NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

February 14, 2018

Group Chairman's Factual Report

METEOROLOGY

DCA17PM024

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A. ACCIDENT

Location: Near Singapore
Date: August 21, 2017
Time: 0524 Singapore Standard Time
2124 Coordinated Universal Time (UTC) on August 20
Vehicles: *USS John S. McCain* collision with *M/V ALNIC MC*

B. METEOROLOGIST

Paul Suffern
Senior Meteorologist
Operational Factors Division (AS-30)
National Transportation Safety Board

C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's (NTSB) Meteorologist did not travel for this investigation and gathered the weather data for this investigation from the NTSB's Washington D.C. office and from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the National Centers for Environmental Information (NCEI). Data was also gathered from United States Coast Guard sources. All times are Singapore Standard Time (SST) on August 21, 2017, and are based upon the 24-hour clock, where local time is +8 hours from UTC, and UTC=Z (unless otherwise noted). Directions are referenced to true north and distances in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles.

The approximate accident site was latitude 1.3300° N, longitude 104.4058° E.

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, the Ocean Prediction Center, and the Weather Prediction Center, located in College Park, Maryland. These are the base products used in describing synoptic weather features and in the creation of forecasts and warnings for the NWS. Reference to these charts can be found at NCEI.[1]

[1] Chart information is found at: https://nomads.ncdc.noaa.gov/ncep/NCEP

1.1 Upper Air Data

The NOAA 850-, 700-, and 500-hectopascals (hPa) tropical analysis charts for 0800 SST are provided as figures 1 through 3. No tropical cyclones or low- and mid-level troughs[2] were located near the accident site at 0800 SST. The 850-hPa chart indicated a temperature of 19° Celsius (C) with a 5-knot southeast wind. By 700-hPa, the temperature was 10° C with a north-northwest wind at 15 knots.

