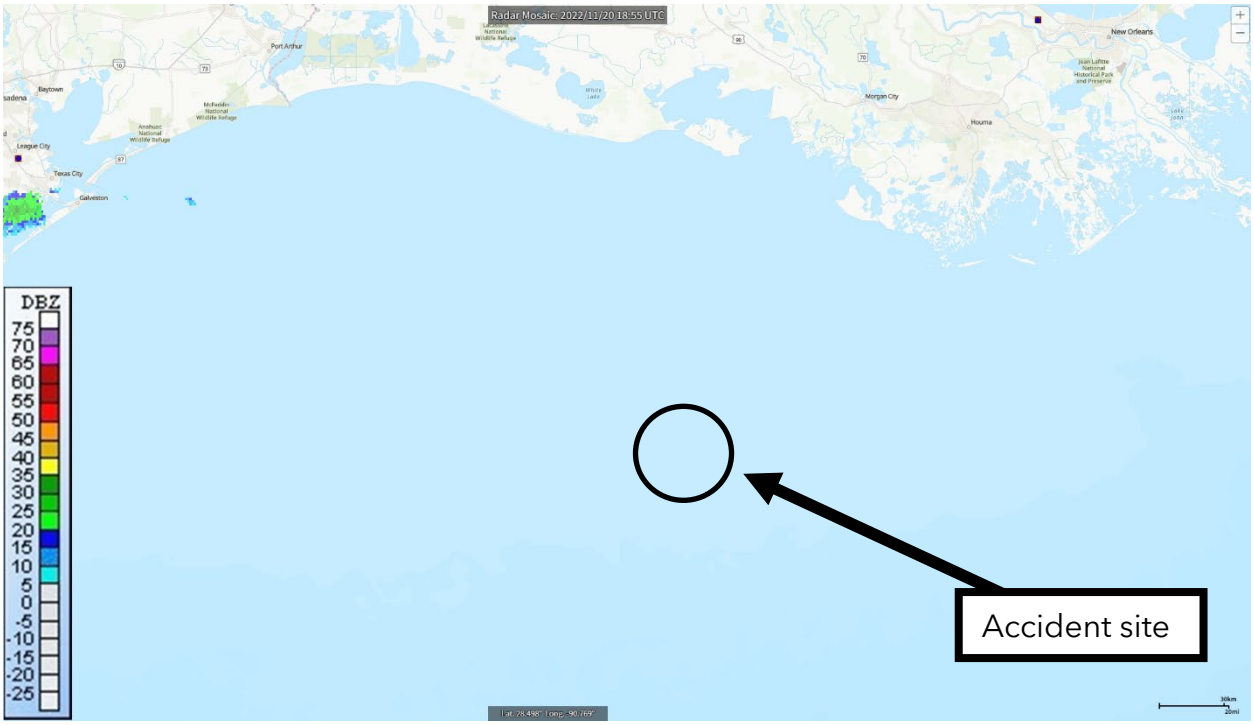

Figure 5. National Reflectivity Mosaic for 1255 CST.

5.0 National Weather Service Marine Weather Products

The accident site was located more than 60 miles from shore and therefore fell into the "Offshore" marine forecast area, whose forecast were issued by the National Hurricane Center (NHC, see figure 6). The accident site was located in forecast area GMZ041. Below figure 6 is the forecast valid at the accident time with text forecast information valid back to the time of last evacuation between 1100 and 1200 CST on November 18. Additional GMZ041 forecast information from the accident time back to November 15 can be found in attachment 5. Additional weather forecast information valid for the shoreline to 60 miles from the shore (Coastal Waters Forecasts, CWF) can be found in attachment 6.

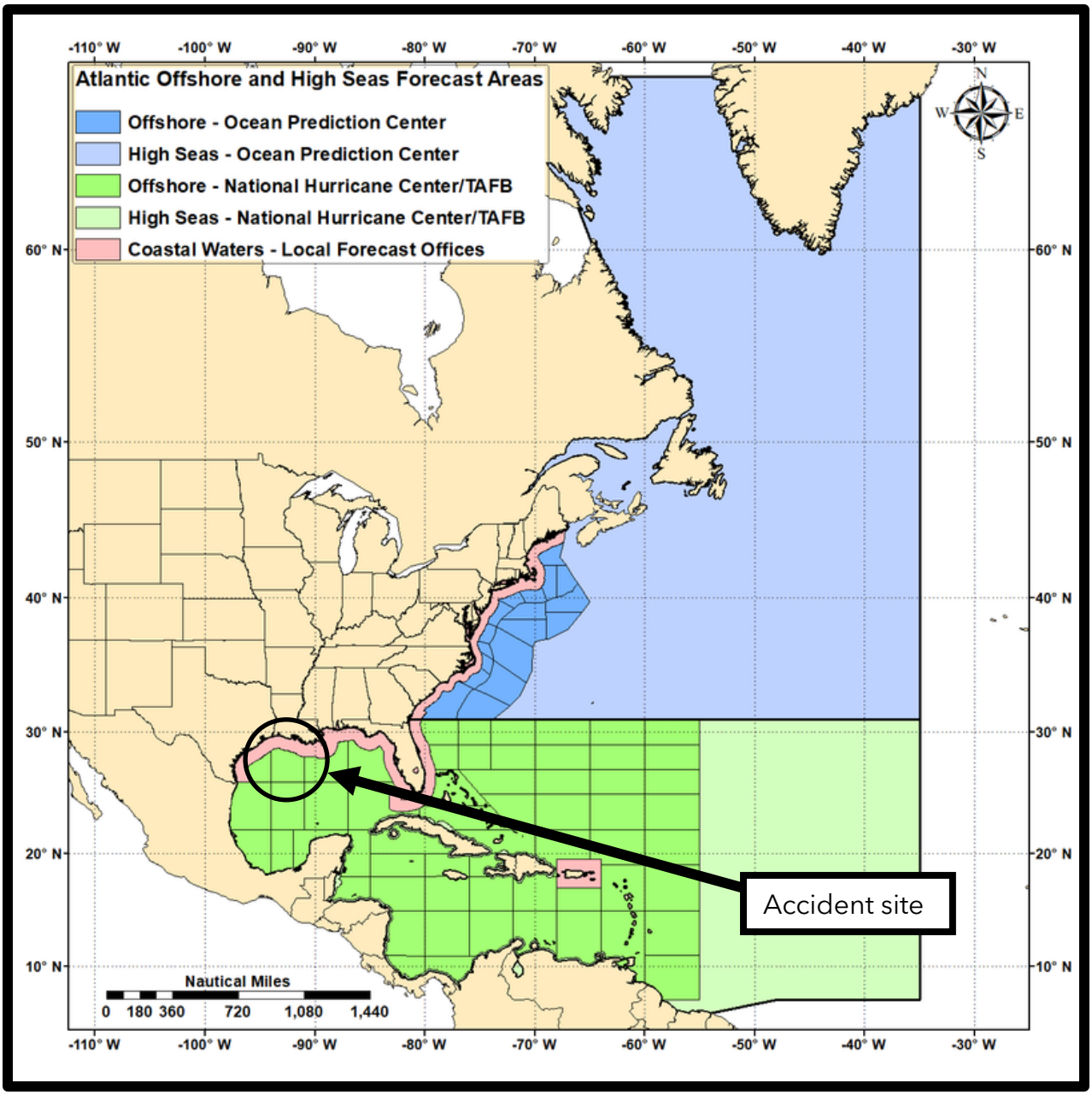

Figure 6. NOAA marine forecast areas and responsible issuing center.

