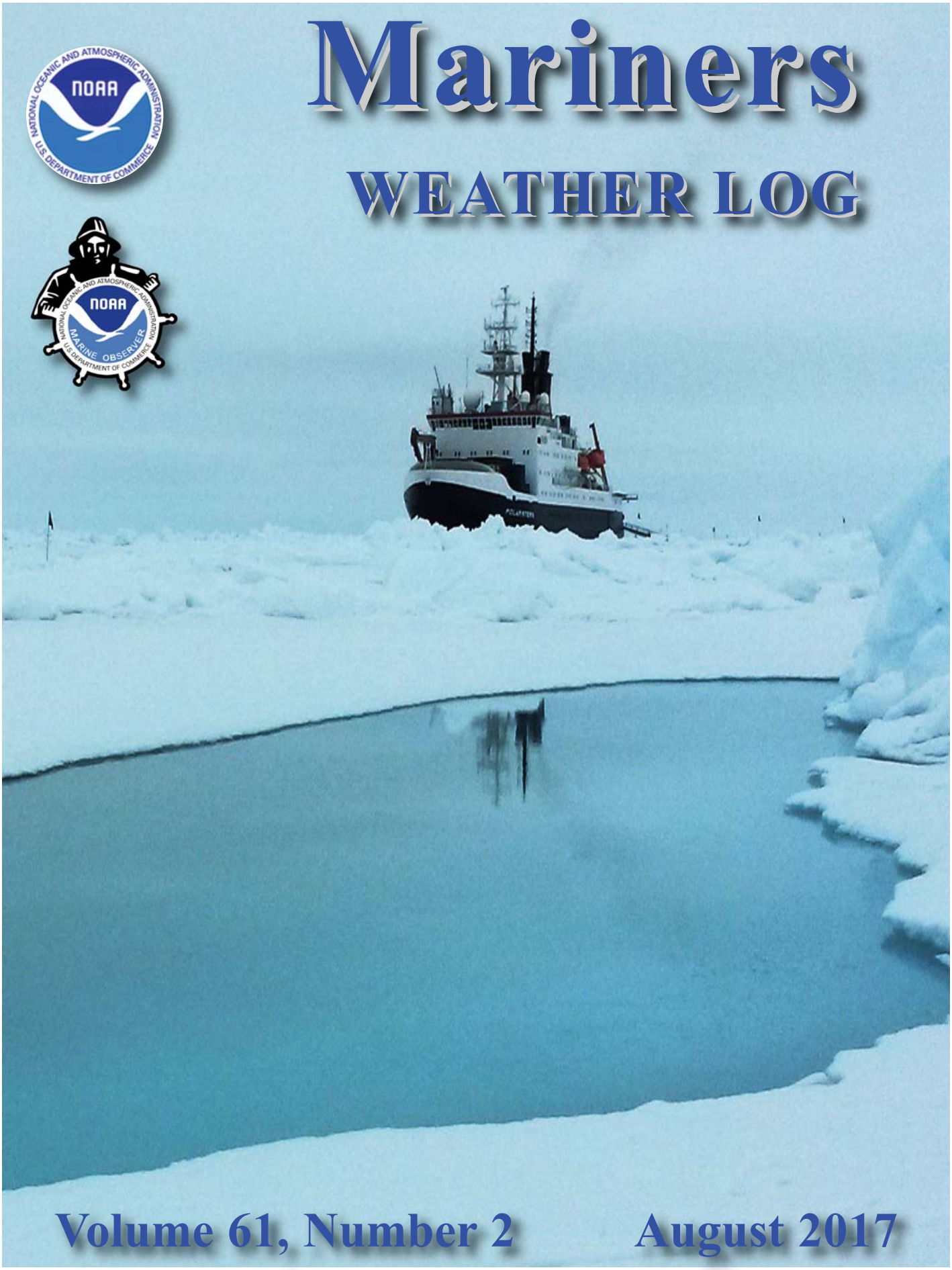
Mariners

WEATHER LOG



Volume 61, Number 2 August 2017

Mariners Weather Log

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http://www.vos.noaa.gov/mwl.shtml

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From the Editor

Greetings and welcome to the August edition of the Mariners Weather Log. In this issue, I would invite you to read our cover story, an interesting article on efforts to collect oceanic and meteorological data supporting Arctic research. This article was submitted by VOS's German colleague, Henry Kleta, who was able to ride on the German Research Vessel **POLARSTERN** and engage in the many scientific data collections: deployment of drifters, Argo floats, and upper-air soundings (to name just a few), in efforts to collect vital Arctic environmental data.

Globally, the need for data collection and analysis is ever so important, and it is this data that gives us our ability to gauge the health of our planet. Data monitoring and collecting from regions of the world (such as the Arctic) have become increasingly more valuable and concerning.

A NOAA-sponsored report, part of NOAA's Arctic Program, shows that unprecedented warming air temperature in 2016 over the Arctic contributed to a record-breaking delay in the fall sea ice freeze-up, leading to extensive melting of Greenland ice sheet and land-based snow cover. NOAA's Arctic Program provides a Web site and a report card giving the latest science from top experts to track changes in the Arctic.

A joint effort between multiple international agencies, government as well as commercial entities, conventional (such as the **POLARSTERN**) and non-conventional (such as VOLVO Racing Yachts), provide the opportunity to collect and provide data necessary for the understanding of the complex Arctic system. This includes the complicated linkages among melting sea ice, changing climate, ecosystems, and weather patterns in the Arctic and around the globe.[1]

For a video clip of the 2016 Arctic report card, please go to this link:

http://www.arctic.noaa.gov/Report-Card/Report-Card-2016

Thank you all for being part of the Voluntary Observing Ship (VOS) Program. Your participation is so valuable to us and our mission. Only ***YOU*** know the weather at your position. Report it!

Now sit back and enjoy the latest issue.

Cheers!

- Paula

[1] http://www.arctic.noaa.gov/Research

Mariners Weather Log

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En Route to the Arctic with RV POLARSTERN

Henry Kleta
DWD Marine Network Manager
Chair JCOMM SOT VOS Panel, Chair E-Surfmar VOS Expert Team

The Polar Regions are important components in the global climate system. The widespread surface snow and ice cover in Polar Regions strongly impacts the surface energy budget, which is tightly coupled to global atmospheric and oceanic circulations. The interaction of different Arctic feedback mechanisms is not yet completely understood. For example, the coupling of sea ice, clouds, and aerosol in the transition zone between open ocean and sea ice has not been well investigated so far.

This issue has been addressed in PASCAL project (physical feedbacks of Arctic PBL, Sea Ice, Cloud, and Aerosol). Within this project, the expedition PS106.1 with the polar research vessel **POLARSTERN** (DBLK, Alfred Wegener Institute, Germany) has been undertaken. The cruise started on 24 May from Bremerhaven and ended on 21 June in Longyearbyen.

Henry Kleta, Marine Network Manager from Germany, and as such responsible for the German VOS fleet, has been on board.

The cruise led from Bremerhaven on a direct route into the central Arctic, where at approximately 82°N 10°E, **POLARSTERN** berthed at an ice floe for 14 days. En route, several SVP Drifters and Argo Floats were deployed in international waters.

While **POLARSTERN** remained in the ice, identical measurements were carried out from the AWIPEV Base (German-French Research Base) in Ny-Ålesund, close to the open ocean. The observations of both surface stations were closely coordinated with collocated airborne activities of the Polar 5 and Polar 6 AWI aircraft operating between both stations along the gradient of sea-ice concentration, as well as close to **POLARSTERN**.

Figure 1. Niels Fuchs and Henry Kleta deploy an SVP drifter (photo: Ulrich Küster).

Figure 2. RV POLARSTERN in the ice (photo: Henry Kleta).

Figure 3. Polar bears investigate scientific equipment (photo: Henry Kleta).

These airborne observations were supplemented by observations of the boundary-layer structure (mean and turbulent quantities) from tethered balloon and several small Unmanned Airborne Vehicles (UAVs), operated during the ice station nearby **POLARSTERN**. In parallel with atmospheric studies, we will conduct oceanographic, physical, and biological research on the drifting ice floe.

Procedures and methods experienced and used during these 14 days at and on the ice floe will be re-used during the MOSAiC Project (Multidisciplinary Drifting Observatory for the Study of Arctic Climate, FS **POLARSTERN**, 2019–2020). Additionally, logistical support could be provided as Skidoo coresponsible and as AWI trained, armed bear guard on the ice.

Within the many impressions gained during work on an Arctic ice floe, the visit of a polar bear with her cub that investigated closely all scientific equipment installed on the flow was certainly a highlight. (See **Figure 3**.)

Figure 4. *Apherusa Glacialis* seen with a microscope on RV POLARSTERN (photo: Henry Kleta).

Relation between Significant Wave Height and Dominant Period during Hurricanes

Professor S. A. Hsu
Louisiana State University
E-mail: sahsu@lsu.edu

In the August 2016 Issue of this Journal, the author proposed following formula under hurricane conditions:

$$H_s = 0.47\ U_{10} - 3, \qquad (1)$$

Here, H_s (in meters) is the significant wave height, and U_{10} (in meters per second) is the wind speed at the height of 10 meters. Moreover, in the April 2017 issue of this Journal, the author presented the following equation between wind speed and wave parameters such that:

$$U_{10} = 36\ H_s / T_p, \qquad (2)$$

Here, T_p is the dominant or peak wave period (in seconds).

Now, by substituting U_{10} from Equations (2) into (1) and rearranging, we have:

$$T_p = 17\ H_s / (H_s + 3). \qquad (3)$$

During Hurricane Katrina in 2005, **Figure 1** shows that Hs increased from less than 2 to approximately 17 meters and T_p from around 2 to over 14 seconds at Buoy 42040 as measured by the National Data Buoy Center (NDBC). Using these H_s data, Equation (3) may be used to estimate T_p. The results appear in **Figure 2**, indicating that the slope is unity and the coefficient of determination, $R^2 = 0.88$, meaning that 88 percent of the variation between H_s and T_p can be explained by Equation (3). In other words, if one accepts the high correlation coefficient **($R = 0.94$)**, Equation (3) may be used to estimate T_p from H_s as a first approximation during hurricanes. More verification is presented in **Figure 3**, which is based on pertinent measurements made at NDBC Buoy 42003 during Katrina. Further verifications for Equation (3) appear in **Figure 4** based on the datasets **Table 1** provides.

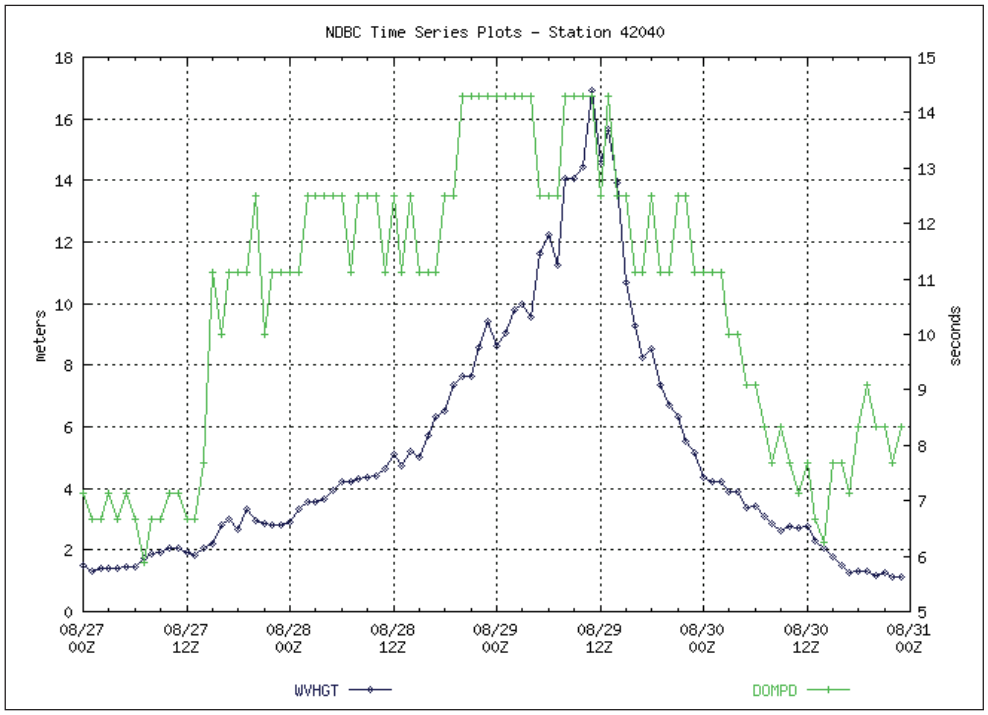


Figure 1. Significant Wave Height (in blue, see vertical scale on the left) and Dominant Period (in green, on the right) at Buoy 42040 during Hurricane Katrina.

http://www.ndbc.noaa.gov/hurricanes/2005/katrina/

Again, if one accepts the statistics shown in the **Figure 4**, Equation (3) is validated. For quick estimates of T_p from H_s, a graphic representation for Equation (3) is also provided in **Figure 5**. Note that, as shown in these figures, the aforementioned formulas are valid for the wind seas when the effects of swell are minimized that:

$$U_{10} \geq 9 \text{ m s}^{-1}, \quad (4)$$

$$H_s/L_p \geq 0.020, \quad (5)$$

$$L_p = (g/2\pi)\, T_p^2 = 1.56 T_p^2. \quad (6)$$

Here, L_p is the peak or dominant wave length in meters, and g is the gravitational acceleration (**= 9.8 m s $^{-2}$**). Note that the parameter H_s / L_p is called "wave steepness."

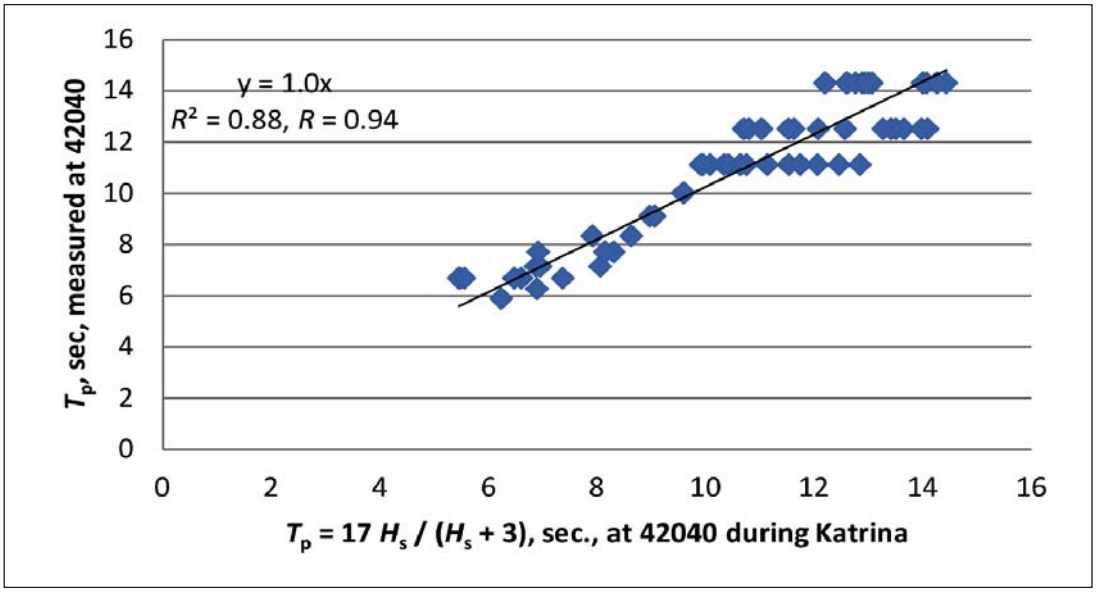


Figure 2. Verification of Equation (3) at NDBC Buoy 42040 during Hurricane Katrina.

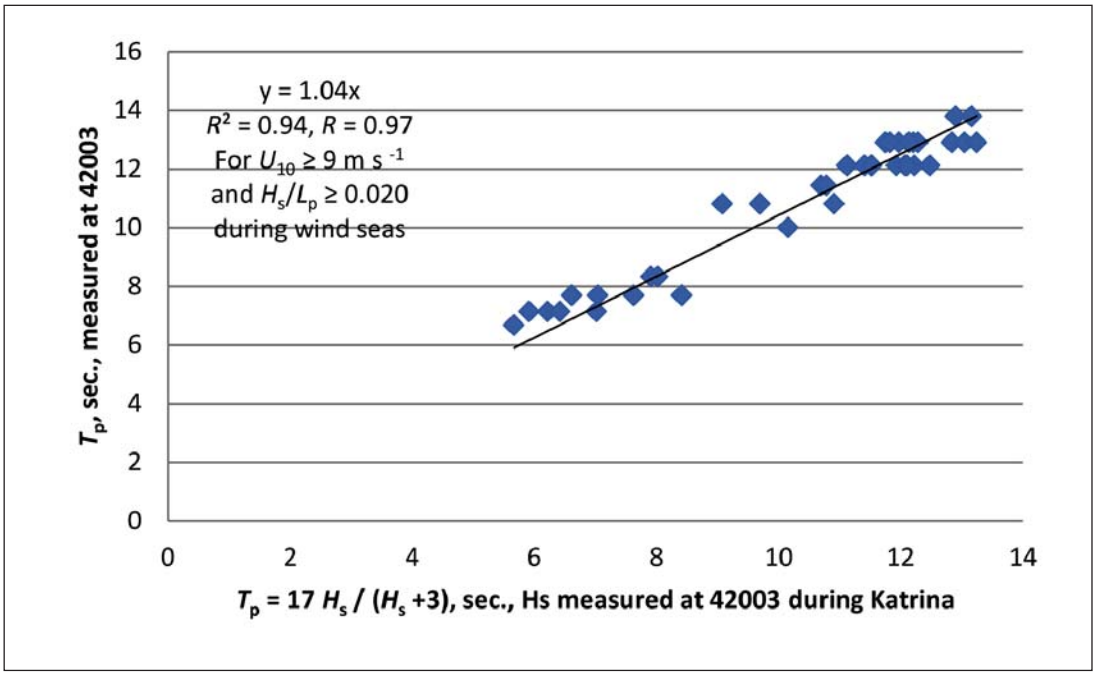


Figure 3. Verification of Equation (3) at NDBC Buoy 42003 during Hurricane Katrina.

Table 1. Data Sources Used in This Study Based on Buoy Measurements by the National Data Buoy Center (NDBC) (www.ndbc.noaa.gov) during Wind Seas when:

$$H_s/L_p \geq 0.020 \text{ and } U_{10} \geq 9 \text{ m s}^{-1}.$$

HURRICANE	YEAR	MONTH	DATE	BUOY	Air Pressure
Kate	1985	11	19–21	42003	9–47
Lili	2002	10	1–3	42001	9–47
Rita	2005	9	21–24	42001	10–41
Wilma	2005	10	19–24	42056	12–32

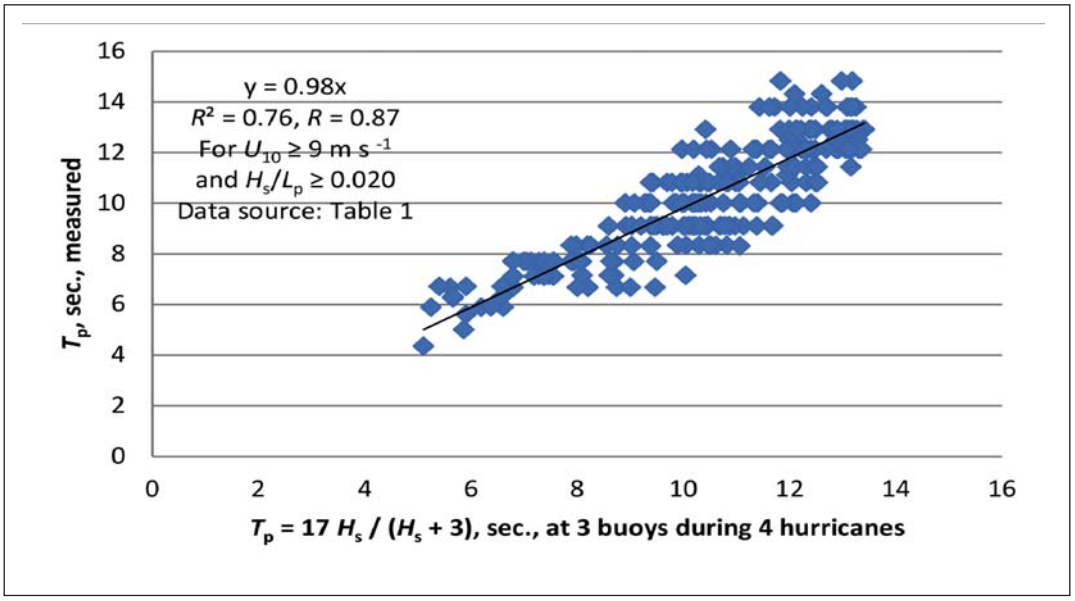


Figure 4. Verification of Equation (3) at Three NDBC Buoys during Four Hurricanes.

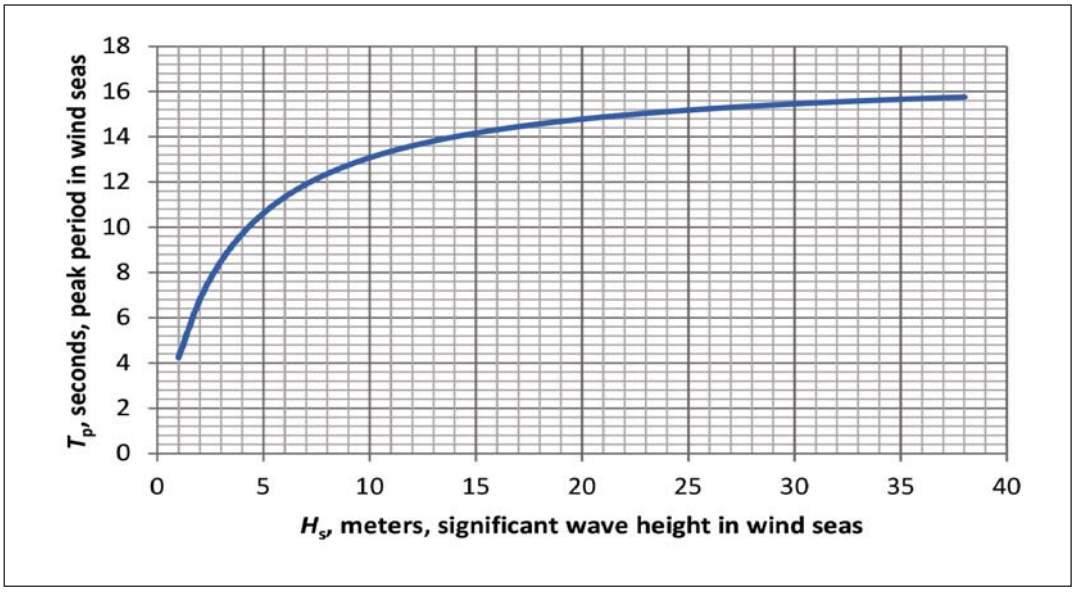


Figure 5. Graphic Representation for Equation (3).

Acknowledgments: Appreciation goes to the NDBC for providing **Figure 1** and essential datasets used in this study.

Eastern Pacific Offshores and Low Bandwidth Graphical Composite Page

Andy Latto, Jeff Lewitsky, and Eric Christensen
Tropical Analysis and Forecast Branch
National Hurricane Center, Miami, Florida
NOAA National Centers for Environmental Prediction

The experimental Eastern Pacific offshore waters forecasts have been issued publicly for nearly a year now, with TAFB having begun routine issuance in July 2016. The experimental offshore waters forecasts are derived from the value added gridded data manipulated by the forecaster at a minimum of every 6 hours, when new model data is ingested into the computer systems at TAFB. The offshore waters cover the waters within 250 nm of the west coast of Mexico and Central America, and within 750 nm of Ecuador as seen in **Figure 1**.

In an effort to create a graphical representation of what the mariner is reading in the offshore forecasts, an interactive graphical Web page has been designed to display the same sectors of the offshores forecasts, with a westward extension to cover additional waters of our AOR also included in the high-seas forecast. This interface allows any mariner with an Internet connection, including one with low bandwidth, to access the end product of the very same gridded graphics that TAFB is producing 24/7. These graphics, including the wind speeds, wave heights, hazards, surface-analysis features, and forecast features are the same parameters that the forecast systems in TAFB utilize to produce the offshore forecasts. The offshore forecast product also includes swell direction and period, parameters that are anticipated to be added to the graphical composite Web page in the near future.

Figure 1. The Mexico, Central America, and Ecuador TAFB offshore forecast zones. There are 10 zones for the Mexico offshores, and 7 for Central America and Ecuador.

The offshore forecast, as seen in **Figure 2** The product is issued every 6 hours by TAFB. This particular product under AWIPS header OFFPZ7 is separated into 10 zones offshore of Mexico (the product header and zone 9 are shown here), gives the mariner an easily retrievable text product while at sea. The forecast extends to 5 days, and includes 12-hour time periods. The synopsis, which is created by the forecaster every 6 hours, conveys a summary of the main weather players over the area during the upcoming 5-day time period.

The two offshore products currently issued by TAFB for the eastern Pacific are named under the NWS AWIPS headers OFFPZ7 (Mexico) and OFFPZ8 (Central America and Ecuador) and can be found on our Web page at: http://www.nhc.noaa.gov/experimental/epoffshores/data/WRKOFFPZ7 and http://www.nhc.noaa.gov/experimental/epoffshores/data/WRKOFFPZ8.

```
EXPERIMENTAL...OFFSHORE WATERS FORECAST
NWS NATIONAL HURRICANE CENTER MIAMI FL
216 PM PDT Sun Jun 4 2017

...THIS MESSAGE IS FOR EXPERIMENTAL PURPOSES ONLY...
...UPDATES MAY NOT ALWAYS BE AVAILABLE...

OFFSHORE WATERS FORECAST FOR THE E PACIFIC WITHIN 250 NM OF
MEXICO

SEAS GIVEN AS SIGNIFICANT WAVE HEIGHT...WHICH IS THE AVERAGE
HEIGHT OF THE HIGHEST 1/3 OF THE WAVES. INDIVIDUAL WAVES MAY BE
MORE THAN TWICE THE SIGNIFICANT WAVE HEIGHT.

PMZ001-050930-
SYNOPSIS FOR THE E PACIFIC WITHIN 250 NM OF MEXICO
216 PM PDT Sun Jun 4 2017

.SYNOPSIS...GENTLE TO MODERATE NW WINDS WILL CONTINUE W OF BAJA
CALIFORNIA THROUGH FRI NIGHT. GENTLE TO MODERATE NW TO N WINDS
ARE EXPECTED ELSEWHERE. NW SWELL OF 6 TO 9 FT WILL AFFECT THE
WATERS W OF BAJA CALIFORNIA NORTE N OF 27N MON THROUGH TUE NIGHT.

$$

PMZ009-050930-
MEXICO BORDER S TO 29N WITHIN 60 NM OF SHORE-
216 PM PDT Sun Jun 4 2017

.TONIGHT...W TO NW WINDS 5 TO 10 KT. SEAS 6 FT IN SW SWELL.
PERIOD 15 SECONDS.
.MON...SW TO W WINDS 5 TO 10 KT. SEAS 6 TO 7 FT IN W TO NW SWELL.
PERIOD 14 SECONDS.
.MON NIGHT...SW TO W WINDS 5 TO 10 KT. SEAS 7 FT IN NW SWELL.
PERIOD 13 SECONDS.
.TUE...SW WINDS LESS THAN 5 KT. SEAS 6 TO 7 FT IN NW SWELL.
PERIOD 15 SECONDS.
.TUE NIGHT...W WINDS LESS THAN 5 KT. SEAS 6 FT IN NW SWELL.
PERIOD 16 SECONDS.
.WED...SW WINDS LESS THAN 5 KT. SEAS 6 FT IN W TO NW SWELL.
PERIOD 17 SECONDS.
.WED NIGHT...W WINDS 5 TO 10 KT. SEAS 5 TO 6 FT IN SW TO W SWELL.
PERIOD 16 SECONDS.
.THU...W WINDS LESS THAN 5 KT. SEAS 5 FT IN NW SWELL.
PERIOD 15 SECONDS.
.THU NIGHT...NW WINDS 10 TO 15 KT. SEAS 5 FT. PERIOD 14 SECONDS.
.FRI...NW WINDS 10 TO 15 KT. SEAS 6 FT. PERIOD 14 SECONDS.
.FRI NIGHT...NW WINDS 15 TO 20 KT. SEAS 7 FT. PERIOD 13 SECONDS.
```

Figure 2. A clip from the experimental offshore forecast for the eastern Pacific within 250 nm of Mexico. The product is issued every 6 hours by TAFB. This particular product under AWIPS header OFFPZ7 is separated into 10 zones offshore of Mexico (the product header and zone 9 are shown here).

A preview of the latest update to the graphical composite page in **Figure 3** shows 12 hourly time resolution of our forecast wind barbs, wave heights and surface features out to 72 hours. This interface is available through the main composite page at www.hurricanes.gov/marine/forecast where the mariner can choose five regions: eastern Pacific offshore from Mexico to 122W, eastern Pacific offshore from Central America to 97W, the Gulf of Mexico, Caribbean Sea and tropical North Atlantic waters east to 64W, and the southwestern North Atlantic east to 64W.

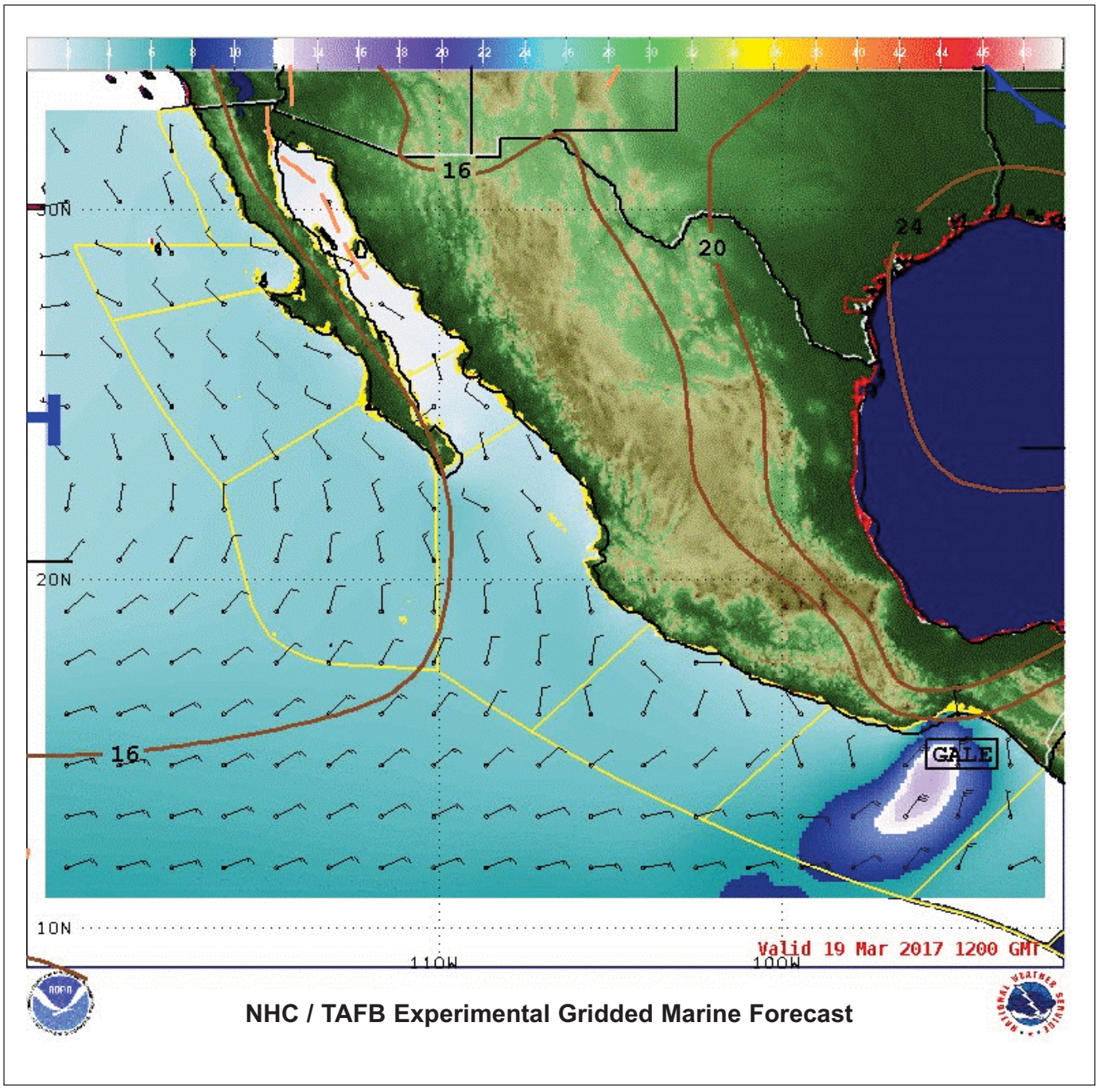


Figure 3. The graphical composite forecast Web page with low-bandwidth capability. (www.hurricanes.gov/marine/forecast). The page is capable of displaying in 12-hour resolution, winds, significant wave heights, hazards, surface features, and the offshore synopsis for the eastern Pacific, Caribbean, Gulf of Mexico, and southwestern North Atlantic Ocean.

Mean Circulation Highlights and Climate Anomalies

January through April 2017

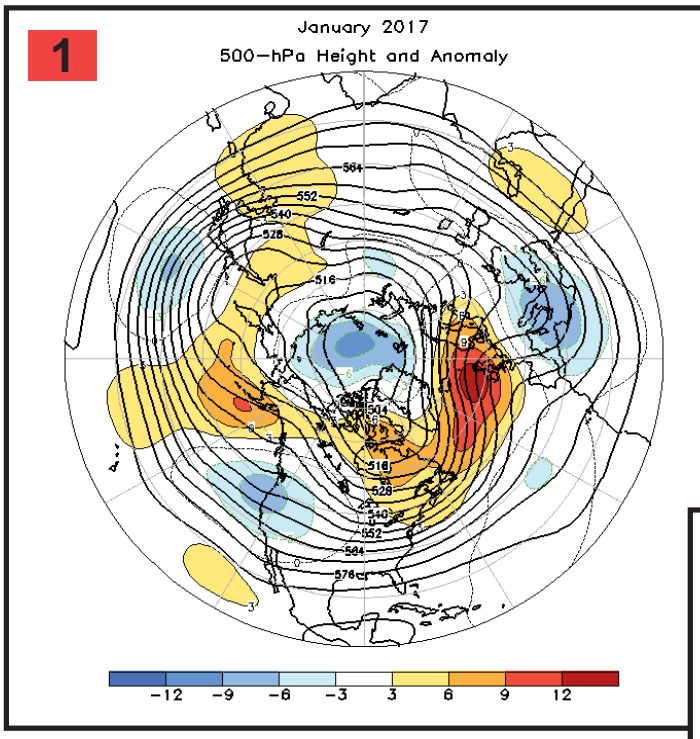
Anthony Artusa, Meteorologist, Operations Branch,
Climate Prediction Center NCEP/NWS/NOAA

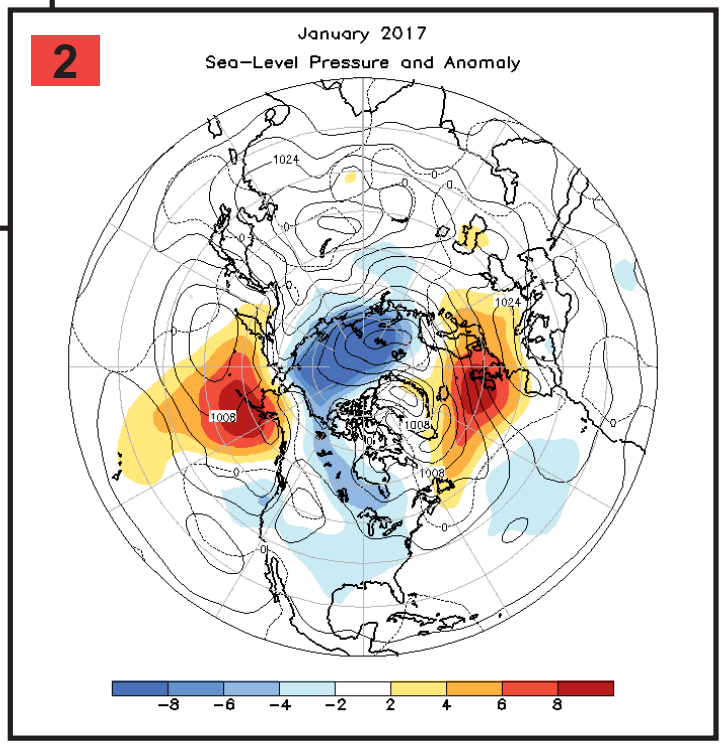
All anomalies reflect departures from the 1981–2010 base period.

January/February 2017

The 500-hPa mean circulation during January 2017 featured positive height anomalies across the high latitudes of the eastern North Pacific, eastern Canada, the high latitudes of the North Atlantic, and China. Negative height anomalies prevailed across the western contiguous U.S., the polar region, and the Mediterranean Sea (**Figure 1**).The corresponding Sea-Level Pressure (SLP) and Anomaly map (**Figure 2**) generally mirrored the midtropospheric circulation pattern, though the prominent SLP anomalies were noted poleward of about 40N.

During February, the 500-hPa circulation was characterized by above-average heights over the high latitudes of the central North Pacific, the southern contiguous U.S., Eastern Europe, and much of central Asia, with below-average heights over western North America and western Russia (**Figure 3**).

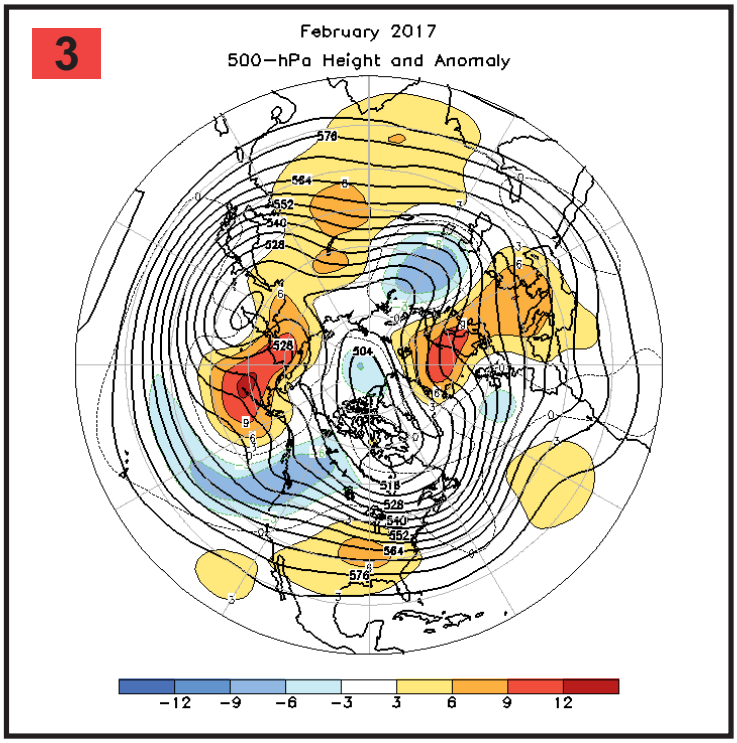




Caption for 500 hPa Heights and Anomalies: Figures 1,3,5,7 Northern Hemisphere mean and anomalous 500-hPa geopotential height (CDAS/Reanalysis). Mean heights are denoted by solid contours drawn at an interval of 6 dam. Anomaly contour interval is indicated by shading. Anomalies are calculated as departures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

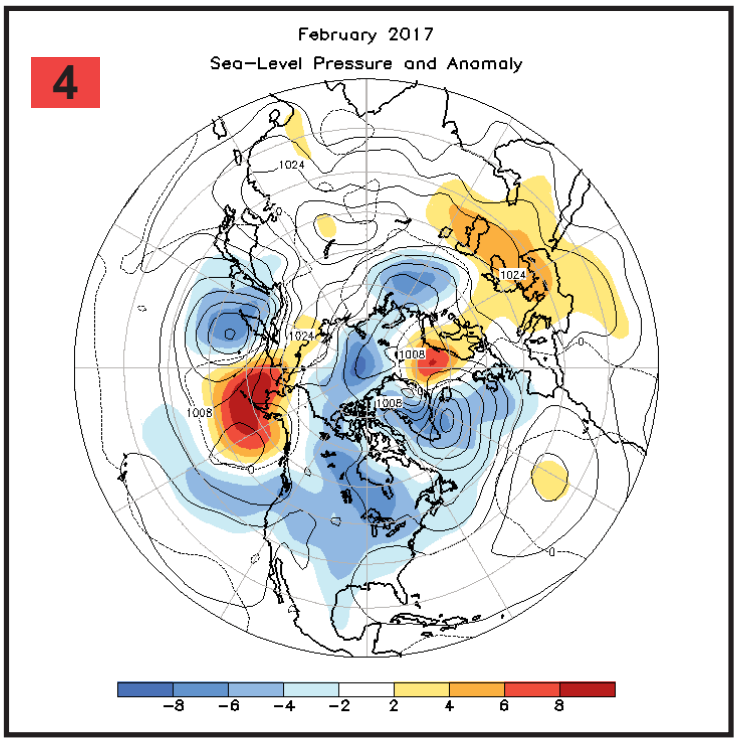
Caption for Sea-Level Pressure and Anomaly: Figures 2,4,6,8 Northern Hemisphere mean and anomalous sea level pressure (CDAS/Reanalysis). Mean values are denoted by solid contours drawn at an interval of 4 hPa. Anomaly contour interval is indicated by shading. Anomalies are calculated as departures from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

The corresponding SLP and Anomaly Map depicts only some of the anomaly features observed at the 500 hPa level (**Figure 4**). SLP was notably higher than normal over the high latitudes of the central North Pacific, Eastern Europe, and from the eastern Mediterranean region to the Caspian Sea. Lower-than-normal SLP was observed over much of North America, the Arctic Ocean, the high latitudes of the North Atlantic, including Greenland and Iceland, western Russia, and the Kamchatka Peninsula/Sea of Okhotsk region.



The Tropics

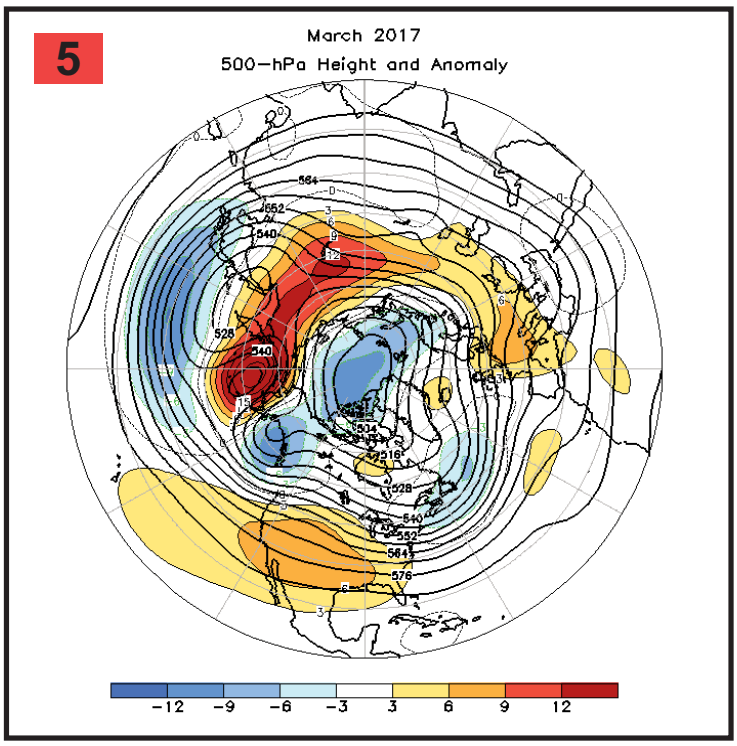
Sea surface temperatures (SSTs) were slightly below to near average in the central equatorial Pacific during January (and February). SSTs were also above average in the eastern Pacific during February. The latest monthly Niño index for the Niño 3.4 region was –0.3C (January) and +0.1C (February). The depth of the oceanic thermocline (measured by the depth of the 20C isotherm) and subsurface temperatures were close to the long-term average during the 2-month period. Equatorial low-level winds were near average across the central Pacific and enhanced over the western Pacific during January and February. Tropical convection was suppressed over the central and eastern equatorial Pacific, but enhanced across Indonesia and the western equatorial Pacific. Collectively, these oceanic and atmospheric anomalies reflect the transition from La Niña to ENSO-neutral conditions. During much of the winter, enhanced tropical convection was concentrated over the eastern Indian Ocean and Maritime Continent region, resulting from constructive interference of the low-frequency base state (coming out of a La Niña), a negatively phased Indian Ocean Dipole, and occasional MJO activity.



