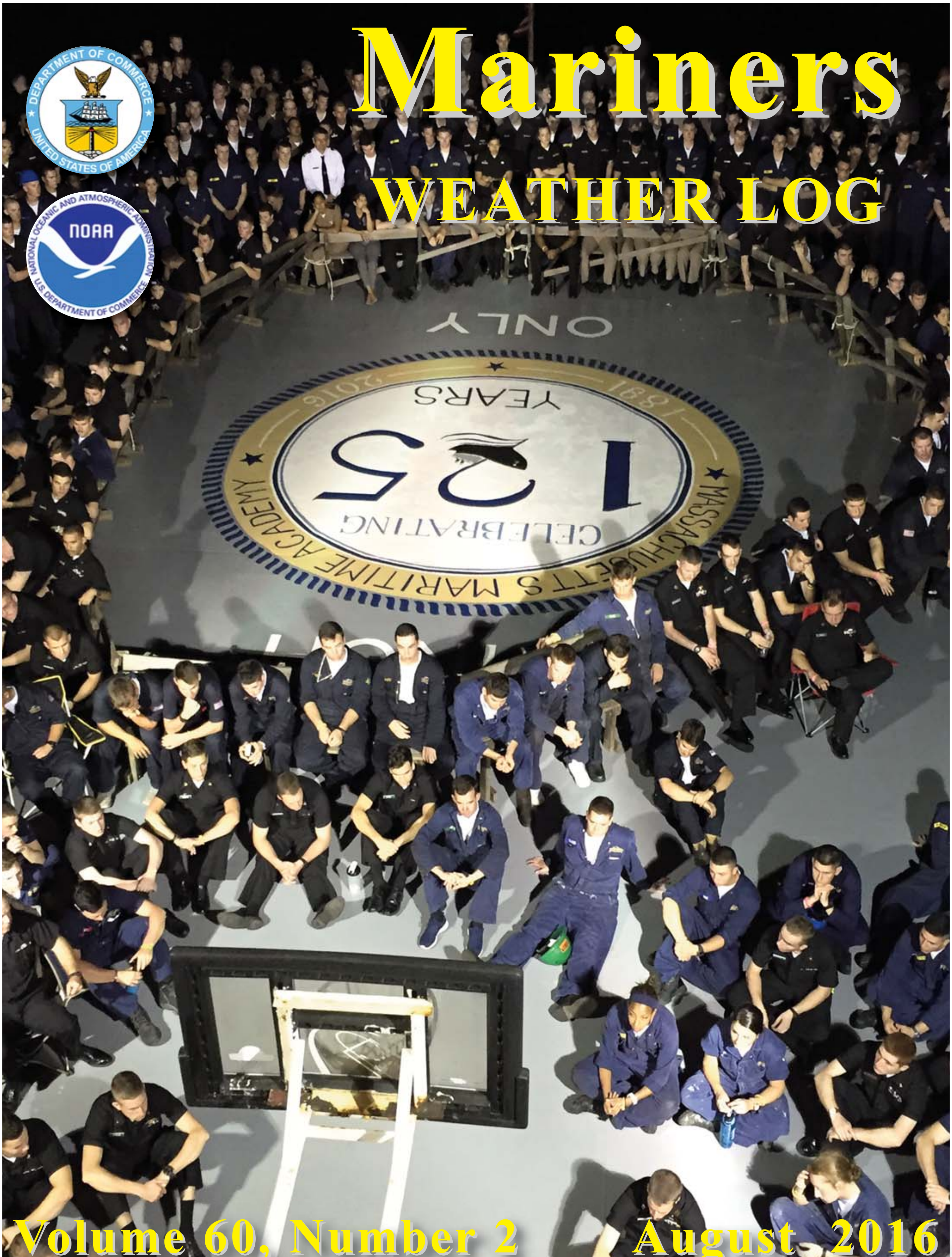
Mariners WEATHER LOG



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See these Web pages for further links.

From the Editor

Greetings and welcome to another issue of the Mariners Weather Log!

What a great edition we have for you. One of the most rewarding things in life is to have a sense of accomplishment, and knowing that you have left a lasting impression on others' lives in a positive manner. I refer to the cover story on the Massachusetts Maritime Academy cadet training efforts. This article gives a good idea of the hard work and dedication it takes to spread the word on the importance of marine weather observations and becoming environmentally aware and instilling a passion early on in these cadets to be good stewards of this beautiful planet we call home. I know you will like the article, but I can be sure you will like the little video clip at the end of the story. This is dedicated to a good friend, colleague and mentor; Captain Thomas L. Bushy, happy retirement, we will miss you!

After many years of the Mariners 1-2-3 Rule, the National Hurricane Center's Tropical Analysis and Forecast Branch has replaced this older graphic with the wind speed probabilities in the Tropical Cyclone Danger Graphic. This new graphic became available on the 15th of July. You can find this product on the NHC website at http://www.nhc.noaa.gov/marine/ as well as the radio fax New Orleans, LA, Point Reyes, CA and Honolulu, HI. I encourage you to visit their website and check it out…and remember…it is hurricane season! Got weather? Report it!

Thank you all for sending in your marine weather observations and being a part of the Voluntary Observing Ship Program. Your dedication to this international program is essential to our ever growing need to monitor our global well-being. Accurate data collection is essential for our ability to provide you with the best forecasts we can generate, keeping you safe at sea. Forecasting is just a piece of the pie though. Your data is critical; oceans are an important component of the Earth's environment because they regulate the weather and the climate. Your data helps us monitor our oceans, giving us a better understanding of the changing circulations and patterns, sea level heights, sea temperature and climate. All these components plus many more, too many to mention, helps us make better decisions towards sustainable development and protecting our precious resources. Thank you!

So please, enjoy this August issue of the Mariners Weather Log and stay safe.

- Paula

On the Cover: Massachusetts Maritime Academy Captain's Brief, on the deck of the **TS KENNEDY**. Photograph by VOS PMO Rob Niemeyer.

Mariners Weather Log

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Massachusetts Maritime Academy:
…Riding the T.S. KENNEDY
…Sea Term 2016!

By Paula Rychtar
Voluntary Observing Ship Program,
Deputy Program Manager / Operations

Photo courtesy Massachusetts Maritime Academy

The Voluntary Observing Ship Program is an international program in which our global mission is pretty straight forward; we focus on collecting and disseminating critical real-time marine weather conditions. We do this by the recruitment of ships, so that we can fulfill our national needs and international agreements supporting commerce, forecasts and warning programs and the Safety of Life at Sea (SOLAS) worldwide. Marine observations are essential to help define the global climate and help in the assessment of extreme weather events, climate variability and long term climate changes. I just recapped our mission statement.

This would not be possible without the dedicated men and women across the globe who are hard wired to the task of gathering quality environmental data, the Port Meteorological Officers (PMOs). PMOs are the weather services representatives. Without the dedication and enthusiasm of the PMO to maintain an active VOS Ship Fleet, the quality and quantity of recorded and reported environmental data from ships would be adversely affected. Duties of the PMO are overreaching to say the least. PMOs must maintain a strong allegiance to our mission and be a self-starter in efforts to maintain a level of expertise and skill sets necessary for supporting our participants. This is absolutely essential for the success to our mission. To describe the work ethics of the PMO in one word, dedication, and that is the focus of this article. Highlighting the dedicated PMO's who provide instruction to sea-going cadets at the Massachusetts Maritime Academy (https://www.maritime.edu/) and the dedication of the Academy for keeping a strong working relationship with the VOS program (http://www.vos.noaa.gov/) providing the opportunity for our PMOs to sail upon their ship; giving cadets classroom instruction and hands-on VOS training, instilling a sense of global stewardship in the cadets during their formative years of seamanship.

The Massachusetts Sea Term (https://www.maritime.edu/sea-term) is conducted between two Academic Semesters, January and February and is considered to be one of the highlights of the academy year. Cadets who have accomplished all prerequisites will be accepted on this voyage which averages 52 days. In addition to the offered accredited curriculum, the cadets are given opportunity to gain instruction and hands-on training by Rob Niemeyer, Jacksonville PMO, covering meteorology, oceanography and environmental data collection. He designs and teaches the cadets marine weather observing, proper coding and dissemination practices and the importance of data quality and timeliness. In addition, cadets are afforded classroom instruction such as "introduction to the VOS program" as well as "introduction to weather" (giving basic sun earth relationship and forecasting fundamentals).

Rob has created quite the reputation, developing classroom instruction and power points geared to increasing the students understanding and productivity. Yearly, Rob creates innovative training methods and strives towards standardized methods of training for VOS. Seasoned cadets will be given a more challenging portfolio such as introduction to tropical weather, marine products, pilot chart climatological data, forecasting techniques and interpretation. The amount of preparation and effort that goes into this yearly training at sea is notable.

The 2016 cruise introduced another exceptional opportunity for the cadets. In cooperation with the Atlantic Oceanographic and Meteorological Laboratory (AOML) Physical Oceanography Division, the Global Drifter Program (http://www.aoml.noaa.gov/phod/dac/index.php) (which is another program which falls under NOAA), the cadets were provided a drifting buoy to deploy during their cruise. These are satellite tracked surface drifting buoys which observe currents, sea surface temperatures, atmospheric pressure, winds and salinity. (http://www.aoml.noaa.gov/phod/dac/gdp_drifter.php)
How exciting for the cadets to be a part of such and effort in environmental data collection.

This was a particular busy cruise; VOS had several activities in which were only able to be accomplished because of a very accommodating Captain Bushy. VOS has had a longtime professional working relationship with Captain Thomas Bushy and his willingness to be flexible on this cruise to accommodate VOS was and is so appreciated. Not only did Rob get his yearly training session with the cadets, but he mentored our newly hired PMO Rusty Albaral (Area of Responsibility, New Orleans) who joined the ship in Key West Florida. Rusty accompanied Rob for the remainder of the training cruise into Buzzards Bay so that he could gain experience, training and guidance from Rob to insure our commitment to the Massachusetts Maritime Academy for future support. We now have two capable PMO's available to continue the training of their cadets on sea-term.

But wait, there's more! So…training, training a new trainer, educating cadets on drifting buoys and then getting to deploy one…what else???? A video. Yup… A long waited well overdue and much needed video which would be used for the VOS programs education / outreach and program promotional purposes. So once again, I contacted Captain Bushy to ask if he would be able to accommodate yet another person on his ship with a load of video equipment. With approval and full blessings to this project by Captain Bushy, our NOAA Videographer Bob Schwartz met up with the ship in Key West Florida (along with Rusty) and sailed off on February 15th to Buzzards Bay…arriving on Sunday the 21st of February. In this video, we wanted to show hands on training, comments from the Captain on how important weather is to any ship sailing anywhere. VOS wanted to show clips of actual sea state and conditions at sea with personal commentary from our PMO's providing the training.

Captain Thomas Bushy

Rusty Albaral and Rob Niemeyer (center kneeling)

Except where noted, photographs by VOS PMO Rob Niemeyer

The final video is still being fine-tuned and will be available in the very near future. I have seen portions and I just love it. We even have professional voices to narrate the script…it was a difficult decision choosing the perfect voice…they were all great. So not many opportunities come along like this to accomplish so many things at one time. The planets just lined up perfectly for this trip, we accomplished all our projects. As I mentioned earlier in this article, flexibility is important and a seasoned Captain such as Thomas Bushy knows this and recognized this rare opportunity.

I would like to thank Rob Neimeyer for such a great job on his support of the Massachusetts Maritime Academy. I would like to thank Rusty for taking time to join this ship in Key West to prepare himself for future voyages with Mass Maritime. I would like to thank Rob and Rusty for taking the time and extra effort assisting in the production of our new VOS video. Bob Schwartz could not have done this without you two.

To all the cadets, ***Bravo Zulu!!!***

More photos of sea-term 2016

Writing this article was yin and yang for me. I need to acknowledge, give a fond farewell, and many wishes for a happy retirement to Captain Thomas Bushy. I have known Captain Bushy for quite some time and have such a respect for this man; he is funny, kindhearted and such a good person. I value our friendship and his willingness to collaborate with VOS management to continue our training efforts. He will be missed. It is with such heartfelt thanks to Captain Thomas Bushy for all the years of support he has given to VOS and our PMO's. So without further ado, here is a video which was made while on sea-term 2016 in honor of Captain Thomas L. Bushy.

Fair Winds and Following Seas to you Tom!

A tribute for Massachusetts Maritime and Captain Thomas L. Bushy.

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Follow the Voyage:
FTV Surface Velocity Program Drifter Buoy Launch

By Meredith Emery
Captain's log posts: **TS KENNEDY**
Massachusetts Maritime Academy
Cape Cod, Massachusetts

The 2016 cruise introduced another exceptional opportunity for the cadets. In cooperation with the Atlantic Oceanographic and Meteorological Laboratory (AOML), Physical Oceanographic Division, the Global Drifter Program, (http://www.aoml.noaa.gov/phod/dac/index.php) (which is another program which falls under NOAA), the cadets were provided a drifting buoy to deploy during their cruise.

These are satellite tracked surface drifting buoys which observe currents, sea surface temperatures, atmospheric pressure, winds and salinity. (http://www.aoml.noaa.gov/phod/dac/gdp_drifter.php) How exciting for the cadets to be a part of such and effort in environmental data collection.