FZNT24 KNHC 201509
OFFNT4

Offshore Waters Forecast for the Gulf of Mexico
NWS National Hurricane Center Miami, FL
1009 AM EST Sun Nov 20 2022

Offshore Waters Forecast for the Gulf of Mexico

Seas given as significant wave height, which is the average
height of the highest 1/3 of the waves. Individual waves may be

more than twice the significant wave height.

GMZ001-210315-
Synopsis for the Gulf of Mexico
1009 AM EST Sun Nov 20 2022

.SYNOPSIS...A stationary front extends from the Florida Keys to 25N87W to 1013 mb low pressure near 24N92W with a cold front extending from the low to the SW Gulf near 19N91.5W. These features are combining with strong high pressure north of the area to support strong to gale force winds north and west of the fronts. Very large seas to around 20 ft accompany these winds. The low will weaken to a trough while the front stalls across the southern waters through Mon, with associated gales diminishing by early Mon. Conditions will improve modestly on Mon and then more significantly Tue through Wed. The next cold front will move across the basin Thu through the end of the week.

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GMZ041-210315-
SW Louisiana Offshore Waters including Flower Garden Bank Marine Sanctuary-
1009 AM EST Sun Nov 20 2022

.TODAY...NE winds 20 to 25 kt in the afternoon. Seas 12 to 19 ft in E swell.
.TONIGHT...NE to E winds 20 to 25 kt. Seas 9 to 14 ft in E swell.
.MON...NE to E winds 15 to 20 kt. Seas 7 to 11 ft in E swell.
.MON NIGHT...NE winds 15 to 20 kt. Seas 6 to 9 ft in E swell. Scattered showers.
.TUE...NE winds 15 to 20 kt. Seas 6 to 9 ft in E swell.
.TUE NIGHT...NE winds 15 to 20 kt. Seas 6 to 8 ft.
.WED...NE to E winds 10 to 15 kt. Seas 5 to 7 ft in E swell.
.WED NIGHT...E winds 10 to 15 kt. Seas 4 to 6 ft.
.THU...NE winds 10 kt. Seas 3 to 5 ft.
.THU NIGHT...N winds 15 to 20 kt. Seas 3 to 5 ft.

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FZNT24 KNHC 200750
OFFNT4

Offshore Waters Forecast for the Gulf of Mexico
NWS National Hurricane Center Miami, FL
250 AM EST Sun Nov 20 2022

Offshore Waters Forecast for the Gulf of Mexico

Seas given as significant wave height, which is the average height of the highest 1/3 of the waves. Individual waves may be more than twice the significant wave height.

GMZ001-202000-
Synopsis for the Gulf of Mexico
250 AM EST Sun Nov 20 2022

.SYNOPSIS...A stationary front extends from the Straits of Florida near 24N81W to 1014 mb low pressure near 25N93W with a cold front extending from the low to the SW Gulf near 18N95.5W. These features are combining with high pressure north of the area to support strong to gale force winds north and west of the fronts. Very large seas to around 20 ft are with these winds. The low will weaken to a trough while the front stalls across the southern waters through Mon, with associated gales diminishing by early Mon. Conditions will improve modestly on Mon and then more significantly Tue through Wed. The next cold front may move across the basin Thu through the end of the week.

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GMZ041-202000-
SW Louisiana Offshore Waters including Flower Garden Bank Marine Sanctuary-
250 AM EST Sun Nov 20 2022

...GALE WARNING...

.TODAY...NE winds 25 to 35 kt, diminishing to 20 to 30 kt in the late morning. Seas 12 to 18 ft in E swell.
.TONIGHT...NE to E winds 20 to 25 kt. Seas 9 to 14 ft in E swell.
.MON...NE to E winds 15 to 20 kt. Seas 7 to 11 ft in E swell.
.MON NIGHT...NE winds 15 to 20 kt. Seas 6 to 9 ft in E swell. Scattered showers.
.TUE...NE winds 15 to 20 kt. Seas 6 to 9 ft in E swell.
.TUE NIGHT...NE winds 15 to 20 kt. Seas 6 to 8 ft.
.WED...NE to E winds 10 to 15 kt. Seas 5 to 7 ft in E swell.
.WED NIGHT...E winds 10 to 15 kt. Seas 4 to 6 ft.
.THU...NE winds 10 kt. Seas 3 to 5 ft.
.THU NIGHT...N winds 15 to 20 kt. Seas 3 to 5 ft.

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FZNT24 KNHC 200210
OFFNT4

Offshore Waters Forecast for the Gulf of Mexico
NWS National Hurricane Center Miami, FL
910 PM EST Sat Nov 19 2022

Offshore Waters Forecast for the Gulf of Mexico

Seas given as significant wave height, which is the average height of the highest 1/3 of the waves. Individual waves may be more than twice the significant wave height.

GMZ001-201415-
Synopsis for the Gulf of Mexico
910 PM EST Sat Nov 19 2022

.SYNOPSIS...A stationary front extends from the Straits of Florida near 24N81W to 1012 mb low pressure near 26N93.5W with a cold front extending from the low to the SW Gulf near 19N96W. These features are combining with high pressure north of the area to support fresh to strong winds across much of the Gulf west of 85W. The low will weaken to a trough while the front stalls across the southern waters through Mon. The pressure gradient will strengthen the winds and produce strong to gale force winds across much of the Gulf of Mexico this evening through Sun night, with large seas to near 20 ft. Conditions will improve modestly on Mon and then more significantly Tue through Wed.

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GMZ041-201415-
SW Louisiana Offshore Waters including Flower Garden Bank Marine Sanctuary-
910 PM EST Sat Nov 19 2022

...GALE WARNING...