March/April 2017

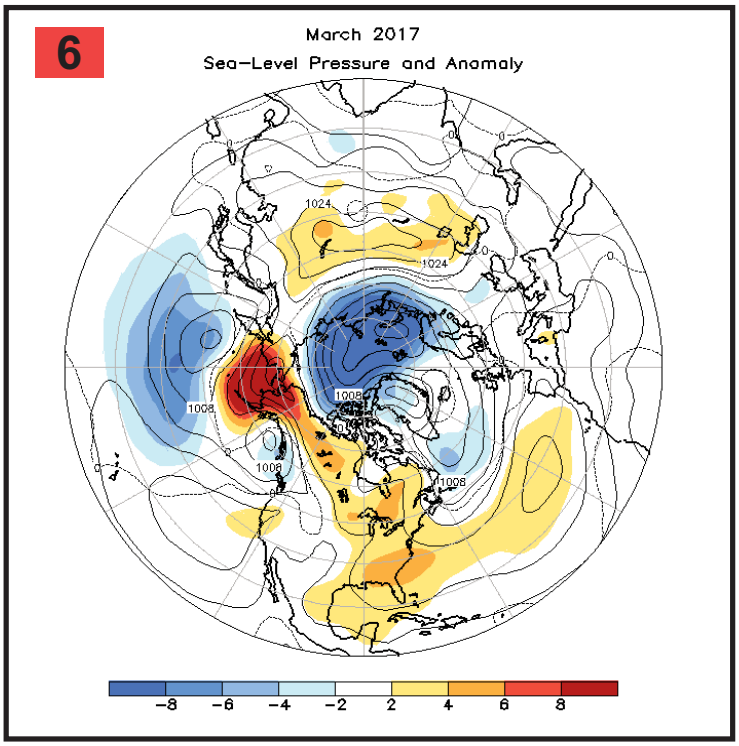
The March circulation pattern featured above-average 500 hPa heights over the high latitudes of the central North Pacific, most of the contiguous U.S., Europe, and much of central and northern Asia (**Figure 5**). Below-average heights were noted over the North Pacific from Japan to just east of the Date Line, the Gulf of Alaska, the western North Atlantic, and the polar region. The SLP and Anomaly map generally reflected the midtropospheric height-anomaly pattern, except for Europe which had SLP anomalies close to normal **(Figure 6).**

The mean 500-hPa circulation during April 2017 was characterized by above-average heights from the eastern contiguous U.S. across the North Atlantic to Western Europe and from central Alaska northward towards the Pole (**Figure 7**). Below-average heights were observed across the central North Pacific far northern Canada, and Scandinavia /Russia. The SPL and Anomaly map generaly mirrored the midtropospheric pattern (**Figure 8**).

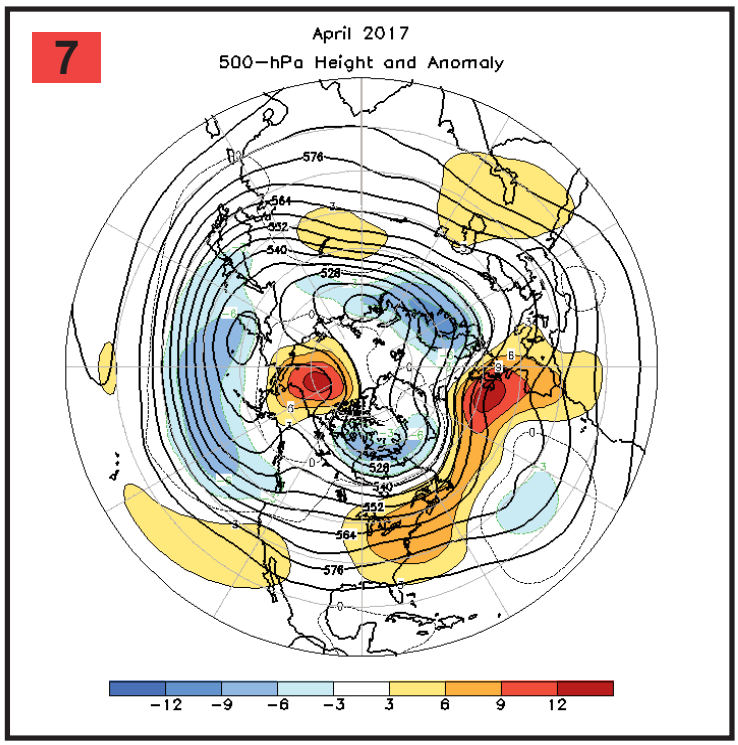


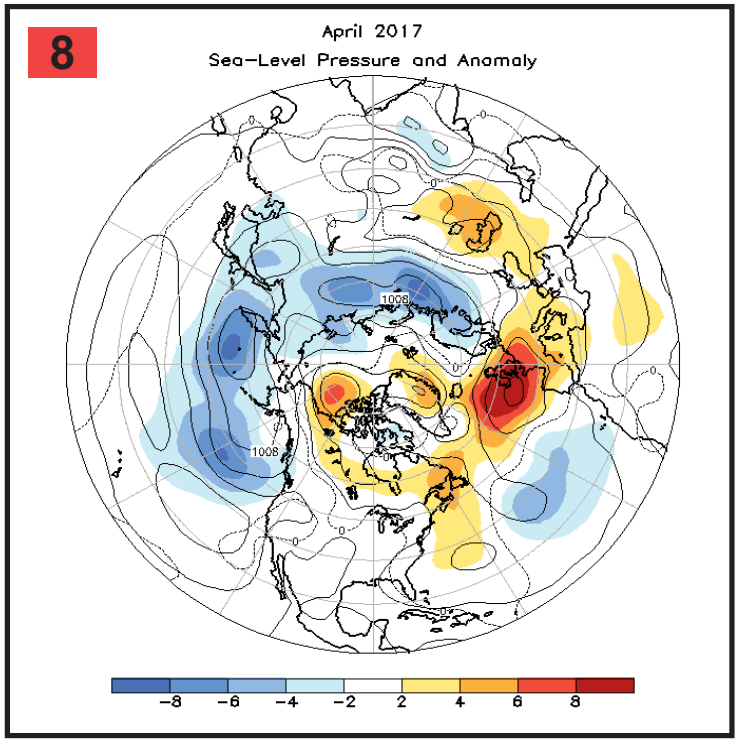
The Tropics

SSTs remained near average in the central equatorial Pacific and above average in the eastern Pacific during the March–April period. The latest monthly Niño indices for the Niño 3.4 region were +0.1C (March) and +0.3C (April). The depth of the oceanic thermocline was slightly above average in the far-eastern Pacific (March and April), and in the central Pacific (April). Corresponding subsurface temperatures were 1–2C above average during the 2-month period. Low-level winds were enhanced over the western and central equatorial Pacific (March) and near average across the equatorial Pacific (April). Deep convective cloudiness and thunderstorms were suppressed over the central equatorial Pacific and enhanced over Indonesia/western equatorial Pacific in March and April. Collectively, these oceanic and atmospheric anomalies reflect ENSO-neutral conditions.mal over both Canada and China.



One of the tropical highlights during the March–April 2017 period was a southern hemisphere Tropical Cyclone named Debbie (**Reference 1**). This system developed over the Coral Sea on 23 March and generally tracked southward towards the coast of Queensland, Australia. SSTs of 30C and good upper level outflow contributed to the intensification of the low into a Tropical Cyclone. At maximum intensity, sustained winds were near 195 km/h, and the minimum central pressure was 943 hPa. Debbie made landfall south of Townsville, near Airlie Beach, Queensland, causing significant damage, electrical power outages, and flooding along its track. After becoming extratropical on March 30, the remnants of Debbie passed over New Zealand, causing flash flooding in many areas. The system dissipated on April 7.





Caption for 500-hPa Heights and Anomalies: Figures 1, 3, 5, and 7.

Northern Hemisphere mean and anomalous sea level pressure (CDAS/Reanalysis). Solid contours drawn at an interval of 4 hPa denote mean values.. Shading indicates the anomaly contour interval. Anomalies are calculated as departures from the 1981–2010 base period monthly means.

Caption for Sea-Level Pressure and Anomaly: Figures 2, 4, 6, and 8.

Northern Hemisphere mean and anomalous sea level pressure (CDAS/Reanalysis). Solid contours drawn at an interval of 4 hPa denote mean values.. Shading indicates the anomaly contour interval. Anomalies are calculated as departures from the 1981–2010 base period monthly means.

References:

1. http://www.bom.gov.au/announcements/sevwx/qld/qldtc20170325.shtml

Much of the information used in this article originates from the Climate Diagnostics Bulletin archive: (http://www.cpc.ncep.noaa.gov/products/CDB/CDB_Archive_html/CDB_archive.shtml)

Marine Weather Review – North Atlantic Area

September to December 2016

George P. Bancroft
NOAA National Center for Environmental Prediction
Ocean Prediction Center (OPC), College Park, Maryland

Introduction

The fall to early winter period of September to December 2016 featured the onset of mainly a progressive and amplified pattern of developing cyclones moving from southwest to northeast across the North Atlantic toward Greenland and Iceland, with cyclones less frequently taking a more northerly track toward the Davis Strait or a more southern track over the central North Atlantic waters. Cyclones tracked mainly to the west and north of the British Isles during the period. In terms of hurricane-force events, activity was unevenly distributed, with December featuring 13 such events, more than occurred in the other months combined. The heavy weather season started early with two hurricane-force lows developing in September. October featured four such lows, including Posttropical Cyclone Matthew. November, with only one hurricane-force event, was the least-active month, contrary to what was found during an early study of the frequency of hurricane-force systems (Von Ahn and Sienkiewicz, 2005). Very intense cyclones with central pressures below 950 hPa were confined to the month of December.

The 4-month period includes the last half of the hurricane season in the Atlantic basin. Of the six tropical systems affecting OPC's marine area of responsibility north of 31N, four occurred in September, considered the peak of the hurricane season in the Atlantic basin. They were all tropical storms, although Hermine at the beginning of the month was a hurricane in the northeast Gulf of Mexico. The other cyclones were hurricanes in early to mid-October, with Nicole, attaining Category 4 on the Saffir-Simpson hurricane wind scale while approaching Bermuda from the south. The other hurricane, Matthew, was even stronger while in the Caribbean at the beginning of the month and briefly made landfall on the South Carolina coast as a Category-1 hurricane early in October. Matthew had major impacts from the Caribbean to the southeastern U.S. (See **Reference 6** for more details on Matthew and other tropical cyclones, including those that stayed south of OPC's marine area.)

Tropical Activity

Tropical Storm Hermine:

After making landfall over northwest Florida as a Category-1 hurricane (**Reference 6**), Hermine moved just inland over the southeastern U.S. on September 2 as a tropical storm, before meandering off the mid-Atlantic coast of the U.S. as a strong extratropical low for a few days (**Figure 1**). **Figure 2** is a Geo-color image of Hermine off the mid-Atlantic coast, a type of imagery providing true color in the daytime, with clear and crisp cloud features and land areas clearly visible. The former tropical cyclone shows an eye-like feature near the center and convection to the north and west and also frontal features. From 1200 UTC on the 3rd through 0600 UTC on the 5th, Posttropical Cyclone Hermine maintained a peak intensity of 60 kt for sustained winds before beginning a slow weakening trend on the 5th and then drifting toward the northeast from late on the 6th into the 8th. Dissipation followed on the 8th, near Cape Cod. **Table 1** lists some notable observations taken during this event.

Tropical Storm Ian:

Tropical Storm Ian moved north of 31N into OPC's high seas area along 53N on the morning of September 14 with 45-kt sustained winds and then turned northeast, while maintaining nearly this intensity before transition to an extratropical storm, as depicted in **Figure 3**.

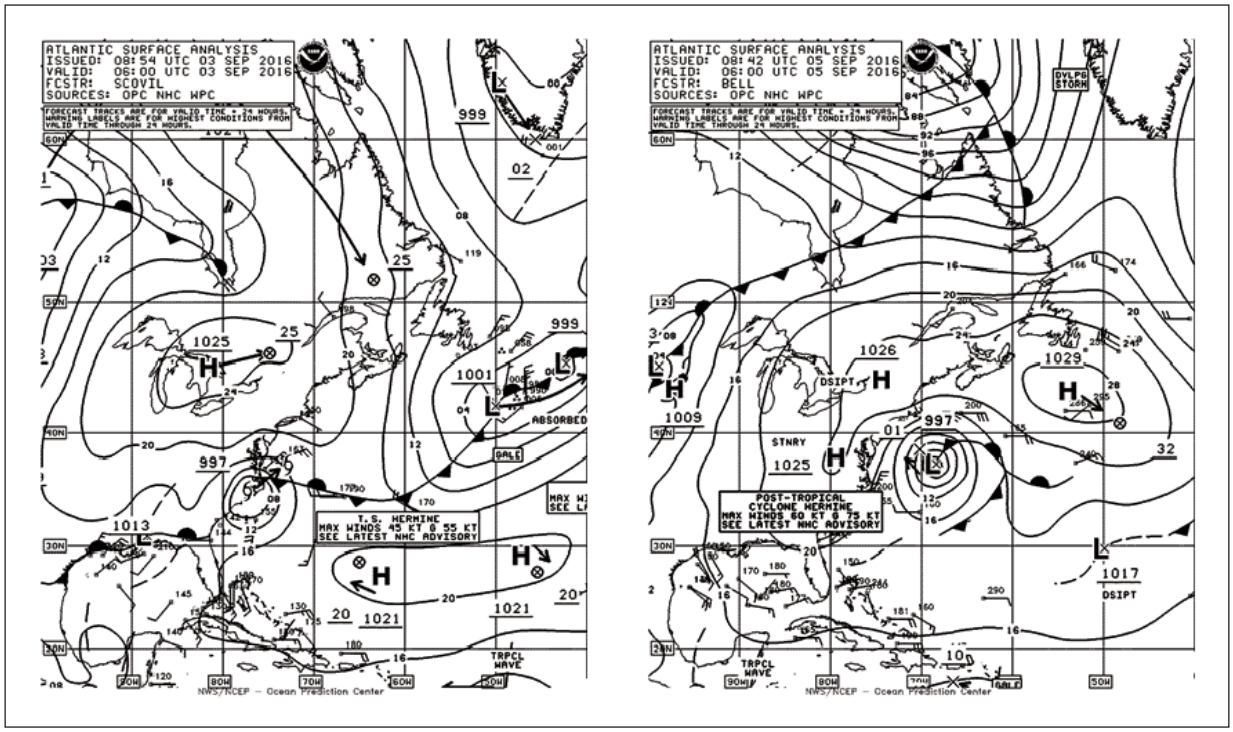


Figure 1. OPC North Atlantic Surface Analysis Charts (Part 2 — West) valid 0600 UTC September 3 and 5, 2016. The 24-hour forecast tracks are shown with the forecast central pressures given as the last two whole digits in hPa or millibars, except for tropical cyclones at 24 hours (tropical symbol at the forecast position). Text boxes contain warning and tropical cyclone information.

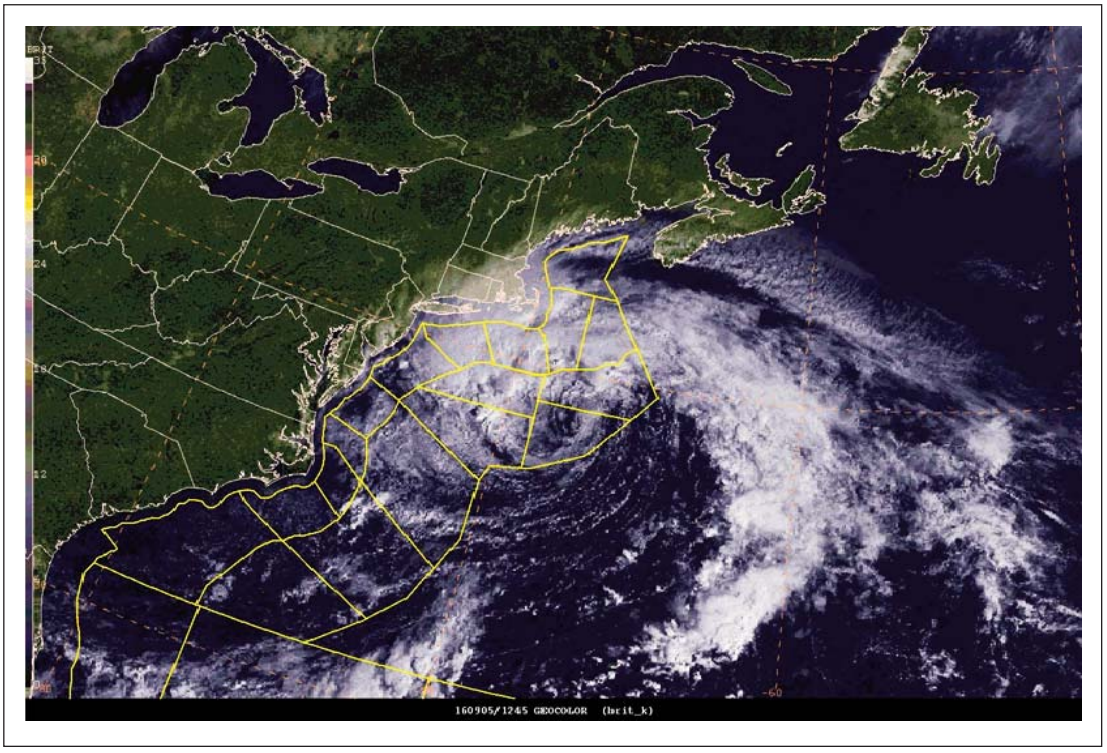


Figure 2. Geocolor daytime true color image of Posttropical Cyclone Hermine valid at 1245 UTC September 5, 2016, or 6.75 hours later than the valid time of the second part of **Figure 1**. See Reference 1 for more information on this type of imagery. Credit: OPC Social Media Team for saving the image.

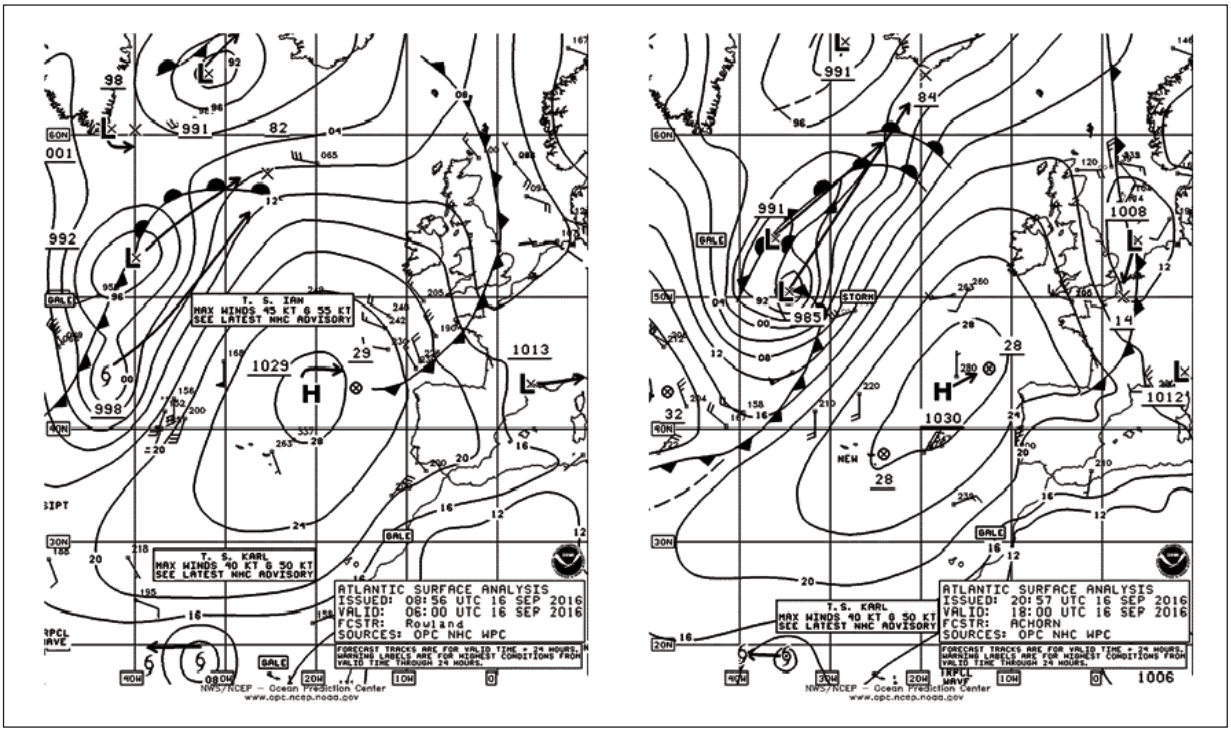


Figure 3. OPC North Atlantic Surface Analysis Charts (Part 1 — East) valid 0600 and 1800 UTC September 16, 2016.

The National Hurricane Center later reclassified this system as a subtropical storm with sustained winds of 45 kts from 1800 UTC on the 14th to 0600 UTC on the 15th, and then called Ian extra-tropical at 1200 UTC on the 16th with sustained winds of 55 kts. The infrared satellite image of Ian taken 3 hours later (**Figure 4**) shows a tropical-like feature with possible convection north and west of the center along with frontal clouds to the east and south. The cyclone then moved off to the northeast with its winds weakening to gale force by the 17th and north of Iceland later that day. The **ARCADIA** (ZCDN2) near 42N 50W reported northwest winds of 45 kt and 4.0-meter seas (13 feet) at 0500 UTC on the 16th. Some 13 hours later, the **FAUST** (SLKQ) near 45N 34W encountered southwest winds of 50 kt and 5.8-meter seas (19 feet). The **HELGAFELL** (OZ2049) later reported south winds 45 kt near 62N 13W at 1500 UTC on the 17th.

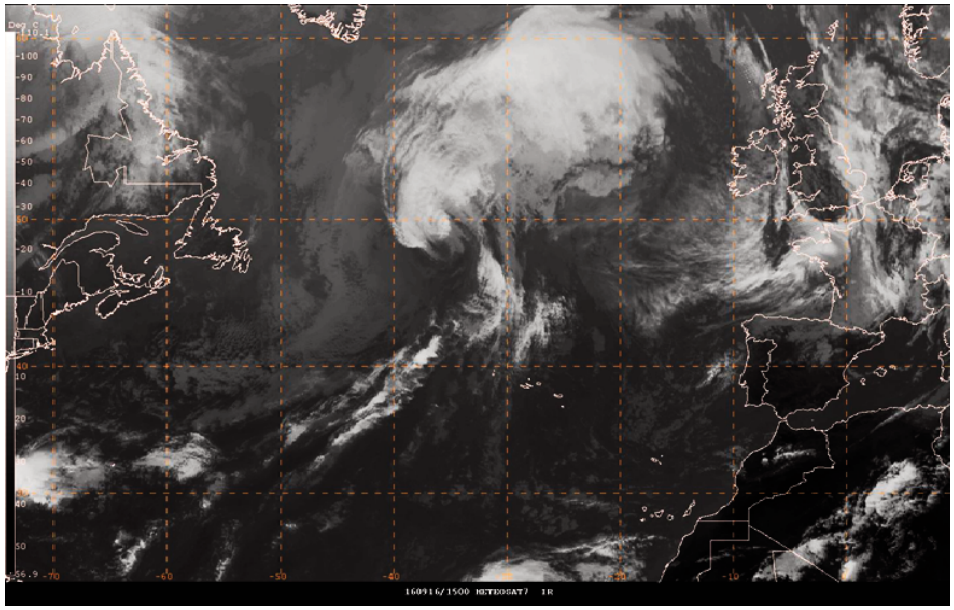


Figure 4. METEOSAT7 infrared satellite image valid at 1500 UTC September 16, 2016, or 3 hours prior to the valid time of the second part of **Figure 3**. Satellite senses temperature on a scale from black (warm) to white (cold) in this type of imagery.

Tropical Storm Julia:

Julia was a weak tropical storm affecting the far southwestern waters in mid-September. It formed near the north Florida coast early on September 13th and reached a maximum intensity of 40 kt near the Georgia coast and drifted offshore on the 15th. The cyclone then turned southeast and made an anticyclonic loop near 31N 76W while weakening to a depression on the 16th and 17th (**Figure 10**). The cyclone then drifted back toward the Carolina coast on the 18th and 19th and lingered over eastern North Carolina as an extratropical low into the 21st. Buoy 41033 (32.3N 80.4W) reported northeast winds of 31 kt with gusts to 49 kt at 2100 UTC September 14th.

Tropical Storm Karl:

Karl was a long-lived tropical storm that moved north of 31N near 65W with 55-kt sustained winds on the evening of September 23rd. **Figure 12** shows Karl approaching a frontal zone at 0600 UTC on the 25th. The cyclone became extratropical near 38N 50W 6 hours later with a central pressure of 986 hPa and sustained winds to 60 kt, and then merged with another cyclone east of Newfoundland 12 hours later.

Table 1. Selected Ship, Buoy, and C/MAN Station Observations taken during the Passage of Tropical Storm/Posttropical Cyclone Hermine.

OBSERVATION	POSITION	DATE/TIME (UTC)	WIND	SEAS (m/ft)
ANTHEM OF THE SEAS (C6B17)	36.6N 66W	05/0000	SW 51	
MAERSK OHIO (KABP)	40.4N 68.2W	05/0600	NE 45	
LAKE MARION (V7AP5)	37.5N 68.5W	05/1000	SW 45	
ZUIDERDAM (PBIG)	40.5N 69.3W 40.5N 70.3W	05/1500 05/2000	NE 60	6.7/22
Buoy 41033	32.3N 80.4W	02/1600 02/1700	S 35 G 51 Peak Gust 56	
Buoy 41004	32.5N 79.1W	02/2100 02/2300	SW 40 G 49 Peak Gust 52	5.5/18
Buoy 41013	33.4N 77.7W	03/0100	S 37 G 45	5.5/18
Buoy 44014	36.6N 74.8W	03/1700 03/1400	NE 47 G 60	5.5/18 Maximum 6.7/22
Buoy 44008	40.5N 69.2W	05/1300 05/1200	W 35 G 45	5.5/18 Maximum 6.0/20
Buoy 44011	41.1N 66.6W	05/1900		Maximum 7.0/23
Buoy 44066	39.6N 72.6W	05/0300		Maximum 6.0/20
Folly Island (FBIS1)	32.7N 79.8W	02/1900	S 40 G 46	

Hurricane Matthew:

Matthew was a major hurricane south of the area that attained Category-5 intensity on the Saffir-Simpson scale while in the Caribbean and weakened to a Category-1 storm with 75-kt winds while making landfall on the South Carolina coast at 1500 UTC October 8. Matthew then moved along the coast as a 65-kt hurricane before becoming an extratropical hurricane force low off Cape Hatteras on the 9th (**Figure 5**). The scatterometer image in **Figure 6** shows Matthew with a compact circulation with strongest wind retrievals on its west side, up to 60 kt, about 9

hours before becoming extratropical. **Table 2** lists some observations taken during Matthew's passage, including reports of gusts to hurricane force. Buoy 41004 (32.5N 79.1W) also reported a pressure of 957.6 hPa at 0400 UTC October 8th. Posttropical Cyclone Matthew subsequently accelerated northeast as a storm-force low on the 10th, and then became absorbed by a new low forming northeast of the island of Newfoundland on the 11th.

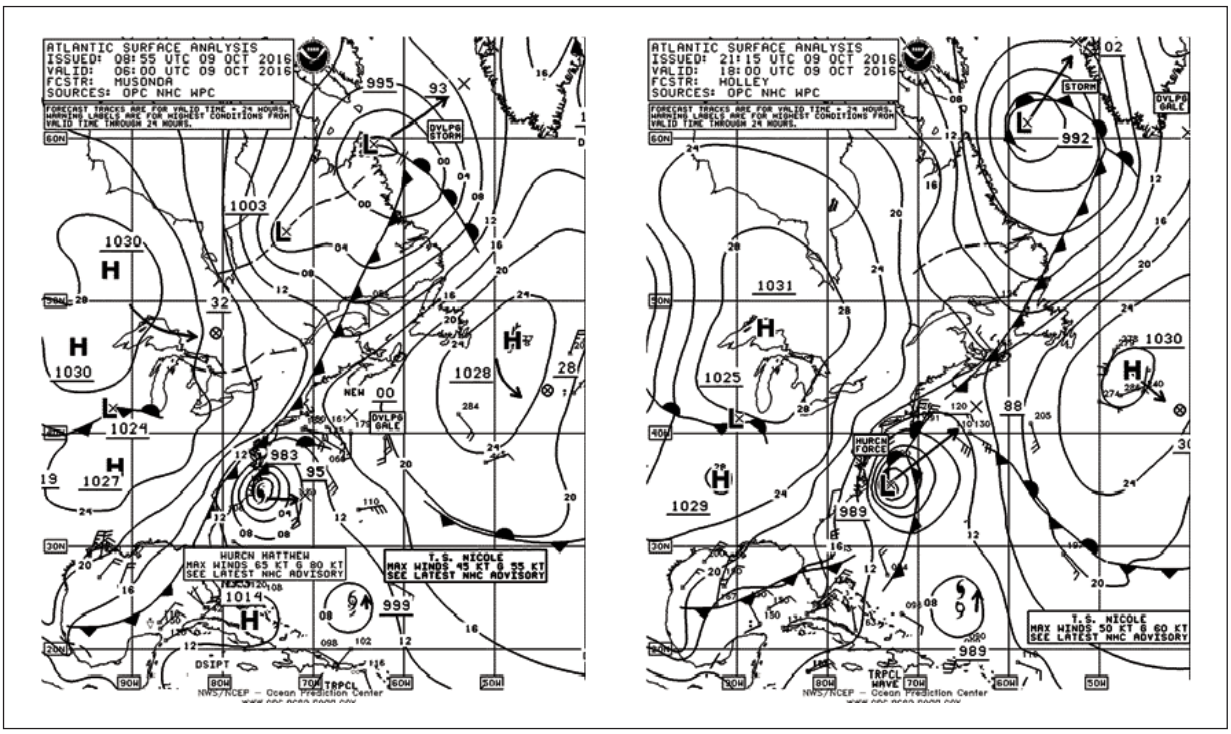


Figure 5. OPC North Atlantic Surface Analysis Charts (Part 2) valid 0600 and 1800 UTC October 9, 2016.

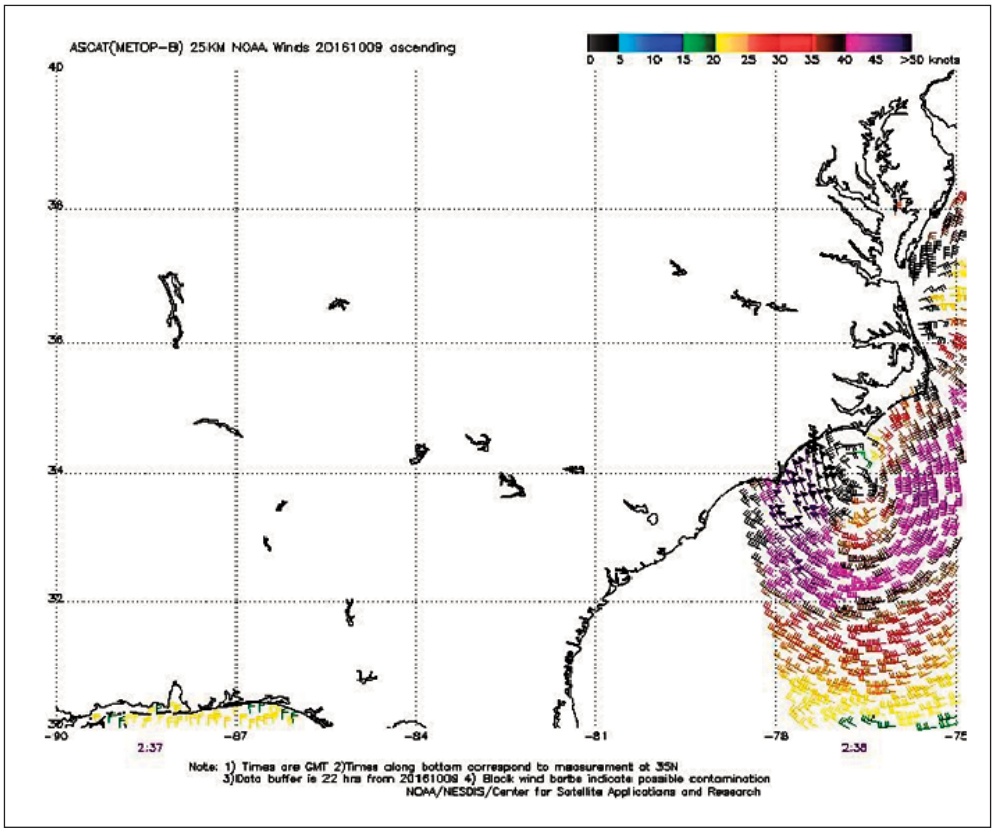


Figure 6.
ASCAT METOP-B (Advanced Scatterometer) image of satellite-sensed winds with 25-km resolution around Hurricane Matthew shown in the first part of **Figure 5**. The valid time of the pass is 0238 UTC October 9, 2016, or about 3.5 hours prior to the valid time of the first part of **Figure 5**. Imagery is courtesy of NOAA/NESDIS/Center for Satellite Applications and Research.

Hurricane Nicole:

Nicole became a major hurricane with a peak intensity of 120 kt upon entering OPC high-seas waters about 120 nm southwest of Bermuda at 0600 UTC October 13th and then began a weakening trend while moving northeast across Bermuda. The Bermuda airport reported an east wind of 67 kt with gusts to 90 kt at 13/1355 UTC and a pressure of 962 hPa less than 1 hour later. The **MAERSK IOWA** (KABL) near 39N40W reported an east wind of 35 kt and 4.6-meter seas (15 feet) at 1800 UTC on the 17th. The ship **BATEU01** encountered west winds of 40 kt near 46N 37W at 1700 UTC on the 19th. **Figure 7** depicts Nicole with intensity down to 65 kt prior to weakening further to a 55-kt tropical storm at 0600 UTC on the 18th and becoming posttropical 6 hours later. Nicole then merged with another low to the northwest and became a large storm with a pressure as low as 960 hPa near 60N 37W at 1200 UTC on the 19th before becoming absorbed by a new low forming near Greenland later that day.

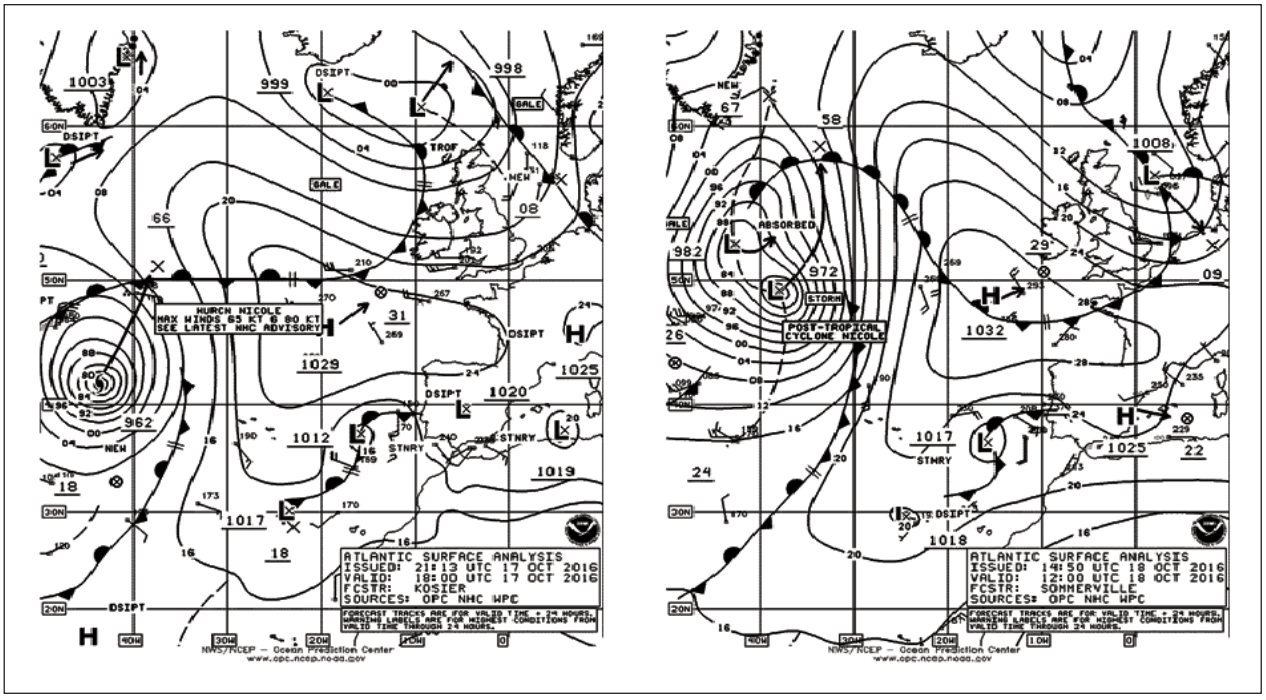


Figure 7. OPC North Atlantic Surface Analysis Charts (Part 1) valid 1800 UTC October 17 and 1200 UTC October 18, 2016.

Table 2. Selected Ship, Buoy, and C/MAN Station Observations taken during the Passage of Tropical Storm/Posttropical Cyclone Matthew.

OBSERVATION	POSITION	DATE/TIME (UTC)	WIND	SEAS (m/ft)
SEVEN SEAS MARINER	40.4N 69.3W	09/1600	NE 52	
CORAL BAY (D5FR8)	37.6N 73.1W	09/1800	N 60	9.0/30
BATFR28	41.5N 69W	10/0100	N 55	
INDEPENDENT VOYAGER (A8XY2)	40N 69W	10/0600	N 56	7.0/23
Buoy 41004	32.5N 79.1W	08/1400	S 47 G 58 Peak Gust 64	7.5.25
Buoy 41008	31.4N 80.9W	08/0300 08/0400	NE 54 G 68	

Table 2. (continued) Selected Ship, Buoy, and C/MAN Station Observations taken during the Passage of Tropical Storm/Posttropical Cyclone Matthew.

OBSERVATION	POSITION	DATE/TIME (UTC)	WIND	SEAS (m/ft)
Buoy 41025	35N 75.4W	09/1100 09/1000 09/0500	N 52 G 62 Peak Gust 68	5.0/16 Maximum 7.0/23
Buoy 44013	33.4N 77.7W	09/0100	NW 45 G 62	5.0/16
Buoy 44014	36.6N 74.8W	09/1300 09/1400	N 51 G 64 Peak Gust 68	7.0/23
Cape Lookout (CLKN7)	34.6N 76.4W	09/0600 09/0800	NW 46 G 59 Peak Gust 66	

Other Significant Events of the Period

North Atlantic Storm, September 4–5:

Low pressure originating near 41N 62W late on September 1st moved northeast and intensified the next day and into the 4th, becoming a storm force low near 52N 30W with a 977-hPa pressure at 1200 UTC on the 4th. The **INDEPENDENCE II** (WGAX) reported northwest winds of 40 kt near 45N 32W at 0000 UTC on the 5th. An ASCAT pass from 1220 UTC on the 5th returned southwest winds as high as 50 kt at the edge of the pass. The cyclone developed a lowest pressure of 976 hPa later that day before passing northeast of Iceland.

Northeastern Atlantic Storm, September 8–10:

Three subsequent cyclones followed similar tracks over the eastern waters, intensifying rapidly while passing to the west and then northwest of the British Isles, with the second one (described here) the strongest and a third system immediately following developing a lowest pressure of 969 hPa. The strongest developing low moved east off the southern Labrador coast late on September 7th and then turned toward the northeast while rapidly intensifying (**Figure 8**). The central pressure fell 28 hPa in the 24-hour period ending at 1800 UTC on the 9th, qualifying as a "bomb" (Sanders and Gyakum, 1980). **Figure 8** shows the cyclone at maximum intensity while passing east of Iceland. Buoy 64045 (59.1N11.7W) reported west winds of 47 kt with gusts to 62 kt at 2200 UTC on the 9th, and seas as high as 6.4 meters (21 feet) 2 hours later. The scatterometer data in **Figure 9** returned retrievals as high as 60 kt at the edge of a pass, and due to low bias, it appears this cyclone was the first hurricane-force low with nontropical origin of the season.

Northwestern Atlantic Storms, September 12–18:

Low pressure moving off the central Labrador coast early on September 12th developed storm force winds and a lowest central pressure of 970 hPa near 57N 57W at 1800 UTC that day. The **CRYSTAL SERENITY** (C6SY3) near 48N 60W reported west winds of 45 kt at 0400 UTC on the 12th. An ASCAT pass from 2308 UTC on the 12th returned east winds of 50 kt to the northeast of the cyclone's center. The system then weakened to gale force the next day and to below gale force east of Greenland by the 15th. A second cyclone followed late on the 16th and the 17th (**Figure 10**) and was not as intense, but developed stronger winds as indicated by the 55-kt winds retrieved by ASCAT (**Figure 11**).

The **IRENA ARTICA** (BATEU05) reported west winds of 45 kt near 61N 48W at 0000 UTC on the 19th. The system then weakened east of southern Greenland the next day and became absorbed by a stronger system passing to the east on the 21st.

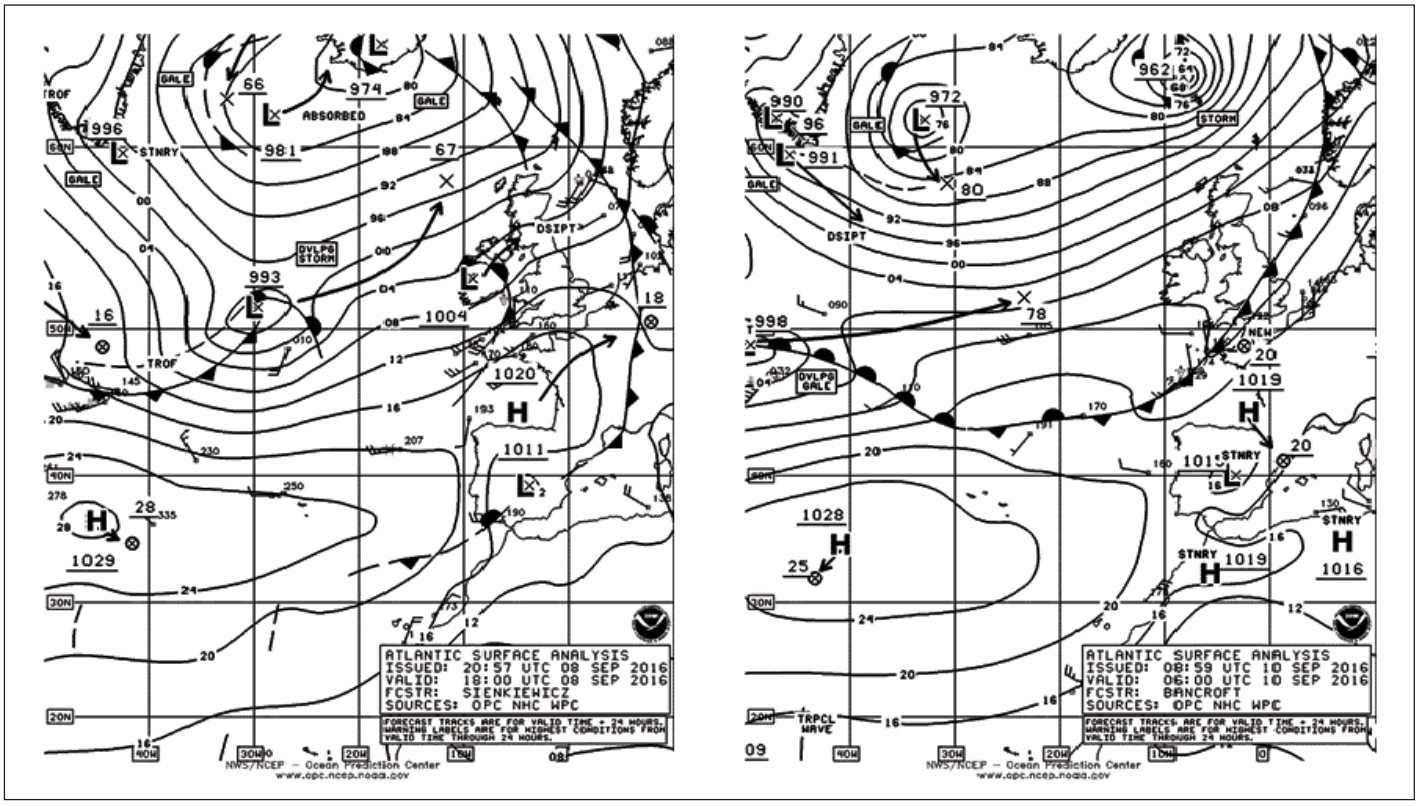


Figure 8. OPC North Atlantic Surface Analysis Charts (Part 1) valid 1800 UTC September 8 and 0600 UTC September 10, 2016.