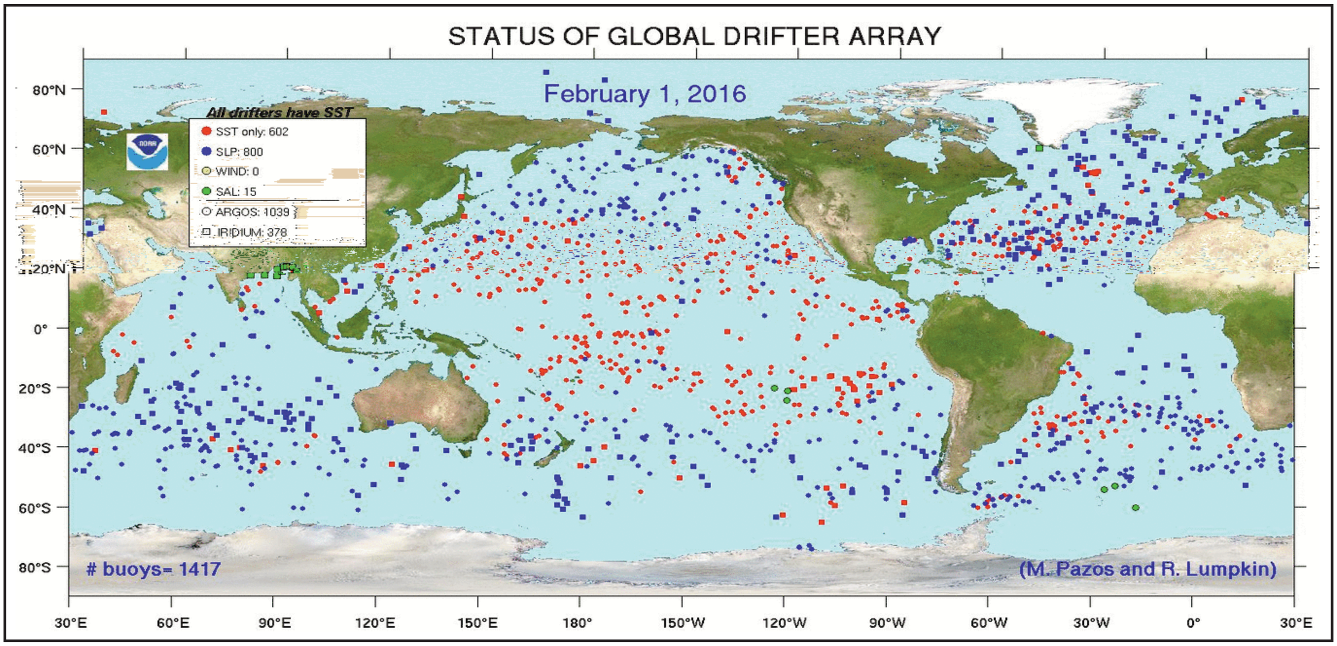
Photograph by VOS PMO Rob Niemeyer

Drift Buoy Launch Team:

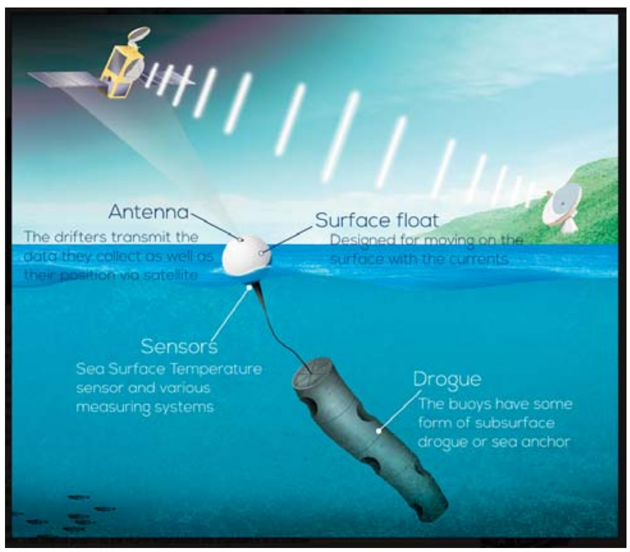
On the evening of January 27th, at approximately 1900, a group of Cadets from the **TS KENNEDY** assisted the NOAA, National Weather Service representative, Rob Niemeyer, in deploying a Surface Velocity Program (SVP) Drifter Buoy in the southern Pacific at approximately 2° degrees North Latitude, 82° West Longitude. A second drifter buoy by a second group of cadets was deployed the next morning at sunrise at a position of approximately 5° North Latitude, 83° West Longitude.

http://mmaseaterm.blogspot.com/2016/02/ftv-surface-velocity-program-drifter.html

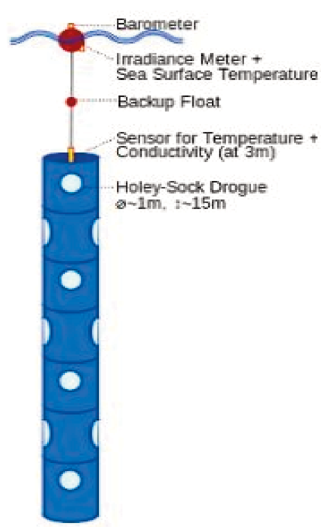
https://www.maritime.edu/



The drifter buoys are a high-tech version of the "message in a bottle". It consists of a surface buoy and a subsurface drogue (sea anchor), attached by a long, thin tether. The buoy measures temperature and other properties, and has a transmitter to send the data to passing satellites. The drogue/sea anchor dominates the total area of the instrument and is centered at a depth of 15 meters beneath the sea surface so that the dominant buoy drift is influenced by the ocean currents, not the surface wind flow and waves. The Drifter Buoys can provide over 400 days of information to analysts ashore. The hopes of the two drifter buoys deployed by the Cadets of the **TS KENNEDY** are that they will provide valuable information to analysts about the "El Nino" located in the southern pacific. El Nino is characterized by unusually warm ocean temperatures in the Equatorial Pacific.



A drifter nicknamed HOLEY SOCK



Graphics courtesy AOML

Weather is important to all that go to sea and it is regularly monitored by the bridge cadets. This special project by the NOAA emphasizes the importance of marine vessels to monitor daily weather conditions both in their current location as well as the weather along the planned course. The cadets on the **TS KENNEDY** are trained to monitor weather during their watches, as weather affects the ships course.On the bridge temperature and pressure measurements along with observing clouds, reading surface maps, and observing waves are among daily watch activities. These observations are forwarded to NOAA everyday so that the information can be shared with other ships traveling in the same area.

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Changes to NHC / TAFB's Tropical Cyclone Danger Graphic

Hugh Cobb
Tropical Analysis and Forecast Branch
National Hurricane Center, Miami, FL
NOAA/National Centers for Environmental Prediction

The Tropical Analysis and Forecast Branch (TAFB) of the National Hurricane Center (NHC) has been providing the **Tropical Cyclone Danger Graphic** for both the Atlantic and East Pacific basins since the 2003 hurricane season. The graphic depicts the danger area associated with tropical cyclones from the equator to 60°N between 0° and 100°W, including the Pacific east of 100°W, and from the equator to 40°N between 80°W and 175°W, including the Gulf of Mexico and Western Caribbean. The tropical cyclone danger graphic depicts the forecast track and corresponding area of avoidance for all active tropical cyclones through 72 hours, and areas for which tropical cyclone formation is possible within the next 48 hours over the Atlantic and East Pacific waters between May 15 and November 30. Traditionally, the three-day forecast track of each active tropical cyclone is depicted along with a shaded "danger" region, or area of avoidance. The danger area is determined by adding 100, 200, and 300 nautical miles (nmi) to the tropical storm force wind radii (34 knots) at the 24-, 48-, and 72-hour forecast positions, respectively (hence the "1-2-3" nomenclature or the "mariners 1-2-3 rule"). **Figure 1** illustrates the "mariners 1-2-3 rule".

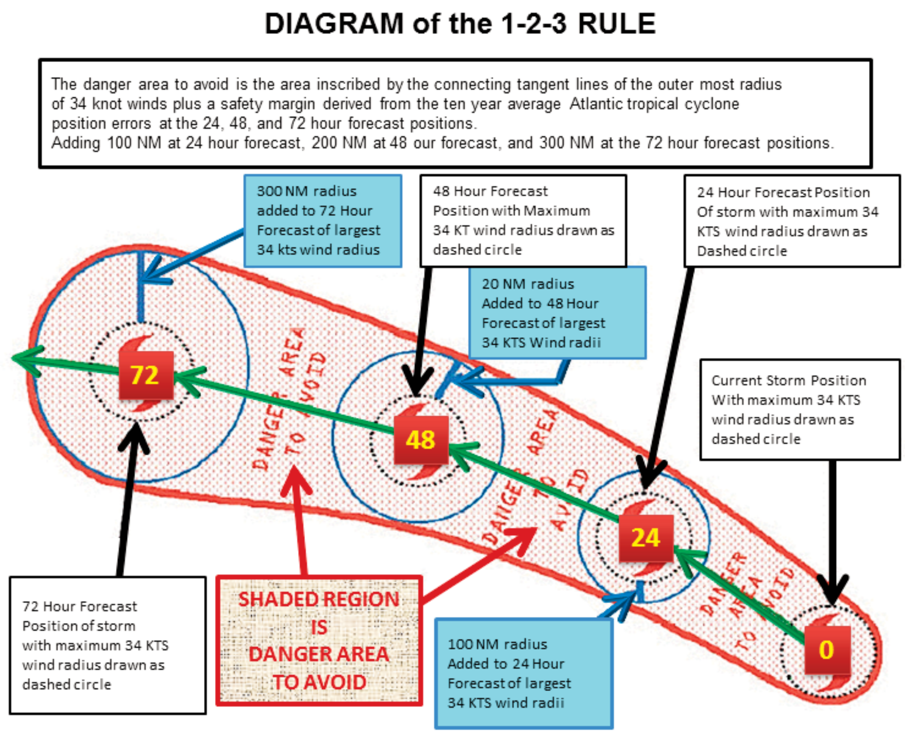

Figure 1. Illustration of the Mariners 1-2-3 Rule.

The Tropical Cyclone Danger graphic in **Figure 2** valid 0300 UTC 25 August 2011 depicts the area of avoidance associated with Hurricane Irene advancing along the United States east coast and an area of possible tropical cyclogenesis within 48 hours over the southwest of the Cape Verde Islands.

There have been significant improvements in hurricane track forecasting over the past five decades. **Figure 3** shows the improvement in average forecast track errors from the 1970s through the current decade. The 100-nmi, 200-nmi and 300 nmi errors comprising the "mariners 1-2-3" rule reflect forecast track errors observed in the 1980s. In the current decade, average forecast track errors have been reduced by over 60% from what they were in the 1980s. Because of these improvements in tropical cyclone track forecasting, the "mariners 1-2-3 rule" methodology depicts excessively large potential tropical cyclone danger areas and leads to "over-warning" of tropical cyclone avoidance areas. Wind speed probabilities offer a way to convey uncertainty in experiencing specific wind speed thresholds in a quantitative sense. The advantage of this approach is that it allows the depiction of any particular desired level of risk. In addition, wind speed probability calculations consider the spread of the track model guidance and therefore has some situational variability. It also considers uncertainty in the forecasts of tropical cyclone size and intensity as well as the track of the cyclone. Thus each set of wind speed probabilities and their conveyance of risk are unique to each advisory issuance. This is an additional advantage the wind speed probabilities have over the empirically based Mariners 1-2-3 rule.

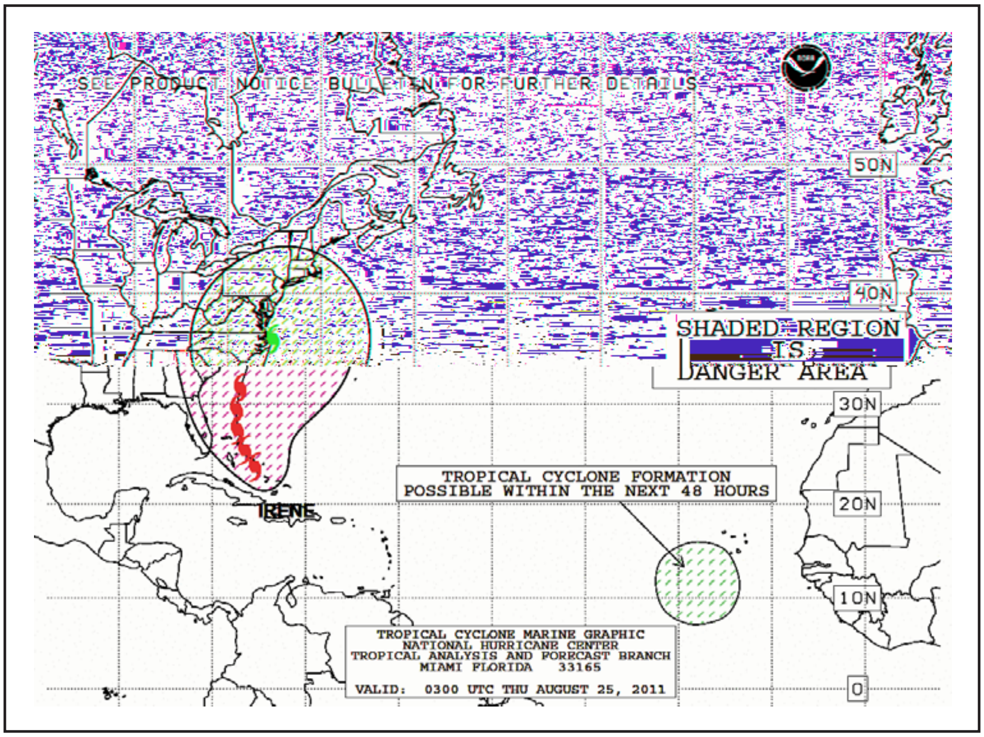

Figure 2. Tropical Cyclone Danger Graphic valid 0300 UTC 25 August 2011.

the depiction of any particular desired level of risk. In addition, wind speed probability calculations consider the spread of the track model guidance and therefore has some situational variability. It also considers uncertainty in the forecasts of tropical cyclone size and intensity as well as the track of the cyclone. Thus each set of wind speed probabilities and their conveyance of risk are unique to each advisory issuance. This is an additional advantage the wind speed probabilities have over the empirically based Mariners 1-2-3 rule. In 2012, the National Hurricane Center developed an alternative experimental version of the **Tropical Cyclone Danger** graphic based on the wind speed probability calculations discussed above. Two avoidance thresholds were developed for the experimental wind-speed based product. The avoidance area encompassed by the 5% 34-kt wind speed probability swath conveys a low risk of experiencing tropical storm force winds within the area through 72 hours and is denoted with a dashed line and hatched. The avoidance area encompassed by the 50% 34-kt wind speed probability swath conveys a high risk of experiencing tropical storm force winds through 72 hours. This area is denoted within a solid line with solid cross-hatching. **Figure 4** is a wind speed probability-based Tropical Cyclone Danger graphic valid 2100 UTC 1 October 2015 depicting the avoidance areas associated with Hurricane Joaquin over the Bahamas and off the southeastern United States. TAFB is replacing the empirical Mariner's 1-2-3 rule with the wind speed probabilities in the **Tropical Cyclone Danger Graphic** on or around 15 July 2016. This product will be available on the National Hurricane Center's website at http://www.nhc.noaa.gov/marine/ and on the New Orleans, LA, Point Reyes, CA and Honolulu, HI marine radio fax.