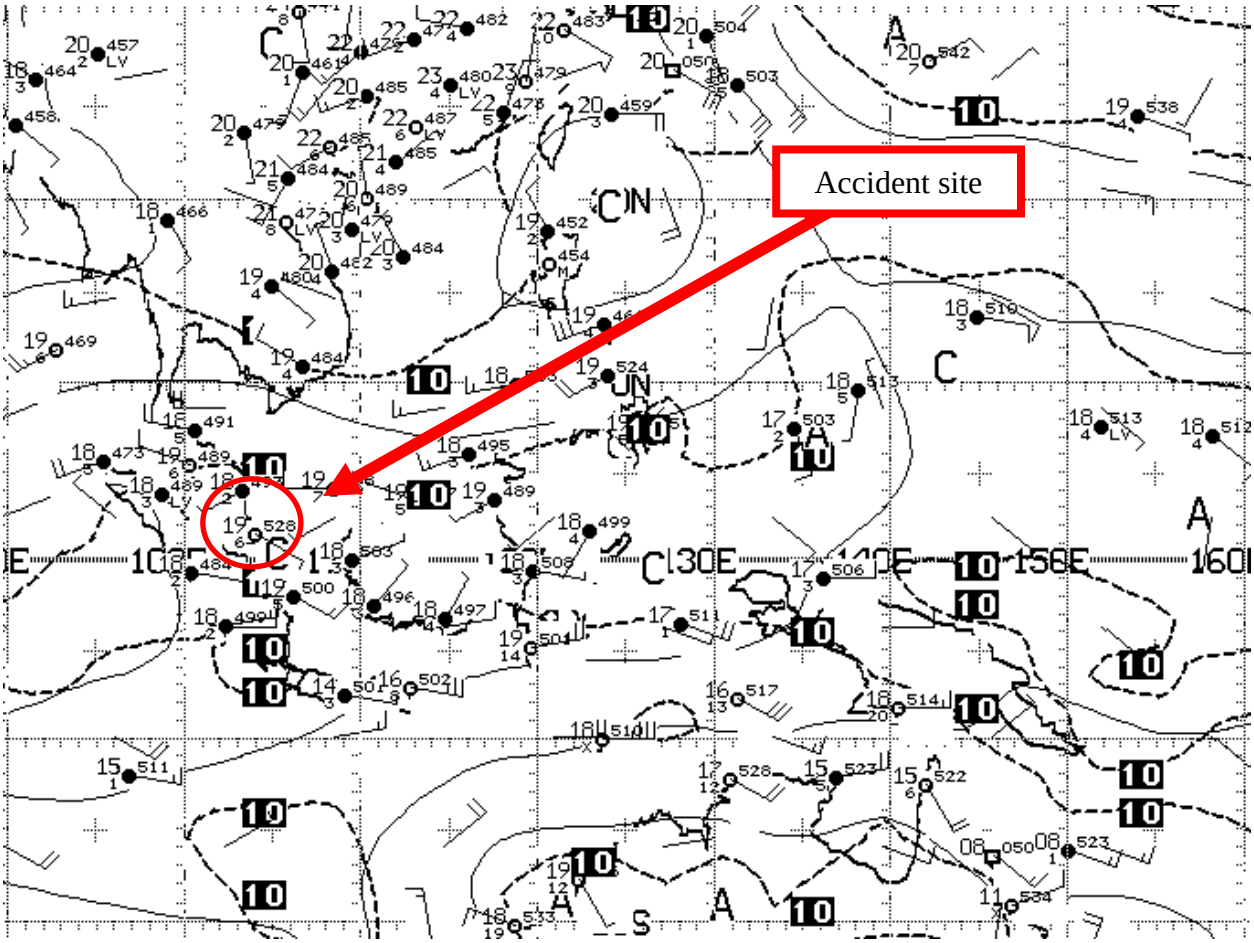

Figure 1 – NOAA 850-hPa tropical analysis chart for 0800 SST

[2] Trough – An elongated area of relatively low atmospheric pressure or heights.