.OVERNIGHT...NE winds 25 to 35 kt. Seas 12 to 19 ft in E swell. Numerous showers and scattered tstms.
.SUN...NE winds 20 to 25 kt. Seas 10 to 15 ft in E swell.
.SUN NIGHT...NE to E winds 20 to 25 kt. Seas 9 to 13 ft in E swell.
.MON...NE winds 15 to 20 kt. Seas 7 to 11 ft in E swell. Scattered showers and isolated tstms.
.MON NIGHT...NE winds 20 to 25 kt. Seas 7 to 10 ft in E swell.
.TUE...NE winds 15 to 20 kt. Seas 6 to 9 ft in E swell.
.TUE NIGHT...NE to E winds 15 to 20 kt. Seas 6 to 8 ft in E swell.
.WED...NE to E winds 10 to 15 kt. Seas 5 to 7 ft in E swell.
.WED NIGHT...E winds 10 to 15 kt. Seas 4 to 6 ft.
.THU...N to NE winds 10 kt. Seas 2 to 4 ft.
.THU NIGHT...NW to N winds 15 to 20 kt, increasing to 25 kt late. Seas 2 to 4 ft, building to 5 to 7 ft late.

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FZNT24 KNHC 192054
OFFNT4

Offshore Waters Forecast for the Gulf of Mexico
NWS National Hurricane Center Miami, FL
354 PM EST Sat Nov 19 2022

Offshore Waters Forecast for the Gulf of Mexico

Seas given as significant wave height, which is the average height of the highest 1/3 of the waves. Individual waves may be more than twice the significant wave height.

GMZ001-200900-
Synopsis for the Gulf of Mexico
354 PM EST Sat Nov 19 2022

.SYNOPSIS...A 1013 mb low in the W Gulf near 25.5N96W. . A sharp trough extends from the low to 19N91W. These features are combining with high pressure north of the area to support fresh to strong winds across much of the Gulf west of 86W. The low will weaken to a trough and drift S through Mon as high pressure strengthens N of the Gulf. north over the weekend. The pressure gradient will strengthen the winds and produce strong to gale force winds across much of the Gulf of Mexico this evening through Sun night, with seas to 18 ft. A cold front will develop E to W across the central Gulf tonight and shift southward, then stall across the south-central waters early Mon. Conditions will improve modestly on Mon and then more significantly Tue through Wed.

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GMZ041-200900-
SW Louisiana Offshore Waters including Flower Garden Bank Marine Sanctuary-
354 PM EST Sat Nov 19 2022

...GALE WARNING...

.TONIGHT...NE winds 25 to 35 kt. Seas 12 to 19 ft in E swell. Scattered showers and isolated tstms.
.SUN...NE winds 20 to 30 kt. Seas 10 to 15 ft in E swell.
.SUN NIGHT...NE to E winds 20 to 25 kt. Seas 9 to 13 ft in E swell.
.MON...NE to E winds 15 to 20 kt. Seas 7 to 11 ft in E swell.
.MON NIGHT...NE winds 15 to 20 kt. Seas 7 to 10 ft in E swell.
.TUE...NE winds 15 to 20 kt. Seas 6 to 9 ft in E swell.
.TUE NIGHT...NE to E winds 15 to 20 kt. Seas 6 to 8 ft in E swell.
.WED...NE to E winds 10 to 15 kt. Seas 5 to 7 ft in E swell.
.WED NIGHT...E winds 10 to 15 kt. Seas 4 to 6 ft.
.THU...N to NE winds 10 kt. Seas 2 to 4 ft.
.THU NIGHT...NW to N winds 15 to 20 kt, increasing to 25 kt late. Seas 2 to 4 ft, building to 5 to 7 ft late.

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FZNT24 KNHC 192058 CCA
OFFNT4

Offshore Waters Forecast for the Gulf of Mexico

NWS National Hurricane Center Miami, FL
354 PM EST Sat Nov 19 2022

Offshore Waters Forecast for the Gulf of Mexico

Seas given as significant wave height, which is the average height of the highest 1/3 of the waves. Individual waves may be more than twice the significant wave height.

GMZ001-200900-
Synopsis for the Gulf of Mexico
354 PM EST Sat Nov 19 2022

.SYNOPSIS...A 1013 mb low in the W Gulf near 25.5N96W. A sharp trough extends from the low to 19N91W. These features are combining with high pressure north of the area to support fresh to strong winds across much of the Gulf west of 86W. The low will weaken to a trough and drift S through Mon as high pressure strengthens N of the Gulf. north over the weekend. The pressure gradient will strengthen the winds and produce strong to gale force winds across much of the Gulf of Mexico this evening through Sun night, with seas to 18 ft. A cold front will develop E to W across the central Gulf tonight and shift southward, then stall across the south-central waters early Mon. Conditions will improve modestly on Mon and then more significantly Tue through Wed.

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GMZ041-200900-
SW Louisiana Offshore Waters including Flower Garden Bank Marine Sanctuary-
354 PM EST Sat Nov 19 2022

...GALE WARNING...

.TONIGHT...NE winds 25 to 35 kt. Seas 12 to 19 ft in E swell. Scattered showers and isolated tstms.
.SUN...NE winds 20 to 30 kt. Seas 10 to 15 ft in E swell.
.SUN NIGHT...NE to E winds 20 to 25 kt. Seas 9 to 13 ft in E swell.
.MON...NE to E winds 15 to 20 kt. Seas 7 to 11 ft in E swell.
.MON NIGHT...NE winds 15 to 20 kt. Seas 7 to 10 ft in E swell.
.TUE...NE winds 15 to 20 kt. Seas 6 to 9 ft in E swell.
.TUE NIGHT...NE to E winds 15 to 20 kt. Seas 6 to 8 ft in E swell.
.WED...NE to E winds 10 to 15 kt. Seas 5 to 7 ft in E swell.
.WED NIGHT...E winds 10 to 15 kt. Seas 4 to 6 ft.
.THU...N to NE winds 10 kt. Seas 2 to 4 ft.
.THU NIGHT...NW to N winds 15 to 20 kt, increasing to 25 kt late. Seas 2 to 4 ft, building to 5 to 7 ft late.

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FZNT24 KNHC 191509
OFFNT4

Offshore Waters Forecast for the Gulf of Mexico
NWS National Hurricane Center Miami, FL
1009 AM EST Sat Nov 19 2022

Offshore Waters Forecast for the Gulf of Mexico

Seas given as significant wave height, which is the average height of the highest 1/3 of the waves. Individual waves may be more than twice the significant wave height.