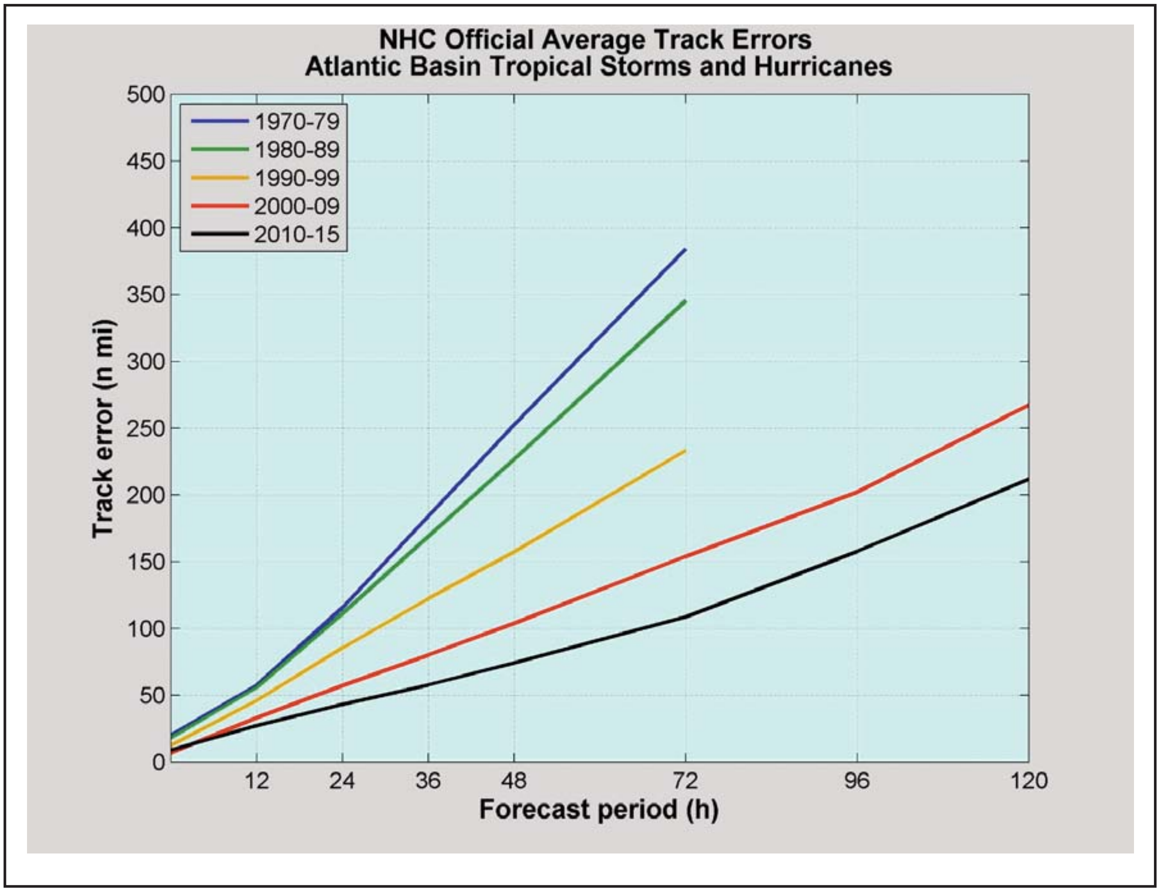

Figure 3. NHC Official Average Track Errors by decade 1970s-2010s.

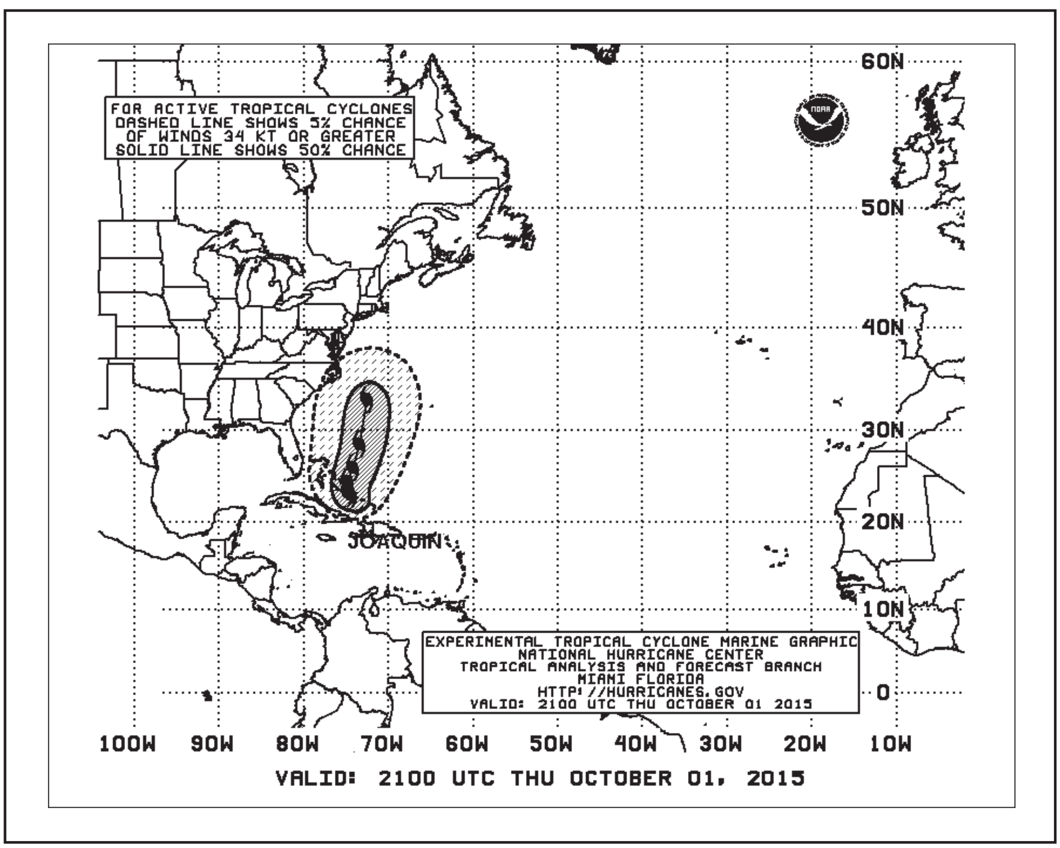

Figure 4. Wind Speed Probability-Based Tropical Cyclone Danger Graphic valid 2100 UTC 1 October 2015.

Relation Between Significant Wave Height and Wind Speed during Hurricanes

Professor S. A. Hsu
Louisiana State University
Email: sahsu@lsu.edu

In the December 2015 Issue of this Journal, the author presented following formulas, for fetch-limited seas,

$$U_{10} = 13413 H_s^3 / T_p^5, \quad (1)$$

And for duration-limited seas,

$$U_{10} = 14754 H_s^3 / T_p^5, \quad (2)$$

Here U_{10} is the wind speed at 10 meters in m/s, H_s is the significant wave height in meters and T_p is the dominant wave period in seconds.

In this research note, more analyses of the relation between H_s and T_p are conducted. Our results are presented in **Figure 1**. The datasets are based on simultaneous measurements of Hs and T_p during Hurricanes Kate (1985), Lili (2002), Rita (2005) and Wilma (2005) by the National Data Buoy Center (NDBC) (see www.ndbc.noaa.gov and for hurricane tracks, see www.nhc.noaa.gov). **Figure 1** shows that, approximately,

$$T_p = 5 H_s^{0.4}, \quad (3)$$

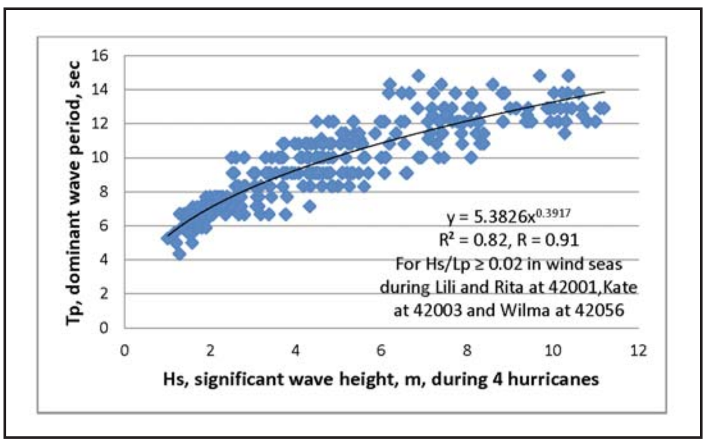

Figure 1. Relation between T_p and H_s during four hurricanes.

Further verification of **Equation (3)** during Hurricanes Ivan (2004) and Katrina (2005) near Buoy 42040 is shown in **Figure 2**. The reason to employ the datasets from Ivan and Katrina is because they contain some extreme measurements of H_s and T_p.

Now, substituting **Equations (3)** into **(1)** or **(2)**, we find that U_{10} and H_s are linearly related. However, in order to minimizing the effects of swell, the wind seas usually start when U_{10} **> 7 m/s**. Therefore, from statistical viewpoints, we need,

$$H_s = aU_{10} - b, \quad (4)$$

Here, "a" and "b" are the slope and the intercept of this proposed linear relation between H_s and U_{10}, respectively. Note that these coefficients can vary with different storms and need to be determined from field measurements.

Now, on the basis of the datasets provided by the NDBC (www.ndnc.noaa.gov) at Buoy 42003, which was located on the right-hand side the storms' track during Hurricanes Ivan (2004) and Katrina (2005), our result to verify **Equation (4)** is presented in **Figure 3**, which shows that

$$H_s = 0.47\, U_{10} - 3. \quad (5)$$

Since the correlation coefficient $R = 96\%$ is very high and the coefficient of determination (R^2) **= 0.92**, meaning that 92% of the linear variation between H_s and U_{10} can be explained, **Equation (5)** is thus recommended for estimating H_s from U_{10} or vice versa.

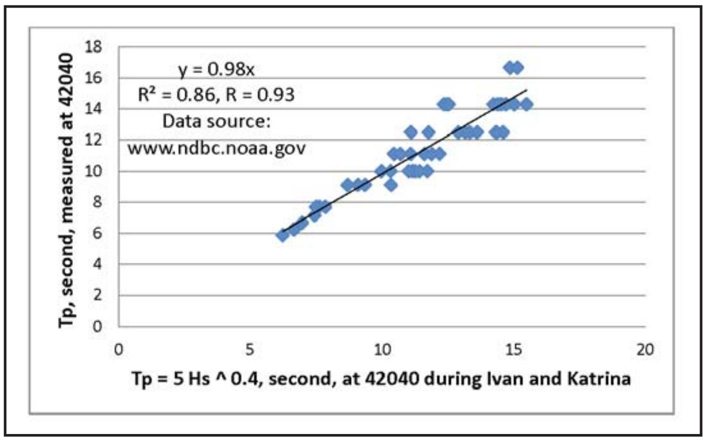

Figure 2. Verification of Equation (3) during Ivan and Katrina near Buoy 42040.

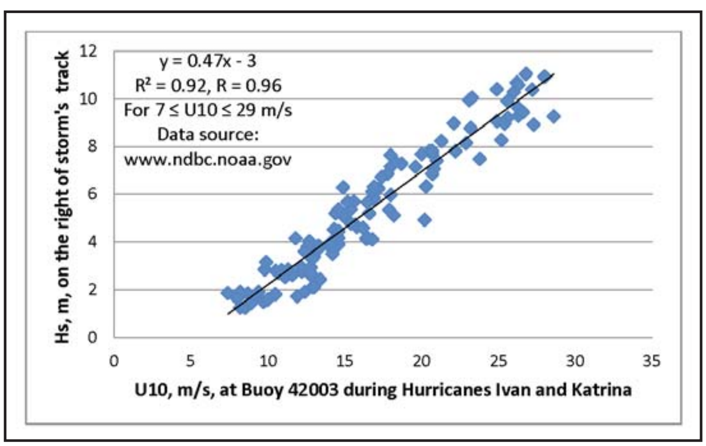

Figure 3. Verification of the linear relation between H_s and U_{10} as suggested in Equation (4) during Ivan and Katrina near Buoy 42003.

Acknowledgements: Buoy measurements provided by the National Data Buoy Center (NDBC) are greatly appreciated.