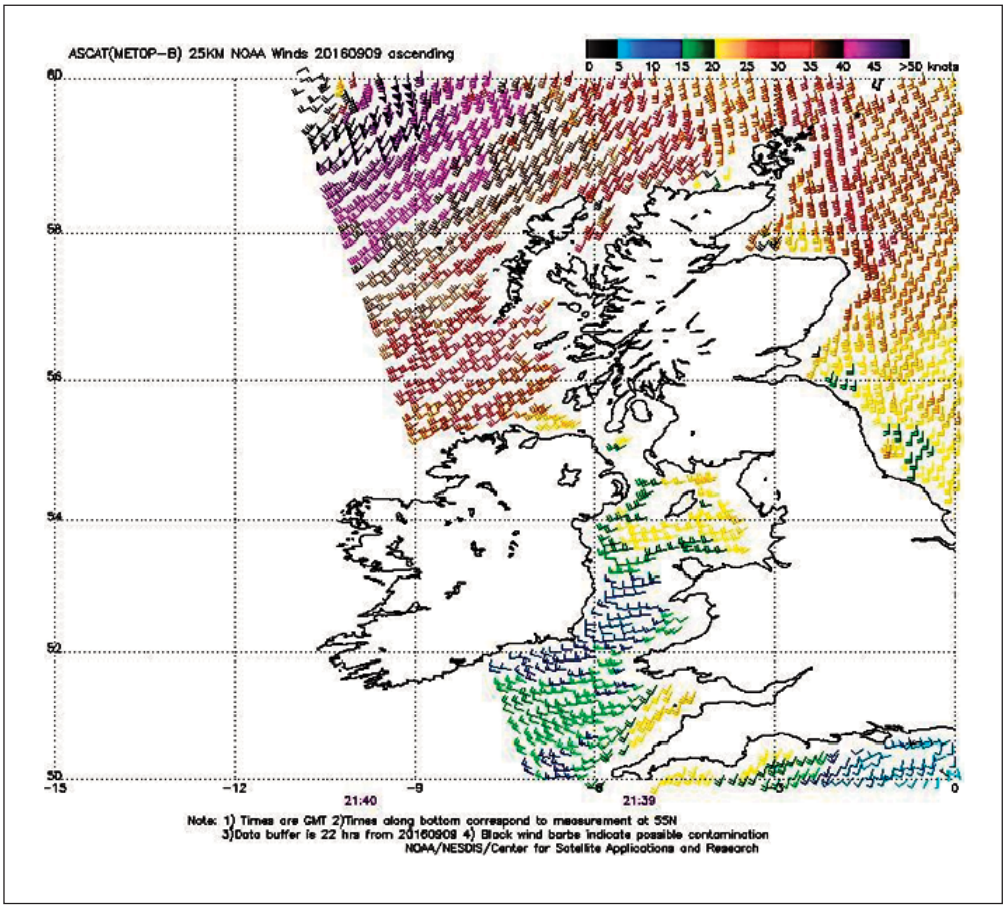


Figure 9.
ASCAT (METOP-B) image of satellite-sensed winds with 25-km resolution around the southeast side of the cyclone northwest of the British Isles shown in the second part of **Figure 8**. The valid time of the pass is 2140 UTC September 9, 2016, or about 8.25 hours prior to the valid time of the second part of **Figure 8**. Imagery is courtesy of NOAA/NESDIS/Center for Satellite Applications and Research.

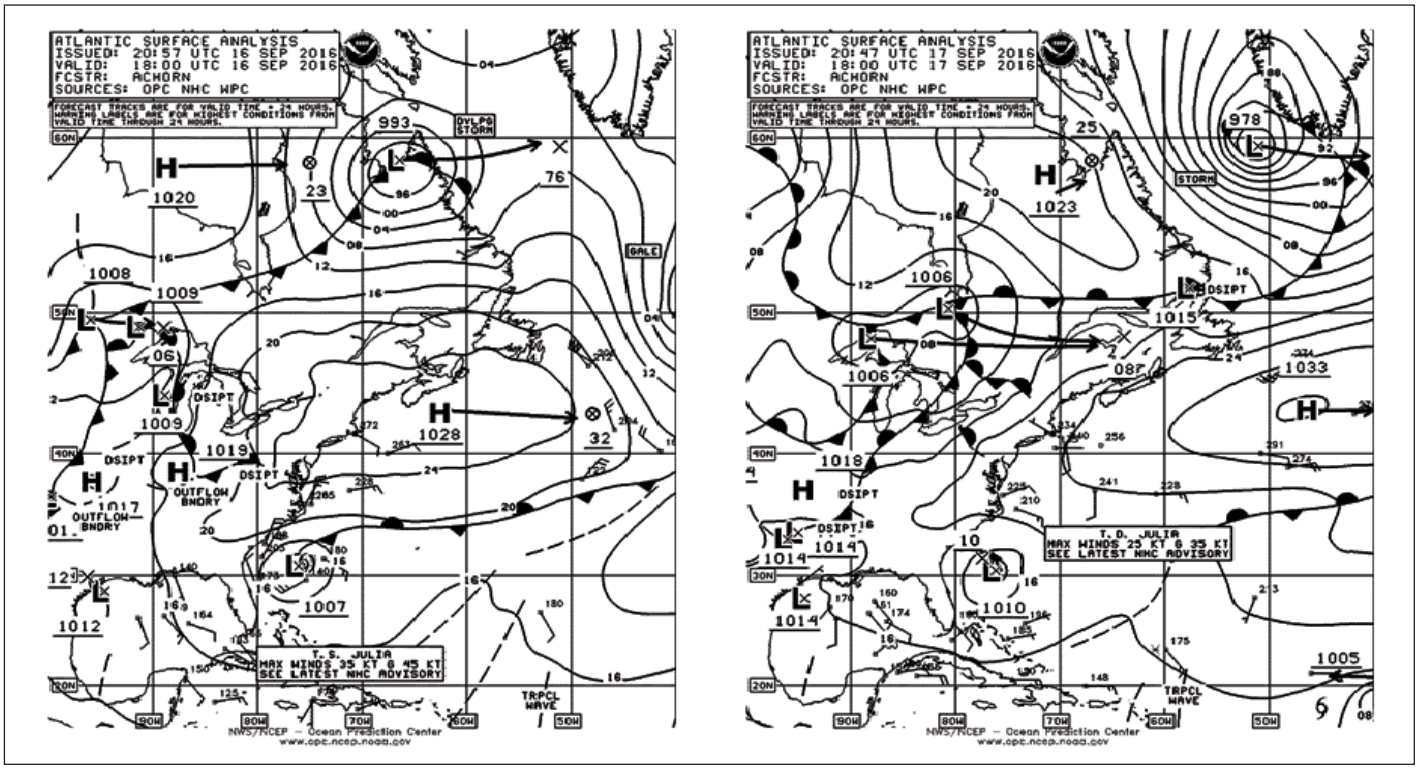


Figure 10. OPC North Atlantic Surface Analysis Charts (Part 2) valid 1800 UTC September 16 and 17, 2016.

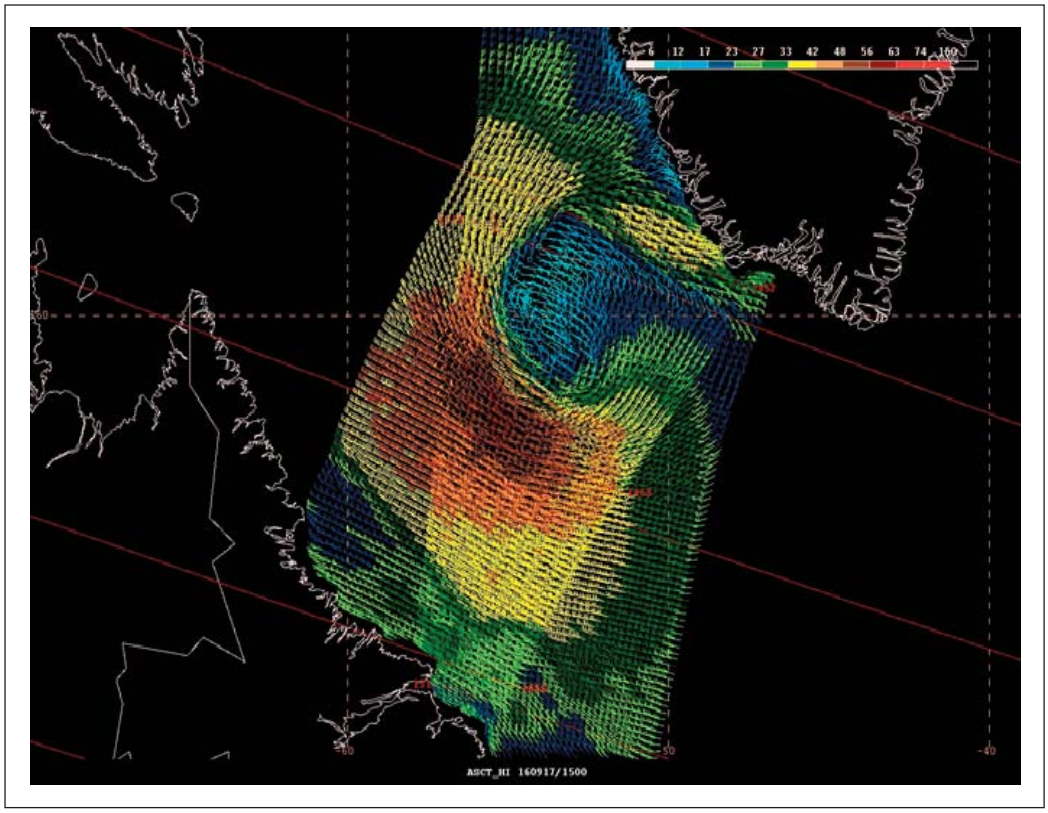


Figure 11. ASCAT (METOP-A) image of satellite-sensed winds with 25-km resolution around the storm shown in the second part of **Figure 10**. The red lines labeled with four-digit UTC times are cross-track time lines of the satellite, with the higher wind retrievals in the lower-middle portion of the image in a pass corresponding to a valid time of 1453 UTC September 17, 2016, about 3 hours prior to the valid time of the second part of **Figure 10**. Wind barbs are colored according to the scale near the top of the image. Imagery is courtesy of NOAA/NESDIS/Center for Satellite Applications and Research, adapted for operational use on OPC workstations.

North Atlantic Storm, September 25–27:

The development of this cyclone that briefly reached hurricane force is depicted in **Figure 12**. The frontal wave at 41N 48W moved northeast and intensified to a storm-force low near 52N 36W with a 978-hPa central pressure while absorbing Posttropical Cyclone Karl by 0600UTC on the 26th. The second part of **Figure 12** shows the cyclone at maximum intensity, when it briefly developed hurricane-force winds. An ASCAT image in **Figure 13** with limited coverage shows retrievals of 50 kt at the edge of a pass and may miss the highest winds. The cyclone then weakened over the northeastern waters the next day and dissipated southeast of Iceland later that day.

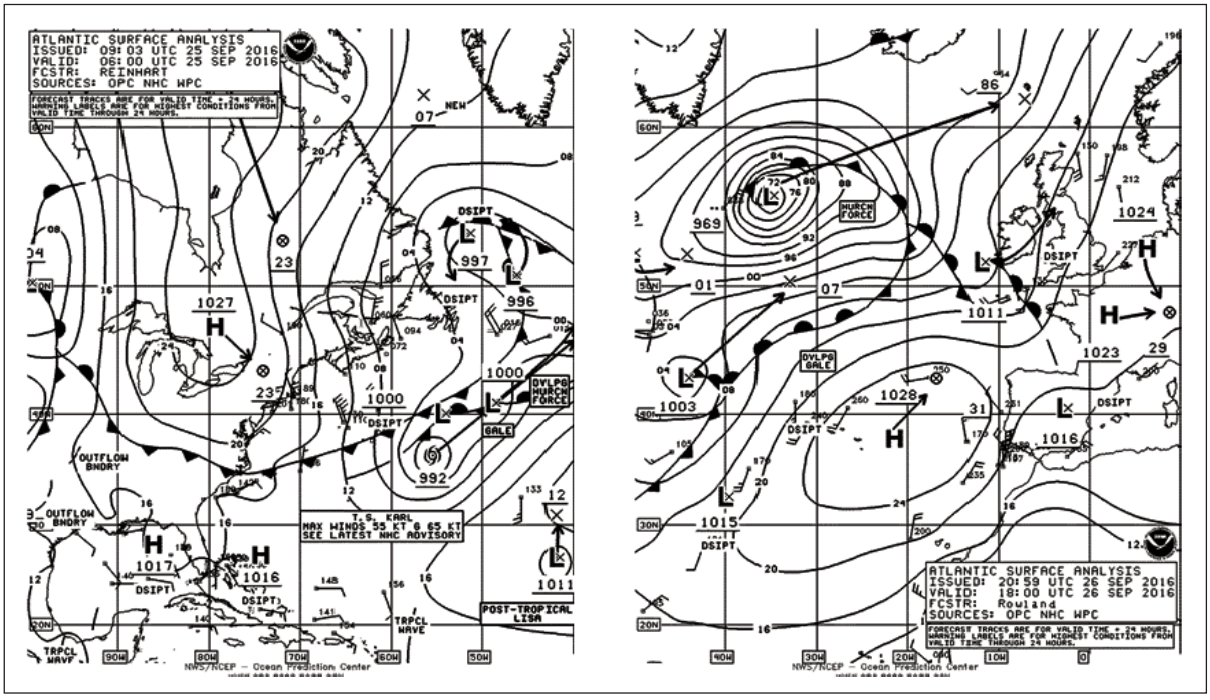


Figure 12. OPC North Atlantic Surface Analysis Charts valid 0600 UTC September 25 (Part 2) and 1800 UTC September 26, 2016 (Part 1).

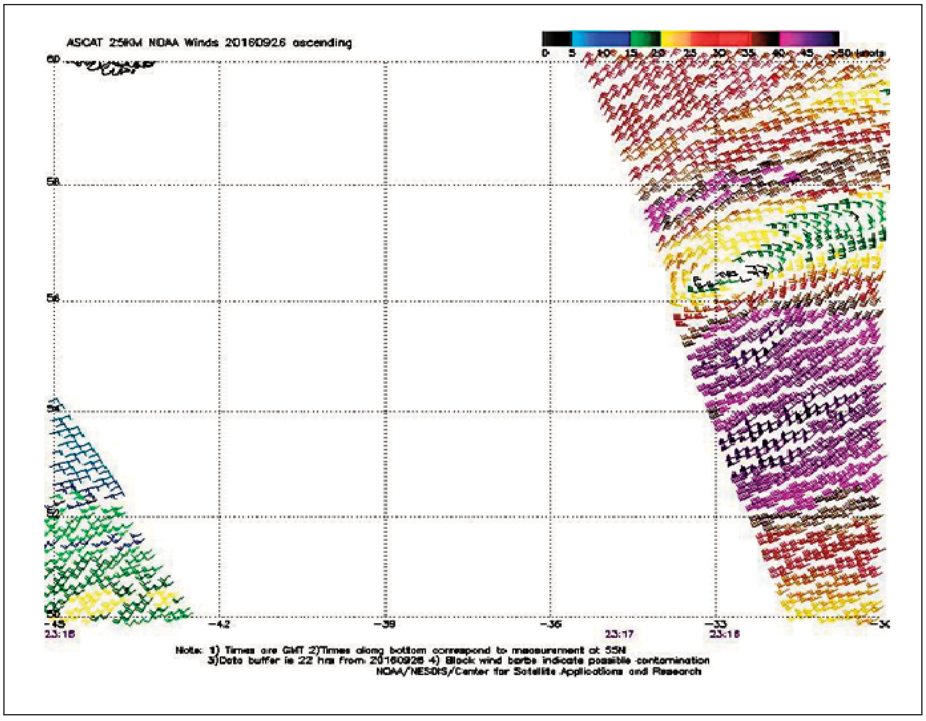


Figure 13.
ASCAT (METOP-A) image of satellite-sensed winds with 25-km resolution around the cyclone shown in the second part of **Figure 12**. The valid time of the pass is 2318 UTC September 26, 2016, or about 5.25 hours later than the valid time of the second part of **Figure 12**. The southern tip of Greenland appears at the upper-left corner of the image. Imagery is courtesy of NOAA/NESDIS/Center for Satellite Applications and Research.

North Atlantic Storms, September 30–October 5:

Two intense cyclones developed in close succession early in October, the first of the fall season with pressures below 960 hPa and were similar in intensity. The first originated near the southeastern U.S. coast on September 27th and moved northeast, then rapidly intensified over the central waters late on the 30th and on October 1st, with the central pressure falling 25 hPa in the 24-hour period ending at 0000 UTC October 2nd. It developed hurricane-force winds near 58N31W at 0000 UTC on the 3rd before turning northwest toward Greenland on the 3rd and weakening.

The **MARY ARCTICA** (BATEU00) reported east winds of 50 kt near 61N 23W at 2000 UTC on the 2nd. **Figure 14** shows it dissipating south of Greenland while the next cyclone to the east reached maximum intensity. This second system developed much more rapidly, from a 1003-hPa center south of Newfoundland early on the 3rd, and its central pressure fell 42 hPa in the 24-hour period ending 1800 UTC on the 4th.

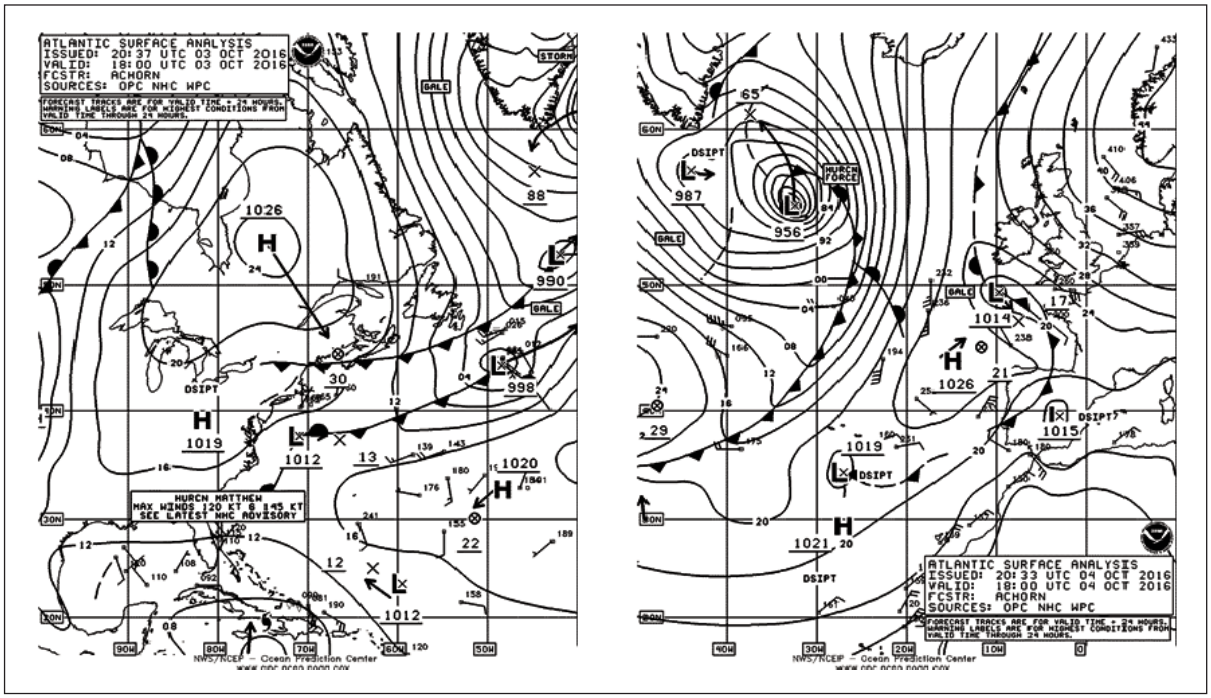


Figure 14. OPC North Atlantic Surface Analysis Charts valid 1800 UTC October 3 (Part 2) and 1800 UTC October 4, 2016 (Part 1).

The **INDEPENDENT VOYAGER** (A8XY2) near 49N 27W encountered south winds of 45 kt and 6.0-meter seas (20 feet) at 1200 UTC on the 4th. An ASCAT pass (**Figure 15**) returned winds 50 to as high as 60 kt southeast of the cyclone center and another pass from ASCAT-B at about the same time revealed winds 50 to 60 kt on the east side. Like the previous cyclone, this low turned northwest weakening near Greenlandover the following 2 days.

North Atlantic Storm, Greenland area, October 19–22

A new low with a central pressure of 960 hPa formed near 64N 38W late on October 19th and drifted southwest along the Greenland coast over the next 36 hours, with its associated storm force winds increasing to hurricane force (**Figure 16**). The lower pressure east of Greenland leads to the formation of a west to northwest winds maximum off the southern tip of Greenland. **Figure 17** shows wind retrievals as high as 65 kt in a Greenland tip jet. The cyclone subsequently drifted away from Greenland and winds weakened to gale force on the 22nd.

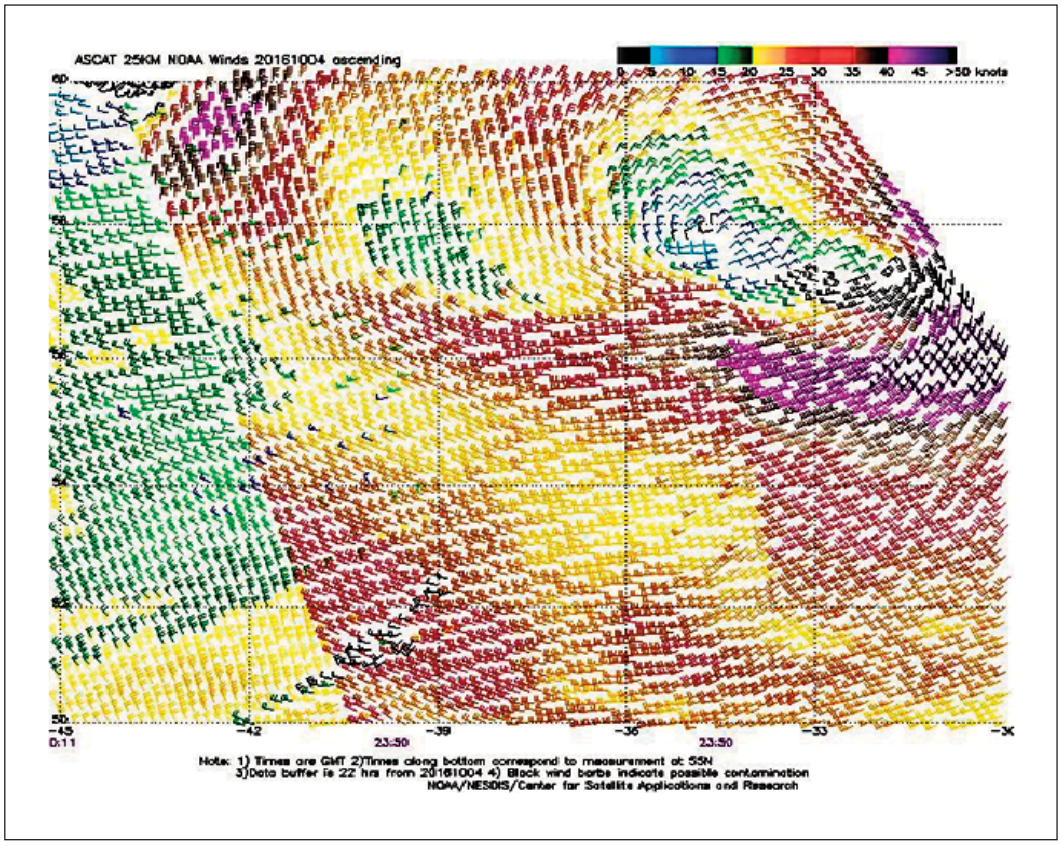


Figure 15. ASCAT (METOP-A) image of satellite-sensed winds with 25-km resolution around the hurricane-force low shown in the second part of **Figure 14**. The pass containing the stronger wind retrievals has a valid time of 2350 UTC October 4, 2016, or about 6 hours later than the valid time of the second part of **Figure 14**. The southern tip of Greenland appears near the upper left corner of the image. Imagery is courtesy of OAA/NESDIS/Center for Satellite Applications and Research.

North Atlantic Storm, November 14–16

A developing low moved northeast off the central Labrador coast early on November 14th and rapidly intensified in the 24-hour period ending at 1200 UTC on the 15th, when the cyclone developed a central pressure of 968 hPa near 64N 28W and hurricane-force winds. An ASCAT-B pass from 1348 UTC on the 15th revealed a swath of west winds 50 to 55 kt between 59N and 60N south of the center. The cyclone moved north of Iceland later that day.

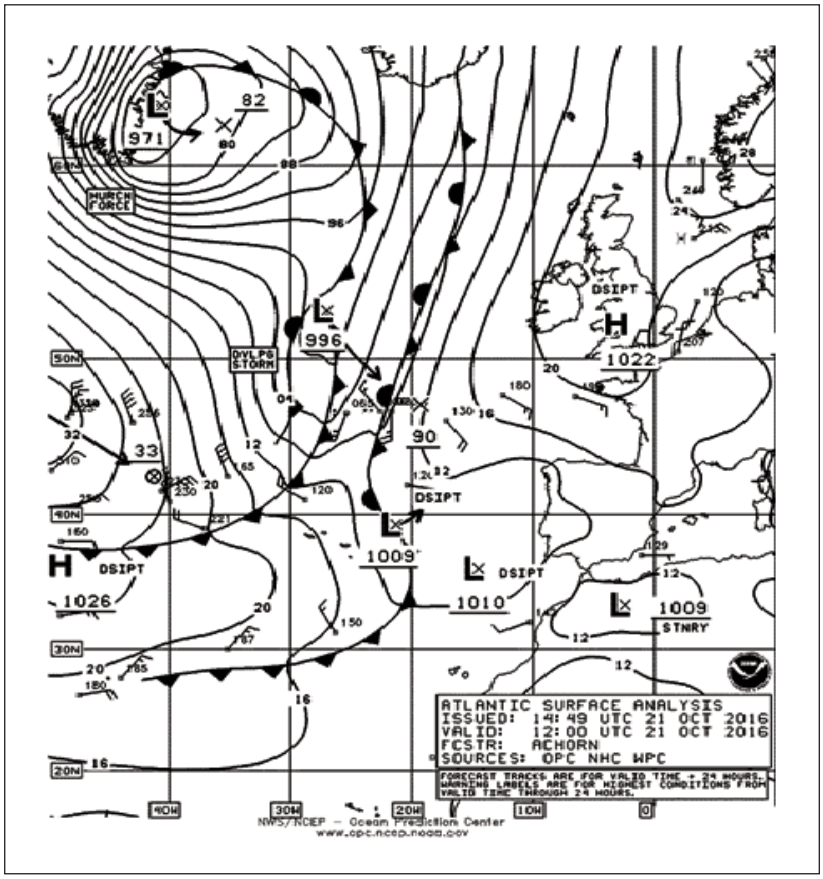


Figure 16. OPC North Atlantic Surface Analysis Chart (Part 1) valid 1200 UTC October 21, 2016.

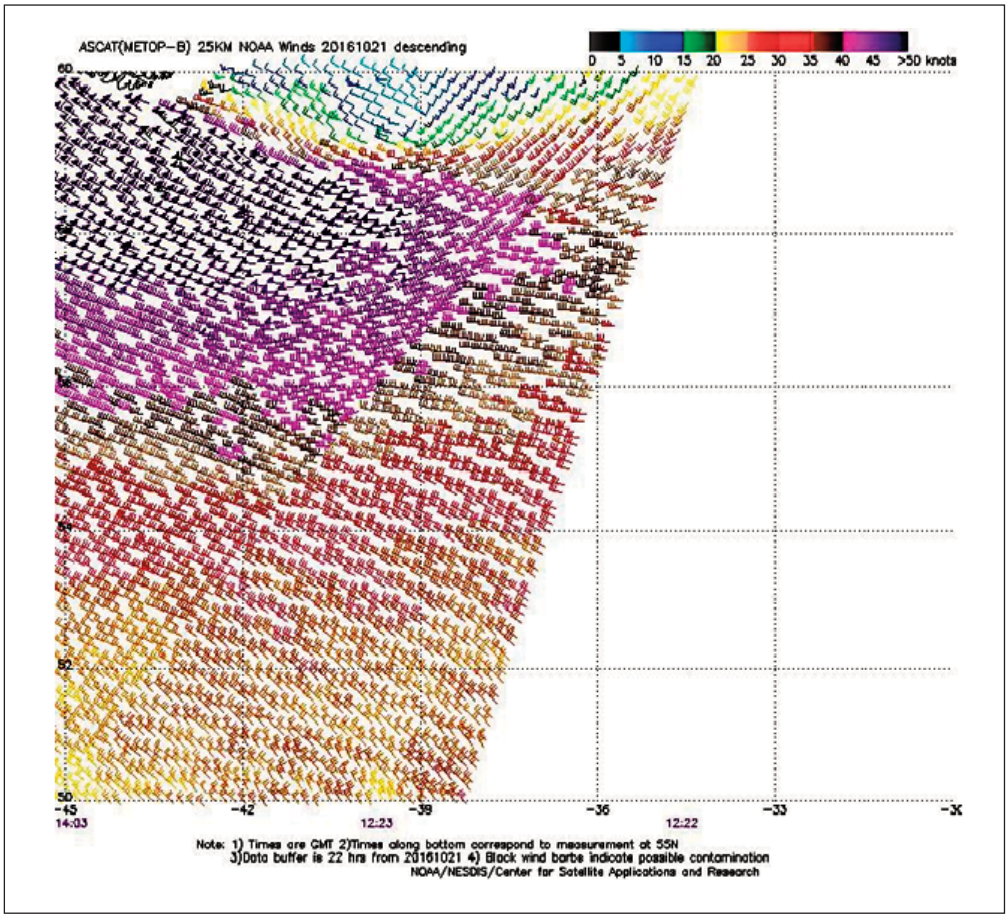


Figure 17. ASCAT (METOP-B) image of satellite-sensed winds with 25-km resolution around the south side of the hurricane-force low shown in **Figure 16**. Portions of two passes are shown (1223 UTC and 1403 UTC October 21, 2016). The valid time of the later pass containing the strongest wind retrievals is about 2 hours later than the valid time of **Figure 16**. The southern tip of Greenland appears near the upper-left corner of the image. Imagery is courtesy NOAA/NESDIS/Center for Satellite Applications and Research.

North Atlantic Storm, December 5–6:

This event over the northern waters originated south of Newfoundland near 38N at 1800 UTC on December 3rd and moved northeast over the central waters with a 964-hPa center and storm-force winds on the 5th, then turned northwest toward the Labrador Sea, where it stalled and briefly developed hurricane-force winds with a 957-hPa center at 1200 UTC on the 6th. An ASCAT-B pass from 1312 UTC on the 6th showed northwest winds to 50 kt at the edge of the pass. Figure 18 depicts the system drifting east and weakening to a gale on the 7th. Dissipation followed by the 9th.

North Atlantic Storm, December 6–9:

Figure 18 also shows a developing hurricane-force low following a southern track in the first 24 hours before turning northeast with additional strengthening, with the central pressure falling 26 hPa. The scatterometer image in **Figure 19** reveals a compact circulation with wind retrievals as high as 60 kt near the center on the south side. The cyclone turned toward the northeast and developed a lowest central pressure of 962 hPa near 46N 27W at 1200 UTC on the 8th. Buoy 62105 (55.2N 12.8W) reported south winds 44 kt with gusts to 57 kt at 0700 UTC on the 9th, a peak gust of 62 kt at 1200 UTC on the 9th, and seas as high as 8.0 meters (26 feet) 1 hour later. The cyclone began to weaken later on the 8th, with winds lowering to gale force as the center passed near Iceland late on the 9th.

North Atlantic Storm, December 8–11:

A subsequent event originating as the complex system near the southeast U.S. coast on December 6th (the first part of **Figure 18**) moved

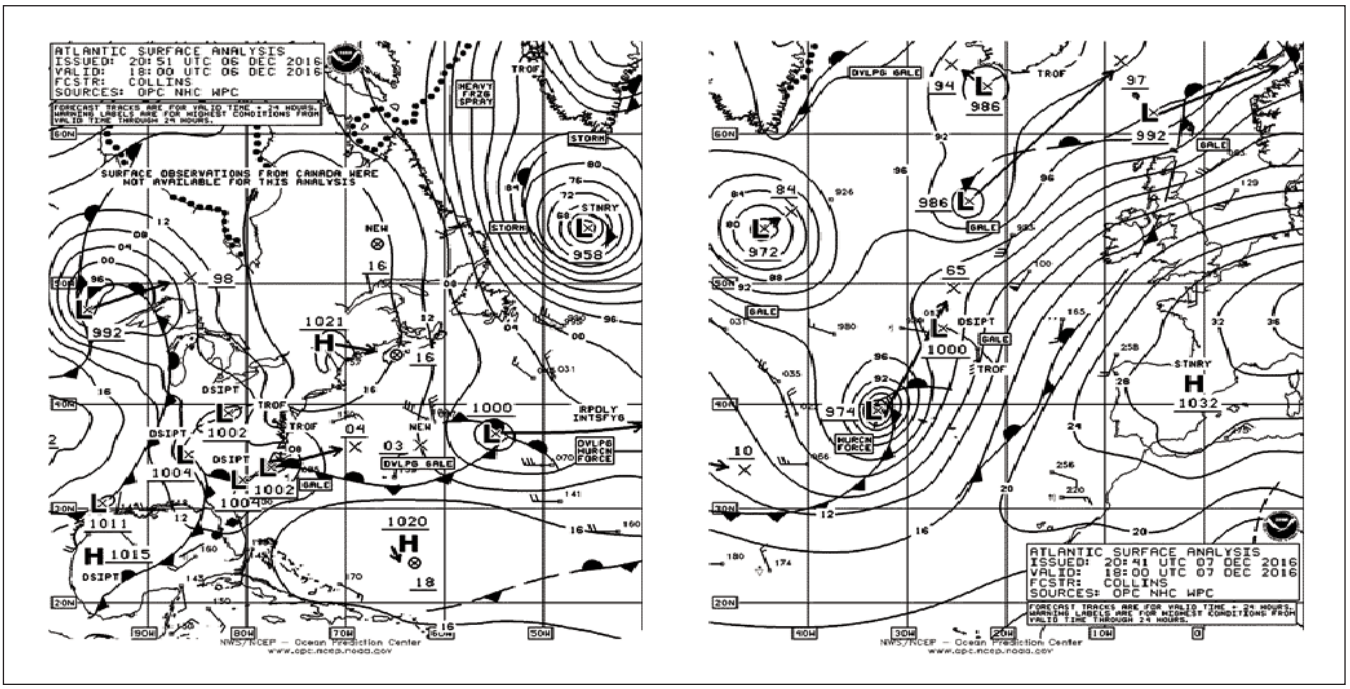


Figure 18. OPC North Atlantic Surface Analysis Charts valid 1800 UTC December 6 (Part 2) and 1800 UTC December 7, 2016 (Part 1).

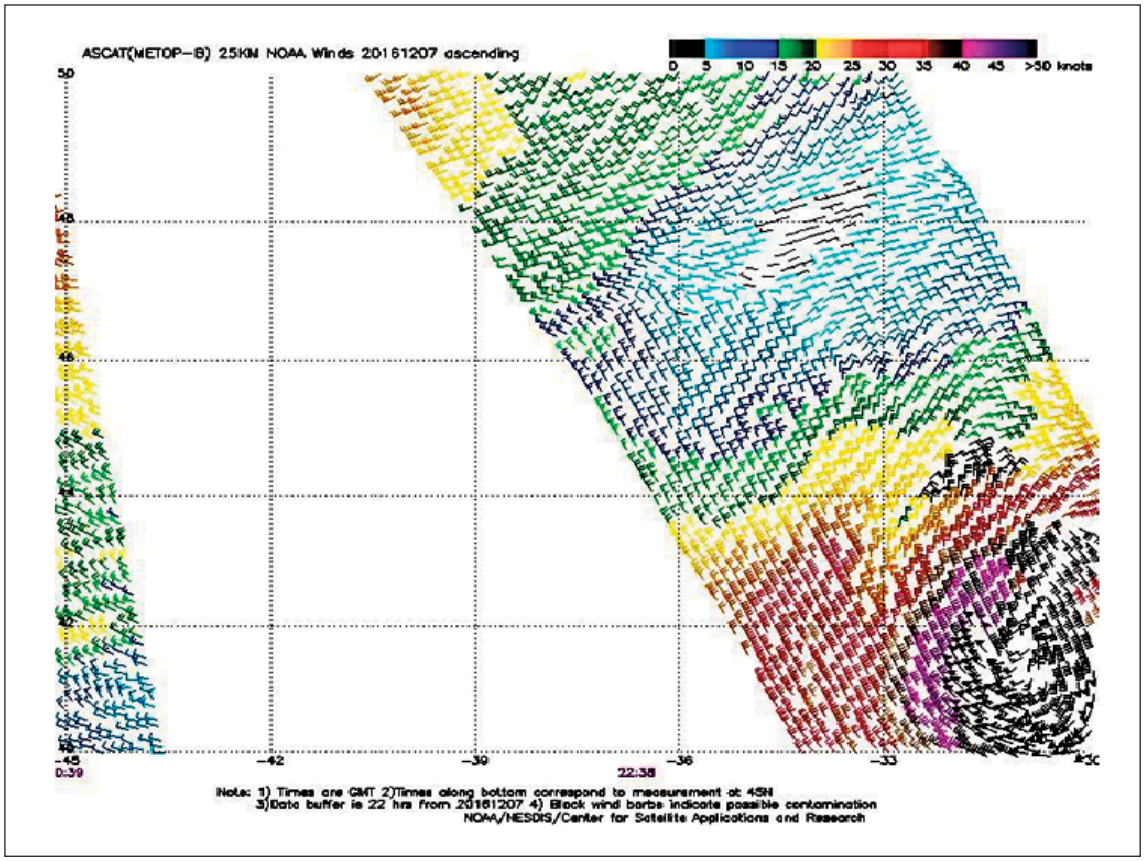


Figure 19. ASCAT (METOP-B) image of satellite-sensed winds with 25-km resolution around the hurricane-force low shown in the second part of **Figure 18**. The valid time of the eastern pass containing the higher wind retrievals is 2238 UTC December 7, 2016, or about 4.5 hours later than the valid time of the second part of **Figure 18**. Imagery is courtesy of NOAA/NESDIS/Center for Satellite Applications and Research.

northeast across the island of Newfoundland while rapidly intensifying late on the 8th and early on the 9th with the central pressure falling 42 hPa in the 24-hour period ending at 0000 UTC on the 10th. Like the December 5th–6th event, the cyclone stalled in the Labrador Sea, where it developed a lowest central pressure of 953 hPa and hurricane-force winds early on the 10th. The **JADE STAR** (VCDR) reported northwest winds of 47 kt near 54N 56W at 0000 UTC on the 10th. An AS CAT pass from 1413 UTC on the 10th revealed retrievals of 50 kt to the northeast and southwest of the center. The stalled low then weakened the next day and became absorbed on the 12th.

North Atlantic Storms, December 12–15:

Figures 20 and **21** cover a 36-hour period and show two intense cyclones over the north central waters that developed in close succession. The 956-hPa cyclone in **Figure 20** developed rapidly from a 986-hPa gale-force low at 0600 UTC on the 12th with its central pressure falling 30 hPa in 18 hours. An ASCAT-B pass with limited coverage from 1248 UTC on the 12th revealed west winds of 60 kt at the pass edge. **Figure 21** shows this cyclone weakening near Greenland as the next intense low reaches maximum intensity, after originating as the 1001-hPa low over Nova Scotia (**Figure 20**). The ASCAT-B image in **Figure 22** reveals retrievals of 50 to 60 kt around the south and west sides of the cyclone and may extend beyond the area covered by the image. The system subsequently weakened while passing near Iceland on the 15th. The **BARBARA** (CQDT) near 49N 31W reported west winds of 55 kt and 6.4-meter seas (21 feet) at 1200 UTC on the 12th (with the first cyclone) and west winds of 50 kt near 47N 45W at 2100 UTC on the 13th (with the second cyclone).

North Atlantic Storm, December 14–16:

Referring back to **Figure 21**, the rapidly intensifying low off the U.S. mid-Atlantic coast developed storm force winds 12 hours later and then briefly developed hurricane-force winds with a 972-hPa center near 57N 40W by 0600 UTC on the 16th. The cyclone then rapidly weakened while passing between Greenland and Iceland in the 16th.

Western North Atlantic Storm, December 15–17:

Originating as a low in the Gulf of Maine early on the 15th, this cyclone developed quickly while

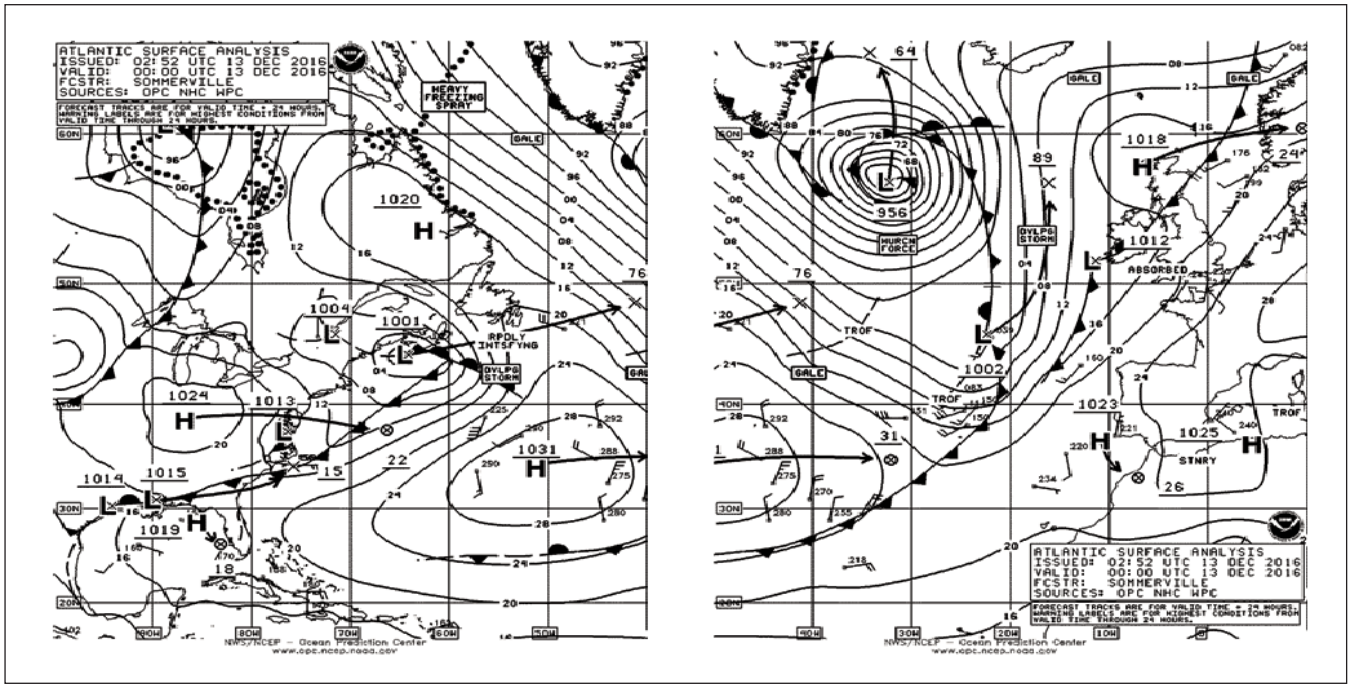


Figure 20. OPC North Atlantic Surface Analysis Charts (Parts 1 and 2) valid at 0000 UTC December 13, 2016. The two parts overlap between 40W and 50W.

passing over the Gulf of St. Lawrence during the next 24 hours, with the central pressure falling 40 hPa. It briefly developed hurricane-force winds with a 960-hPa center near 48N 59W at 1200 UTC on the 16th. The first part of **Figure 23** shows this system 6 hours prior. ASCAT-B passes from 1308 UTC and 1449 UTC on the 16th showed areas of west winds 50 to 60 kt south of Nova Scotia and the island of Newfoundland. **Figure 23** shows this system becoming absorbed by a stronger system to the north at or shortly after 0600 UTC on the 17th.