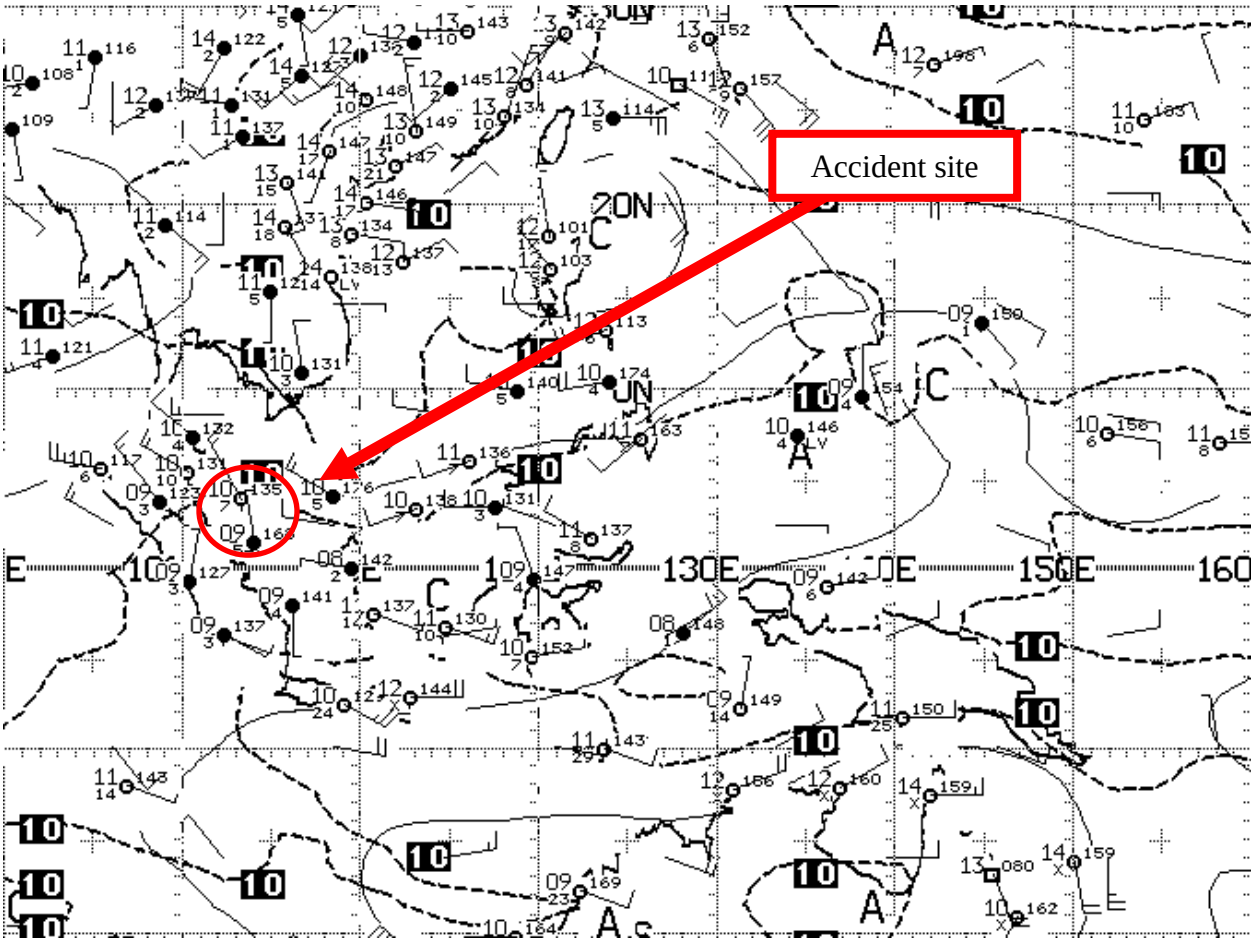

Figure 2 – NOAA 700-hPa tropical analysis chart for 0800 SST

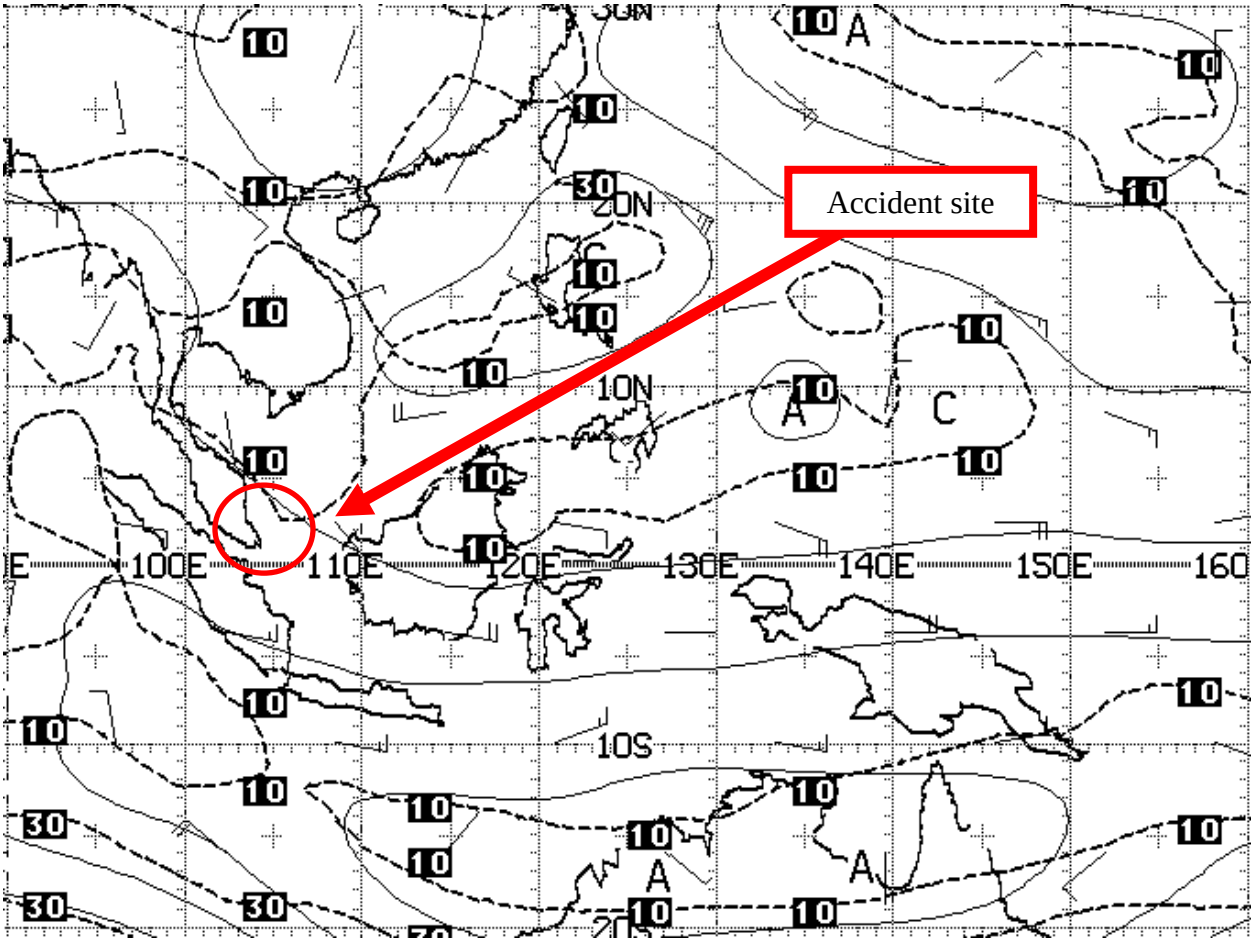

Figure 3 – NOAA 500-hPa tropical analysis chart for 0800 SST

2.0 Surface Observations

The area surrounding the accident site was documented using standard Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). The following observations were taken from standard code and are provided in plain language. Figure 4 is a Google Earth map with the accident site and the closest weather reporting locations marked.

