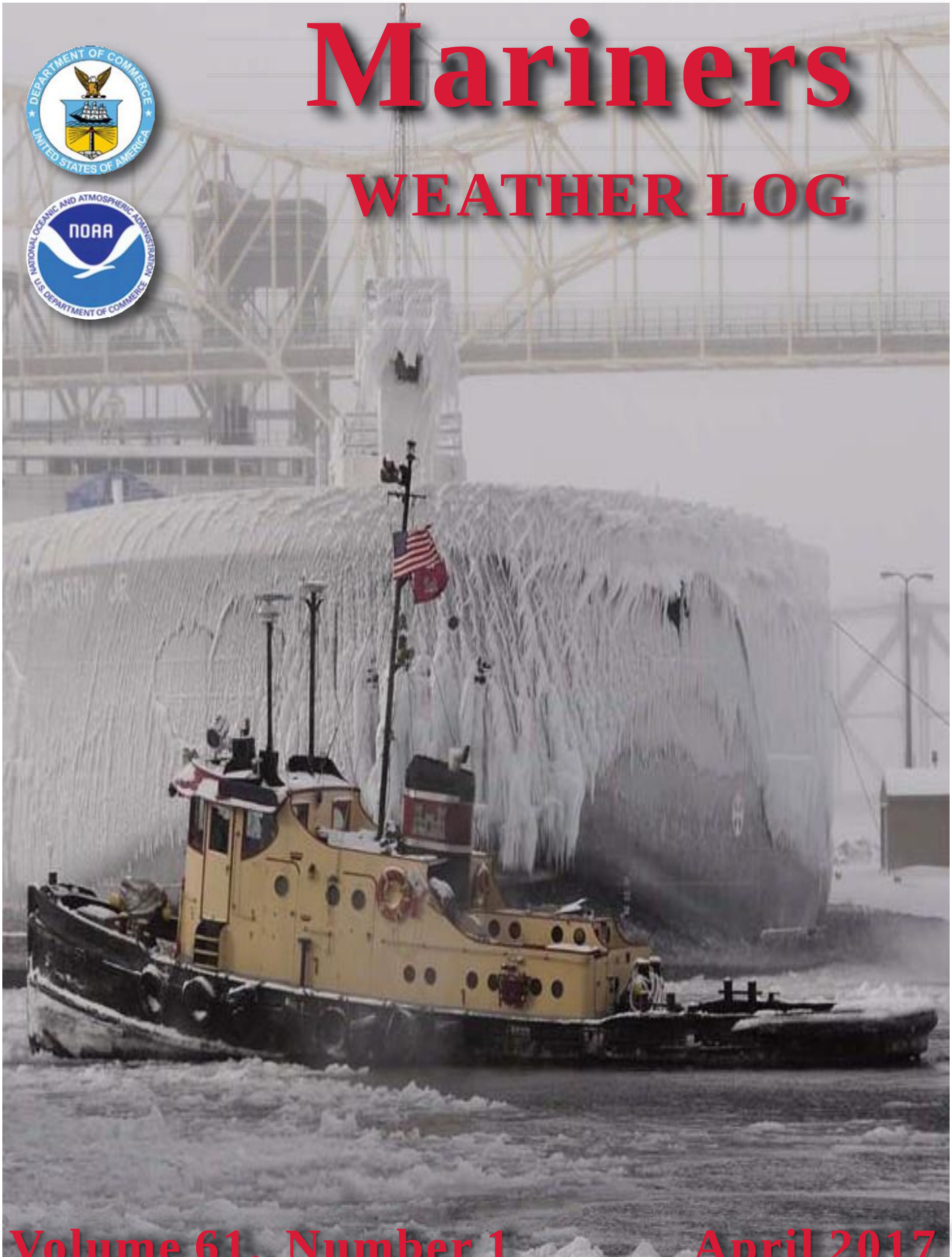
Mariners

WEATHER LOG



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From the Editor

Greetings and welcome to our April issue of the Mariners Weather Log. The last week of March, I was fortunate to attend the Ninth Session of the Ship Observations Team (SOT), which was held at the International Maritime Organization (IMO), London, United Kingdom. The Ship Observations Team is an international team that encompasses three crosscutting programs: Voluntary Observing Ship Program (VOS), Ship of Opportunity (SOOP), and Automated Shipboard Aerological Program (ASAP). This meeting is held every 2 years, and this year seemed significant for the simple reason that our meeting location was at the IMO and we were greeted by Mr. Yamada, the Senior Director of Maritime Safety Division of the IMO. Mr. Yamada highlighted the mission of the IMO "to promote safe, secure, environmentally sound and sustainable shipping, through cooperation. For this purpose, providing meteorological services and warnings to ships are indispensable. For this reason, ships are encouraged to report meteorological data to shore." This statement is stipulated in the International Convention for the Safety of Life at Sea (SOLAS) that is the base IMO instrument, particularly related to SOT.

The IMO is now preparing its new strategic plan for the 6-year period of 2018–2023. The IMO Assembly will adopt this strategic plan by the end of this year, 2017. As anyone in the shipping industry knows, the IMO is the United Nations' specialized agency with responsibility for safety and security of shipping and the prevention of marine pollution by ships. The overarching principle states that the IMO plays an important role in achieving the 2030 "Agenda for Sustainable Development." Within the strategic plan, there are seven Strategic Directions that are of particular focus for the 2018–2023 period, which are related to SOT, "Respond to climate change," and "Engage in ocean governance."

Collectively, it was reiterated that there is a significant emphasis on the importance of in situ ocean observations and ship observations in particular. Globally, there is a continued need for marine observation networks to accommodate science, support of good governance of the ocean, climate mitigation, and operational services geared towards early-warning systems (supporting SOLAS).

Conference attendees were in agreement that today, more than ever, the collection of environmental data is imperative for the better understanding of atmospheric processes if we are to achieve enhanced accuracy and resolution of atmospheric analysis and predictions. These elements benefit forecasts and warnings and can be measured by lives saved, injuries avoided, and the protection of property and commerce. Environmental studies that gauge the environmental qualities that are necessary for the insurance of available clean air, water, food, and safety from the many natural hazards, which can sometimes create life-threatening conditions, are paramount.

Your marine weather observations are fundamental to the ability to understand the atmosphere and oceans. I would like to take this opportunity thank each one of you who make all of this possible by participating in VOS. I would also like to take this opportunity to thank our Port Meteorological Officers, who are the backbone to this program, supporting and liaison to the ships participating at every level, a steadfast bunch.

Bravo Zulu!

So without further ado, sit back with a hot cup of Joe…or tea and enjoy this next issue of the Mariners Weather Log.

Paula

On the Cover: December 14, 2017: At the Duluth Lift Bridge at the head of the lakes on Lake Superior, a frozen Great Lakes Trader. **JOYCE L. VAN ENKEVORT** appears after a week of gale force winds and subzero temperatures on Lake Superior, one of numerous ships arriving having to spend extra time with ice removal before their down-bound departures to the lower lakes.

Credits: "Ghost Ship," Photo taken by:
U.S. Army Corp of Engineers employee Carmen Paris.
Submitted by Ron Williams, PMO Duluth MN

Mariners Weather Log

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VOS Program

Relations among Met-Ocean Parameters during Hurricane Matthew in 2016

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In October 2016, when Hurricane Matthew was over the Central Caribbean Sea, simultaneous meteorological-oceanographic (met-ocean) measurements of air pressure, wind speed at 5 m (U_5), significant wave height (H_s), and dominant wave period (T_p), along with other parameters were made by the National Data Buoy Center (see www.ndbc.noaa.gov) at the NDBC Buoy Station 42058 near the storm track (for buoy location and datasets, see www.ndbc.noaa.gov, and for the hurricane track, see www.nhc.noaa.gov). These datasets appear in **Table 1**. The main purpose of this research note is to investigate the relations among these parameters during the growing wave period prior to the passage of Matthew's eye.

Because the wind speeds were recorded at 5 m instead of the standard 10-m height during Matthew in 2016, one needs to adjust the wind speed from U_5 at 5 m to U_{10} at 10 m. This is performed by using the power-law wind profile approach as provided in Hsu (2003, *J. Waterway, Port, Coastal and Ocean Engineering*, 129 (4), 174–177) such that,

$$U_{10}/U_5 = (10/5)^p \qquad (1)$$

Here $p = (U_{gust}/U_5 - 1)/2 = (G - 1)2$, where G is the gust factor and U_{gust} is the wind gust measured at the buoy. **Figure1** shows that $G = 1.25$ so that $p = 0.125$ with a very high correlation coefficient **(R = 0.99)**. Substituting this p value into **Equation (1)**, we have,

$$U_{10} = 1.1U_5 \qquad (2)$$

Using **Equation (2)**, we can now adjust the wind speed from 5 to 10 m.

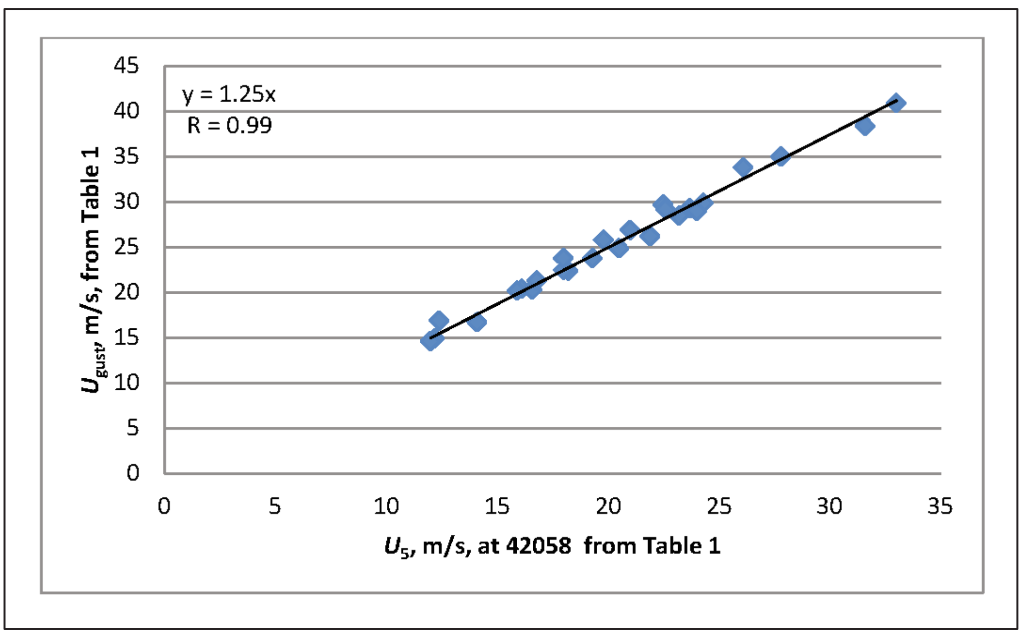


Figure 1. Measurements of the gust factor at Buoy 42058 during Hurricane Matthew in 2016.

Since the standard unit of atmospheric pressure is 1013 mb, we plot the pressure deficit, i.e., **(1013 – Pressure)** against the wind speed as shown in **Figure 2**. It is found that,

$$U_{10} = 5.2\ (1013 - \text{Pressure})^{0.52}. \qquad (3)$$

Figure 3 indicates that similar relation exits between pressure deficit and significant wave height as follows,

$$H_s = 1.7\ (1013 - \text{Pressure})^{0.48}. \qquad (4)$$

Because the exponents in **Equations (3)** and **(4)** are nearly identical (**= 0.5**), we postulate here that U_{10} and H_s can be correlated linearly as shown in **Figure 4** that,

$$H_s = 0.26U_{10} + 0.57. \qquad (5)$$

Since the intercept (**= 0.57**) for **Equation (5)** is small, it is further simplified as follows (see **Figure 5**) that,

$$H_s = 0.29U_{10}. \qquad (6)$$

This equation states that the significant wave height is about 30% of the wind speed. This 30% rule of thumb may be useful for mariners as the author suggested earlier in this journal (see *MWL*, December 2015, available at http://www.vos.noaa.gov/MWL/201512/waveheight.shtml). Note that, although the coefficients in **Equations (5)** and **(6)** may vary depending on different met-ocean conditions (see August and December 2016 issues of *MWL*), the general linear relation between the wind speed and the significant wave height does exist.

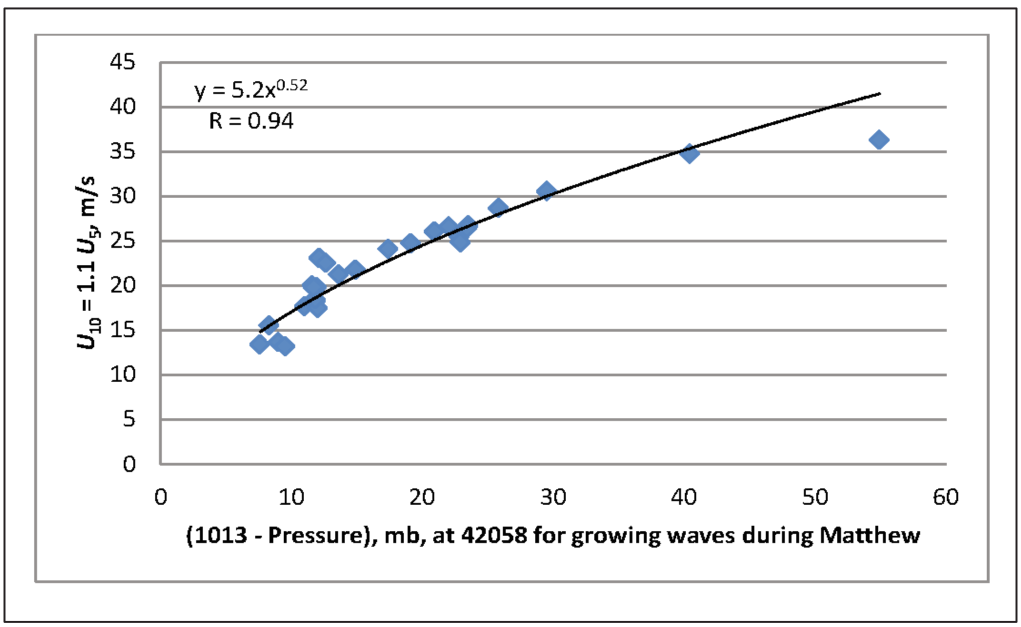


Figure 2. Power-law relation between wind speed and pressure deficit at 42058 during Matthew.

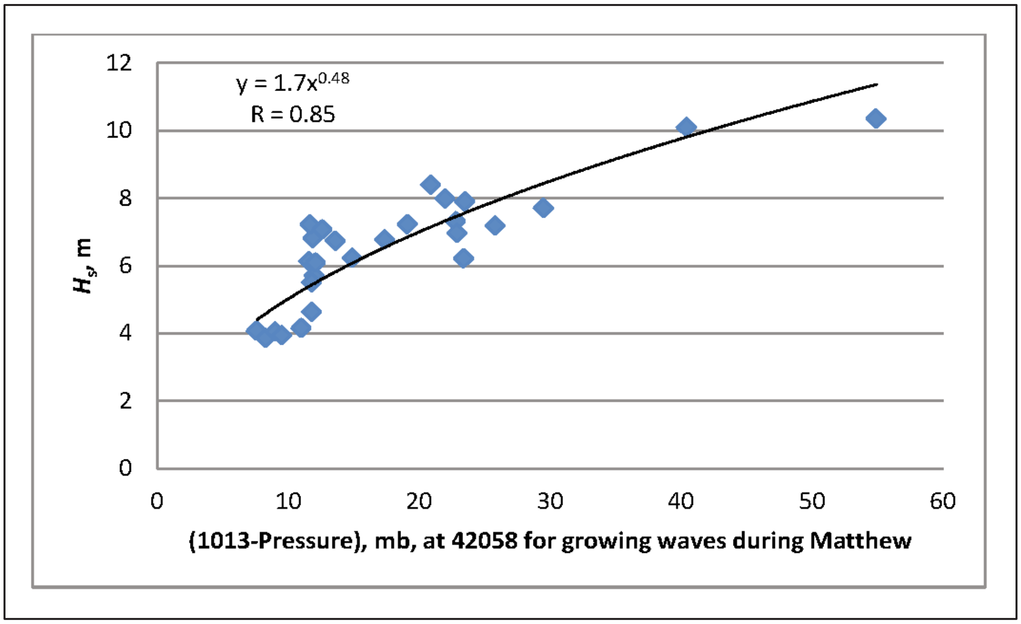


Figure 3. Power-law relation between significant wave height and pressure deficit at 42058 during Matthew.

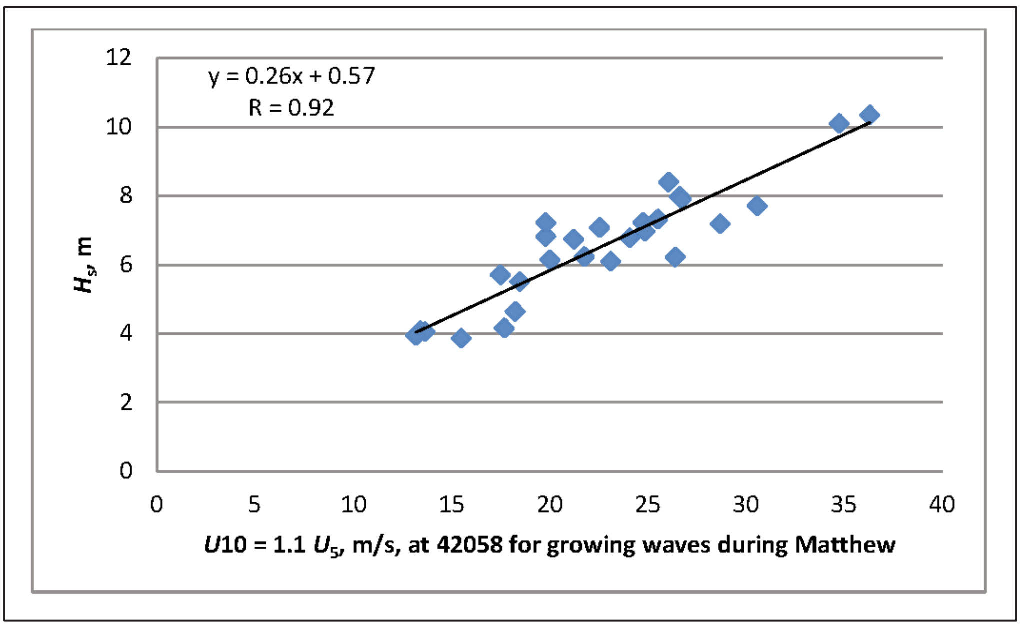


Figure 4. Linear relation between wind speed and significant wave height.

Analytically, the dimensionless wave height, gH_S/U^2_{10} and wave period, gT_p/U_{10} are often related according to a power law that, (see, e.g., Hsu, et al. (2000, *Journal of Coastal Research, 16*, 1063–1067)),

$$gH_S/U^2_{10} = a\,(gT_p/U_{10})^b. \qquad (7)$$

Here g is the gravitational acceleration (**= 9.8 m s^{-2}**) and coefficients **"a"** and **"b"** need to be determined from field experiments.

Using the datasets provided in **Table 1** and **Equation (2)**, **Figure 6** shows that the exponent **"b"** is approximately unity, indicating that the dimensionless wave height and its period are approximately linearly related.

Therefore, if we set **b = 1** in **Equation (7)**, we get following equation based on **Figure 7**,

$$gH_s/U^2_{10} = 0.028\ (gT_p/U_{10}), \qquad (8a)$$

Or approximately,

$$U_{10} = 36\ H_s/T_p. \qquad (8b)$$

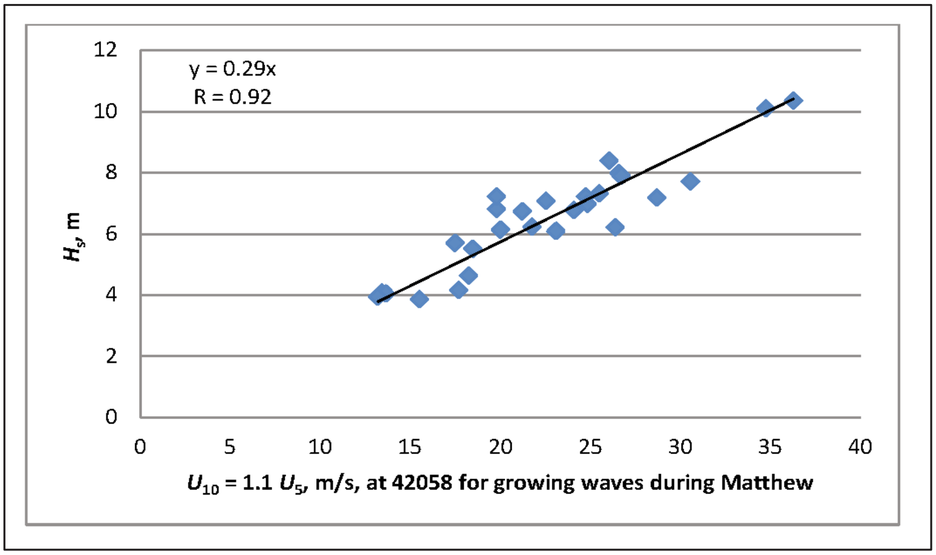


Figure 5. Simplified linear relation between wind speed and significant wave height.

Since the variation of T_p is small around its average of 10.3 seconds, substituting this value into **Equation (8b)**, we have

$$U_{10} = 3.5\ H_s. \qquad (9)$$

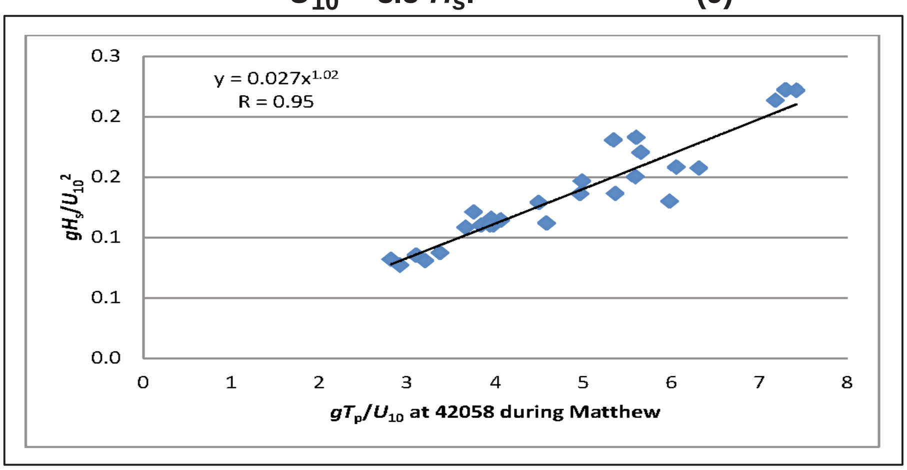


Figure 6. Power-law relation between dimensionless wave height and period.

Since **Equation (9)** is the same as **Equation (6)**, it is concluded that **Equation (8b)** is a useful formula for met-ocean applications among wind and wave parameters. In addition, **Equations (3)** and **(4)** may be used to estimate the wind speed and significant wave height from air pressure measurements.

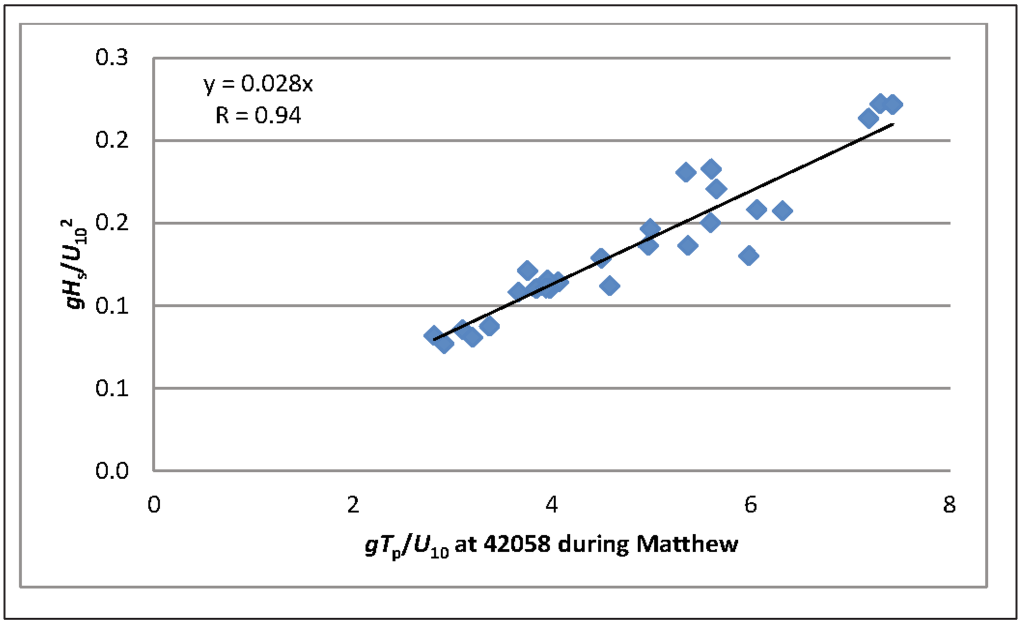


Figure 7. Simplified linear relation between dimensionless wave height and period.

Table 1. Met-ocean measurements at NDBC Buoy 42058 prior to the passage of the eye of Hurricane Matthew in October 2016 (Data source: www.ndbc.noaa.gov).

DATE	HOUR (UTC)	WIND DIRECTION	U_5	U_{gust}	H_s	T_p	WAVE DIRECTION	PRESSURE
		DEG.	M/S	M/S	M	SEC.	DEG.	mb
2	2	55	12.2	14.9	4.08	10	102	1005.4
2	3	60	14.1	16.7	3.86	10	84	1004.7
2	4	55	12.4	16.9	4.05	10	99	1004
2	5	56	12	16.9	3.94	10	96	1003.5
2	6	68	16.1	20.4	4.16	10.81	95	1002
2	7	59	16.6	20.3	4.64	10	87	1001.2
2	8	60	15.9	20.2	5.7	10	96	1001
2	9	58	16.8	21.3	5.51	11.43	111	1001.2
2	10	66	18.2	22.4	6.14	11.43	105	1001.4
2	11	60	18	22.5	6.82	11.43	108	1001.1
2	12	53	18	23.8	7.22	10.81	103	1001.3
2	13	63	21	26.9	6.09	10.81	97	1000.9
2	14	56	20.5	24.9	7.07	11.43	110	1000.4
2	15	55	19.3	23.8	6.74	10.81	100	999.4

Table 1. (continued) Met-ocean measurements at NDBC Buoy 42058 prior to the passage of the eye of Hurricane Matthew in October 2016 (Data source: www.ndbc.noaa.gov).

DATE	HOUR (UTC)	WIND DIRECTION	U_5	U_{gust}	H_s	T_p	WAVE DIRECTION	PRESSURE
		DEG.	M/S	M/S	M	SEC.	DEG.	mb
2	16	56	19.8	25.8	6.23	10	108	998.1
2	17	52	21.9	26.2	6.77	10	108	995.6
2	18	54	22.5	29.7	7.23	10	91	993.9
2	19	50	23.7	29.3	8.4	10	63	992.1
2	20	60	24.2	29.6	7.98	10.81	44	991
2	21	53	24.3	29.9	7.9	10	59	989.5
2	22	75	23.2	28.5	7.32	10	78	990.2
2	23	79	22.6	29.2	6.97	10	63	990.1
3	0	74	24	29	6.22	9.09	83	989.6
3	1	60	26.1	33.8	7.18	9.09	91	987.2
3	2	66	27.8	35	7.71	10	56	983.5
3	3	63	31.6	38.4	10.09	10	305	972.6
3	4	73	33	40.9	10.35	10.81	355	958.1

⚓

Mean Circulation Highlights and Climate Anomalies

September through December 2016

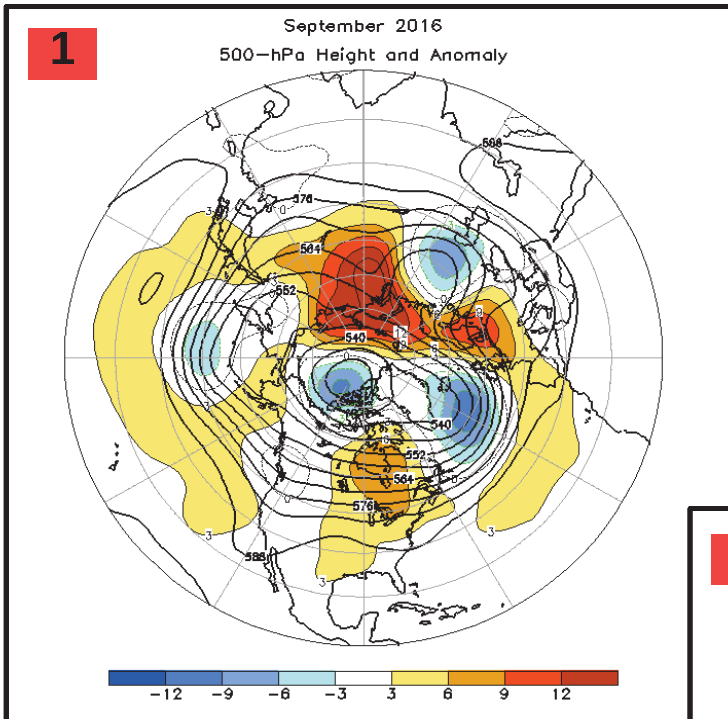
Anthony Artusa, Meteorologist, Operations Branch,
Climate Prediction Center NCEP/NWS/NOAA

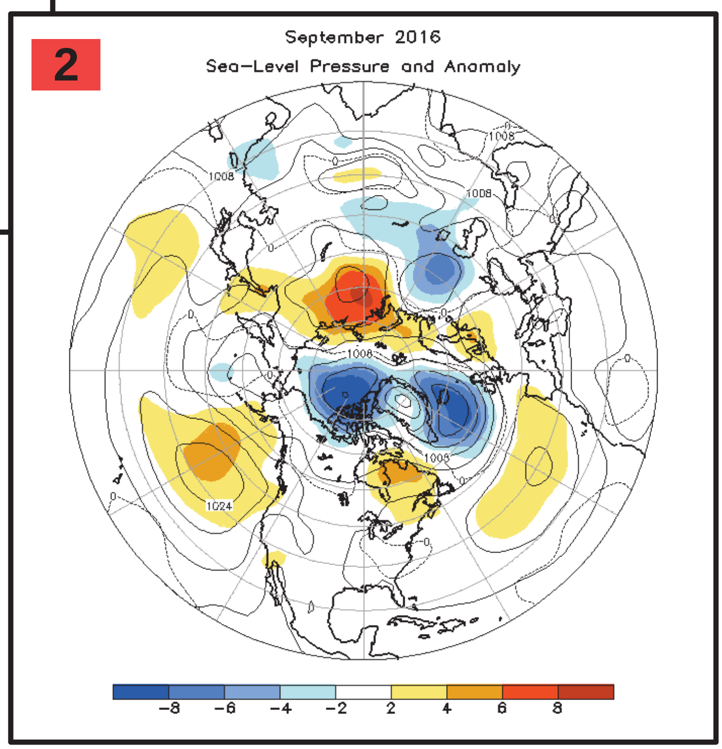
All anomalies reflect departures from the 1981–2010 base period.

September–October 2016

The 500-hPa circulation pattern in September 2016 was characterized by above-average heights over eastern North America, northern Europe, and central Russia and below-average heights over the high latitudes of the North Atlantic, the Arctic Ocean, and western Russia, **Figure 1**. As is often the case, the Sea-Level Pressure (SLP) and Anomaly map bears a similar appearance to that of the 500-hPa circulation map, **Figure 2**.

In October, the Northern Hemispheric 500-hPa flow pattern featured above-average heights over much of the high latitudes, eastern North America, and over the temperate latitudes of the central North Pacific Ocean. Below-average heights were noted over central and eastern Asia, and over the eastern Gulf of Alaska, **Figure 3**. The SLP pattern for October generally mirrored the 500-hPa height anomaly pattern, **Figure 4**.

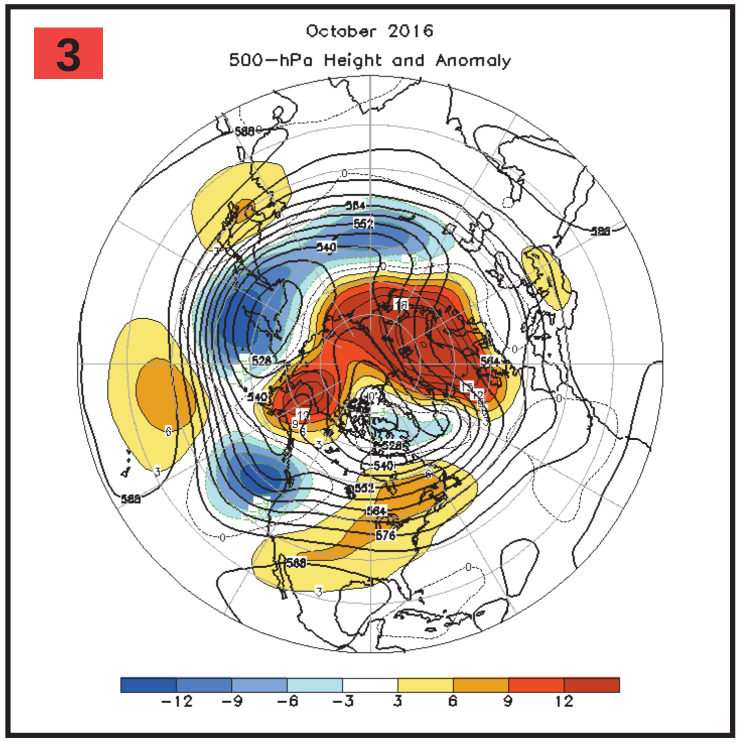




Caption for 500-hPa Heights and Anomalies: Figures 1, 3, 5, & 7 Northern Hemisphere mean and anomalous 500-hPa geopotential height (CDAS/Reanalysis). Mean heights are denoted by solid contours drawn at an interval of 6 dam. Anomaly contour interval is indicated by shading. Anomalies are calculated as departures from the 1981–2010 base period monthly means.