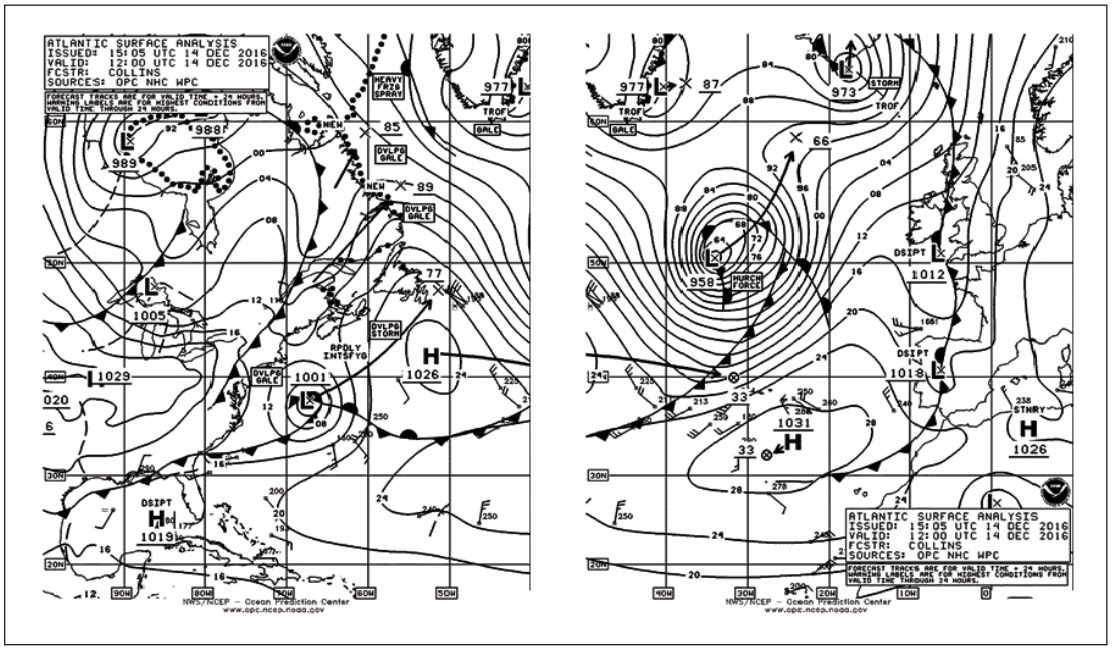


Figure 21. OPC North Atlantic Surface Analysis Charts (Parts 1 and 2) valid at 1200 UTC December 14, 2016. The two parts overlap between 40W and 50W.

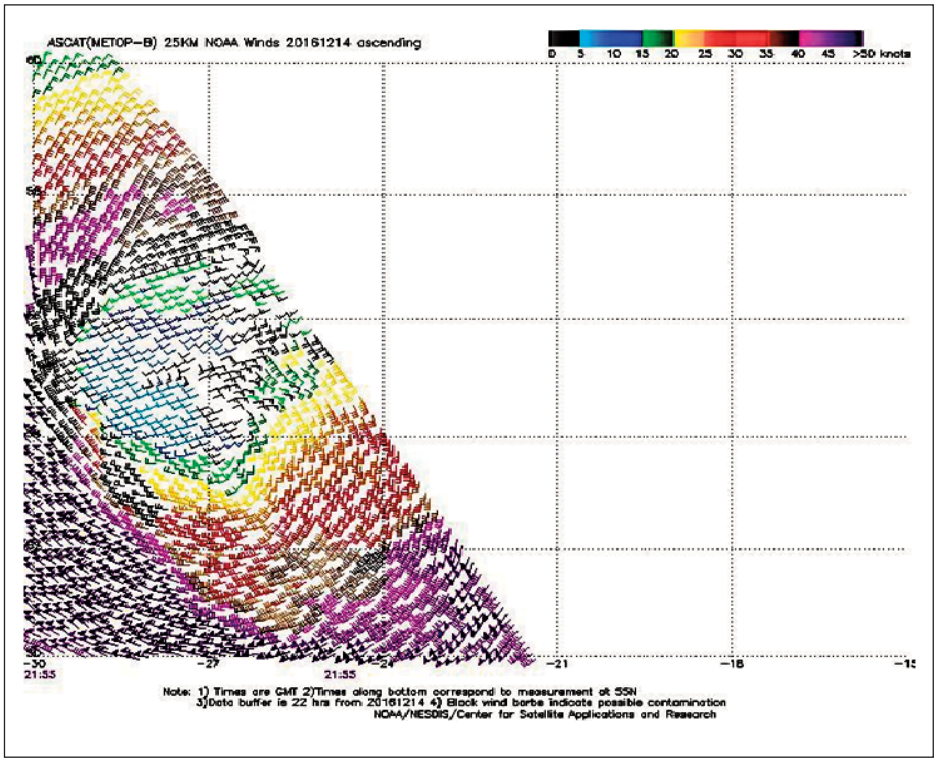


Figure 22. ASCAT (METOP-B) image of satellite-sensed winds with 25-km resolution around the hurricane-force low over the central North Atlantic shown in **Figure 21**. The valid time of the pass is 2155 UTC December 14, 2016, or about 10 hours later than the valid time of **Figure 21**. Imagery is courtesy of NOAA/NESDIS/Center for Satellite Applications and Research.

North Atlantic Storm, December 15–17:

The initial development was near the southeast U.S. coast at 0600 UTC on the 15th. **Figure 23** shows the subsequent rapid development as the cyclone southeast of Newfoundland as it moved north, developed hurricane-force winds in the Labrador Sea late on the 16th, and developed a low central pressure of 953 hPa as depicted in the second part of **Figure 23**. The central pressure fell 34 hPa in the 24-hour period ending at 0600 UTC on the 17th. The ASCAT-B image in **Figure 24** reveals wind retrievals as high as 65 kt in the southerly flow on the southeast side of the system. The cyclone subsequently weakened to a gale in the east Greenland waters on the 18th.

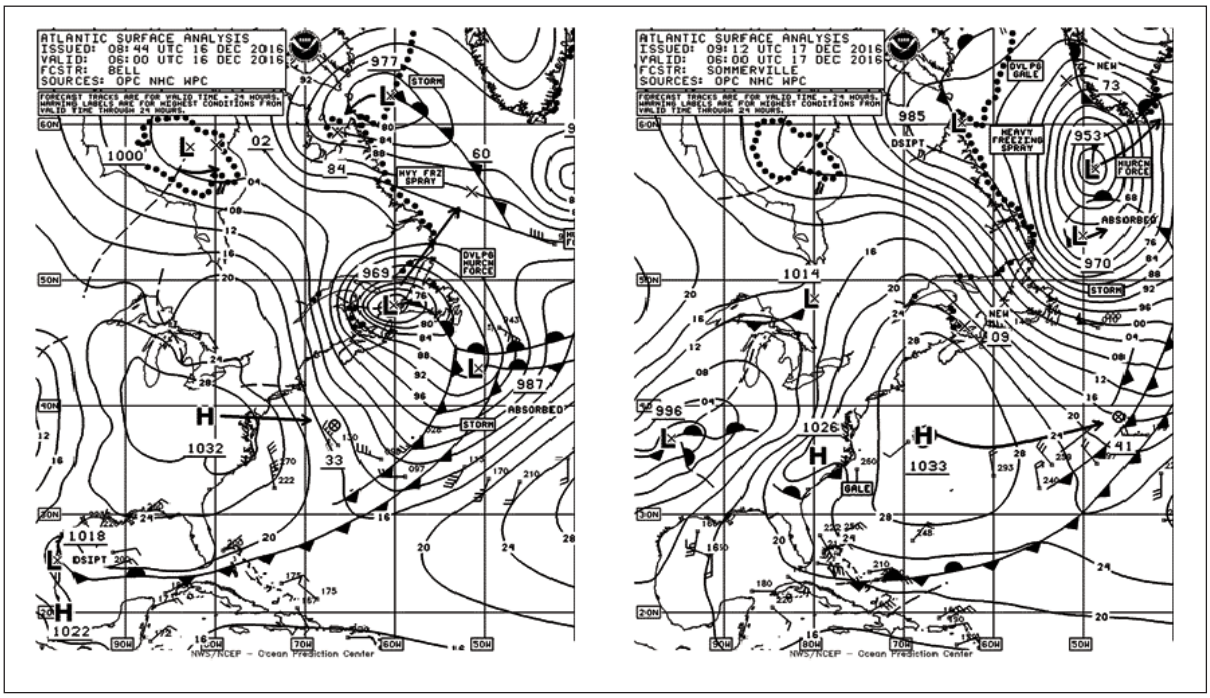


Figure 23. OPC North Atlantic Surface Analysis Charts (Part 2) valid 0600 UTC December 16 and 17, 2016.

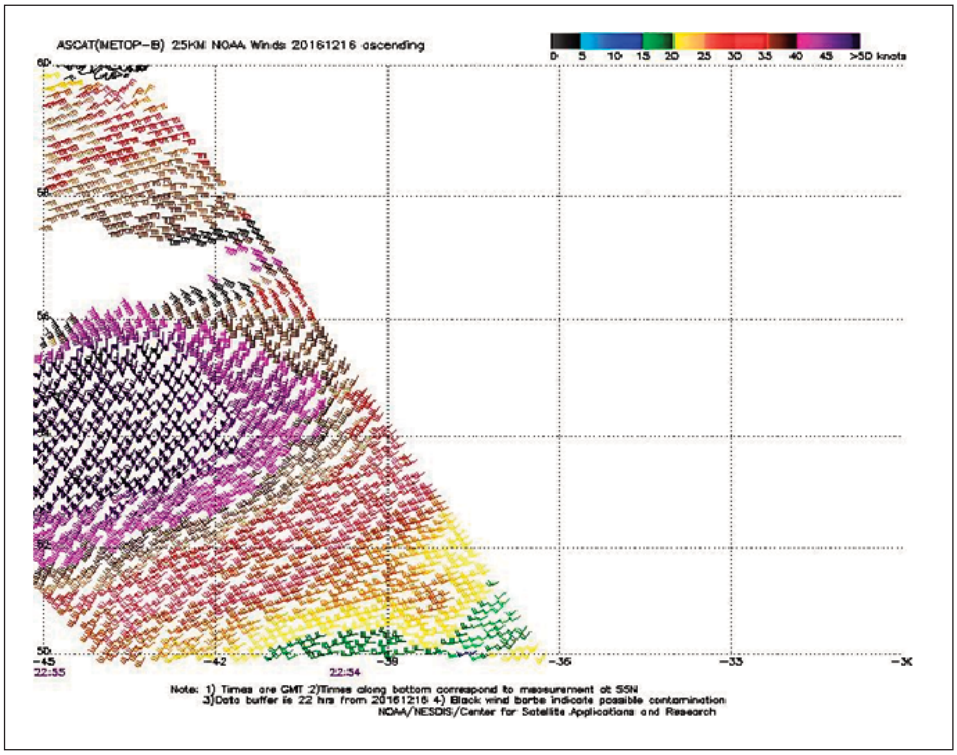


Figure 24.
ASCAT (METOP-B) image of satellite-sensed winds with 25-km resolution around the east semicircle of the hurricane-force cyclone in the second part of **Figure 23**. The valid time of the pass is 2255 UTC December 16, 2016, or about 7 hours prior to the valid time of the second part of **Figure 23**. The southern tip of Greenland appears near the upper-left corner of the image. Imagery is courtesy of NOAA/NESDIS/Center for Satellite Applications and Research.

North Atlantic Storm, December 18–21:

The next developing cyclone originated near the Great Lakes late on December 17th (**Figure 25**) and developed rapidly after moving off the southern Labrador coast late on the 18th. The cyclone developed hurricane-force winds while the center moved over the east Greenland waters late on the 19th (**Figure 25**). The **ORANJEBORG** (PIAG) reported southwest winds of 50 kt near 55N 10W at 0600 UTC on the 20th. Buoy 64045 (59.1N 11.7W) reported southwest winds of 38 kt, with gusts to 64 kt at 0900 UTC on the 20th and highest seas 11.0 meters (36 feet) 2 hours later. **Figure 26** is an ASCAT-B image showing an extensive area of 50- to 55-kt wind retrievals with isolated 60 kt, but mainly south of 56N. The cyclone developed a lowest central pressure of 940 hPa (lowest for a nontropical system in the North Atlantic area during the 4-month period) north of Iceland near 70N 13W at 0000 UTC on the 21st before weakening.

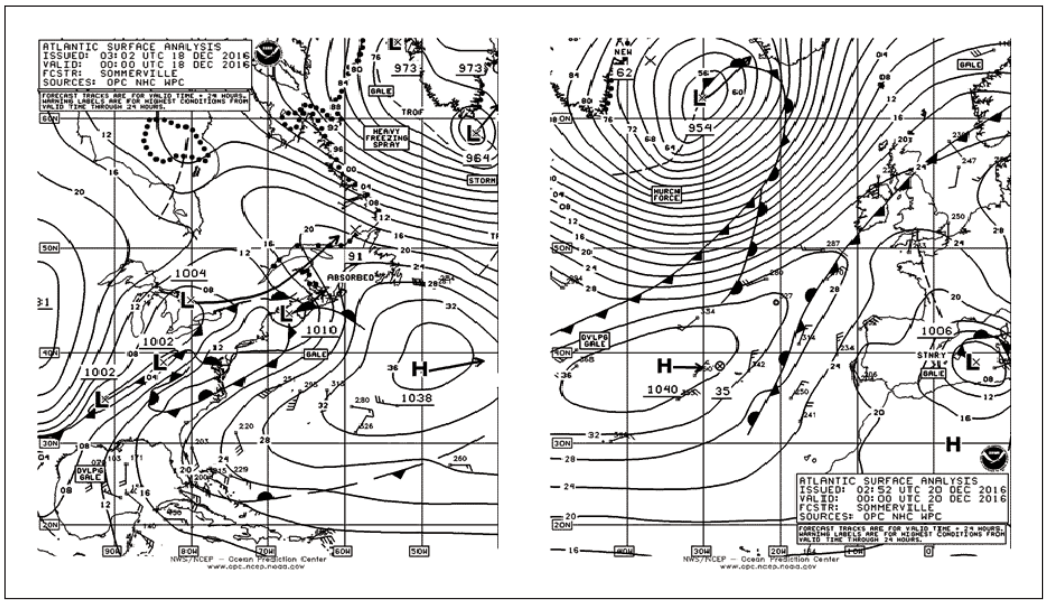


Figure 25.
OPC North Atlantic Surface Analysis Charts valid 0000 UTC December 18 (Part 2) and 0000 UTC December 20, 2016 (Part 1).

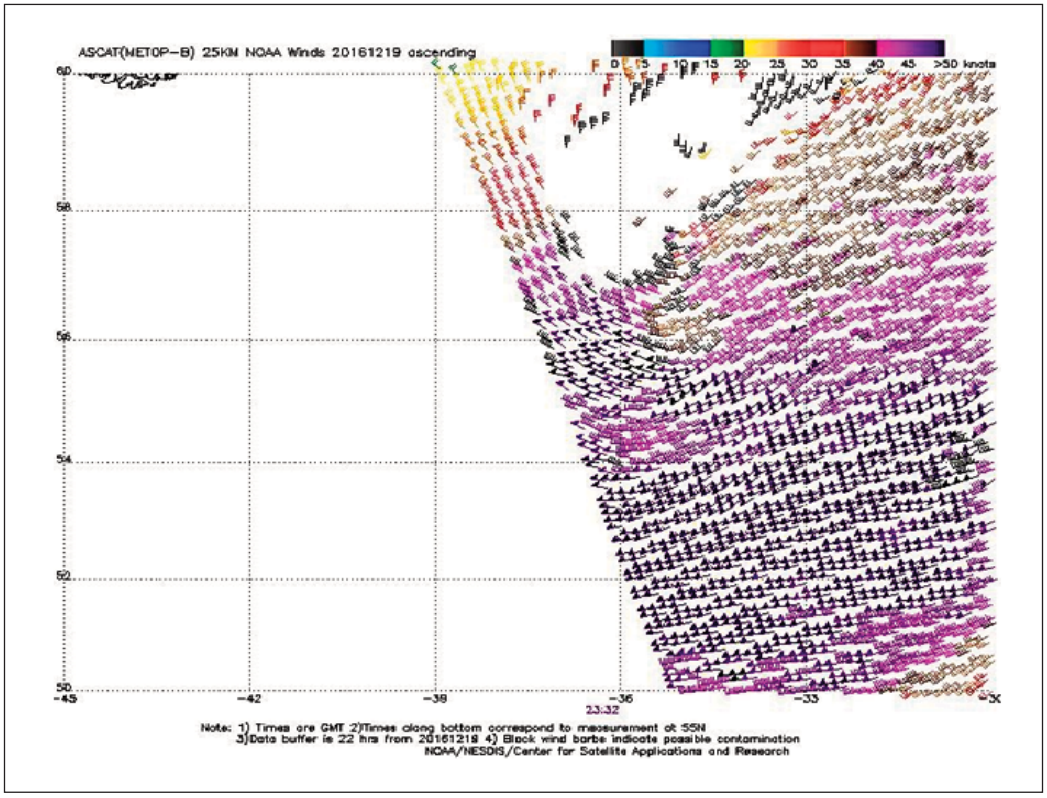


Figure 26.
ASCAT (METOP-B) image of satellite-sensed winds with 25-km resolution around the south side of the large cyclone shown in the second part of **Figure 25**. The valid time of the pass is 2332 UTC December 19, 2016, or 0.5 hour prior to the valid time of the second part of **Figure 25.** The southern tip of Greenland appears near the upper-left corner of the image. Imagery is courtesy of NOAA/NESDIS/Center for Satellite Applications and Research.

North Atlantic Storm, December 21-24:

A low pressure center moved off the mid-Atlantic coast of the U.S. late on December 20th, passed near Newfoundland late on the 21st and then rapidly intensified over the following 24 hours with the central pressure falling 41 hPa. The cyclone developed a pressure of 964 hPa and hurricane-force winds near 57N 28W by 0000 UTC on the 23rd. The cyclone developed a lowest central pressure of 948 hPa while passing east of Iceland late on the 23rd. **Figure 27** depicts the development of this cyclone over a 36-hour period. The scatterometer image in **Figure 28** shows retrievals of 50 to 70 kt south of the cyclone's center. Buoy 64045 (59.1N 11.7W) reported west winds of 50 kt with gusts to 71 kt at 1400 UTC on the 23rd and maximum seas 15.5 meters (51 feet) 6 hours later. Buoy 62105 (55.2N 12.7W) reported southwest winds of 40 kt with gusts to 66 kt at 1900 UTC on the 23rd and maximum seas 11.0 meters (36 feet) 3 hours later. Another buoy, 64046 (60.5N 4.2W), reported maximum seas of 14.3 meters (47 feet) at 0400 UTC on the 24th.

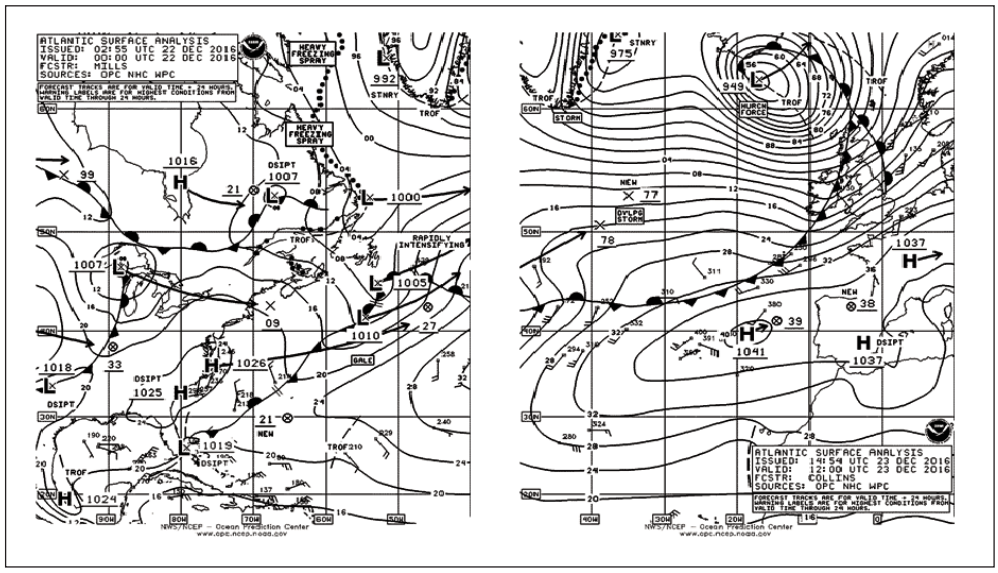


Figure 27.
OPC North Atlantic Surface Analysis Charts valid at 0000 UTC December 22 (Part 2) and 1200 UTC December 23, 2016 (Part 1).

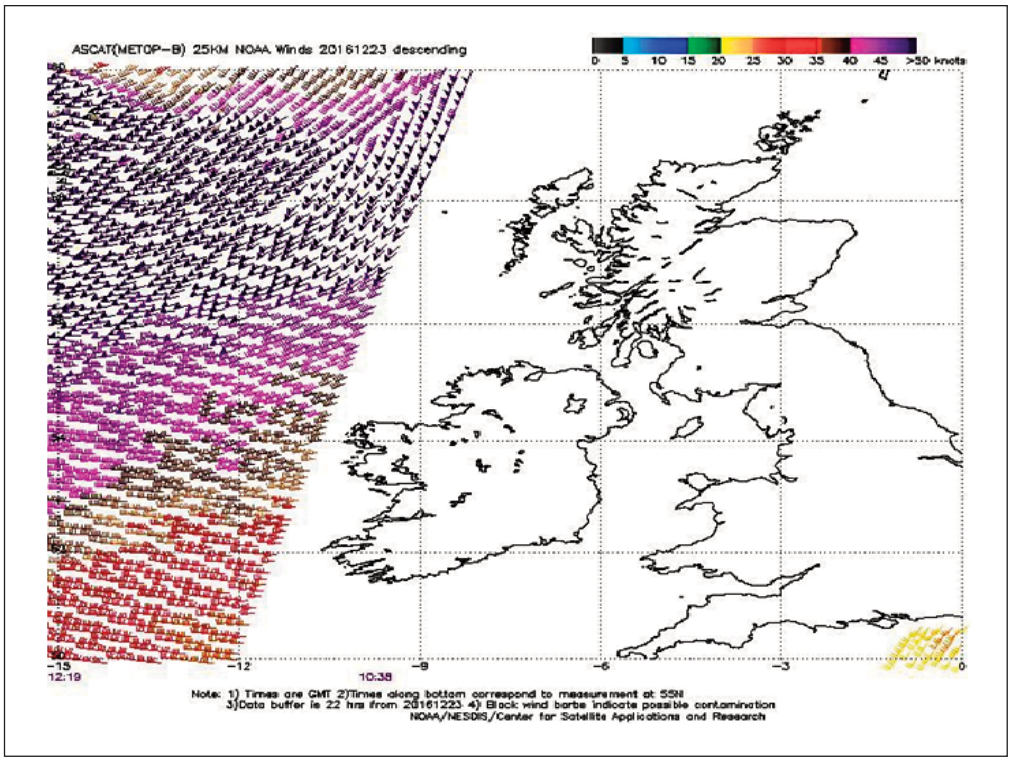


Figure 28.
ASCAT (METOP-B) image with partial coverage of satellite-sensed winds with 25-km resolution around the south side of the hurricane-force cyclone south of Iceland shown in the second part of **Figure 27**. Portions of two passes (1038 UTC and 1219 UTC December 23, 2016) are shown, with the valid time of the later pass containing the strongest winds about 0.25 hour later than the valid time of the second part of **Figure 27**. Imagery is courtesy of NOAA/NESDIS/Center for Satellite Applications and Research.

North Atlantic Storm, December 23–26:

This cyclone, originating over the Great Lakes (**Figure 27**) late on December 21st, moved offshore from New England late on the 22nd and then rapidly strengthened over the north central waters while following a track similar to that of its predecessor. The cyclone developed hurricane-force winds and a lowest central pressure of 950 hPa while passing near and east of Iceland on the 25th. An ASCAT-B pass from 1949 UTC on the 25th returned a swath of west winds 50 to 60 kt between 61N and 64N east of Iceland. The cyclone then moved east and inland over Norway late on the 26th while weakening. The **TROLL A** platform (LF4B, 60.6N 3.8E) encountered west winds of 50 kt with gusts to 65 kt at 1200 UTC on the 26th and maximum seas 10.1 meters (33 feet) 4 hours later. Buoy 64045 (59.1N 11.7W) reported west winds of 45 kt with gusts to 63 kt at 0500 UTC on the 26th and maximum seas 11.3 meters (37 feet) 5 hours later.

The buoy 64046 (60.5N 4.2W) reported highest seas of 14.3 meters (47 feet) at 1200 UTC on the 26th.

North Atlantic Storm, Greenland area, December 26–28:

A new low formed near the Greenland coast at 64N 38W at 0600 UTC December 27 with a 969-hPa center and drifted northeast while rapidly intensifying. It developed hurricane-force winds 12 hours later as it developed a lowest pressure of 952 hPa (**Figure 29**). Wind retrievals from ASCAT-B near this time (**Figure 30**) show a swath of west winds 50 to 60 kts with an isolated 65 kt, likely induced by the southern tip of Greenland. The cyclone drifted northeast and weakened by the 29th as a new system moved into the waters just west of Iceland.

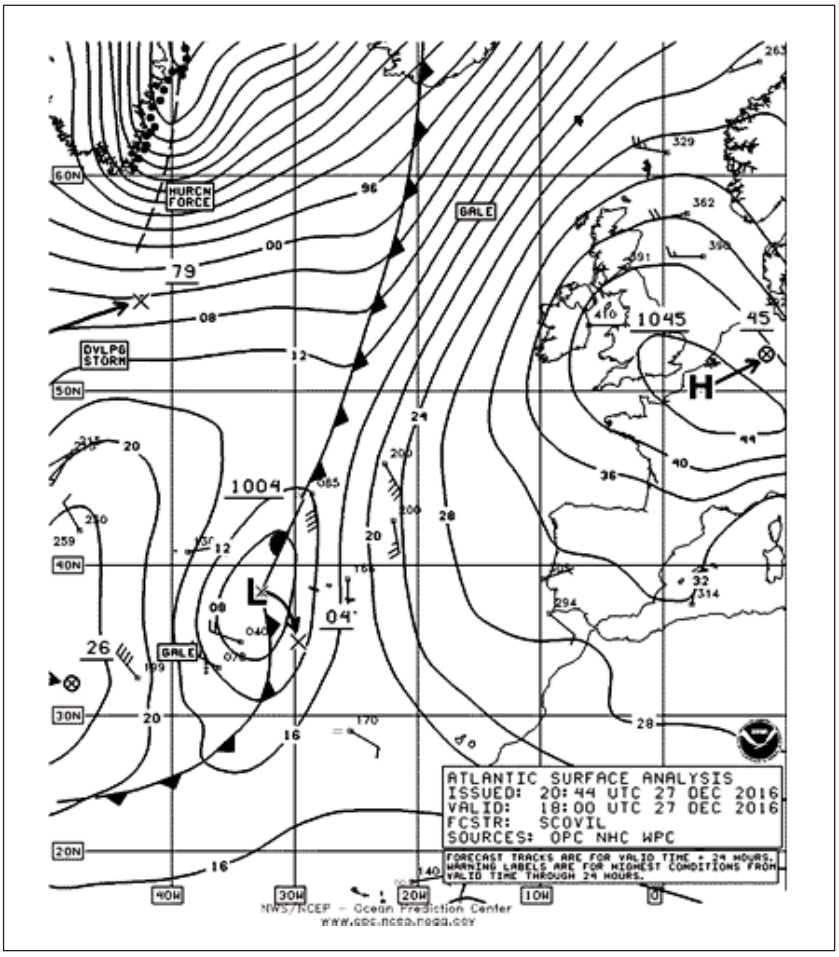


Figure 29. OPC North Atlantic Surface Analysis Chart (Part 1) valid 1800 UTC December 27, 2016.

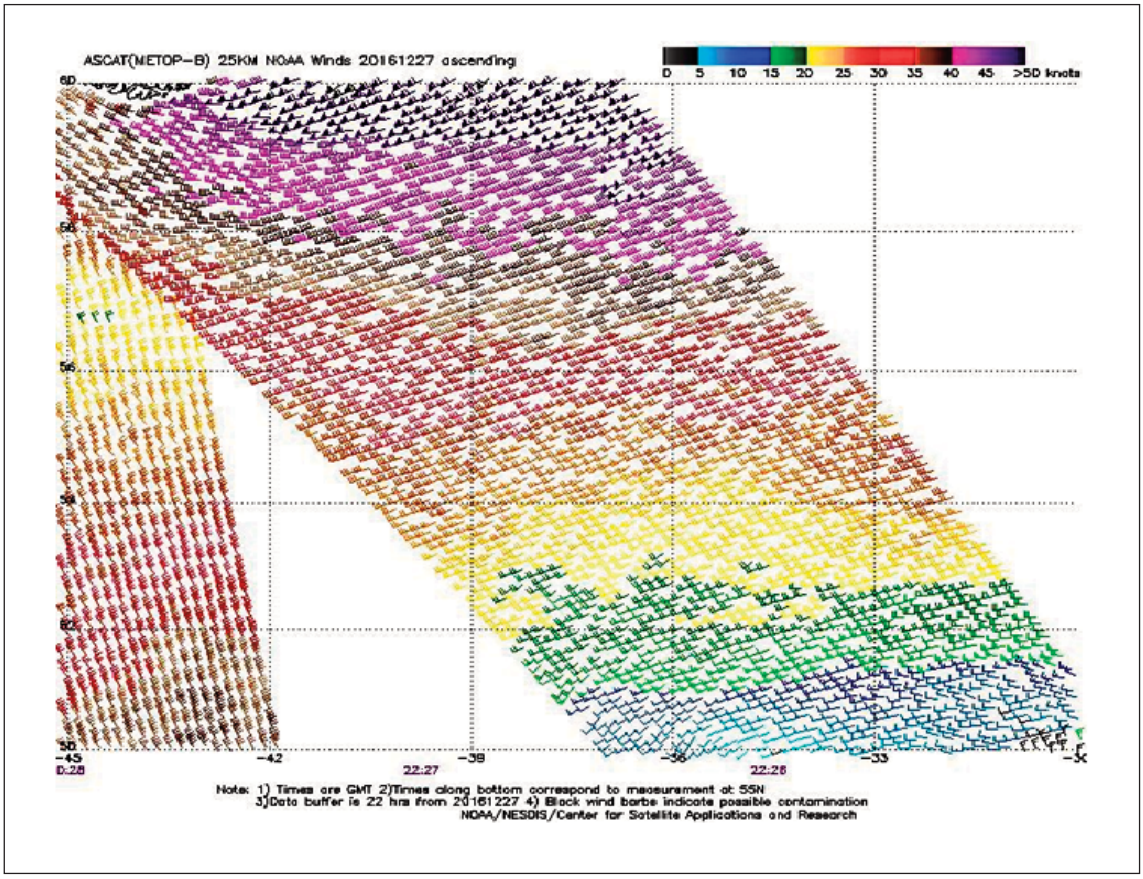


Figure 30. ASCAT (METOP-B) image of satellite-sensed winds with 25-km resolution around the south side of the hurricane-force low with the center near the east coast of Greenland, but off the chart in **Figure 29**. The valid time of the pass containing the higher wind retrievals 2226 UTC December 27, 2016, or 4.25 hours later than the valid time of **Figure 29**. The southern tip of Greenland appears near the upper-left corner of the image. Imagery is courtesy of NOAA/NESDIS/Center for Satellite Applications and Research.

North Atlantic Storm, west of Greenland
December 30–31:

This developing cyclone followed an inland track to the west of the Davis Strait with a lowest central pressure of 966 hPa, briefly developing hurricane-force winds with the center near 62N 69W with a 973-hPa pressure at 1200 UTC on the 31st.

Marine Weather Review – North Pacific Area

September to December 2016

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Introduction

The weather pattern over the North Pacific featured increasingly active weather during the early fall months of September and October, enhanced by tropical activity coming out of the western Pacific and even the central Pacific. Many of the cyclonic systems tracking northeast out of the western North Pacific and sometimes originating in the central and eastern waters during the 2 months developed storm force winds, but the first cyclone of nontropical origin to develop hurricane-force winds did not occur until late in October.

During November and December as the storm track shifted farther south, developing cyclones originated from near or south of Japan and tracked near or south of the Aleutian Islands and into the northeastern Pacific with some of these systems turning north into the Bering Sea. There was a secondary storm track with cyclones moving northeast out of the central and eastern North Pacific at times. Hurricane-force systems were well distributed during November and December, with seven (including former tropical cyclone) occurring in each of those months.

Tropical activity in North Pacific including cyclones appearing on OPC oceanic surface analyses was concentrated from September to early November, with six typhoons and two tropical storms occurring. Of these, Songda became a supertyphoon (sustained winds 130 kt or more) and Meranti developed supertyphoon status after passing west of OPC's oceanic analysis area early in September. Typhoons Chaba, Songda and Meari eventually became hurricane-force extratropical lows.

Tropical Activity

Tropical Storm Lester:

Lester was a long-lived tropical cyclone that originally came from the tropical Eastern Pacific in August. After passing north of Hawaii as a hurricane on September 3rd, Lester weakened to a tropical storm and crossed 30N into OPC's high-seas area near 166W at 0000 UTC on the 6th as a 50-kt tropical storm. The storm tracked north and maintained this intensity until extratropical transition on the 7th. **Figure 1** depicts Posttropical Cyclone Lester about to merge with a nontropical low and front to the north. The combined system briefly developed storm force winds with a 984-hPa center near 58N 138W at 1800 UTC on the 9th before moving inland. The **LIBERTY BAY** (KLBO) near 53N 139W reported southwest winds of 45 kt at 1200 UTC on the 9th. Buoy 46085 (55.9N 142.5W) reported northwest winds of 35 kt, with gusts to 45 kt at 1500 UTC on the 9th and highest seas 5.2 meters (17 feet) 7 hours later.

Typhoon Meranti:

The low-pressure area that would become Meranti originated near 13N 143E early on September 8th and drifted northwest, becoming a tropical storm late on the 9th, and then Typhoon Meranti near 17N 134E late on the 10th with 70 kt winds. While passing west of the area at 18N 130E, its winds increased to 115 kt. Meranti became a supertyphoon west of the area and developed sustained winds of 165 kt on the 13th southeast of Taiwan, making it the strongest storm in the world in 2016 (**Reference 8**).

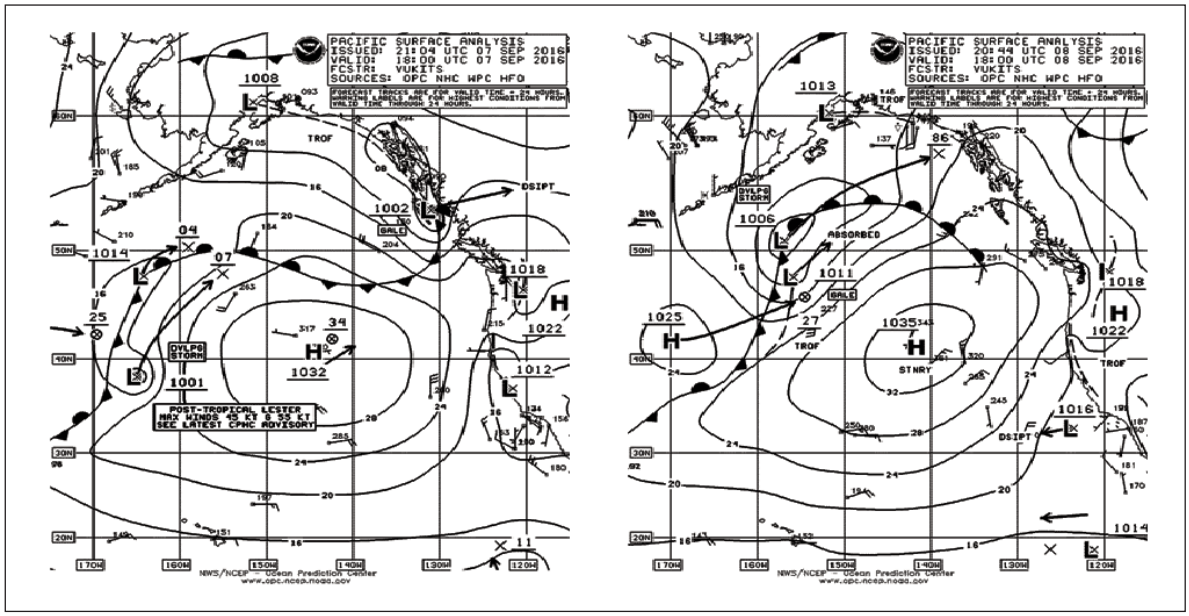

Figure 1. OPC North Pacific Surface Analysis Charts (Part 1 — east) valid 1800 UTC September 7 and 8, 2016. The 24-hour forecast tracks are shown with the forecast central pressures given as the last two whole digits in millibars (hPa), with the exception of tropical cyclones, for which just a tropical symbol is given at the 24-hour position (if still a tropical cyclone). Text boxes contain warning and tropical (or in this case posttropical) cyclone information.

Typhoon Malakas:

A nontropical low at 11N 147E early on September 11th moved northwest, developing into Tropical Storm Malakas early on the 12th and then strengthening into a typhoon with 70-kt winds, near 16N 132E at 1200 UTC on the 14th. Malakas attained maximum intensity of 100 kt near 31N 131E 24 hours later while making a turn toward the northeast. The cyclone weakened to a 65 kt or minimal typhoon by 0000 UTC on the 20th near 33N 133E while approach-ing Japan. **BRITISH COUNCILLOR** (MRSA8) near 35N 131E reported north winds of 40 kt and 9.0-meter seas (30 feet) 2 hours later. The cyclone then rapidly weakened while passing near Tokyo and then east of Japan on the 20th, becoming posttropical (extratropical) later that day. The remnant of Malakas then dissipated east of Japan near 170E on the 23rd.

Typhoon Megi:

Megi originated as a nontropical low near 12N 140E at 1800 UTC September 22nd, developed into a tropical storm near 15N 140E with 40-kt winds 6 hours later and then rapidly intensified while moving northwest, becoming a typhoon with 65-kt winds near 19N 134E at 1200 UTC on the 24th. Megi developed winds of 90 kt later that day while passing west of 130E, the western boundary of the Unified Surface Analysis (www.opc.ncep.noaa.gov).

Typhoon Chaba:

A weak low-pressure area that became Chaba originated near 14N 150E early on September 27th and moved west with gradual strengthening over the next 3 days, becoming a tropical storm late on the 27th. Its winds increased to 55 kt early on the 30th, and the cyclone turned northwestward. Chaba strengthened into a typhoon near 18N 133E at 1200 UTC October 1st, and then the winds reached 105 kt as the cyclone passed west of the area later that day. Chaba then returned as a storm-force posttropical low in the Sea of Japan early on October 5th, which weakened east of Japan that day before re-intensifying into hurricane-force low by the 7th (**Figure 2**). Posttropical Cyclone Chaba then developed a lowest central pressure of 954 hPa in the southern Bering Sea late on the 7th before turning northwest and weakening inland on the 10th. The **SAGA NAVIGATOR** (VRDA4) near 41N 146E reported northeast winds of 45 kt at 2000 UTC on the 5th. Buoy 46072 (51.7N 172.1W) reported southwest winds 39 kt with

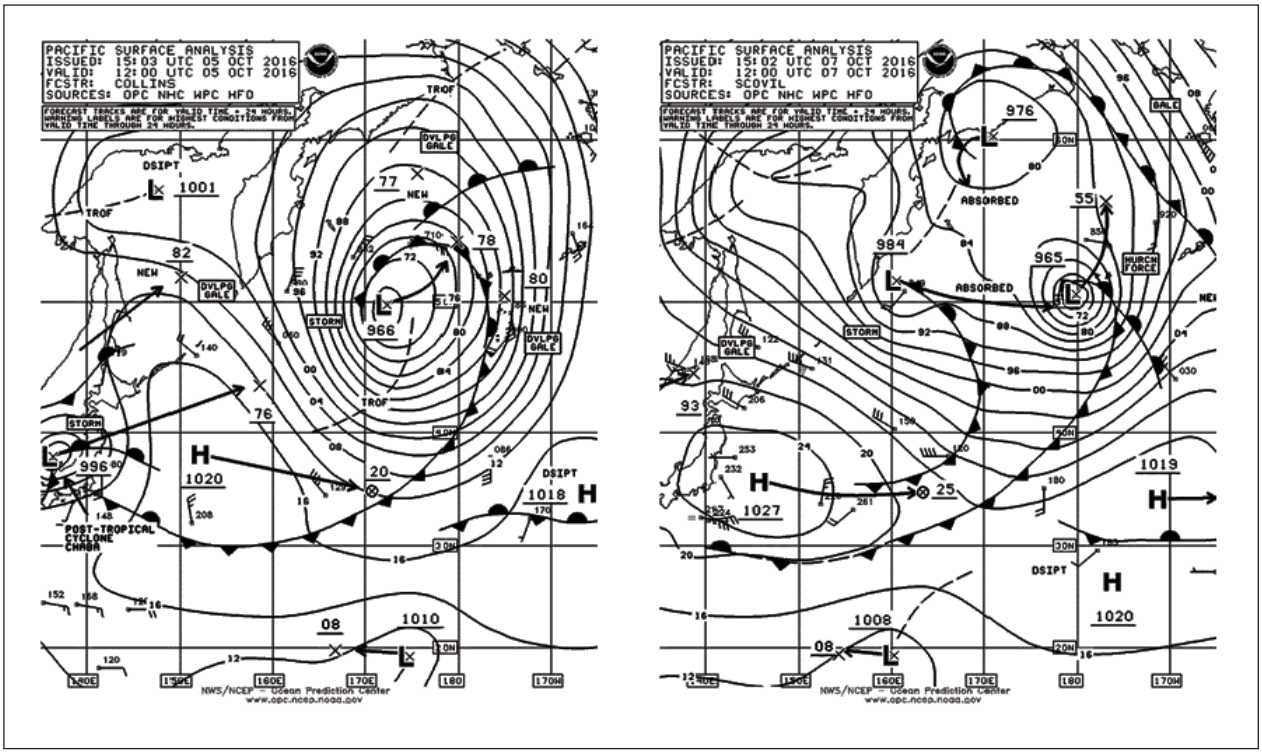

Figure 2. OPC North Pacific Surface Analysis Charts (Part 2 — West) valid 1200 UTC October 5 and 7, 2016.

gusts to 49 kt at 2300 UTC on the 7th, a peak gust of 58 kt 1 hour later and maximum seas of 10.0 meters (33 feet) at 0100 UTC on the 8th. The ASCAT-B wind retrievals in **Figure 3** of up to 60 kt strongly supports a hurricane-force warning label due to the low bias of ASCAT winds.