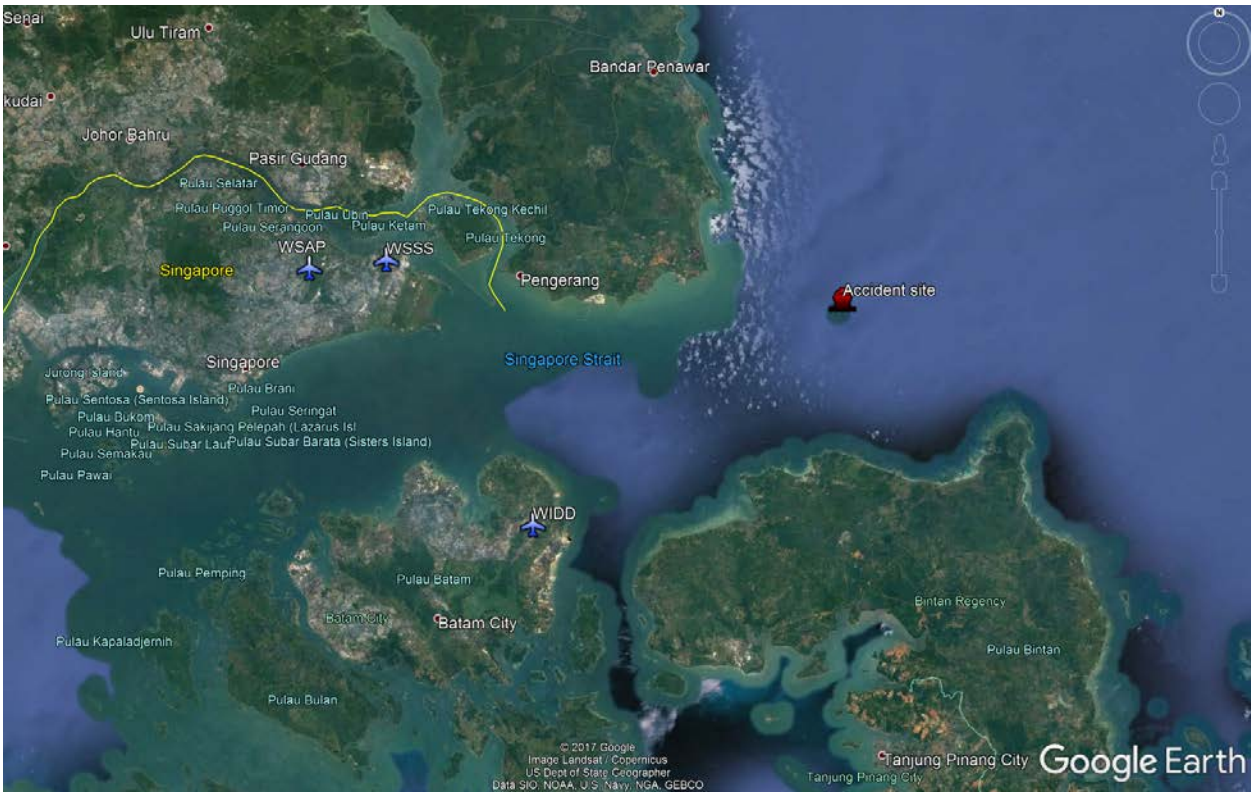

Figure 4 – Google Earth map of accident area with the location of the accident site and surface observation sites

Hang Nadim International Airport, Indonesia (WIDD), was the closest official surface weather station to the accident site. WIDD was located 21 miles southwest of the accident site at an elevation of 126 feet (figure 4). The following observations were taken and disseminated during the times surrounding the accident:[3]

[0300 SST] WIDD 201800Z 10002KT 9000 FEW014 27/25 Q1010

[0330 SST] WIDD 201930Z 00000KT 9000 FEW014 26/25 Q1009

[0400 SST] WIDD 202000Z 13003KT 9000 FEW015 26/25 Q1009

[0430 SST] WIDD 202030Z 14003KT 090V170 9000 FEW015 26/25 Q1009

[0500 SST] WIDD 202100Z 00000KT 9000 FEW014 26/25 Q1009

ACCIDENT TIME 0524 SST

[0530 SST] WIDD 202130Z 12003KT 100V180 9000 FEW014 26/25 Q1009

[3] The bold sections in this NWS product and the rest of products in this report are intended to highlight the sections that directly reference the weather conditions that affected the accident location around the accident time. The local times in section 2.0 next to the METARs are provided for quick reference between UTC and local times around the accident time.

[0600 SST] WIDD 202200Z 12003KT 9000 FEW014 26/25 Q1009

[0630 SST] WIDD 202230Z 00000KT 9000 FEW014 26/25 Q1009

[0700 SST] WIDD 202300Z 13003KT 9000 FEW014 26/25 Q1009

[0730 SST] WIDD 202330Z 00000KT 8000 FEW014 27/26 Q1010

[0800 SST] WIDD 210000Z 12003KT 9999 SCT014 27/26 Q1010 NOSIG

WIDD weather at 0430 SST, wind from 140° at 3 knots, wind direction varying between 090° and 170°, 9 kilometers (km) visibility, few clouds at 1,500 feet above ground level (agl), temperature of 26° C, dew point temperature of 25° C, and an altimeter setting of 1009-hPa.

WIDD weather at 0500 SST, wind calm, 9 km visibility, few clouds at 1,400 feet agl, temperature of 26° C, dew point temperature of 25° C, and an altimeter setting of 1009-hPa.