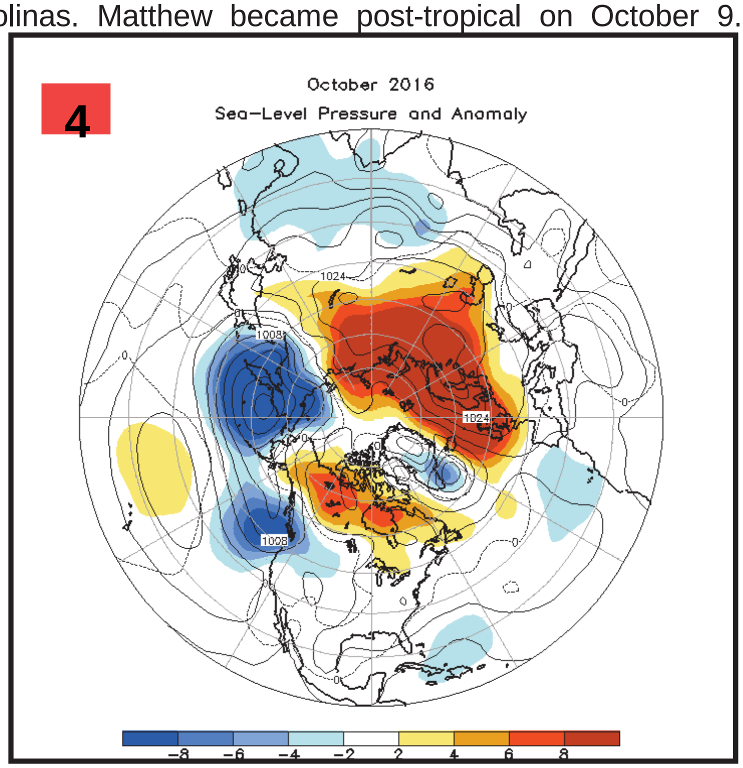
Caption for Sea-Level Pressure and Anomaly: Figures 2, 4, 6, & 8 Northern Hemisphere mean and anomalous sea-level pressure (CDAS/Reanalysis). Mean values are denoted by solid contours drawn at an interval of 4 hPa. Anomaly contour interval is indicated by shading. Anomalies are calculated as departures from the 1981–2010 base period monthly means.

A major weather event that occurred from late September into early October was Hurricane Matthew. Having entered the eastern Caribbean Sea as a strong tropical storm on September 28th, Matthew took a path that was unusually far south for Atlantic basin systems. Tropical storm watches were posted for the far southern Caribbean islands of Aruba, Bonaire, and Curacao, **Reference 1**.



Matthew became a hurricane 300 km northeast of Curacao on September 29th and ultimately reached Category- 5 intensity on the Saffir-Simpson Hurricane Wind Scale the following day at just 13.3N latitude; pending post-storm analysis, this may be the lowest latitude ever recorded for a storm of this intensity in the Atlantic basin (surpassing Hurricane Ivan at latitude 13.7N on September 9th, 2004, **Reference 2**). It also became the strongest Atlantic hurricane since Felix in 2007. Close to the time of Matthew's peak intensity over the south-central Caribbean, electrical phenomena known as "sprites" were photographed above the storm by observers in Puerto Rico, **References 3, 4**. Though not much is known about sprites, these faint red flashes appear to be larger-scale electrical discharges that occur high above towering thunderheads. As the hurricane started to recurve near 15N/75W, in response to a mid-level trough approaching from the northwest, it passed over the western tip of Haiti and the eastern tip of Cuba, while undergoing slight weakening. Matthew then assumed a northwesterly track, with the eye of the hurricane passing between Andros Island and New Providence Island in the Bahamas, coming to within 40 km of Nassau.

The hurricane then skirted the coast of the Southeast United States, resulting in significant damage, before heading out to sea east of the Carolinas. Matthew became post-tropical on October 9. During the life cycle of Hurricane Matthew, the strongest winds recorded by reconnaissance aircraft were 140 knots, and the minimum central pressure was 934-hPa. About 1600 fatalities and $10.5 billion U.S. dollars in damage have been attributed to this storm.



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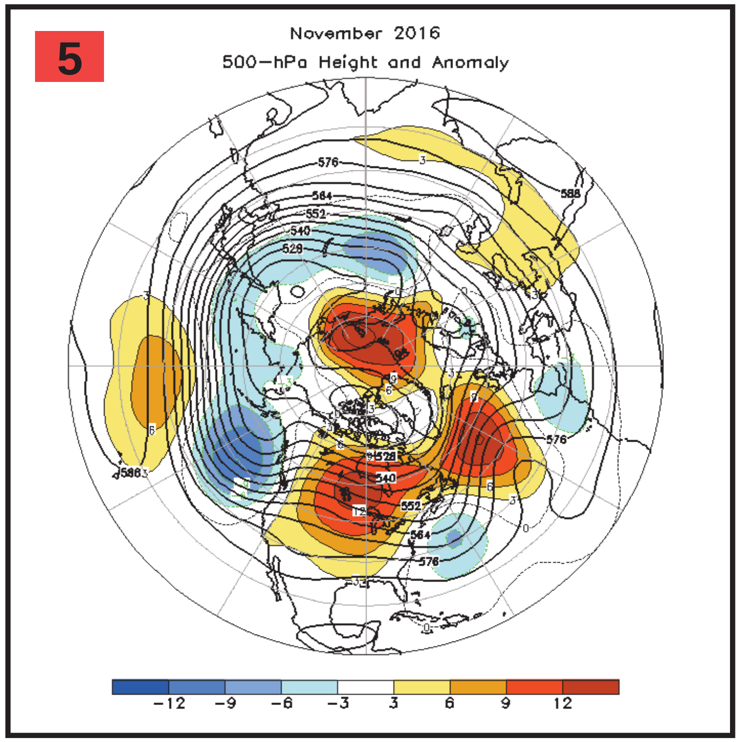
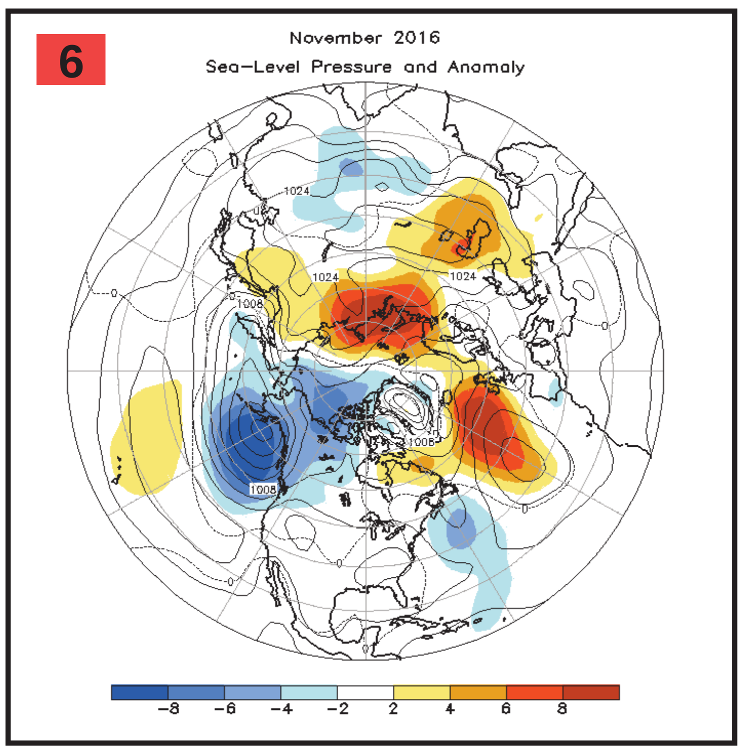
The Tropics



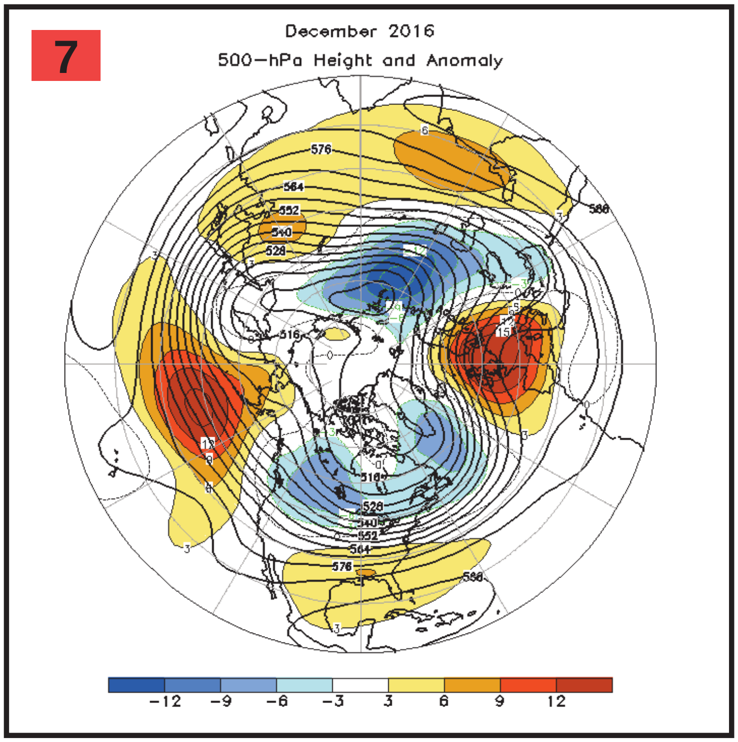
Sea surface temperatures (SSTs) were below average across the central and eastern equatorial Pacific during both September and October, and the monthly Niño 3.4 index values were -0.6C and -0.7C, respectively. The depth of the 20C isotherm (oceanic thermocline) remained below average across the central and eastern equatorial Pacific in September and October, with corresponding subsurface temperatures ranging from 1-3C below-average. Near-average low-level wind anomalies prevailed across much of the central and eastern Pacific (September and October), with enhanced easterlies noted over the western Pacific in October. Deep, tropical cumuliform clouds and thunderstorm activity was suppressed over the central and eastern equatorial Pacific in September, suppressed over the central Pacific in October, and enhanced over Indonesia in October. These oceanic and atmospheric anomalies collectively reflect ENSO-neutral conditions (September) and weak La Niña conditions (October).

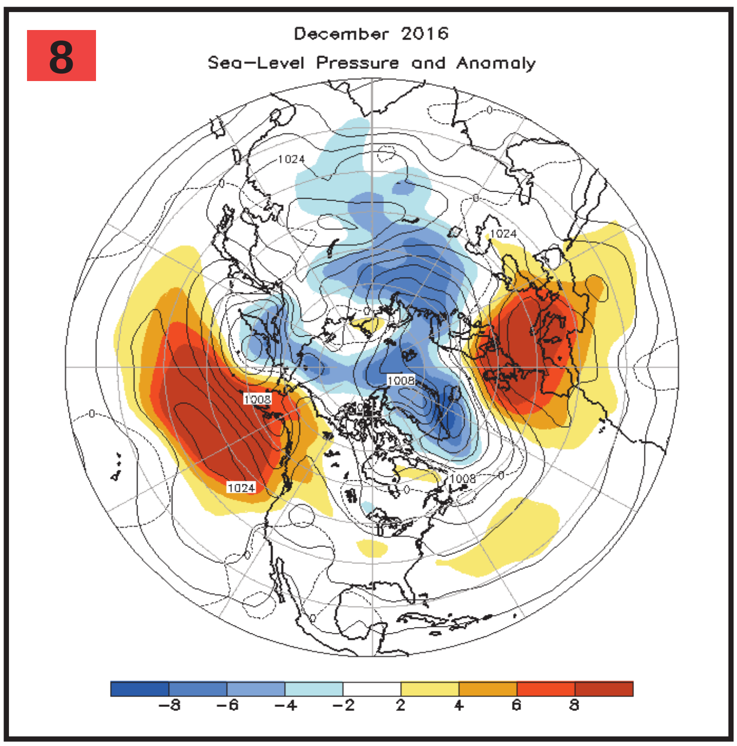
November–December 2016



In November, the mid-tropospheric circulation featured above-average heights over the central North Pacific, North America, the central North Atlantic, and northern Siberia, and below-average heights over the high latitudes of the North Pacific, the Gulf of Alaska, and central and eastern Asia, **Figure 5**. The SLP and Anomaly map generally mirrored the 500-hPa height-anomaly pattern, **Figure 6**, though there were several notable differences. Above-average SLP was noted over and east of the Caspian Sea, and below-average SLP was most anomalous over the Gulf of Alaska and just north of Alaska.

The 500-hPa circulation pattern in December was characterized by above-average heights across the central North Pacific, the southern contiguous U.S., Europe, and China. Below-average heights were noted over Canada, the high latitudes of the North Atlantic, and central Asia, **Figure 7**. The SLP and Anomaly pattern, **Figure 8**, differed in sign from the corresponding 500-hPa height-anomaly pattern in several regards. SLP was close to normal over both Canada and China.





The Tropics

SSTs were below average across the central and eastern equatorial Pacific during both November and December, and the monthly Niño 3.4 index values were -0.6C and -0.4C, respectively. The depth of the 20C isotherm remained below average across the eastern equatorial Pacific in November and December, with corresponding subsurface temperatures ranging from 1–3C below average. Near-average low-level wind anomalies prevailed across much of the central and eastern Pacific (November and December), with enhanced easterlies noted over the western Pacific during the 2-month period. Deep, tropical cumuliform clouds and thunderstorms were suppressed over the central and eastern equatorial Pacific in November and December and enhanced over Indonesia and the western Pacific in both months. These oceanic and atmospheric anomalies collectively reflect weak La Niña conditions.

Caption for 500-hPa Heights and Anomalies: Figures 1, 3, 5, & 7 Northern Hemisphere mean and anomalous 500-hPa geopotential height (CDAS/Reanalysis). Mean heights are denoted by solid contours drawn at an interval of 6 dam. Anomaly contour interval is indicated by shading. Anomalies are calculated as departures from the 1981–2010 base period monthly means.

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Marine Weather Review – North Atlantic Area

May–August 2016

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NOAA National Center for Environmental Prediction

Introduction

The 4-month period covering the transition from spring to the less- active weather of summer was marked by declining activity (in terms of cyclones producing winds of at least storm force) through July, which was the least- active month, followed by some increase in August. Low-pressure systems generally tracked eastward toward Europe and sometimes stalling, or northeastward toward Greenland and Iceland. Although there were no cyclones of non-tropical origin developing central pressures below 970 hPa, the period was not without hurricane force lows, which occurred in May and July, and one approaching hurricane force in August. In the past, hurricane force systems have not occurred every year during these months. This ocean was more active than during the same period in the North Pacific.

The 4-month period includes the first half of the Atlantic basin hurricane season. The first-named storm at the end of May and the beginning of June was a "B" storm, Bonnie, because Alex occurred in January in the eastern Atlantic (**Reference 5**). Other tropical systems affecting OPC's marine area north of 31N included a tropical storm in June a tropical depression, and a major hurricane (Category 3 on the Saffir-Simpson scale) (**Reference 3**) at the end of August. None of these cyclones redeveloped as intense extra-tropical (or post-tropical) cyclones, but one (Colin in June) became strong enough to develop storm-force winds as an extratropical low.

Tropical Activity

Tropical Storm Bonnie:

The weak low- pressure area that became Bonnie originated near 28N 74W on May 27, became Tropical Depression Two the following evening, and then passed near 31N 79W as a tropical storm with maximum sustained winds of 35 kts at 0000 UTC May 29th. Bonnie developed a peak intensity of 40 kts for sustained winds 6 hours later before moving inland over South Carolina and weakening to a depression at 1800 UTC on the 29th. Buoy 41004 (32.5N 79.1W) reported southeast winds of 27 kts with gusts to 33 kts and 2.5-m seas (8 ft) at 1000 UTC on the 29th, followed by a peak gust of 35 kts and 3.0 m seas (10 ft) 1 hour later. Declared a post-tropical low at 1800 UTC May 30th, the remnant of Bonnie moved along the North Carolina coast on the 31st and June 1st. Bonnie then regained tropical characteristics as a depression while passing offshore near Cape Hatteras later on June 2nd and redeveloped into a tropical storm with 35-kt sustained winds late on the 3rd near 36N 70W. The cyclone then weakened to a depression again late on the 4th near 35N 66W and then dissipated as a post-tropical low on the night of the 5th.

Tropical Storm Colin:

Tropical Storm Colin moved out of the northeast Gulf of Mexico late on June 6st and offshore along the southeast U.S. coast early on June 7th with maximum sustained winds of 45 kts. Buoy 41025 (35.0N 75.4W) reported southwest winds of 35 kts with gusts to 43 kts and 2.0-m seas (7 ft) at 1400 UTC on the 7th, and a peak gust of 45 kts and 3.0-m seas (10 ft) 2 hours later. Colin became a post-tropical storm force low at 1800 UTC on the 7th near 37N 74W. **Figure 1** depicts this transition with Colin shown as an extra-tropical low with fronts in the warm sector of another low over New Brunswick. **Figure 2** displays satellite detected winds around the south side of Post-tropical Cyclone Colin with the storm- force winds concentrated over the warmer waters near the location of the Gulf Stream.

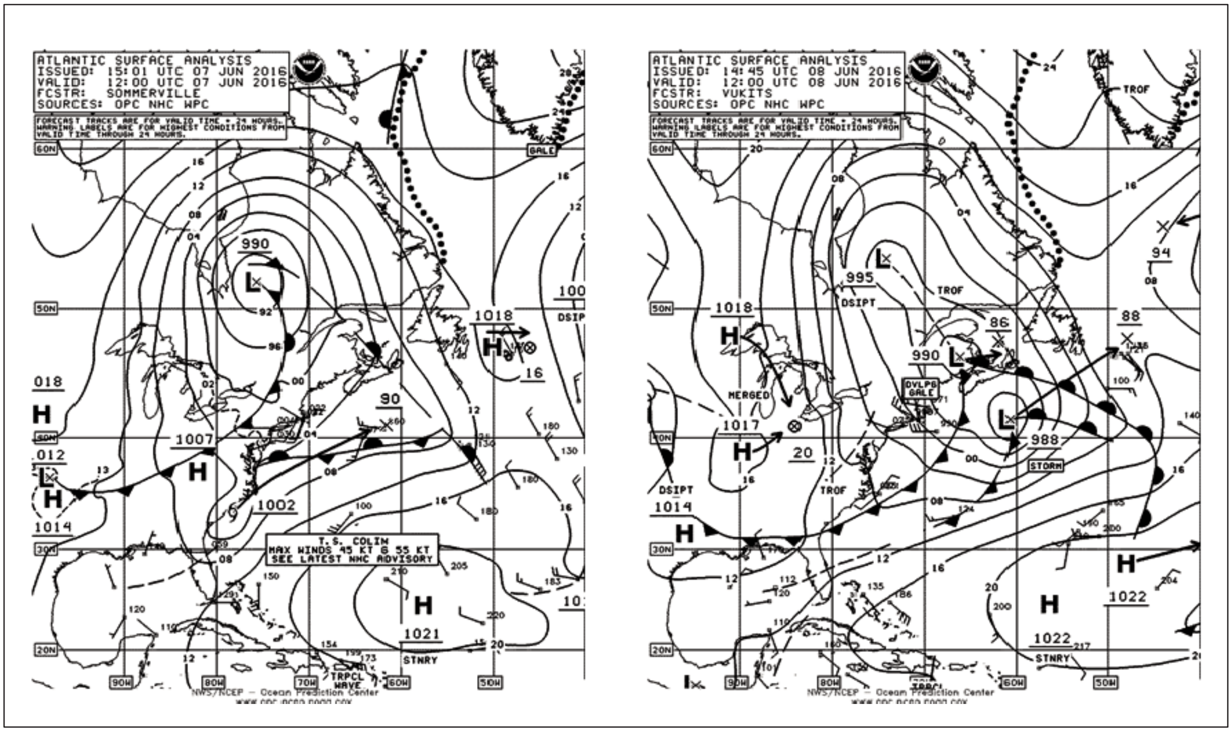


Figure 1. OPC North Atlantic Surface Analysis charts (Part 2 – west) valid 1200 UTC June 7 and 8, 2016. Note 24-hour forecast tracks are shown with the forecast central pressures given as the last two whole digits in millibars (hPa). Tropical cyclone symbols are accompanied by text boxes with intensity information.

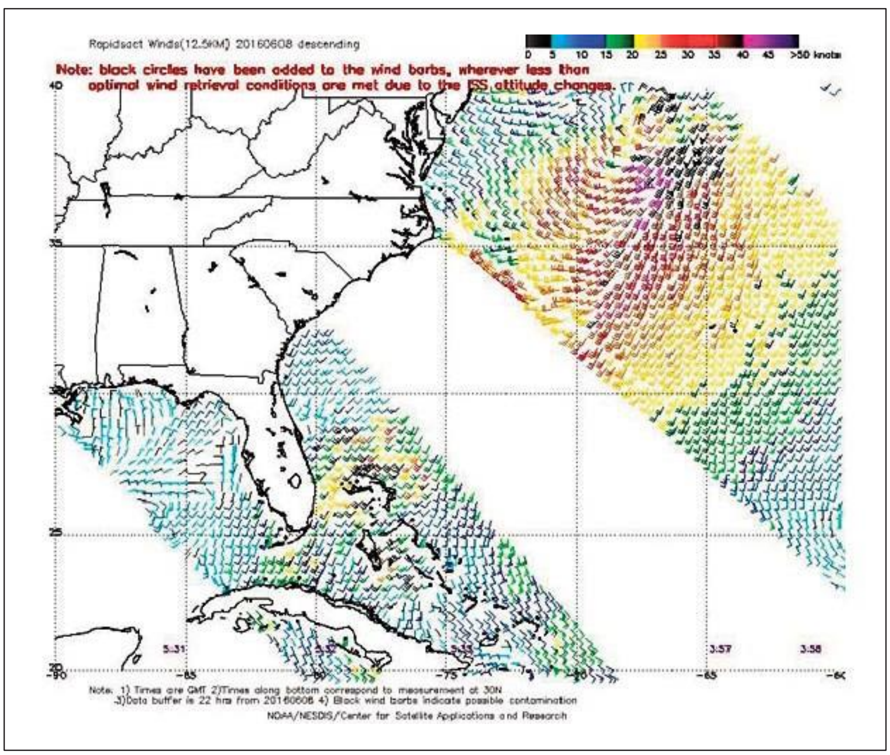


Figure 2. 12.5-km Rapidscat image of satellite-sensed winds around the south semicircle of the storm (Post-tropical Cyclone Colin) shown in the second part of Figure 1. Rapidscat is a QuikSCAT-type scatterometer aboard the International Space Station that was operational at that time.
Satellite overpass times at 30N appear near the bottom of the image. Portions of two passes are shown, with the eastern pass valid at 0357 UTC June 8, 2016, or about 8 hours prior to the valid time of the second part of Figure 1. A color scale for the wind barbs appears at the top of the image.
Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

The top winds of the cyclone diminished to gale force late on the 8th and then as the system moved out over the North Atlantic over the next 4 days, it developed a lowest-central pressure of 981 hPa near 57N 33W at 1800 UTC on the 11th and, on the following day, briefly redeveloped storm-force winds while turning toward the east. The post-tropical low then turned southeast on the 13th and dissipated over France by the 16th.

Tropical Depression Eight:

Tropical Depression Eight formed near 31N 70W at 1200 UTC August 28th and moved northwest, approaching the North Carolina coast on the night of August 30th (**Figure 3**) before turning toward the northeast while maintaining an intensity of 30 kts for sustained winds. The cyclone weakened to a post-tropical low near 38N 69W the following night before merging with a front on September 1st.

Hurricane Gaston:

Hurricane Gaston intensified into a major hurricane while crossing 31N 55W into OPC's high-seas area at 0000 UTC August 29th with maximum sustained winds of 100 kts with gusts to 120 kts, the lower end of Category 3 on the Saffir-Simpson wind scale (Reference 3). After the system weakened to 85 kts for sustained winds near 32N 54W by 0600 UTC on the 30th, Gaston re-intensified to a second peak in intensity of 105 kts at 0000 UTC on the 31st (**Figure 3**). A weakening trend set in the following day as the cyclone moved northeast, with Gaston becoming a tropical storm near 39N 33W at 1200 UTC September 2nd and a post-tropical low just north of the Azores the following day.

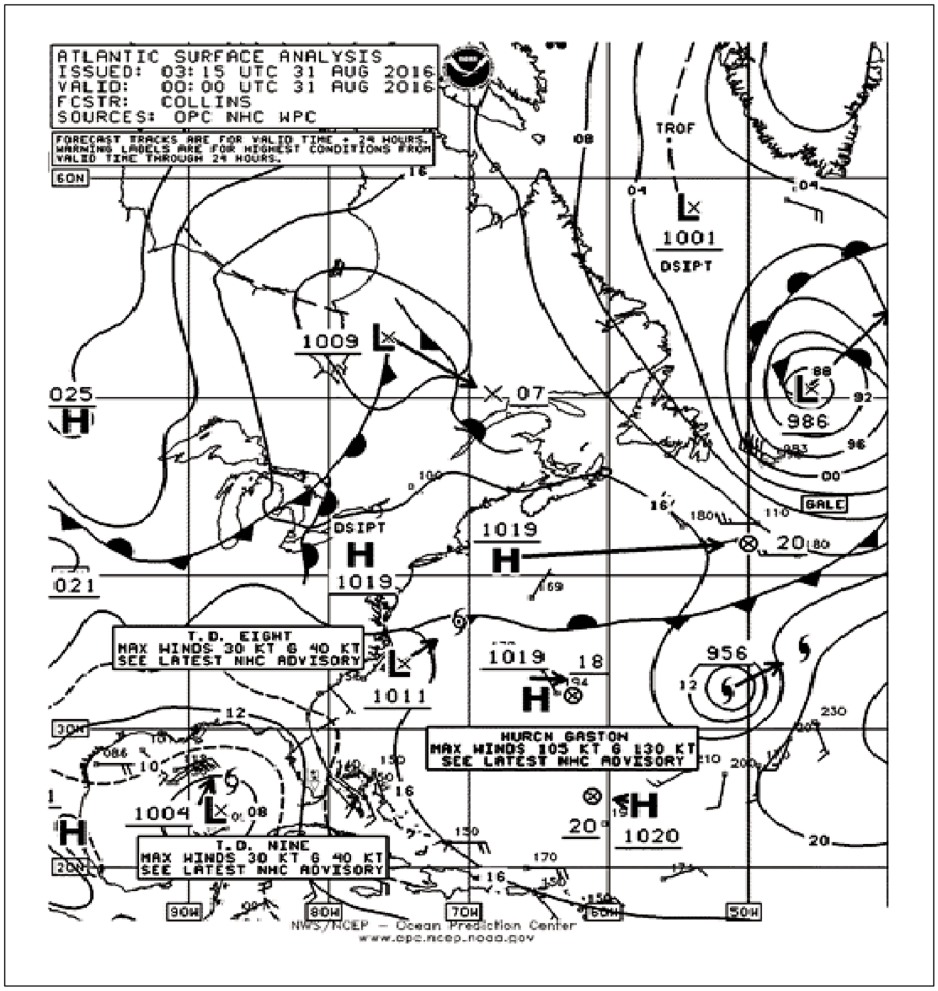


Figure 3. OPC North Atlantic Surface Analysis chart (Part 2) valid 0000 UTC August 31, 2016. Note 24-hour forecast tracks are shown with the forecast central pressures given as the last two whole digits in millibars (hPa), except for tropical cyclones for which just a tropical symbol is given. Tropical cyclone symbols are accompanied by text boxes with intensity information.

Other Significant Events of the Period

Northeastern Atlantic Storm, May 1–2:

This cyclone developed quickly as a complex of lows southeast of Greenland consolidated into a storm-force low near Iceland by 0600 UTC May 2nd (**Figure 4**). The central pressure fell 30 hPa in the 24-hour period covered by **Figure 4**, based on the secondary low where the occluded, cold, and warm fronts meet, becoming the main low and absorbing the other lows. This rate of intensification exceeds the 24 hPa needed at 60N for a “bomb” (Sanders and Gyakum, 1980). An ASCAT METOP-A) scatterometer pass from 2237 UTC May 1st showed an area of west winds up to 45 kts south of the cyclone’s center. Given a small low bias of ASCAT winds, there is some support for actual winds of storm force. The cyclone then passed east of Iceland on May 2nd.

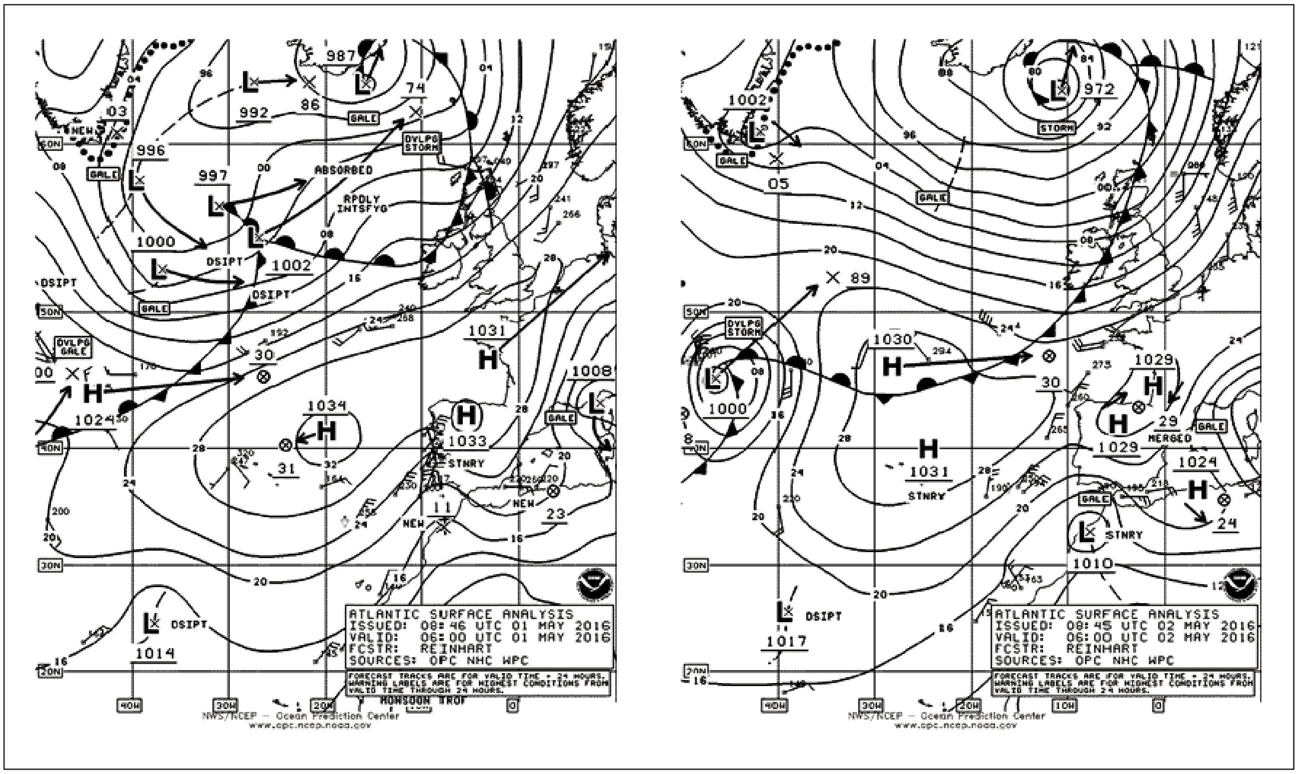


Figure 4. OPC North Atlantic Surface Analysis charts (Part 1 – east) valid 0600 UTC May 1 and 2, 2016.

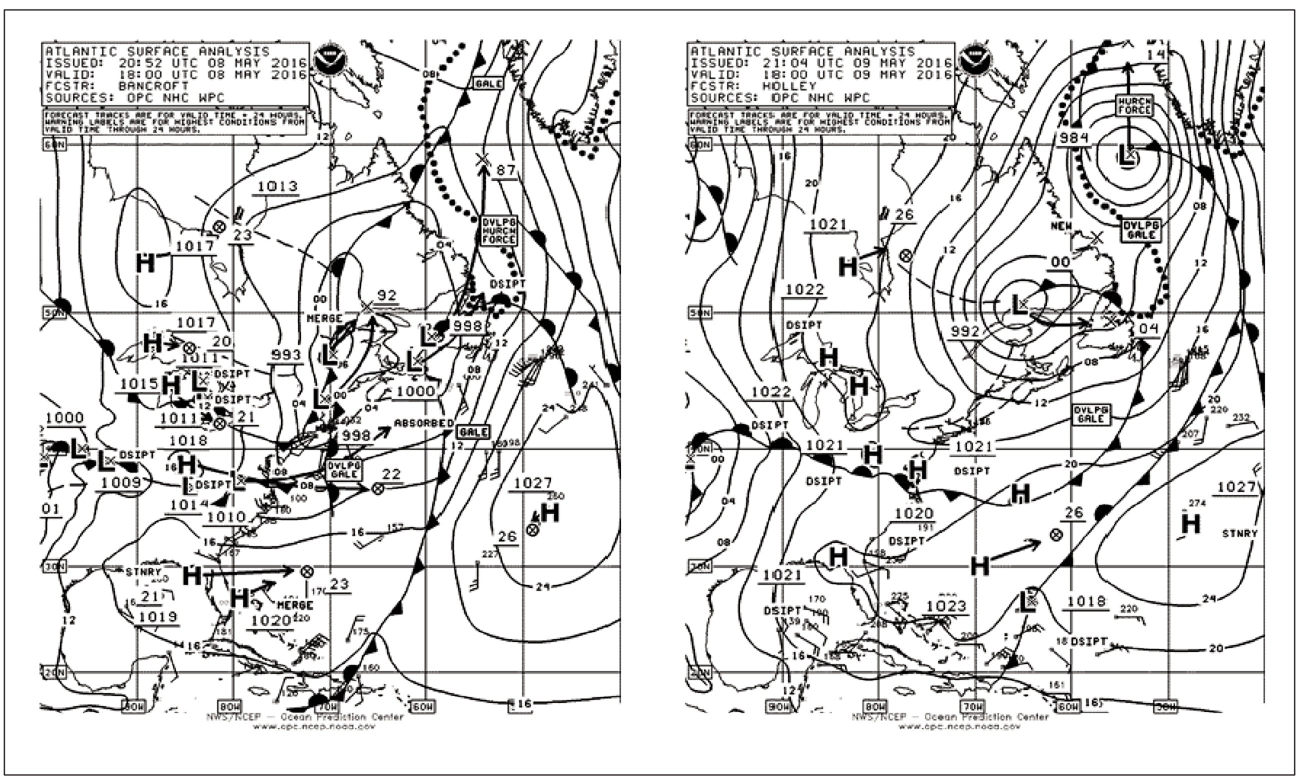


Figure 5. OPC North Atlantic Surface Analysis charts (Part 2) valid 1800 UTC May 8 and 9, 2016.