GMZ001-200315-
Synopsis for the Gulf of Mexico
1009 AM EST Sat Nov 19 2022

.SYNOPSIS...A 1012 mb low in the W Gulf near 24.5N96W is drifting northward. A sharp trough extends from the low to 19N91W. These features combined with high pressure north of the area are supporting fresh to strong winds across the northern and central Gulf west of 88W. The low and trough will drift north over the weekend. The pressure gradient between this low pres and new high pres across the south-central U.S. will strengthen the winds and produce strong to gale force winds across much of the Gulf of Mexico late this afternoon through Sun night while a cold front develops across the northeast Gulf and drops southward. The front will stall across the south-central waters by Sun night. Conditions will improve modestly on Mon and then significantly Tue through Wed.

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GMZ041-200315-
SW Louisiana Offshore Waters including Flower Garden Bank Marine Sanctuary-
1009 AM EST Sat Nov 19 2022

...GALE WARNING...

.TODAY...NE to E winds 25 to 30 kt in the afternoon. Seas 10 to 15 ft in E swell. Numerous showers and scattered tstms.
.TONIGHT...NE winds 25 to 35 kt. Seas 11 to 17 ft in E swell. Scattered showers and isolated tstms.
.SUN...NE winds 20 to 30 kt. Seas 10 to 16 ft in E swell.
.SUN NIGHT...NE to E winds 20 to 25 kt. Seas 9 to 14 ft in E swell.
.MON...NE to E winds 15 to 20 kt. Seas 7 to 11 ft in E swell.
.MON NIGHT...NE winds 15 to 20 kt. Seas 7 to 10 ft in E swell.
.TUE...N to NE winds 15 to 20 kt. Seas 6 to 9 ft in E swell.
.TUE NIGHT...NE winds 15 to 20 kt. Seas 6 to 9 ft in E swell.
.WED...NE winds 10 to 15 kt. Seas 5 to 7 ft in E swell.

.WED NIGHT...E winds 10 to 15 kt. Seas 4 to 6 ft.

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FZNT24 KNHC 190802
OFFNT4

Offshore Waters Forecast for the Gulf of Mexico
NWS National Hurricane Center Miami, FL
302 AM EST Sat Nov 19 2022

Offshore Waters Forecast for the Gulf of Mexico

Seas given as significant wave height, which is the average height of the highest 1/3 of the waves. Individual waves may be more than twice the significant wave height.

GMZ001-192015-
Synopsis for the Gulf of Mexico
302 AM EST Sat Nov 19 2022

.SYNOPSIS...A 1015 mb low is in the SW Gulf near 22N96W. A sharp trough extends from 28N97W through the low to 19N91W. These features combined with high pressure north of the area is supporting fresh to strong winds across the northern and central Gulf west of 90W. The low and trough will drift north over the weekend. The pressure gradient between this low pres and new high pres across the south-central U.S. will strengthen the winds and produce strong to gale force winds across much of the Gulf of Mexico late this afternoon through Sun night while a cold front develops northeast of the low and drops south. The front will stall across the south-central waters by Sun night. Conditions will improve modestly on Mon and then significantly Tue through Wed.

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GMZ041-192015-
SW Louisiana Offshore Waters including Flower Garden Bank Marine Sanctuary-
302 AM EST Sat Nov 19 2022

...GALE WARNING...

.TODAY...NE to E winds 25 to 30 kt, increasing to 25 to 35 kt late. Seas 9 to 13 ft in E swell. Numerous showers and scattered tstms.
.TONIGHT...NE winds 25 to 35 kt. Seas 11 to 17 ft in NE to E swell. Numerous showers and scattered tstms.
.SUN...NE winds 20 to 30 kt, except 25 to 35 kt early.
Seas 10 to 16 ft in E swell.
.SUN NIGHT...NE to E winds 20 to 25 kt. Seas 9 to 14 ft in E swell.
.MON...NE to E winds 15 to 20 kt. Seas 7 to 11 ft in E swell.

.MON NIGHT...NE winds 15 to 20 kt. Seas 7 to 10 ft in E swell.
.TUE...N to NE winds 15 to 20 kt. Seas 6 to 9 ft in E swell.
.TUE NIGHT...NE winds 15 to 20 kt. Seas 6 to 9 ft in E swell.
.WED...NE winds 10 to 15 kt. Seas 5 to 7 ft in E swell.
.WED NIGHT...E winds 10 to 15 kt. Seas 4 to 6 ft.

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FZNT24 KNHC 190206
OFFNT4

Offshore Waters Forecast for the Gulf of Mexico
NWS National Hurricane Center Miami, FL
906 PM EST Fri Nov 18 2022

Offshore Waters Forecast for the Gulf of Mexico

Seas given as significant wave height, which is the average
height of the highest 1/3 of the waves. Individual waves may be
more than twice the significant wave height.

GMZ001-191415-
Synopsis for the Gulf of Mexico
906 PM EST Fri Nov 18 2022

.SYNOPSIS...A 1015 mb low is in the SW Gulf near 21.5N96W. A sharp
trough extends from 26N97W through the low to 19N91W. High
pres to the north of the area is supporting fresh to strong winds
across the majority of the basin. The low and trough will drift N
over the weekend. The pressure gradient between this low pres and
new high pres across the south-central U.S. will strengthen the
winds and produce strong to gale force winds across much of the
Gulf of Mexico late Sat afternoon through Sun night. Conditions
will improve modestly on Mon and then significantly Tue through
Wed.

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GMZ041-191415-
SW Louisiana Offshore Waters including Flower Garden Bank Marine
Sanctuary-
906 PM EST Fri Nov 18 2022

...GALE WARNING...

.OVERNIGHT...NE to E winds 20 to 25 kt. Seas 8 to 12 ft in E
swell. Scattered showers and isolated tstms.
.SAT...NE to E winds 25 to 30 kt. Seas 9 to 14 ft in E swell.
Numerous showers and scattered tstms.
.SAT NIGHT...NE winds 25 to 35 kt. Seas 10 to 16 ft in NE to E
swell. Scattered showers and isolated tstms.
.SUN...NE winds 20 to 30 kt. Seas 10 to 16 ft in E swell.
.SUN NIGHT...NE to E winds 20 to 25 kt. Seas 9 to 14 ft in E

swell.
.MON...NE to E winds 20 to 25 kt. Seas 8 to 12 ft in E swell.
.MON NIGHT...NE winds 20 to 25 kt. Seas 7 to 11 ft in E swell.
.TUE...N to NE winds 20 to 25 kt. Seas 7 to 11 ft in E swell.
.TUE NIGHT...NE winds 15 to 20 kt. Seas 6 to 9 ft in E swell.
.WED...NE winds 10 to 15 kt. Seas 5 to 7 ft in E swell.
.WED NIGHT...E winds 10 kt. Seas 4 to 6 ft in E swell.

$$

FZNT24 KNHC 182119
OFFNT4

Offshore Waters Forecast for the Gulf of Mexico
NWS National Hurricane Center Miami, FL
419 PM EST Fri Nov 18 2022

Offshore Waters Forecast for the Gulf of Mexico

Seas given as significant wave height, which is the average
height of the highest 1/3 of the waves. Individual waves may be
more than twice the significant wave height.