PMO Corner:
Support and Pride...Miami PMO Swears in New OMAO Crew

David Dellinger,
Port Meteorological Officer - Miami

On April 8, 2016, I had the honor and privilege to be part of the hiring process for two new OMAO (NOAA Ship) crew members, Mr. Michael Jones (Relief Crew Member) and Mr. Godfrey Gittens (Able Seaman). Mr. Michael Jones and Mr. Godfrey Gittens were sworn-in today aboard the research ship **BASELINE EXPLORER**, at Port Everglades. Mr. Gittens will be attached to the NOAA ship **FAIRWEATHER**, homeported out of Charleston, SC. Mr. Jones has yet to be assigned a ship. It was a picture perfect day for a memorable occasion.

I would like to thank Capt. Larry Bennett and the crew of the **BASELINE EXPLORER**, for allowing us the use of his ship for this event.

Left to right: Mr. Godfrey Gittens, Mr. Michael Jones, and Miami/S. Florida Port Meteorological Officer David Dellinger

Left to right: Mr. Michael Jones (Able Seaman) and Mr. Godfrey Gittens (Relief Crewman) with Research Ship BASELINE EXPLORER

Mr. Gittens being sworn in as Crewman for OMAO by Miami/S Florida Port Meteorological Officer David Dellinger.

Mr. Michael Jones with Miami/S. Florida Port Meteorological Officer David Dellinger on the bridge of the BASELINE EXPLORER.

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Mean Circulation Highlights and Climate Anomalies

January through April 2016

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

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

January - February 2016

The 500 hPa mean circulation during January 2016 featured positive height anomalies across the North Polar Region and central Russia, and subtropical latitudes of the Pacific, Atlantic, and Africa. Negative height anomalies prevailed across the central North Pacific and Atlantic Oceans and Europe

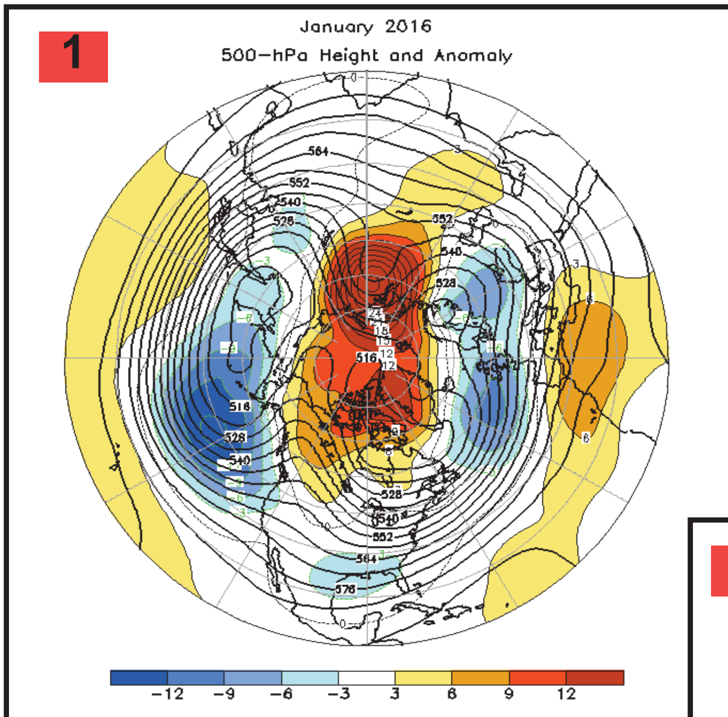
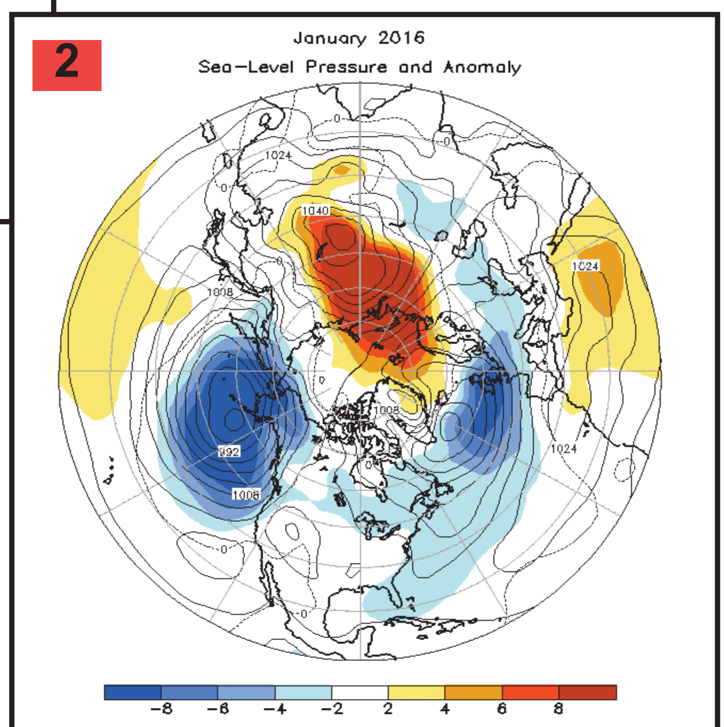


Figure 1. This overall anomaly pattern projected strongly onto the positive phase of the Pacific North American teleconnection pattern (PNA, +1.9). A positive PNA pattern is a typical response to El Nino. The corresponding Sea Level Pressure (SLP) and Anomaly map (**Figure 2**) featured below normal SLP over northeastern portions of both the Pacific and Atlantic, and above normal SLP from northern Scandinavia across central Russia to near Lake Baikal. SLP ranged from about 984 hPa near the Aleutians to 1044 hPa near Lake Baikal, a difference of 60 hPa.

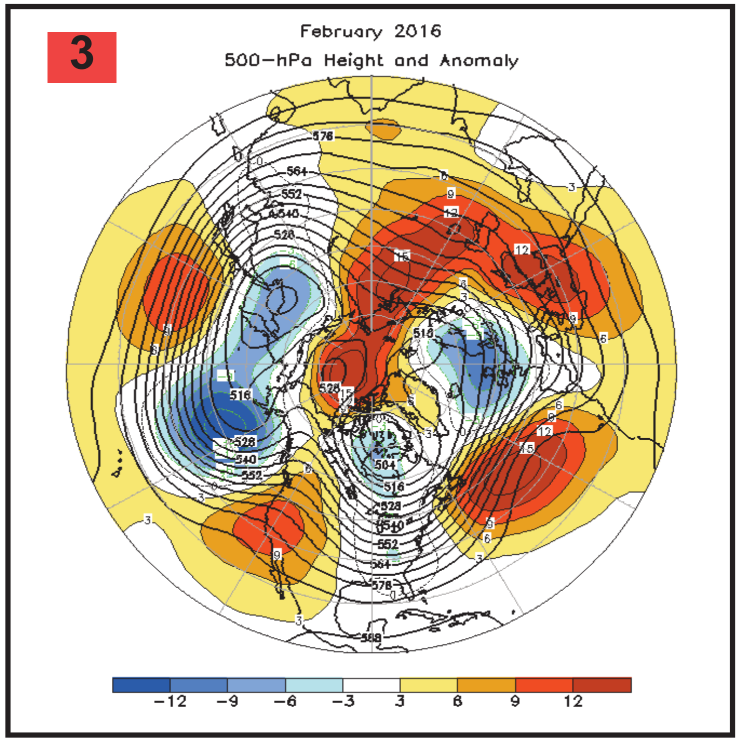


During February, 500 hPa heights were above average across the subtropical North Pacific, western North America, the North Atlantic, and from the eastern Mediterranean region to central Asia, continuing northward to (and including) the Arctic Ocean **Figure 3**.

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.

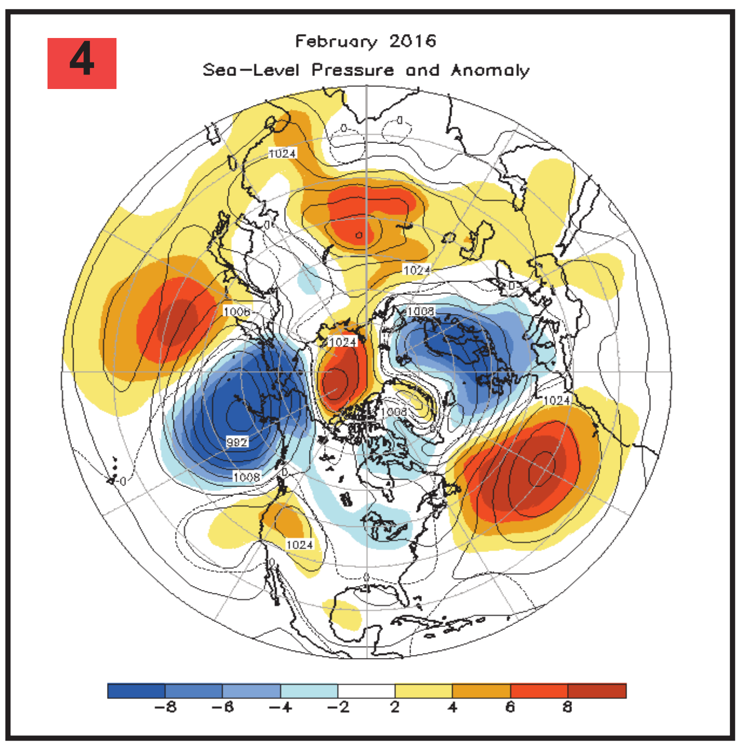
Below average heights were noted from the Sea of Okhotsk area to the eastern North Pacific, eastern North America, and northern Europe. The corresponding SLP and Anomaly map depicts a similar pattern that generally matches the middle tropospheric configuration in anomaly sign **Figure 4**.



The Tropics

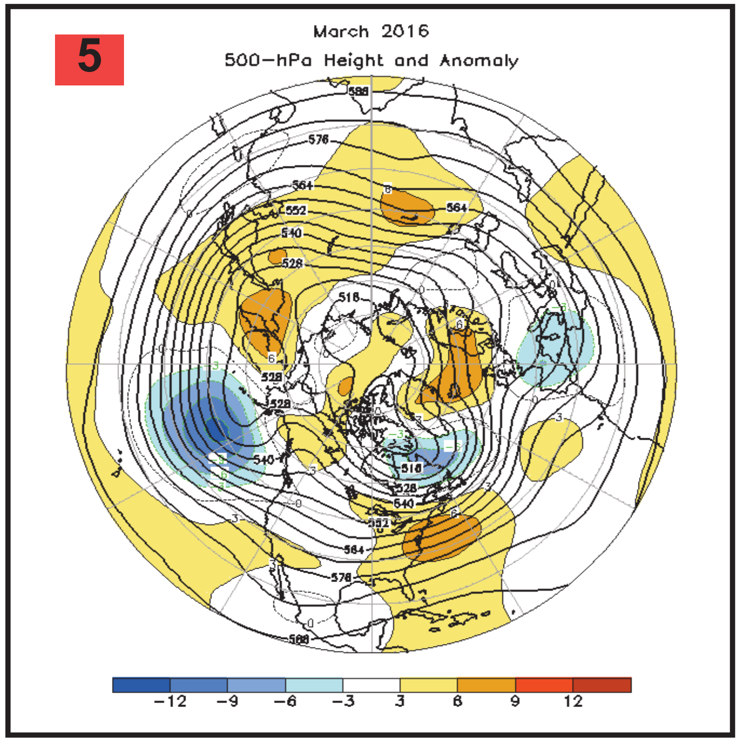
Sea surface temperatures (SSTs) were above average in the central and eastern equatorial Pacific in January and February. The latest monthly Nino index for the Nino 3.4 region was +2.6C (January) and +2.4C (February). The depth of the oceanic thermocline (measured by the depth of the 20C isotherm) was above average in the eastern Pacific, as is typical during an El Nino winter. Sub surface temperatures ranged from 1-5C above average. Equatorial low level westerly wind anomalies and upper level easterly wind anomalies remained fairly strong in the central and eastern Pacific during this two month period. Tropical convection was enhanced over the central and east central Pacific, and suppressed over Indonesia and the western equatorial Pacific. Collectively, these oceanic and atmospheric anomalies reflect the continuation of a strong El Nino.

March - April 2016

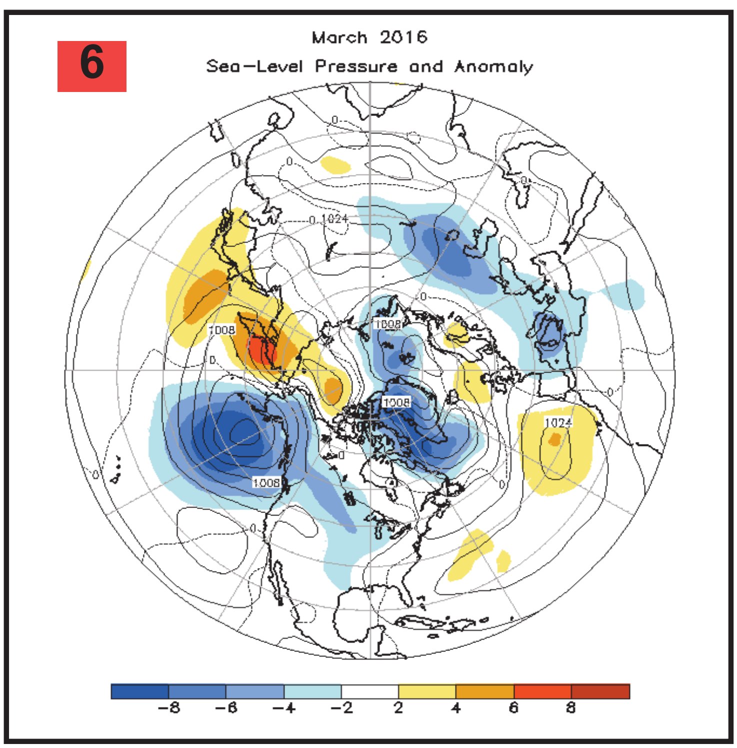


The March circulation pattern featured above average 500 hPa heights across the subtropical North Pacific Ocean, the eastern contiguous U.S., the high latitudes of the North Atlantic and Scandinavia, and central/eastern Asia **Figure 5**. Below average heights were noted across the eastern North Pacific, Newfoundland and the Labrador Sea, and the western Mediterranean region. The SLP and Anomaly map generally reflected the mid tropospheric height anomaly pattern **Figure 6**. The mean 500 hPa circulation during April 2016 was characterized by above average heights across the subtropical North Pacific, the western contiguous U.S., the high latitudes of the North Atlantic and most of the north polar basin, and the Mediterranean Sea **Figure 7**. Below average 500 hPa heights were noted over the high latitudes of the North Pacific, eastern Canada, and the eastern North Atlantic/western Europe. The SLP and Anomaly map generally mirrors the mid tropospheric pattern **Figure 8**.