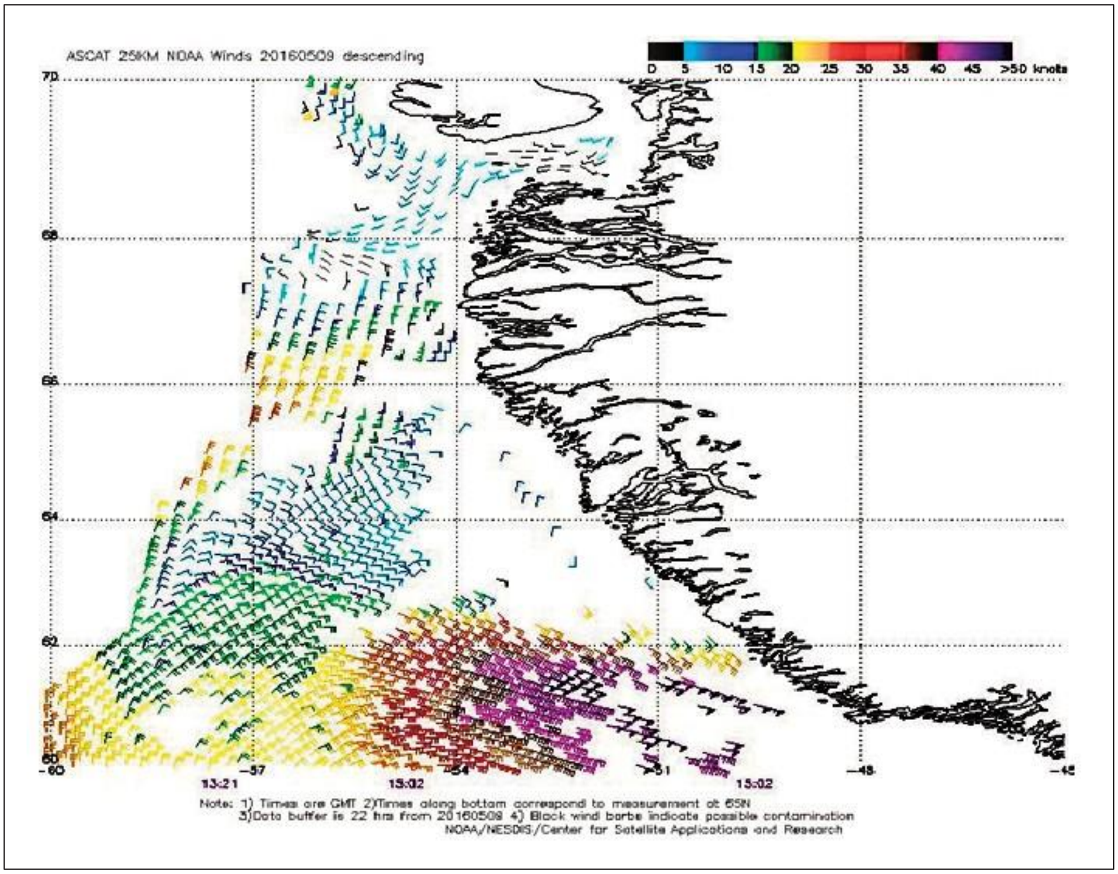


Figure 6. 25-km ASCAT METOP-A (European Advanced Scatterometer) image of satellite-sensed winds around the north side of the cyclone shown in the second part of Figure 5. The valid time of the pass is 1502 UTC May 9, 2016, or approximately 3 hours prior to the valid time of the second part of Figure 5. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

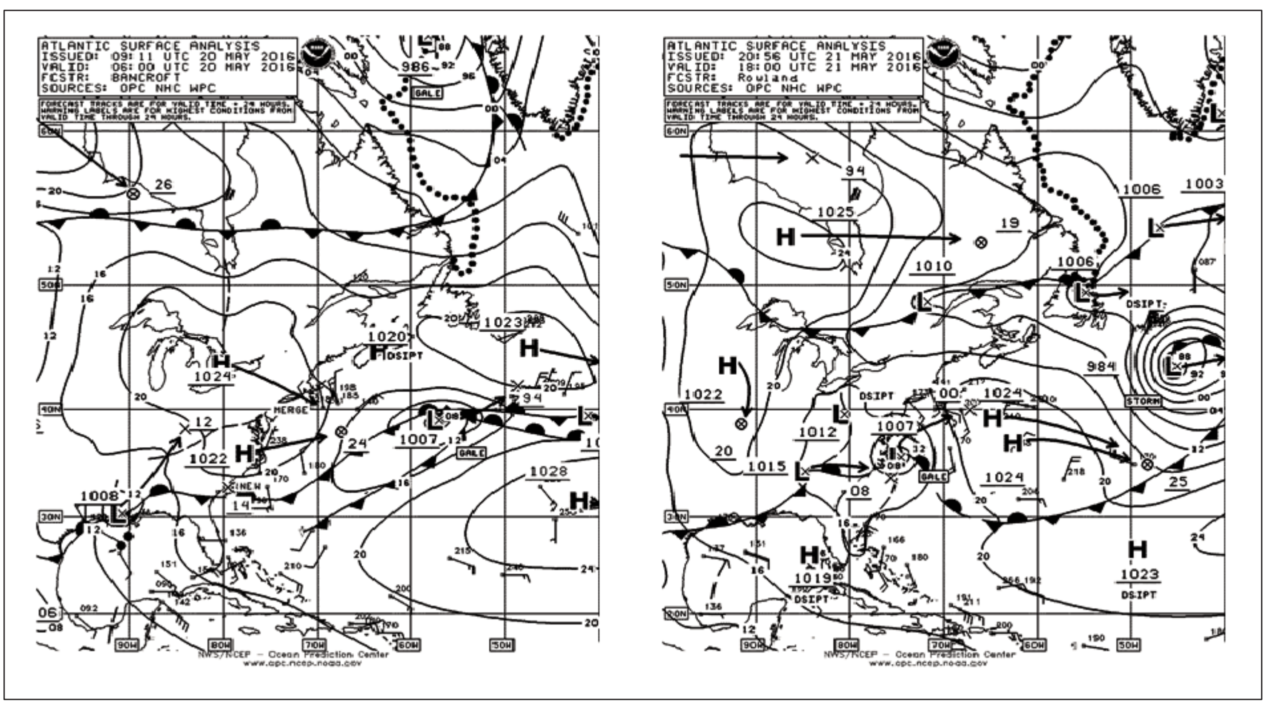


Figure 7. OPC North Atlantic Surface Analysis charts (Part 2) valid 0600 UTC May 20 and 1800 UTC May 21, 2016.

The Rapidscat image in **Figure 10** reveals winds of 50 to 60 kts on the west and northwest sides of the cyclone. The cyclone stalled near 43N 31W on the 31st with its winds weakening to gale force and reformed over the north-central waters on June 1st and 2nd, where it continued to weaken. Meanwhile a second cyclone moved east from the island of Newfoundland on June 1st and briefly developed storm-force winds late on the 3rd with the center passing near 44N 35W. The **TSINGTAO EXPRESS** (DDYL2) near 41N 41W reported northwest winds of 45 kts and 6.4-m seas (21 ft) at 0000 UTC on the 3rd. The **FEDERAL YUKINA** (VRHN7) encountered seas of 7.6 m (25 ft) along with 35-kt west winds near 44N 36W at 1200 UTC on the 3rd. The cyclone then developed a lowest central pressure of 988 hPa near 44N 26W at 1800 UTC on the 4th, but its winds were down to gale force. The system slowly weakened as it drifted northeast toward the British Isles on the 5th and the 6th.

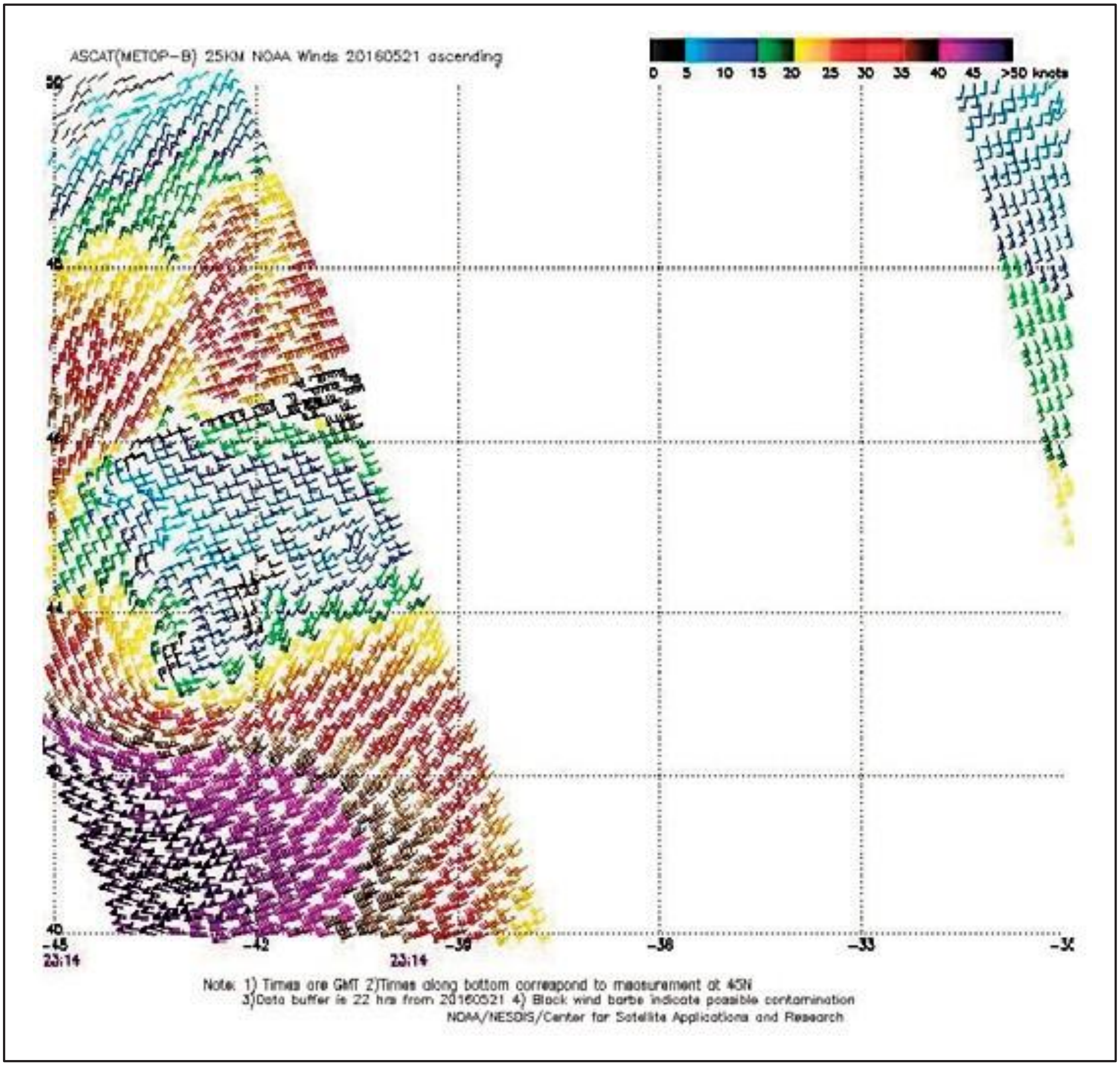


Figure 8. 25-km ASCAT (METOP-B) image of satellite-sensed winds around the storm shown in the second part of Figure 7. The valid time of the pass is 2314 UTC May 21, 2016, or approximately 5.25 hours later than the valid time of the second part of Figure 7. The southern tip of Greenland appears near the northwest corner of the image. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

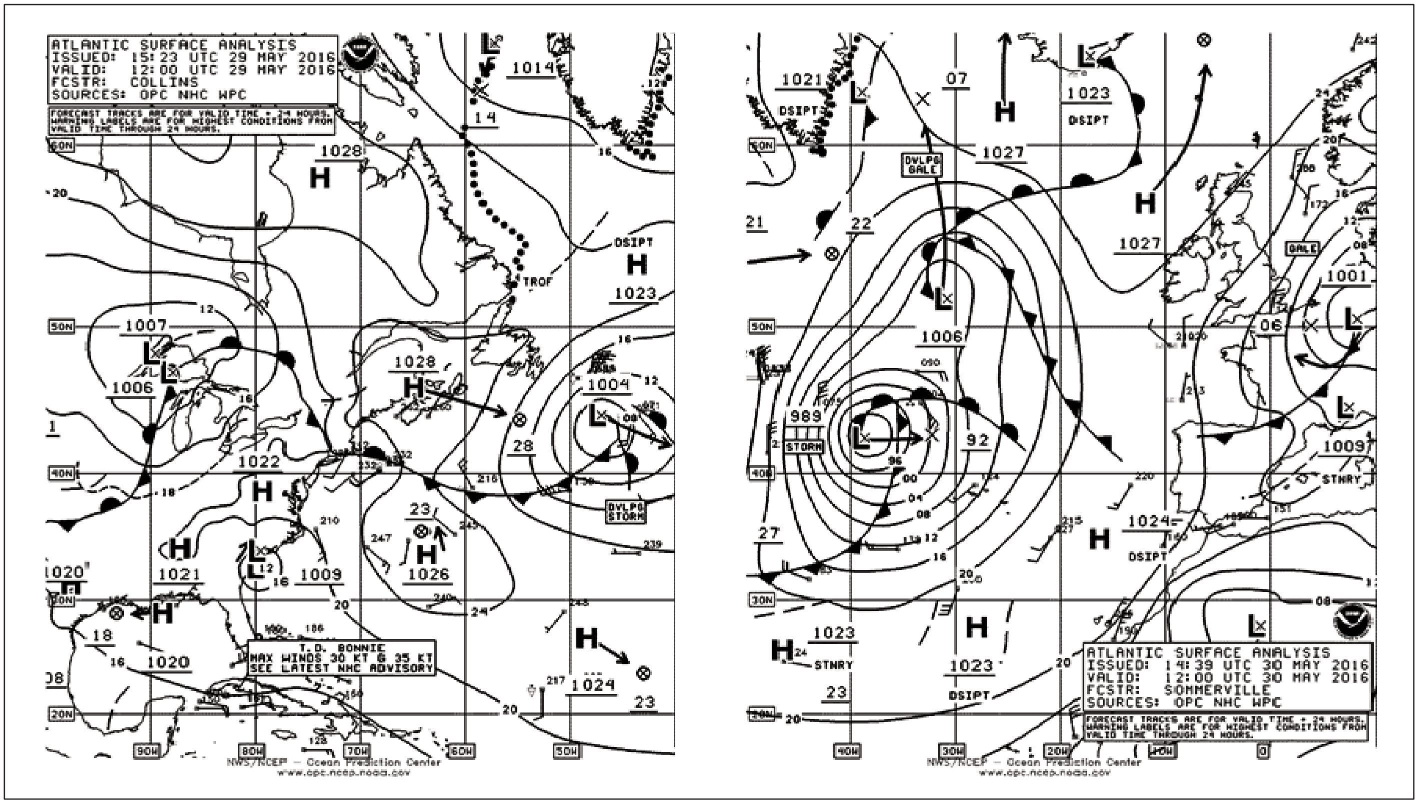


Figure 9. OPC North Atlantic Surface Analysis charts valid 1200 UTC May 29 (Part 2) and 1200 UTC May 30, 2016 (Part 1).

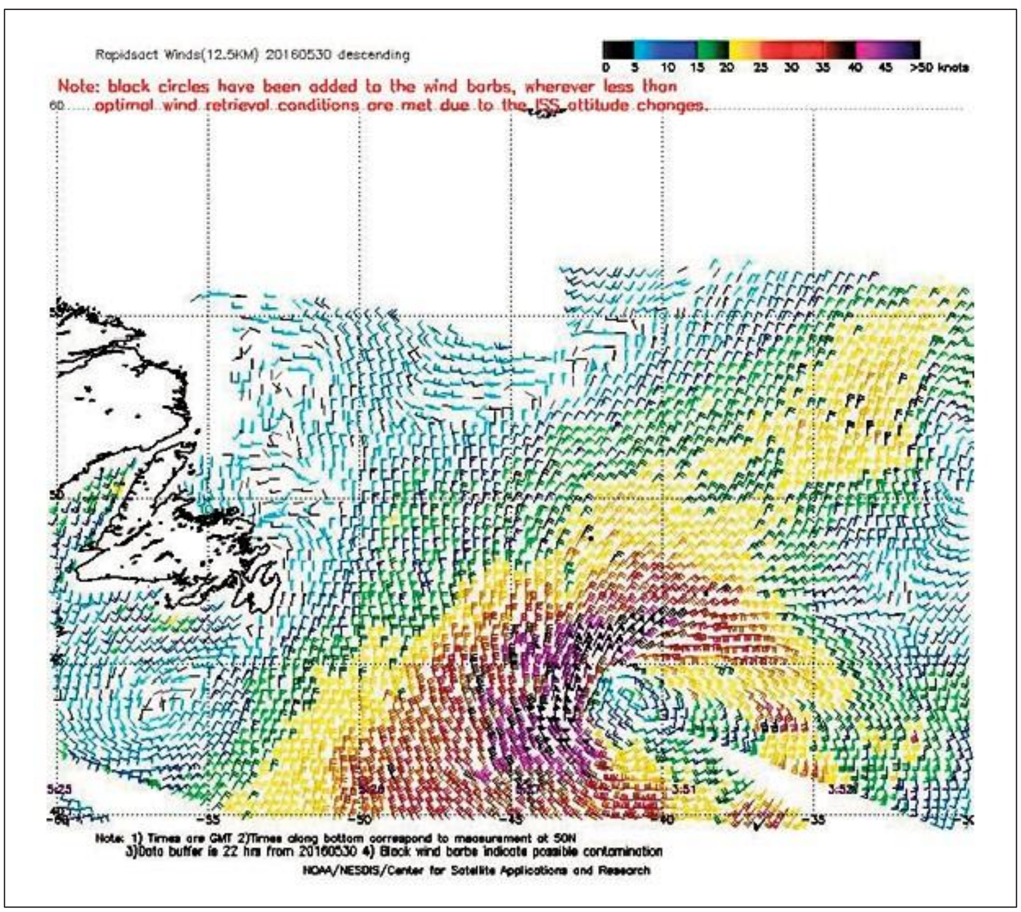


Figure 10. A 12.5-km Rapidscat image of satellite-sensed winds around the storm southeast of the island of Newfoundland shown in the second part of Figure 9. Satellite overpass times at 50N appear near the bottom of the image. The valid time of the pass near the center of the image is approximately 0527 UTC May 30, or about 6.5 hours prior to the valid time of the second part of Figure 9. A color scale for the wind barbs appears at the top of the image. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

North Atlantic Storm Greenland area, June 18–20:

A cyclone moved north into the east Greenland waters on June 18th with a lowest-central pressure of 985 hPa and storm-force winds, after forming to the south near 50N 42W early on the 17th. An ASCAT (METOP-B) pass from 2340 UTC on the 18th revealed a swath of north-to-northeast winds of 30 to 45 kts to the west and north of the center, highest on the west side. The **ARNI FRIDRIKSSON** (TFNA) reported east winds of 35 kts near 64N 26W at 1800 UTC on the 18th. The cyclone remained nearly stationary, and its winds weakened to below gale force late on the 19th.

North Atlantic Storm, July 6–8:

An unseasonably intense cyclone with hurricane force winds formed in the central North Atlantic from the merging of two lows south of Newfoundland over a 24-hour period as depicted in **Figure 11**. Its lowest central pressure of 975 hPa was the third lowest among non-tropical systems. The Rapidscat image in **Figure 12** reveals winds to 70 kts on the south side of the cyclone. Similar winds seen on the north side may be contaminated by rain and unreliable. The **ANTWERPEN EXPRESS** (DGAF) near 40N 46W encountered southwest winds of 50 kts and 9.0-m seas (30 ft) at 0000 UTC on the 7th. Storm-force and hurricane-force winds lasted from late on the 6th to the night of the 7th. Gradual weakening followed as the system moved northeast; with the cyclone becoming absorbed north of Scotland early on the 11th.

North Atlantic Storm, August 4–8:

An area of low pressure with multiple centers moved off the U.S. mid-Atlantic coast on August 2nd and tracked east-northeast with gradual strengthening over the next 3 days. Like some other events of the period, it developed storm-force winds over the central waters (**Figure 13**) before moving off to the northeast. The second part of **Figure 13** shows the cyclone near maximum intensity in terms of central pressure. The ASCAT image from the central waters (**Figure 14**) where winds were strongest reveals wind retrievals of up to 50 kts in the south semicircle of the cyclone.

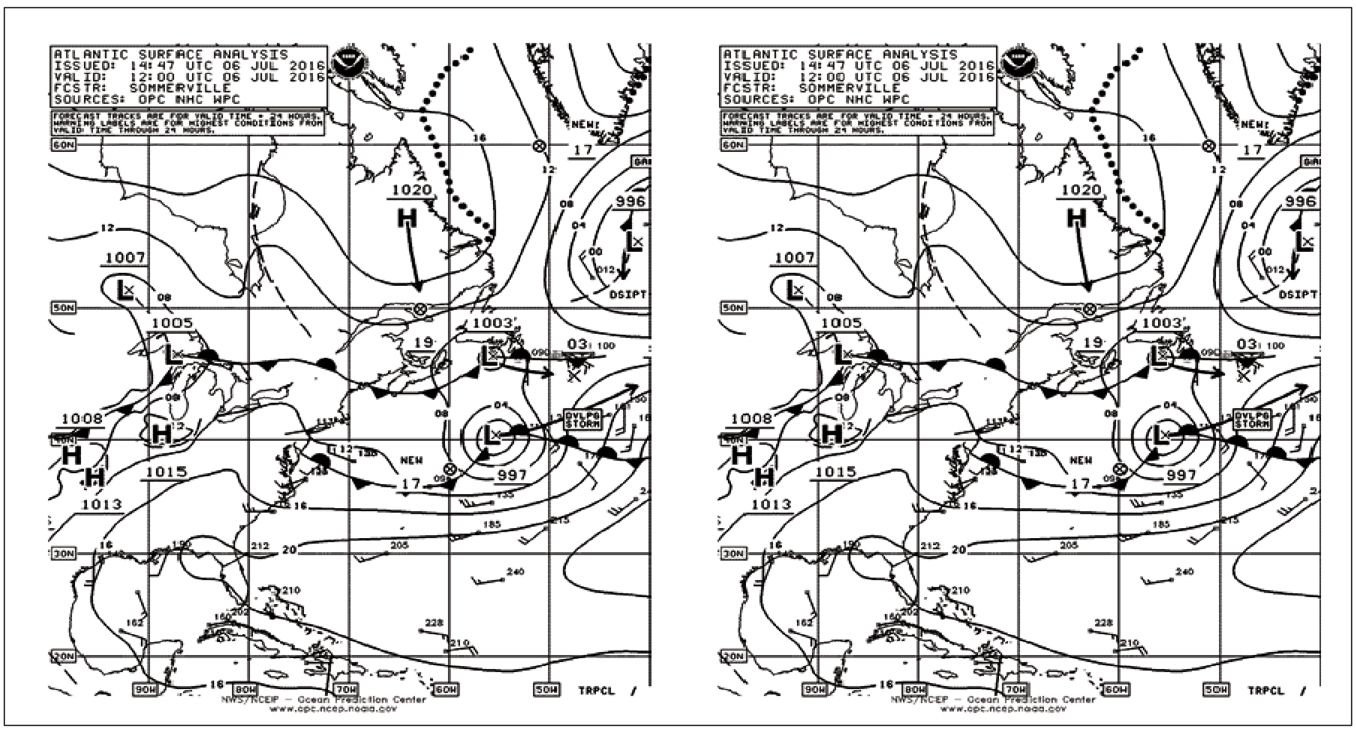
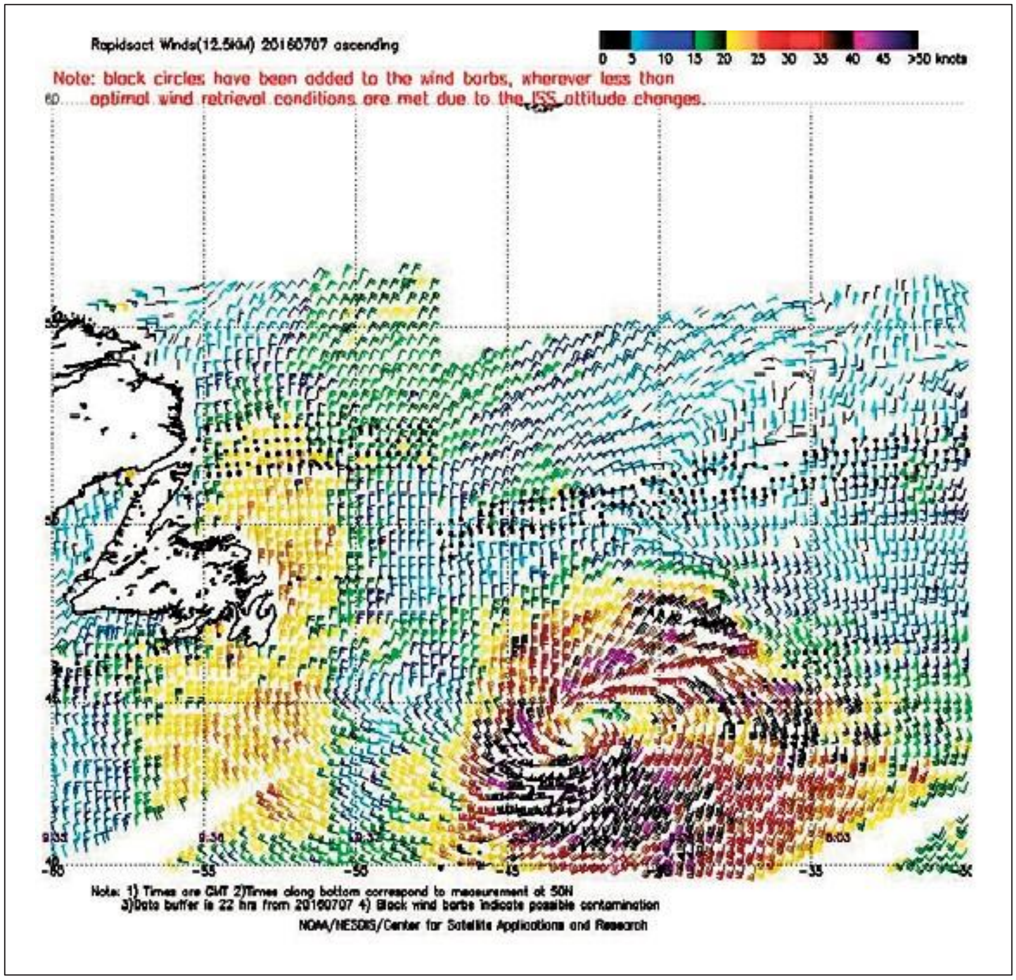


Figure 11. OPC North Atlantic Surface Analysis charts valid 1200 UTC July 6 (Part 2) and 1200 UTC July 7, 2016 (Part 1).

Figure 12. A 12.5-km Rapidscat image of satellite-sensed winds around the storm southeast of the island of Newfoundland shown in the second part of Figure 11. Satellite overpass times at 50N appear near the bottom of the image. The valid time of the pass containing the strongest wind retrievals is 0802 UTC July 7, or about 4 hours prior to the valid time of the second part of Figure 11. A color scale for the wind barbs appears at the top of the image. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.



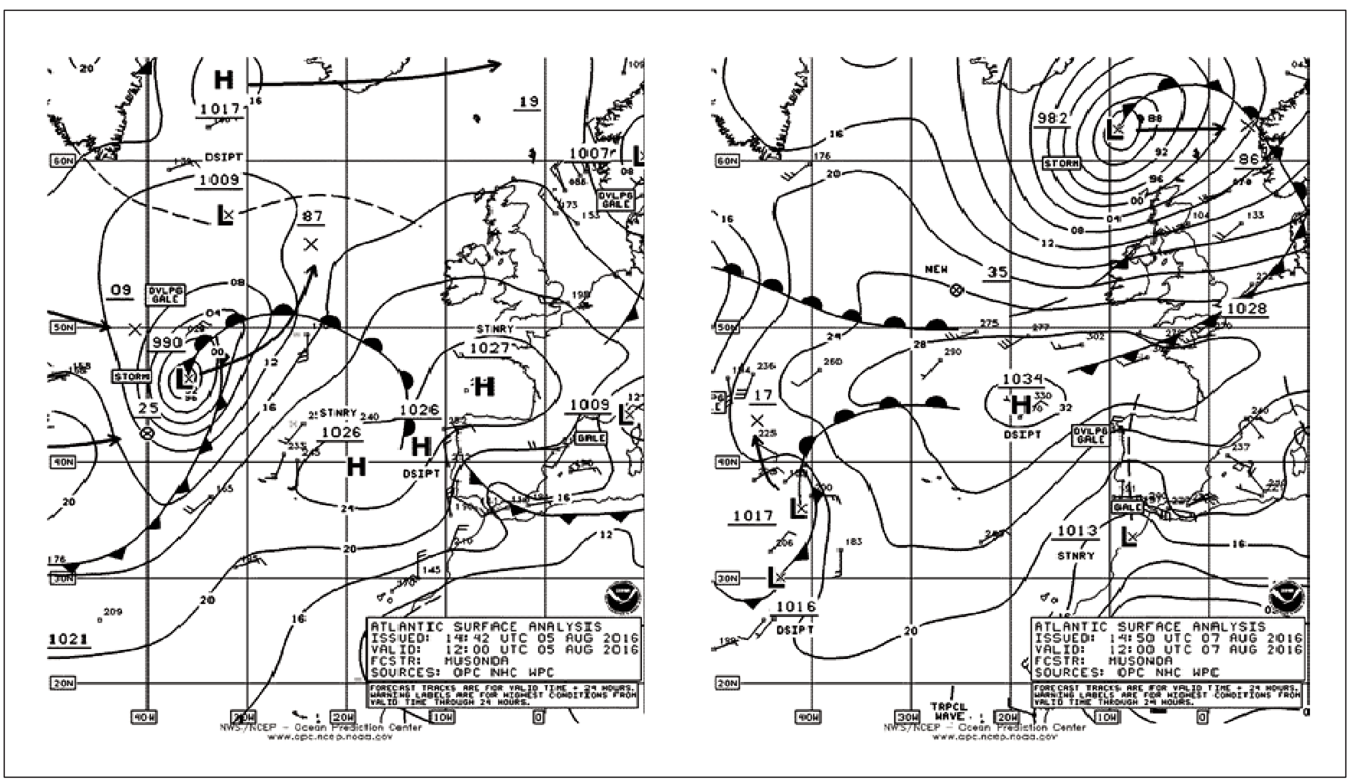


Figure 13. OPC North Atlantic Surface Analysis charts (Part 1) valid 1200 UTC August 5 and 7, 2016.

The buoy 62095 (53.0N 15.8W) reported west winds of 41 kts with gusts to 55 kts at 1900 UTC on the 6th and highest seas 7.0 m (23 ft) 3 hours later. Buoy 64045 (59.1N 11.7W) reported northwest winds of 36 kts with gusts to 59 kts at 2000 UTC on the 7th, and highest seas 7.0 m (23 ft) 1 hour earlier. Another buoy, 64046 (60.5N 4.2W), reported seas to 9.0 m (30 ft) at 2000 UTC on the 7th. The cyclone subsequently tracked east and weakened inland over Norway on August 8th.