WIDD weather at 0530 SST, wind from 120° at 3 knots, wind direction varying between 100° and 180°, 9 km visibility, few clouds at 1,400 feet agl, temperature of 26° C, dew point temperature of 25° C, and an altimeter setting of 1009-hPa.

WIDD weather at 0600 SST, wind from 120° at 3 knots, 9 km visibility, few clouds at 1,400 feet agl, temperature of 26° C, dew point temperature of 25° C, and an altimeter setting of 1009-hPa.

Singapore/Changi Airport, Singapore (WSSS), was the next closest official surface weather station to the accident site. WSSS was located 26 miles west-northwest of the accident site at an elevation of 22 feet (figure 4). The following observations were taken and disseminated during the times surrounding the accident:

[0300 SST] WSSS 201900Z 15005KT 9999 FEW015 BKN300 28/25 Q1008 NOSIG

[0330 SST] WSSS 201930Z 14006KT 9999 FEW015 BKN300 27/25 Q1007 NOSIG

[0400 SST] WSSS 202000Z 15005KT 9999 FEW014 BKN300 27/25 Q1007 NOSIG

[0430 SST] WSSS 202030Z 15005KT 9999 FEW014 BKN300 27/25 Q1007 NOSIG

[0500 SST] WSSS 202100Z 15006KT 9999 FEW012 BKN300 27/25 Q1008 NOSIG

ACCIDENT TIME 0524 SST

[0530 SST] WSSS 202130Z 15007KT 110V210 9999 FEW012 BKN300 27/25 Q1008 NOSIG

[0600 SST] WSSS 202200Z 14006KT 9999 FEW014 BKN300 27/25 Q1008 NOSIG

[0630 SST] WSSS 202230Z 14007KT 9999 SCT014 BKN300 27/25 Q1008 NOSIG

[0700 SST] WSSS 202300Z 14006KT 110V170 9999 FEW013 SCT015 BKN300 27/25 Q1008 NOSIG

[0730 SST] WSSS 202330Z 15008KT 110V200 9999 SCT015 BKN300 28/25 Q1009 NOSIG

[0800 SST] WSSS 210000Z 15007KT 9999 SCT016 BKN300 28/25 Q1009 NOSIG

WSSS weather at 0430 SST, wind from 150° at 5 knots, 10 km visibility or greater, few clouds at 1,400 feet agl, broken ceiling at 30,000 feet agl, temperature of 27° C, dew point temperature of 25° C, an altimeter setting of 1007-hPa, and no significant weather change is expected within the next 2 hours.

WSSS weather at 0500 SST, wind from 150° at 6 knots, 10 km visibility or greater, few clouds at 1,200 feet agl, broken ceiling at 30,000 feet agl, temperature of 27° C, dew point temperature of 25° C, an altimeter setting of 1008-hPa, and no significant weather change is expected within the next 2 hours.

WSSS weather at 0530 SST, wind from 150° at 7 knots, wind direction varying between 110° and 210°, 10 km visibility or greater, few clouds at 1,200 feet agl, broken ceiling at 30,000 feet agl, temperature of 27° C, dew point temperature of 25° C, an altimeter setting of 1008-hPa, and no significant weather change is expected within the next 2 hours.

WSSS weather at 0600 SST, wind from 140° at 6 knots, 10 km visibility or greater, few clouds at 1,400 feet agl, broken ceiling at 30,000 feet agl, temperature of 27° C, dew point temperature of 25° C, an altimeter setting of 1008-hPa, and no significant weather change is expected within the next 2 hours.

Singapore/Paya Lebar Air Base, Singapore (WSAP), was the next closest official surface weather station to the accident site. WSAP was located 30 miles west-northwest of the accident site at an elevation of 65 feet (figure 4). The following observations were taken and disseminated during the times surrounding the accident:

[0100 SST] WSAP 201700Z 13004KT 9999 FEW018 BKN300 29/26 Q1009

[0200 SST] WSAP 201800Z 14005KT 9999 FEW018 BKN300 28/25 Q1008

[0300 SST] WSAP 201900Z 13004KT 9999 FEW018 BKN300 28/25 Q1007

[0400 SST] WSAP 202000Z 12003KT 9999 FEW016 BKN300 28/25 Q1007

[0500 SST] WSAP 202100Z 14005KT 9999 FEW016 BKN300 28/25 Q1007

ACCIDENT TIME 0524 SST

[0600 SST] WSAP 202200Z 15005KT 9999 FEW016 BKN300 28/25 Q1008

[0700 SST] WSAP 202300Z 15005KT 9999 SCT016 BKN300 28/25 Q1008

[0800 SST] WSAP 210000Z 15006KT 9999 SCT015 BKN300 28/26 Q1008

[0900 SST] WSAP 210100Z 15005KT 9999 SCT016 BKN300 29/26 Q1009

[1000 SST] WSAP 210200Z 13006KT 9999 SCT017 BKN300 30/26 Q1009

[1100 SST] WSAP 210300Z 13006KT 9999 SCT018 BKN300 31/26 Q1009

[1200 SST] WSAP 210400Z 17007KT 9999 FEW018TCU SCT020 BKN300 31/25 Q1009

WSAP weather at 0400 SST, wind from 120° at 3 knots, 10 km visibility or greater, few clouds at 1,600 feet agl, broken ceiling at 30,000 feet agl, temperature of 28° C, dew point temperature of 25° C, and an altimeter setting of 1007-hPa.