GMZ001-190930-
Synopsis for the Gulf of Mexico
419 PM EST Fri Nov 18 2022

.SYNOPSIS...A frontal boundary has stalled across the NW
Caribbean. A sharp surface trough extends from the Yucatan
Peninsula near 19.5N91W to 1017 mb low pres near 21N95W to extreme
S Texas. High pressure to the north of the area is supporting
strong winds to the north of the trough to 27N, and to the W of
the trough to the Mexican coast. The low and trough will drift N
over the weekend. The pressure gradient between this low pres and
new high pres across the south-central U.S. will strengthen the
winds and produce strong to gale force winds across much of the
Gulf of Mexico Sat afternoon through Sun night. Conditions will
improve modestly on Mon and then significantly Tue through Wed.

$$

GMZ041-190930-
SW Louisiana Offshore Waters including Flower Garden Bank Marine
Sanctuary-
419 PM EST Fri Nov 18 2022

...GALE WARNING SAT NIGHT...

.TONIGHT...NE to E winds 20 to 25 kt. Seas 8 to 12 ft in E swell.
Scattered showers and isolated tstms.
.SAT...NE to E winds 25 to 30 kt. Seas 9 to 14 ft in E swell.
Numerous showers and scattered tstms.
.SAT NIGHT...NE winds 25 to 35 kt. Seas 10 to 16 ft in E swell.

Numerous showers and scattered tstms.
.SUN...NE winds 20 to 30 kt. Seas 10 to 16 ft in E swell.
.SUN NIGHT...NE to E winds 20 to 25 kt. Seas 9 to 14 ft in E swell.
.MON...NE to E winds 20 to 25 kt. Seas 8 to 12 ft in E swell.
.MON NIGHT...NE winds 20 to 25 kt. Seas 7 to 11 ft in E swell.
.TUE...N to NE winds 20 to 25 kt. Seas 7 to 11 ft in E swell.
.TUE NIGHT...NE winds 15 to 20 kt. Seas 6 to 9 ft in E swell.
.WED...NE winds 10 to 15 kt. Seas 5 to 7 ft in E swell.
.WED NIGHT...E winds 10 kt. Seas 4 to 6 ft in E swell.

$$

FZNT24 KNHC 181510
OFFNT4

Offshore Waters Forecast for the Gulf of Mexico
NWS National Hurricane Center Miami, FL
1010 AM EST Fri Nov 18 2022

Offshore Waters Forecast for the Gulf of Mexico

Seas given as significant wave height, which is the average height of the highest 1/3 of the waves. Individual waves may be more than twice the significant wave height.

GMZ001-190315-
Synopsis for the Gulf of Mexico
1010 AM EST Fri Nov 18 2022

.SYNOPSIS...A stationary front extends from just south of the Yucatan Channel across the northern Yucatan Peninsula to 1015 mb low pres in the SW Gulf near 21.5N96W. The stationary front will weaken to a shearline this evening. Strong winds prevail N of the front to 26N and W of 87W, where seas remain in excess of 12 ft, while strong winds persist across the far SW Gulf from 18N to 24N. The low will drift N over the weekend. The gradient between this low pres and high pres across the south-central U.S. will produce strong to gale force winds across much of the Gulf of Mexico late Sat through Sun night. Conditions should gradually improve early next week.

$$

GMZ041-190315-
SW Louisiana Offshore Waters including Flower Garden Bank Marine Sanctuary-
1010 AM EST Fri Nov 18 2022

...GALE WARNING LATE SAT...

.TODAY...NE to E winds 15 to 20 kt in the afternoon. Seas 6 to 9 ft in NE to E swell. Scattered showers and isolated tstms.

.TONIGHT...NE to E winds 20 to 25 kt. Seas 7 to 10 ft in E swell.
Scattered showers and isolated tstms.
.SAT...E winds 20 to 25 kt becoming NE to E 25 to 35 kt late.
Seas 8 to 12 ft in E swell. Numerous showers and scattered tstms.
.SAT NIGHT...NE to E winds 25 to 35 kt. Seas 11 to 17 ft in E
swell. Numerous showers and scattered tstms.
.SUN...NE winds 20 to 30 kt. Seas 10 to 16 ft in E swell.
.SUN NIGHT...NE to E winds 20 to 25 kt. Seas 9 to 14 ft in E
swell.
.MON...NE to E winds 20 to 25 kt. Seas 7 to 11 ft in E swell.
.MON NIGHT...NE winds 20 to 25 kt. Seas 7 to 10 ft in E swell.
.TUE...NE winds 15 to 20 kt. Seas 6 to 9 ft in E swell.
.TUE NIGHT...NE winds 10 to 15 kt. Seas 6 to 8 ft in E swell.

$$

6.0 National Weather Service Graphical information

The OPC Wind and Wave Analysis valid at 1200 CST is found in figure 7 with significant wave heights between 9 and 15 ft identified for the accident site. Additional marine graphical forecast information can be found in attachment 7.