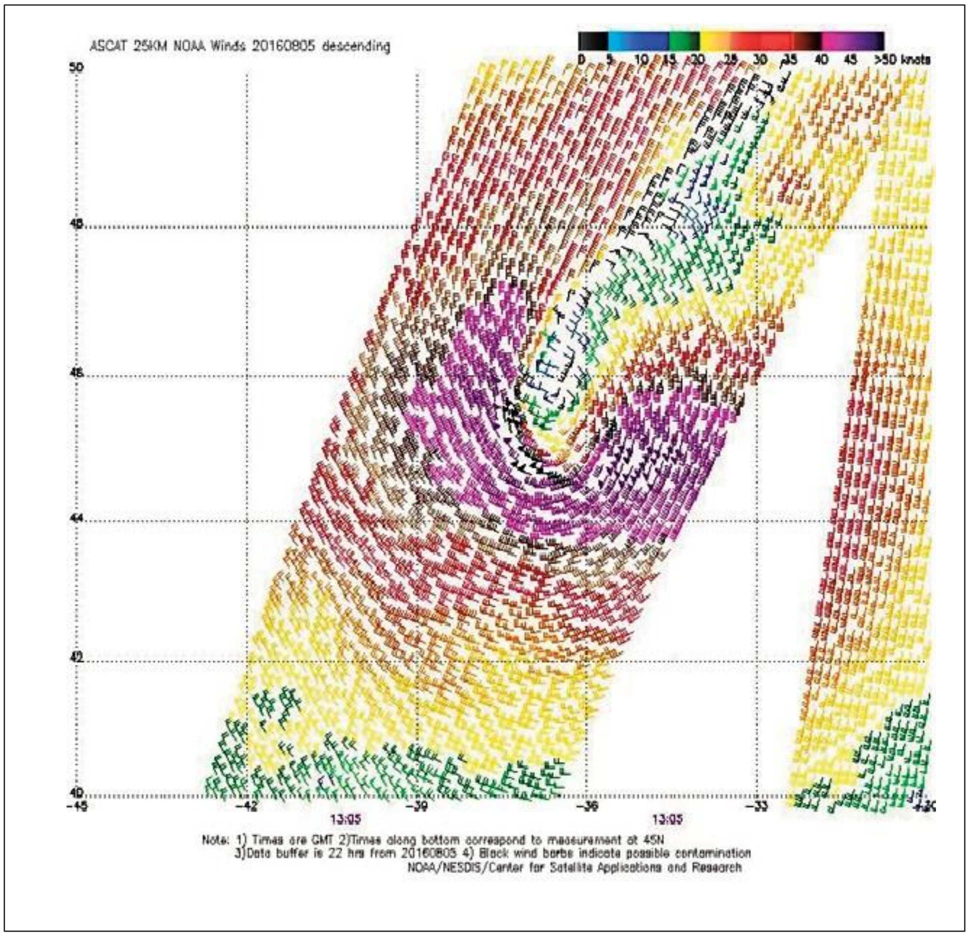


Figure 14. A 25-km ASCAT (METOP-A) image of satellite-sensed winds around the storm shown in the first part of Figure 13. The valid time of the pass is 1305 UTC August 5, 2016, or approximately 1 hour later than the valid time of the first part of Figure 13. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

North Atlantic Storm, August 13–15:

A complex area of low pressure south of Greenland and another low center in the Labrador Sea consolidated over a 24-hour period to form a storm-force low over the northern waters (**Figure 15**). Its lowest central pressure of 970 hPa made it the deepest of the period among non-tropical systems. The scatterometer image in **Figure 16** returned a swath of winds to 50 kts around the west side where the winds were strongest. There is some indication of enhancement near the southern tip of Greenland. Due to low bias of ASCAT winds, actual winds were likely at least 55 kts. Gradual weakening occurred over the following 4 days as the cyclone became stationary in the east Greenland waters, with winds dropping to below gale force by the 18th.

Eastern North Atlantic Storm August 17-19:

One other intense cyclone formed in the last half of August with central pressures below 980 hPa and was accompanied by winds approaching hurricane force (**Figures 17** and **18**). It originated as a new low near Nova Scotia at 0000 UTC on the 15th and tracked east at first with little development, not developing gales until it passed east of 30W on the 17th. The central pressure dropped 23 hPa in the 24-hour period ending at 0000 UTC on the 19th, when the center developed a lowest pressure of 977 hPa. Rapidscat imagery in **Figure 18** reveals a compact circulation with winds to 60 kts. The **CAP HARVEY** (A8VE2) near 51N 18W reported north winds of 45 kts and 8.5-m seas (28 ft) at 2100 UTC on the 18th. Buoy 62029 (48.8N 12.4W) reported southwest winds of 41 kts with gusts to 56 kts and 8.2-m seas (27 ft) at 0400 UTC on the 19th. The cyclone subsequently weakened late on the 19th near the British Isles and dissipated over the North Sea on the 21st.

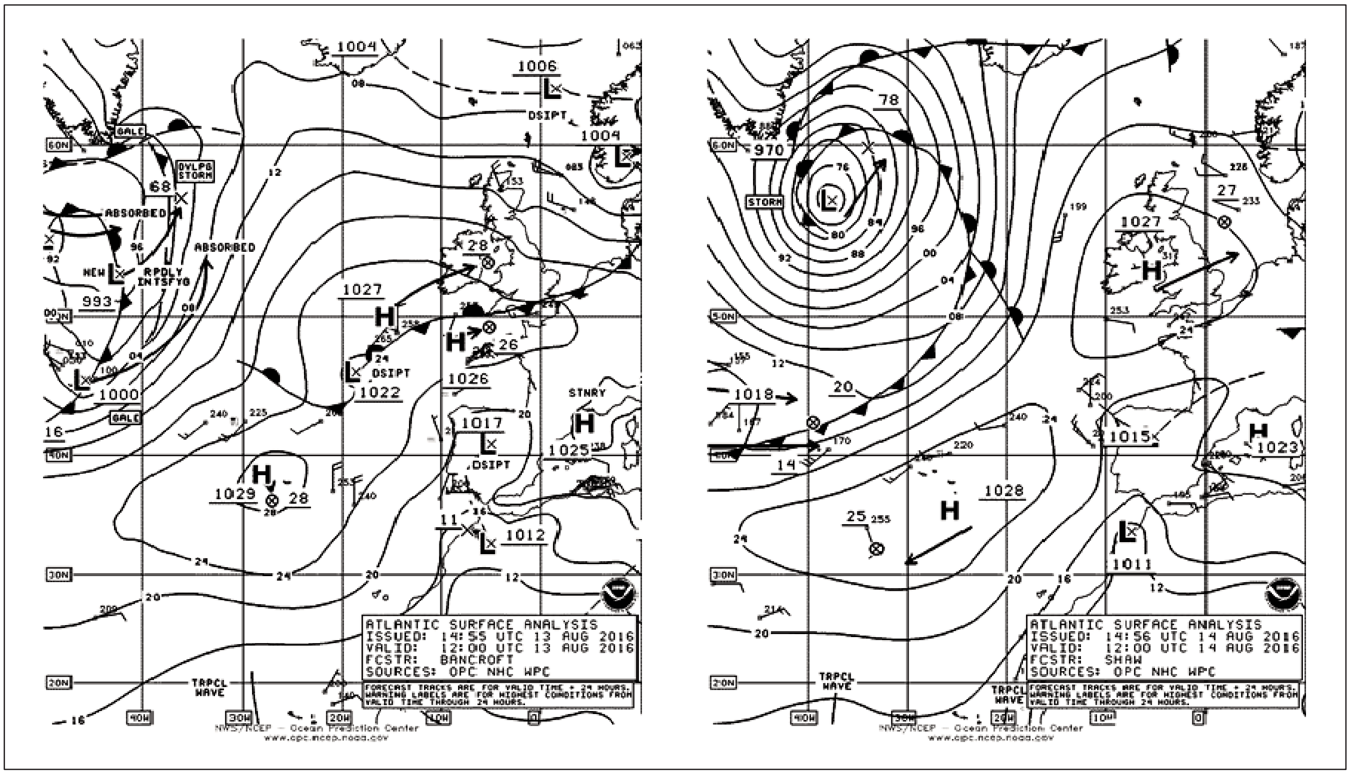
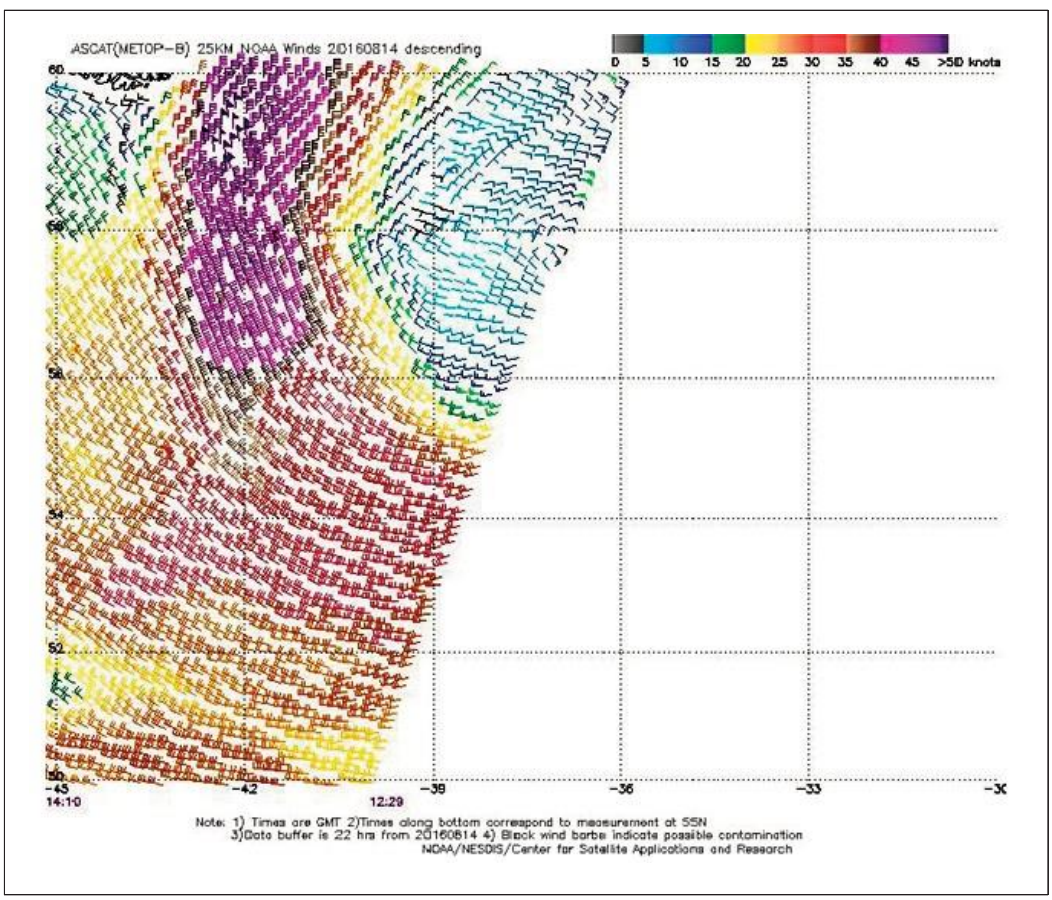


Figure 15. OPC North Atlantic Surface Analysis charts (Part 1) valid 1200 UTC August 13 and 14, 2016.

Figure 16. A 25-km ASCAT (METOP-B) image of satellite-sensed winds around the west semicircle of the cyclone shown in the second part of Figure 15. Portions of two satellite overpasses are shown (1229 UTC and 1410 UTC August 14, 2016). The valid time of the later pass containing the strongest wind retrievals is approximately 2 hours later than the valid time of the second part of Figure 15. The southern tip of Greenland appears near the northwest corner of the image. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.



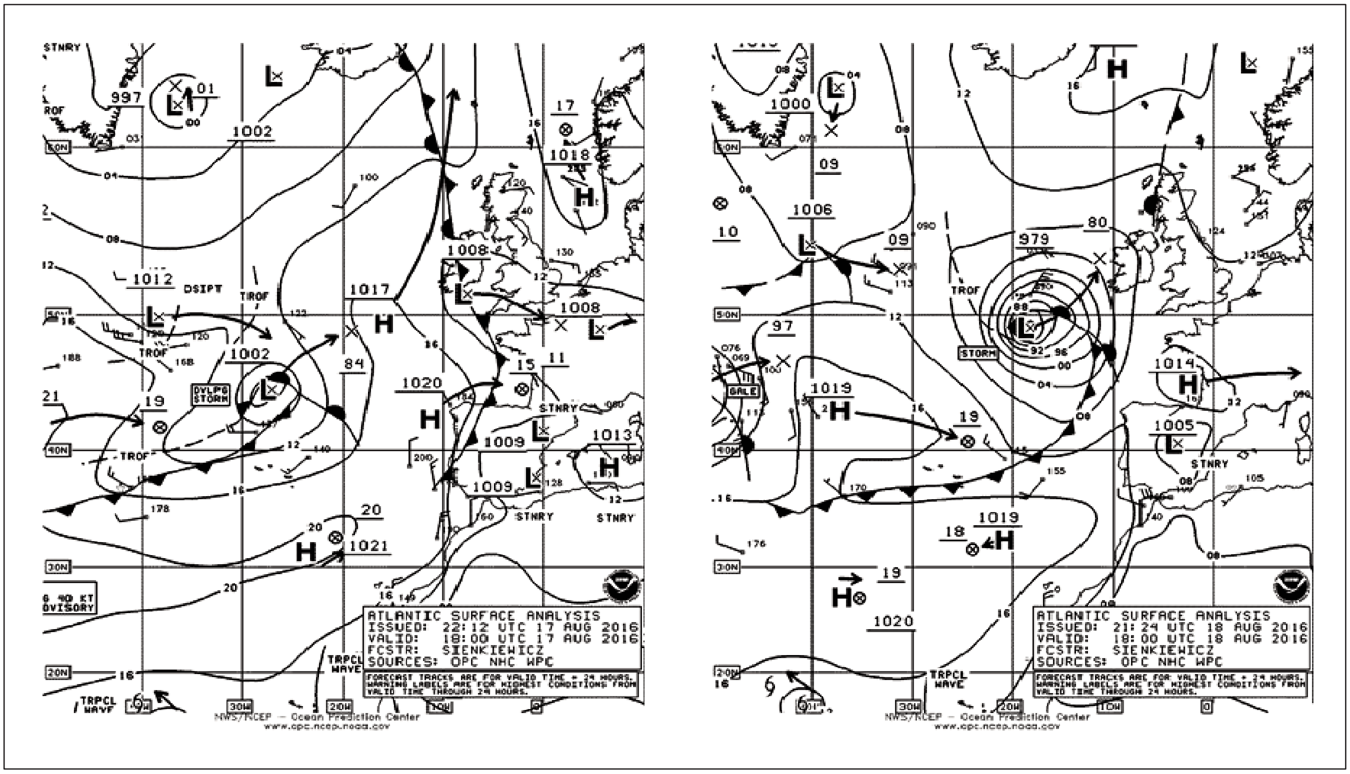


Figure 17. OPC North Atlantic Surface Analysis charts (Part 1) valid 1800 UTC August 17 and 18, 2016.

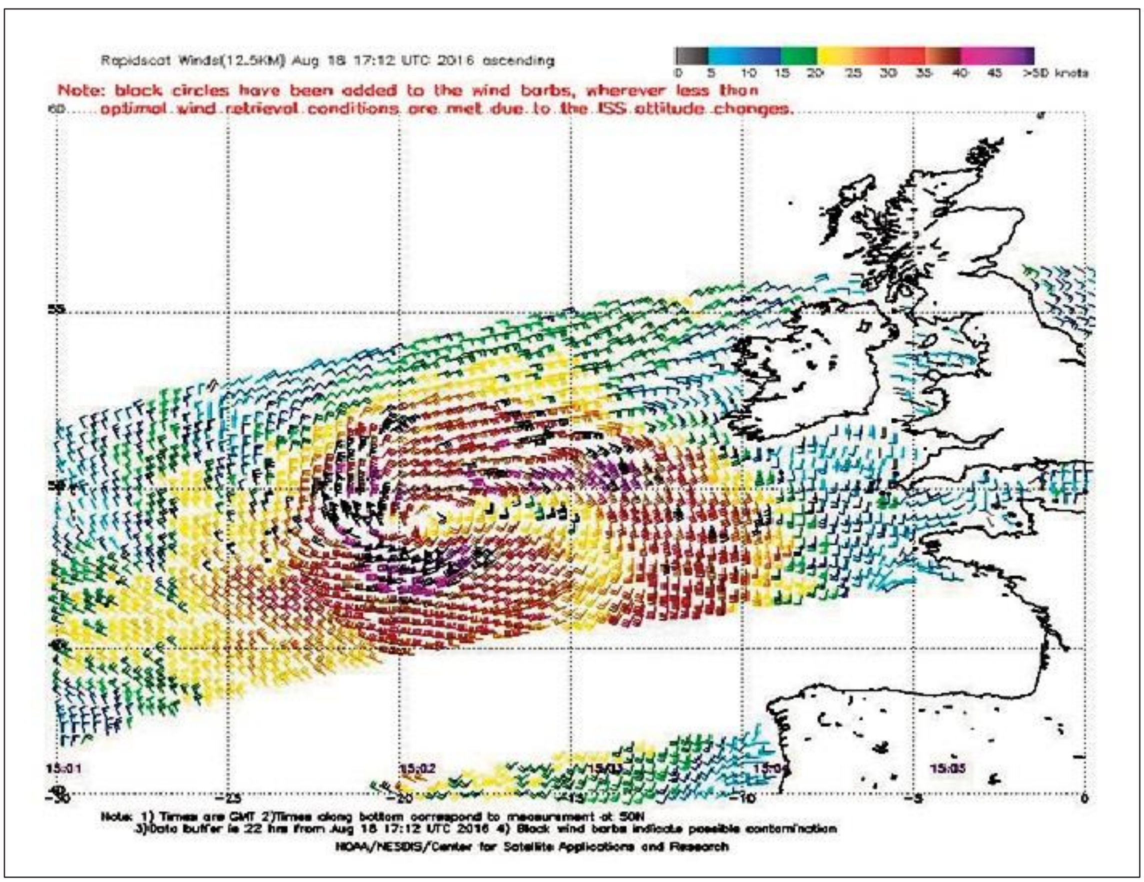


Figure 18. A 12.5-km Rapidscat image of satellite-sensed winds around the storm off the coast of western Europe shown in the second part of Figure 17. Satellite overpass times at 50N appear near the bottom of the image. The valid time of the pass across the center of the image is 1502 UTC August 18, 2016, or about 3 hours prior to the valid time of the second part of Figure 17. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

Marine Weather Review – North Pacific Area

Late April–August 2016

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Introduction

After a very active winter with a record number of hurricane force lows (**Reference 5**), the weather pattern over the North Pacific became much less active in May and especially in June and July. A significant event from the end of April, not included in the previous issue, is included in this article and was the strongest of the non-tropical systems, developing winds approaching hurricane force. In May, there were only two cyclones producing storm-force winds, and in June, the only storm-force low occurred in the Sea of Japan, outside the main North Pacific basin. In July, there was a brief period of storm-force easterly winds late in the month when a low-pressure trough and weak low formed south of a strong high-pressure area, but that month is normally the least-active month. August became more active with late-summer activity, including former tropical systems entering the westerlies.

Two tropical cyclones, Nepartak in early July and Lionrock late in August, intensified into typhoons well south of Japan with the former passing west of OPC's oceanic analysis area and the latter re-appearing on OPC's oceanic analysis charts. Six other tropical cyclones affected the waters east and south of Japan in late July and in August, all of them tropical storms. None of them redeveloped into intense post-tropical cyclones, but three of them (Omais, Chanthu and Mundulle) in August became strong enough as post-tropical lows to develop storm-force winds.

Tropical Activity

Typhoon Nepartak:

The only typhoon of the period appearing on OPC's oceanic analysis charts originated as a non-tropical low near 9N 144E at 1800 UTC July 2 and moved northwest, developing into a tropical storm with 35-kt sustained winds 6 hours later and then continuing gradual strengthening. **PAPUAN CHIEF** (VROO7) near 5N 135E reported west winds of 40 kts at 1800 UTC July 4 as the strengthening system passed to the north. The cyclone became Typhoon Nepartak near 15N 136E at 0000 UTC on the 5th with maximum sustained winds of 65 kts with gusts to 80 kts, and then strengthened more rapidly with 80 kts sustained winds 6 hours later while passing west of 135W. A vessel reporting with the call sign **SHIP** (19N 136E) encountered east winds of 35 kts and 5.8 m seas (19 ft) at 1200 UTC on the 5th.

Tropical Storm Lupit:

A weak low formed at the end of a stationary front near 24N 146E at 1800 UTC July 21, moved northeast over the next 36 hours, and became Tropical Storm 04W near 28N 155E 6 hours later with 35-kt sustained winds. It was named Lupit at 1800 UTC on the 23rd and then attained a maximum intensity of 40 kts for sustained winds while approaching OPC's western high-seas boundary of 160E late on the 23rd, before becoming a post-tropical gale near 35N 159E at 1200 UTC on the 24th. The remains of Lupit then moved northwest and dissipated near the central Kurile Islands early on the 26th.

Tropical Storm Omais:

Omais was the strongest of the tropical cyclones that did not reach typhoon strength. It originated as a non-tropical low near 20N 149E at 0000 UTC August 4th and moved north, becoming a strengthening tropical storm 6 hours later. Omais developed a maximum intensity of 60 kts for sustained winds near 25N 148E at 0600 UTC on the 6th and began weakening the following day, leading to extratropical transition late on the 8th, (**Figure 1**). Post-tropical Omais briefly developed storm force winds late on the 8th before re-intensifying near the Kamchatka Peninsula late on the 10th (**Figure 1**), and developed a lowest central pressure of 982 hPa at 0600 UTC on the 11th in the western Bering Sea. The Rapidscat image in **Figure 2** reveals winds to 50 kts both north and south of the center. Buoy 46071 (51.1N 179.0E) reported highest seas of 7.5 m (25 ft) at 2100 UTC on the 11th. The cyclone then turned eastward across the Bering Sea as a gale from the 11th to the 13th and weakened in the northern Gulf of Alaska from the 14th to the 16th.

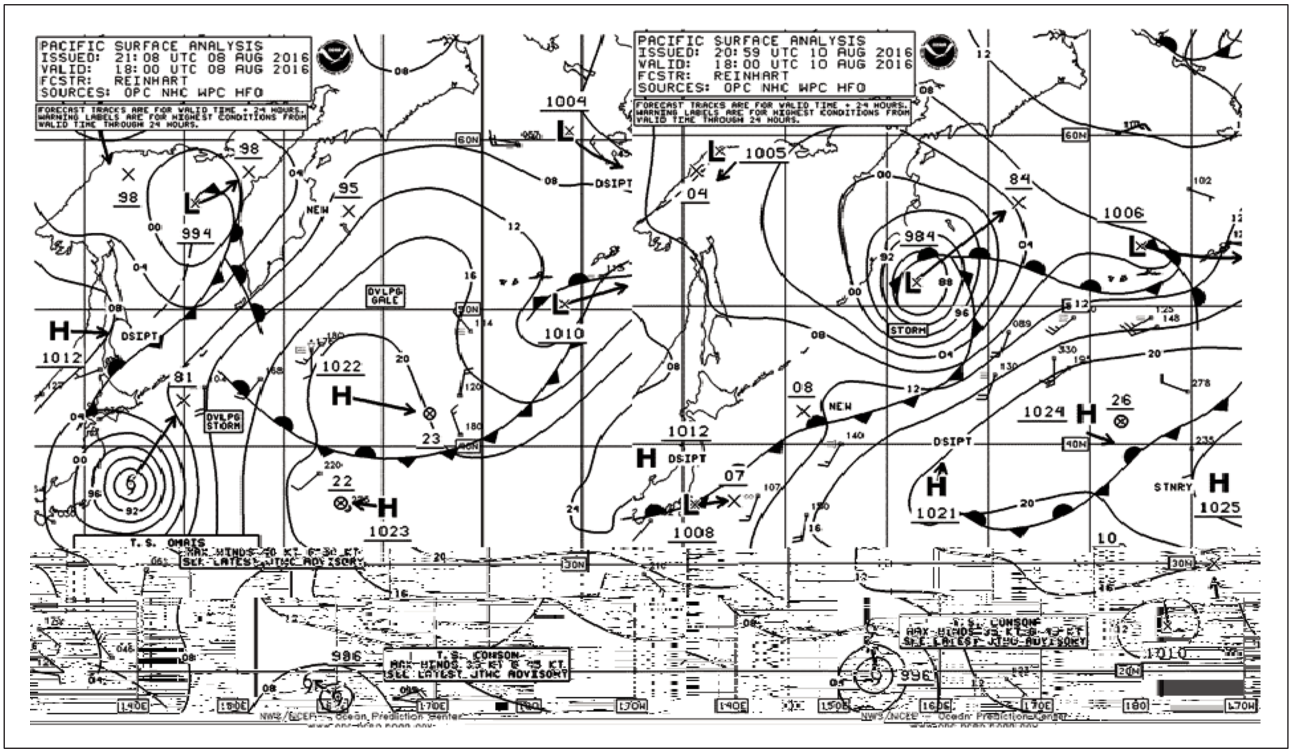
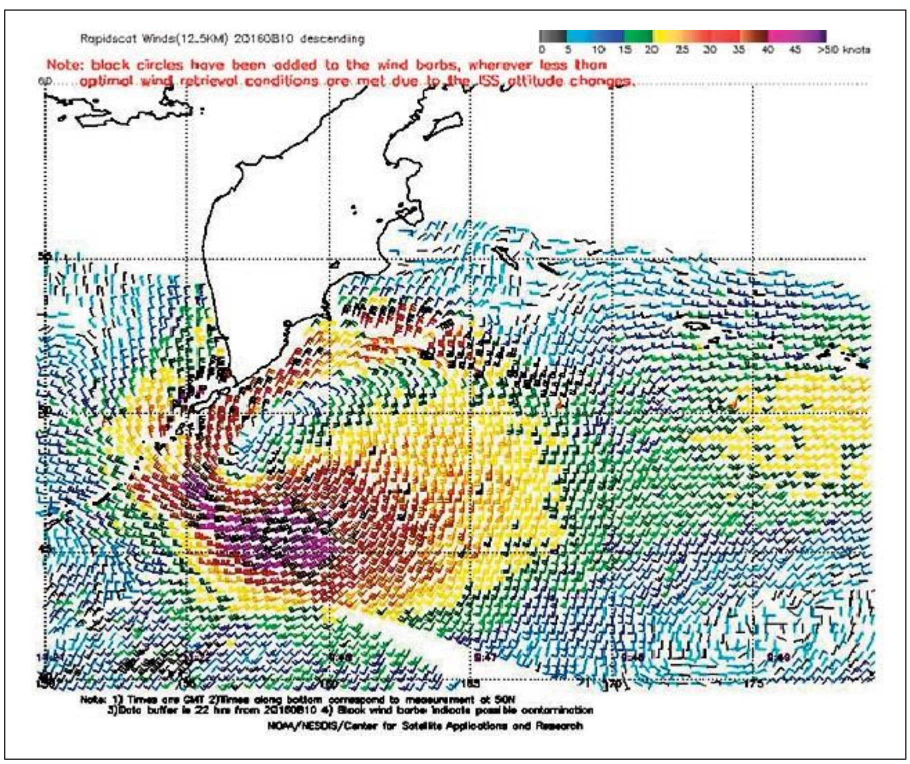


Figure 1. OPC North Pacific Surface Analysis charts (Part 2 – west) valid 1800 UTC August 8 and 10, 2016. The 24-hour forecast tracks are shown with the forecast central pressures given as the last two whole digits in millibars (hPa). Text boxes with intensity information accompany tropical cyclone symbols.

Figure 2. A 12.5-km Rapidscat image of satellite-sensed winds around the storm (Posttropical Cyclone Omais) shown in the second part of Figure 1. Rapidscat is a QuikSCAT-type scatterometer aboard the International Space Station that was operational at that time. Satellite overpass times at 50N appear near the bottom of the image. The overpass time of 1121 UTC August 10, 2016, near the left edge of the image is about 6.75 hours prior to the valid time of the second part of Figure 1. A color scale for the wind barbs appears at the top of the image. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.



Tropical Storm Conson:

Conson developed from a non-tropical low near 16N 159E early on August 8th and became a tropical storm at 1800 UTC that day (**Figure 1**). The cyclone moved northwest with fluctuating intensity and developed a maximum intensity of 50 kts for sustained winds near 34N 152E at 1800 UTC on the 13th before becoming a post-tropical, gale-force low the next day. The remains of Conson merged with a front west of the Kamchatka Peninsula late on the 15th and dissipated inland on the 16th.

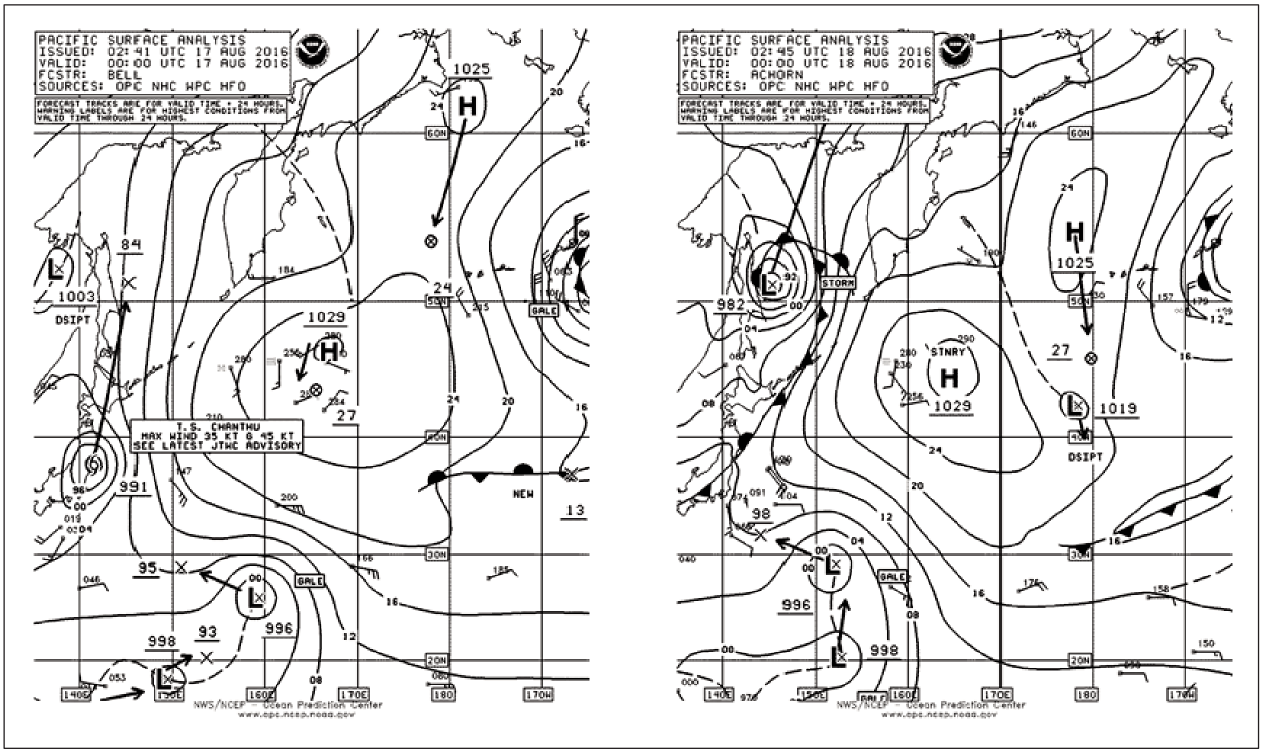


Figure 3. OPC North Pacific Surface Analysis charts (Part 2) valid 0000 UTC August 17 and 18, 2016.

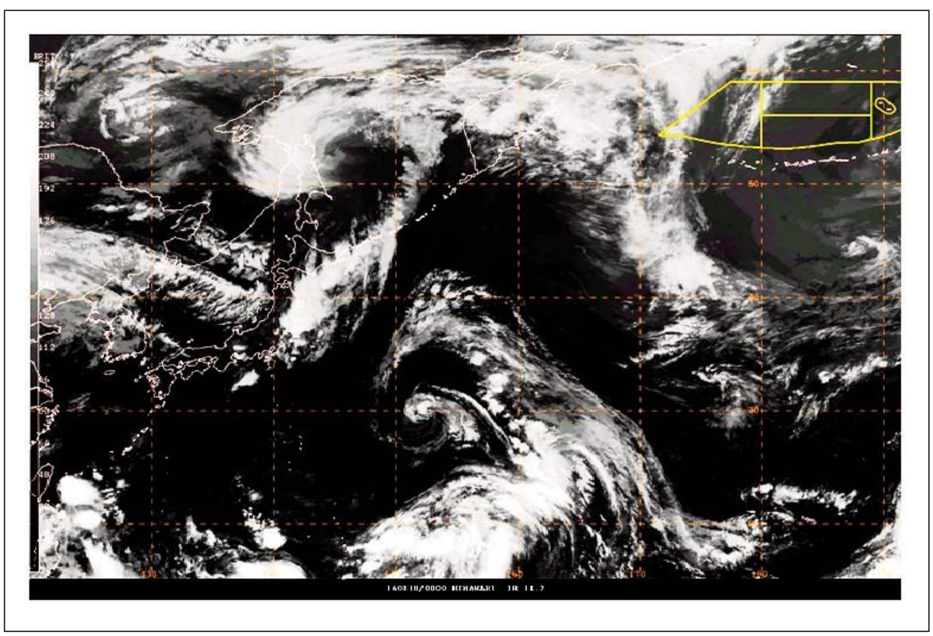


Figure 4. Himawari infrared satellite image valid 0000 UTC August 18, 2016, which is the valid time of the second part of Figure 3. The satellite senses temperature on a scale from black (warm) to white (cold) in this type of imagery.

Tropical Storm Chanthu:

Chanthu developed from a non-tropical low well south of Japan near 17N 139E at 0000 UTC on the 13th and strengthened to a tropical storm 18 hours later. The cyclone developed a maximum intensity of 45 kts for sustained winds at 1800 UTC on the 14th near 26N 145E. **Figure 3** depicts the extratropical transition of Chanthu. An infrared satellite image (**Figure 4**) reveals Post-tropical Chanthu as an occluded system as in an extratropical low, but with an enhanced comma head that hints at its tropical origin. A Rapidscat image from 0414 UTC on the 18th with limited coverage showed winds to 60 kts south of the cyclone center. The cyclone subsequently moved north and weakened inland over Russia the following day.