The Tropics



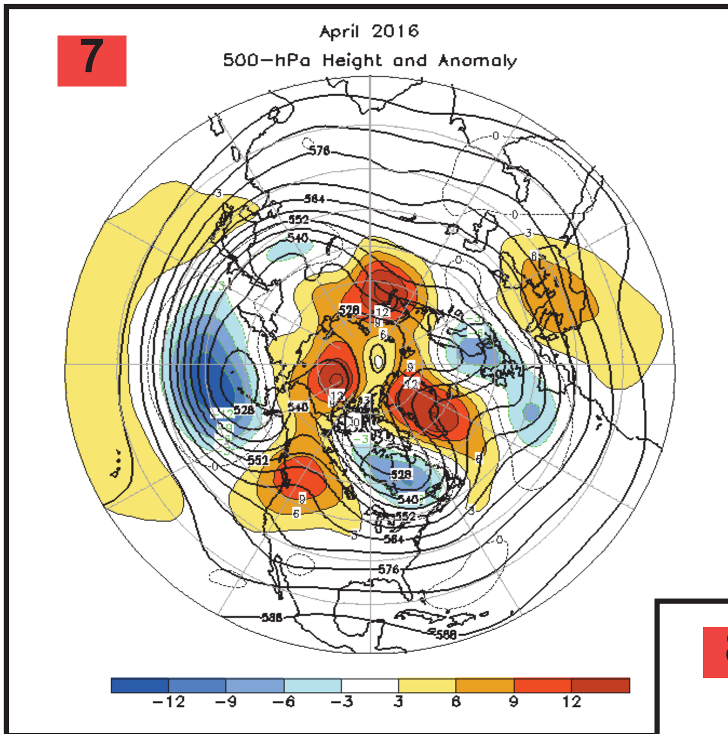
SSTs were above average in the central and eastern equatorial Pacific for the two month period, though the magnitude of the anomalies has decreased. The latest monthly Nino indices for the Nino 3.4 region were +1.7C (March) and +1.1C (April). In March, the depth of the oceanic thermocline remained above average in the far eastern Pacific, and corresponding sub surface temperatures were 1-3C above average. However, cooler than average subsurface water extended eastward across the central and east central Pacific, significantly reducing the equatorial Oceanic Heat Content (OHC) in those regions. During April, the thermocline shoaled (rose) over the central and eastern Pacific, with subsurface temperatures ranging from 1-3C below average. Low level westerly wind anomalies were slightly above average in the central and eastern Pacific in March and April. Upper level easterly wind anomalies remained strong over the central Pacific during the two month period. Tropical convection was enhanced over the central and east central Pacific (March) and the eastern Pacific (April), and suppressed over Indonesia and the western Pacific (March and April). Collectively, these oceanic and atmospheric anomalies reflect a weakening El Nino.

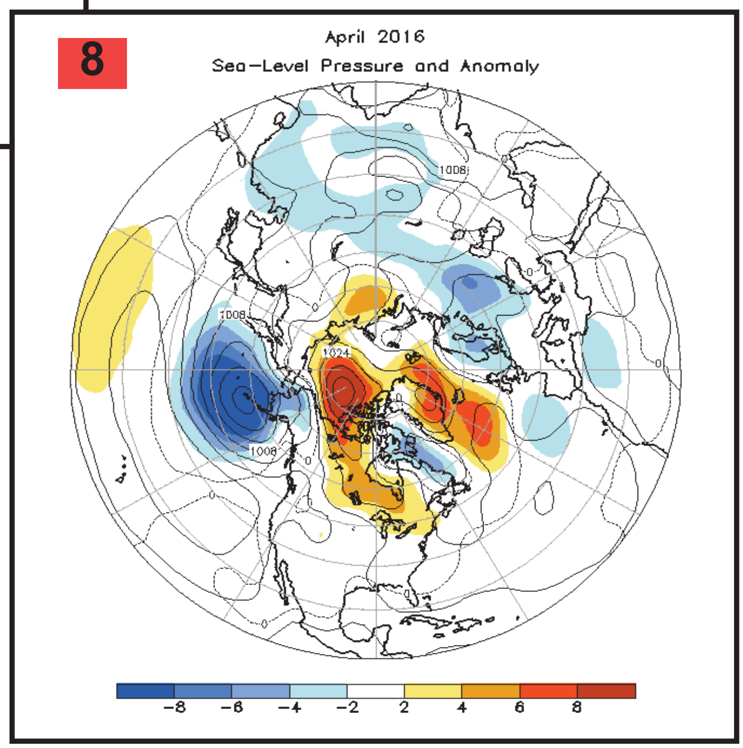


Early to mid January 2016 featured two out of season hurricanes; one in the Atlantic (Alex), the other in the Central Pacific (Pali) **Reference 1**. This marked the first known occurrence of simultaneous January tropical cyclones, one in each basin. Alex developed from a subtropical cyclone over the eastern Atlantic, with peak sustained winds of 140 km/hr, and a minimum central pressure of 981 hPa. It made landfall on the island of Terceira in the Azores as a strong tropical storm, though resulting damage was somewhat less than expected. In the Central Pacific, Pali acquired peak wind speeds of 155 km/hr, and a minimum pressure of 977 hPa, remaining well away from land. Pali was also the earliest forming tropical cyclone ever recorded in the Central Pacific.

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.





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

References

1. http://www.nhc.noaa.gov/data/ (historical archive)

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 2015

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Introduction

The fall to early winter period of September to December 2015 featured mainly a progressive pattern of developing cyclones moving from southwest to northeast across the North Atlantic toward Greenland and Iceland, with some of cyclones less frequently taking a more northerly track toward the Davis Strait then weakening and reforming to the east of Greenland, or a more southern track over the central North Atlantic waters toward Europe. There was an uneven trend toward the usual increase in the number of hurricane force lows as the season progressed toward early winter. September featured one such event toward the end of the month, in the far northern waters northwest of Iceland. There were five hurricane force lows in October and ten in December, but November brought only one such system of non-tropical origin. Otherwise the trend supported the seasonal increase in numbers of hurricane force lows found in a study done in 2005 based on QuikSCAT winds (VonAhn and Sienkiewicz, 2005). The most intense cyclones occurred in December, with four developing central pressures below 950 hPa in the northern waters including the deepest at 928 hPa at the end of the month.

The four month period includes the last half of the hurricane season in the Atlantic basin. It was a continuation of less active than normal season, influenced by a strong El Nino pattern. Of the six named systems occurring during this period, three moved north or northeastward into OPC's area of responsibility and included two hurricanes. One of these, Joaquin, was the strongest and was a major hurricane south of the area near the Bahamas. There was one named cyclone in November, compared to the previous season which had none. All became post tropical (or extratropical) as they gained latitude and entered the mid-latitude westerlies. Additional information on tropical cyclones may be found in Reference 5 (Tropical Cyclone Reports).

Tropical Activity

Tropical Storm Henri:

Henri was a short lived tropical storm over the southwestern waters early in September, drifting northeast and crossing 31N into OPC's marine area near 61W as a tropical storm on the afternoon of September 9 with maximum sustained winds of 45 kts. Henri then accelerated northward the following night and on the 10th, passing near 36N 60W at 0600 UTC on the 11th before dissipating as a trough the following day.

Hurricane Joaquin:

After attaining major hurricane status near the Bahamas by October 3, a weakening Hurricane Joaquin accelerated northeast into OPC's marine area of responsibility with 85 kts sustained winds at 1800 UTC on the 4th and passed 60 nm northwest of Bermuda six hours later. Joaquin then maintained 75 kts sustained winds the following night and through the morning of the 6th before weakening further and becoming a tropical storm near 41N 44W at 1800 UTC on the 7th with 60 kts sustained winds. As the hurricane passed to the north, the **INDEPENDENT PURSUIT** (A8MB5) near 35N 60W reported southwest winds of 40 kts at 1200 UTC on the 6th. **Figure 1** depicts Joaquin transitioning to a post tropical storm force low over the twelve hour period ending at 0600 UTC on the 6th. Post Tropical Joaquin then passed near 43N 24W at 0000 UTC on the 9th. Two hours later the **NORWEGIAN STAR** (C6FR3) encountered southeast winds of 60 kts and 7.0 m seas (23 ft) near 41N 19W. The cyclone then moved east and then southeast over the following two days and weakened to a gale on the 9th, passed briefly inland over Portugal on the 12th and then turned toward the south and dissipated south of Portugal late on the 14th.

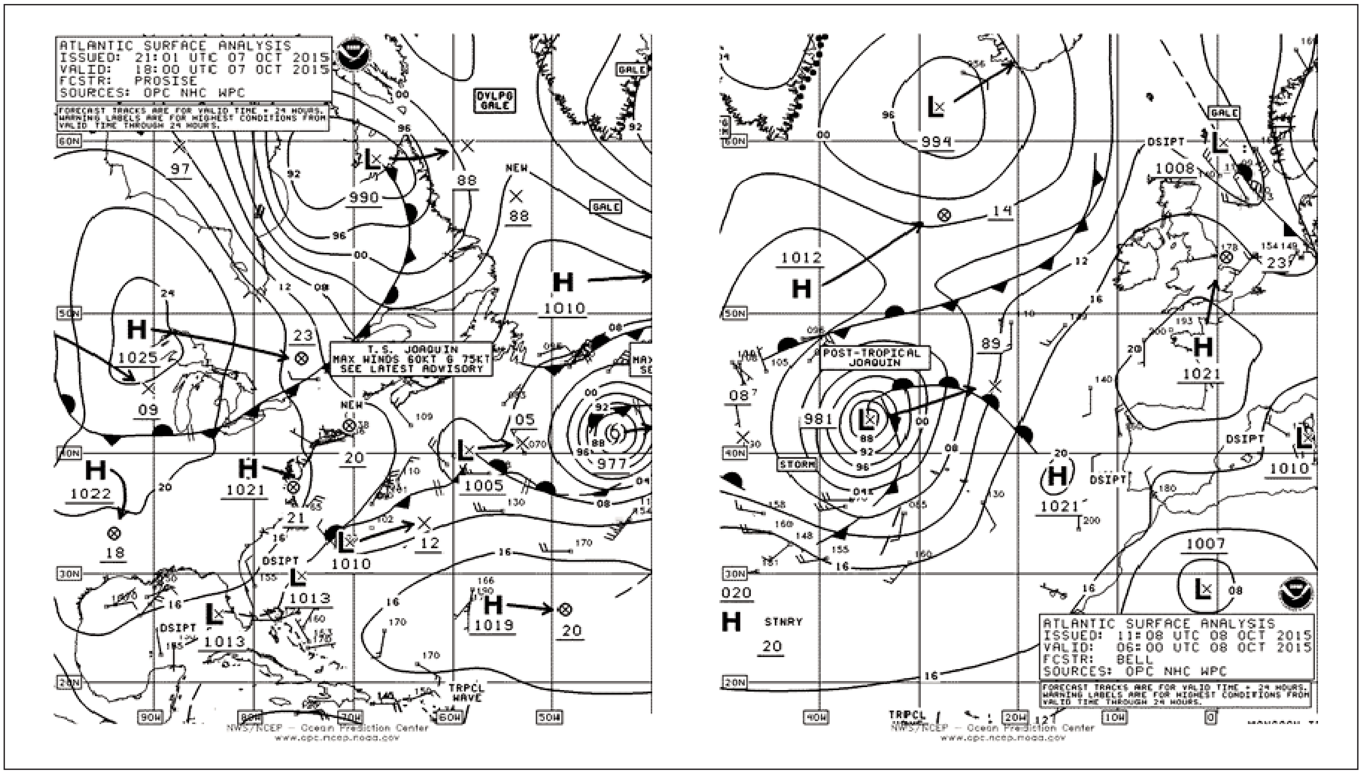

Figure 1. OPC North Atlantic Surface Analysis charts valid 1800 UTC October 7 (Part 2 – west) and 1800 UTC October 8, 2015 (Part 1 – east). 24 hour forecast tracks are shown with the forecast central pressures given as the last two whole digits in hPa or millibars except for tropical cyclones at 24 hours (tropical symbol at the forecast position).