Supertyphoon Songda:

Songda originated as a nontropical low near 20N 156E late on October 7th, which developed rapidly into a 45-kt tropical storm by 0600 UTC on the 9th while moving northwest. After another 24

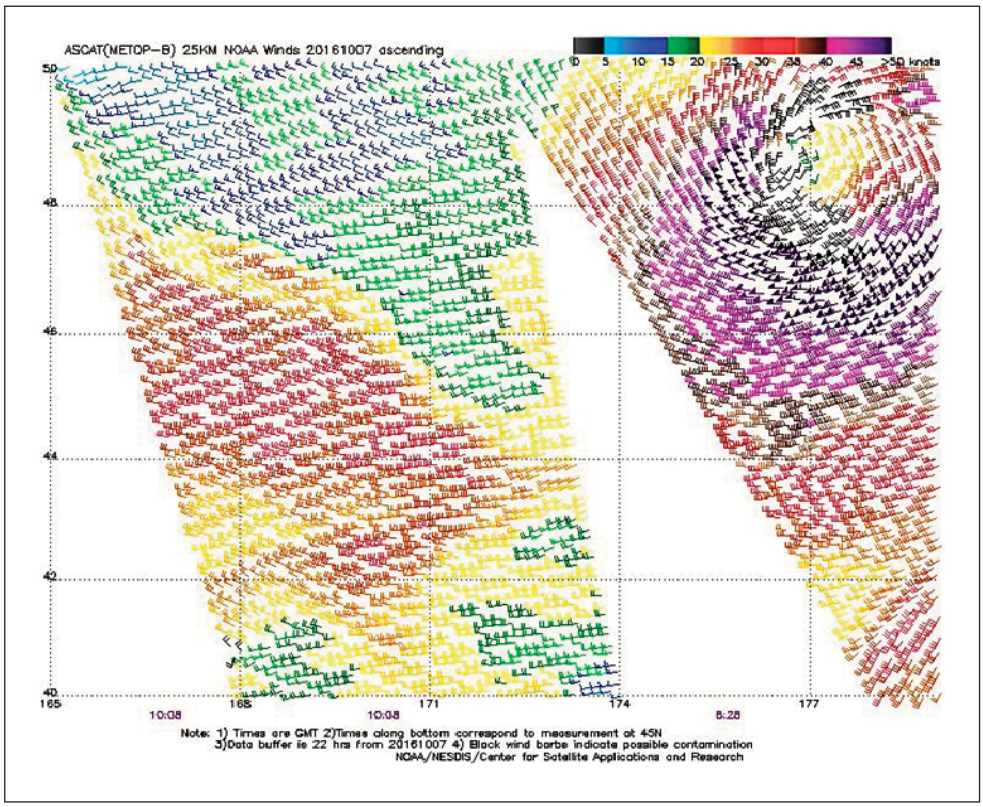

Figure 3.
ASCAT METOP-B (Advanced Scatterometer) image of satellite-sensed winds (25-km resolution) around the hurricane-force low (Posttropical Cyclone Chaba) shown in the second part of **Figure 2**. The valid time of the pass containing the stronger wind retrievals is 0828 UTC October 7, 2016, or about 3.5 hours prior to the valid time of the second part of **Figure 2**. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

hours, Songda became a typhoon with 90-kt winds and began a turn toward the north. At 1800 UTC on the 11th, Songda briefly became a super- typhoon with sustained winds of 130 kt near 30N 149E. Extratropical transition followed early on the 12th with Songda becoming an intense post- tropical hurricane-force low (**Figure 4**). The ASCAT-B image in **Figure 5** captures the cyclone when it was a typhoon (the old pass on the left) and when it was classified as a hurricane-force extratropical low. The eastern pass still shows the strongest winds close to the center like in a tropical cyclone, but lacks the symmetry seen in the western pass, and the wind retrievals in the typhoon are likely too low. Songda rapidly weakened while passing over the central waters and then re-intensified into a hurricane-force low again on the 15th before moving inland (**Figure 6**), with the central pressure falling 25 hPa. Buoy 46029 (46.2N 124.5W) reported south winds of 43 kt with gusts to 56 kt at 2000 UTC on the 15th and maximum seas of

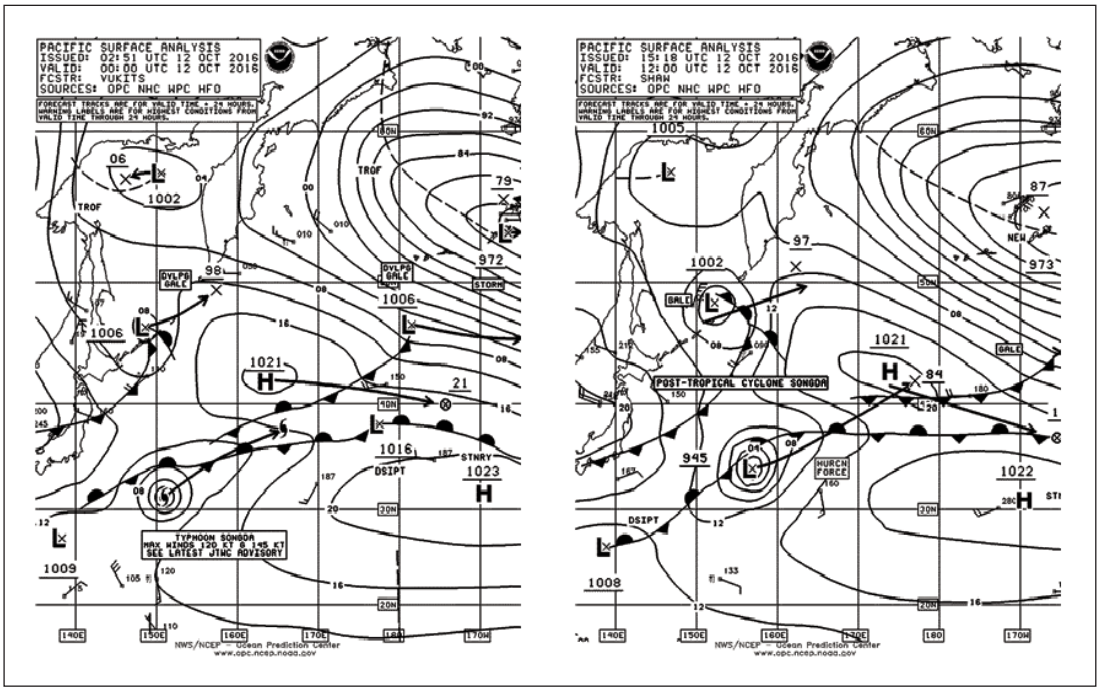

Figure 4. OPC North Pacific Surface Analysis Charts (Part 2) valid 0000 UTC and 1200 UTC October 12, 2016.

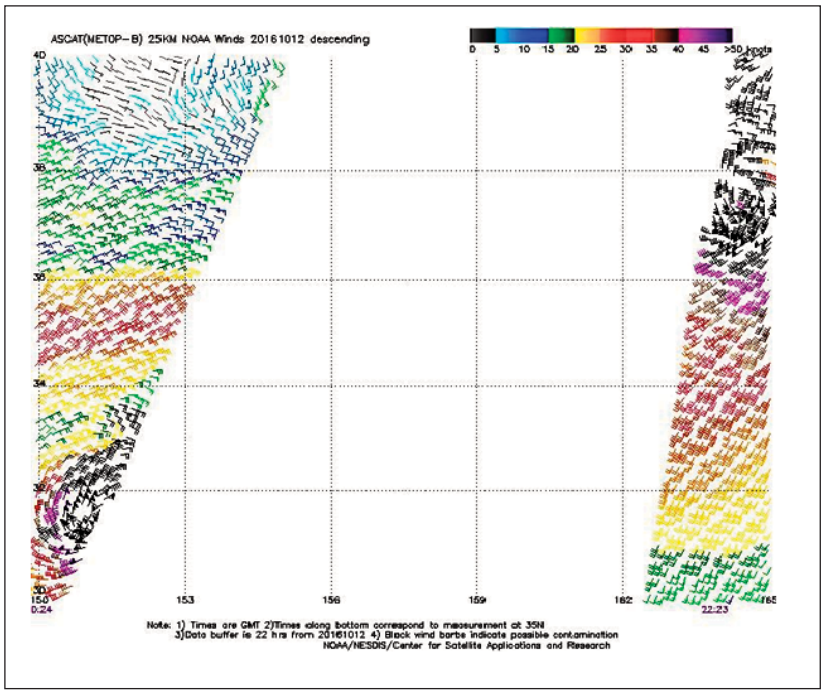

Figure 5. ASCAT (METOP-B) image of satellite-sensed winds (25-km resolution) around Typhoon Posttropical Cyclone Songda shown in **Figure 4**. The eastern or more current pass from 2223 UTC October 12, 2016, is valid about 10.25 hours later than the valid time of the second part of **Figure 4**. The older western pass has a valid time of 0024 UTC October 12, or 0.25 hour later than the valid time of the first part of **Figure 4**. Image is courtesy of NOAA/NESDIS/Center for Satellite Application and Research.

7.0 meters (23 feet) 2 hours later. Buoy 46248 (46.1N 124.6W) reported maximum seas of 7.5 meters (25 feet) at 2100 UTC on the 15th. The Destruction Island C/MAN (47.7N 124.4W) reported southeast winds of 56 kt with gusts to 68 kt at 2200 UTC on the 15th.

Typhoon Meari:

Tropical Storm Meari formed near 14N 139E at 0000 UTC November 4 with 50-kt winds and moved north while intensifying to a typhoon 24 hours later. A maximum intensity of 90 kt occured by 0000 UTC on the 6th as the typhoon

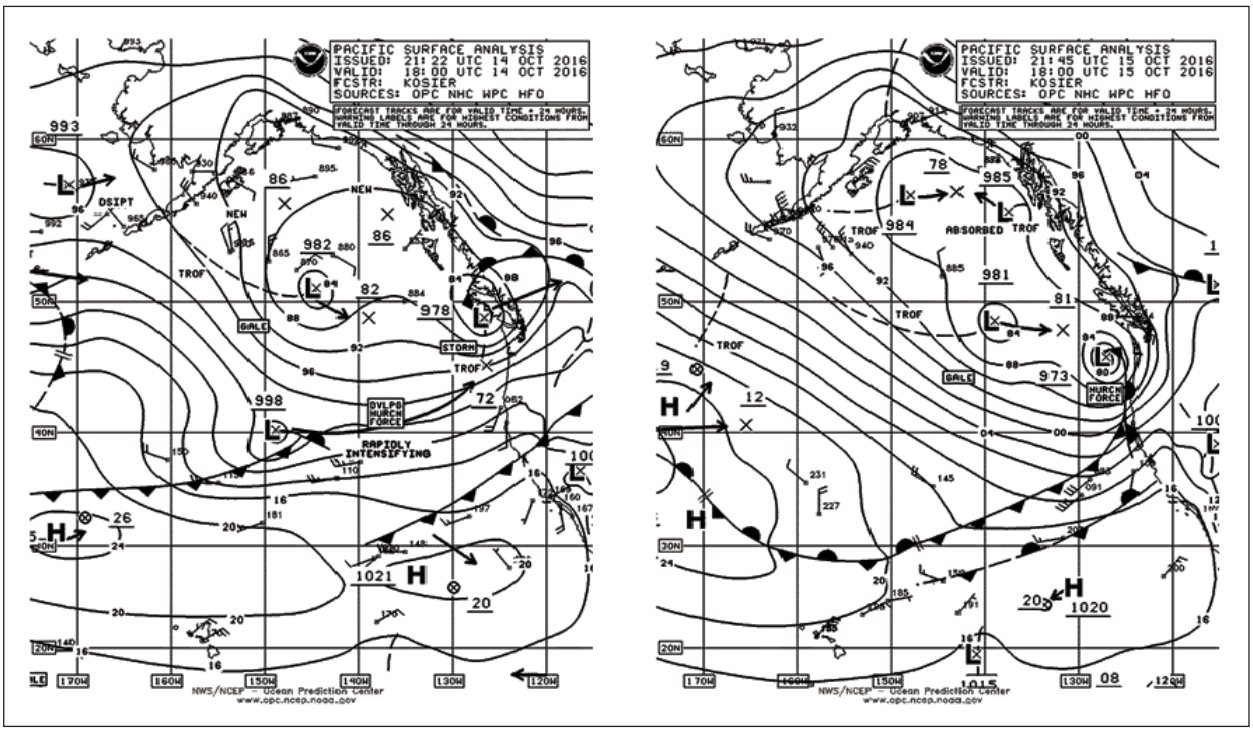

Figure 6. OPC North Pacific Surface Analysis Charts (Part 1) valid 1800 UTC October 14 and 15, 2016.

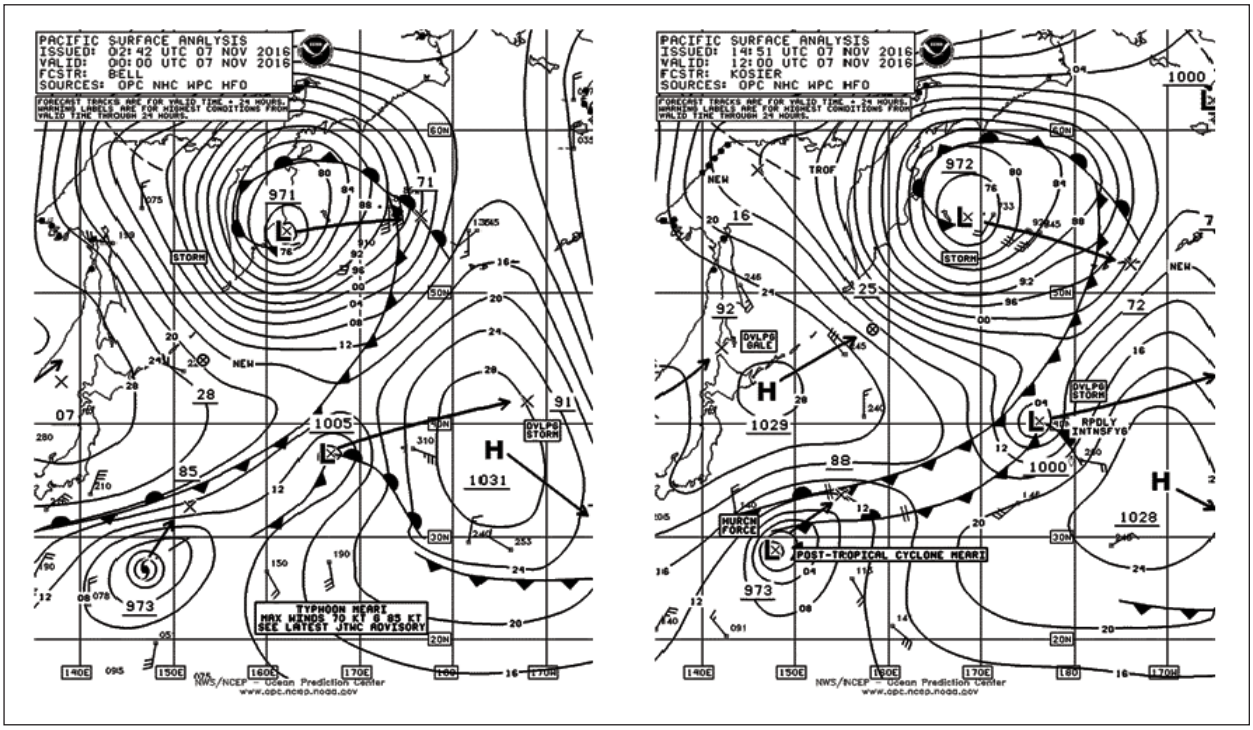

Figure 7. OPC North Pacific Surface Analysis Charts (Part 2) valid 0000 UTC and 1200 UTC November 7, 2016.

turned toward the northeast, and then a weakening trend began. A vessel reporting with the **SHIP** call sign reported north winds of 40 kt and 6.4-meter seas (21 feet) near 20N 140E at 0300 UTC on the 6th. **Figure 7** shows the typhoon becoming a posttropical hurricane-force low over at 12-hour period. The ASCAT-B data in **Figure 8** indicate a compact circulation, but the strongest wind retrievals, up to 60 kt, are shifted to the west and northwest of the center. The cyclone subsequently weakened rapidly to a gale late on the 7th, re-intensified into a storm near 48N 178E with a 973-hPa center by 1200 UTC on the 11th, and then turned toward the southeast and dissipated as a trough late on the 11th.

Tropical Storm Ma-On:

A nontropical low near 16N 157E at 1800 UTC November 9th moved northwest, developed into a weak tropical storm 12 hours later, and reached a peak intensity of 40 kt near 19N 151E at 0600 UTC on the 11th. Tropical Storm Ma-On then weakened to a tropical depression later that day and to a remnant low the following day, near 21N 142E.

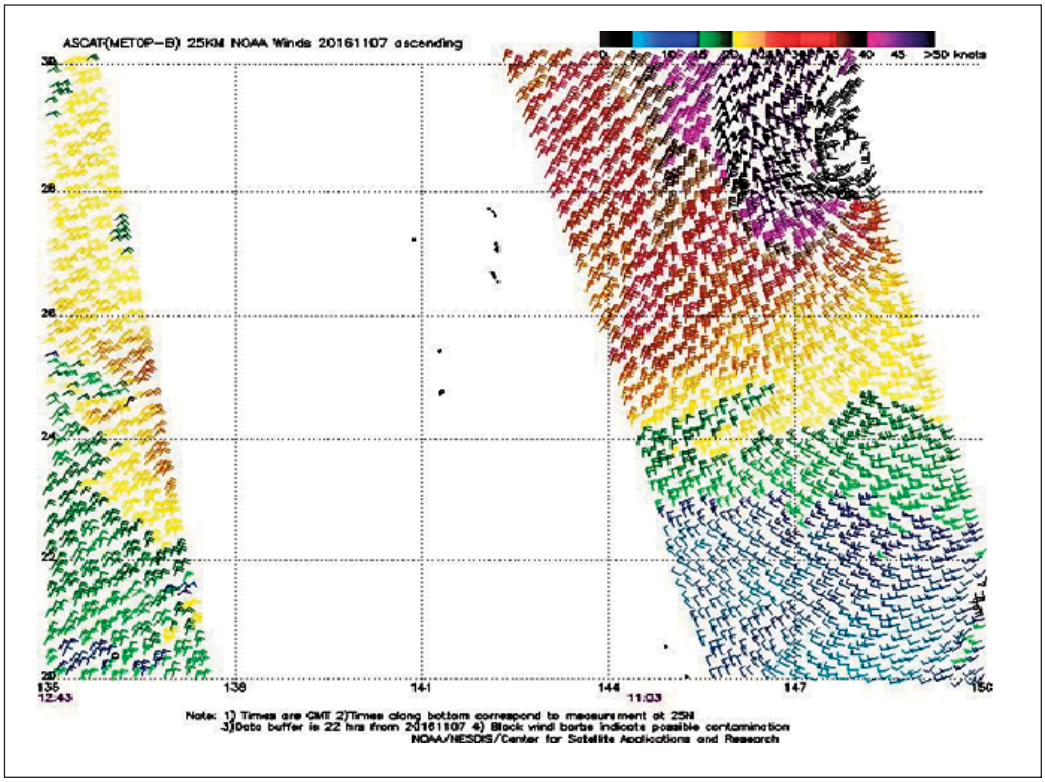

Figure 8.
ASCAT (METOP-B) image of satellite-sensed winds (25-km resolution) around the south and west sides of the hurricane-force low (Posttropical Cyclone Meari) shown in the second part of **Figure 7**. The valid time of the eastern pass is 1103 UTC November 7, 2016, or about 1 hour prior to the valid time of the second part of **Figure 7**. Image is courtesy of NOAA/NESDIS/Center for Satellite Application and Research.

Other Significant Events of the Period

Northwest Pacific Storm, September 21–23:

Figure 9 depicts the rapid development of this storm from a new low on a front near 53N 147W. It developed a peak intensity of 976 hPa near 60N 149W at 1200 UTC on September 22nd. The ASCAT-B image in **Figure 10** showed some coastal enhancement of the winds ahead of the occluded front as analyzed in the second part of **Figure 9**, with retrievals of up to 50 kt. Buoy 46083 (58.3N 138.0W) reported southeast winds of 35 kt with gusts to 47 kt at 1100 UTC on the 22nd and maximum seas of 7.9 meters (26 feet) 4 hours later. Buoy 46061 (60.2N 146.8W) reported east winds 45 kt with gusts to 56 kt at 1000 UTC on the 22nd, and there was a gust to 58 kt and a report of seas 4.9 meters (16 feet) at 0500 UTC on the 22nd. The low dissipated inland late on the 22nd.

Northwest Pacific/Bering Storm, October 23–25:

A developing low originating east of northern Japan near 157W early on the 23rd moved northeast to the western Bering Sea by the 24th where it rapidly intensified. The central pressure reached 948 hPa in the northwest Bering Sea at

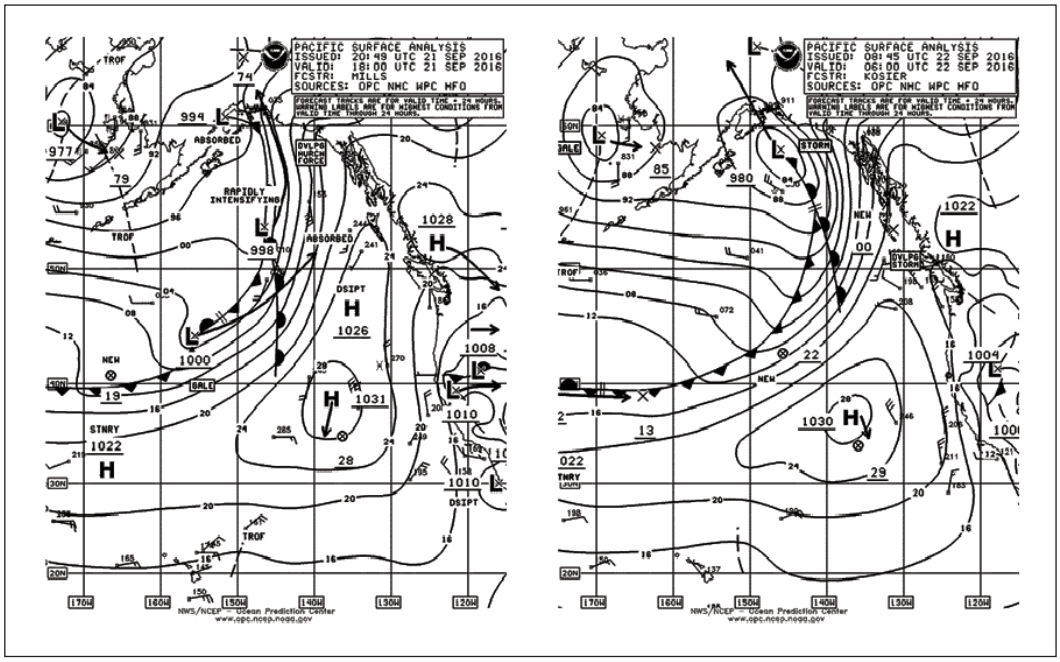

Figure 9. OPC North Pacific Surface Analysis Charts (Part 1) valid 1800 UTC September 21 and 0600 UTC September 22, 2016.

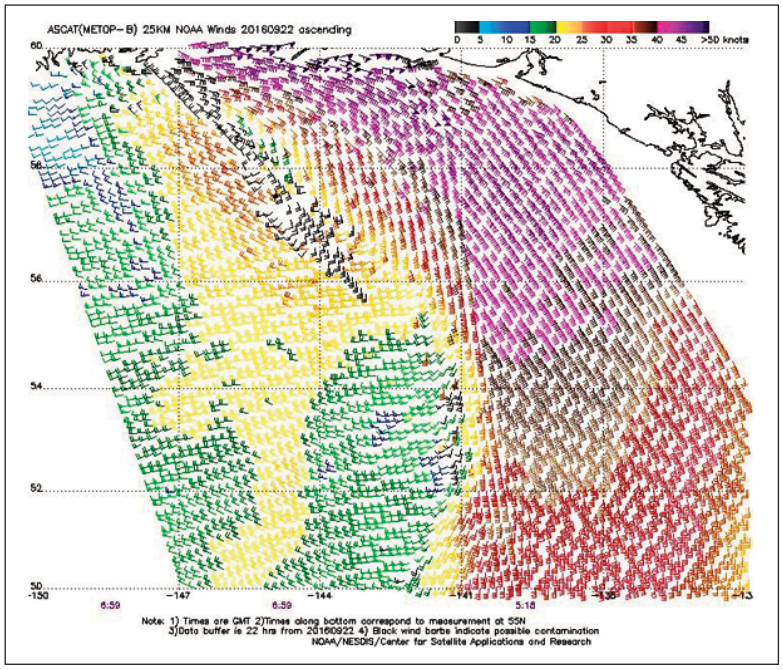

Figure 10.
A 25-km ASCAT (METOP-B) image of satellite-sensed winds around the cyclone near the southern coast of Alaska depicted in the second part of **Figure 9**. Portions of two passes are shown (0518 UTC and 0659 UTC September 22, 2016). The valid time of the later pass containing the highest wind retrievals is 1 hour later than the valid time of the second part of **Figure 9**. Image is courtesy of NOAA/NESDIS/Center for Satellite Application and Research.

0600 UTC on the 25th before moving inland. The central pressure fell 36 hPa in the 24-hour period ending at 0000 UTC on the 25th. **Figure 11** shows this cyclone moving inland over Siberia. An ASCAT pass from 2355 UTC on the 24th revealed retrievals up to 50 kt southeast of the low center, suggesting winds not reaching hurricane force, but the central pressure in the 940s was the first of the season. Buoy 46035 (57.0 177.7W) reported southeast winds of 39 kt with gusts to 49 kt at 0000 UTC on the 25th and highest seas 8.0 meters (26 feet) 3 hours later.

Western North Pacific Storm, October 25–26:

Figures 11 and **12** depict the rapid development of this relatively compact system over 24 hours, from a frontal wave in the Sea of Japan. The ASCAT image in **Figure 13** reveals a compact circulation with wind retrievals as high as 65 kts on the southeast side at a pass edge. This was the first hurricane-force low of the season with no tropical origin. This cyclone was short lived as it became absorbed by another developing low

moving into the Bering Sea from the west on the 27th.

Eastern North Pacific Storm, October 25–27:

Figures 11 and **12** also show the development of a secondary hurricane-force low from a "triple point," or where an occluded front, warm front, and cold front meet. The cyclone briefly developed hurricane-force winds with a 973-hPa center near 53N 152W at 0600 UTC on the 27th. An ASCAT-B pass from 0635 UTC on the 27th returned west to northwest wind retrievals of 50 kt at the edge of a pass. The **APL THAILAND** (WCX8882) reported northwest winds of 45 kt near 45N 156W at 0000 UTC on the 27th. Winds diminished to gale force by the 28th as the system drifted southeast with dissipation near the Washington coast on the 31st.

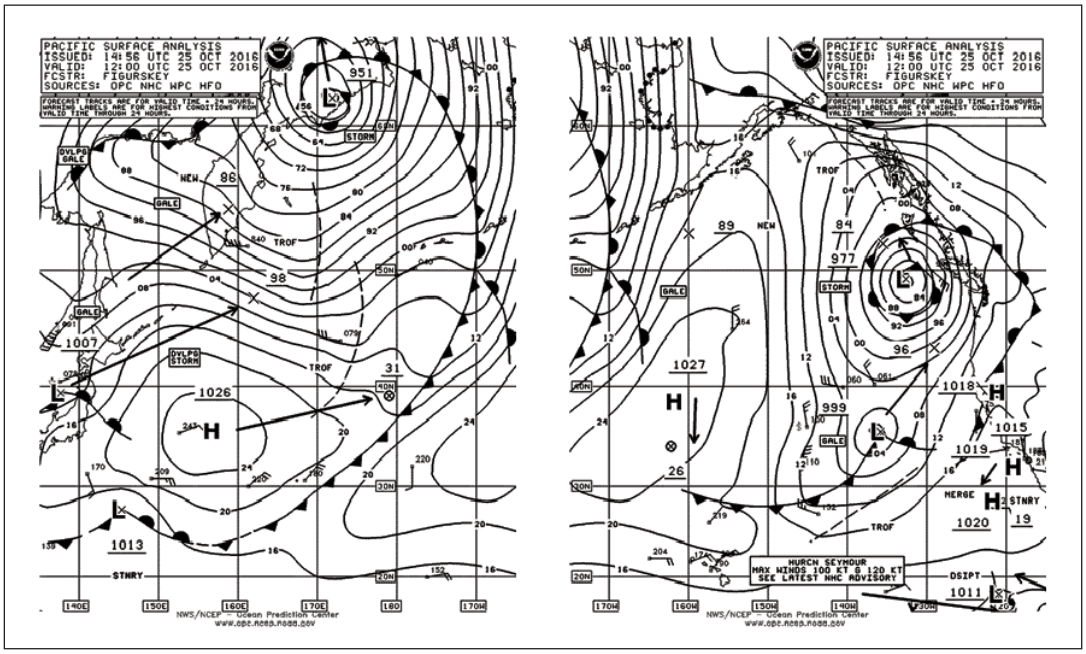

Figure 11. OPC North Pacific Surface Analysis Charts (Parts 1 and 2) valid 1200 UTC October 25, 2016. The two parts overlap between 165W and 175W.

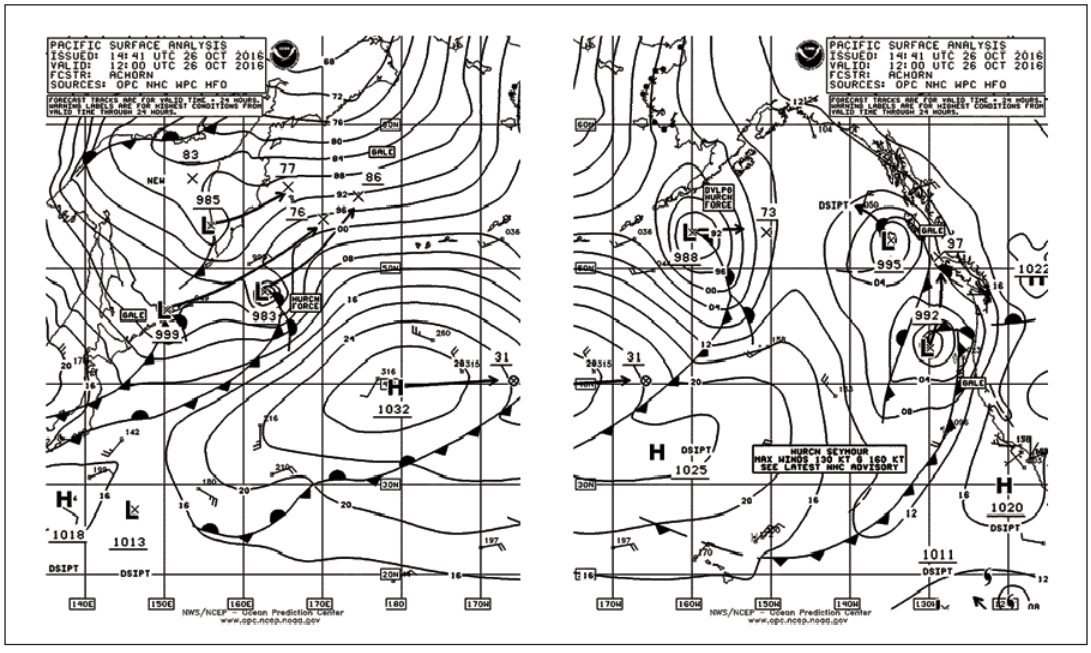

Figure 12. OPC North Pacific Surface Analysis Charts (Parts 1 and 2) valid 1200 UTC October 26, 2016. The two parts overlap between 165W and 175W.

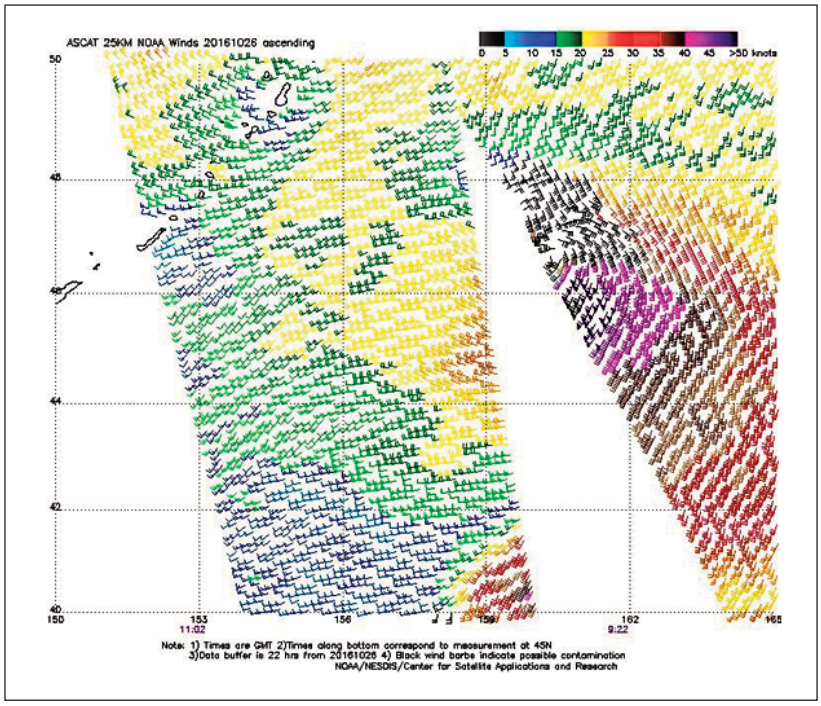

Figure 13.
ASCAT (METOP-A) image of satellite-sensed winds (25-km resolution) around the western hurricane-force low displayed in **Figure 12**. The valid time of the pass containing the strongest winds is 0922 UTC October 26, 2016, or about 2.75 hours prior to the valid time of **Figure 12**. A portion of the Kurile Islands appears on the upper left side of the image. Image is courtesy of NOAA/NESDIS/Center for Satellite Application and Research.

North Pacific/Bering Sea Storm, October 28–31:

Figure 14 depicts the development of an intense low in the Bering Sea from a frontal wave of low pressure east of Japan. The central pressure fell 39 hPa in the 24-hour period ending at 0600 UTC on the 30th. The ASCAT-B wind retrievals in **Figure 15** reveals a swath of 50 to 65 kt to the south and southeast of the cyclone centered near Adak Island. The lowest central pressure of 953 hPa occurred 6 hours later, at 0000 UTC on the 31st. The **LIBERTY EAGLE** (WHIA) encountered southwest winds of 50 kt near 38N 153E at 0200 UTC on the 29th. The **SEAFREEZE AMERICA** (WDH8281) near 58N 166W reported southeast winds of 60 kt at 1800 UTC on the 30th. Buoy 46072 (51.7N 172.1W) reported west winds of 47 kt with gusts to 64 kt and 11.0-meter seas (36 feet). Buoy 46075 (54.0 160.8W) reported seas as high as 13.0 meters (43 feet) at 0400 UTC on the 31st. The cyclone subsequently stalled and weakened to a gale in the Bering Sea by November 1st then dissipated November 5th.

Eastern North Pacific Storm, October 31–November 3:

A new low formed in a trough near 45N 173W at 1800 UTC October 31st and moved east, briefly developing hurricane-force winds with a 991-hPa center near 44N 152W 24 hours later. An ASCAT pass from 2110 UTC on the 1st revealed 50- to 55-kt winds at a pass edge. The system otherwise moved east and then turned north along 140W, and the central pressure lowered to 964 hPa near 49N 139W by 0000 UTC on the 3rd. The cyclone then weakened in the eastern Gulf of Alaska on the 3rd.

Eastern North Pacific Complex Storm, November 3–5:

Figure 16 reveals a continued active eastern Pacific with a multicentered storm system moving toward the eastern Gulf of Alaska, to replace the preceding cyclone, the October 31st to November 3rd event. The **MATSON TACOMA** (KGTY) reported northwest winds of 65 kt and 8.2-meter seas (27 feet) near 55N 138W at 0100 UTC November 5th, followed by a report of 9.4-meter seas (31 feet) 2 hours later.

The **EAGLE BAY** (KEBO) near 46N 134W encountered southwest winds of 60 kt and 9.4-meter seas (31 feet). Buoy 46185 (52.4N 129.8) reported southeast winds of 43 kt with gusts to 52 kt and 9.0-meter seas (30 feet) at 2000 UTC on the 4th and a peak gust of 54 kt 2 hours prior. The multicentered system subsequently moved inland late on the 5th.

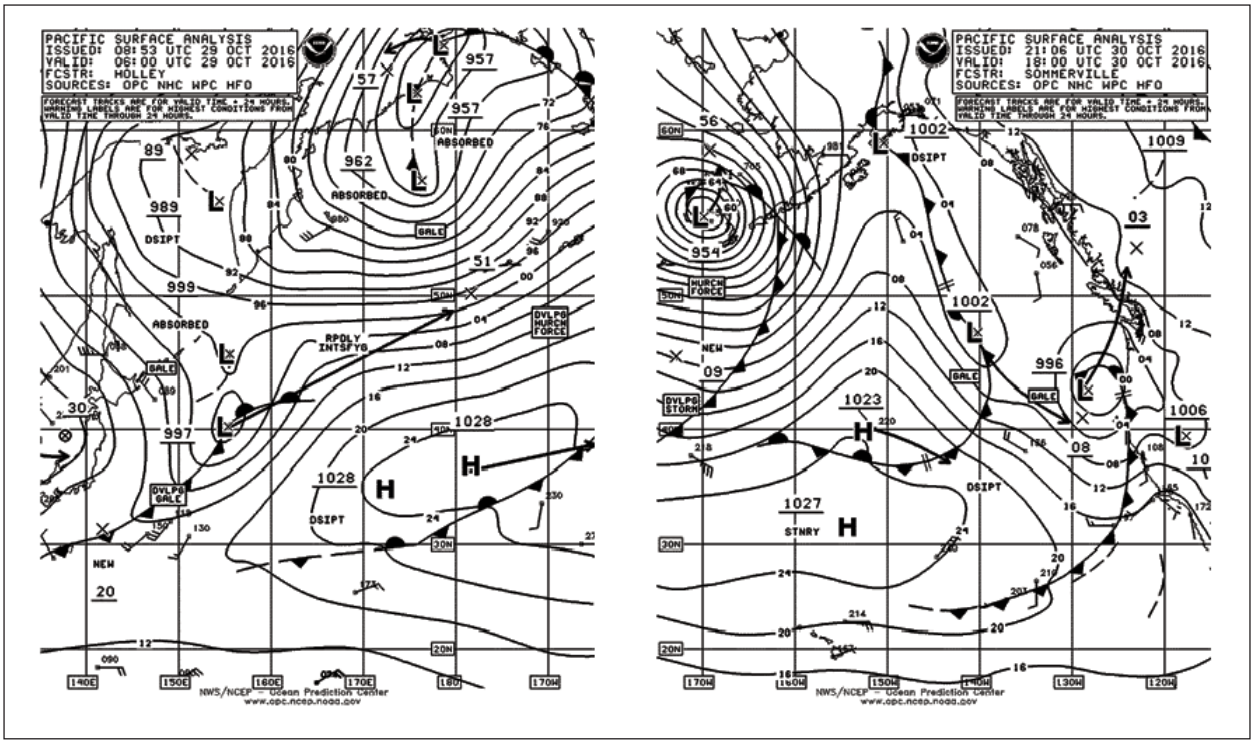

Figure 14. OPC North Pacific Surface Analysis Charts (Part 1) valid 0600 UTC October 29 (Part 2) and 1800 UTC October 30, 2016 (Part 1).

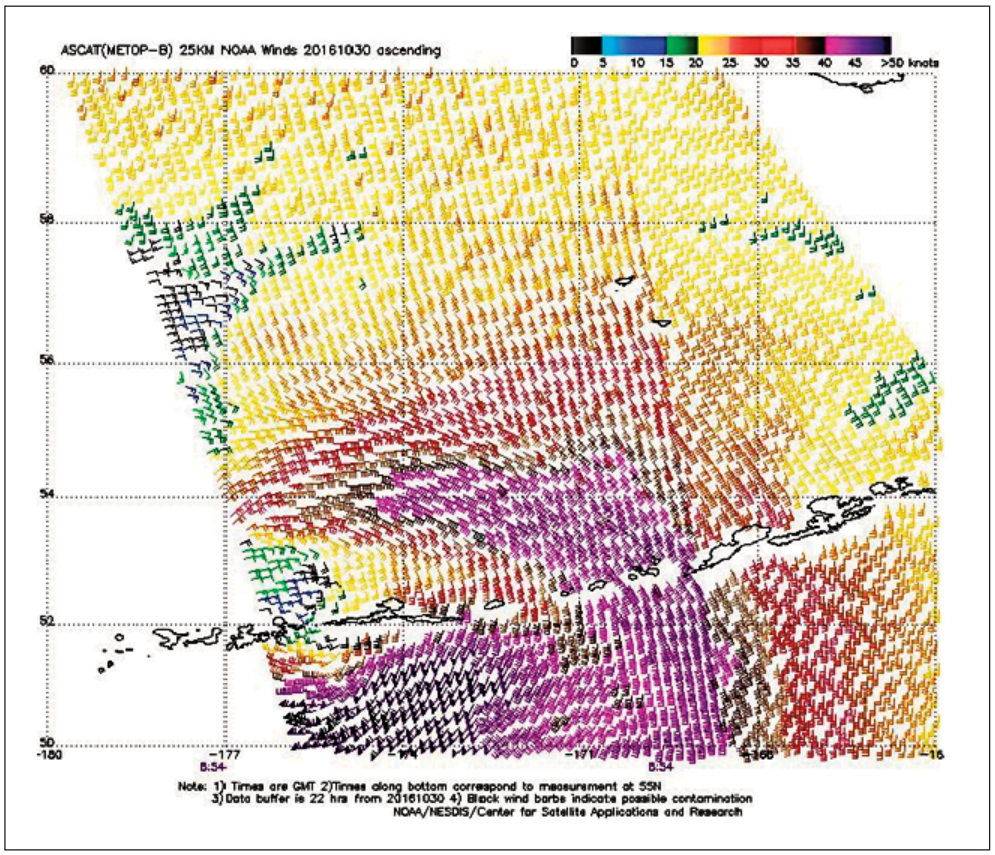

Figure 15. A 25-km ASCAT (METOP-B) image of satellite-sensed winds around the east semicircle of the hurricane-force low shown in the second part of **Figure 14**. The valid time of the pass is 0854 UTC October 30, 2016, or about 9 hours prior to the valid time of the second part of **Figure 14.** Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

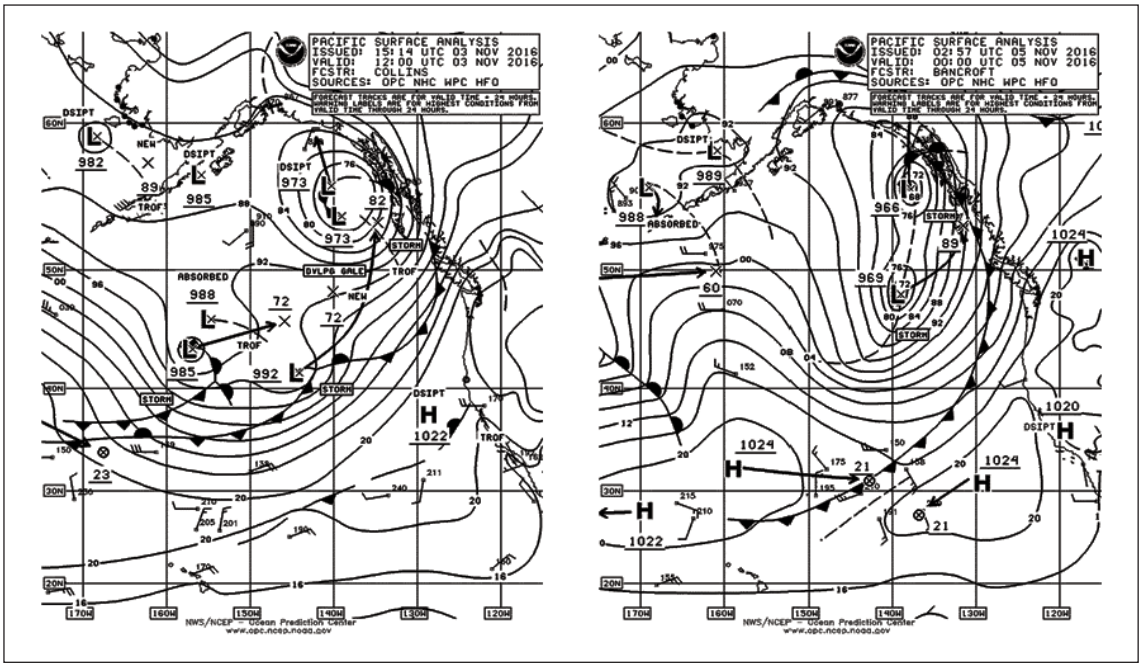

Figure 16. OPC North Pacific Surface Analysis Charts (Part 1) valid 1200 UTC November 3 and 0000 UTC November 5, 2016.

Eastern North Pacific Storm, November 7–10:

Figure 7 displays the initial development of this intense system from a frontal wave near 38N 168E at 0000 UTC November 7th. **Figure 17** shows the final development over a 36-hour period, with the second part of **Figure 17** depicting the cyclone at maximum intensity, the second-deepest nontropical low of the period in the North Pacific. The central pressure fell 32 hPa in the 24-hour period ending at 1200 UTC on the 9th. The scatterometer image in **Figure 18** reveals a rather compact inner core of higher wind retrievals, up to 60 kt. The cyclone subsequently drifted northeast into the Gulf of Alaska on the 11th, when its winds weakened to gale force and dissipated on the Alaska coast by the 12th.

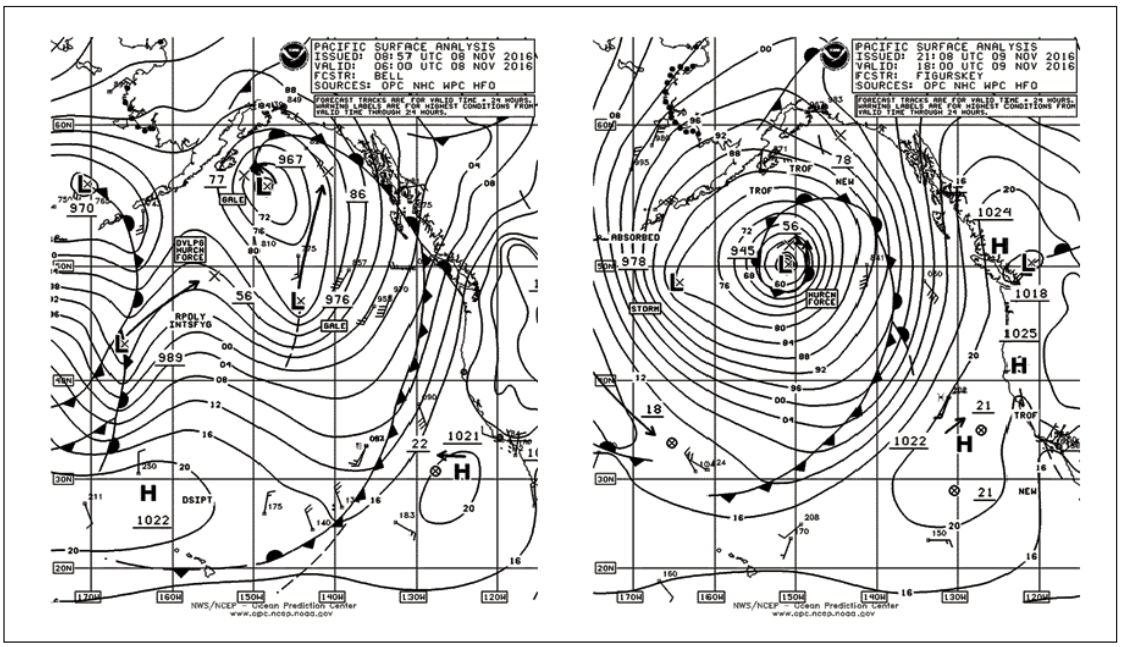

Figure 17. OPC North Pacific Surface Analysis Charts (Part 1) valid 0600 UTC November 8 and 1800 UTC November 9, 2016.