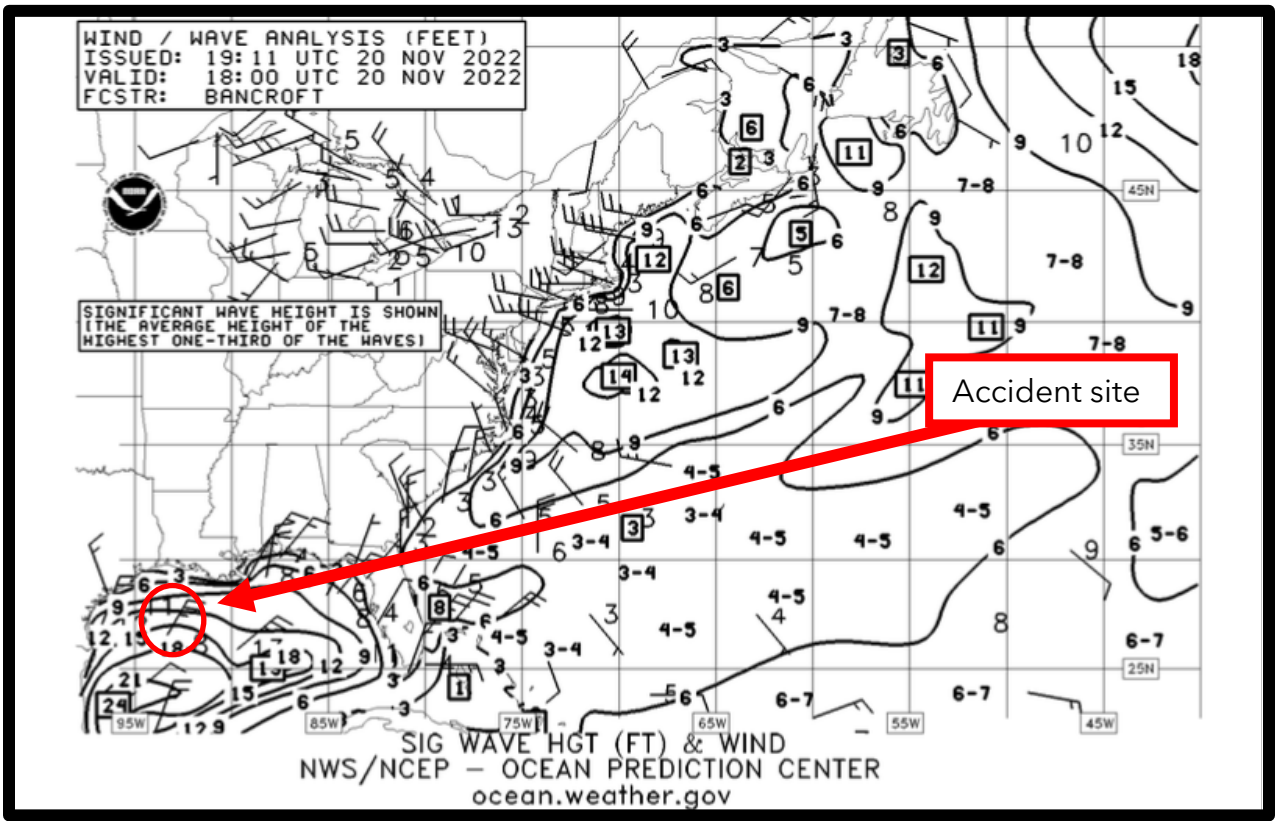

Figure 7. OPC marine wind and wave analysis valid at 1200 CST.

7.0 Captain and Company Weather Information

The accident captain and company provided several sources of weather information used in their decision-making. That information can be found in attachment 8. For further discussion on when and where the weather information was used please see the interviews and operations information located in the docket of this investigation.

8.0 Significant Wave Height

The standard ocean wave forecast set forth by the World Meteorological Organization (WMO) states that the countries responsible for the weather forecasts for the world's oceans should use significant wave height for their ocean wave height forecasts. The OPC and the National Hurricane Center's Tropical Analysis and Forecast Branch are responsible for the NOAA forecasts for the northern Atlantic and northern Pacific Oceans. NWS Weather Forecast Offices (WFO)s are responsible for NOAA forecasts for coastal regions. As mentioned above, the NHC was responsible for the NOAA forecasts for the accident site.

The wavy water surface in the ocean is made up of an entire spectrum of waves and the waves can vary quite a bit for a given wind speed and fetch. Significant wave height is defined as the average height of the highest one-third of the waves in a wave spectrum. Figure 8 shows a typical wave spectrum distribution. This distribution shows that for a given wavy ocean surface the most probable wave height and mean wave height a person would encounter would be lower than the significant wave height, with statistically a much smaller chance of encountering a wave whose height is larger than the significant wave height. For example, given a significant wave height observed of 20 ft, the mean wave height encountered by a vessel for that wave spectrum would be 12.8 ft with the most probable wave height encountered of 12 ft. However, the highest 10 percent of waves within that wave spectrum would be 25.4 ft and the highest one percent of waves would be around 33.4 ft high. The highest wave a vessel could encounter with a significant wave height of 20 ft would be 40 ft. From the NWS marine forecast for the accident site at the accident time seas[14] of 12 to 19 ft were forecast, meaning the highest wave heights the accident vessel could have expected would have been 24 to 38 ft with most of the waves encountered around 7.2 to 11.4 ft high. Data from the closest buoys indicated significant wave heights up to 22.6 ft at Station 42002 (section 2.0) around the accident time, which means the highest waves possible at Station 42002 would have been 45.2 ft with most of the waves around 13.6 ft high.

[14] Seas = significant wave height

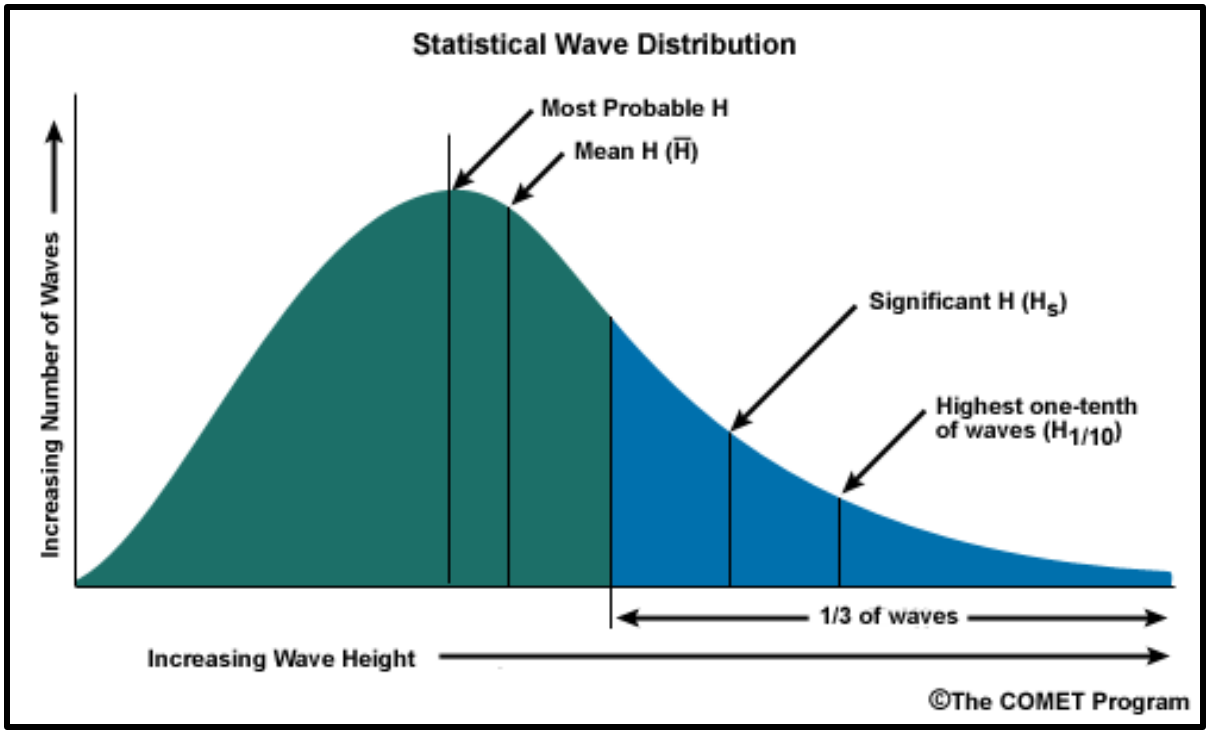

Figure 8. Typical statistical wave distribution.