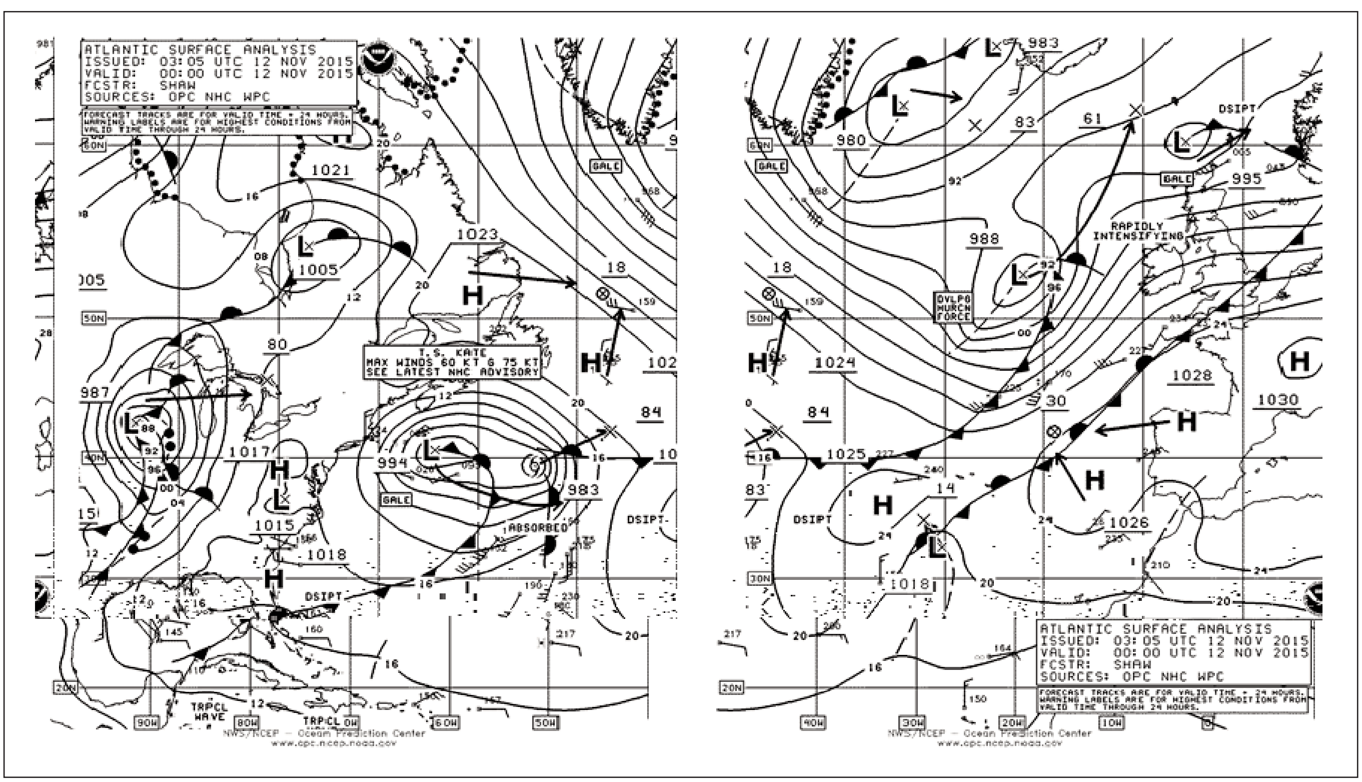

Figure 2. OPC North Atlantic Surface Analysis charts (Parts 1 and 2) valid 0000 UTC November 12, 2015. The two parts include an overlap area between 40W and 50W.

Hurricane Kate:

Tropical Depression 12 formed near 23N 74W on the night of November 8 and moved north, became Tropical Storm Kate the following day and then crossed 31N as a strong tropical storm with sustained winds of 60 kts; at 1800 UTC on the 10th. Kate then became a 65 kts hurricane near 33N 71W six hours later while turning toward the northeast. The maximum intensity was 75 kts, reached 12 hours later.

The **BREMEN EXPRESS** (DGZL) near 34N 57W reported southwest winds of 35 kts and 11.3 m seas (37 ft) at 1800 UTC on the 11th. Kate then weakened to a tropical storm on the 11th. **Figure 2** and **Figure 3** shows Kate developing frontal structure and becoming fully extratropical in the 24 hour period ending at 0000 UTC on the 13th. **Figure 4** is an ASCAT image of the post tropical low with hybrid wind structure still showing a core of stronger winds of 50 kts close to the center. The extratropical Kate subsequently moved east through the 13th and then became absorbed by a larger low to the north by the 14th; resulting to a large gale to the north early on the 17th.

Other Significant Events of the Period

North Atlantic Storms, September 5-10:

A series of strong lows developed and moved through the northern waters early in September, developing similar intensities with central pressures of 975 to 980 hPa. An initial developing low dropped southeast out of the Davis Strait on the 4th and 5th, developed storm force winds with a 980 hPa central pressure in the Labrador Sea on the night of the 5th, then turned east and then north on the 6th before dissipating near the east Greenland coast on the 7th.

The **MARIA S. MERIAN** (DBBT) near 53N 55W reported northwest winds of 50 kts at 0600 UTC on the 6th. Another developing low originating over the south central waters early on the 6th moved northeast and and then north and became a storm near 46N 28W on the afternoon of the 7th. It developed a lowest central pressure of 978 hPa near 54N 25W at 1200 UTC on the 8th. The ASCAT image in **Figure 7** reveals gale force winds and even some 50 kts wind retrievals on the east side near that time.

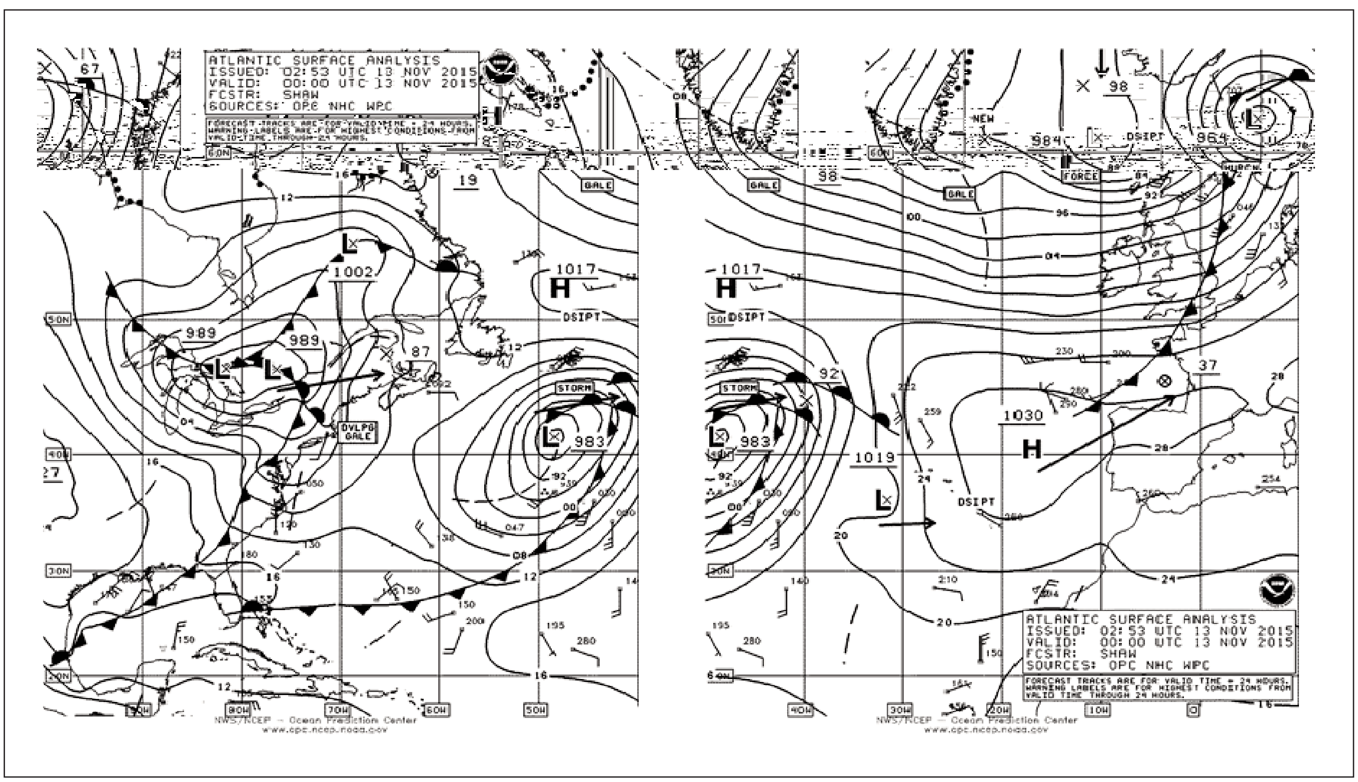

Figure 3. OPC North Atlantic Surface Analysis charts (Parts 1 and 2) valid 0000 UTC November 13, 2015. The two parts include an overlap area between 40W and 50W.

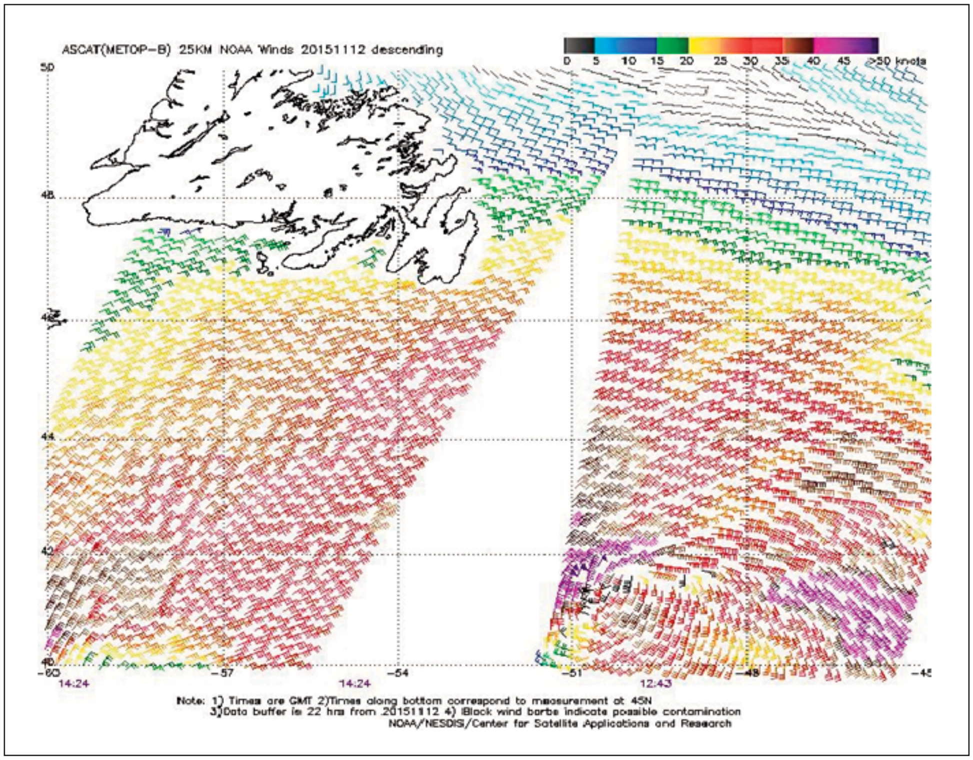

Figure 4. ASCAT METOP-B (Advanced Scatterometer) image of satellite-sensed winds with 25-km resolution around the storm (Post-tropical Kate) southeast of the island of Newfoundland shown in Figure 3. The valid time of the eastern pass containing the strongest winds is 1243 UTC November 12, 2015, or about eleven and one-quarter hours prior to the valid time of Figure 3. Imagery is courtesy of NOAA/NESDIS/ Center for Satellite Applications and Research.

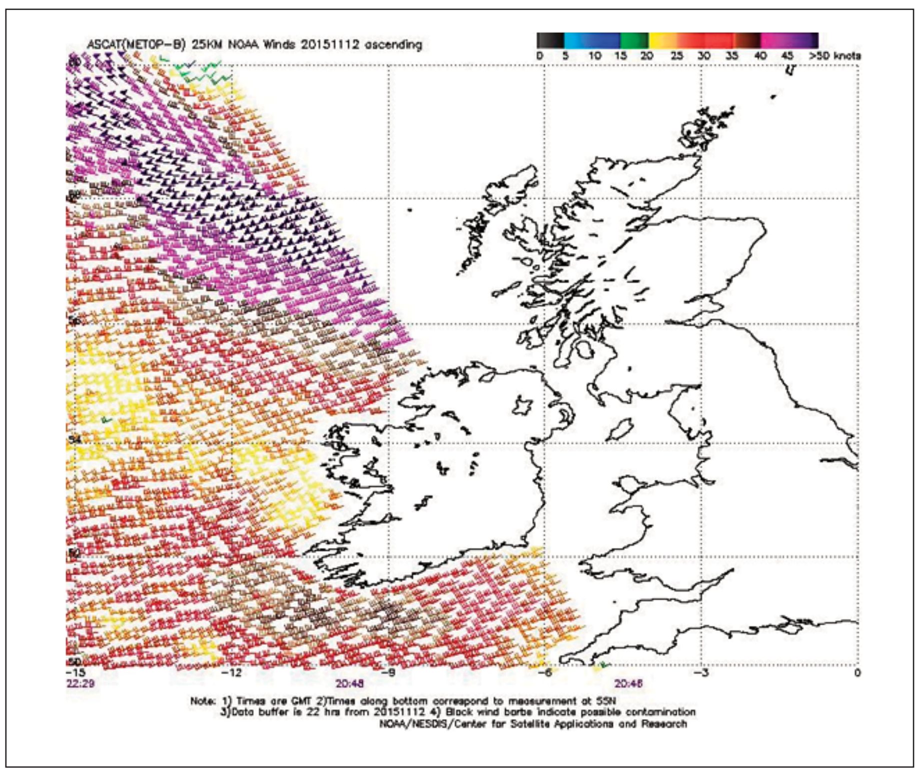

Figure 5. ASCAT (METOP-B) image of satellite-sensed winds with 25-km resolution around the south side of the hurricane-force cyclone northwest of the British Isles shown in Figure 3. Portions of two satellite passes are shown, with the eastern pass containing most of the stronger winds having a valid time of 2048 UTC November 12, 2015, or about three and one-quarter hours prior to the valid time of Figure 3. Imagery is courtesy of NOAA/NESDIS/ Center for Satellite Applications and Research.