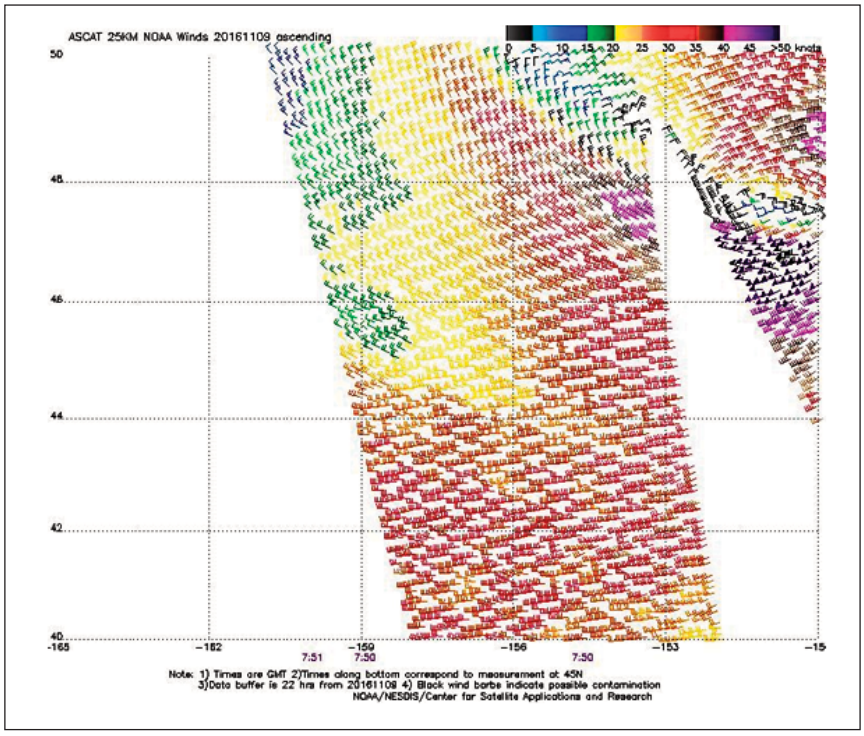

Figure 18.
ASCAT (METOP-A) image of satellite-sensed winds (25-km resolution) around mainly the west semicircle of the hurricane-force low shown in the second part of **Figure 17**. The valid time of the pass is 0750 UTC November 9, 2016, or about 10.25 hours prior to the valid time of the second part of **Figure 17**. Image is courtesy of NOAA/NESDIS/Center for Satellite Application and Research.

North Pacific Storm, November 14–17:

Low pressure originating south of Japan on November 10th moved slowly east-northeast across the western waters through the 14th while intensifying. **Figure 19** displays the final development over a 36-hour period, with the second part of **Figure 19** showing the cyclone at maximum intensity. Although the central pressure is rather modest compared to the very intense cyclones that can develop, the circulation is compact, and ASCAT-B wind retrievals are strong, with 50-kt winds or higher both northeast and southwest and west of the center (**Figure 20**). The cyclone's top winds weakened to gale force by the 17th in the eastern waters. The cyclone re-intensified to a storm-force low on the 18th before moving inland near Vancouver Island on the 20th.

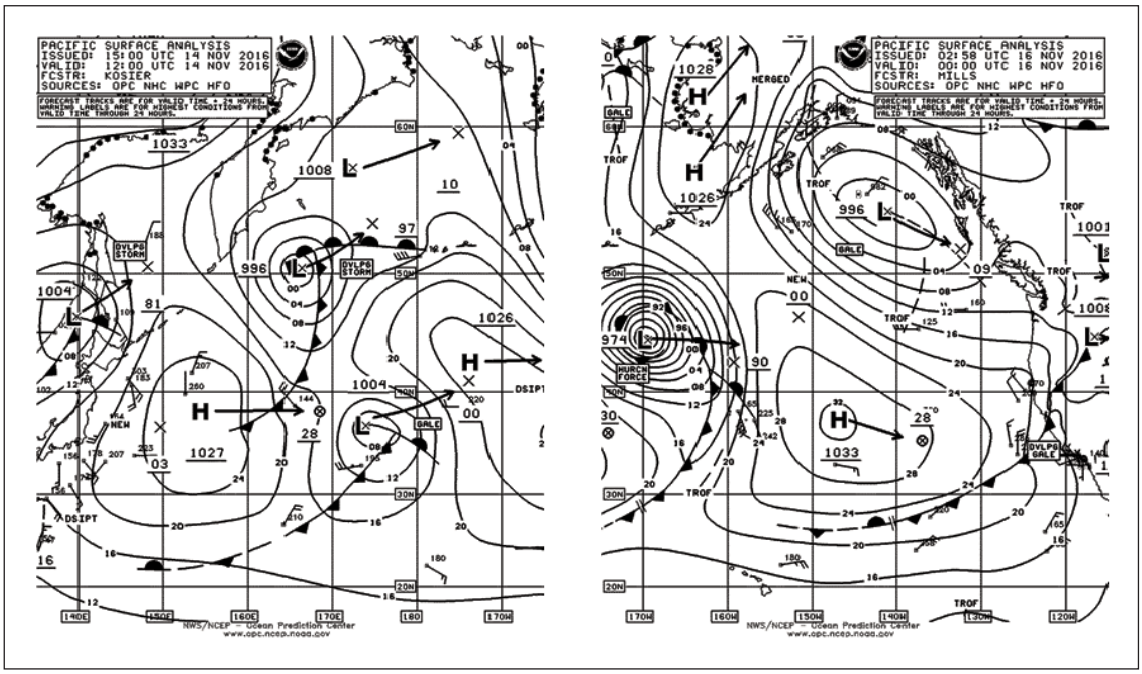

Figure 19. OPC North Pacific Surface Analysis Charts valid 1200 UTC November 14 (Part 2) and 0000 UTC November 16, 2016 (Part 1).

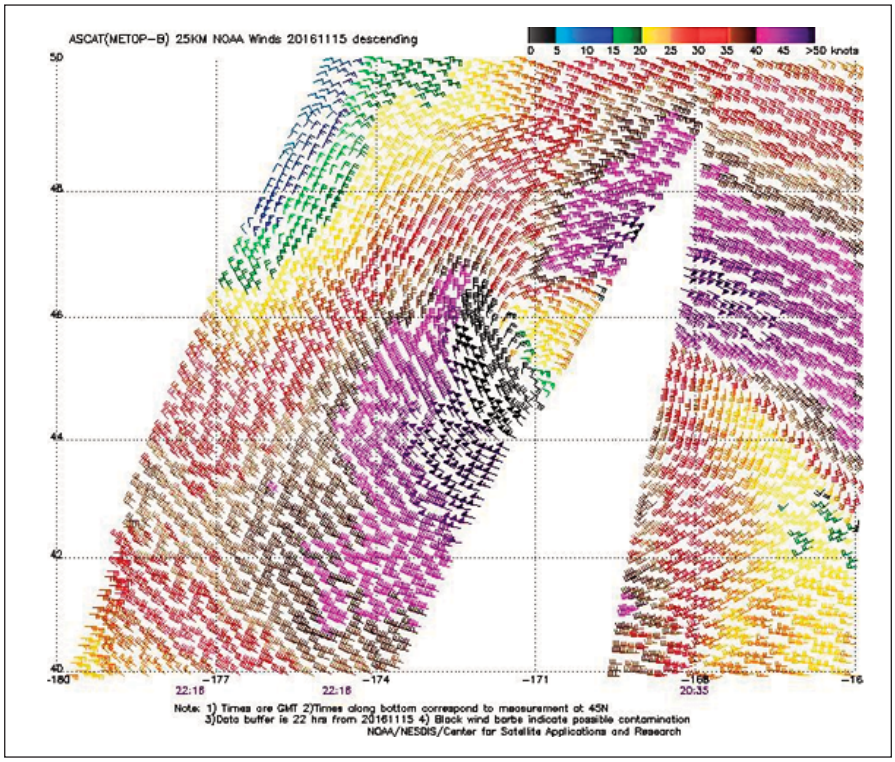

Figure 20.
A 25-km ASCAT (METOP-B) image of satellite-sensed winds around the hurricane-force low shown in the second part of **Figure 19**. Portions of two passes are shown (2035 UTC and 2218 UTC November 15, 2016). The valid time of the later pass is about 1.75 prior to the valid time of the second part of **Figure 19**. Image is courtesy of NOAA/NESDIS/Center for Satellite Application and Research.

North Pacific Storm, November 27–30:

This intense cyclone intensified explosively during the final 24-hour period of development as depicted in **Figure 21**. The central pressure dropped 48 hPa during this period, at twice the rate needed for a cyclone to be considered a "bomb" at 60N (Sanders and Gyakum, 1980). The ASCAT-B image in **Figure 22** reveals a large swath of winds 50 to 55 kt south of the cyclone center and even northeast to 50 kt on the north side. The **CHAMPION BAY** (VRYP3) near 54N 177W reported northeast winds of 55 kt and 6.7-meter seas (22 feet) at 2200 UTC on the 29th. Buoy 46071 (51.1N 179E) reported east winds 37 kt with gusts to 47 kt at 0800 UTC on the 29th and maximum seas 10.0 meters at 0300 UTC on the 30th. The cyclone then moved east northeast, slowly weakened, and dissipated as a trough extending to a new low to the northeast on the 30th.

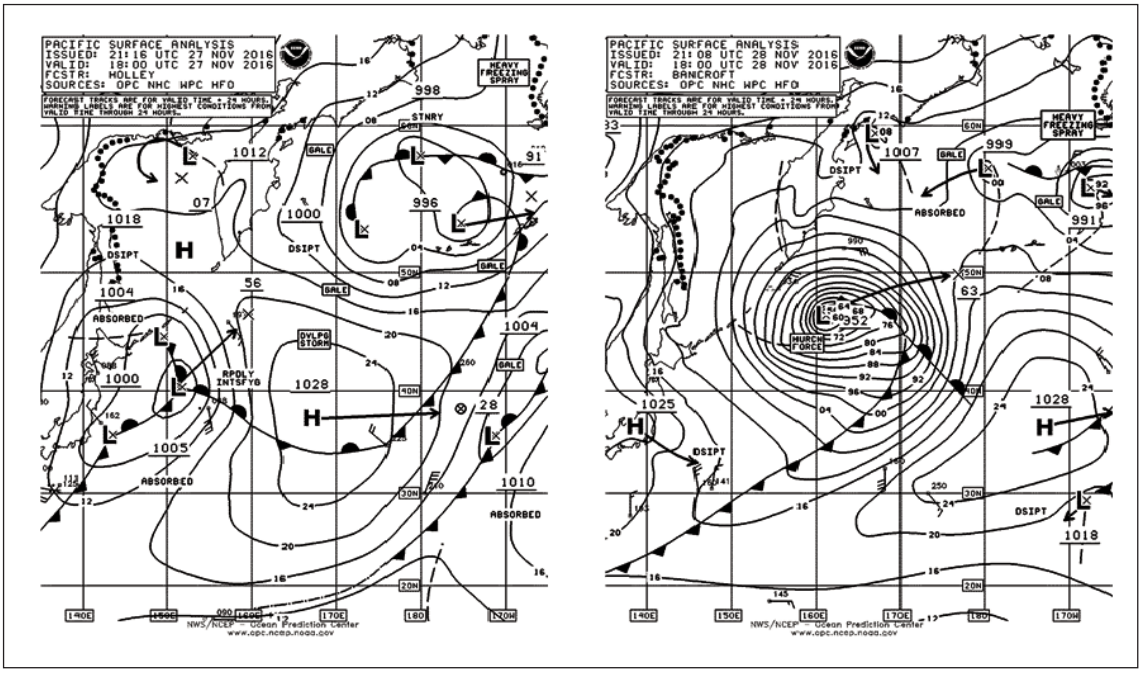

Figure 21. OPC North Pacific Surface Analysis Charts (Part 2) valid 1800 UTC November 27 and 28, 2016.

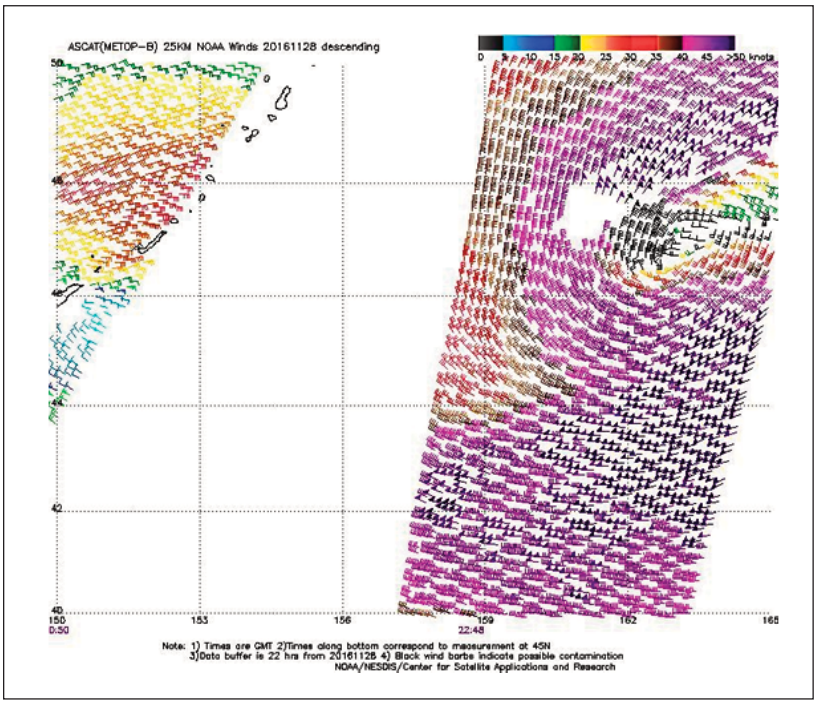

Figure 22.
ASCAT (METOP-B) image of satellite-sensed winds (25-km resolution) around the hurricane-force cyclone shown in the second part of **Figure 21**. The valid time of the pass containing the higher wind retrievals is 2248 UTC November 28, 2016, or about 4.75 hours later than the valid time of the second part of **Figure 21**. Image is courtesy of NOAA/NESDIS/Center for Satellite Application and Research.

North Pacific Storms, November 28–December 2:

The first of a pair of cyclones with similar tracks and intensities developed from a central low-pressure wave with a central pressure of 1004 at 1800 UTC November 27th (**Figure 21**) and moved northeast over the next 2 days, with its central pressure dropping 32 hPa in the 24-hour period ending at 1200 UTC on the 29th. The cyclone developed a lowest central pressure of 960 hPa and (briefly) hurricane-force winds near 55N 145W at that time. **POLAR ENDEAVOUR** (WCAJ) near 55N 145W encountered northwest winds of 50 kt and 7.9-meter seas (26 feet) at 2000 UTC on the 29th. Buoy 46184 (53.9N 138.9W) reported southwest winds of 35 kt with gusts to 51 kt at 1700 UTC on the 29th and maximum seas of 10.0 meters (33 feet) 3 hours later. The cyclone subsequently weakened and moved inland on the 30th. The second system developed as depicted in **Figure 23**. Like in the

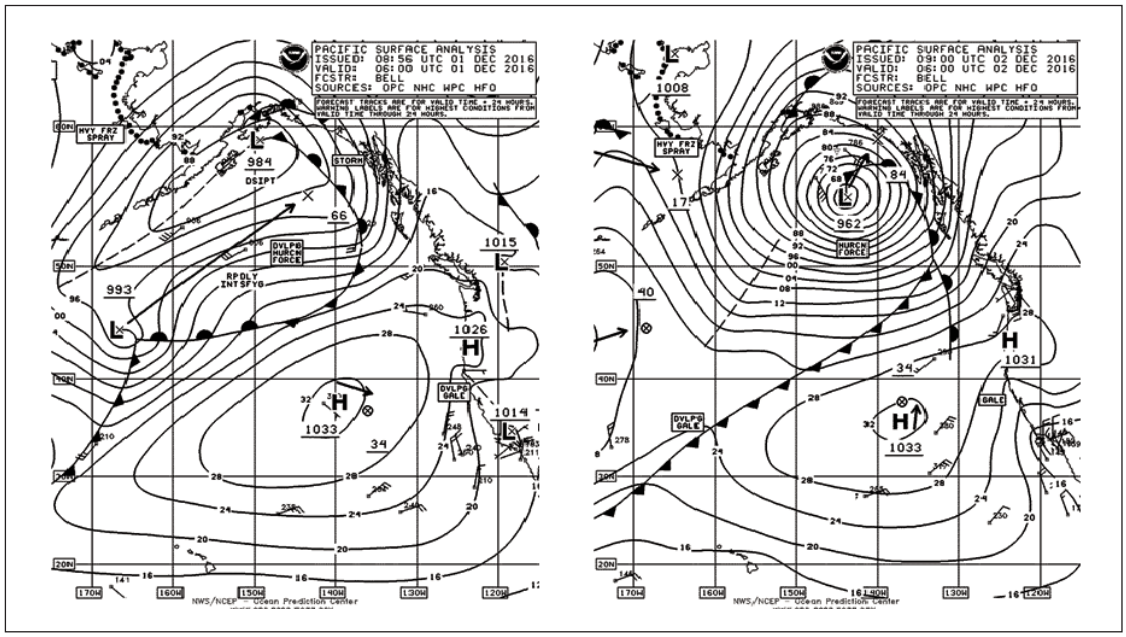

Figure 23. OPC North Pacific Surface Analysis Charts (Part 1) valid 0600 UTC December 1 and 2, 2016.

previous event, the central pressure fell 32 hPa in a 24-hour period, in this case ending at 0000 UTC on December 2. The second part of **Figure 23** shows the cyclone at maximum intensity. The wind retrievals in the 50- to 60-kt range, seen in **Figure 24**, show strong support for hurricane-force winds. The cyclone weakened to a gale in the northern Gulf of Alaska late on December 3rd.

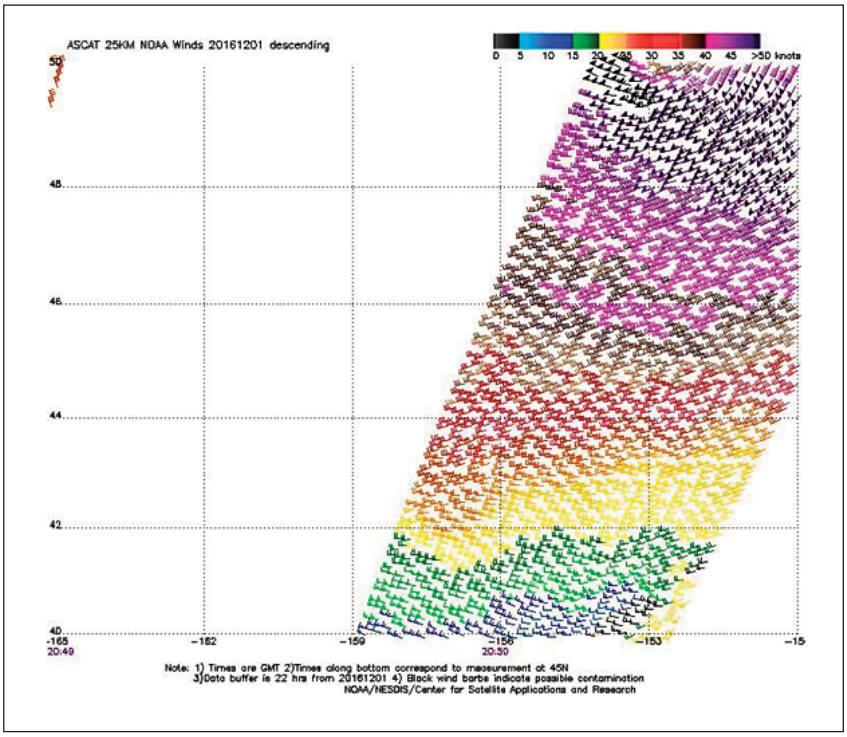

Figure 24.
ASCAT (METOP-A) image of satellite-sensed winds (25-km resolution) around the south side of the hurricane-force low shown in the second part of **Figure 23**. The valid time of the pass is 2050 UTC December 1, 2016, or about 9.25 hours prior to the valid time of the second part of **Figure 23**. Image is courtesy of NOAA/NESDIS/Center for Satellite Application and Research.

Western North Pacific Storm, December 8–9:

The development of this relatively compact cyclone is depicted in **Figure 25**. The central pressure fell 27 hPa in the 24-hour period ending at 0000 UTC December 9th, when the cyclone reached maximum intensity. The ASCAT-B image (**Figure 26**) valid near this time reveals a compact circulation with the highest wind retrievals, 50 to 65 kt, in the southwest semicircle. At 1800 UTC on the 8th the **APL SINGAPORE** (WCX8812) reported north winds of 40 kt near 42N 158E. A weakening trend set in by the 9th with the cyclone dissipating near the central Aleutian Islands late on the 10th.

North Pacific / Bering Sea Storms. December 13–19:

A pair of intense cyclones of similar intensity moved out of the western North Pacific into the Bering Sea, where they developed central pressures of 946 hPa. The first of these is displayed in **Figure 27**. It originated from the frontal wave of low pressure near Japan. The central pressure dropped 37 hPa in the 24-hour period ending at 0000 UTC December 15th, with the cyclone reaching maximum intensity 18 hours later. The ASCAT image in **Figure 28** covers an area where the wind retrievals were highest, in the 50- to 60-kt range, but areas of missing data indicate the passes may omit higher winds. The satellite derived altimeter data in **Figure 29** indicates the highest significant wave heights are around 54 feet (16.5 meters) just south of the western Aleutian Islands.

The **EDWARD OLDENDORFF** (9HA3853) near 48N 175E encountered southwest winds of 50 kt and 7.9-meter seas (26 feet) at 2300 UTC on the 15th. Buoy 46071 (51.1N 179.0E) reported southwest winds of 43 kt with gusts to 60 kt at 2100 UTC on the 15th and maximum seas 15.0 meters (49 feet). The cyclone subsequently dissipated inland near 64N 177E late on the 17th. Again referring to Figure 27, the next developing cyclone involved the merging of two lows near 150E in the second part. The central pressure

fell 48 hPa in the 24-hour period ending at 1800 UTC on the 17th. The cyclone reached its maximum intensity at that time, near the central Aleutian Islands, before stalling in the southern Bering Sea through the 18th and then weakening to a gale in the southeast Bering Sea on the 19th.

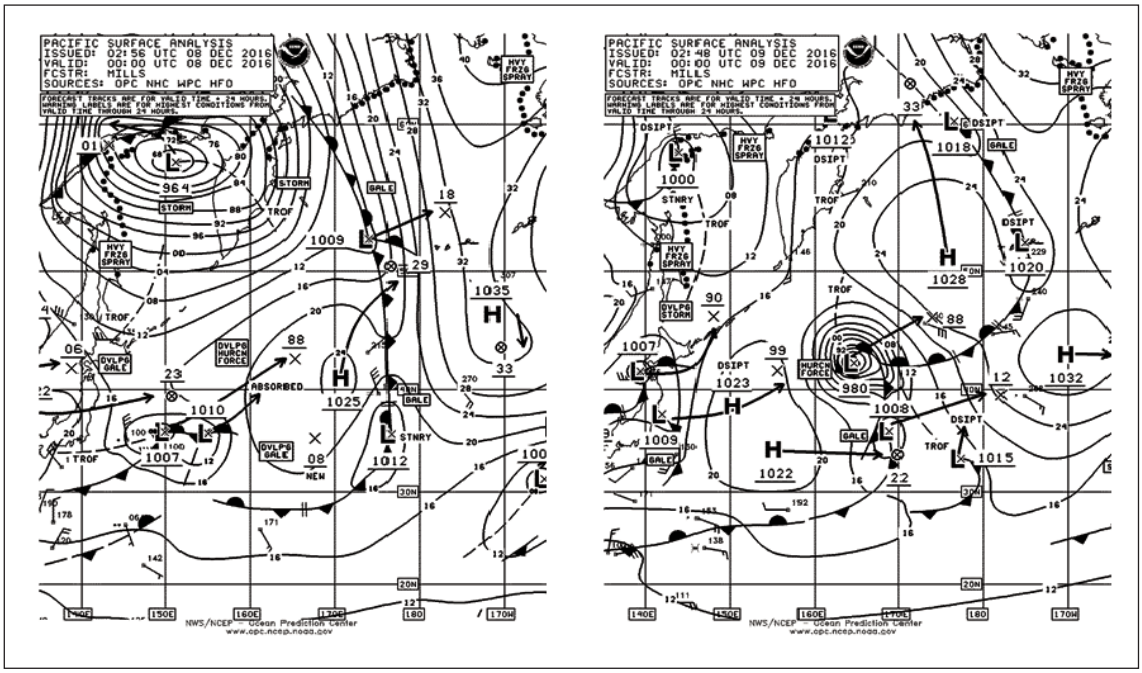

Figure 25. OPC North Pacific Surface Analysis Charts (Part 2) valid 0000 UTC December 8 and 9, 2016.

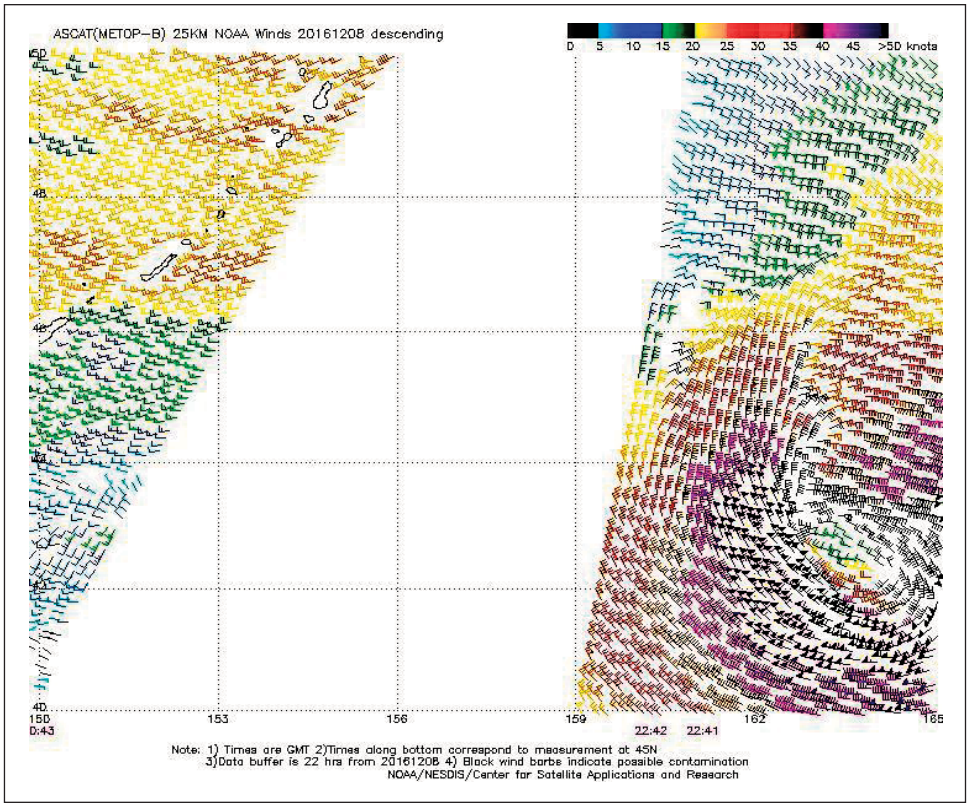

Figure 26. ASCAT (METOP-B) image of satellite-sensed winds (25-km resolution) around the hurricane-force low shown in the second part of **Figure 25**. The valid time of the pass containing the higher wind retrievals is 2241 UTC December 8, 2016, or about 1.25 hours prior to the valid time of the second part of **Figure 25**. A portion of the Kurile Islands appears on the upper left side of the image. Image is courtesy of NOAA/NESDIS/Center for Satellite Application and Research.

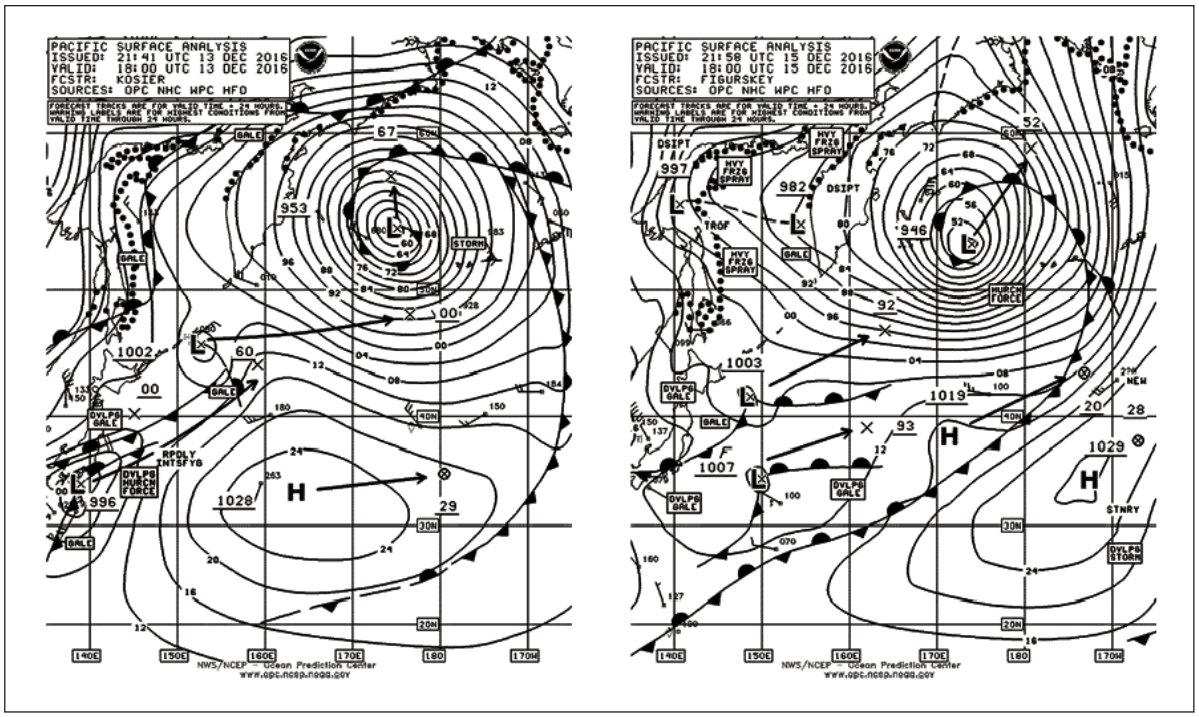

Figure 27. OPC North Pacific Surface Analysis charts (Part 2) valid 1800 UTC December 13 and 15, 2016.

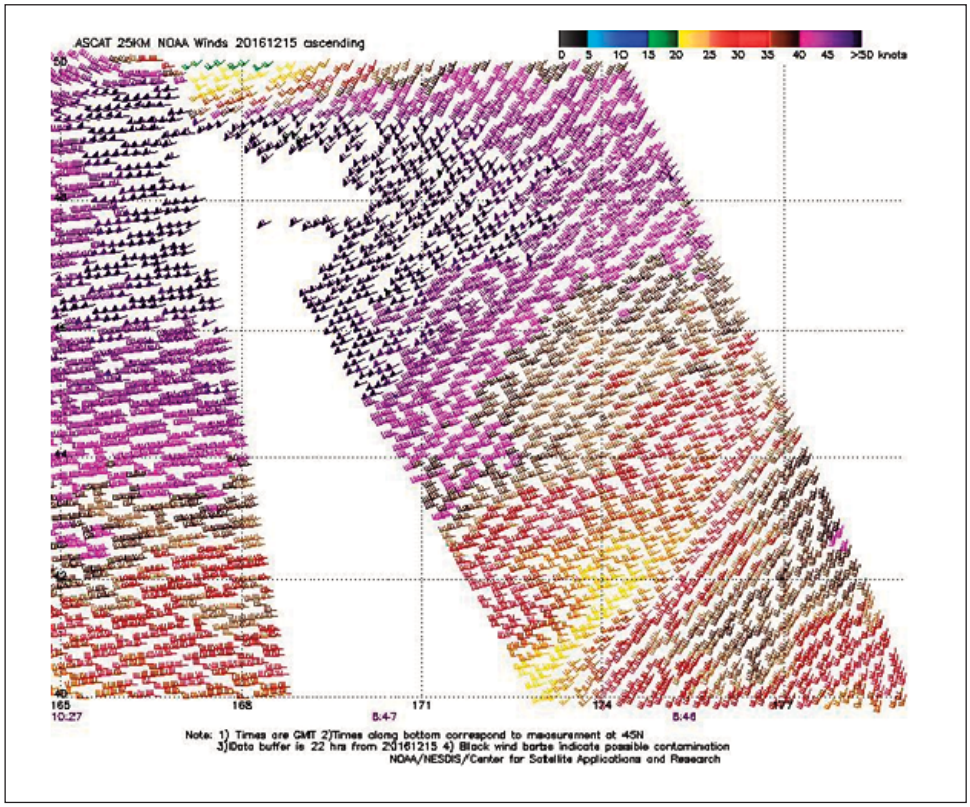

Figure 28.
ASCAT (METOP-A) image of satellite-sensed winds (25-km resolution) around the south side of the hurricane-force low shown in the second part of **Figure 27**. Portions of two passes are shown (0846 UTC and 1027 UTC December 15, 2016). The valid time of the later pass is about 7.5 hours prior to the valid time of the second part of **Figure 27**. Image is courtesy of NOAA/NESDIS/Center for Satellite Application and Research.

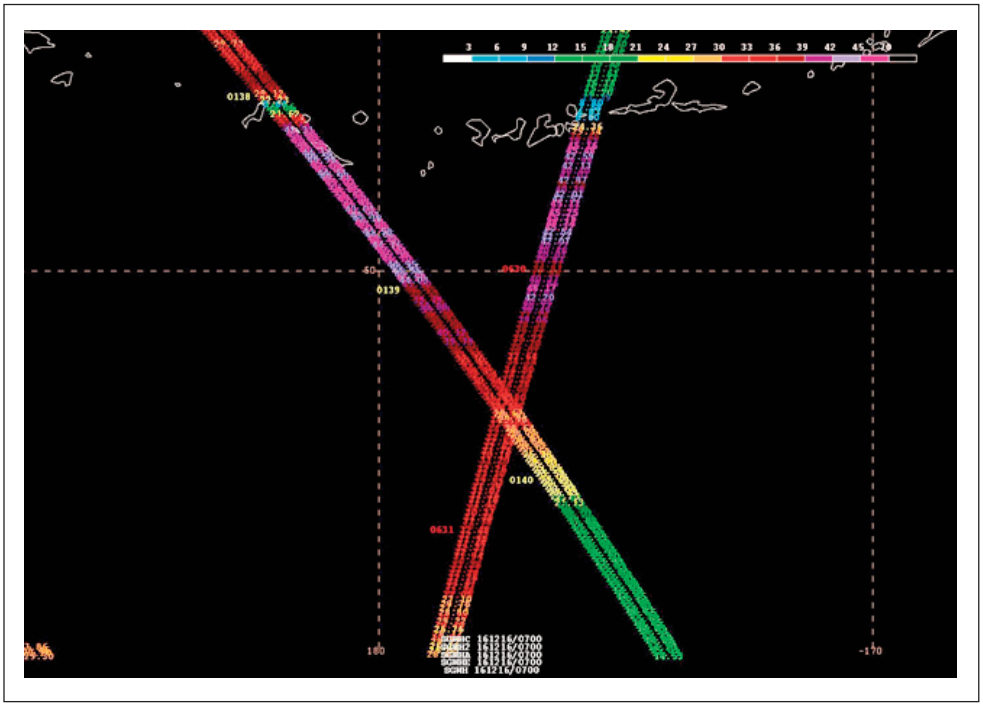

Figure 29. AltiKa and Sentinel-3a satellite altimeter passes through the south side of the hurricane-force low shown in the second part of **Figure 27**. The satellite tracks include four-digit significant wave heights in feet to two decimal places and four-digit times to the left in UTC, and a color scale for the wave heights appears at the top edge. The valid times of the passes at 50N are 0139 UTC and 0630 UTC December 16, 2016. The valid time of the earlier pass containing the highest wave heights is about 7.75 hours later than the valid time of the second part of **Figure 27**. A portion of the Aleutian Islands appears near the top of the image. Image is courtesy of NOAA/NESDIS/Center for Satellite Application and Research, adapted for operational use on OPC workstations.

Northeastern Pacific Storm, December 20–21:

This was a short lived event, as a cyclone suddenly formed on a front al system approaching the coast of British Columbia from the west (**Figure 30**), and then moved inland shortly thereafter. Sartine Island near the northwest end of Vancouver Island reported WSW 68 G81 kt at 1200 UTC on the 20th and a peak gust of 84 kt 1 hour later. The **MATSON CONSUMER** (WCHF) encountered west winds of 55 kt near 50.3N 128.8W at 1800 UTC on the 20th. Buoy 46147 (51.8N 131.2W) reported west winds 47 kt with gusts to 58 kt at 1300 UTC on the 20th and highest seas of 9.5 meters (31 feet) 1 hour later.

North Pacific Storm/Bering Sea Storm, December 27–29:

An intense low developed from a frontal wave of low pressure well east of northern Japan and followed a track across the western Bering Sea and into eastern Siberia (**Figure 31**). The central pressure dropped 44 hPa in the 24-hour period ending at 0000 UTC December 29th. The central pressure reached 938 hPa at that time, making it the most intense extratropical low of the 4-month period. A 500-mb analysis from the period of rapid intensification (**Figure 32**), shows support for intensification including a short wave trough and unusually strong wind maximum rounding the base of an upper trough. See **Reference 7** for more information on use of the 500-mb chart. The ASCAT image in Figure 33 covers an area north of the warm front seen in **Figure 31**, where the wind retrievals were highest. Although large and intense, this event was short lived, with the cyclone weakening inland over Siberia.

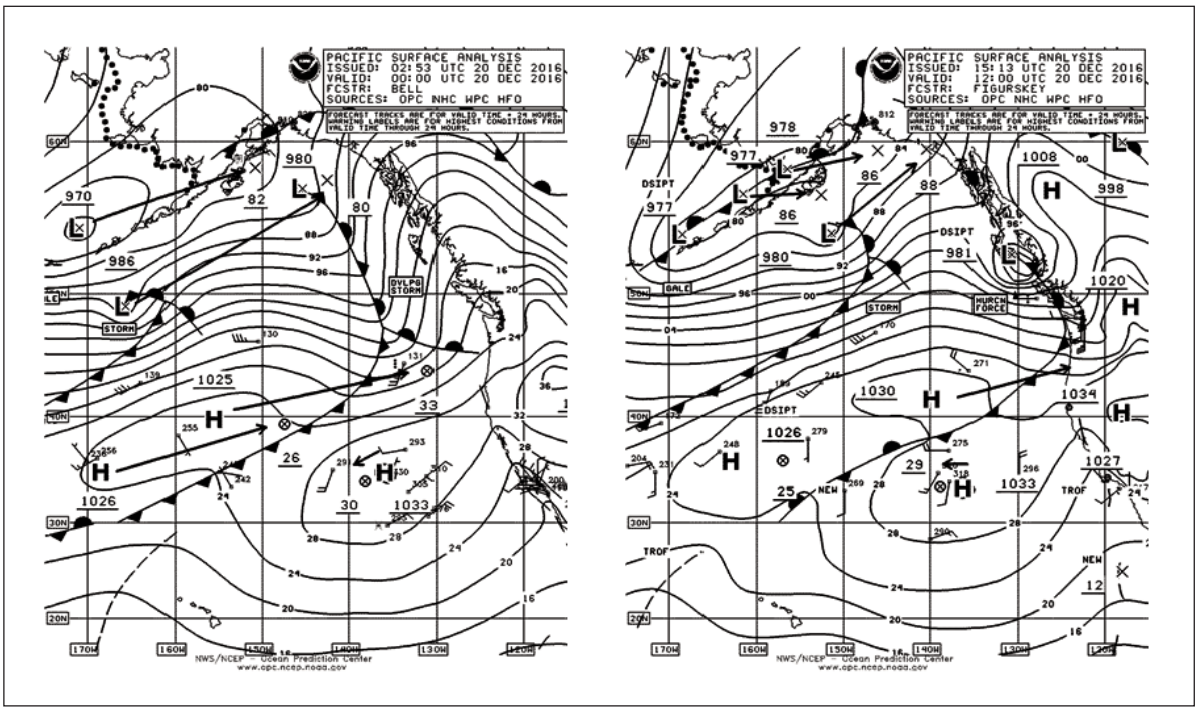

Figure 30. OPC North Pacific Surface Analysis charts (Part 1) valid 0000 UTC and 1200 UTC December 20, 2016.

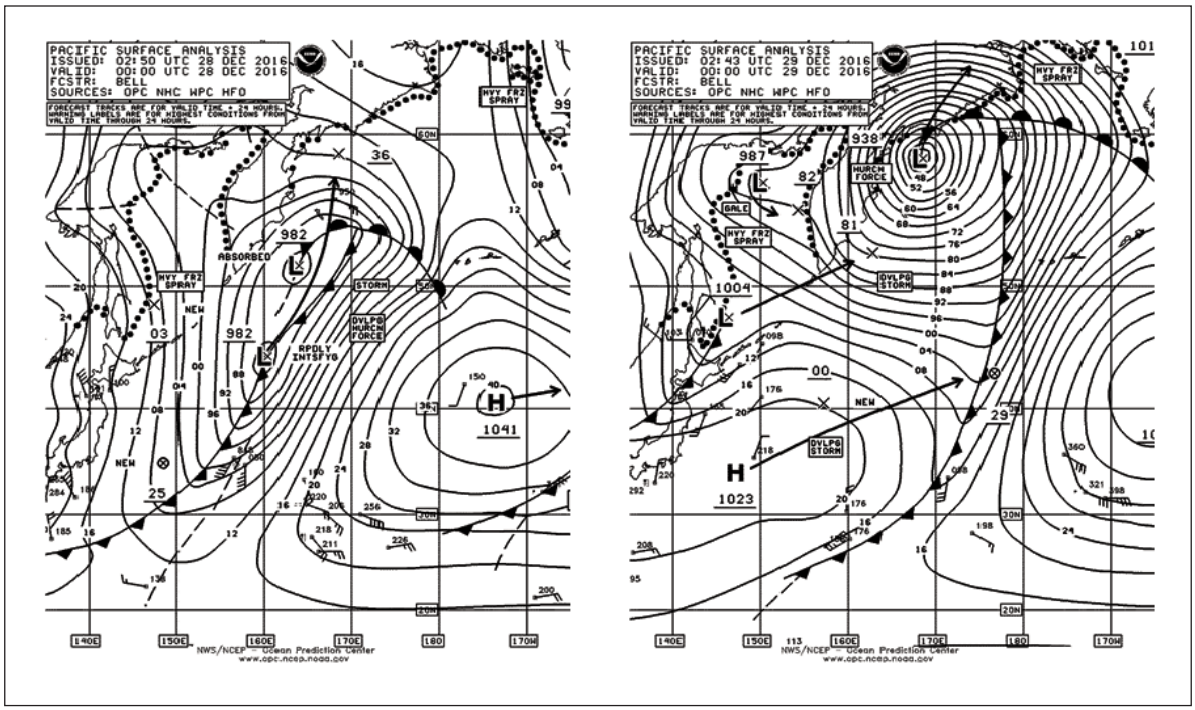

Figure 31. OPC North Pacific Surface Analysis charts (Part 2) valid 0000 UTC December 28 and 29, 2016.