A journal article studying the return frequency of significant wave heights across the Gulf of Mexico (attachment 9) noted that significant wave heights of 5 meters (~16 ft) for any given point in the Gulf of Mexico occurred around 2 times each year. Significant wave heights around 3 meters (~10 ft) occurred on a monthly frequency for any given point in the Gulf of Mexico. Plots and data for Station 42002[15] and Station 42019[16] can be found in figures 9 and 10 in box plot format.

[15] NDBC - Station 42002 - Climatic Summary Plots for significant wave height (noaa.gov)
[16] NDBC - Station 42019 - Climatic Summary Plots for significant wave height (noaa.gov)

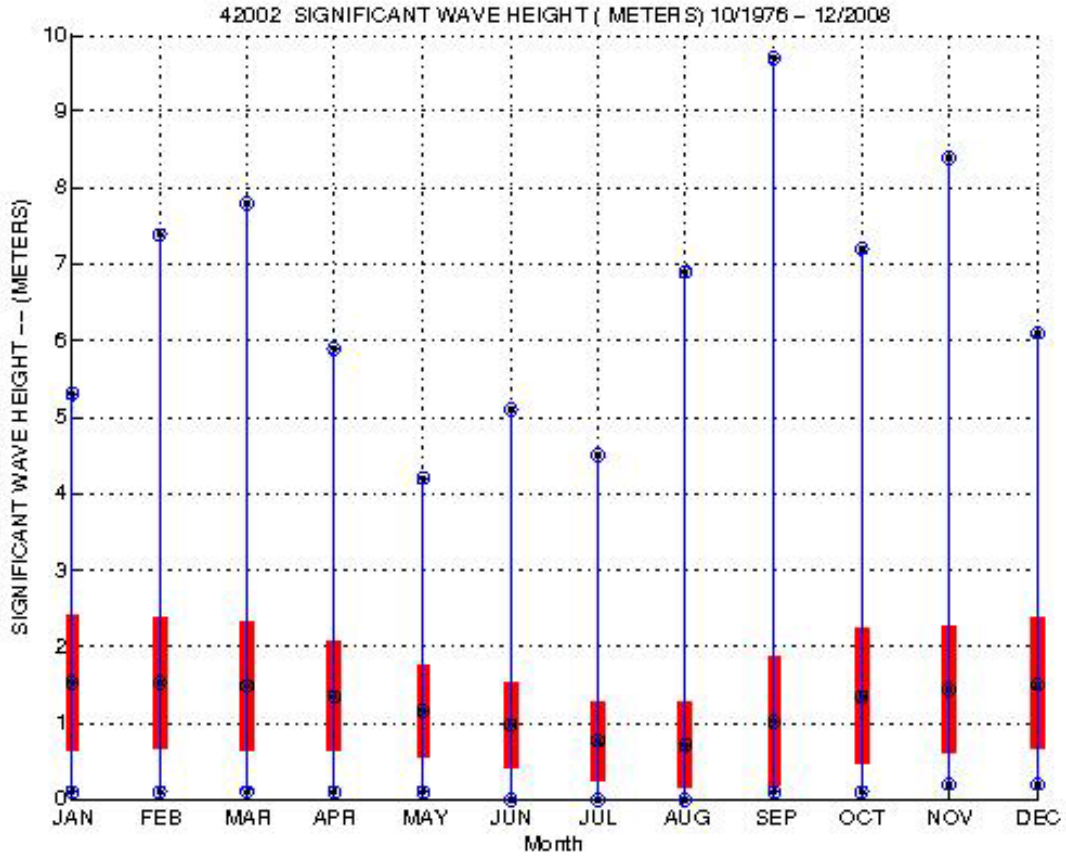

Figure 9. Significant wave height distribution at Station 42002 between 1976 and 2008 in meters in box plot format.