Tropical Storm Mindulle:

Figure 5 shows three tropical systems that formed at nearly the same time in mid-August. The first to develop was Mindulle, originating from a non-tropical low near 15N 141E early on August 17th. It became Tropical Depression 10W 6 hours later and then a tropical storm 1800 UTC on the 18th near 16N 143E.

The **TRANS FUTURE 7** (D5KF6) near 13N 147E reported southwest winds of 40 kts and 3.4-m seas (11 ft) at 1200 UTC on the 18th. The cyclone developed a maximum intensity of 55 kts for sustained winds from 0000 UTC on the 20th to 0600 UTC on the 21st, then fluctuated in intensity through the 22nd before becoming posttropical near northern Japan 0000 UTC on the 23rd. The second part of **Figure 5** shows Mindulle as a gale moving through the Sea of Okhotsk, as maximum intensity as an extratropical low.

Typhoon Lionrock:

Lionrock developed from a nontropical gale near 29N 152E late on August 17th and became a tropical storm 6 hours later. The cyclone remained a weak tropical storm while drifting to about 120 nmi south of Japan early on the 19th and then turning toward the southwest and passing just west of 135E late on the 20th. Lionrock began to strengthen while drifting south near 133W on the 22nd and 23rd, became a typhoon on the 23rd, and then a major typhoon with a maximum intensity of 115 kts for sustained winds near 24N 134E at 0600 UTC on the 27th.

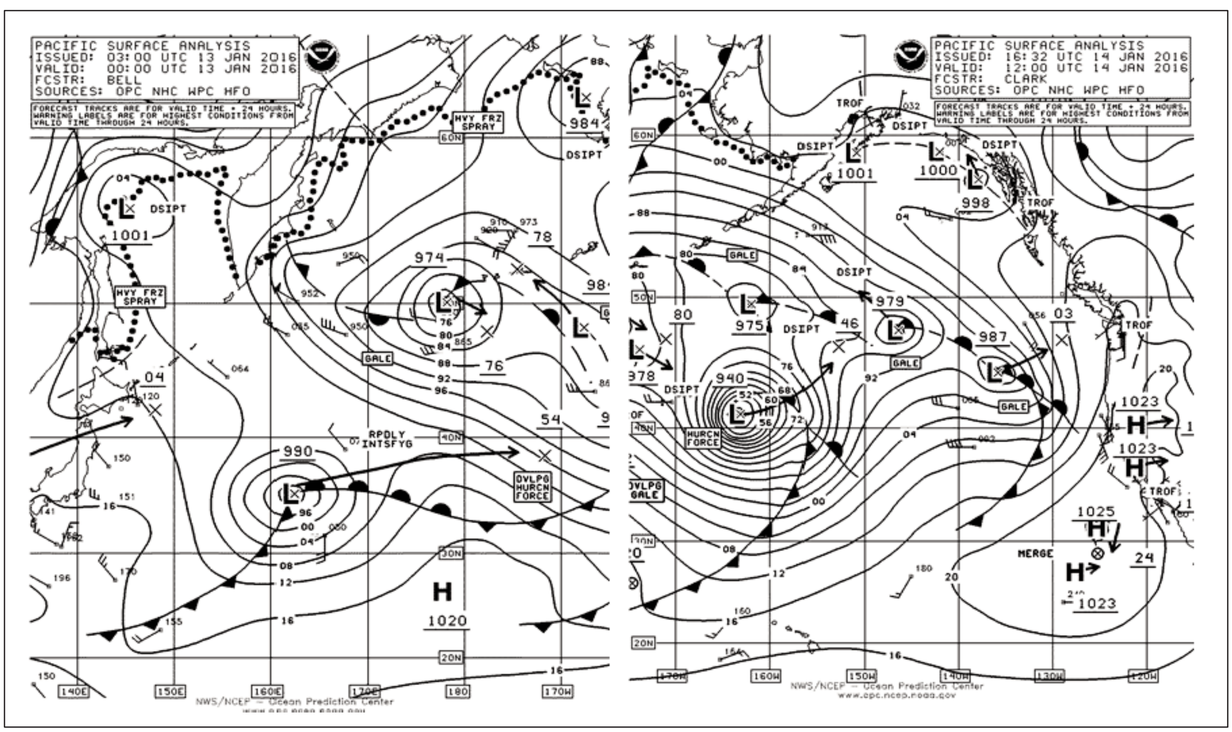


Figure 5. OPC North Pacific Surface Analysis charts (Part 2) valid 1800 UTC August 20 and 0600 UTC August 24, 2016.

The cyclone then moved northeast, weakened to a 65-kt typhoon near 35N 144E at 1800 UTC on the 29th, and then turned northwest and weakened further to a depression in the northern Sea of Japan on the 30th. Lionrock then moved inland as a post-tropical low late on the 30th.

Tropical Storm Kompasu:

Kompasu developed from a nontropical gale near 29N 151E at 1200 UTC August 19th then tracked northwest as a weak tropical storm with sustained winds mostly at 35 kts to the waters just east of Japan on the 20th. Kompasu was short lived as a tropical cyclone and weakened to a post-tropical low near northern Japan late on the 21st.

Other Significant Events of the Period

Western North Pacific Storm, April 28–30:

This cyclone originated just south of western Japan early on April 27th and developed over a period of three days while tracking northeast, becoming strongest near the central Kurile Islands by 0600 UTC on the 30th (**Figure 6**).

The **COSCO JAPAN** (VRFX5) near 46N 146E reported northwest winds of 45 kts and 7.9-m seas (26 ft) at 0000 UTC on the 30th. The Rscat image in **Figure 7** returned a swath of west winds of 50 to 60 kts, but there is one 65-kt wind retrieval near 150E at the edge of the pass. This cyclone was the deepest of the period in the North Pacific with a lowest central pressure of 965 hPa at 0000 UTC on the 30th. The cyclone subsequently weakened to a gale late on the 30th and to a low with winds below gale force just south of the western Aleutian Islands early on May 2nd.

Eastern North Pacific Storm, May 15–16:

This developing cyclone tracked from near northern Japan late on May 11th southeastward to the central waters before turning more northeastward and developing storm-force winds upon passing east of 165W. **Figure 8** depicts this development over the final 24-hour period. The ASCAT image in **Figure 9** reveals winds to 45 kts south of the storm center with some support for

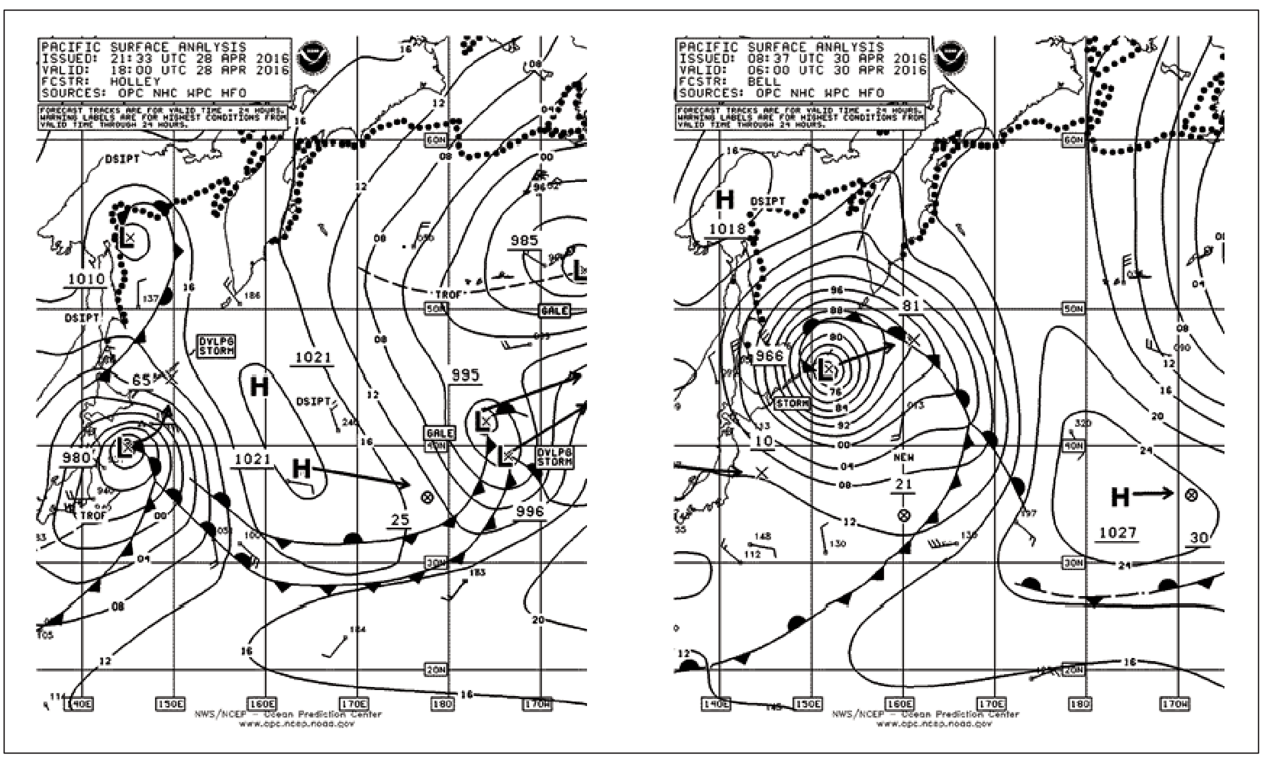


Figure 6. OPC North Pacific Surface Analysis charts (Part 2) valid 1800 UTC April 28 and 0600 UTC April 30, 2016.

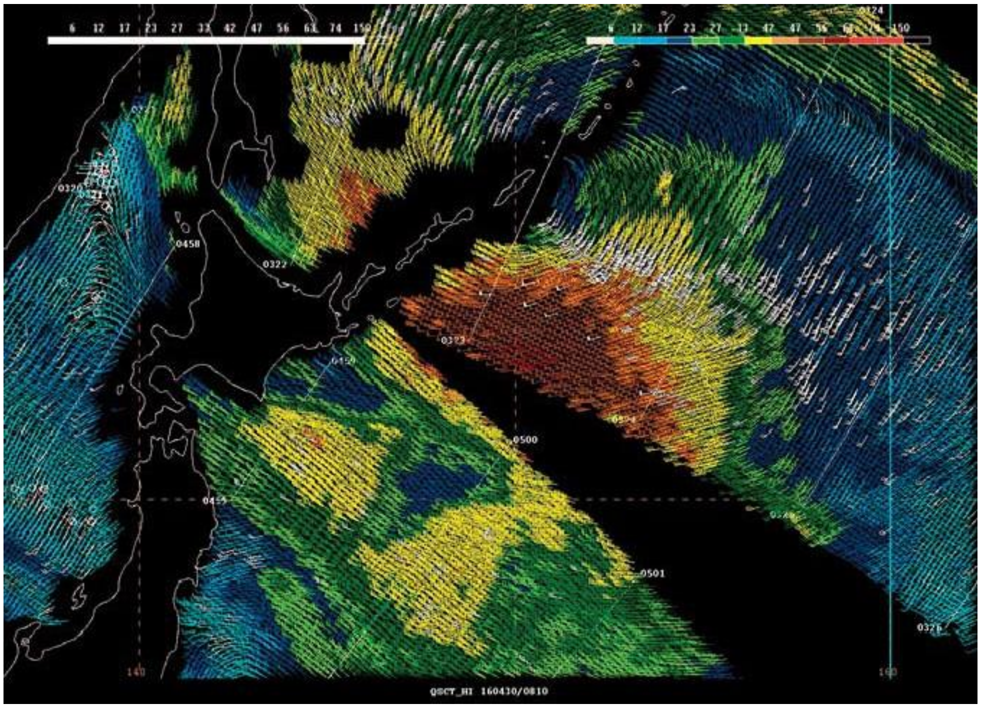


Figure 7. A 12.5-km Rapidscat image of satellite-sensed winds around the storm shown in the second part of Figure 6. Portions of two satellite overpasses are shown with cross-track timelines labeled in UTC. The timeline near the center of the image, 0323 UTC April 30, 2016, is about 2.5 hours prior to the valid time of the second part of Figure 6. A color scale for the wind barbs appears at the top of the image. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

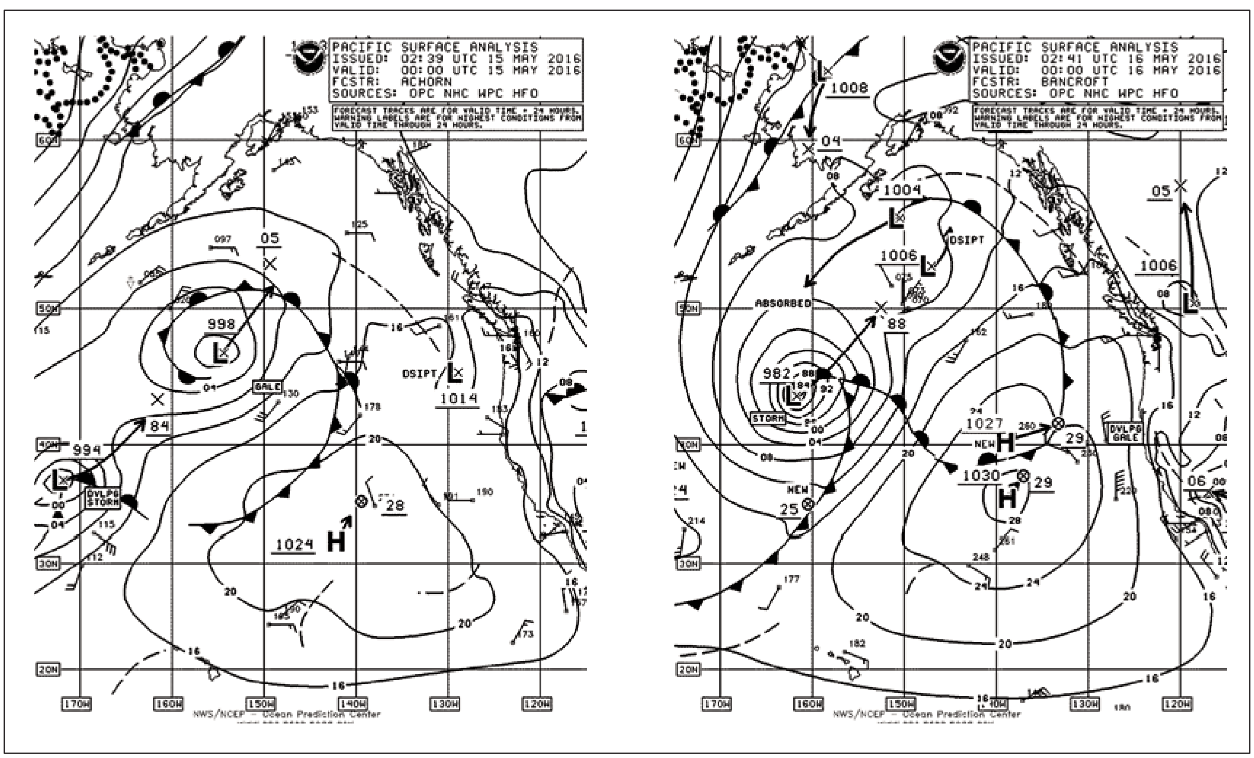


Figure 8. OPC North Pacific Surface Analysis charts (Part 1 - east) valid 0000 UTC May 15 and 16, 2016.

designating this cyclone as a storm due to low bias of ASCAT winds. The buoy 46246 (50N 145.2W) reported highest seas of 7.5 m (25 ft) at 1000 UTC on the 17th. A weakening trend set in on the 16th as the system moved northeast. The cyclone dissipated near the Queen Charlotte Islands by early on May 19th.

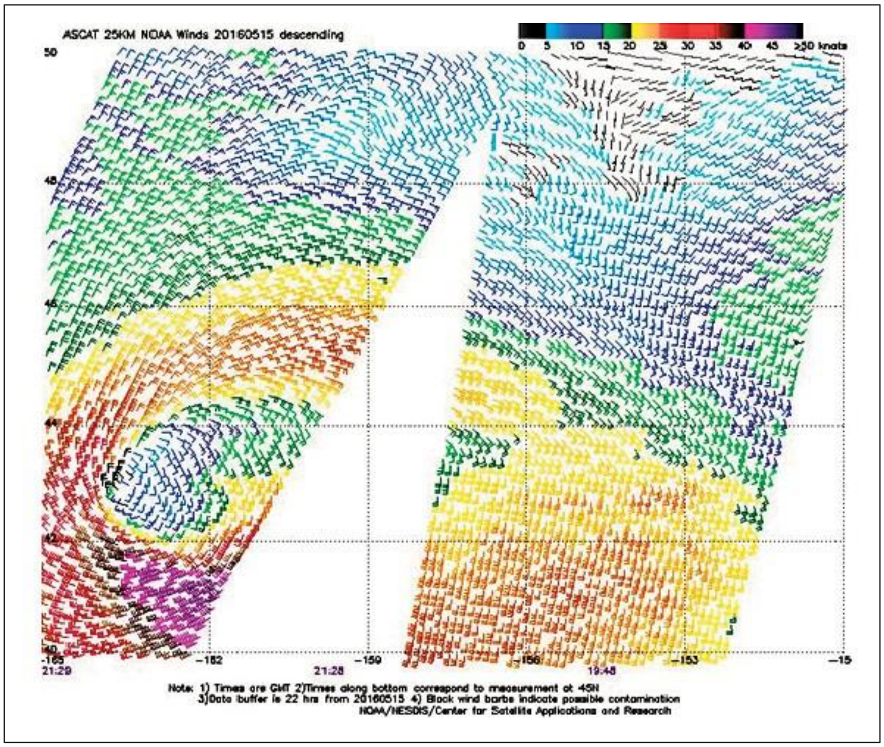


Figure 9. A 25-km ASCAT METOP-A (European Advanced Scatterometer) image of satellite-sensed winds around the cyclone shown in the second part of Figure 8. Portions of two satellite overpasses valid 1948 UTC and 2129 UTC May 15, 2016, are shown. The valid time of the later pass containing the strongest wind retrievals is approximately 2.5 hours prior to the valid time of the second part of Figure 8. A color scale for the wind barbs appears at the top of the image.
Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

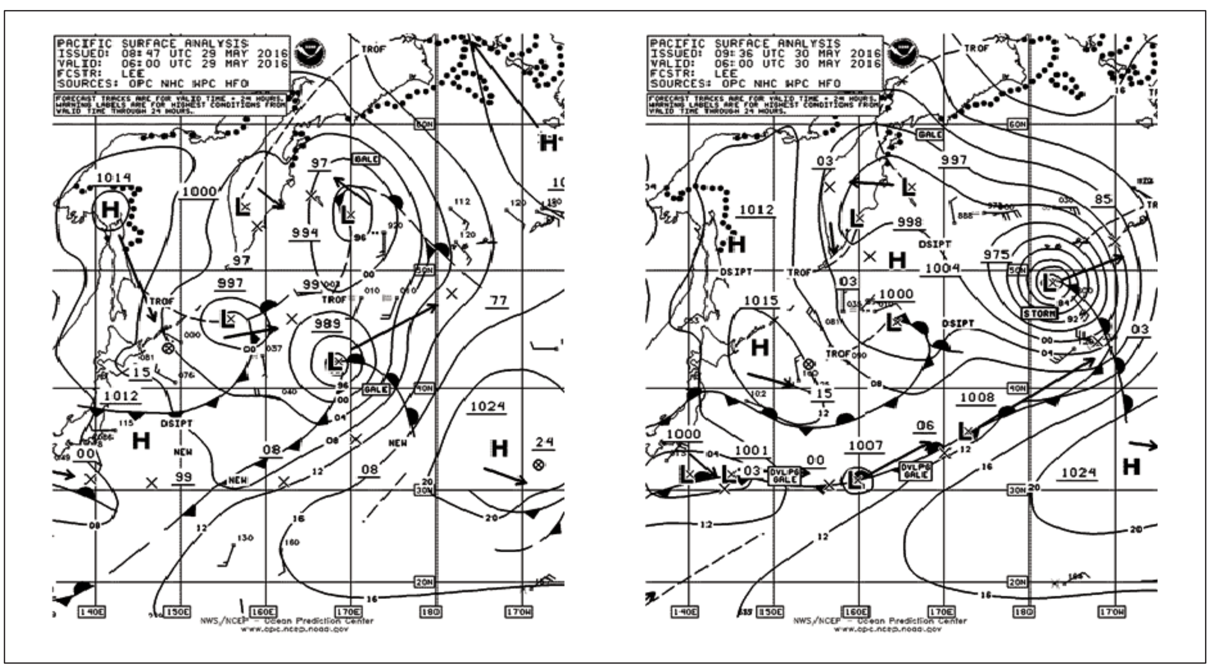


Figure 10. OPC North Pacific Surface Analysis charts (Part 2) valid 0600 UTC May 29 and 30, 2016.

Figure 11. A 25-km ASCAT (METOP-B) image of satellite-sensed winds around the cyclone shown in the second part of Figure 10. The valid time of the pass with the high east winds is 0815 UTC May 30, 2016, or 2.25 hours later than the valid time of the second part of Figure 10. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

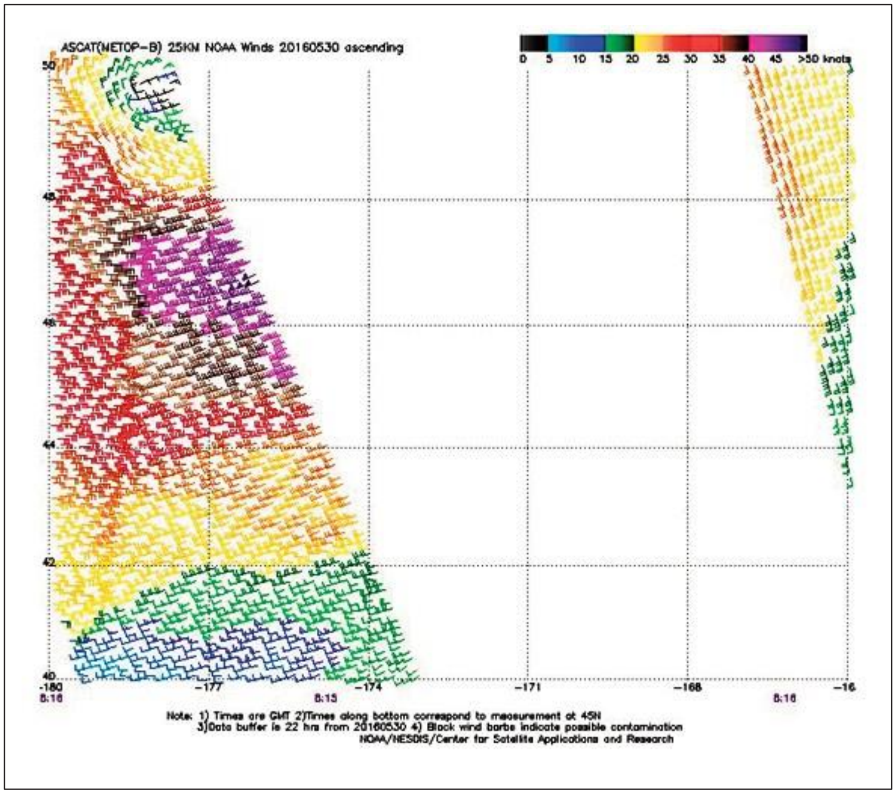


Figure 12. OPC North Pacific Surface Analysis chart (Part 2) valid 1200 UTC June 25, 2016.

North Pacific Storm, May 29–30:

This cyclone briefly developed storm-force winds and a central pressure as low as 975 hPa while passing about 200 nmi south of the central Aleutian Islands early on May 30th, after originating just south of Japan early on May 26th. **Figure 10** displays the final 24 hours of development. A scatterometer image of this system (**Figure 11**) reveals winds that are somewhat higher than those in the preceding event even with only partial coverage of the highest wind retrievals. The **ALLIANCE ST. LOUIS** (WGAE) near 44N 177W encountered south winds of 45 kts at 1800 UTC on the 29th. The cyclone then weakened to a gale while moving near the eastern Aleutian Islands late on the 30th and on the 31st.

Western North Pacific/Sea of Japan Storm, June 24–25:

This developing cyclone is a weaker version of a strong system that developed in the same area in mid-April 2016 (**Reference 5**), but was strong enough to develop storm-force winds with a central pressure as low as 985 hPa, at 0000 June 25th. **Figure 12** shows this small system in the Sea of Japan, and the Rapidscat image in **Figure 13** reveals a compact circulation with storm-force winds on the northwest side. The event was short lived, with the cyclone dissipating the following day as new development on a front occurred east of northern Japan.

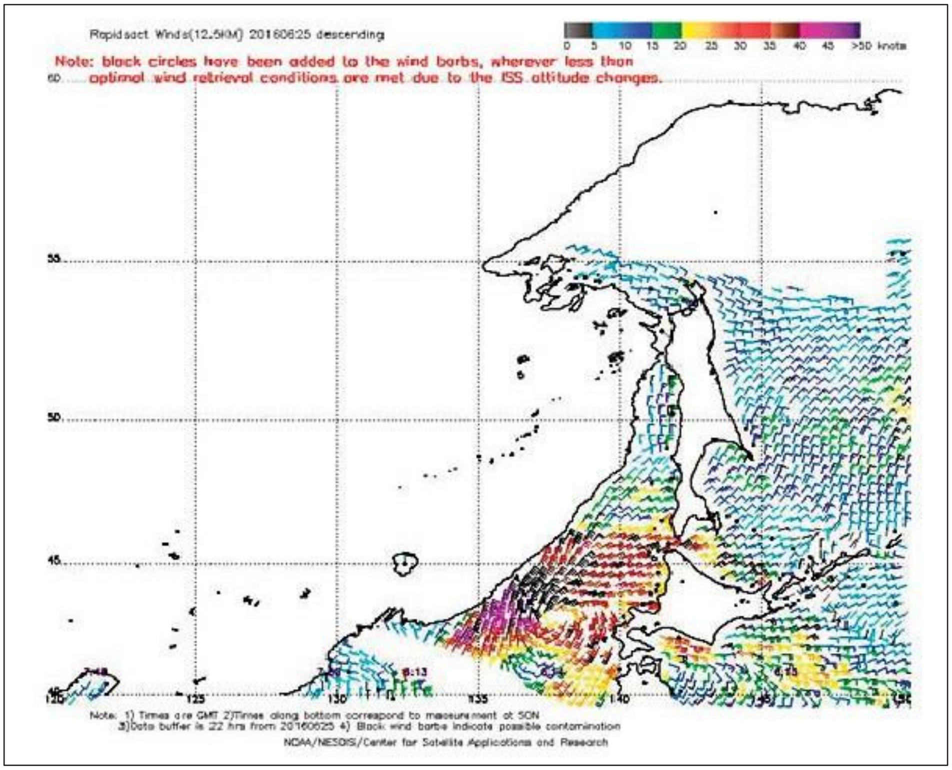


Figure 13. A 12.5-km Rapidscat image of satellite-sensed winds around the storm in the northern Sea of Japan shown in Figure 12. Satellite overpass times at 50N appear near the bottom of the image. The overpass time of 0814 UTC June 25, 2016, near the center of the image is about 3.75 hours prior to the valid time of Figure 12. A color scale for the wind barbs appears at the top of the image.
Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

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1. Sanders, Frederick and Gyakum, John R., Synoptic-Dynamic Climatology of the "Bomb", *Monthly Weather Review*, October 1980.

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Tropical Atlantic and Tropical East Pacific Areas

September–December 2016

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NOAA National Centers for Environmental Prediction

North Atlantic Ocean to 31N and Eastward to 35W, including the Caribbean Sea and the Gulf of Mexico

Atlantic Highlights

The period of September– December 2016 proved to be active in terms of gale conditions across the TAFB Area of Responsibility (AOR). The 15 non-tropical marine warnings issued for the Tropical North Atlantic and the 18 non-tropical marine warnings issued for the Tropical Northeast Pacific basins during this time were above average compared to the past several years.

Table 1 below shows the non-tropical marine warnings that occurred across the Tropical Atlantic, Gulf of Mexico, and Caribbean Sea during this period. Only four warnings occurred from September–October, with the first three events of this period originating from tropical phenomena, followed by the first significant cold front of the fall season that moved into the Gulf of Mexico on October 21. A strengthened blocking pattern in the upper atmosphere spanning North America from early November through early December then led to a very active warning period, with eight gales occurring during a 35- day span. All but one of these November– December warnings occurred with cold frontal boundaries moving across the Gulf of Mexico.

Table 1. Nontropical Warnings issued for the Atlantic Basin between 01 September 2013 and 31 December 2016.

ONSET	REGION	PEAK WIND (kts)	GALE DURATION (STORM)	FORCING
0000 UTC 05 Sep	Tropical North Atlantic / Caribbean	35	12 h	Tropical Wave
1200 UTC 11 Sep	Tropical North Atlantic	40	24 h	Low pressure/Pre Ian
0600 UTC 28 Sep	Tropical North Atlantic	35	06 h	Low pressure/Pre Matthew
1800 UTC 21 Oct	Gulf of Mexico	35	24 h	Cold Front
0000 UTC 03 Nov	Gulf of Mexico	35	30 h	Low pressure
0000 UTC 10 Nov	Gulf of Mexico	35	24 h	Cold Front
0600 UTC 12 Nov	Gulf of Mexico	35	42 h	Cold Front
0600 UTC 19 Nov	Gulf of Mexico	40	36 h	Cold Front
1800 UTC 28 Nov	Gulf of Mexico	35	12 h	Prefrontal Return Flow
1800 UTC 30 Nov	Gulf of Mexico	35	12 h	Cold Front
1200 UTC 04 Dec	Central Atlantic	35	24 h	Cold Front

Table 1. (continued) Non-tropical Warnings issued for the Atlantic Basin between 01 September 2013 and 31 December 2016.

ONSET	REGION	PEAK WIND (kts)	GALE DURATION (STORM)	FORCING
1200 UTC 08 Dec	Gulf of Mexico	45	60 h	Cold Front
1200 UTC 18 Dec	Gulf of Mexico	40	48 h	Cold Front
0000 UTC 19 Dec	South Central Caribbean	35	36 h	Pressure Gradient
1800 UTC 29 Dec	Gulf of Mexico	35	24 h	Cold Front

Figure 1 shows the mean 500-HPa height anomalies across the North Atlantic, North America, and Northeast Pacific Oceans during November 2016 and illustrates the prevailing upper-tropospheric pattern across both of these basins. A persistent blocking pattern prevailed during this period, consisting of high-amplitude, upper-level ridging centered over the Mississippi Valley extending across the Hudson Bay, with upper-level troughing occurring both to the east and west of the ridge. This pattern provided for frequent short wave troughs to sweep southeastward across the western U.S. while supporting cold fronts and cold-air intrusions deep into the TAFB AOR. This focused the vast majority of warnings across the Gulf of Mexico, where cold continental polar air moved southward behind the fronts and across the slowly cooling waters of the Gulf. These cold northerly winds then funneled through Mexico's Chivela Pass and across Gulf of Tehuantepec in the eastern Pacific to produce several Tehuantepec gales.

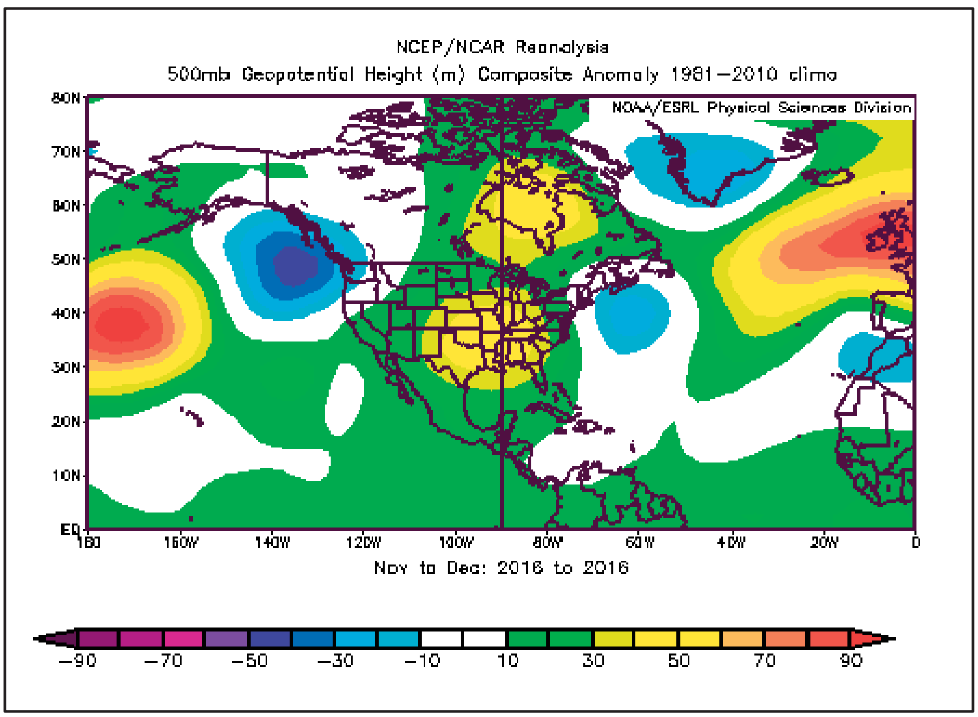

Figure 1. NOAA ESRL Reanalysis plot of mean 500 HPa height anomalies for November to December 2016, where warm colors represent above-normal heights and cool colors below-normal heights. Note the high-amplitude, high-pressure ridge prevailing from the SE U.S. to Hudson Bay, and low pressure occurring on either side, across the far NE Pacific and across the NW Atlantic. This blocking pattern allowed for numerous short wave troughs to sweep SE across the western U.S., transporting surface cold fronts and cold maritime polar air into the Gulf of Mexico.