WSAP weather at 0500 SST, wind from 140° at 5 knots, 10 km visibility or greater, few clouds at 1,600 feet agl, broken ceiling at 30,000 feet agl, temperature of 28° C, dew point temperature of 25° C, and an altimeter setting of 1007-hPa.

WSAP weather at 0600 SST, wind from 150° at 5 knots, 10 km visibility or greater, few clouds at 1,600 feet agl, broken ceiling at 30,000 feet agl, temperature of 28° C, dew point temperature of 25° C, and an altimeter setting of 1008-hPa.

WSAP weather at 0700 SST, wind from 150° at 5 knots, 10 km visibility or greater, scattered clouds at 1,600 feet agl, broken ceiling at 30,000 feet agl, temperature of 28° C, dew point temperature of 25° C, and an altimeter setting of 1008-hPa.

2.1 Local Marine Observations

There were no known official buoy observations within 200 miles of the accident site.

3.0 Satellite Data

Infrared data from the Himawari number 8 (HIMAWARI-8) data was 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. Infrared imagery (HIMAWARI-8 band 13) at wavelengths of 10.4 microns was retrieved for the period. Satellite imagery surrounding the time of the accident, from 0300 SST through 0900 SST at approximately 5-minute intervals were reviewed, and the images closest to the time of the accident are documented here.

Figures 5 and 6 present the HIMAWARI-8 infrared imagery from 0520 and 0530 SST at 4X magnification with the accident site highlighted with a red square. Inspection of the infrared imagery indicated scattered cloud cover around the accident site area, Malacca Strait, and in and east of the Strait of Singapore. The cloud cover was moving from northeast to southwest (attachment 1). It should be noted these figures have not been corrected for any parallax error.