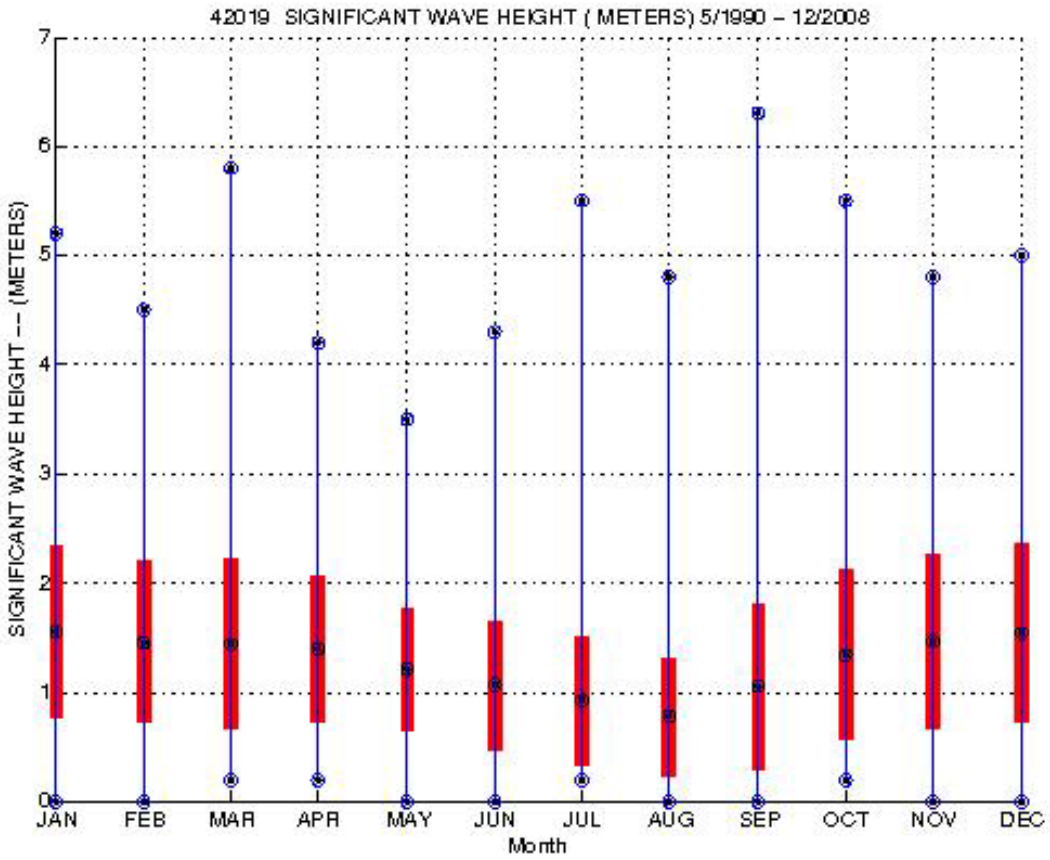

Figure 10. Significant wave height distribution at Station 42019 between 1990 and 2008 in meters in box plot format.

9.0 Water Temperature

The sea surface temperature was analyzed from the Hybrid Coordinate Ocean Model (HYCOM)[17] data from 1300 CST on November 20, 2022, with the data plotted in figure 11. The sea surface temperature around the accident site was 17°C.

[17] HYCOM + NCODA Gulf of Mexico 1/25° Analysis (GOMu0.04/expt_90.1m000) NetCDF Subset Service for Grids (hycom.org)

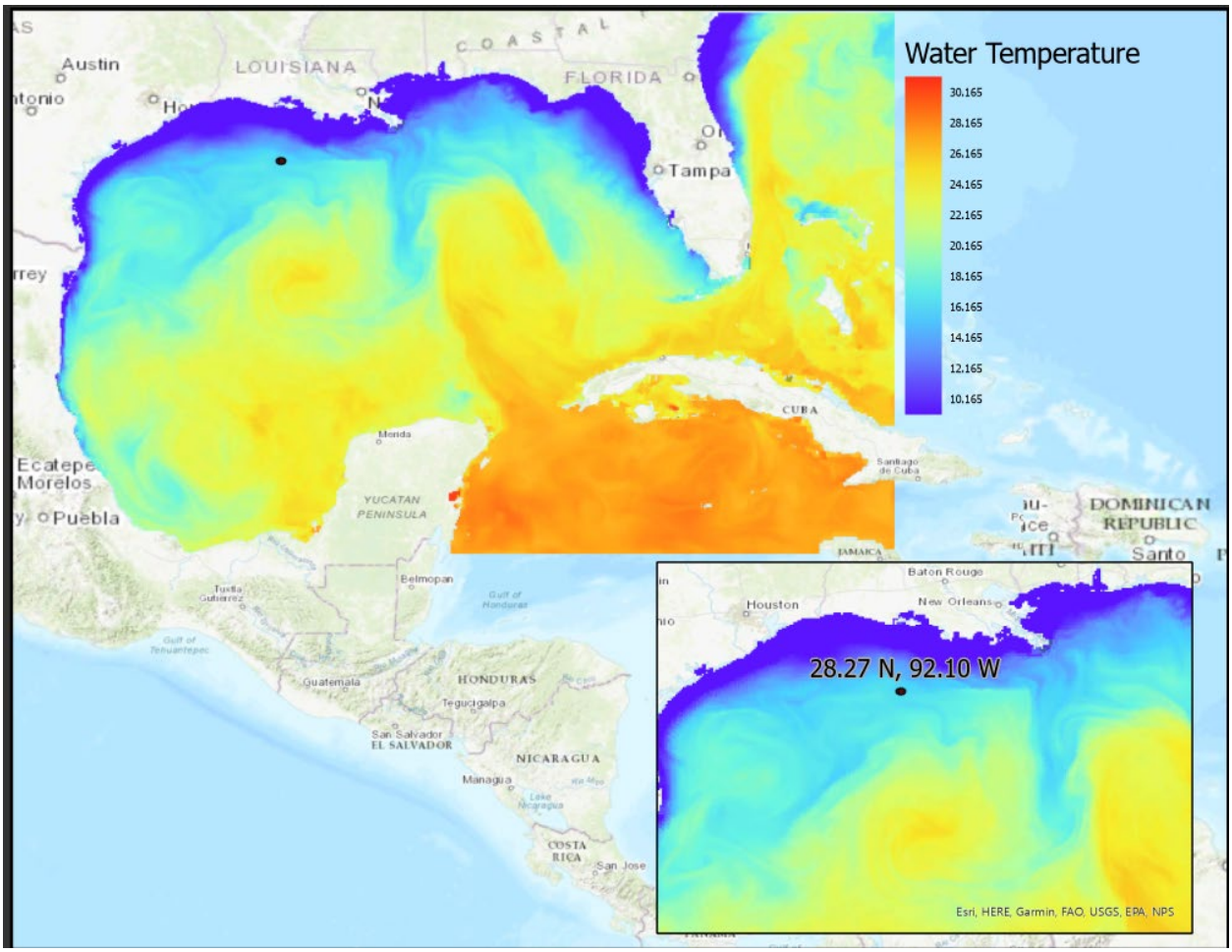

Figure 11. Sea surface temperature plot from 1300 CST on November 20, 2022.

10.0 Astronomical Data

The astronomical data obtained for the accident site on November 20, 2022, indicated the following:

SUN	
Begin civil twilight	0609 CST
Sunrise	0634 CST
Sun transit	1154 CST
Accident time	**1256 CST**[18]
Sunset	1714 CST
End civil twilight	1739 CST

At the time of the accident the Sun was located at an altitude of 39.66° and azimuth of 199.03°.

[18] Inserted accident time for reference and context.

E. LIST OF ATTACHMENTS

Attachment 1 – Additional weather information from KGBK AWOS surrounding the accident time

Attachment 2 – Additional weather information from KGHB AWOS surrounding the accident time

Attachment 3 – Buoy 42002 weather information around the accident time

Attachment 4 – Buoy 42019 weather information around the accident time

Attachment 5 – Additional NHC marine forecast valid for the accident site

Attachment 6 – Weather forecast information valid from the shore to 60 miles from the shoreline

Attachment 7 – Additional NWS marine graphical information

Attachment 8 – Accident company weather information

Attachment 9 – Journal article on wave heights in the Gulf of Mexico

Attachment 10 – Gulf of Mexico AWOS information

Submitted by:

Paul Suffern
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