Tremendous Wave Field Generated by Hurricane Nicole 16 October 2016

After two consecutive Atlantic hurricane seasons with storm totals below the recent 20-year average, 2016 rebounded with 15 named storms forming, slightly above the long-term average of 12 for the basin. Three major hurricanes, Matthew, Gaston, and Nicole, provided 70% of the season's Accumulated Cyclone Energy (ACE), which is a measure of the combined strength and duration of tropical cyclone activity. All three of these major hurricanes significantly impacted marine traffic across the Atlantic during their peak intensities, with Matthew and Nicole warranting drastic vessel-routing changes. Individual reports for each tropical cyclone of the 2016 Atlantic Hurricane Season can be found at http://www.nhc.noaa.gov/data/tcr/.

Marine observations across the open oceans are often few and far between, requiring marine forecasters to use all data sources at their disposal to assess current conditions and validate the global models. Thus buoy and ship observations are critical pieces of data assimilation for NHC forecasters and are augmented by remotely sensed or satellite-derived data. In the past decade, near real-time data from polar-orbiting satellites have provided surface-wind estimates via scatterometer data and wave-heights estimates via onboard altimeter measurements. These data have become mainstay data sources for NHC forecasters and allow us to add high-resolution detail and fine tune our bulletins and warning products. A fine example of this occurred during Hurricane Nicole, as is shown below.

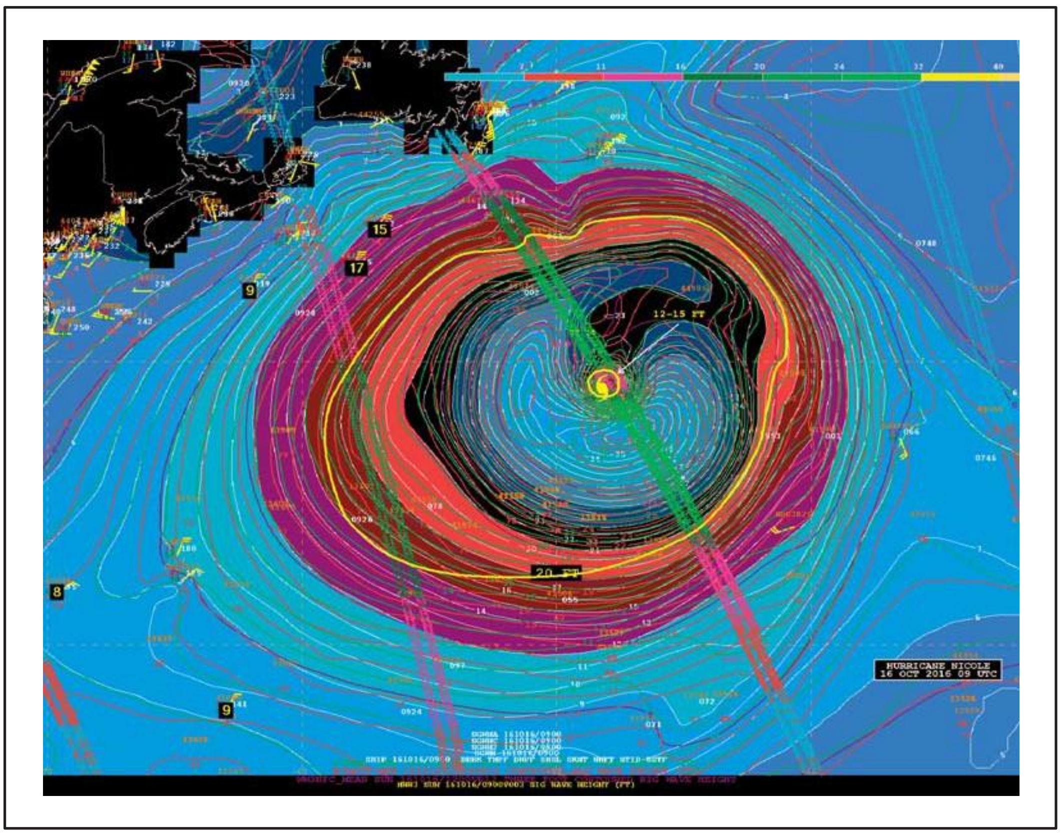

Figure 2. TAFB screen capture showing NOAA WWIII SWH 06-HR forecast for 1200 UTC 16 Oct, overlaid with ship and buoy observations (with wave heights labeled in ft), and a 0600–0930 UTC compilation of altimeter wave-heights measurements (ft) in multicolored vertical swaths. The 0900 UTC position of Nicole is depicted by a yellow hurricane icon. Altimeter wave-height color scale is at the top. Note the relative minimum in-wave heights of 12–15 ft across the center of Nicole, as well as very large area of 20-ft+ seas identified inside the yellow circle surrounding Nicole.

Hurricane Nicole reached a peak intensity of 120 kts early on 13 October, located about 120 nmi SW of Bermuda, as it moved north-northeast-ward. Nicole then accelerated northeastward and crossed Bermuda during the late-morning hours of 13 October, while weakening slowly, and continued on this northeast trajectory through 16 October. Nicole interacted with a series of upper-level troughs during the period 13–16 October, causing it to weaken further and to gradually attain some subtropical cyclone characteristics. In fact, despite weakening in strength from 14–16 October, this transition process led to a doubling in size of the wind field of Nicole, which provided for extreme wave growth. **Figure 2** shows a TAFB screen capture from 1200 UTC 16 October as a Category 1 hurricane. Nicole was moving northeastward across the open NW Atlantic. In this image, the center of Nicole at 0900 UTC is depicted by a yellow hurricane icon, with the background colored image showing the 1200 UTC wave height forecast from NOAA's Wave Watch III model, overlaid with numerous ship, buoy, and altimeter data. Numerous polar-orbiting satellites provide the altimeter data from 0600–0930 UTC in the image and combine with the observations to aid TAFB in assessing the wave field of Nicole. A timely and fortunate 0600 UTC Jason-2 pass sampled the central circulation of Nicole, showing a relative minimum of 12- to 15-ft seas in magenta colors. The compilation of other altimeter data also aids in defining a 20-ft wave-height contour surrounding Nicole, showing a tremendous area of 20-ft+ seas covering a roughly 1150- x 900-nmi area. This areal distribution of very high seas is much larger than a typical Category-1 hurricane would produce, and can be attributed to 3 factors occasionally seen in "recurving" Atlantic hurricanes; an expanding wind field due to subtropical or extratropical transition, a period of relatively straight-line motion, and an extended period of wave growth produced by the wind field and waves remaining in synch for 18 or more hours. The process leading to extreme wave growth due to synchronicity of the wind and wave fields has been termed "Trapped Fetch Waves." Somewhat similar scenarios have also been identified as factors leading to anomalously large wave fields from other Atlantic hurricanes, such as Debby in 1982, Felix in 1995, and Sandy of 2012, to name a few. Mariners are reminded that each hurricane is unique, and these conditions generated by Nicole illustrate the extreme dangers that recurving Atlantic hurricanes can produce, even with weakening intensities.

Strong Gale Event across Gulf of Mexico December 09–10, 2016

A pair of stalled frontal boundaries lingered across the Gulf of Mexico on 7 December, one across the southern Gulf, and a second across the northwestern Gulf. A short wave trough and deep-layered low-pressure system moving east-northeast off the middle Atlantic coast supported the southernmost front, and dragged the front southeastward across extreme south Florida, where it stalled through the morning of 8 December. During this time, the northernmost front lingered nearly east to west across the northern coastal waters, while a 1044-hPa surface high moved into the Great Plains and began to build southeast to the north Gulf coast. The associated pressure gradient between the very strong high pressure and the stationary front along the northern coastal waters enhanced the northerly winds spilling off the Texas and southwest Louisiana coastal waters, producing gales beginning around 1200 UTC 8 December. The tanker **BRITISH ROBIN** (MGSH7) sitting just off- shore of Galveston Bay first reported gale force winds from 1000 to 1300 UTC. Meanwhile, the southernmost front across the southwest gulf began to drift northward and became attached to a weak low-pressure center that developed offshore of La Pesca, Mexico. This low drifted east-southeast throughout the day, while the strong high pressure shifted slightly eastward across the central U.S. and built farther southeast into the northern gulf. This further increased the pressure gradient across the north central and northwest gulf and allowed gales to spill down the Mexican coastal waters to the west of the surface low, shown in **Figure 3**.

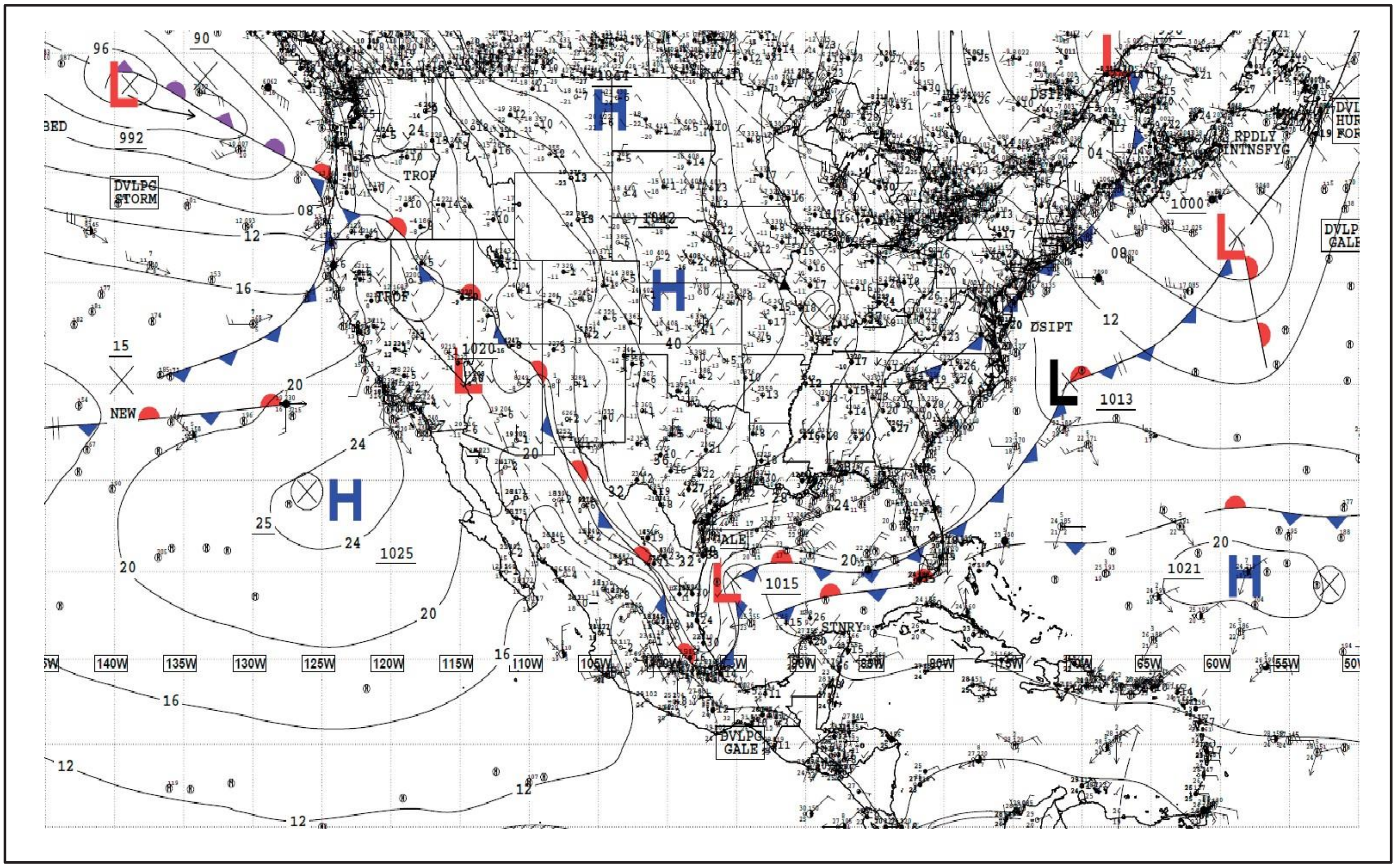

Figure 3. NWS Unified Surface Analysis for 0000 UTC 09 Dec showing 1042-hPa high pressure building from the Great Plains southeastward across the northern Gulf of Mexico. This ridging forced a stalled cold front across the northern gulf to sink southward across the northeast gulf, while a 1015-hPa low center along the west end of the front drifted east-southeast. Note the ridge nosing southward across the Mexican Gulf coast and to the west of the low, where gales to 40 kts were spilling south behind the front. Gale symbols indicate general areas of NHC Gale Warnings.

The **HAWK HUNTER** (A8RH6) located southeast of La Pesca, reported NNW gales to 38 kts at 2100 8 December. From 00 UTC 09 to 00 UTC 10 December, the strong ridge across the continental U.S. shifted slowly eastward to the Mississippi Valley and forced the cold front farther south across the Gulf of Mexico, and over the Straits of Florida. The low-pressure center along the west end of the front persisted and aided in maintaining strong gales to the west of the low and trailing cold front, which by 00 UTC 10 December had swept across the west and central portions of the Bay of Campeche and allowed northerly gales to spill through the Chivela Pass and across the Gulf of Tehuantepec in the eastern Pacific. A 1541 UTC ASCAT scatterometer pass sampled the western Gulf of Mexico during this time and depicted an elongated area of 30- to 452 kt NW winds extending from the coastal waters off of Matamoros, Mexico to the central Bay of Campeche. Wave-model guidance suggested that seas would have built 18 to 21 ft across southern portions of this fetch area and offshore of Veracruz, Mexico. **Figure 4** shows a TAFB screen capture with a GOES-E infrared satellite image at 1515 UTC 9 December, with 1500 UTC ship and buoy observations showing wave heights labeled in yellow (ft), and a 1500–1600 UTC compilation of ASCAT wind vectors. A long fetch of 30- to 45-kt NW winds can be seen extending from near the Texas-Mexico border S-SE into the western Bay of Campeche. The strong ridge north of the gulf continued to shift slowly eastward and across the southeastern U.S., while weakening modestly on December 10 and gradually forced the cold front southward and inland across the Yucatan Peninsula and the Yucatan Channel

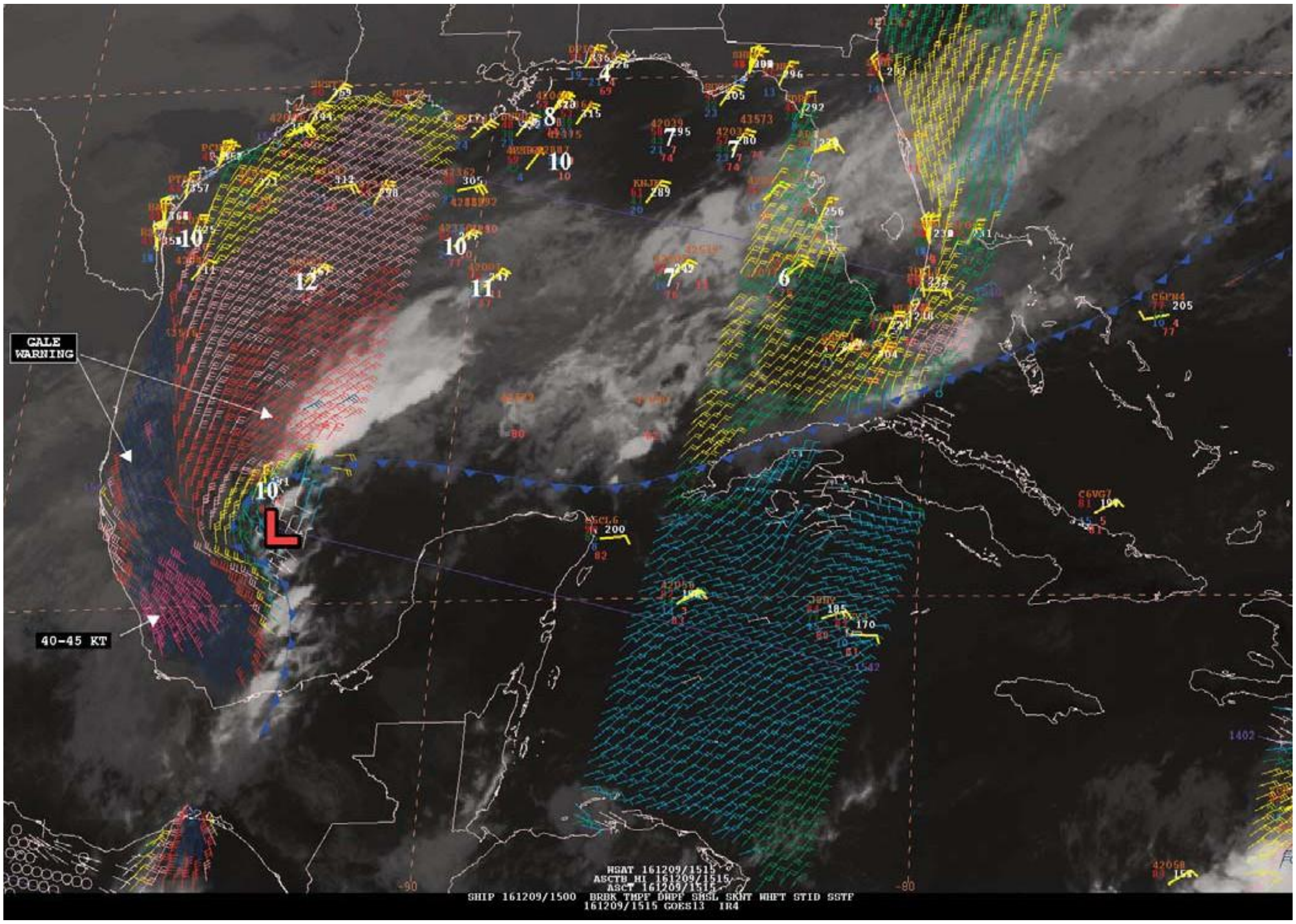

Figure 4. TAFB screen capture showing GOES-E IR image at 1515 UTC 09 Dec across Gulf of Mexico region, overlaid with 1500 UTC buoy and ship observations, ASCAT wind vectors, and frontal position. A persistent weak low-pressure center is depicted by ASCAT winds across the southwestern Gulf of Mexico, with the cold front wrapped across its north and western periphery. ASCAT wind data reveals strong NW gales extending along the entire length of the Mexican coast and into the west half of the Bay of Campeche. Magenta-colored wind flags depict wind speeds of 40–45 kts. ASCAT color wind speed scale at top right.

by 1200 UTC. Winds behind the front begin to veer northeasterly by this time, and the relaxing pressure gradient allowed for winds to diminish below gale force by 1800 UTC. This gale event lasted 60 hours and was the longest-lived warning event of this period.

Eastern North Pacific Ocean to 30N and East of 140W

The most dangerous threat to maritime navigation over this portion of the Eastern Pacific Ocean for the time period of 1 September to 31 December 2016 is tropical cyclone activity, which peaks in August and September. However, the fall and early-winter months usher in the westerlies over the eastern Pacific Ocean region, south of 31N. Occasional gales and storms occur in conjunction with the passage of strong frontal systems. These gales and storms are always baroclinic in nature and usually get stronger in the late-fall months. Another source for gales and storms occur on the lee side of mountain gaps, such as the Gulf of California, the Gulf of Tehuantepec, the Gulf of Papagayo, and the Gulf of Fonseca. The most frequent of these gap locations is typically over the Gulf of Tehuantepec. This 2016 fall season had 15 Gulf of Tehuantepec gales, and 3 Gulf of California gales (**Table 2**).

Ship reports received through the Voluntary Observing Ship (VOS) program are a vital source

Table 2. Non-tropical cyclone warnings issued for the Pacific Basin between 01 September 2016 and 31 December 2016.

ONSET	REGION	PEAK WIND (kts)	DURATION
1200 UTC 09 Oct	Gulf of Tehuantepec	35	06 h
1200 UTC 10 Oct	Gulf of Tehuantepec	35	06 h
0600 UTC 11 Oct	Gulf of Tehuantepec	35	36 h
1200 UTC 13 Oct	Gulf of Tehuantepec	35	06 h
1800 UTC 21 Oct	Gulf of Tehuantepec	40	192 h
1200 UTC 04 Nov	Gulf of Tehuantepec	35	48 h
0600 UTC 10 Nov	Gulf of Tehuantepec	35	126 h
1200 UTC 16 Nov	Gulf of Tehuantepec	35	36 h
1200 UTC 19 Nov	Gulf of Tehuantepec	45	60 h
1200 UTC 23 Nov	Gulf of Tehuantepec	45	90 h
1800 UTC 03 Dec	Gulf of California	35	12 h
1200 UTC 09	Gulf of Tehuantepec	45	60 h
0600 UTC 16 Dec	Gulf of Tehuantepec	35	18 h
1200 UTC 17 Dec	Gulf of California	35	12 h
1200 UTC 19 Dec	Gulf of Tehuantepec	50	96 h/12 h
0000 UTC 20 Dec	Gulf of California	35	12 h
0600 UTC 28 Dec	Gulf of Tehuantepec	35	42 h
0600 UTC 30 Dec	Gulf of Tehuantepec	40	30 h

Table 3. Ship reports that verified gale events over the Gulf of Tehuantepec and Baja California between 01 September 2016 and 31 December 2016.

TIME/DATE	SHIP	LOCATION	WIND SPEED/SEAS
0500 UTC 11 Oct	**ZAANDAM** (PDAN)	15.3N 94.5W	47 kts 3 ft (1 m)
0500 UTC 13 Oct	**ISLAND PRINCESS** (ZCDG4)	14.9N 94.0W	40 kts 10 ft (3 m)
0100 UTC 14 Oct	**NIEUW AMSTERDAM** (PBWQ)	15.3N 95.1W	53 kts 10 ft (3 m)
0400 UTC 23 Oct	**ISLAND PRINCESS** (ZCDG4)	15.5N 94.4W	35 kts 7 ft (2m)
1700 UTC 23 Oct	**NORWEGIAN SUN** (C6RN3)	15.0N 95.4W	37 kts 10 ft (3 m)
0600 UTC 21 Nov	**MAERSK DHAHRAN** (A8PX5)	13.9N 95.7W	43 kts 13 ft (4 m)
0500 UTC 11 Dec	**ISLAND PRINCESS** (ZCDG4)	15.2N 94.6W	46 kts 10 ft (3m)

Table 3. (continued) Ship reports that verified gale events over the Gulf of Tehuantepec and Baja California between 01 September 2016 and 31 December 2016.

TIME/DATE	SHIP	LOCATION	WIND SPEED/SEAS
0700 UTC 17 Dec	**CARNIVAL MIRACLE** (H3VS)	32.0N 117.5W	42 kts 10 ft (3 m)
0600 UTC 20 Dec	**MISAGO ARROW** (C6BZ9)	14.8N 95.6W	42 kts 16 ft (5m)
0500 UTC 30 Dec	**ISLAND PRINCESS** (ZCDG4)	15.4N 94.0W	48 kts 10 ft (3m)

of data in verifying gales and storms. Some select ship reports that directly verified some of this season's gales are listed in **Table 3**. The Gulf of Tehuantepec wind events are usually driven by midlatitude cold-frontal passages through the narrow Chivela Pass in the Isthmus of Tehuantepec between the Sierra Madre de Oaxaca Mountains on the west and the Sierra Madre de Chiapas Mountains on the east. The northerly winds from the southwest Gulf of Mexico funnel through the pass delivering stronger winds into the Gulf of Tehuantepec. The events are of various duration with the longer events associated with reinforcing secondary cold fronts in the Gulf of Mexico. The events are usually void of precipitation in the Gulf of Tehuantepec, thus scatterometer passes are not rain contaminated and wind retrievals are of the highest quality. The Gulf of Tehuantepec gales and storms for the 2016 season totaled 864 hours, a 58% increase from last season's 546 hours. The 2014 and 2013 seasons had 606 and 642 hours respectively. The 2012 and 2011 seasons both had 492 hours.

The upsurge of gales during 2016 may be the result of the use of a finer resolution Global Forecast System (GFS) model at the National Hurricane Center. Numerous wind events this year just barely reached the 34-knot threshold. Furthermore, these events were maintained for long durations. The new model consistently forecasted these numerous events, and scatterometer imagery together with ship reports confirmed the forecasts. There was only one Tehuantepec storm over this this time period for 2016 that reached 50 kts. A possible cause for the shortage of storms is the lack of strong cold fronts pushing southward across the Gulf of Mexico. This also may account for the lack of gale force winds in the Gulf of Papagayo. However, the following ships did report near gales. The **NORWEGIAN JEWEL** (C6TX6) reported near gale on 16 December 2016 at 11.1N 86.6W. The **EVER LAUREL** (9V9287) reported near gale on 22 December 2016 at 10.3N 88.6W. The **VEENDAM** (PHEO) reported near gale on 28 December 2016 at 11.5N 86.8W and the **AMSTERDAM** (PBAD) on 29 December 2016 at 10.8N 86.3W. One of the first extended period of Gulf of Tehuantepec gales of the season occurred between 21–29 October 2016. Gale force northerly winds in the southwest Gulf of Mexico behind a cold front funneled through the Chivela Pass resulting in gales in the Gulf of Tehuantepec, (**Figure 5**). Note that the 1020-hPa isobar extending south of Tampico, Mexico, and the 1010-hPa low over the eastern Pacific, significantly increased the surface pressure gradient over the Isthmus of Tehuantepec. This wind event commenced at 1800 UTC 21 October 2016 as a gale. Winds persisted at gale force for 192 hours until 29 October 1800 UTC, when the event ended. It was the longest event of the season.

A European Advanced Scatterometer (ASCAT A) pass captured the gale portion of the event in both the Bay of Campeche and the Gulf of Tehuantepec (**Figure 6**). A gale area was depicted over the Gulf of Tehuantepec surrounded by a larger area of 20- to 30-kt winds. Gale-force winds extended southward to 15N between 94W and 96W. The **SEA-LAND LIGHTNING** (9V3291), the **ISLAND PRINCESS** (ZCDG4),
and the **NORWEGIAN SUN** (C6RN3) traversed the area and reported gale force winds between 21 and 23 October 2016.

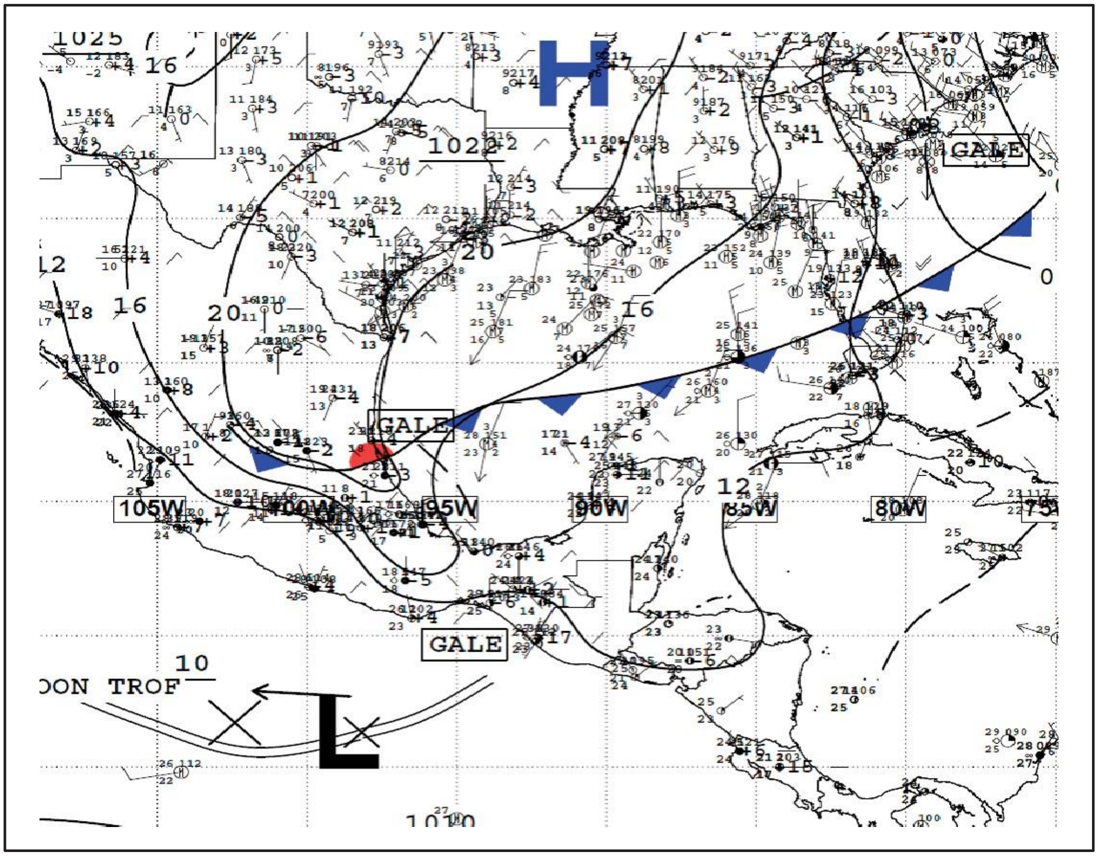

Figure 5. National Weather Service Unified Surface Analysis (USA) valid 0600 UTC 22 October 2016.

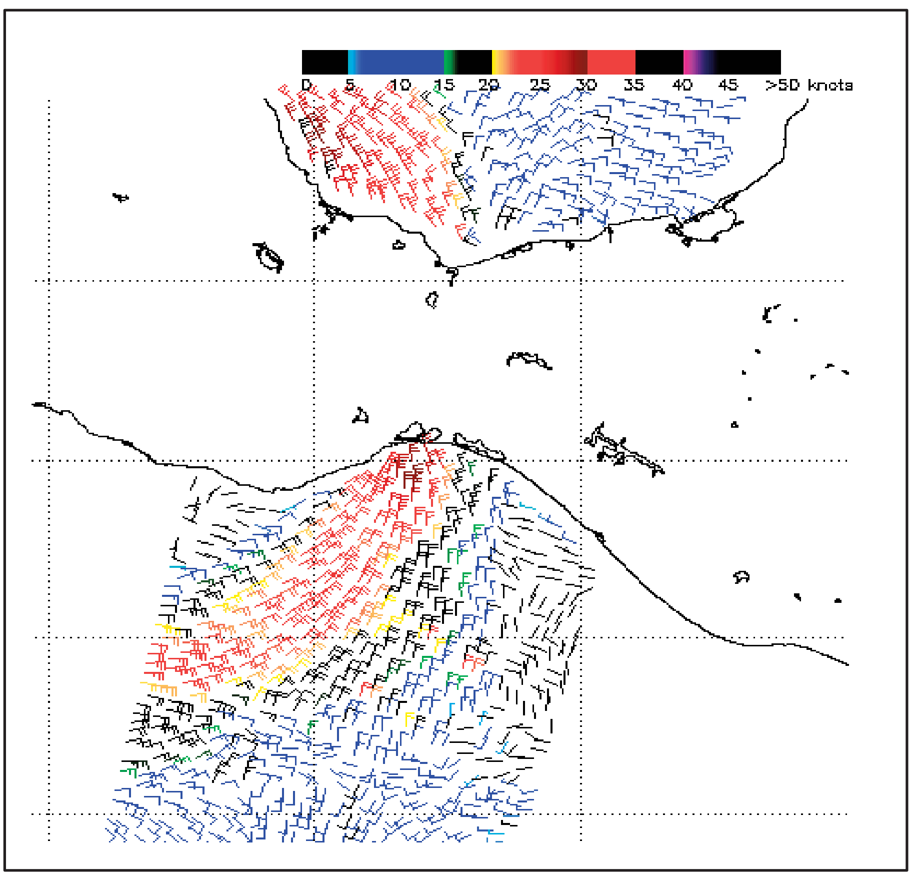

Figure 6. European Advanced Scatterometer (ASCAT A) pass valid at 1622 UTC 22 October 2016. Note the 35-kt wind barbs south of the Gulf of Tehuantepec near 15N96W.

Another extended period of Gulf of Tehuantepec gales and storm occurred between 19–24 December 2016. Gale-force northerly winds in the southwest Gulf of Mexico behind a cold front funneled through the Chivela Pass resulting in a gale in the Gulf of Tehuantepec, (**Figure 7**). Note that the 1037-hPa high over northeast Mexico significantly increased the surface-pressure gradient over the Isthmus of Tehuantepec. This wind event commenced at 1200 UTC 19 December 2016 as a gale. Storm-force winds developed at 1200 UTC 20 December 2016 and lasted 12 hours. Winds then decreased back to gale and continued until 0000 UTC 24 December 2016. The total period of gale-force winds was 108 hours.