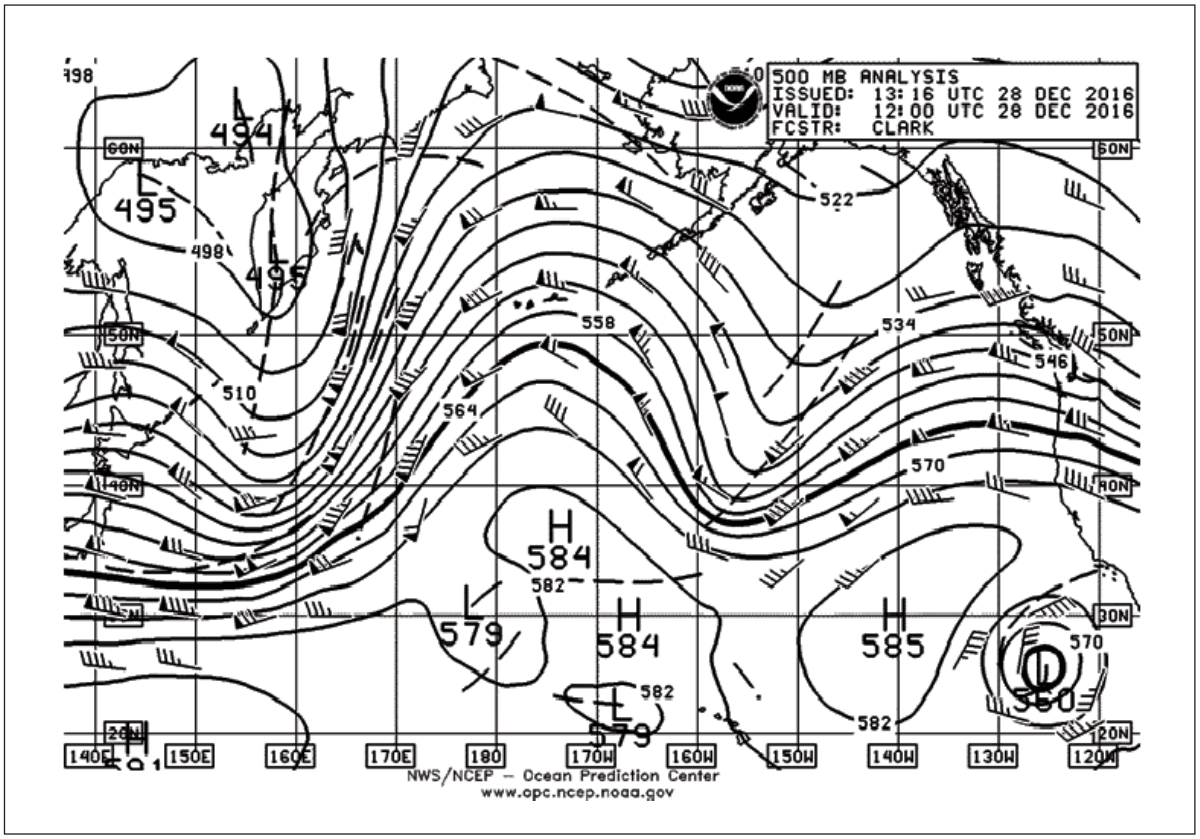

Figure 32. OPC North Pacific 500-MB Analysis valid 1200 UTC December 28, 2016. The chart is computer generated, with short-wave troughs (dashed lines) manually added.

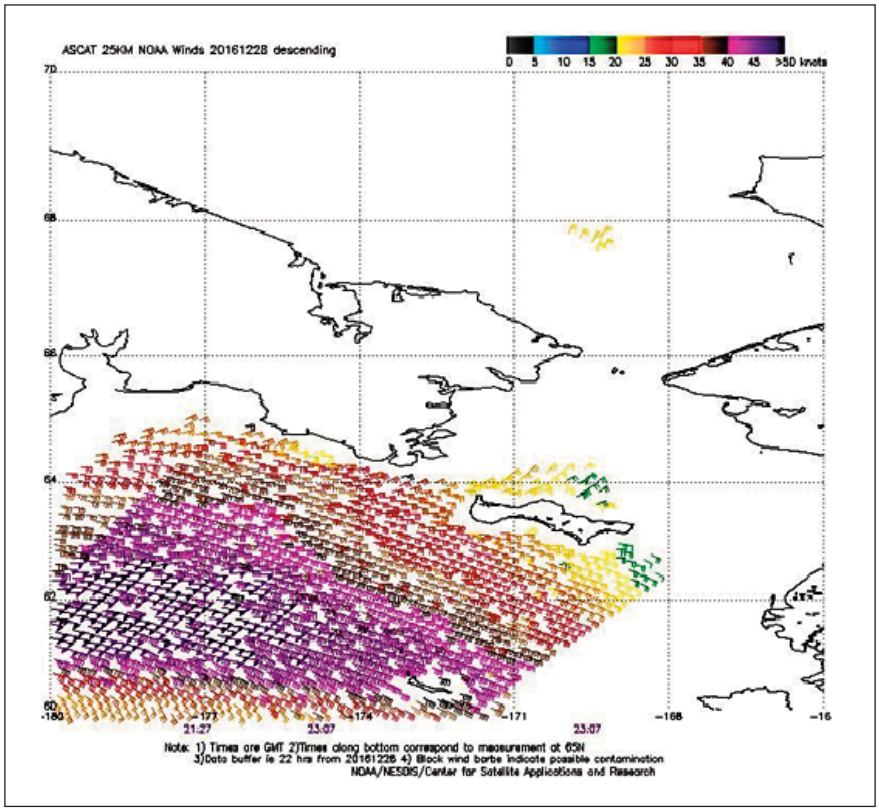

Figure 33. ASCAT (METOP-A) image of satellite-sensed winds (25-km resolution) on the northeast side of the large hurricane-force system shown in the second part of **Figure 31**. Portions of two passes are shown, with the valid time of the later pass (2307 UTC December 28, 2016) about 1 hour prior to the valid time of the second part of **Figure 31**. Image is courtesy of NOAA/NESDIS/Center for Satellite Application and Research.

References

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Tropical East Pacific Area

January through April 2017

Andy Latto
Tropical Analysis and Forecast Branch
National Hurricane Center, Miami, Florida
NOAA National Centers for Environmental Prediction

Tropical Northeast Pacific Ocean

The TAFB Northeast Pacific High Seas area of responsibility (AOR) extends from the equator to 30°N east of 140°W and from the equator to 3.4°S east of 120°W. A total of 16 Gale Warnings and 1 Storm Warning were issued across this area from January through April 2017. This was over a 35% decrease in the number of combined Gales and Storm Warnings comparatively to last year during the same time period, with 25 Gale Warnings (4 Storm Warnings) in 2016, and 30% less than the same time period in 2015, with 23 Gale Warnings (7 Storm Warnings). The most notable difference this year was that there was only one Storm Warning compared to the multiple storm events that have occurred during the same time period in recent years past.

Of the 16 warnings that occurred during this time period, 12 were across the Gulf of Tehuantepec, 2 were over the open waters west of Baja California, and 2 were over the Gulf of California.

Table 1. Non-tropical cyclone warnings issued for the Pacific Ocean between 01 January 2017 and 30 April 2017. Storm events are shaded pale yellow and the duration of the storm warning is in parentheses.

ONSET	REGION	PEAK WIND	GALE DURATION (STORM)	FORCING
1200 UTC 07 Jan	Gulf of Tehuantepec	55 kts	90 hrs (21 hrs)	Gap
0000 UTC 13 Jan	Gulf of Tehuantepec	35 kts	60 hrs	Gap
1200 UTC 23 Jan	Gulf of Tehuantepec	35 kts	06 hrs	Gap
1800 UTC 27 Jan	Gulf of California	35 kts	42 hrs	High Pressure
0600 UTC 29 Jan	Gulf of Tehuantepec	45 kts	60 hrs	Gap
0600 UTC 30 Jan	Eastern Pacific 27N	35 kts	54 hrs	Frontal
0000 UTC 04 Feb	Gulf of Tehuantepec	35 kts	36 hrs	Gap
0600 UTC 10 Feb	Gulf of Tehuantepec	35 kts	12 hrs	Gap
0000 UTC 17 Feb	Eastern Pacific 25 N	40 kts	36 hrs	Frontal
0000 UTC 18 Feb	Gulf of California	35 kts	24 hrs	Frontal
0000 UTC 22 Feb	Gulf of Tehuantepec	35 kts	12 hrs	Gap
0000 UTC 03 Mar	Gulf of Tehuantepec	40 kts	60 hrs	Gap

Table 1. (continued) Non-tropical cyclone warnings issued for the Pacific Ocean between 01 January 2017 and 30 April 2017. Storm events are shaded pale yellow and the duration of the storm warning is in parentheses.

ONSET	REGION	PEAK WIND (kts)	GALE DURATION (STORM)	FORCING
1200 UTC 14 Mar	Gulf of Tehuantepec	40 kts	168 hrs	Gap
1630 UTC 06 Apr	Gulf of Tehuantepec	40 kts	54 hrs	Gap
1630 UTC 12 Apr	Gulf of Tehuantepec	35 kts	30 hrs	Gap
1030 UTC 24 Apr	Gulf of Tehuantepec	35 kts	06 hrs	Gap

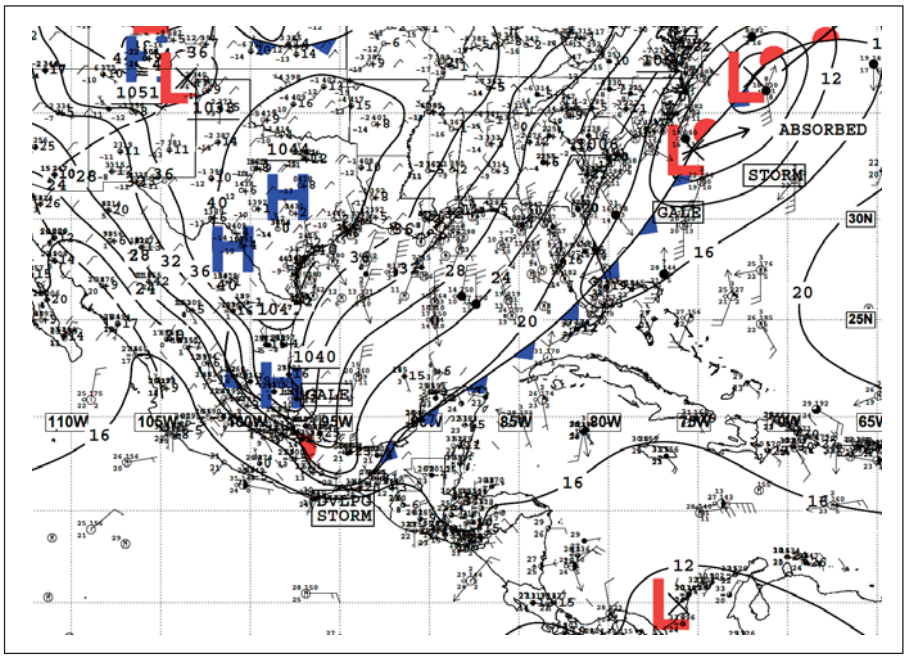

Figure 1. Unified Surface Analysis issued by the Ocean Prediction Center (OPC), the Weather Prediction Center (WPC), and the Tropical Analysis and Forecast Branch (TAFB) valid 1800 UTC 07 January 2017. The cold front over southeastern Mexico has already reached the Chivela Pass, with a 1044-hPa high centered over Texas and strong ridging nosing southward along eastern Mexico.

07–08 January Gulf of Tehuantepec Storm:

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. **Table 1** details the warnings issued in the TAFB Eastern Pacific High Seas AOR from January through April 2017. The strongest wind event this winter season was a storm-force event that occurred over the Gulf of Tehuantepec that developed as a cold front reached southeastern Mexico on 07 January. An arctic air mass building over the region behind the front, associated with a 1044-hPa high centered over Texas, shown in **Figure 1**, produced gale-force northerly winds over the western Gulf of Mexico north of the front. **Figure 2** shows an ASCAT-A scatterometer pass shortly after the gale began, just before winds reached storm force. Note the gale over the Gulf of Mexico, and then the gale-force winds spreading away from the Isthmus of Tehuantepec over the eastern Pacific.

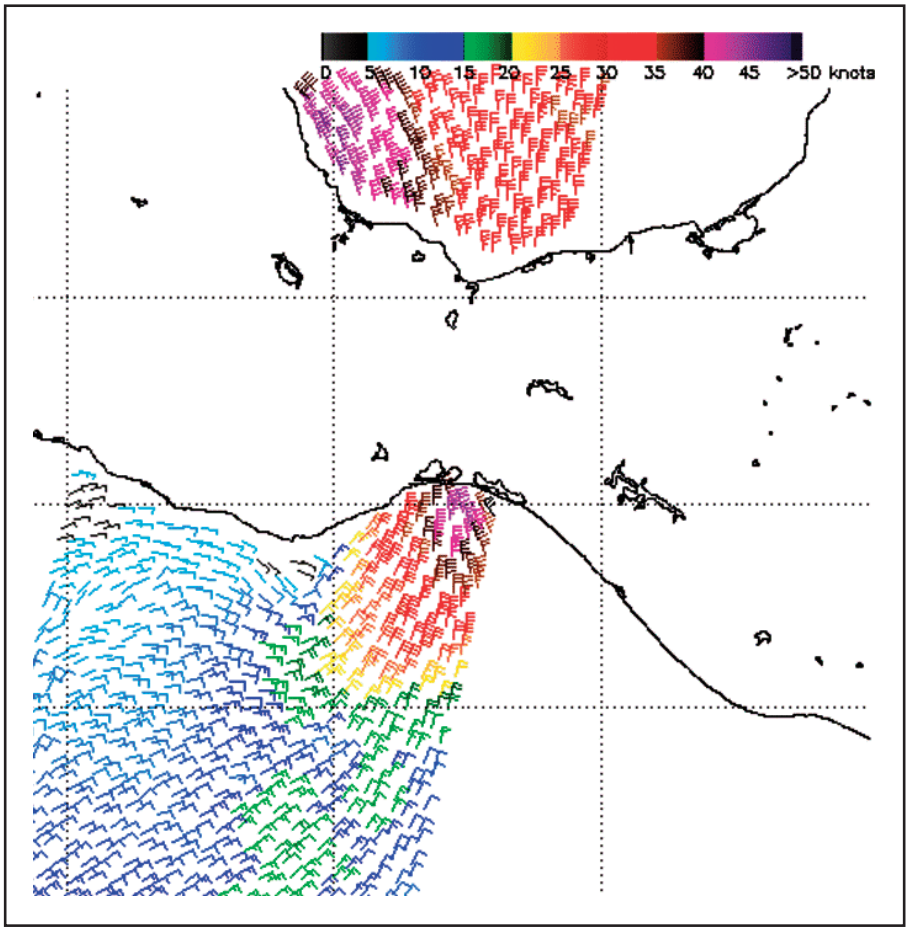

Figure 2. A scatterometer pass from the MetOp Advanced Scatterometer (ASCAT-A) valid around 1629 UTC 07 January. Note the magenta wind barbs over the Gulf of Tehuantepec indicating gale-force winds between 40 kts and 45 kts.

Table 2. Ship observations during the gale-warning period beginning 07 January 1200 UTC and ending 11 January 0600 UTC

SHIP	CALL SIGN	WIND SPEED	LOCATION	DATE/TIME
SEVEN SEAS EXPLORER	V7QK9	35 kts	15.6N 94.2W	07 Jan 1500 UTC
SUN RUBY	VRZU4	48 kts	14.7N 95.7W	08 Jan 1900 UTC
SAGA CREST	VRWR7	37 kts	15.4N 95.1W	08 Jan 2100 UTC
SAGA CREST	VRWR7	44 kts	15.7N 95.4W	09 Jan 0600 UTC

During this storm force wind event, several ships reported gale- and storm-force winds, which are summarized in **Table 2.**

27–29 January Gulf of California and East Pacific Gale:

Two gale events occurred over the Gulf of California during January through April. The longest duration event was 42 hours, with a Gale Warning that was issued 27 January at 1800 UTC. **Figure 3** shows very strong high pressure building southward over the western United States, with the highest pressure reading of 1051 hPa from the high center over Idaho. Meanwhile, low pressure of 1012 hPa was centered near Guadalajara, Mexico. This pressure difference of 39 hPa between these systems forced the gale across the northern half of the Gulf of California and also just west of Baja California Norte. The gale persisted through the night of 28–29 January, before the high shifted to the east of the region and winds decreased below gale force.

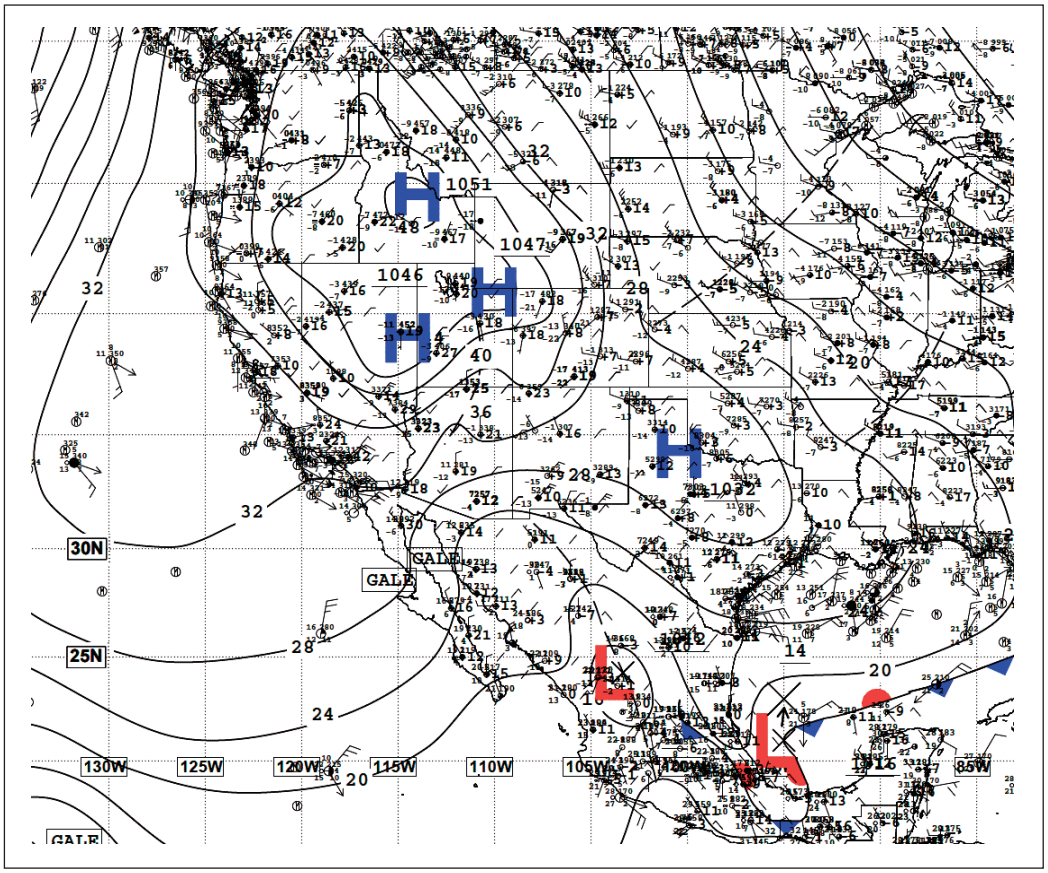

Figure 3.
Unified Surface Analysis issued by OPC, WPC, and the TAFB valid 1800 UTC 27 January 2017. A 1051-hPa high is centered over Idaho, while a 1012-hPa low is centered over interior Mexico.

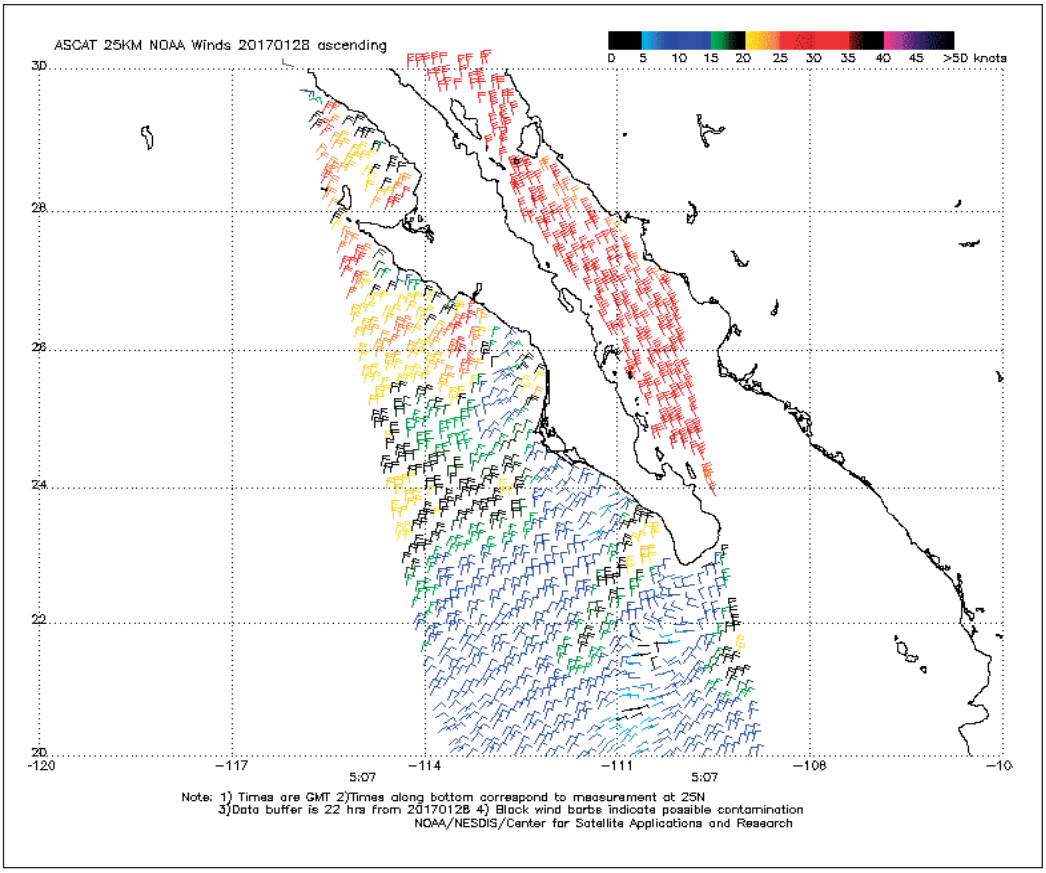

Figure 4.
A scatterometer pass from the MetOp Advanced Scatterometer (ASCAT-B) valid around 0507 UTC 28 January. Note the red wind barbs over the Gulf of California and locally along the west coast of Baja California Norte indicating winds between 30 and 35 kts.

Scatterometer data seen in **Figure 4** captured the gale over the region. The scatterometer shows gale-force winds occurring across the majority of the Gulf of California, with near-gale to gale-force winds localized just along the coast of the western Baja California Norte.

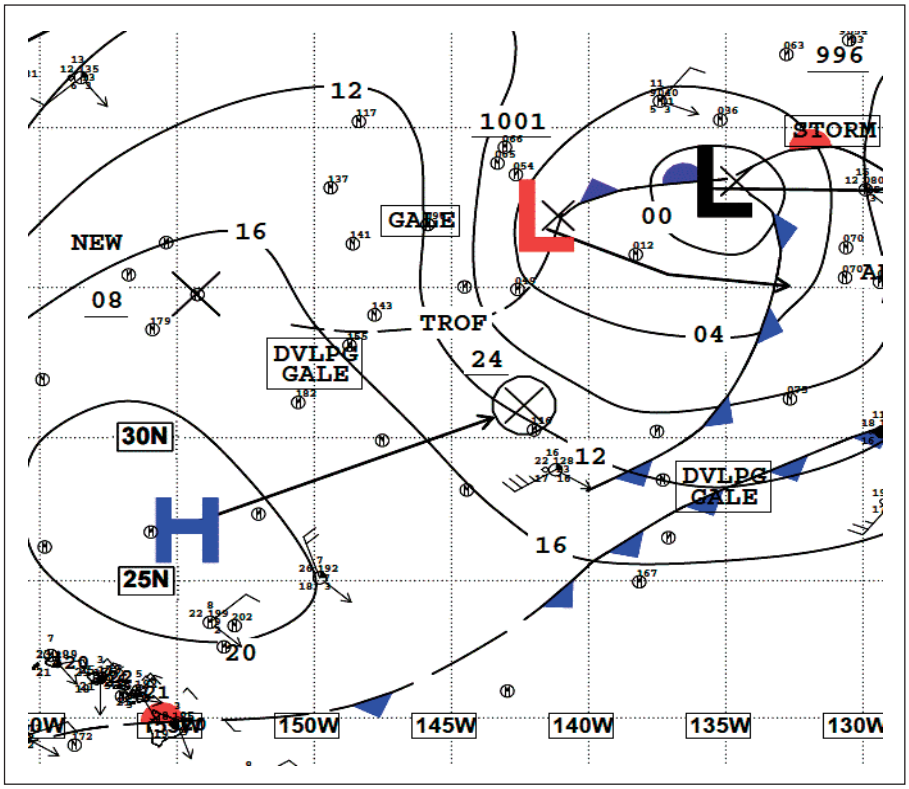

Figure 5. Unified Surface Analysis issued by OPC, TAFB, and the National Weather Service Honolulu Forecast Office valid 0000 UTC 17 February 2017. A storm north of the region supports a cold front with developing gale-force winds north of the front.

17–18 February East Pacific Gale:

Of the two gales that occurred during January through April over the open waters of the eastern Pacific waters south of 30N, the gale that occurred in the middle of February was the stronger. A gale warning went into effect at 0000 0000 UTC 17 February as a cold front swept over the region supported by a storm center near 37N135W as seen in **Figure 5**. The gale-force northwest winds spread over the region behind the cold front due to the tight pressure gradient between the storm and high pressure building northeastward from near Hawaii.

Table 3. Ship observations during the gale-warning period beginning 17 February 0000 UTC and ending 18 February 1200 UTC.

SHIP	CALL SIGN	WIND SPEED	LOCATION	DATE/TIME
HOLLAND AMERICA WESTERDAM	PINX	35 kts	25.7N 131.5W	17 Feb 1000 UTC
HOLLAND AMERICA WESTERDAM	PINX	36 kts	25.3N 132.0W	17 Feb 1200 UTC
MAUNAWILI	WGEB	40 kts	29.0N 133.6W	17 Feb 1200 UTC
TANGGUH HIRI	C6XC2	40 kts	30.5N 122.9W	17 Feb 1600 UTC

Figure 6 illustrates the broad area of gale-force northwest winds over the warned area occurring 17 February. Although there is a data gap in the scatterometer winds over a portion of the warned thanks to the Voluntary Observing Ship (VOS) data in **Table 3**, some of the data gaps can be filled in.

A good example is the observation on the morning of 17 February from the ship **TANGGUH HIRI** where 40-kt southwest winds were reported just north of our AOR, across an area missed by the scatterometer pass. By the next morning of 18 February, winds decreased below gale force across the region as high pressure built just north of the AOR and the front shifted to the east of the region.

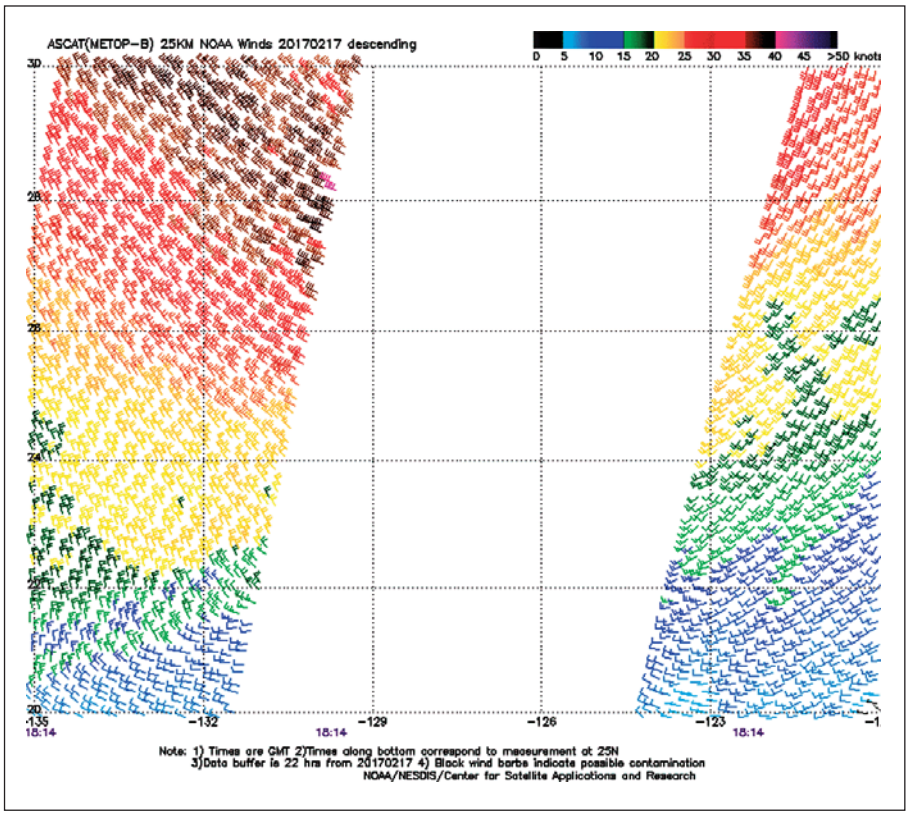

Figure 6. A scatterometer pass from the MetOp Advanced Scatterometer (ASCAT-B) valid around 1814 UTC 17 February. A broad area of bright-red to dark-brown wind barbs over the eastern Pacific waters north of 26N are indicating northwest winds between 35 kts and 40 kts.

National Weather Service VOS Program New Recruits:

March 1, 2017, through June 31, 2017

SHIP NAME	CALL SIGN	PMO	RECRUIT DATE
EVER LIBERAL	2HDG2	New York City	3-Mar-17
HC MELINA	V2FR2	Norfolk	3-Mar-17
APL SAIPAN	WDJ2573	Anchorage	7-Mar-17
NYK NEBULA	3ENG6	Charleston	8-Mar-17
EVER LADEN	3FXM3	Charleston	23-Mar-17
ATLANTIC HURON	VCQN	Duluth	1-Apr-17
BROTONNE BRIDGE	VRHO2	New York City	2-Apr-17
JOSCO JINZHOU	VRLE3	Anchorage	5-Apr-17
MARCELLUS LADY	9V3144	Anchorage	5-Apr-17
STAR LYGRA	V7FA7	Anchorage	5-Apr-17
MSC STELLA	H8PA	New Orleans	10-Apr-17
ECLIPS	V7BP2	New York City	27-Apr-17
MSC TAMARA	3EOC	New Orleans	11-May-17
MAERSK SEMARANG	D5MK9	Charleston	23-May-17
COSCO KOREA	VRGH3	New York City	1-Jun-17
EVER LUCID	BKIY	New York City	2-Jun-17
JUPITER EXPRESS	V7XY7	Anchorage	6-Jun-17
EVER LOGIC	BKIF	New York City	8-Jun-17
COSCO INDONESIA	VRHE3	New York City	9-Jun-17
MOL MANEUVER	V7VC5	Charleston	15-Jun-17
SOZON	9HA3546	New Orleans	16-Jun-17
PARAMOUNT HATTERAS	2CWB5	Houston	21-Jun-17

VOS Program
Cooperative Ship Report:
March 1, 2017, through June 30, 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	2	0	0							7
ADVENTURE OF THE SEAS	C6SA3	A	Miami	0	74	62	58	14	0							208
ALASKA MARINER	WSM5364	A	Anchorage	12	0	12	0	0	19							43
ALASKA TITAN	WDE4789	A	Anchorage	19	12	14	26	6	8							85
ALASKAN EXPLORER	WDB9918	A	Anchorage	15	34	20	18	21	21							129
ALASKAN FRONTIER	WDB7815	A	Anchorage	5	0	0	0	17	21							43
ALASKAN LEADER	WDB7198	A	Anchorage	0	3	1	0	1	0							5
ALASKAN LEGEND	WDD2074	A	Anchorage	64	59	147	63	126	75							534
ALASKAN NAVIGATOR	WDC6644	A	Anchorage	124	24	24	32	67	181							452
ALBEMARLE ISLAND	C6LU3	A	Miami	5	0	0	0	0	0							5
ALBERT MAERSK	OUOW2	I	New York City	0	0	0	0	0	0							0
ALERT	WCZ7335	A	Anchorage	2	0	9	6	2	1							20
ALGOLAKE	VCPX	A	Duluth	16	0	3	41	26	10							96
ALGOMA DISCOVERY	CFK9796	A	Duluth	0	0	0	0	28	43							71
ALGOMA GUARDIAN	CFK9698	A	Duluth	0	0	0	31	43	48							122
ALGOMA MARINER	CFN5517	A	Duluth	14	0	2	3	32	14							65
ALGOMA SPIRIT	CFN4309	A	Duluth	0	0	0	0	78	51							129
ALGOWAY	VDFP	A	Duluth	0	0	0	0	2	7							9
ALLIANCE FAIRFAX	WLMQ	A	Jacksonville	51	17	56	33	46	18							221
ALLIANCE NORFOLK	WGAH	A	Jacksonville	0	0	0	18	1	22							41
ALLIANCE ST LOUIS	WGAE	A	Charleston	0	0	29	24	42	7							102
ALLURE OF THE SEAS	C6XS8	A	Miami	55	30	17	12	36	29							179
ALPENA	WAV4647	A	Duluth	14	0	0	9	30	35							88
AM GHENT	A8ZA8	A	Anchorage	145	347	597	596	626	432							2743
AMERICAN CENTURY	WDD2876	A	Duluth	26	0	42	190	237	306							801
AMERICAN INTEGRITY	WDD2875	A	Duluth	13	0	0	5	6	0							24
AMERICAN MARINER	WQZ7791	A	Duluth	10	0	5	109	75	23							222
AMERICAN NO. 1	WCD7842	A	Anchorage	0	0	0	0	4	0							4
AMERICAN SPIRIT	WCX2417	A	Duluth	0	0	6	59	35	5							105
AMSTERDAM	PBAD	A	Anchorage	165	170	146	166	166	88							901
ANDROMEDA VOYAGER	C6FZ6	A	Anchorage	55	43	63	5	2	18							186
ANTHEM OF THE SEAS	C6BI7	A	New York City	3	0	26	5	5	0							39
ANTWERPEN	VRBK6	A	Anchorage	40	15	20	10	3	0							88
APL BELGIUM	WDG8555	A	Los Angeles	38	33	39	20	31	21							182
APL CHINA	WDB3161	A	Los Angeles	141	132	213	210	219	31							946
APL CORAL	WDF6832	A	Charleston	0	2	0	0	0	0							2
APL GUAM	WAPU	A	Anchorage	52	63	50	31	34	34							264
APL HOLLAND	9VKQ2	A	Charleston	0	0	0	0	0	17							17

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
APL HOUSTON	9V9921	A	Los Angeles	19	19	19	23	2	1							83
APL KOREA	WCX8883	A	Los Angeles	90	62	50	42	36	50							330
APL PHILIPPINES	WCX8884	A	Los Angeles	23	49	30	63	57	44							266
APL PHOENIX	9V9918	A	Los Angeles	0	2	0	0	0	0							2
APL SAIPAN	WDJ2573	A	Anchorage	0	6	40	53	55	83							237
APL SINGAPORE	WCX8812	A	Los Angeles	61	61	62	49	124	18							375
APL THAILAND	WCX8882	A	Los Angeles	181	52	169	70	95	105							672
APPALOOSA	V7CH8	A	New Orleans	1	0	3	0	0	0							4
AQUARIUS VOYAGER	C6UC3	A	Jacksonville	87	30	24	40	55	45							281
ARCTIC BEAR	WBP3396	A	Anchorage	0	0	0	1	8	0							9
ARCTIC TITAN	WDG2803	A	Anchorage	19	13	16	7	17	6							78
ARCTURUS VOYAGER	C6YA7	A	Anchorage	75	80	78	58	132	143							566
ARIES VOYAGER	C6UK7	A	Anchorage	75	33	27	32	34	28							229
ARNOLD MAERSK	OXES2	A	Seattle	77	84	23	25	9	1							219
ATLANTIC BRAVE	D5LQ8	A	New Orleans	66	11	17	33	14	13							154
ATLANTIC CARTIER	SCKB	A	Norfolk	2	0	4	4	7	0							17
ATLANTIC FRONTIER	VRDJ7	A	Anchorage	0	0	0	97	85	14							196
ATLANTIC GEMINI	VRDO9	A	Anchorage	18	9	1	0	1	0							29
ATLANTIC GRACE	V7UX9	A	Anchorage	0	0	0	1	0	0							1
ATLANTIC HURON	VCQN	A	Duluth	0	0	16	49	40	43							148
ATLANTIS (AWS)	KAQP	A	Anchorage	730	660	735	715	737	683							4260
ATTENTIVE	WCZ7337	A	Anchorage	1	0	0	1	3	0							5
AURORA	WYM9567	A	Anchorage	28	2	4	146	175	150							505
AVIK	WDB7888	A	Anchorage	0	0	0	0	6	13							19
AWARE	WCZ7336	A	Anchorage	3	0	2	5	3	0							13
AYESHA	V7LC9	A	Baltimore	39	13	0	0	0	0							52
BADGER	WBD4889	A	Duluth	0	0	0	0	28	92							120
BALTIC COUGAR	V7AA2	A	Anchorage	0	0	0	2	0	0							2
BARRINGTON ISLAND	C6QK	A	Miami	12	12	27	19	25	27							122
BELL M. SHIMADA (AWS)	WTED	A	Seattle	304	435	220	446	227	0							1632
BERGE NANTONG	VRBU6	A	Anchorage	11	2	35	3	58	72							181
BERGE NINGBO	VRBQ2	A	Anchorage	0	0	42	55	13	33							143
BEARING LEADER	WDC7227	A	Anchorage	0	6	12	1	0	0							19
BERLIAN EKUATOR	HPYK	A	Anchorage	1	5	0	0	4	2							12
BERNARDO QUINTANA A.	C6KJ5	A	New Orleans	81	63	72	71	27	0							314
BILLIE H.	WCY4992	A	Anchorage	2	0	0	0	0	0							2
BISMARCK SEA	WDE5016	A	Anchorage	4	5	4	12	0	0							25
BLUEFIN	WDC7379	A	Seattle	53	85	86	67	19	82							392
BRILLIANCE OF THE SEAS	C6SJ5	A	Miami	37	8	2	28	36	54							165
BROTONNE BRIDGE	VRHO2	A	New York City	0	0	0	30	7	22							59
BUFFALO	WXS6134	A	Duluth	19	0	0	0	0	0							19
BURNS HARBOR	WDC6027	A	Duluth	0	0	11	43	40	19							113

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
CAFER DEDE	V7PR8	A	New York City	0	0	13	42	18	14							87
CALIFORNIA VOYAGER	WDE5381	A	New Orleans	19	20	37	26	6	15							123
CALUMET	WDE3568	A	Duluth	141	0	0	4	14	12							171
CAPE MORETON	VRGG6	A	Anchorage	0	26	26	0	32	11							95
CAPRICORN VOYAGER	C6UZ5	A	Anchorage	3	0	30	44	78	31							186
CAPT. HENRY JACKMAN	VCTV	A	Duluth	0	0	2	1	2	12							17
CARNIVAL BREEZE	3FZO8	A	Houston	19	43	33	16	30	43							184
CARNIVAL CONQUEST	3FPQ9	A	Miami	91	93	66	88	60	71							469
CARNIVAL DREAM	3ETA7	A	New Orleans	15	67	139	124	17	41							403
CARNIVAL ECSTASY	H3GR	A	Miami	6	10	111	93	110	100							430
CARNIVAL ELATION	3FOC5	A	Jacksonville	33	9	16	0	0	1							59
CARNIVAL FANTASY	H3GS	A	Miami	4	1	23	10	32	31							101
CARNIVAL FASCINATION	C6FM9	A	Jacksonville	12	1	6	1	26	10							56
CARNIVAL FREEDOM	3EBL5	A	Houston	80	72	76	74	82	111							495
CARNIVAL GLORY	3FPS9	A	Miami	49	66	29	37	14	4							199
CARNIVAL IMAGINATION	C6FN2	A	Los Angeles	61	42	24	6	0	0							133
CARNIVAL INSPIRATION	C6FM5	A	Los Angeles	26	54	0	1	63	69							213
CARNIVAL LEGEND	H3VT	A	Miami	178	231	295	363	209	78							1354
CARNIVAL LIBERTY	HPYE	A	Jacksonville	7	12	15	24	13	21							92
CARNIVAL MAGIC	3ETA8	A	Jacksonville	60	25	35	5	42	45							212
CARNIVAL MIRACLE	H3VS	A	Seattle	41	8	7	6	13	7							82
CARNIVAL PARADISE	3FOB5	A	Miami	7	0	83	59	30	21							200
CARNIVAL PRIDE	H3VU	A	Jacksonville	22	0	10	66	114	107							319
CARNIVAL SENSATION	C6FM8	A	Miami	6	1	9	35	88	78							217
CARNIVAL SPLENDOR	3EUS	A	Anchorage	238	133	53	35	13	22							494
CARNIVAL SUNSHINE	C6FN4	A	Jacksonville	20	0	91	65	44	38							258
CARNIVAL TRIUMPH	C6FN5	A	New Orleans	0	43	2	21	32	19							117
CARNIVAL VALOR	H3VR	A	Houston	0	0	12	24	43	37							116
CARNIVAL VICTORY	3FFL8	A	Miami	42	23	23	18	20	38							164
CAROLINE MAERSK	OZWA2	A	Seattle	22	0	1	1	45	88							157
CASON J. CALLAWAY	WDH7556	A	Duluth	7	0	12	38	21	36							114
CASTOR VOYAGER	C6UZ6	A	Anchorage	19	87	21	3	0	0							130
CELEBRITY CONSTELLATION	9HJI9	A	Miami	0	61	196	72	58	75							462
CELEBRITY ECLIPSE	9HXC9	A	Miami	135	296	416	426	243	208							1724
CELEBRITY EQUINOX	9HXD9	A	Miami	46	51	165	329	372	450							1413
CELEBRITY INFINITY	9HJD9	A	Miami	0	84	188	245	154	181							852
CELEBRITY MILLENNIUM	9HJF9	A	Anchorage	213	116	72	91	137	123							752
CELEBRITY REFLECTION	9HA3047	A	Miami	117	97	132	173	163	151							833
CELEBRITY SILHOUETTE	9HA2583	A	Miami	32	180	258	271	205	94							1040
CELEBRITY SOLSTICE	9HRJ9	A	Seattle	54	34	99	108	66	278							639
CELEBRITY SUMMIT	9HJC9	A	Miami	10	172	77	64	108	81							512
CHARLES ISLAND	C6JT	A	Miami	19	14	21	30	16	0							100
CHARLESTON EXPRESS	WDD6126	A	Houston	76	68	28	15	39	72							298
CHICAGO	A8PS5	A	Seatlle	12	0	0	0	0	0							12

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
CHUKCHI SEA	WDE2281	A	Anchorage	1	0	2	5	2	5							15
CMB PAULE	VRJF3	A	New Orleans	0	0	0	14	4	7							25
COASTAL NAVIGATOR	WCY9686	A	Seattle	0	0	2	0	1	3							6
COASTAL NOMAD	WDC6439	A	Anchorage	8	6	9	5	8	8							44
COASTAL PROGRESS	WDC6363	A	Anchorage	16	4	11	6	9	8							54
COASTAL TRADER	WSL8560	A	Anchorage	0	8	9	11	4	0							32
COASTAL VENTURE	WDF3547	A	Charleston	0	0	0	0	0	0							0
COLUMBINE MAERSK	OUHC2	A	Norfolk	13	0	0	0	8	23							44
CORNELIA MAERSK	OWWS2	I	New York City	0	0	0	0	2	10							12
CORWITH CRAMER	WTF3319	A	Anchorage	0	0	0	5	4	0							9
COSCO DEVELOPMENT	VRIZ9	A	Anchorage	45	38	21	21	65	69							250
COSCO EXCELLENCE	VRJT8	A	Anchorage	38	46	56	62	35	0							237
COSCO FAITH	VRKE9	A	Anchorage	68	55	35	34	40	9							241
COSTA FORTUNE	VRKE9	A	Anchorage	50	58	69	29	11	2							217
COSCO INDONESIA	VRHE3	A	New York City	10	24	1	0	11	15							61
COSCO KOREA	VRGH3	A	New York City	112	76	28	22	22	20							280
COSCO MALAYSIA	VRGV9	A	New York City	0	0	13	43	51	111							218
COSCO PHILIPPINES	VRGM7	A	New York City	59	52	24	36	38	42							251
COSCO PRINCE RUPERT	VRID6	A	New York City	11	40	21	7	63	50							192
COSCO THAILAND	VRHM2	A	Anchorage	74	68	25	25	10	25							227
COSCO VIETNAM	VRID5	A	New York City	0	0	0	25	46	42							113
COSTA FORTUNA	IBNY	A	Miami	42	0	0	0	0	0							42
CROSS POINT	WDA3423	A	Anchorage	0	0	0	4	1	0							5
CRYSTAL MARINE	9VIC4	A	Anchorage	0	0	0	0	82	142							224
CRYSTAL SERENITY	C6SY3	A	Anchorage	83	61	86	83	100	60							473
CRYSTAL SUNRISE	9V2024	A	Anchorage	61	58	22	7	19	33							200
CS GLOBAL SENTINEL	KGSU	A	Seattle	26	62	50	14	0	3							155
CS RELIANCE	V7CZ2	A	Baltimore	10	9	0	4	3	7							33
CSCL AFRICA	VRBI3	A	Anchorage	0	7	26	14	0	0							47
CSCL MELBOURNE	VRBI8	A	Anchorage	0	0	26	7	9	0							42
CSCL OCEANIA	VRBI2	A	Anchorage	52	34	23	16	9	43							177
CSL LAURENTIEN	VCJW	A	Duluth	0	0	0	10	12	0							22
DARYA MA	VRJH5	A	Anchorage	0	0	0	1	12	0							13
DEPENDABLE	V7DI6	A	Baltimore	0	0	1	13	24	74							112
DIANE H	WUR7250	A	Anchorage	0	0	0	0	0	2							2
DISCOVERER CLEAR LEADER	V7MO2	A	Houston	111	59	123	120	123	119							655
DISCOVERER INSPIRATION	V7MO3	A	Houston	3	3	5	3	0	0							14
DISNEY DREAM	C6YR6	A	Jacksonville	48	62	78	59	40	54							341
DISNEY FANTASY	C6ZL6	A	Jacksonville	0	7	1	1	0	6							14
DISNEY MAGIC	C6PT7	A	Jacksonville	3	30	4	5	1	0							43
DISNEY WONDER	C6QM8	A	Miami	119	69	48	31	75	25							367
DOMINATOR	WBZ4106	A	Anchorage	23	56	35	0	0	22							136
DREW FOSS	WYL5718	A	Anchorage	0	0	0	0	0	11							11
DUNCAN ISLAND	C6JS	A	Miami	27	19	21	22	23	14							126