The first part of **Figure 6** shows the cyclone six hours later near 57N 25W turning northwest toward Greenland, where it weakened the following day. A third developing storm, moving east of Newfoundland on the 7th, turned toward the northeast and then north as depicted in Figure 6, developing a lowest central pressure of 975 hPa before weakening northwest of Iceland on the 10th. Its winds were similar to those shown in **Figure 7**.

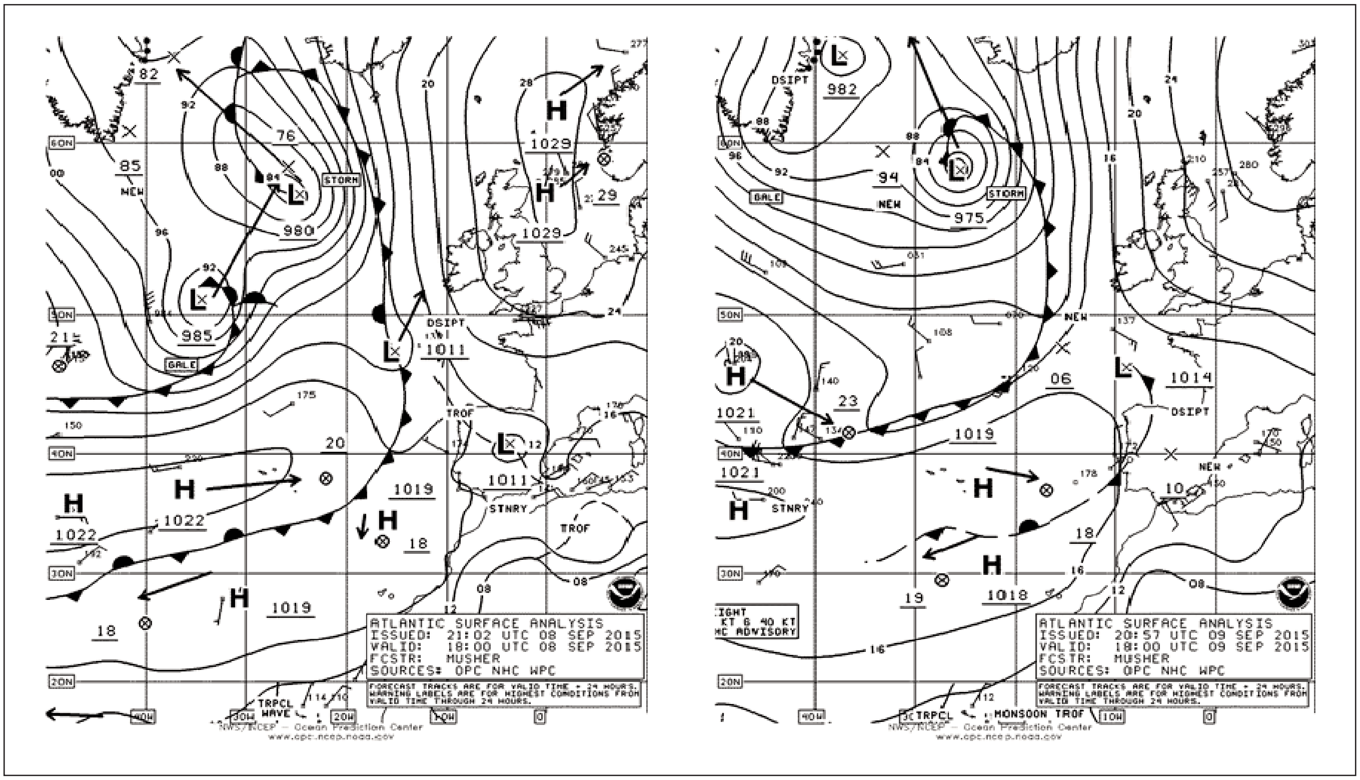

Figure 6. OPC North Atlantic Surface Analysis charts (Part 1) valid 1800 UTC September 8 and 9, 2015.

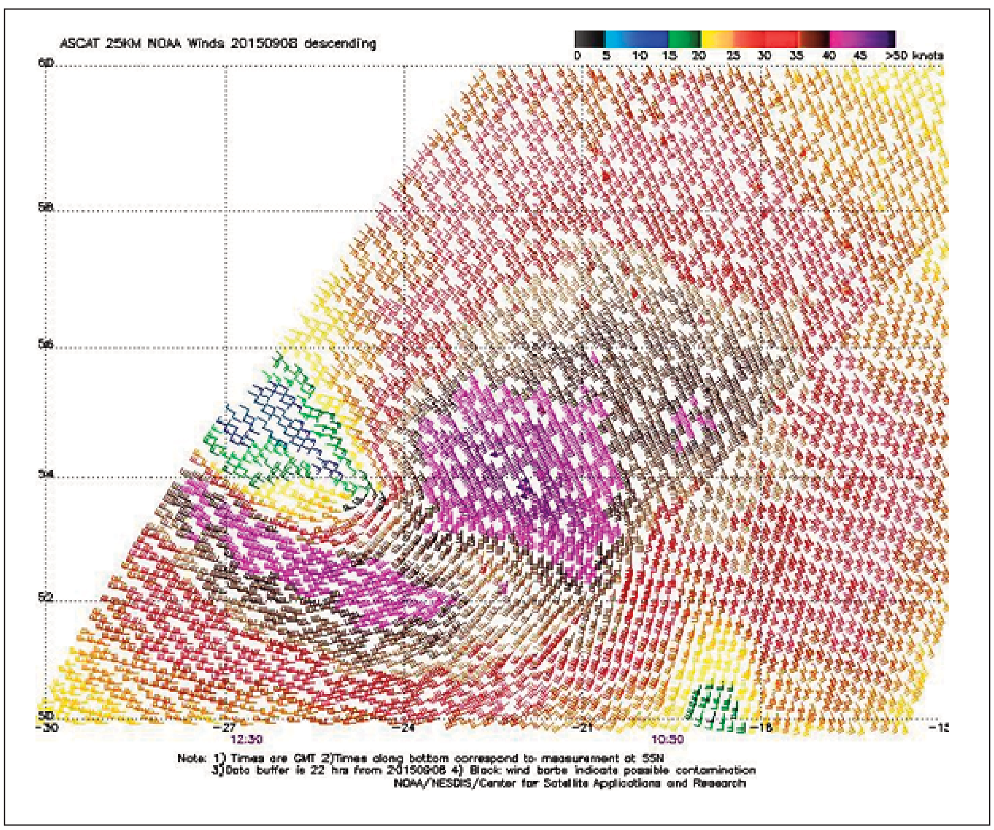

Figure 7. ASCAT (METOP-A) image of satellite-sensed winds with 25-km resolution around the storm shown in the second part of Figure 6. Portions of two satellite passes valid 1050 UTC and 1230 UTC September 8, 2015 are shown, with the western pass containing the stronger winds valid five and one-half hours prior to the valid time of the second part of Figure 6.
Imagery is courtesy of NOAA/NESDIS/ Center for Satellite Applications and Research.

North Atlantic / Greenland Storm, September 16-20:

A developing low, originating in the Gulf of Saint Lawrence on September 15th, developing storm force winds as it moved just north of the Grand Banks on the night of the 16th. The platform **TERRA NOVA** (VCXF, 46.4N 48.4W) reported northwest winds of 51 kts and 8.5 m seas (28 ft) at 1200 UTC on the 17th. **HIBERNIA** (VEP717, 46.7N 48.7W) at the higher height of 139 m reported northwest winds of 60 kts at that time. A Rapidscat pass from 0706 UTC on the 17th showed winds to 50 kts over the Grand Bank. The cyclone reformed as a new center to the north late on the 17th which moved toward the east Greenland waters and developed a lowest central pressure of 977 hPa near 58N 38W at 0000 UTC on the 19th. The cyclone then turned east along 63N and then southeast and dissipated south of Iceland late on the 21st.

North Atlantic Storm, Greenland area, September 25-26:

Low pressure originating over the north central waters on the afternoon of September 25 moved north to the east Greenland waters where it briefly developed hurricane force northeast winds north of the center in the Denmark Strait, based on the appearance of ASCAT winds of 50 to 60 kts on the 26th. This was the first hurricane force event of the season. Winds were similar to those of the next event in early October (**Figure 9**) except a little weaker. The cyclone then looped to the west and then southwest late on the 26th and weakened near the Greenland coast on the 27th.

North Atlantic Storm, Greenland area, October 4-5:

While a pair of developing storms dropped southeast from the Davis Strait and southern Labrador Sea, low pressure formed near the east Greenland coast and made a cyclonic loop in the east Greenland waters and intensified to as low as 969 hPa over a 36 hour period (**Figure 8**). The hurricane force winds with this low were north of the chart area in the Denmark Strait as shown in **Figure 9**. The ASCAT-B image has several 65 kts wind retrievals. The cyclone then drifted northwest and weakened near the Greenland coast the next day.

Northwestern Atlantic Storm, October 10-12:

In this increasingly active pattern, the next developing cyclone moved northeast from the Gulf of Saint Lawrence and developed a lowest central pressure of 960 hPa in the Labrador Sea over a 24 hour period (**Figure 10**). The central pressure fell 35 hPa in the 24 hour period ending at 0000 UTC on the 11th, well above the “bomb” threshold at 60N (Sanders and Gyakum, 1980). At 0000 UTC on the 11th the platform **HIBERNIA** (VEP717, 46.7N 48.7W) reported southwest winds of 50 kts, and twelve hours later seas of 3.5 m (11 ft). To the north, the **MARY ARCTICA** (BATEU00) near 65N 32W encountered east winds of 40 kts. The ASCAT-A pass in **Figure 11** returned the strongest winds in the easterly flow between the occluded front and southern Greenland, which given the low bias in ASCAT this may support a marginal hurricane force event. OPC included a hurricane force label for this system on the analysis near this time (**Figure 10**). A similar pattern of winds occurred in a December event but with a deeper low and stronger winds, to be covered below. The cyclone then reformed east of Greenland with a weakening trend late on the 11th and the system then weakened in the Denmark Strait on the 13th.

North Atlantic Storm, October 19-22:

The development of the first in a series of systems moving northeast and developing hurricane force winds over the northern waters is depicted in **Figure 12**, covering a 24 hour period in which the central pressure fell 30 hPa, leading to a maximum intensity of 970 hPa. It originated as a low pressure wave south of Nova Scotia near 35N early on the 18th.

The **ATLANTIC COMPASS** (SKUN) near 50N 37W reported west winds of 60 kts and 11.9 m seas (39 ft) at 0000 UTC on the 21st.

The **MAERSK NEWCASTLE** (A8DM9) near 46N 47W encountered northwest winds of 45 kts and 7.9 m seas (26 ft) 12 hours earlier.

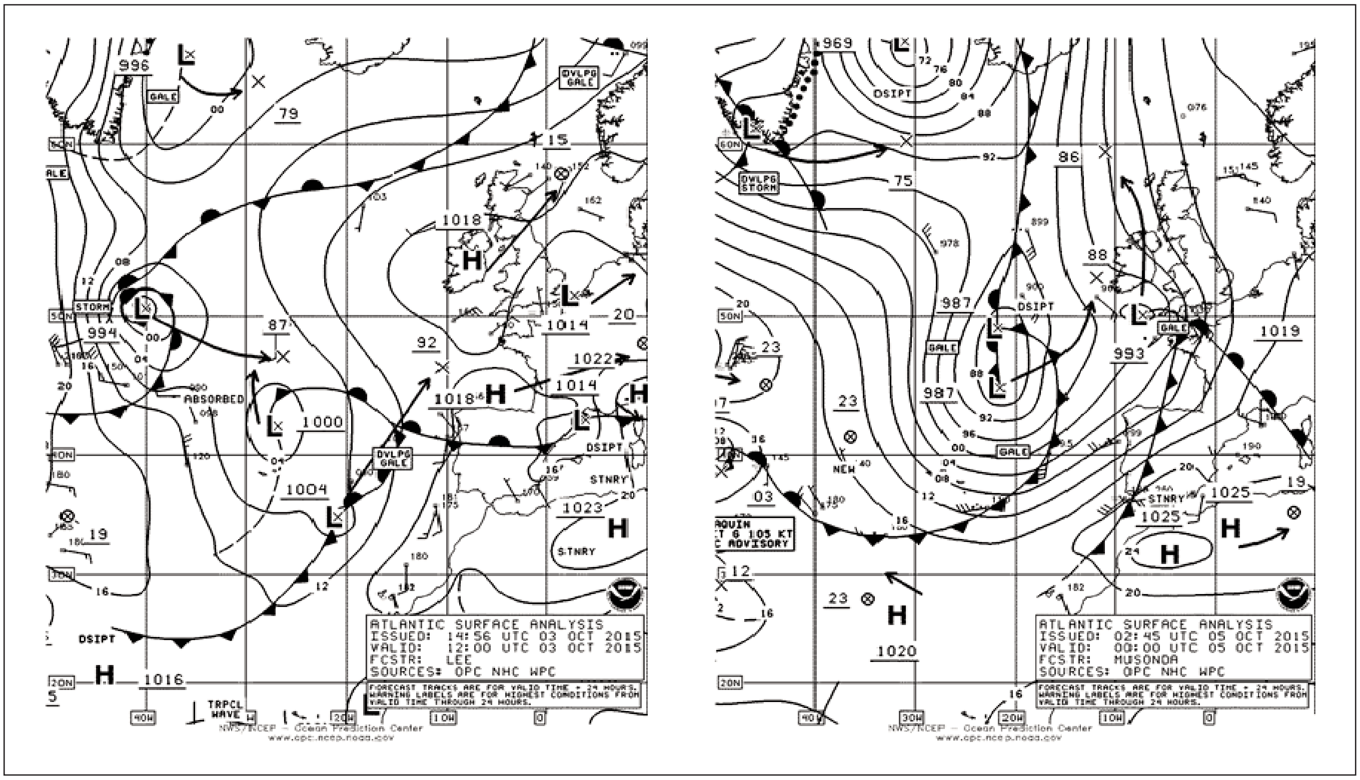

Figure 8. OPC North Atlantic Surface Analysis charts (Part 1) valid 1200 UTC October 3 and 0000 UTC October 5, 2015.