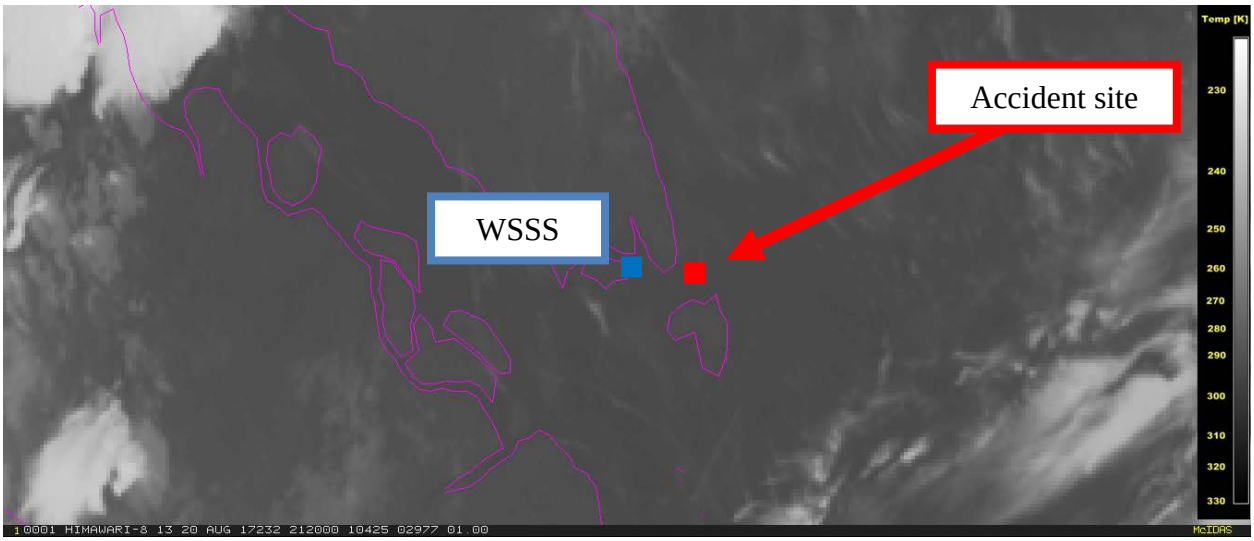

Figure 5 – HIMAWARI-8 infrared image at 0520 SST

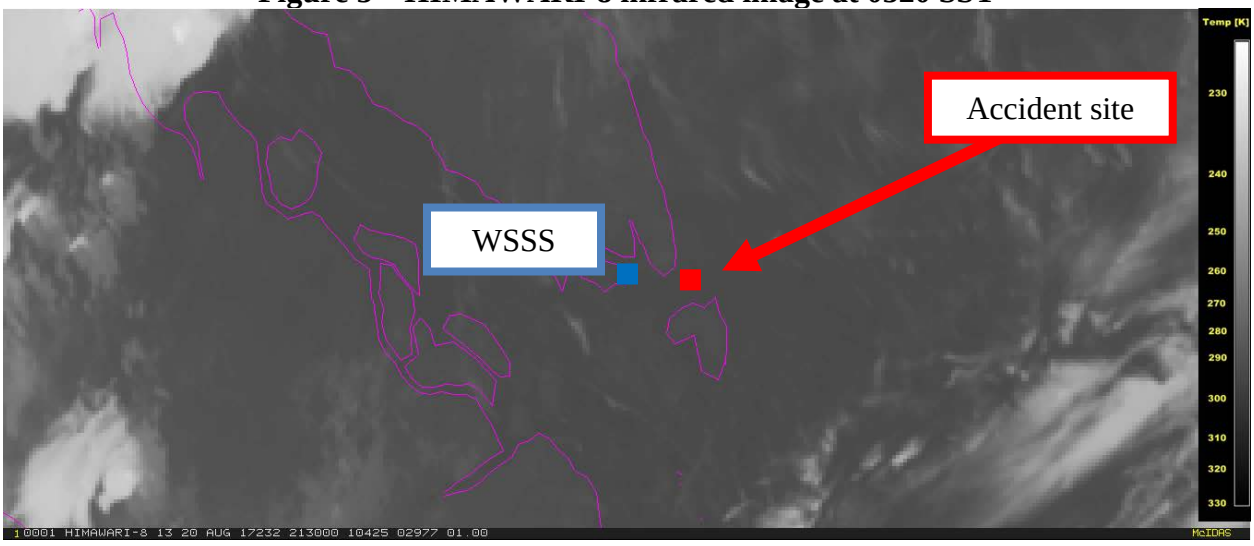

Figure 6 – HIMAWARI-8 infrared image at 0530 SST

4.0 Radar Imagery Information

No official weather radar imagery could be retrieved for the accident site around the accident time.

5.0 Marine Information

Data was retrieved from the Naval Oceanographic Office Global Hybrid Coordinate Ocean Model (HYCOM)[4] and the NOAA Wavewatch III (WW3)[5] model for the accident site around the accident time. Data from the HYCOM and WW3 were available at 3-hour time increments. At 0500 SST HYCOM and WW3 indicated a sea surface temperature of 29.03° C, an air temperature of 28.03° C, a surface sea current from 187° at 1.152 knots, a wind from 157° at 8.39 knots. At 0800 SST HYCOM and WW3 indicated a surface sea current from 057° at 1.732 knots, a wind from 159° at 8.46 knots, a wave height of 1.12 feet, a wave direction from 135°, and a wave period of 3.08 seconds. Figure 7 shows a regional view of the HYCOM surface sea current data surrounding the accident site from 0500 SST.

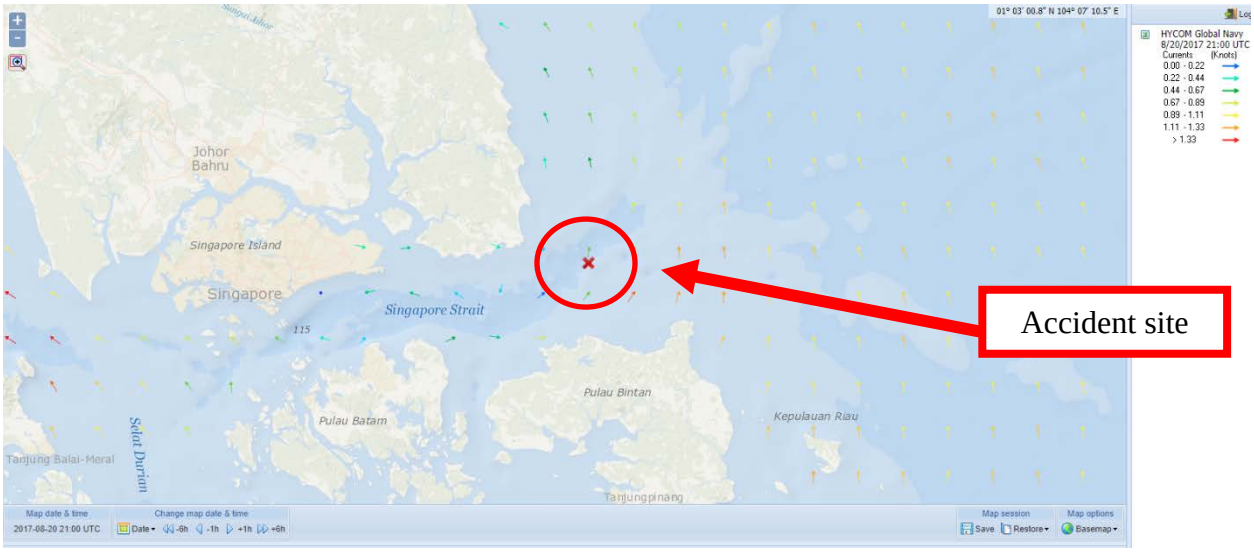

Figure 7 –HYCOM surface sea current information around the accident site from 0500 SST