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
EAGLE ATLANTA	S6TE	A	Houston	0	0	42	61	221	43							367
EAGLE KLANG	9V8640	A	Houston	45	0	0	0	0	0							4
EAGLE STAVANGER	3FNZ5	A	Houston	0	0	0	0	0	9							9
EAGLE SYDNEY	3FUU	A	New York City	0	0	44	11	11	82							148
EAGLE TAMPA	S6NK6	A	Houston	0	82	77	205	209	39							612
EAGLE TUCSON	S6NK5	A	Houston	0	0	0	19	28	24							71
ECLIPS	V7BP2	A	New York City	0	0	0	3	4	0							7
EDGAR B. SPEER	WDH7562	A	Duluth	1	0	33	137	114	24							309
EDWIN H. GOTT	WDH7558	A	Duluth	84	0	4	112	167	137							504
EMPIRE STATE	KKFW	A	New York City	0	0	0	0	111	119							230
ENCHANTMENT OF THE SEAS	C6FZ7	A	Miami	30	29	40	41	30	45							215
ENDEAVOR (AWS)	WCE5063	A	New York City	103	182	526	81	611	715							2218
ENDURANCE	WDE9586	A	Baltimore	58	60	76	80	44	61							379
ENDURANCE	WDF7523	A	Anchorage	15	0	15	0	10	0							40
EOT SPAR	WDE9193	A	Jacksonville	1	0	0	21	45	35							102
ERNEST CAMPBELL	WDI8651	A	Anchorage	21	0	0	0	0	0							21
EURODAM	PHOS	A	Miami	89	138	168	116	65	48							624
EVER DECENT	9V7952	A	New York City	208	187	63	0	0	0							458
EVER DEVOTE	9V7954	A	New York City	0	9	0	0	17	20							46
EVER DIADEM	9V7955	A	New York City	92	88	101	81	84	81							527
EVER ELITE	VSJG7	A	Los Angeles	85	6	53	76	58	49							327
EVER LADEN	3FXM3	A	Charleston	11	3	22	5	0	0							41
EVER LAMBENT	2FRE8	A	New York City	26	29	18	12	23	7							115
EVER LEARNED	2GNG3	A	Norfolk	0	49	36	34	77	45							241
EVER LEGACY	9V9290	A	New York City	11	37	47	43	47	52							237
EVER LEGION	9V9725	A	New York City	2	16	12	11	26	27							94
EVER LIBERAL	2HDG2	A	New York City	4	22	42	19	3	11							101
EVER LIFTING	2ILJ7	A	New York City	8	6	9	5	7	9							44
EVER LISSOME	2HDG3	A	New York City	0	25	4	6	49	48							132
EVER LIVEN	BKIE	A	New York City	0	0	0	30	26	18							74
EVER LIVING	9V9791	A	Norfolk	13	26	25	40	38	41							183
EVER LOGIC	BKIF	A	New York City	0	0	0	0	4	12							16
EVER LOVELY	9V9793	A	Charleston	1	0	0	0	0	0							1
EVER LUCENT	9V9792	A	Norfolf	6	0	0	0	0	0							6
EVER LUCID	BKIY	A	New York City	20	0	0	33	29	41							123
EVER LUCKY	3FAE4	A	New York City	9	17	34	24	0	0							138
EVER LUNAR	BKKF	A	New York City	18	13	0	26	22	26							105
EVER SALUTE	3ENU5	A	Anchorage	0	0	0	12	8	1							21
EVER SHINE	MJKZ4	A	Anchorage	6	0	0	15	10	14							45
EVER STEADY	3EHT6	A	Anchorage	9	16	43	35	33	57							193
EVER STRONG	3EJG3	A	Seattle	0	0	0	6	0	0							6
EVER SUMMIT	3EKU3	A	Anchorage	7	5	34	62	41	0							149
EVER ULYSSES	9V7962	A	Anchorage	0	0	15	12	9	7							43
EVER UNIFIC	9V7961	A	Anchorage	9	19	0	0	0	0							28

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
EVER UNIQUE	9V7959	A	Seattle	0	0	0	14	7	0							21
EVER UNITED	9V7957	A	Seattle	0	0	0	0	6	65							71
EVER USEFUL	3FCC9	A	Anchorage	10	11	3	1	0	0							25
EVER UTILE	3FZA9	A	Seattle	0	0	7	0	0	0							7
EVERGREEN STATE	WDE4430	A	San Francisco	4	2	3	5	15	5							34
EXCALIBUR	ONCE	A	Houston	18	43	36	1	1	0							99
EXCEL	ONAI	A	Houston	42	86	115	89	57	37							426
EXCELSIOR	ONCD	A	Houston	0	0	0	59	64	31							154
EXPLORER OF THE SEAS	C6SE4	A	Jacksonville	109	50	114	105	103	74							555
EXPRESS	ONFL	A	Houston	43	24	49	56	51	29							252
FAIRWEATHER	WDB5604	A	Anchorage	3	0	0	0	1	1							5
FEDERAL HUDSON	V7RE9	A	Anchorage	14	0	0	3	0	0							17
FEDERAL KIVALINA	V7RF2	A	Anchorage	0	0	0	9	12	11							32
FEDERAL TIBER	V7YW2	A	Anchorage	0	0	0	0	1	0							1
FEDERAL YUKINA	VRHN7	A	Anchorage	0	0	0	5	50	0							55
FERDINAND R. HASSLER	WTEK	A	Norfolk	38	212	504	4	0	0							758
FISH HAWK	WDF2995	I	Anchorage	0	0	0	10	12	13							35
FLORIDA	WFAF	A	Houston	0	2	2	0	0	0							4
FLORIDA VOYAGER	WDF4764	A	New Orleans	0	0	0	18	38	29							85
FREEDOM	WDB5483	A	Jacksonville	48	30	6	31	31	25							171
FREEDOM OF THE SEAS	C6UZ7	A	Miami	18	0	14	50	26	27							135
G. L. OSTRANDER	WCV7620	A	Duluth	2	0	0	12	5	58							77
G3 MARQUIS	XJBO	A	Duluth	0	0	0	18	12	26							56
GENCO AUGUSTUS	VRDD2	A	Anchorage	5	0	0	0	0	0							5
GENCO CLAUDIUS	V7SY6	A	Anchorage	83	2	0	19	0	0							104
GENCO HADRIAN	V7QN8	A	Anchorage	0	11	17	17	24	17							86
GENCO TITUS	VRDI7	A	Anchorage	36	25	0	0	34	0							95
GENERAL RUDDER	WTAU	A	Houston	0	0	0	0	0	56							56
GEORGE N	A8PQ5	A	Anchorage	21	159	82	28	7	41							338
GLEN CANYON BRIDGE	3EFD9	A	Norfolk	44	42	51	61	23	5							236
GOLDEN BEAR	WDL2000	A	San Francisco	0	0	0	17	71	31							119
GORDON GUNTER (AWS)	WTEO	A	New Orleans	0	24	0	0	536	403							963
GORDON JENSEN	WDG3440	A	Anchorage	0	0	0	0	0	0							0
GRANDEUR OF THE SEAS	C6SE3	A	Jacksonville	3	9	2	1	1	0							16
GREAT REPUBLIC	WDH7561	A	Duluth	0	0	0	22	24	14							60
GREEN BAY	WDI3177	A	Jacksonville	1	12	33	1	34	5							86
GREEN COVE	WDG5660	A	Baltimore	0	0	15	15	0	0							30
GREEN LAKE	WDDI	A	Jacksonville	36	17	0	4	69	64							190
GREEN RIDGE	WZZF	A	Jacksonville	15	28	9	8	4	0							64
GRETCHEN H	WDC9138	A	Anchorage	0	1	1	1	5	0							8
GUARDIAN	WBO2511	A	Anchorage	2	4	2	8	8	0							24
GUARDSMAN	WBN5978	A	Anchorage	0	1	2	0	0	8							11
GULF TITAN	WDA5598	A	Anchorage	1	0	0	0	0	0							1
H. LEE WHITE	WZD2465	A	Duluth	5	0	0	43	95	118							261

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
HALIFAX EXPRESS	VRMW7	A	New Orleans	18	27	26	34	1	26							132
HARMONY OF THE SEAS	C6BX8	A	Miami	0	2	1	2	0	1							6
HC MELINA	V2FR2	A	Norfolk	0	0	0	0	0	0							0
HENRY GOODRICH	YJQN7	A	Houston	204	201	210	190	209	205							1219
HERBERT C. JACKSON	WL3972	A	Duluth	235	0	274	720	708	718							2655
HI'IALAKAI (AWS)	WTEY	A	Honolulu	0	279	121	378	47	287							1112
HOEGH CHIBA	LAVD7	A	Jacksonville	8	26	34	25	31	25							149
HON. JAMES L. OBERSTAR	WL3108	A	Duluth	374	0	10	586	738	719							2427
HONOR	WDC6923	A	Baltimore	1	14	5	7	26	12							65
HOOD ISLAND	C6LU4	A	Miami	17	14	24	27	22	15							119
HORIZON ENTERPRISE	KRGB	A	Seattle	78	58	70	63	83	73							425
HORIZON PACIFIC	WSRL	A	Seattle	63	46	51	41	0	0							201
HORIZON RELIANCE	WFLH	A	Los Angeles	0	1	0	20	40	35							96
HORIZON SPIRIT	WFLG	A	Los Angeles	0	0	0	0	28	36							64
HOUSTON	KCDK	A	Miami	4	1	23	10	1	0							39
HUNTER	WBN3744	A	Anchorage	3	10	1	0	0	1							15
HYDRA VOYAGER	C6AB8	A	Anchorage	11	18	64	47	12	7							159
IBRAHIM DEDE	V7QW6	A	New York City	4	11	0	2	5	18							40
INDEPENDENCE II	WGAX	A	Baltimore	49	23	45	47	38	53							255
INDEPENDENCE OF THE SEAS	C6WW4	A	Miami	10	36	39	2	0	0							87
INDIANA HARBOR	WXN3191	A	Duluth	3	0	1	22	9	19							54
INTEGRITY	WDD7905	A	Anchorage	1	1	46	1	124	16							189
INTEGRITY	WDC6925	A	Baltimore	22	20	45	30	0	0							117
ISLA BELLA	WTOI	A	Jacksonville	43	61	72	66	56	57							355
IVER FOSS	WYE6442	A	Anchorage	0	0	0	0	0	7							7
JAKARTA EXPRESS	VRBR5	A	New York City	0	0	0	0	8	0							8
JAMES L. KUBER	WDF7020	A	Duluth	62	0	0	114	225	194							595
JAMES R. BARKER	WYP8657	A	Duluth	296	0	291	717	613	720							2637
JEAN ANNE	WDC3786	A	Los Angeles	3	0	3	7	7	10							30
JENNY N	A8PQ7	A	Anchorage	554	46	25	6	11	148							790
JEWEL OF THE SEAS	C6FW9	A	Miami	19	40	36	33	7	1							136
JOHN G. MUNSON	WDH7557	A	Duluth	0	0	0	0	15	26							41
JOHN J. BOLAND	WZE4539	A	Duluth	3	0	0	39	19	14							75
JONATHAN SWIFT	A8SN5	A	New York City	90	61	43	68	66	38							366
JOSCO JINZHOU	VRLE3	A	Anchorage	0	0	0	2	0	0							2
JOSEPH L. BLOCK	WXY6216	A	Duluth	285	0	0	11	15	0							311
JOYCE L. VANENKEVORT	WDB9821	A	Duluth	0	0	12	35	5	0							52
JUPITER EXPRESS	V7XY7		Anchorage	0	0	0	0	0	15							15
JUSTINE FOSS	WYL4978	A	Anchorage	40	26	23	6	3	13							111
KAMBOS	3ESY5	A	New Orleans	7	6	38	16	8	5							80
KAPRIJKE	ONIK	A	Houston	41	86	114	135	129	107							612
KAREN ANDRIE	WBS5272	A	Duluth	14	1	0	2	2	0							19
KAROLINE N	A8PQ8	A	Anchorage	19	15	115	99	103	89							440
KAYE E. BARKER	WCF3012	A	Duluth	290	3	163	717	738	720							2631

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
KENNICOTT	WCY2920	A	Anchorage	0	0	0	3	7	17							27
KESWICK	C6XE5	A	Anchorage	16	15	36	21	128	226							442
KILO MOANA	WDA7827	A	Honolulu	56	34	0	0	15	39							144
KONINGSDAM	PBGJ	A	Miami	269	195	85	62	82	89							782
LAURENCE M. GOULD (AWS)	WCX7445	A	Seattle	744	573	743	719	744	351							3874
LECONTE	WZE4270	A	Anchorage	0	0	24	7	7	3							41
LEE A. TREGURTHA	WUR8857	A	Duluth	382	0	293	717	738	683							2813
LEGEND OF THE SEAS	C6SL5	A	Anchorage	10	4	0	0	0	0							14
LEO VOYAGER	C6AB7	A	Anchorage	9	7	9	4	1	9							39
LIBERTY	KLIG	A	Baltimore	0	34	69	66	40	21							230
LIBERTY EAGLE	WHIA	A	Houston	3	53	72	58	25	97							308
LIBERTY GLORY	WADP	A	Houston	57	48	30	57	50	62							304
LIBERTY GRACE	WADN	A	Houston	0	0	0	0	0	0							0
LIBERTY OF THE SEAS	C6VQ8	A	Houston	0	0	0	26	37	36							99
LIBERTY PASSION	WPLI	A	Charleston	0	18	14	0	51	15							98
LIBERTY PRIDE	KRAU	A	Charleston	55	32	46	50	37	55							275
LIBERTY PROMISE	WWMZ	A	Jacksonville	31	17	0	0	0	0							48
LOIS H	WTD4576	A	Anchorage	0	0	0	1	0	2							3
LOWLANDS PHOENIX	9HIY9	A	Anchorage	8	24	22	0	0	0							54
MAASDAM	PFRO	A	Miami	185	169	159	285	206	138							1139
MAERSK ATLANTA	WNTL	A	Charleston	17	43	18	0	31	39							148
MAERSK CAROLINA	WBDS	A	Charleston	19	37	0	0	0	0							36
MAERSK CHICAGO	WMCS	A	Norfolk	23	13	0	3	15	20							74
MAERSK COLUMBUS	WMCU	A	Norfolk	25	0	14	43	21	15							118
MAERSK DENVER	WMDQ	A	New York City	21	3	21	0	3	10							58
MAERSK DETROIT	WMDK	A	Norfolk	3	5	16	22	4	0							50
MAERSK HARTFORD	WMHA	A	New York City	25	8	19	63	29	0							144
MAERSK HEIWA	9V9746	A	Anchorage	1	1	0	4	0	3							9
MAERSK IDAHO	WKPM	A	Baltimore	0	0	0	17	29	33							79
MAERSK IOWA	KABL	A	Norfolk	26	35	72	51	13	53							250
MAERSK KENSINGTON	WMKN	A	Charleston	85	64	65	55	96	81							446
MAERSK KENTUCKY	WKPY	A	Norfolk	9	23	17	38	66	56							209
MAERSK KINLOSS	WMKA	A	New York City	16	0	17	0	0	46							79
MAERSK KOTKA	CQHT	A	Charleston	0	0	0	0	1	57							58
MAERSK MEMPHIS	WMMK	A	Charleston	34	53	31	45	14	41							218
MAERSK MISSOURI	WAHV	A	Norfolk	12	11	54	50	24	0							151
MAERSK MONTANA	WCDP	A	Norfolk	30	30	48	30	42	30							210
MAERSK NIAGARA	VREO9	A	Anchorage	43	34	2	42	35	47							203
MAERSK OHIO	KABP	A	New York City	72	134	196	205	143	93							843
MAERSK PEARY	WHKM	A	Houston	108	84	74	15	16	5							302
MAERSK PITTSBURGH	WMPP	A	New York City	40	40	47	46	28	42							243
MAERSK WILMINGTON	3EXT3	A	New York City	0	3	2	0	0	0							5
MAERSK WISCONSIN	WKPN	A	Norfolk	19	2	0	1	0	0							22
MAHIMAHI	WHRN	A	Los Angeles	0	7	28	10	6	2							53

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
MAJESTY OF THE SEAS	C6FZ8	A	Jacksonville	22	28	12	61	6	50							179
MALOLO	WYH6327	A	Anchorage	0	0	0	7	16	12							35
MANITOWOC	WDE3569	A	Duluth	0	0	0	0	23	91							114
MANOA	KDBG	A	San Francisco	20	7	0	0	0	0							27
MANUKAI	WRGD	A	Los Angeles	14	33	25	26	34	42							174
MANULANI	WECH	A	Los Angeles	28	23	37	17	20	5							130
MARCUS G. LANGSETH (AWS)	WDC6698	A	Anchorage	743	444	535	719	731	706							3878
MARJORIE C	WDH6745	A	Los Angeles	9	16	20	8	2	7							62
MATANUSKA	WN4201	A	Anchorage	0	1	4	8	28	30							71
MATSON ANCHORAGE	KGTX	A	Anchorage	39	22	8	45	65	51							230
MATSON CONSUMER	WCHF	A	Seattle	2	0	13	0	0	0							15
MATSON KODIAK	KGTZ	A	Anchorage	53	55	61	33	35	37							274
MATSON NAVIGATOR	WPGK	A	Los Angeles	54	19	35	51	65	0							224
MATSON TACOMA	KGTY	A	Anchorage	49	52	41	24	26	22							214
MATSONIA	KHRC	A	Los Angeles	52	14	20	51	25	6							168
MAUNALEI	KFMV	A	Baltimore	38	24	17	2	6	37							124
MAUNAWILI	WGEB	A	Los Angeles	21	23	7	19	49	28							147
MEHUIN	A8SG8	A	Chaleston	23	18	0	0	0	0							41
MESABI MINER	WYQ4356	A	Duluth	0	0	0	310	744	718							1772
MIDNIGHT SUN	WAHG	A	Seattle	12	4	6	21	34	24							101
MIKE O'LEARY	WDC3665	A	Anchorage	0	0	0	0	7	7							14
MINERAL BEIJING	ONAR	A	Anchorage	17	4	2	3	0	15							41
MINERAL BELGIUM	VRKF5	A	Anchorage	22	30	21	39	15	4							131
MINERAL DALIAN	ONFW	A	Anchorage	82	51	27	53	36	39							288
MINERAL DRAGON	ONFN	A	Anchorage	124	70	25	0	3	13							235
MINERAL FAITH	VRKS4	A	Anchorage	22	66	104	0	0	0							192
MINERAL KYOTO	ONFI	A	Anchorage	42	62	28	83	52	32							299
MINERAL NEW YORK	ONGI	A	Anchorage	32	67	50	69	49	42							309
MINERAL NINGBO	ONGA	A	Anchorage	0	13	36	36	21	31							137
MINERAL NOBLE	ONAN	A	Anchorage	54	15	12	23	28	23							155
MINERAL TIANJIN	ONBF	A	Anchorage	82	69	16	20	24	36							247
MOKIHANA	WNRD	A	Los Angeles	4	42	53	59	59	53							270
MOL BRAVO	VRNJ2	A	New York City	0	0	1	2	0	0							3
MOL MANEUVER	V7VC5	A	Charleston	0	0	0	0	5	0							5
MOL PARADISE	9V3118	A	Anchorage	10	0	0	0	0	0							10
MOUNT OWEN	VRDU6	A	Anchorage	0	107	126	83	65	68							449
MSC POESIA	3EPL4	A	Miami	0	0	0	0	0	0							0
MSC STELLA	H8PA	A	New Orleans	0	0	0	12	1	0							13
MV GEYSIR	WDF3296	A	Norfolk	0	0	51	16	0	3							70
NACHIK	WDE7904	A	Anchorage	0	0	0	0	17	14							31
NANCY FOSTER (AWS)	WTER	A	Charleston	0	0	0	329	422	210							961
NANUQ	WDF2026	A	Anchorage	0	0	0	0	1	0							1
NATHANIEL B. PALMER (AWS)	WBP3210	A	Seattle	743	671	711	720	744	715							4304
NATIONAL GLORY	WDD4207	A	Houston	0	25	48	41	49	48							211

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
NAVIGATOR OF THE SEAS	C6FU4	A	Miami	18	13	11	3	32	4							81
NEIL ARMSTRONG (AWS)	WARL	A	Anchorage	0	311	731	717	734	696							3191
NEPTUNE VOYAGER	C6FU7	A	New Orleans	6	0	14	3	45	71							139
NEVZAT KALKAVAN	TCMO2	A	New York City	11	7	30	34	41	30							153
NIEUW AMSTERDAM	PBWQ	A	Miami	209	351	295	199	102	75							1231
NILEDUTCH OSPREY	V7AP5	A	New York City	0	0	0	0	33	17							50
NOAA FAIRWEATHER	WTEB	AWS*	Anchorage	0	0	0	0	0	369							369
NOAA RONALD H. BROWN	WTEC	AWS*	Charleston	668	441	588	76	624	706							3103
NOAA HENRY BIGELOW	WTDF	AWS*	New York City	0	332	401	479	277	190							1679
NOAA OKEANOS EXPLORER	WTDH	AWS*	New York City	199	561	554	418	430	0							2162
NOORDAM	PHET	A	Anchorage	272	232	218	119	97	286							1224
NORFOLK	WDI3067	A	Charleston	0	0	0	0	0	0							0
NORTH STAR	KIYI	A	Seattle	3	4	3	1	48	39							98
NORTHERN VICTOR	WCZ6534	A	Anchorage	0	14	9	16	2	0							41
NORTHWEST SWAN	ZCDJ9	A	Anchorage	46	50	32	2	51	101							282
NORWEGIAN BREAKAWAY	C6ZJ3	A	New York City	61	51	36	37	30	160							375
NORWEGIAN DAWN	C6FT7	A	New Orleans	284	372	389	370	294	102							1811
NORWEGIAN ESCAPE	C6BR3	A	Miami	36	36	51	30	0	47							200
NORWEGIAN GEM	C6VG8	A	Jacksonville	130	113	225	210	144	94							916
NORWEGIAN GETAWAY	C6ZJ4	A	Miami	34	102	53	28	12	0							229
NORWEGIAN JADE	C6WK7	A	Anchorage	134	71	124	118	47	26							520
NORWEGIAN JEWEL	C6TX6	A	Jacksonville	179	0	176	223	122	56							756
NORWEGIAN PEARL	C6VG7	A	Anchorage	423	83	328	405	440	509							2188
NORWEGIAN SKY	C6PZ8	A	Miami	0	0	22	22	17	7							68
NORWEGIAN SPIRIT	C6TQ6	A	Jacksonville	62	2	137	58	107	26							392
NORWEGIAN STAR	C6FR3	A	Anchorage	44	0	49	66	63	50							272
NORWEGIAN SUN	C6RN3	A	Miami	418	316	332	243	236	338							272
NUNANIQ	WRC2049	A	Anchorage	0	0	0	1	1	0							2
NYK ATHENA	HPDY	A	Anchorage	7	9	22	16	12	31							97
NYK NEBULA	3ENG6	A	Charleston	1	0	20	12	23	13							69
NYK RUMINA	9V7645	A	New York City	112	80	46	15	10	18							281
NYK TRITON	3FUL2	A	Los Angeles	60	8	0	15	8	20							111
OASIS OF THE SEAS	C6XS7	A	Jacksonville	71	15	24	19	6	8							143
OCEAN CRESCENT	WDF4929	A	Houston	52	53	47	48	50	75							325
OCEAN FREEDOM	WDF9323	A	Houston	0	0	0	0	18	4							22
OCEAN GIANT	WDG4379	A	Jacksonville	9	0	0	0	0	16							25
OCEAN GLORY	KOGH	A	Charleston	29	10	31	55	62	2							189
OCEAN HOPE 3	WDF2354	A	Anchorage	0	0	1	1	0	0							2
OCEAN MARINER	WCF3990	A	Anchorage	0	0	0	0	2	11							13
OCEAN NAVIGATOR	WSC2552	A	Anchorage	0	0	5	8	0	0							13
OCEAN RANGER	WAM7635	A	Anchorage	0	0	0	0	0	25							25
OCTAVIA	V7HB6	A	New York City	0	0	0	0	63	50							113
OLEANDER	V7SX3	A	New York City	38	36	36	32	31	30							203

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
OLIVE L. MOORE	WDF7019	A	Duluth	0	0	0	0	0	1							1
OOSTERDAM	PBKH	A	Anchorage	100	77	148	101	138	153							717
ORANGE BLOSSOM 2	D5DS3	A	New York City	3	5	22	22	30	19							101
ORANGE OCEAN	D5DS2	A	New York City	21	1	10	0	33	26							82
ORANGE SKY	ELZU2	A	New York City	0	39	36	20	65	25							185
ORANGE STAR	A8WP6	A	New York City	69	6	15	12	1	5							108
ORANGE SUN	A8HY8	A	New York City	72	14	96	56	73	56							367
ORE ITALIA	9V9129	A	Anchorage	110	386	674	317	189	248							1924
OREGON II (AWS)	WTDO	A	New Orleans	0	1	40	429	576	22							1068
OREGON VOYAGER	WDF2960	A	San Francisco	66	11	9	0	3	21							110
ORIENTAL QUEEN	VRAC9	A	Anchorage	4	19	30	27	29	5							114
OSCAR DYSON (AWS)	WTEP	A	Anchorage	167	218	536	192	664	532							2309
OSCAR ELTON SETTE (AWS)	WTEE	A	Honolulu	0	0	340	253	333	74							1000
OURO DO BRASIL	ELPP9	A	Baltimore	50	72	82	47	54	72							377
OVATION OF THE SEAS	C6BX9	A	Anchorage	36	39	82	47	54	72							237
OVERSEAS ANACORTES	KCHV	A	Miami	31	17	15	11	9	2							85
OVERSEAS BOSTON	WJBU	A	Anchorage	17	44	3	2	28	41							135
OVERSEAS CASCADE	WOAG	A	Miami	12	12	17	29	62	66							198
OVERSEAS CHINOOK	WNFQ	A	Houston	1	7	24	0	7	2							41
OVERSEAS HOUSTON	WWAA	A	Miami	0	0	1	0	4	0							5
OVERSEAS LONG BEACH	WAAT	A	Jacksonville	8	8	11	10	12	6							55
OVERSEAS LOS ANGELES	WABS	A	Seattle	102	81	16	142	37	74							452
OVERSEAS MARTINEZ	WPAJ	A	Anchorage	6	13	9	11	11	0							50
OVERSEAS NIKISKI	WDBH	A	Anchorage	18	21	15	1	4	3							62
OVERSEAS SANTORINI	WOSI	A	Houston	0	0	7	21	10	44							82
OVERSEAS TAMPA	WOTA	A	Baltimore	1	0	0	0	3	5							9
OVERSEAS TEXAS CITY	WHED	A	Houston	22	23	26	34	27	31							163
PACIFIC FREEDOM	WDD3686	A	Anchorage	2	0	2	0	32	53							89
PACIFIC RAVEN	WDD9283	A	Anchorage	2	0	0	0	5	10							17
PACIFIC SANTA ANA	A8W13	A	Houston	22	14	0	6	1	28							71
PACIFIC SHARAV	D5DY4	A	Houston	35	29	40	23	46	43							216
PACIFIC STAR	WDD3686	A	Anchorage	0	0	0	1	0	0							1
PACIFIC TITAN	WCZ6844	A	Anchorage	4	0	1	0	0	0							5
PACIFIC WOLF	WDD9286	A	Anchorage	0	10	11	7	2	5							35
PANDALUS	WAV7611	A	Anchorage	0	0	0	0	6	18							24
PARAMOUNT HAMILTON	2CWB2	A	Houston	0	0	95	69	93	10							267
PARAMOUNT HATTERAS	2CWB5	A	Houston	0	0	0	0	0	0							0
PATRIOT	WAIU	A	Charleston	42	16	29	16	5	53							161
PAUL GAUGUIN	C6TH9	A	Anchorage	66	51	57	89	4	0							267
PAUL R. TREGURTHA	WYR4481	A	Duluth	181	0	345	470	712	720							2428
PERLA DEL CARIBE	KPDL	A	Jacksonville	35	27	9	30	35	32							168
PERSEVERANCE	WDE5328	A	Anchorage	2	0	3	0	1	0							6
PHILADELPHIA EXPRESS	WDC6736	A	Houston	82	56	60	44	66	90							398
PHILIP R CLARKE	WDH7554	A	Duluth	14	0	14	72	34	24							398

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
PISCES (AWS)	WTDL	A	New Orleans	0	0	22	296	237	126							681
POLAR ADVENTURE	WAZV	A	Seattle	8	8	53	81	48	18							216
POLAR CLOUD	WDF5296	A	Anchorage	5	5	6	0	3	3							22
POLAR DISCOVERY	WACW	A	Seattle	17	17	28	9	13	25							109
POLAR ENDEAVOUR	WCAJ	A	Seattle	25	40	34	0	0	5							104
POLAR ENTERPRISE	WRTF	A	Seattle	47	59	58	53	49	44							310
POLAR RANGER	WDC8652	A	Anchorage	0	0	0	0	2	7							9
POLAR RESOLUTION	WDJK	A	Seattle	15	19	7	20	16	16							93
POLAR STORM	WDE8347	A	Anchorage	0	6	5	0	0	0							11
POLAR VIKING	WDD6494	A	Anchorage	0	0	0	0	10	14							24
PREMIUM DO BRASIL	A8BL4	A	Baltimore	29	32	55	38	33	36							223
PRESQUE ISLE	WDH7560	A	Duluth	30	0	0	56	180	69							335
PRINSENDAM	PBGH	A	Miami	124	141	100	71	122	93							651
PSU EIGHTH	9V6346	A	Anchorage	0	0	PS	1	0	0							1
QUANTUM OF THE SEAS	C6BH8	A	New York City	113	55	0	0	20	61							249
R. J. PFEIFFER	WRJP	A	Los Angeles	60	57	63	52	49	61							330
R/V KIYI	KAO107	A	Duluth	0	0	0	0	13	33							46
RADIANCE OF THE SEAS	C6SE7	A	Anchorage	238	388	96	2	8	39							771
RAINIER (AWS)	WTEF	A	Seattle	0	0	0	97	112	116							325
REDOUBT	WDD2451	A	Anchorage	0	0	0	0	0	26							26
REGATTA	V7DM3	A	Seattle	4	9	50	28	16	14							121
RESOLVE	WCZ5535	A	Baltimore	27	21	18	27	15	34							142
RESPONDER	V7CY9	A	Baltimore	4	49	49	19	26	92							239
REUBEN LASKER (AWS)	WTEG	A	Los Angeles	409	0	234	511	554	527							2235
RHAPSODY OF THE SEAS	C6UA2	A	Miami	32	27	7	21	16	0							103
RICHARD BRUSCO	WDC3031	A	Anchorage	1	0	0	0	0	0							1
ROBERT C. SEAMANS	WDA4486	A	Anchorage	0	0	11	16	19	26							72
ROBERT GORDON SPROUL (AWS)	WSQ2674	A	Los Angeles	736	273	729	718	744	719							3919
ROBERT BLOUGH	WDH7559	A	Duluth	46	0	22	168	169	83							488
ROGER REVELLE (AWS)	KAOU	A	Los Angeles	572	672	736	617	736	713							4046
RONALD N	A8PQ3	A	Anchorage	36	35	18	10	13	13							125
RTM DHAMBUL	9V2783	A	Anchorage	28	35	20	13	0	10							106
SABINE	V7UU6	A	Baltimore	153	75	79	17	0	2							326
SAGA ADVENTURE	VRBL4	A	Anchorage	58	54	18	2	41	29							202
SAGA ANDORINHA	VRMV6	A	Anchorage	0	0	26	5	10	20							61
SAGA CREST	VRWR7	A	Anchorage	102	5	59	33	40	0							239
SAGA DISCOVERY	VRBR8	A	Seattle	14	20	6	1	0	0							41
SAGA ENTERPRISE	VRCC8	A	Anchorage	1	19	6	0	0	0							26
SAGA FRIGG	VRLK7	A	Anchorage	150	90	225	19	29	0							513
SAGA FRONTIER	VRCP2	A	Anchorage	0	0	0	0	20	35							55
SAGA FUTURE	VRKX8	A	Anchorage	16	0	0	46	37	5							104
SAGA MONAL	VRZQ9	A	Anchorage	2	0	0	79	45	40							166
SAGA NAVIGATOR	VRDA4	A	Anchorage	43	38	59	41	43	72							296
SAGA ODYSSEY	VRDU9	A	Anchorage	314	260	491	243	84	73							1465

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SAGA PIONEER	VRED4	A	Anchorage	0	0	36	5	4	0							45
SAGA SPRAY	VRWW5	A	Anchorage	34	79	75	0	26	9							223
SAGA TUCANO	VRVP2	A	Anchorage	113	197	175	151	184	238							1058
SAGA WAVE	VRYO7	A	Anchorage	0	46	63	27	88	29							253
SAGA WIND	VRUR7	A	Anchorage	16	3	0	0	0	0							19
SAKURA OCEAN	3FRC8	A	New Orleans	0	0	0	1	25	68							94
SALLY RIDE	WSAF	A	Seattle	0	10	40	19	0	0							69
SAM LAUD	WZC7602	A	Duluth	9	0	0	0	0	0							9
SAMSON MARINER	WCN3586	A	Anchorage	1	0	0	0	5	6							12
SAMUEL DE CHAMPLAIN	WDC8307	A	Duluth	13	0	6	5	13	21							58
SANDRA FOSS	WYL4908	A	Anchorage	0	0	0	0	0	16							16
SEA HAWK	WDD9287	A	Anchorage	8	2	1	0	7	8							26
SEA PRINCE	WYT8569	A	Anchorage	0	0	0	0	5	25							30
SEA VOYAGER	WCX9106	A	Anchorage	16	16	14	12	18	9							85
SEABOURN QUEST	C6YZ5	A	Miami	0	0	6	30	7	1							44
SEABULK ARCTIC	WCY7054	A	Miami	5	16	25	27	11	5							89
SEABULK TRADER	KNJK	A	Miami	26	32	37	33	31	19							178
SEAFREEZE AMERICA	WDH8281	A	Anchorage	10	15	27	26	28	15							121
SEA-LAND CHARGER	9V3589	A	Los Angeles	0	0	0	0	0	0							0
SEA-LAND COMET	9V3292	A	Los Angeles	0	0	0	0	0	0							0
SEA-LAND INTREPID	9V3293	A	Los Angeles	0	0	0	0	0	0							0
SEASPAN CHIWAN	VRBH3	A	Anchorage	24	16	3	4	14	16							77
SEASPAN FELIXSTOWE	VRBH8	A	Seattle	3	1	34	51	32	0							121
SEASPAN RIO DE JANEIRO	VRCR9	A	Anchorage	28	13	30	34	24	16							145
SEASPAN SAIGON	VRBT7	A	New York City	0	0	14	17	19	15							65
SEOUL TRADER	9HA3782	A	Los Angeles	0	0	0	0	0	0							0
SERENADE OF THE SEAS	C6FV8	A	Miami	4	0	0	0	0	0							4
SESOK	WDE7899	A	Anchorage	0	0	0	1	9	8							18
SEVEN SEAS EXPLORER	V7QK9	A	Anchorage	131	94	128	141	65	55							614
SEVEN SEAS MARINER	C6VV8	A	Jacksonville	224	328	31	27	30	1							641
SEVEN SEAS NAVIGATOR	C6ZI9	A	Miami	547	142	76	96	35	6							902
SEVEN SEAS VOYAGER	C6SW3	A	Anchorage	281	93	0	169	215	385							1143
SHANDONG DA CHENG	9V9131	A	Anchorage	733	276	337	455	597	423							2821
SHANDONG DA DE	9V9128	A	Anchorage	91	29	68	52	23	46							309
SIANGTAN	9V9832	A	Seattle	37	21	14	29	57	22							180
SIGAS SILVIA	S6ES6	A	Anchorage	432	192	15	1	1	2							643
SIKU	WCQ6174	A	Anchorage	0	0	0	74	184	133							391
SIKULIAQ (AWS)	WDG7520	A	Anchorage	597	626	604	689	719	719							3954
SILVER DISCOVERER	C6OZ3	I	Anchorage	0	0	0	0	0	1							1
SILVER SHADOW	C6FN6	A	Anchorage	0	0	0	0	4	2							6
SOL DO BRASIL	ELQQ4	A	Baltimore	50	58	26	16	47	30							227
SOMBEKE	ONHD	A	Houston	85	35	3	0	0	0							123
SOZON	9HA3546	A	New Orleans	0	0	0	0	0	5							5
SPICA	A8QJ5	A	New Orleans	22	13	16	16	14	22							103

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
SS MAUI	WSLH	A	Seattle	62	29	55	44	47	64							301
ST LOUIS EXPRESS	WDD3825	A	Houston	87	64	122	171	35	86							565
STAR HERDLA	LAVD4	A	New Orleans	0	0	47	31	6	0							84
STAR HIDRA	LAVN4	A	Baltimore	12	31	2	38	3	0							86
STAR ISFJORD	LAOX5	A	New Orleans	0	11	2	7	29	25							74
STAR ISTIND	LAMP5	A	Seattle	0	0	0	8	6	8							22
STAR JAPAN	LAZV5	A	Seattle	7	17	27	7	7	30							95
STAR JAVA	LAJS6	A	Baltimore	1	3	0	0	1	0							5
STAR JUVENTAS	LAZU5	A	Baltimore	19	17	9	11	9	4							69
STAR KILIMANJARO	LAIG7	A	Anchorage	9	14	39	5	60	21							148
STAR KINN	LAJF7	A	Anchorage	0	0	0	8	51	14							73
STAR KIRKENES	LAHR7	A	New Orleans	19	0	0	28	0	0							47
STAR KVARVEN	LAJK7	A	Seattle	47	52	73	15	31	5							223
STAR LIMA	LAPE7	A	Jacksonville	24	19	5	6	0	2							56
STAR LINDESNES	LAQJ7	A	Jacksonville	20	0	41	56	24	13							154
STAR LIVORNO	LAQM7	A	Houston	12	7	0	61	44	16							140
STAR LUSTER	LAQO7	A	Anchorage	5	0	0	21	2	78							106
STAR LYGRA	V7FA7	A	Anchorage	0	1	33	63	30	24							151
STAR MINERVA	V7GR8	A	Jacksonville	22	30	25	24	31	51							183
STATE OF MAINE	WCAH	A	New York City	0	0	0	0	43	62							105
STELLAR VOYAGER	C6FV4	A	New Orleans	37	18	21	18	30	9							133
STEWART J. CORT	WDC6055	A	Duluth	332	0	238	707	738	719							2734
SUNSHINE STATE	WDE4432	A	Miami	18	10	3	2	25	32							90
SUPERSTAR GEMINI	C6LG5	A	Anchorage	48	52	38	47	37	21							243
SUPERSTAR LIBRA	C6DM2	A	Anchorage	116	105	124	114	120	112							691
SUSAN MAERSK	OYIK2	A	Seattle	0	58	99	29	18	40							244
TAKU WIND	WI9436	A	Anchorage	0	11	0	0	0	0							11
TALISMAN	LAOW5	A	Jacksonville	60	6	27	34	30	13							170
TAMESIS	LAOL5	I	Norfolk	0	0	0	0	0	0							0
TANGGUH HIRI	C6XC2	A	Anchorage	44	81	114	133	64	95							531
THUNDER BAY	CFN6288	A	Duluth	20	0	0	13	5	13							51
TIGLAX	WZ3423	A	Anchorage	0	0	0	0	6	1							7
TIM S. DOOL	VGPY	A	Duluth	0	0	6	14	19	22							61
TIME BANDIT	WDH2111	A	Anchorage	5	0	0	0	0	0							5
TROPIC CARIB	J8PE3	A	Miami	63	103	115	114	163	108							666
TROPIC EXPRESS	J8QB8	A	Miami	47	39	35	39	46	53							259
TROPIC JADE	J8NY	A	Miami	40	33	19	7	53	74							226
TROPIC LURE	J8PD	A	Miami	36	19	60	70	95	91							371
TROPIC MIST	J8NZ	A	Miami	41	37	39	56	32	57							262
TROPIC NIGHT	J8NX	A	Miami	25	79	84	107	95	114							504
TROPIC OPAL	J8NW	A	Miami	128	89	107	57	77	57							515
TROPIC PALM	J8PB	A	Miami	67	46	80	71	70	66							400
TROPIC SUN	J8AZ2	A	Miami	125	96	93	61	39	61							475
TROPIC TIDE	J8AZ3	A	Miami	24	81	86	97	74	94							456

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TROPIC UNITY	J8PE4	A	Miami	94	104	136	125	88	76							623
TS KENNEDY	KVMU	A	New York City	104	78	0	0	0	0							182
TUG DEFIANCE	WDG2047	A	Duluth	19	0	0	26	120	89							254
TUG DOROTHY ANN	WDE8761	A	Duluth	0	126	519	592	735	715							2687
TUG MICHIGAN	WDF5344	A	Duluth	32	20	11	16	47	104							230
TUG SPARTAN	WDF5483	A	Duluth	0	0	2	0	12	15							29
TUSTUMENA	WNGW	A	Anchorage	55	44	26	0	0	0							125
TYCO DECISIVE	V7DI7	A	Baltimore	0	0	0	68	64	10							142
U. S. INTREPID	WDE2670	A	Anchorage	0	0	0	1	0	0							1
USCGC HEALY	NEPP	I	Seattle	0	0	0	0	23	6							29
USCGC MACKINAW	NBGB	A	Duluth	1	0	0	0	0	0							1
VALDEZ RESEARCH (AWS)	WXJ63	A	Anchorage	743	671	743	720	744	720							4341
VEENDAM	PHEO	A	Miami	288	344	182	63	50	78							1005
VERMONT TRADER	9HYN7	A	Charleston	0	0	0	0	0	65							65
VISION OF THE SEAS	C6SE8	A	Miami	0	0	0	8	1	6							15
VOLENDAM	PCHM	A	Anchorage	661	664	512	469	358	203							2867
W. H. BLOUNT	C6JT8	A	New Orleans	52	57	65	76	54	40							344
WALTER J. MCCARTHY JR.	WXU3434	A	Duluth	16	0	0	20	53	31							120
WASHINGTON EXPRESS	WDD3826	A	Houston	18	10	66	144	58	9							305
WESTERDAM	PINX	A	Miami	98	104	83	44	43	43							415
WESTERN MARINER	WRB9690	A	Anchorage	2	0	0	0	0	0							2
WESTERN RANGER	WBN3008	A	Anchorage	20	0	0	5	0	0							25
WESTWOOD COLUMBIA	C6SI4	A	Seattle	2	22	25	14	43	41							147
WESTWOOD OLYMPIA	C6UB2	A	Seattle	15	7	2	0	0	1							25
WESTWOOD RAINIER	C6SI3	A	Seattle	34	34	32	33	52	17							202
WHITTIER RESEARCH (AWS)	KXI29	A	Anchorage	744	672	743	720	744	720							4343
WILFRED SYKES	WC5932	A	Duluth	0	0	0	441	619	668							1728
XPEDITION	HC2083	A	Anchorage	9	5	0	9	19	14							56
YM ANTWERP	VRET5	A	Anchorage	23	0	0	0	0	0							23
YM ULTIMATE	V7IK7	A	Charleston	201	199	78	140	51	77							746
YORKTOWN EXPRESS	WDD6127	A	Houston	41	39	36	39	19	19							193
YUHSAN	H9TE	A	Anchorage	17	13	37	49	53	54							223
ZAANDAM	PDAN	A	Anchorage	45	87	247	431	491	357							1658
ZIM SAN DIEGO	A8SI7	A	New York City	0	0	22	43	54	19							138
ZIM SHANGHAI	VRGA6	A	New York City	26	25	20	20	17	26							134
ZUIDERDAM	PBIG	A	Anchorage	155	119	62	164	93	101							694

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Intergovernmental Oceanographic Commission:

http://www.ioc-unesco.org/

Useful contacts in the IOC:

http://ioc-unesco.org/index.php?option=com_oe&task=viewGroupRecord&groupID=126

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), 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.

Bull Moose has a go at MAWS unit; just a little something our equipment must endure....
Photo is courtesy of Eddie Zingone, National Weather Service, Anchorage Forecast Office.

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