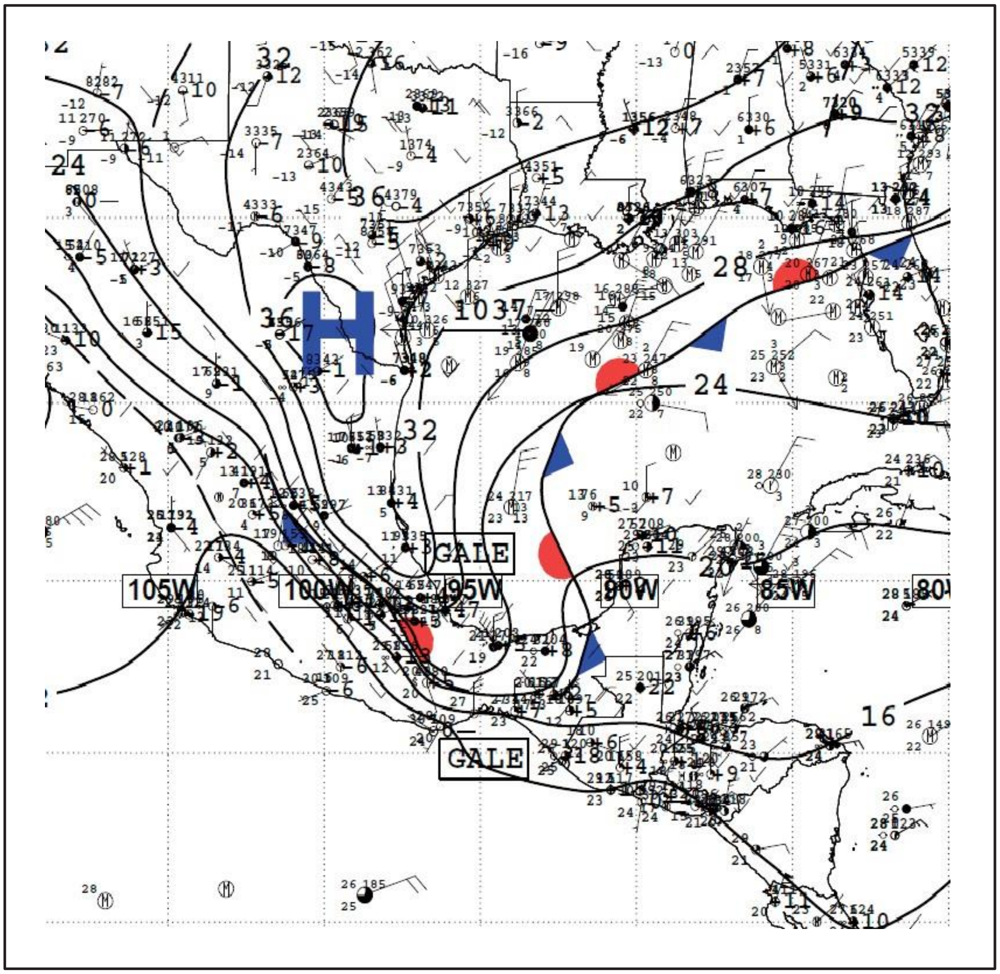

Figure 7. National Weather Service Unified Surface Analysis (USA) Gulf of Tehuantepec section valid 0000 UTC 20 December 2016.

A high-resolution European Advanced Scatterometer (ASCAT HI) pass captured the gale portion of the event in both the Gulf of Tehuantepec, (**Figure 8**). A 40- to 45-kt gale area was depicted over the Gulf of Tehuantepec surrounded by a 34- to 40-kt gale area. Gale-force winds extended southward to 14N between 94W and 96W. Five other colored wind areas depicts the gradual decrease of wind southward.

The **MISAGO ARROW** (C6BZ9) traversed the area and reported gale-force winds on 20 December 2016. The Gulf of California is a long narrow sea between the higher elevations of Baja California and the Sierra Madre Occidental Mountains on the Mexican mainland. A valley extends from the southern California Salton Sea to the Delta of the Colorado River where northerly gap winds may flow into the northern Gulf of California. Cold fronts that traverse the northern Gulf of California are often followed by high winds that spill into the Sea then propagates southward. Furthermore, if a gale is off the southern California coast, the likelihood of a Gulf of California gale is high soon after.

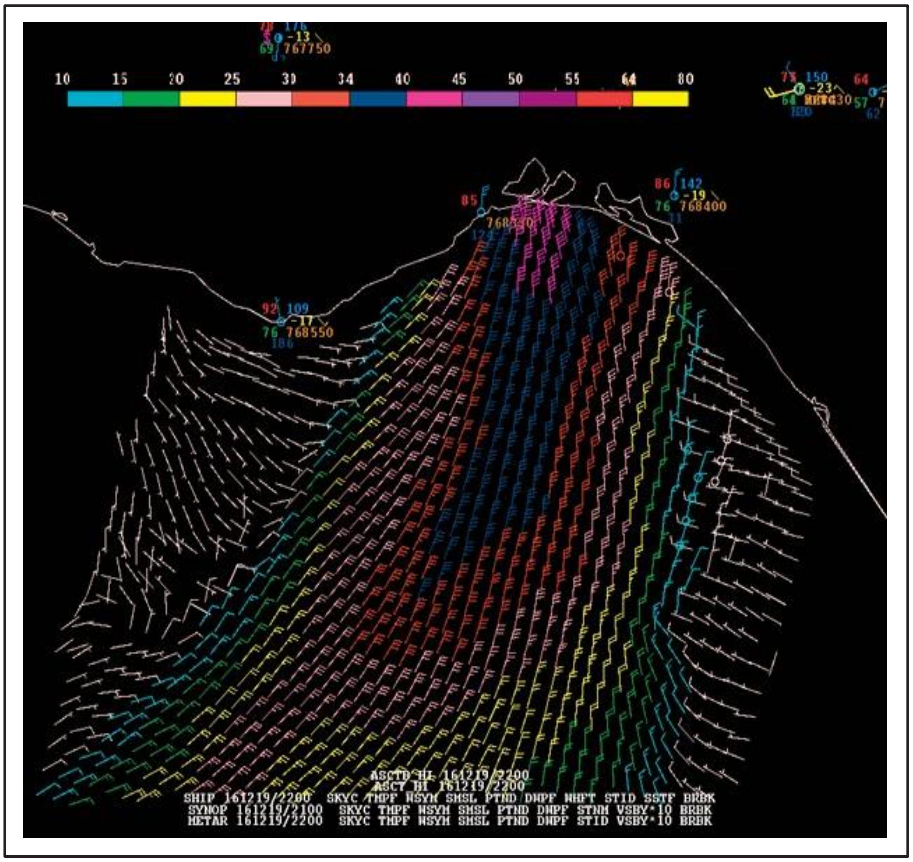

Figure 8. European Advanced Scatterometer (ASCAT-HI) pass valid at 2200 UTC 19 December 2016. Note the 40- to 45-kt wind barbs in purple over the Gulf of Tehuantepec near 16N 95W. Also note the 34- to 40-kt wind barbs in blue.

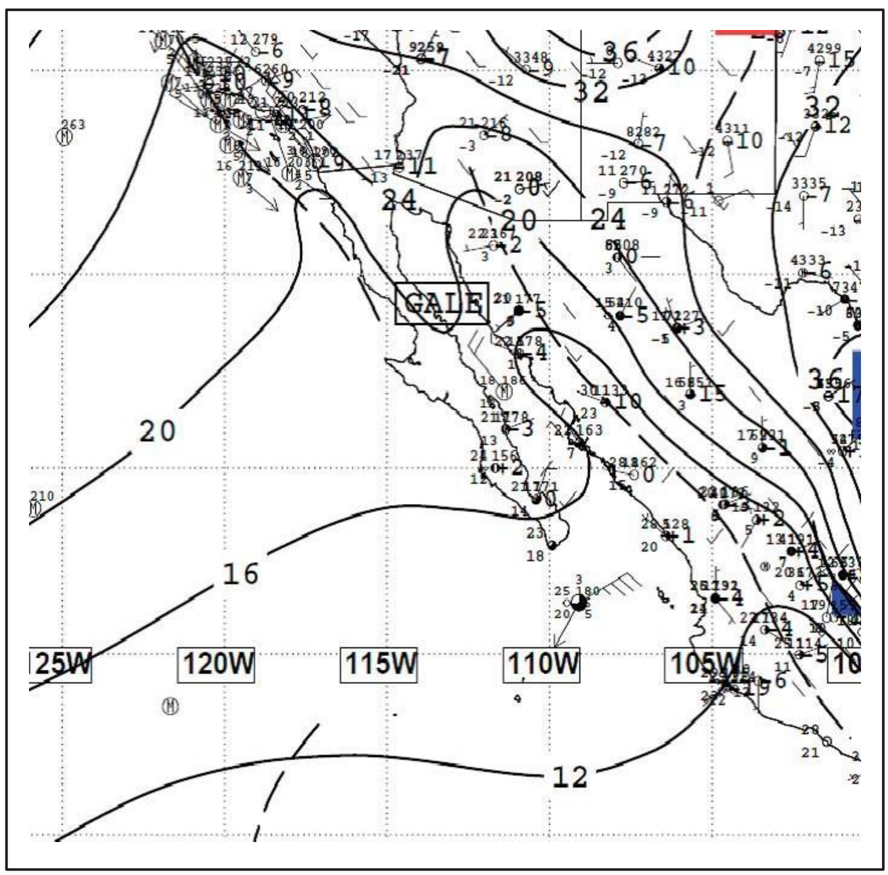

Figure 9. National Weather Service Unified Surface Analysis (USA) Gulf of California section valid 0000 UTC 20 December 2016.

The **CARNIVAL MIRACLE** (H3VS) traversed the California coast and reported gale-force winds on 17 December 2016 at 32.0N 117.5W. This 2016 season had three Gulf of California gales in December. The last Gulf of California gales events occurred on 20 Dec 2016 for 12 hours, (**Figure 9**). Most of the gale winds for this event were north of 30N off the coast of San Felipe Mexico. A high-resolution European Advanced Scatterometer (ASCAT HI) pass captured the gale portion of the event in the Gulf of California (**Figure 10**).

A 34-40 kts gale area was depicted over the northern Gulf of California in blue, surrounded by a 30- to 34-kt near gale area in red. Gale force winds were closer to the Baja California coast north of 30N. Three other colored wind areas depict the gradual decrease of wind southward.

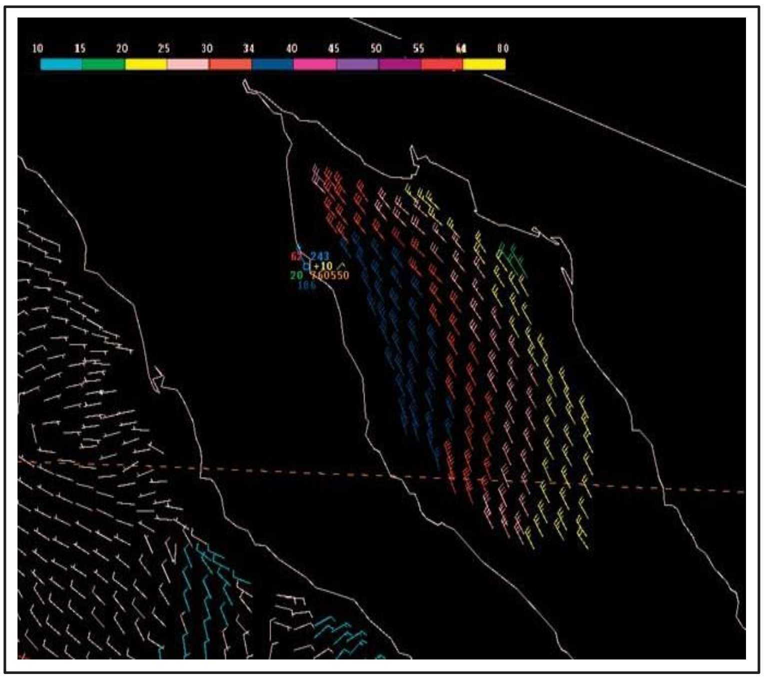

Figure 10. European Advanced Scatterometer (ASCAT-HI) pass valid at 1900 UTC 19 December 2016. . Note the 34- to 40-kt wind barbs in blue over the Gulf of California near 31N 114W

References

http://www.nhc.noaa.gov/text/MIATWSAT.shtml

http://www.nhc.noaa.gov/data/tcr/AL152016_Nicole.pdf

Bowyer, P.J., MacAfee, A.W. 2005: The Theory of Trapped-Fetch Waves with Tropical Cyclones - An Operational Perspective, *Weather and Forecasting*, 20, 229–244.

Alves, J-H, G.M., et al., 2015: Operational Wave Guidance at the U.S. National Weather Service during Tropical/Post–Tropical Storm Sandy, October 2012, *Monthly Weather Review*, 143, 1687–1701.⚓

VOS Program
Cooperative Ship Report:
November 1, 2016, through February 28, 2017

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
ADRIAN MAERSK	OXLD2	A	New York City	4	1									0	0	5
ADVENTURE OF THE SEAS	C6SA3	A	Miami	0	74									1	0	75
ALASKA MARINER	WSM5364	A	Anchorage	12	0									0	12	24
ALASKA TITAN	WDE4789	A	Anchorage	19	12									32	1	64
ALASKAN EXPLORER	WDB9918	A	Anchorage	15	34									59	25	133
ALASKAN FRONTIER	WDB7815	A	Anchorage	5	0									14	0	19
ALASKAN LEADER	WDB7198	A	Anchorage	0	3									0	0	3
ALASKAN LEGEND	WDD2074	A	Anchorage	64	59									25	1	149
ALASKAN NAVIGATOR	WDC6644	A	Anchorage	124	24									79	79	306
ALBEMARLE ISLAND	C6LU3	A	Miami	5	0									7	5	17
ALBERT MAERSK	OUOW2	I	New York City	0	0									0	0	0
ALERT	WCZ7335	A	Anchorage	2	0									0	0	2
ALGOLAKE	VCPX	A	Duluth	16	0									56	70	142
ALGOMA DISCOVERY	CFK9796	A	Duluth	0	0									14	5	19
ALGOMA GUARDIAN	CFK9698	A	Duluth	0	0									39	31	70
ALGOMA MARINER	CFN5517	A	Duluth	14	0									9	22	45
ALGORAIL	VYNG	A	Duluth	0	0									39	7	46
ALGOWAY	VDFP	A	Duluth	0	0									16	11	27
ALLIANCE FAIRFAX	WLMQ	A	Jacksonville	51	17									51	40	159
ALLIANCE NORFOLK	WGAH	A	Jacksonville	0	0									0	0	0
ALLIANCE ST LOUIS	WGAE	A	Charleston	0	0									0	0	0
ALLURE OF THE SEAS	C6XS8	A	Miami	55	30									69	41	195
ALPENA	WAV4647	A	Duluth	14	0									46	74	134
AMERICAN CENTURY	WDD2876	A	Duluth	26	0									98	236	360
AMERICAN INTEGRITY	WDD2875	A	Duluth	13	0									42	28	83
AMERICAN MARINER	WQZ7791	A	Duluth	10	0									35	24	69
AMERICAN NO. 1	WCD7842	A	Anchorage	0	0									17	0	17
AMERICAN SPIRIT	WCX2417	A	Duluth	0	0									0	4	4
AMSTERDAM	PBAD	A	Anchorage	165	170									287	297	919
ANDROMEDA VOYAGER	C6FZ6	A	Anchorage	55	43									30	22	150
ANTHEM OF THE SEAS	C6BI7	A	New York City	3	0									6	0	9
ANTWERPEN	VRBK6	A	Anchorage	40	15									65	63	183
APL AGATE	WDE8265	A	Charleston	0	0									31	0	31
APL BELGIUM	WDG8555	A	Los Angeles	38	33									50	9	130
APL CHINA	WDB3161	A	Los Angeles	141	132									151	230	654
APL CORAL	WDF6832	A	Charleston	0	2									4	1	7
APL GUAM	WAPU	A	Anchorage	52	63									66	46	227
APL HOUSTON	9V9921	A	Los Angeles	19	19									23	19	80

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
APL KOREA	WCX8883	A	Los Angeles	90	62									86	46	284
APL PHILIPPINES	WCX8884	A	Los Angeles	23	49									24	12	108
APL PHOENIX	9V9918	A	Los Angeles	0	2									0	0	2
APL SCOTLAND	9VDD3	A	New York City	1	0									0	8	9
APL SINGAPORE	WCX8812	A	Los Angeles	61	61									68	52	242
APL THAILAND	WCX8882	A	Los Angeles	181	52									323	327	883
APPALOOSA	V7CH8	A	New Orleans	1	0									1	18	20
AQUARIUS VOYAGER	C6UC3	A	Jacksonville	87	30									2	2	121
ARCTIC BEAR	WBP3396	A	Anchorage	0	0									0	0	0
ARCTIC TITAN	WDG2803	A	Anchorage	19	13									8	22	62
ARCTURUS VOYAGER	C6YA7	A	Anchorage	75	80									73	40	268
ARI CRUZ	WDG9588	A	Anchorage	0	0									1	0	1
ARIES VOYAGER	C6UK7	A	Anchorage	75	33									22	57	187
ARNOLD MAERSK	OXES2	A	Seattle	77	84									0	22	183
ARTHUR M. ANDERSON	WDH7563	A	Duluth	87	0									71	138	296
ATLANTIC BRAVE	D5LQ8	A	New Orleans	66	11									42	65	184
ATLANTIC BREEZE	VRDC6	A	Anchorage	0	0									11	2	13
ATLANTIC CARTIER	SCKB	A	Norfolk	2	0									6	17	25
ATLANTIC EXPLORER (AWS)	WDC9417	A	Anchorage	0	0									0	0	0
ATLANTIC GEMINI	VRDO9	A	Anchorage	18	9									95	46	168
ATLANTIC GRACE	V7UX9	A	New Orleans	0	0									28	0	28
ATLANTIC HOPE	VRDT5	A	Baltimore	39	13									107	39	198
ATLANTIS (AWS)	KAQP	A	Anchorage	730	660									712	730	2832
ATTENTIVE	WCZ7337	A	Anchorage	1	0									2	3	6
AUGUSTA KONTOR	V7HG7	I	Charleston	0	0									0	0	0
AURORA	WYM9567	A	Anchorage	28	2									0	44	74
AVIK	WDB7888	A	Anchorage	0	0									0	0	0
AWARE	WCZ7336	A	Anchorage	3	0									10	1	14
AZAMARA JOURNEY	9HOB8	A	Anchorage	0	0									1	0	1
BADGER	WBD4889	A	Duluth	0	0									0	0	0
BAIE ST. PAUL	CFN6120	A	Duluth	0	0									0	8	8
BARBARA FOSS	WYL4318	A	Anchorage	0	0									0	0	0
BARRINGTON ISLAND	C6QK	A	Miami	12	12									11	24	59
BELL M. SHIMADA (AWS)	WTED	A	Seattle	304	435									0	0	739
BERGE NANTONG	VRBU6	A	Anchorage	11	2									2	0	15
BERGE NINGBO	VRBQ2	A	Anchorage	0	0									92	31	123
BEARING LEADER	WDC7227	A	Anchorage	0	6									0	0	6
BERLIAN EKUATOR	HPYK	A	Anchorage	1	5									0	0	6
BERNARDO QUINTANA A.	C6KJ5	A	New Orleans	81	63									77	86	307
BILLIE H.	WCY4992	A	Anchorage	2	0									0	7	9
BISMARCK SEA	WDE5016	A	Anchorage	4	5									6	0	15
BLS LIWA	VREF5	A	Anchorage	0	0									0	0	0
BLUEFIN	WDC7379	A	Seattle	53	85									0	0	138

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
BRILLIANCE OF THE SEAS	C6SJ5	A	Miami	37	8									17	61	123
BUFFALO	WXS6134	A	Duluth	19	0									62	42	123
BUFFALO HUNTER	VROJ5	A	New York City	86	25									55	107	273
BULWARK	WBN4113	A	Anchorage	0	0									2	0	2
BURNS HARBOR	WDC6027	A	Duluth	0	0									13	8	21
CAFER DEDE	V7PR8	A	New York City	0	0									0	0	0
CALIFORNIA VOYAGER	WDE5381	A	New Orleans	19	20									42	24	105
CALUMET	WDE3568	A	Duluth	141	0									49	62	252
CAPITAINE TASMAN	S6SS	A	Anchorage	0	0									0	0	0
CAPRICORN VOYAGER	C6UZ5	A	Anchorage	3	0									28	29	60
CAPT. HENRY JACKMAN	VCTV	A	Duluth	0	0									8	0	8
CARNIVAL BREEZE	3FZO8	A	Miami	19	20									40	41	143
CARNIVAL CONQUEST	3FPQ9	A	Miami	91	93									68	105	357
CARNIVAL DREAM	3ETA7	A	New Orleans	16	67									37	18	137
CARNIVAL ECSTASY	H3GR	A	Miami	6	10									74	26	116
CARNIVAL ELATION	3FOC5	A	Jacksonville	33	9									69	43	154
CARNIVAL FANTASY	H3GS	A	Miami	4	1									12	22	39
CARNIVAL FASCINATION	C6FM9	A	Jacksonville	12	1									0	0	13
CARNIVAL FREEDOM	3EBL5	A	Houston	80	72									58	87	297
CARNIVAL GLORY	3FPS9	A	Miami	49	66									47	40	202
CARNIVAL IMAGINATION	C6FN2	A	Los Angeles	61	42									0	53	156
CARNIVAL INSPIRATION	C6FM5	A	Los Angeles	26	54									39	24	143
CARNIVAL LEGEND	H3VT	A	Miami	178	231									245	84	738
CARNIVAL LIBERTY	HPYE	A	Houston	7	12									15	11	45
CARNIVAL MAGIC	3ETA8	A	Jacksonville	60	25									53	36	174
CARNIVAL MIRACLE	H3VS	A	Seattle	41	8									51	49	149
CARNIVAL PARADISE	3FOB5	A	Miami	7	0									10	20	37
CARNIVAL PRIDE	H3VU	A	Jacksonville	22	0									29	22	73
CARNIVAL SENSATION	C6FM8	A	Miami	6	1									24	16	47
CARNIVAL SPLENDOR	3EUS	A	Anchorage	238	133									0	0	371
CARNIVAL SUNSHINE	C6FN4	A	Jacksonville	20	0									43	52	115
CARNIVAL TRIUMPH	C6FN5	A	New Orleans	0	43									3	0	46
CARNIVAL VALOR	H3VR	A	Jacksonville	0	0									3	6	9
CARNIVAL VICTORY	3FFL8	A	Jacksonville	42	23									82	50	197
CAROLINE MAERSK	OZWA2	A	Seattle	22	0									27	9	58
CASON J. CALLAWAY	WDH7556	A	Duluth	7	0									33	11	51
CASTOR VOYAGER	C6UZ6	A	Anchorage	19	87									4	2	112
CELEBRITY CONSTELLATION	9HJI9	A	Miami	0	61									218	166	445
CELEBRITY ECLIPSE	9HXC9	A	Miami	135	296									153	183	767
CELEBRITY EQUINOX	9HXD9	A	Miami	46	51									33	60	190
CELEBRITY INFINITY	9HJD9	A	Miami	0	84									0	0	84
CELEBRITY MILLENNIUM	9HJF9	A	Anchorage	213	116									79	165	573
CELEBRITY REFLECTION	9HA3047	A	Miami	117	97									109	122	445
CELEBRITY SILHOUETTE	9HA2583	A	Miami	32	180									129	117	458
CELEBRITY SOLSTICE	9HRJ9	A	Seattle	54	34									25	66	179

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
CELEBRITY SUMMIT	9HJC9	A	Miami	10	172									33	24	239
CHARLES ISLAND	C6JT	A	Miami	19	14									19	12	64
CHARLESTON EXPRESS	WDD6126	A	Houston	76	68									75	75	294
CHICAGO	A8PS5	A	Seattle	12	0									12	0	24
CHUKCHI SEA	WDE2281	A	Anchorage	1	0									2	8	11
CMB PAULE	VRJF3	A	New Orleans	0	0									0	0	0
COASTAL NOMAD	WDC6439	A	Anchorage	8	6									3	4	21
COASTAL PROGRESS	WDC6363	A	Anchorage	16	4									7	12	39
COASTAL TRADER	WSL8560	A	Anchorage	0	8									0	0	8
COASTAL VENTURE	WDF3547	A	Charleston	0	0									0	0	0
COLUMBIA	WYR2092	A	Seattle	0	0									0	0	0
COLUMBINE MAERSK	OUHC2	A	Norfolk	13	0									8	0	21
CORNELIA MAERSK	OWWS2	I	New York City	0	0									0	0	0
CORWITH CRAMER	WTF3319	A	Anchorage	0	0									10	15	25
COSCO PHILIPPINES	VRGM7	A	New York City	59	52									28	24	163
COSCO PRINCE RUPERT	VRID6	A	New York City	11	40									4	0	55
COSCO VIETNAM	VRID5	A	New York City	0	0									33	0	33
COSTA FORTUNA	IBNY	A	Miami	42	0									32	65	139
CROSS POINT	WDA3423	A	Anchorage	0	0									0	0	0
CRYSTAL SERENITY	C6SY3	A	Anchorage	83	61									142	120	406
CRYSTAL SUNRISE	9V2024	A	Anchorage	61	58									78	85	282
CS GLOBAL SENTINEL	KGSU	A	Seattle	26	62									54	8	150
CS RELIANCE	V7CZ2	A	Baltimore	10	9									2	30	51
CSCL MELBOURNE	VRBI8	A	Anchorage	0	0									0	0	0
CSL ASSINIBOINE	VCKQ	A	Duluth	0	0									0	0	0
CSL LAURENTIEN	VCJW	A	Duluth	0	0									3	11	14
CSL ST-LAURENT	CFK5152	A	Duluth	0	0									3	1	4
DIANE H	WUR7250	A	Anchorage	0	0									0	0	0
DISCOVERER CLEAR LEADER	V7MO2	A	Houston	111	59									112	123	405
DISCOVERER INSPIRATION	V7MO3	A	Houston	3	3									2	6	14
DISNEY DREAM	C6YR6	A	Jacksonville	48	62									13	0	123
DISNEY FANTASY	C6ZL6	A	Jacksonville	0	7									0	25	32
DISNEY MAGIC	C6PT7	A	Jacksonville	3	30									0	25	32
DISNEY WONDER	C6QM8	A	Miami	119	69									18	87	293
DOMINATOR	WBZ4106	A	Anchorage	23	56									0	0	79
DREW FOSS	WYL5718	A	Anchorage	0	0									28	0	28
DUNCAN ISLAND	C6JS	A	Miami	27	19									24	29	99
EAGLE KANGAR	9V8472	A	Houston	0	0									0	0	0
EAGLE KLANG	9V8640	A	Houston	45	0									77	33	155
EAGLE STAVANGER	3FNZ5	A	Houston	0	0									6	0	6
EAGLE SYDNEY	3FUU	A	New York City	0	0									22	40	62
EAGLE TAMPA	S6NK6	A	Houston	0	82									0	0	82
EAGLE TORRANCE	9VMG5	I	Houston	0	0									0	0	0
EDGAR B. SPEER	WDH7562	A	Duluth	1	0									162	196	359
EDWIN H. GOTT	WDH7558	A	Duluth	84	0									208	158	450

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
ENCHANTMENT OF THE SEAS	C6FZ7	A	Jacksonville	30	29									24	33	116
ENDEAVOR (AWS)	WCE5063	A	New York City	103	182									69	0	354
ENDURANCE	WDE9586	A	Baltimore	58	60									67	46	231
ENDURANCE	WDF7523	A	Anchorage	15	0									14	13	42
EOT SPAR	WDE9193	A	Jacksonville	1	0									0	0	1
ERNEST CAMPBELL	WDI8651	A	Anchorage	21	0									0	3	24
ERNEST N	A8PQ6	A	Anchorage	0	0									0	0	0
EURODAM	PHOS	A	Miami	89	138									112	77	416
EVER DECENT	9V7952	A	New York City	208	187									89	155	639
EVER DEVELOP	3FLF8	A	New York City	0	0									6	12	18
EVER DEVOTE	9V7954	A	New York City	0	9									7	0	16
EVER DIADEM	9V7955	A	New York City	92	88									83	99	362
EVER ELITE	VSJG7	A	Los Angeles	85	6									65	76	232
EVER LAMBENT	2FRE8	A	New York City	26	29									42	14	111
EVER LASTING	2FRK7	A	New York City	0	0									77	19	96
EVER LAWFULL	9V9288	A	New York City	1	6									31	12	50
EVER LEARNED	2GNG3	A	Norfolk	0	49									0	0	49
EVER LEGACY	9V9290	A	New York City	11	37									2	2	52
EVER LEGION	9V9725	A	New York City	2	16									0	0	18
EVER LENIENT	2HDF9	A	Los Angeles	0	0									3	0	3
EVER LIFTING	2ILJ7	A	New York City	8	6									11	18	43
EVER LISSOME	2HDG3	A	New York City	0	25									3	0	28
EVER LIVING	9V9791	A	Norfolk	13	26									0	0	39
EVER LOVELY	9V9793	A	Charleston	1	0									0	0	1
EVER LUCENT	9V9792	A	Norfolk	6	0									0	6	12
EVER LUCKY	3FAE4	A	New York City	9	17									65	60	205
EVER LUNAR	BKKF	A	New York City	18	13									21	13	65
EVER SALUTE	3ENU5	A	Anchorage	0	0									0	1	1
EVER SHINE	MJKZ4	A	Anchorage	6	0									1	3	10
EVER STEADY	3EHT6	A	Anchorage	9	16									0	0	25
EVER STRONG	3EJG3	A	Seattle	0	0									0	0	0
EVER SUMMIT	3EKU3	A	Anchorage	7	5									2	0	14
EVER SUPERB	3EGL5	A	Anchorage	0	0									23	17	40
EVER UNIFIC	9V7961	A	Anchorage	9	19									23	18	69
EVER UNIQUE	9V7959	A	Seattle	0	0									0	0	0
EVER UNITY	3FCD9	A	New York City	0	0									0	0	0
EVER URBAN	3FXN9	A	Seattle	0	0									1	1	2
EVER USEFUL	3FCC9	A	Anchorage	10	11									0	0	21
EXCALIBUR	ONCE	A	Houston	18	43									96	24	181
EXCEL	ONAI	A	Houston	42	86									11	52	191
EXCELSIOR	ONCD	A	Houston	0	0									22	7	29
EXPLORER OF THE SEAS	C6SE4	A	Jacksonville	109	50									114	107	380
EXPRESS	ONFL	A	Houston	43	24									20	78	165
FAIRCHEM MAVERICK	V7EP2	A	Anchorage	0	0									0	0	0
FAIRWEATHER	WDB5604	A	Anchorage	3	0									0	0	3

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
FAIRWEATHER (AWS)	WTEB	A	Anchorage	0	0									514	240	754
FEDERAL KIVALINA	V7RF2	A	Anchorage	0	0									0	0	0
FEDERAL YUKON	V7RG8	A	Anchorage	0	0									17	1	18
FERDINAND R. HASSLER	WTEK	A	Norfolk	38	212									15	260	525
FISH HAWK	WDF2995	I	Anchorage	0	0									11	260	525
FLORIDA	WFAF	A	Houston	0	2									3	0	5
FLORIDA VOYAGER	WDF4764	A	Los Angeles	0	0									0	0	0
FORUM PACIFIC	9VEY2	A	Anchorage	0	0									29	0	29
FREEDOM	WDB5483	A	Jacksonville	48	30									19	27	124
FREEDOM OF THE SEAS	C6UZ7	A	Miami	18	0									17	29	64
FRITZI N	A8PQ4	A	Anchorage	0	0									5	0	5
G. L. OSTRANDER	WCV7620	A	Duluth	2	0									128	81	211
G3 MARQUIS	XJBO	A	Duluth	0	0									18	87	105
GENCO AUGUSTUS	VRDD2	A	Anchorage	5	0									23	10	38
GENCO CLAUDIUS	V7SY6	A	Anchorage	83	2									68	61	214
GENCO HADRIAN	V7QN8	A	Anchorage	0	11									10	2	23
GENCO TITUS	VRDI7	A	Anchorage	36	25									5	0	66
GEORGE N	A8PQ5	A	Anchorage	21	159									1	30	211
GLEN CANYON BRIDGE	3EFD9	A	Norfolk	44	42									30	31	147
GORDON GUNTER (AWS)	WTEO	A	New Orleans	0	24									192	0	216
GORDON JENSEN	WDG3440	A	Anchorage	0	0									0	7	7
GRANDEUR OF THE SEAS	C6SE3	A	Jacksonville	3	9									0	1	13
GREAT REPUBLIC	WDH7561	A	Duluth	0	0									44	14	58
GREEN BAY	WDI3177	A	Jacksonville	1	12									0	3	16
GREEN LAKE	WDDI	A	Jacksonville	36	17									35	5	93
GREEN RIDGE	WZZF	A	Jacksonville	15	28									52	18	113
GUARDIAN	WBO2511	A	Anchorage	2	4									3	0	9
GUARDSMAN	WBN5978	A	Anchorage	0	1									0	0	1
GULF TITAN	WDA5598	A	Anchorage	1	0									29	1	31
GUNDE MAERSK	OUIY2	I	Seattle	0	0									0	0	0
H A SKLENAR	C6CL6	A	Houston	139	0									100	153	392
H. LEE WHITE	WZD2465	A	Duluth	5	0									94	56	155
HALIFAX EXPRESS	VRMW7	A	New Orleans	18	27									17	31	93
HARMONY OF THE SEAS	C6BX8	A	Miami	0	2									14	61	77
HENRY B. BIGELOW (AWS)	WTDF	A	New York City	0	332									283	0	615
HENRY GOODRICH	YJQN7	A	Houston	204	201									176	219	800
HERBERT C. JACKSON	WL3972	A	Duluth	235	0									715	743	1693
HHL RHINE	D5AM2	A	New Orleans	0	0									0	0	0
HI'IALAKAI (AWS)	WTEY	A	Honolulu	0	279									219	0	498
HOEGH CHIBA	LAVD7	A	Jacksonville	8	26									9	17	60
HON. JAMES L. OBERSTAR	WL3108	A	Duluth	374	0									704	742	1820
HONOR	WDC6923	A	Baltimore	1	14									13	3	31
HOOD ISLAND	C6LU4	A	Miami	17	14									20	15	66
HORIZON ENTERPRISE	KRGB	A	Seattle	78	58									79	66	281
HORIZON PACIFIC	WSRL	A	Seattle	63	46									59	62	230