6.0 Witness Information[6]

The Assistant Navigator of the *USS John S. McCain* indicated that there were no issues with visibility and there was no fog, haze, or rain, and they could make out the NAV lights at the accident time. During the watch relief pass down brief at approximately 0400 SST on the *M/V ALNIC MC* the weather was logged as cloudy skies with approximately 10 miles visibility and seas were logged as "slight."

[4] https://www.ncdc.noaa.gov/data-access/model-data/model-datasets/navoceano-hycom-glb
[5] http://polar.ncep.noaa.gov/waves/index2.shtml
[6] For more information please see the witness interviews and information located in the docket for this accident.

7.0 Significant Wave Height

The standard ocean wave forecast set forth by the World Meteorological Organization (WMO) instructs that the countries responsible for the weather forecast for the world's oceans use significant wave height for their ocean wave height forecasts. The Ocean Prediction Center and the National Hurricane Center's Tropical Analysis and Forecast Branch are responsible for the NOAA forecasts for the northern Atlantic and Pacific oceans. NWS Weather Forecast Offices (WFO)s are responsible for NOAA forecasts closer to the coastal regions (including the Bering Sea) and the NWS Anchorage WFO was the responsible office for the weather forecast for the accident area.

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 feet, the mean wave height encountered by a vessel for that wave spectrum would be 12.8 feet with the most probable wave height encountered of 12 feet. However, the highest 10 percent of waves within that wave spectrum would be 25.4 feet and the highest 1 percent of waves would be around 33.4 feet high. The highest wave a vessel would likely encounter within a wave spectrum whose significant wave height was 20 feet would be 40 feet. From the HYCOM and WW3 data for the accident site with seas of 1.12 feet[7], the highest wave heights the accident vessel could have expected would have been 2.24 feet with most of the waves encountered around 0.67 feet high.

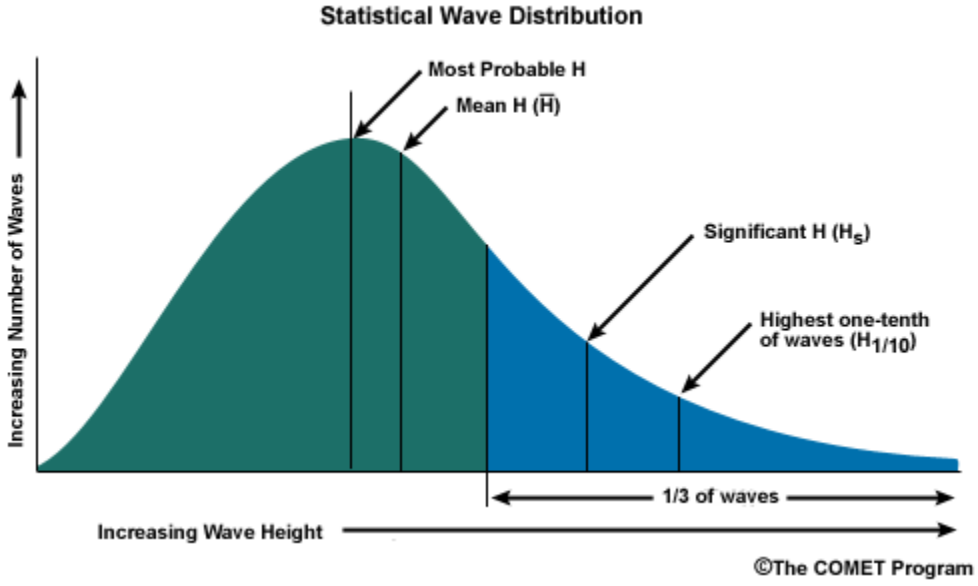

Figure 8 – Typical statistical wave distribution

[7] Seas = significant wave height

8.0 Astronomical Data

The astronomical data obtained from the United States Naval Observatory for the accident site on August 21, 2017, indicated the following:

SUN	
Begin civil twilight	0640 SST
Sunrise	0701 SST
Sun transit	1306 SST
Sunset	1910 SST
End civil twilight	1931 SST

MOON	
Moonrise	0621 SST
Moon transit	1236 SST
Moonset	1850 SST

The phase of the Moon was Waning Crescent with 0% of the Moon's visible disk illuminated.

E. LIST OF ATTACHMENTS

Attachment 1 – HIMAWARI-8 weather satellite animation from 0450 to 0600 SST

Submitted by:

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Paul Suffern
Senior Meteorologist

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