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
HORIZON RELIANCE	WFLH	A	Los Angeles	0	1									41	25	67
HORIZON SPIRIT	WFLG	A	Los Angeles	0	0									66	27	93
HOUSTON	KCDK	A	Miami	4	1									0	0	5
HUNTER	WBN3744	A	Anchorage	3	10									1	0	14
HYDRA VOYAGER	C6AB8	A	Anchorage	11	18									0	0	29
IBRAHIM DEDE	V7QW6	A	New York City	4	11									19	10	44
INDEPENDENCE II	WGAX	A	Baltimore	49	23									36	38	146
INDEPENDENCE OF THE SEAS	C6WW4	A	Miami	10	36									12	14	72
INDIANA HARBOR	WXN3191	A	Duluth	3	0									0	20	23
INLAND SEAS	WCJ6214	A	Duluth	0	0									0	0	0
INTEGRITY	WDC6925	A	Baltimore	22	20									26	11	79
INTEGRITY	WDD7905	A	Anchorage	1	1									0	0	2
ISLA BELLA	WTOI	A	Jacksonville	43	61									55	40	199
IVER FOSS	WYE6442	A	Anchorage	0	0									28	0	28
JAMES L. KUBER	WDF7020	A	Duluth	62	0									114	99	305
JAMES R. BARKER	WYP8657	A	Duluth	296	0									713	744	1753
JEAN ANNE	WDC3786	A	Los Angeles	3	0									1	6	10
JENNY N	A8PQ7	A	Anchorage	554	46									540	482	1622
JEWEL OF THE SEAS	C6FW9	A	Miami	19	40									11	13	83
JOHN B. AIRD	VCYP	A	Duluth	0	0									13	5	18
JOHN J. BOLAND	WZE4539	A	Duluth	3	0									8	12	23
JONATHAN SWIFT	A8SN5	A	New York City	90	61									118	90	359
JOSEPH L. BLOCK	WXY6216	A	Duluth	285	0									396	450	1131
JOYCE L. VANENKEVORT	WDB9821	D	Duluth	0	0									0	0	0
JUSTINE FOSS	WYL4978	A	Anchorage	40	26									1	22	89
K. GARNET	3EVU4	A	New Orleans	0	0									0	0	0
KAAN KALKAVAN	TCTX2	A	New York City	15	0									7	32	54
KAMBOS	3ESY5	A	New Orleans	7	6									87	27	127
KAPRIJKE	ONIK	A	Houston	41	86									79	96	302
KAREN ANDRIE	WBS5272	A	Duluth	14	1									19	30	64
KAROLINE N	A8PQ8	A	Anchorage	19	15									21	25	80
KAUAI	WSRH	A	San Francisco	0	0									0	2	2
KAYE E. BARKER	WCF3012	A	Duluth	290	3									714	744	1751
KENNICOTT	WCY2920	A	Anchorage	0	0									0	0	0
KESWICK	C6XE5	A	Anchorage	16	15									16	15	62
KILO MOANA	WDA7827	A	Honolulu	56	34									9	75	174
KONINGSDAM	PBGJ	A	Miami	269	195									112	455	1031
LAUREN FOSS	WDG8426	A	Anchorage	0	0									0	0	0
LAURENCE M. GOULD (AWS)	WCX7445	A	Seattle	744	573									720	744	2781
LAVENDER PASSAGE	3FJY6	A	Anchorage	3	0									0	0	3
LECONTE	WZE4270	A	Anchorage	0	0									23	0	23
LEE A. TREGURTHA	WUR8857	A	Duluth	382	0									710	723	1815
LEGEND OF THE SEAS	C6SL5	A	Anchorage	10	4									10	9	33
LEO VOYAGER	C6AB7	A	Anchorage	9	7									9	10	35
LIBERTY	KLIG	A	Baltimore	0	34									0	0	34

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
LIBERTY EAGLE	WHIA	A	Houston	3	53									115	32	203
LIBERTY GLORY	WADP	A	Houston	57	48									0	57	162
LIBERTY GRACE	WADN	A	Houston	0	0									20	4	24
LIBERTY OF THE SEAS	C6VQ8	A	Houston	0	0									0	0	0
LIBERTY PASSION	WPLI	A	Charleston	0	15									0	0	15
LIBERTY PRIDE	KRAU	A	Charleston	55	32									78	35	200
LIBERTY PROMISE	WWMZ	A	Jacksonville	31	17									21	35	104
LOIS H	WTD4576	A	Anchorage	0	0									0	0	0
LOWLANDS PHOENIX	9HIY9	A	Anchorage	8	24									27	21	80
MAASDAM	PFRO	A	Miami	185	169									127	136	617
MAERSK ATLANTA	WNTL	A	Charleston	17	43									43	9	112
MAERSK CAROLINA	WBDS	A	Charleston	19	37									50	35	141
MAERSK CHICAGO	WMCS	A	Norfolk	23	13									15	29	80
MAERSK COLUMBUS	WMCU	A	Norfolk	25	0									17	39	81
MAERSK DENVER	WMDQ	A	New York City	21	3									35	32	91
MAERSK DETROIT	WMDK	A	Norfolk	3	5									47	11	66
MAERSK HARTFORD	WMHA	A	New York City	25	8									12	41	86
MAERSK HEIWA	9V9746	A	Anchorage	1	1									87	1	90
MAERSK IDAHO	WKPM	A	Baltimore	0	0									2	0	2
MAERSK IOWA	KABL	A	Norfolk	26	35									45	26	132
MAERSK KENSINGTON	WMKN	A	Charleston	85	64									47	88	284
MAERSK KENTUCKY	WKPY	A	New York City	9	23									4	0	36
MAERSK KINLOSS	WMKA	A	New York City	16	0									0	13	29
MAERSK MEMPHIS	WMMK	A	Charleston	34	53									0	0	87
MAERSK MISSOURI	WAHV	A	Norfolk	12	11									112	43	178
MAERSK MONTANA	WCDP	A	Norfolk	30	30									50	18	128
MAERSK NIAGARA	VREO9	A	Anchorage	43	34									20	39	136
MAERSK OHIO	KABP	A	New York City	72	134									44	94	344
MAERSK PEARY	WHKM	A	Houston	108	84									42	34	268
MAERSK PITTSBURGH	WMPP	A	New York City	40	40									47	55	182
MAERSK UTAH	9V3588	A	Norfolk	0	0									0	0	0
MAERSK WESTPORT	VRFO4	A	Charleston	0	0									13	0	13
MAERSK WILMINGTON	3EXT3	A	New York City	0	3									0	0	3
MAERSK WISCONSIN	WKPN	A	Norfolk	19	2									24	14	59
MAGNOLIA STATE	KGNQ	A	Charleston	0	0									0	0	0
MAHIMAHI	WHRN	A	Los Angeles	0	7									11	10	28
MAIA H	WYX2079	A	Anchorage	0	0									0	0	0
MAJESTY OF THE SEAS	C6FZ8	A	Jacksonville	22	28									34	29	113
MALOLO	WYH6327	A	Anchorage	0	0									0	3	3
MANITOWOC	WDE3569	A	Duluth	0	0									42	50	92
MANOA	KDBG	A	San Francisco	20	7									2	1	30
MANUKAI	WRGD	A	Los Angeles	14	33									30	18	95
MANULANI	WECH	A	Los Angeles	28	23									28	52	131
MARCUS G. LANGSETH (AWS)	WDC6698	A	Anchorage	743	444									712	740	2639
MARJORIE C	WDH6745	A	Los Angeles	9	16									19	15	59

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
MATANUSKA	WN4201	A	Anchorage	0	1									0	0	1
MATSON ANCHORAGE	KGTX	A	Anchorage	39	22									0	43	104
MATSON CONSUMER	WCHF	A	Seattle	2	0									33	24	59
MATSON KODIAK	KGTZ	A	Anchorage	53	55									40	39	187
MATSON NAVIGATOR	WPGK	A	Los Angeles	54	19									3	47	123
MATSON TACOMA	KGTY	A	Anchorage	49	52									44	49	194
MATSONIA	KHRC	A	Los Angeles	52	14									31	43	140
MAUNALEI	KFMV	A	Baltimore	38	24									37	27	126
MAUNAWILI	WGEB	A	Los Angeles	21	23									11	11	66
MEHUIN	A8SG8	A	Charleston	23	18									0	41	82
MESABI MINER	WYQ4356	A	Duluth	0	0									710	88	798
MIDNIGHT SUN	WAHG	A	Seattle	12	4									13	4	33
MIKE O'LEARY	WDC3665	A	Anchorage	0	0									0	0	0
MINERAL BEIJING	ONAR	A	Anchorage	17	4									17	7	45
MINERAL BELGIUM	VRKF5	A	Anchorage	22	30									2	22	76
MINERAL DALIAN	ONFW	A	Anchorage	82	51									25	30	208
MINERAL DRAGON	ONFN	A	Anchorage	124	70									28	12	234
MINERAL FAITH	VRKS4	A	Anchorage	22	66									11	6	105
MINERAL KYOTO	ONFI	A	Anchorage	42	62									86	27	217
MINERAL NEW YORK	ONGI	A	Anchorage	32	67									32	11	142
MINERAL NINGBO	ONGA	A	Anchorage	0	13									0	0	13
MINERAL NOBLE	ONAN	A	Anchorage	54	15									40	28	137
MINERAL TIANJIN	ONBF	A	Anchorage	82	69									10	1	162
MOKIHANA	WNRD	A	Los Angeles	4	42									16	0	62
MOL PARADISE	9V3118	A	Anchorage	10	0									0	0	10
MORNING HARUKA	A8GK7	A	Anchorage	0	0									0	0	0
MSC POESIA	3EPL4	A	Miami	0	0									0	0	0
MV GEYSIR	WDF3296	A	Norfolk	0	0									55	0	55
NACHIK	WDE7904	A	Anchorage	0	0									0	0	0
NANCY FOSTER (AWS)	WTER	A	Charleston	0	0									227	193	420
NATHANIEL B. PALMER (AWS)	WBP3210	A	Seattle	743	671									720	743	2877
NATIONAL GLORY	WDD4207	A	Houston	0	25									7	0	32
NAVIGATOR OF THE SEAS	C6FU4	A	Miami	18	13									8	13	52
NEPTUNE VOYAGER	C6FU7	A	New Orleans	6	0									0	2	8
NEVZAT KALKAVAN	TCMO2	A	New York City	11	7									44	17	79
NIEUW AMSTERDAM	PBWQ	A	Miami	209	351									103	352	1015
NILEDUTCH OSPREY	V7AP5	A	New York City	0	0									7	19	26
NOORDAM	PHET	A	Anchorage	272	232									70	194	768
NORFOLK	WDI3067	A		0	0									0	0	0
NORMAN O	WDC5066	I	Anchorage	0	0									0	0	0
NORTH STAR	KIYI	A	Seattle	3	4									14	3	24
NORTHERN VICTOR	WCZ6534	A	Anchorage	0	14									0	0	14
NORTHWEST SWAN	ZCDJ9	A	Anchorage	46	50									2	1	99
NORWEGIAN BREAKAWAY	C6ZJ3	A	New York City	61	51									0	96	208
NORWEGIAN DAWN	C6FT7	A	New Orleans	284	372									20	58	734

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
NORWEGIAN ESCAPE	C6BR3	A	Miami	36	36									45	0	117
NORWEGIAN GEM	C6VG8	A	Jacksonville	130	113									186	133	562
NORWEGIAN GETAWAY	C6ZJ4	A	Miami	34	102									57	61	254
NORWEGIAN JADE	C6WK7	A	Anchorage	134	71									241	176	622
NORWEGIAN JEWEL	C6TX6	A	Jacksonville	179	0									231	285	695
NORWEGIAN PEARL	C6VG7	A	Anchorage	423	83									516	463	1485
NORWEGIAN SKY	C6PZ8	A	Miami	0	0									30	17	47
NORWEGIAN SPIRIT	C6TQ6	A	Jacksonville	62	2									0	49	113
NORWEGIAN STAR	C6FR3	A	Anchorage	44	0									79	69	192
NORWEGIAN SUN	C6RN3	A	Miami	418	316									319	193	1246
NUNANIQ	WRC2049	A	Anchorage	0	0									0	0	0
NYK RUMINA	9V7645	A	New York City	112	80									118	58	368
NYK TRITON	3FUL2	A	Los Angeles	60	8									5	83	156
OASIS OF THE SEAS	C6XS7	A	Jacksonville	71	15									6	65	157
OCEAN CRESCENT	WDF4929	A	Houston	52	53									53	63	221
OCEAN EAGLE	WDG8082	A	Anchorage	0	0									0	1	1
OCEAN GIANT	WDG4379	A	Houston	9	0									3	0	12
OCEAN GLORY	KOGH	A	Charleston	29	10									25	4	68
OCEAN GRACIOUS	3EUP5	A	New Orleans	0	0									0	0	0
OCEAN MARINER	WCF3990	A	Anchorage	0	0									1	0	1
OCEAN NAVIGATOR	WSC2552	I	Anchorage	0	0									0	0	0
OCEAN RANGER	WAM7635	A	Anchorage	0	0									0	0	0
OCEANUS	WXAQ	A	Seattle	0	0									0	0	0
OKEANOS EXPLORER (AWS)	WTDH	A	New York City	199	561									0	171	931
OLEANDER	V7SX3	A	New York City	38	36									34	30	138
OLIVE L. MOORE	WDF7019	A	Duluth	0	0									210	11	221
ONEGO CAPRI	V2ED7	A	New Orleans	0	0									0	0	0
OOSTERDAM	PBKH	A	Anchorage	100	77									126	97	400
ORANGE BLOSSOM 2	D5DS3	A	New York City	3	5									27	24	59
ORANGE OCEAN	D5DS2	A	New York City	21	1									68	101	182
ORANGE SKY	ELZU2	A	New York City	0	39									32	22	93
ORANGE STAR	A8WP6	A	New York City	69	6									6	36	117
ORANGE SUN	A8HY8	A	New York City	72	14									22	13	121
ORANGE WAVE	ELPX7	A	New York City	0	0									0	0	0
ORE ITALIA	9V9129	A	Anchorage	110	386									296	386	1178
OREGON II (AWS)	WTDO	A	New Orleans	0	1									92	0	93
OREGON VOYAGER	WDF2960	A	San Francisco	66	11									0	0	77
ORIENTAL QUEEN	VRAC9	A	Anchorage	4	19									24	12	59
OSCAR DYSON (AWS)	WTEP	A	Anchorage	167	218									0	0	385
OSCAR ELTON SETTE (AWS)	WTEE	A	Honolulu	0	0									88	0	88
OURO DO BRASIL	ELPP9	A	Baltimore	50	72									36	46	204
OVERSEAS ANACORTES	KCHV	A	Miami	31	17									28	30	106
OVERSEAS BOSTON	WJBU	A	Anchorage	17	44									9	42	112
OVERSEAS CASCADE	WOAG	A	Miami	12	12									8	17	49
OVERSEAS CHINOOK	WNFQ	A	Houston	1	7									60	15	83

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
OVERSEAS HOUSTON	WWAA	A	Miami	0	0									0	0	0
OVERSEAS LONG BEACH	WAAT	A	Jacksonville	8	8									12	16	44
OVERSEAS LOS ANGELES	WABS	A	Seattle	102	81									28	0	211
OVERSEAS MARTINEZ	WPAJ	A	Anchorage	6	13									8	5	32
OVERSEAS NIKISKI	WDBH	A	Anchorage	18	21									13	3	55
OVERSEAS SANTORINI	WOSI	A	Houston	0	0									21	12	33
OVERSEAS TAMPA	WOTA	A	Baltimore	1	0									4	2	7
OVERSEAS TEXAS CITY	WHED	A	Houston	22	23									22	54	121
PACIFIC FREEDOM	WDD3686	A	Anchorage	2	0									1	4	7
PACIFIC RAVEN	WDD9283	A	Anchorage	2	0									8	7	17
PACIFIC SANTA ANA	A8W13	A	Houston	22	14									28	58	122
PACIFIC SHARAV	D5DY4	A	Houston	35	29									21	29	114
PACIFIC STAR	WDD3686	A	Anchorage	0	0									0	0	0
PACIFIC TITAN	WCZ6844	A	Anchorage	4	0									1	0	5
PACIFIC WARRIOR	WCZ5243	I	Anchorage	0	0									0	0	0
PACIFIC WOLF	WDD9286	A	Anchorage	0	10									0	0	10
PANDALUS	WAV7611	I	Anchorage	0	0									0	0	0
PARAGON	WDD9285	A	Anchorage	0	0									3	0	3
PARAMOUNT HALIFAX	2CWC2	A	Houston	0	0									3	0	3
PARAMOUNT HAMILTON	2CWB2	A	Houston	0	0									1	0	1
PATRIARCH	WBN3014	I	Jacksonville	0	0									0	0	0
PATRIOT	WAIU	A	Charleston	42	16									29	24	111
PAUL GAUGUIN	C6TH9	A	Anchorage	66	51									2	72	191
PAUL R. TREGURTHA	WYR4481	A	Duluth	181	0									706	718	1605
PERLA DEL CARIBE	KPDL	A	Jacksonville	35	27									50	35	147
PERSEVERANCE	WDE5328	A	Anchorage	2	0									0	0	2
PHILADELPHIA EXPRESS	WDC6736	A	Houston	82	56									83	60	281
PHILIP R CLARKE	WDH7554	A	Duluth	14	0									28	41	83
PISCES (AWS)	WTDL	A	New Orleans	0	0									172	101	273
POLAR ADVENTURE	WAZV	A	Seattle	8	8									42	13	71
POLAR CLOUD	WDF5296	A	Anchorage	5	5									0	0	10
POLAR DISCOVERY	WACW	A	Seattle	17	17									52	43	129
POLAR ENDEAVOUR	WCAJ	A	Seattle	25	40									40	32	137
POLAR ENDURANCE	WDG2085	A	Anchorage	0	0									0	0	0
POLAR ENTERPRISE	WRTF	A	Seattle	47	59									7	44	157
POLAR RESOLUTION	WDJK	A	Seattle	15	19									12	3	49
POLAR STORM	WDE8347	A	Anchorage	0	6									0	0	6
POLAR VIKING	WDD6494	A	Anchorage	0	0									1	1	2
PREMIUM DO BRASIL	A8BL4	A	Baltimore	29	32									27	31	119
PRESQUE ISLE	WDH7560	A	Duluth	30	0									87	68	185
PRIDE OF AMERICA	WNBE	A	Anchorage	0	0									2	4	6
PRIDE OF BALTIMORE II	WUW2120	A	Baltimore	0	0									0	0	0
PRINSENDAM	PBGH	A	Miami	124	141									302	201	768
PRT DREAM	3EXT	A	New Orleans	0	0									0	0	0
PSU EIGHTH	9V6346	A	Anchorage	0	0									56	20	76

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
QUANTUM OF THE SEAS	C6BH8	A	New York City	113	55									41	86	295
R. J. PFEIFFER	WRJP	A	Los Angeles	60	57									59	41	217
R/V KIYI	KAO107	A	Duluth	0	0									11	0	11
RADIANCE OF THE SEAS	C6SE7	A	Anchorage	238	388									2	0	628
RAINIER (AWS)	WTEF	A	Seattle	0	0									36	0	36
REBECCA LYNN	WCW7977	A	Duluth	0	0									3	2	5
REDOUBT	WDD2451	A	Anchorage	0	0									0	0	0
REGATTA	V7DM3	A	Seattle	4	9									27	0	40
RESOLVE	WCZ5535	A	Baltimore	27	21									28	31	107
RESPONDER	V7CY9	A	Baltimore	4	49									8	0	61
REUBEN LASKER (AWS)	WTEG	A	Seattle	409	0									42	0	451
RHAPSODY OF THE SEAS	C6UA2	A	Anchorage	32	27									0	14	73
RICHARD BRUSCO	WDC3031	A	Anchorage	1	0									2	7	10
ROBERT C. SEAMANS	WDA4486	A	Anchorage	0	0									10	33	43
ROBERT GORDON SPROUL (AWS)	WSQ2674	A	Los Angeles	736	273									719	741	2469
ROBERT BLOUGH	WDH7559	A	Duluth	46	0									167	125	338
ROGER REVELLE (AWS)	KAOU	A	Los Angeles	572	672									634	296	2174
RONALD H. BROWN (AWS)	WTEC	A	Charleston	668	441									247	535	1891
RONALD N	A8PQ3	A	Anchorage	36	35									38	2	111
RTM DHAMBUL	9V2783	A	Anchorage	28	35									38	2	111
SABINE	V7UU6	A	Baltimore	153	75									0	48	276
SAGA ADVENTURE	VRBL4	A	Anchorage	58	54									12	37	161
SAGA CREST	VRWR7	A	Anchorage	102	5									0	0	107
SAGA DISCOVERY	VRBR8	A	Seattle	14	20									7	0	41
SAGA ENTERPRISE	VRCC8	A	Anchorage	1	19									21	11	52
SAGA FUTURE	VRKX8	A	Anchorage	16	0									49	100	165
SAGA MONAL	VRZQ9	A	Anchorage	2	0									0	0	2
SAGA NAVIGATOR	VRDA4	A	Anchorage	43	38									79	75	235
SAGA PIONEER	VRED4	A	Anchorage	0	0									0	0	0
SAGA SPRAY	VRWW5	A	Anchorage	34	79									124	8	245
SAGA TUCANO	VRVP2	A	Anchorage	113	197									0	0	310
SAGA WIND	VRUR7	A	Anchorage	16	3									0	0	310
SAIPEM 7000	C6NO5	I	Anchorage	0	0									0	0	0
SALLY RIDE	WSAF	A	Seattle	0	10									0	0	10
SAM LAUD	WZC7602	A	Duluth	9	0									39	42	90
SAMSON MARINER	WCN3586	A	Anchorage	1	0									6	0	7
SAMUEL DE CHAMPLAIN	WDC8307	A	Duluth	13	0									29	2	44
SANDRA FOSS	WYL4908	A	Anchorage	0	0									28	0	28
SAVITA NAREE	9V5030	A	New Orleans	0	0									0	0	0
SEA HAWK	WDD9287	A	Anchorage	8	2									0	2	12
SEA VOYAGER	WCX9106	A	Anchorage	16	16									15	8	55
SEA-LAND CHARGER	9V3589	A	Los Angeles	0	0									0	0	0
SEA-LAND COMET	9V3292	A	Los Angeles	0	0									0	0	0
SEA-LAND INTREPID	9V3293	A	Los Angeles	0	0									0	0	0
SEA-LAND LIGHTNING	9V3291	A	New York City	0	0									20	1	21

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
SEABOURN QUEST	C6YZ5	A	Miami	0	0									30	24	54
SEABULK ARCTIC	WCY7054	A	Miami	5	16									4	23	48
SEABULK TRADER	KNJK	A	Miami	26	32									46	31	135
SEAFREEZE AMERICA	WDH8281	A	Anchorage	10	15									26	5	56
SEASPAN CHIWAN	VRBH3	A	Anchorage	24	16									0	5	45
SEASPAN FELIXSTOWE	VRBH8	A	Seattle	3	1									24	18	46
SEASPAN SAIGON	VRBT7	A	New York City	0	0									3	0	3
SEOUL TRADER	9HA3782	A	Los Angeles	0	0									0	0	0
SERENADE OF THE SEAS	C6FV8	A	Miami	4	0									43	35	82
SESOK	WDE7899	A	Anchorage	0	0									9	0	9
SEVEN SEAS EXPLORER	V7QK9	A	Anchorage	131	94									34	83	342
SEVEN SEAS MARINER	C6VV8	A	Jacksonville	224	328									106	326	984
SEVEN SEAS NAVIGATOR	C6ZI9	A	Miami	547	142									444	716	1849
SEVEN SEAS VOYAGER	C6SW3	A	Anchorage	281	93									168	228	770
SHANDONG DA CHENG	9V9131	A	Anchorage	733	276									196	398	1603
SHANDONG DA DE	9V9128	A	Anchorage	91	29									133	119	372
SIANGTAN	9V9832	A	Seattle	37	21									39	25	122
SIGAS SILVIA	S6ES6	A	Anchorage	432	192									567	553	1744
SIKU	WCQ6174	A	Anchorage	0	0									111	0	111
SIKULIAQ (AWS)	WDG7520	A	Anchorage	597	626									366	459	2048
SILVER DISCOVERER	C6OZ3	I	Anchorage	0	0									0	0	0
SILVER SHADOW	C6FN6	A	Anchorage	0	0									0	0	0
SKYWALKER	D5IB9	A	New Orleans	0	0									0	0	0
SNOHOMISH	WDB9022	A	Anchorage	0	0									0	0	0
SOL DO BRASIL	ELQQ4	A	Baltimore	50	58									15	47	170
SOMBEKE	ONHD	A	Houston	85	35									0	49	169
SPICA	A8QJ5	A	New Orleans	22	13									33	32	100
SS MAUI	WSLH	A	Seattle	62	29									0	7	98
ST LOUIS EXPRESS	WDD3825	A	Houston	87	64									65	69	285
STACEY FOSS	WYL4909	A	Anchorage	0	0									24	0	24
STAR HERDLA	LAVD4	A	New Orleans	0	0									1	0	1
STAR HIDRA	LAVN4	A	Baltimore	12	31									0	8	51
STAR ISFJORD	LAOX5	A	New Orleans	0	11									1	13	25
STAR ISTIND	LAMP5	A	Seattle	0	0									24	10	34
STAR JAPAN	LAZV5	A	Seattle	7	17									27	4	55
STAR JAVA	LAJS6	A	Baltimore	1	3									1	0	5
STAR JUVENTAS	LAZU5	A	Baltimore	19	17									0	12	48
STAR KILIMANJARO	LAIG7	A	Anchorage	9	14									18	25	66
STAR KINN	LAJF7	A	Anchorage	0	0									7	1	8
STAR KIRKENES	LAHR7	A	New Orleans	19	0									16	16	51
STAR KVARVEN	LAJK7	A	Seattle	47	52									11	5	115
STAR LIMA	LAPE7	A	Jacksonville	24	19									37	74	154
STAR LINDESNES	LAQJ7	A	Jacksonville	20	0									0	30	50
STAR LIVORNO	LAQM7	A	Houston	12	7									0	2	21
STAR MINERVA	V7GR8	A	Jacksonville	22	30									18	30	100

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STELLAR VOYAGER	C6FV4	A	Seattle	37	18									45	31	131
STEWART J. CORT	WDC6055	A	Duluth	332	0									713	683	1728
SUNSHINE STATE	WDE4432	A	Miami	18	10									5	12	45
SUPERSTAR GEMINI	C6LG5	A	Anchorage	48	52									29	60	189
SUPERSTAR LIBRA	C6DM2	A	Anchorage	116	105									102	103	426
SUSAN MAERSK	OYIK2	A	Seattle	0	58									0	0	58
TAKU WIND	WI9436	A	Anchorage	0	11									0	0	11
TALISMAN	LAOW5	A	Jacksonville	60	6									39	73	178
TAMESIS	LAOL5	I	Norfolk	0	0									0	0	0
TANGGUH HIRI	C6XC2	A	Anchorage	44	81									86	92	303
THOMAS JEFFERSON (AWS)	WTEA	A	Norfolk	0	0									329	2	331
THUNDER BAY	CFN6288	A	Duluth	20	0									2	0	22
TIGLAX	WZ3423	A	Anchorage	0	0									0	0	0
TIM S. DOOL	VGPY	A	Duluth	0	0									9	5	14
TIME BANDIT	WDH2111	A	Anchorage	5	0									0	0	5
TRIUMPH	WDC9555	A	Anchorage	0	0									0	0	0
TROPIC CARIB	J8PE3	A	Miami	63	103									70	42	278
TROPIC EXPRESS	J8QB8	A	Miami	47	39									39	38	163
TROPIC JADE	J8NY	A	Miami	40	33									50	26	149
TROPIC LURE	J8PD	A	Miami	36	19									102	45	202
TROPIC MIST	J8NZ	A	Miami	41	37									57	54	189
TROPIC NIGHT	J8NX	A	Miami	25	79									2	59	165
TROPIC OPAL	J8NW	A	Miami	128	89									100	132	449
TROPIC PALM	J8PB	A	Miami	67	46									78	58	249
TROPIC SUN	J8AZ2	A	Miami	125	96									120	117	458
TROPIC TIDE	J8AZ3	A	Miami	24	81									1	0	106
TROPIC UNITY	J8PE4	A	Miami	94	104									82	102	382
TS KENNEDY	KVMU	A	New York City	104	78									0	0	182
TUG DEFIANCE	WDG2047	A	Duluth	19	0									82	34	135
TUG DOROTHY ANN	WDE8761	A	Duluth	0	126									715	539	1380
TUG MICHIGAN	WDF5344	A	Duluth	32	20									85	58	195
TUG SPARTAN	WDF5483	A	Duluth	0	0									1	0	1
TUSTUMENA	WNGW	A	Anchorage	55	44									39	43	181
TYCO DECISIVE	V7DI7	A	Baltimore	0	0									0	0	0
U. S. INTREPID	WDE2670	A	Anchorage	0	0									9	2	11
USCGC HEALY	NEPP	I	Seattle	0	0									0	0	0
USCGC MACKINAW	NBGB	A	Duluth	1	0									2	1	4
VALDEZ RESEARCH (AWS)	WXJ63	A	Anchorage	743	671									717	725	2856
VEENDAM	PHEO	A	Miami	288	344									177	112	921
VISION OF THE SEAS	C6SE8	A	Miami	0	0									0	0	0
VOLENDAM	PCHM	A	Anchorage	661	664									237	159	1721
W. H. BLOUNT	C6JT8	A	New Orleans	52	57									59	37	205
WALTER J. MCCARTHY JR.	WXU3434	A	Duluth	16	0									73	34	123
WASHINGTON EXPRESS	WDD3826	A	Houston	18	10									62	81	171
WENDY O.	WDF8784	A	Anchorage	0	0									0	0	0

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
WESTERDAM	PINX	A	Miami	98	104									97	87	386
WESTERN MARINER	WRB9690	A	Anchorage	2	0									0	0	2
WESTERN RANGER	WBN3008	A	Anchorage	20	0									0	0	20
WESTWOOD COLUMBIA	C6SI4	A	Seattle	2	22									3	2	29
WESTWOOD OLYMPIA	C6UB2	A	Seattle	15	7									22	14	58
WESTWOOD RAINIER	C6SI3	A	Seattle	34	34									28	23	119
WHITTIER RESEARCH (AWS)	KXI29	A	Anchorage	744	672									719	725	2860
WILFRED SYKES	WC5932	A	Duluth	0	0									623	328	951
XPEDITION	HC2083	A	Anchorage	9	5									15	8	37
YM ANTWERP	VRET5	A	Anchorage	23	0									12	4	39
YORKTOWN EXPRESS	WDD6127	A	Houston	41	39									44	47	171
YUHSAN	H9TE	A	Anchorage	17	13									148	42	220
ZAANDAM	PDAN	A	Anchorage	45	87									106	85	323
ZIM SAN DIEGO	A8SI7	A	New York City	0	0									2	1	3
ZIM SHANGHAI	VRGA6	A	New York City	26	25									25	26	102
ZUIDERDAM	PBIG	A	Anchorage	155	119									105	113	492

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⚓

NOAA Weather Radio Network

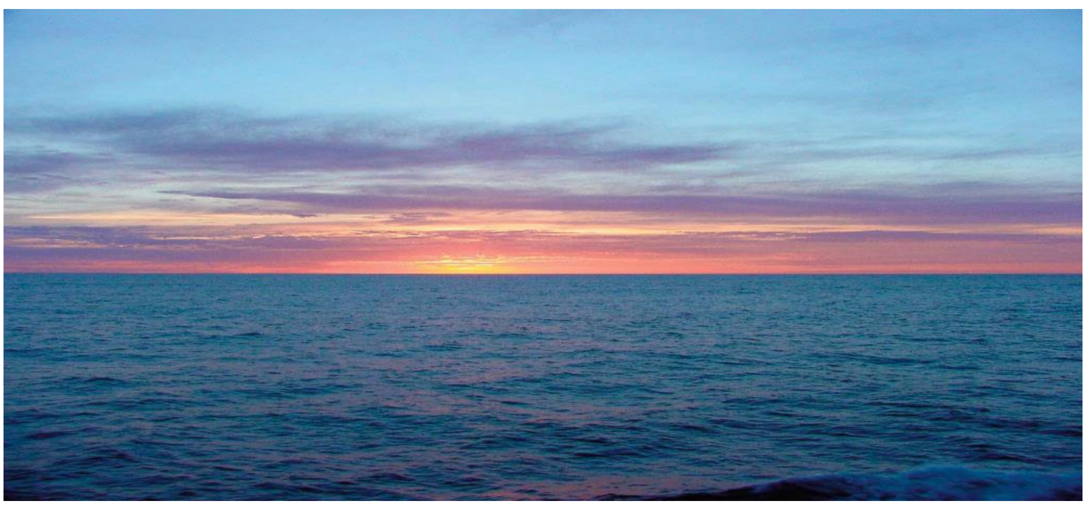
(1) 162.550 mHz
(2) 162.400 mHz
(3) 162.475 mHz
(4) 162.425 mHz
(5) 162.450 mHz
(6) 162.500 mHz
(7) 162.525 mHz

Channel numbers, e.g., (WX1, WX2), etc., have no special significance, but are often designated this way in consumer equipment. Other channel numbering schemes are also prevalent.

The NOAA Weather Radio network provides voice broadcasts of local and coastal marine forecasts on a continuous cycle. The forecasts are produced by local National Weather Service Forecast Offices.

Coastal stations also broadcast predicted tides and real-time observations from buoys and coastal meteorological stations operated by NOAA's National Data Buoy Center. Based on user demand, and where feasible, Offshore and Open Lake forecasts are broadcast as well.

The NOAA Weather Radio network provides near-continuous coverage of the coastal U.S., Great Lakes, Hawaii, and populated Alaska coastline. Typical coverage is 25 nautical miles offshore, but may extend much further in certain areas.



Parting Shot: Photography by Raymond Boone, NDBC/NTSC Electronics Technician, Maint III.
Photo is courtesy NOAA's National Data Buoy Center, Stennis Space Center, MS. USA

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