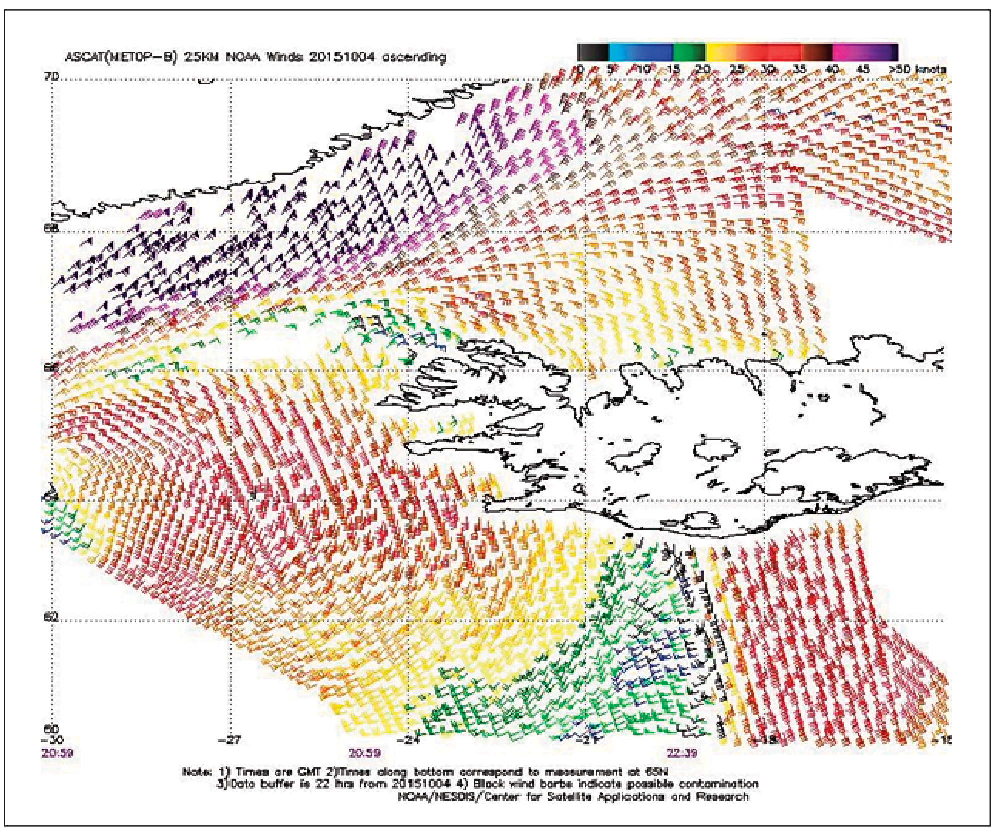

Figure 9. ASCAT (METOP-B) image of satellite-sensed winds with 25-km resolution around the east semicircle of the cyclone between Iceland and Greenland shown in the second part of Figure 8. Portions of two satellite passes are shown, with the western pass containing the stronger winds having a valid time of 2059 UTC October 4, 2015, or about three hours prior to the valid time of the second part of Figure 8. The stronger winds are north of the cyclone's center and off the chart in Figure 8. Imagery is courtesy of NOAA/NESDIS/Center for Satellite Applications and Research.

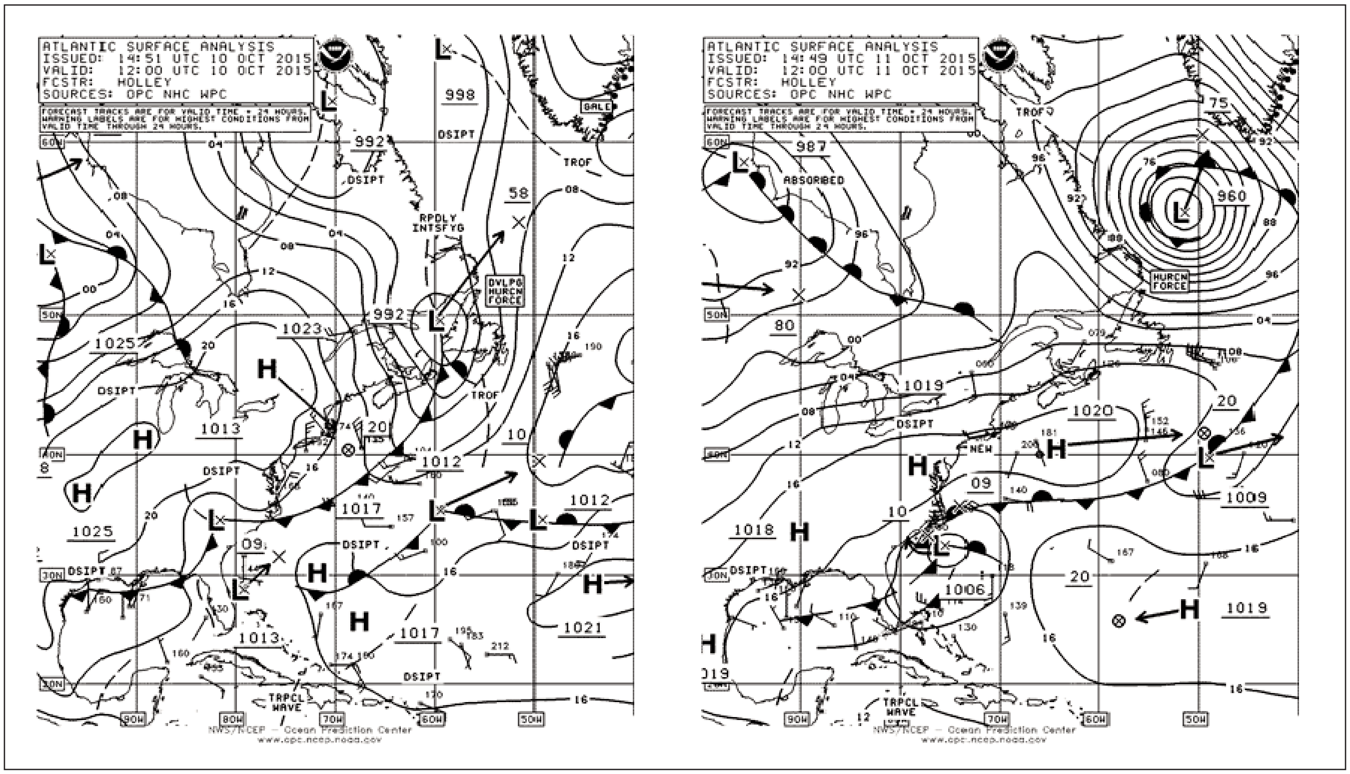

Figure 10. OPC North Atlantic Surface Analysis charts (Part 2) valid 1200 UTC October 10 and 11, 2015.

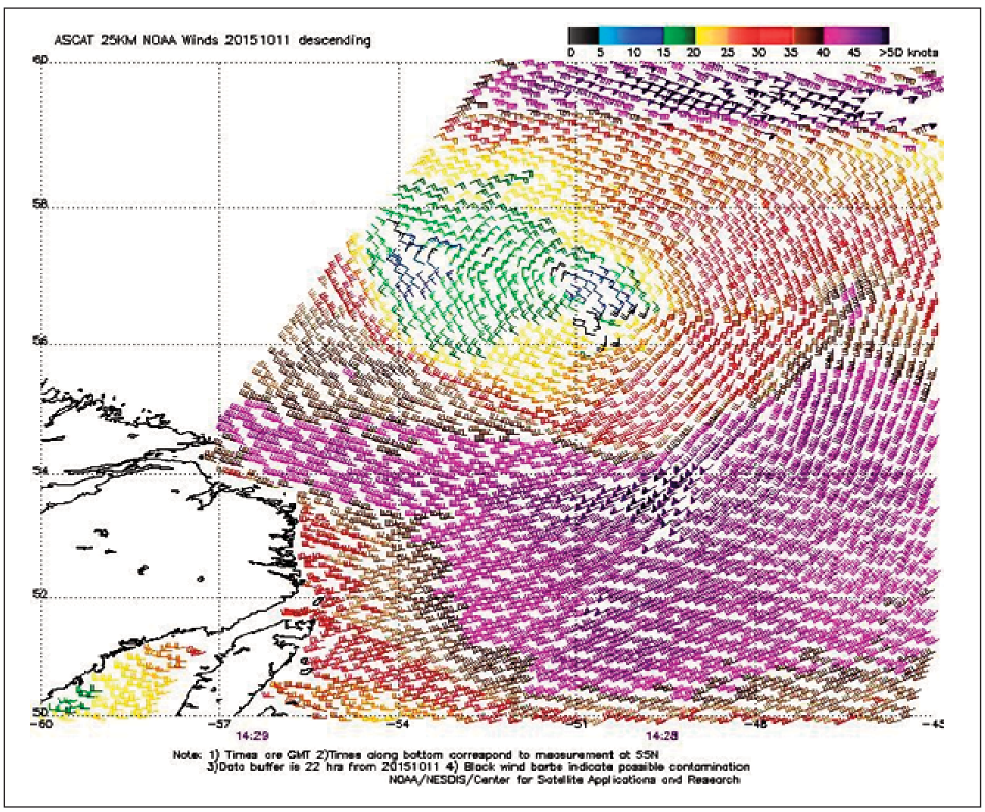

Figure 11. ASCAT (METOP-A) image of satellite-sensed winds with 25-km resolution around the hurricane-force low shown in the second part of Figure 10. The valid time of the pass is 1429 UTC October 11, 2015, or about two and one-half hours later than valid time of the second part of Figure 10.
Imagery is courtesy of NOAA/NESDIS/ Center for Satellite Applications and Research.

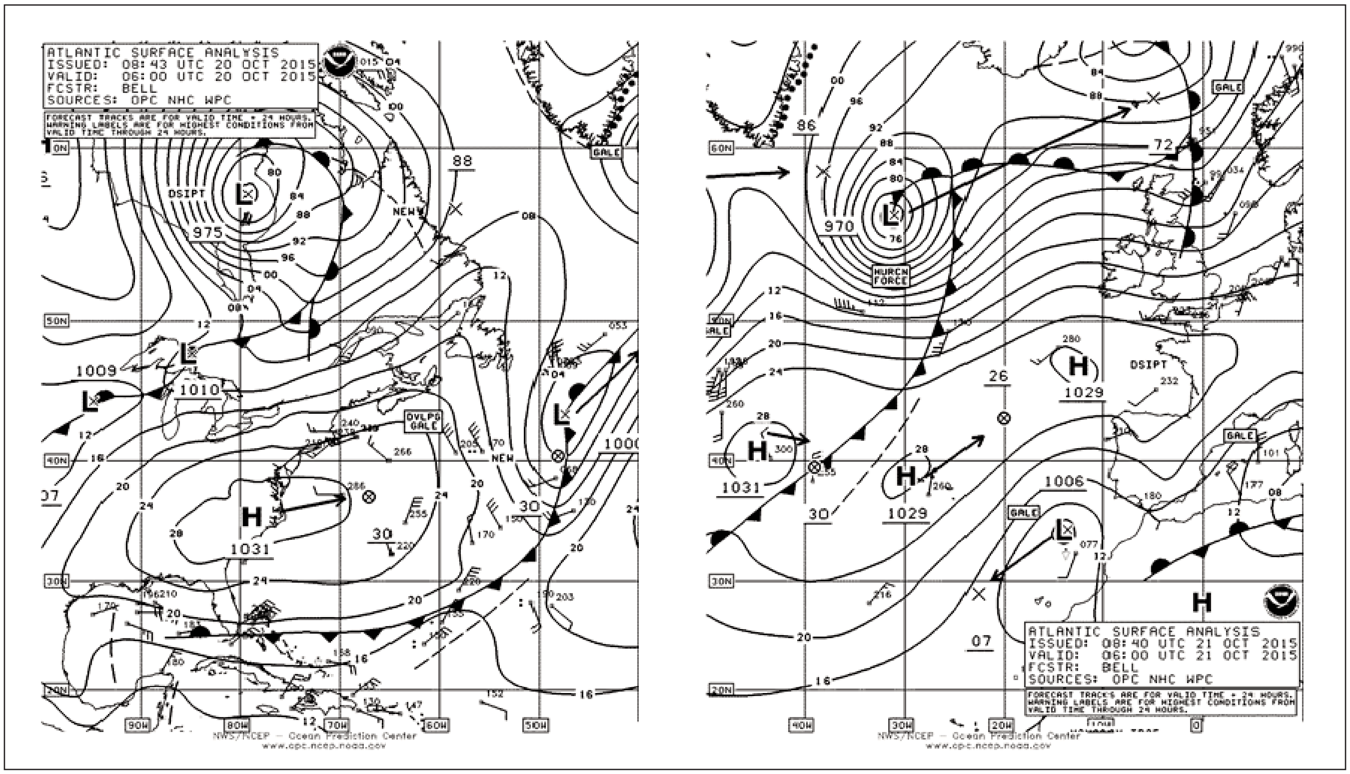

Figure 12. OPC North Atlantic Surface Analysis charts valid 0600 UTC October 20 (Part 2) and 0600 UTC October 21, 2015 (Part 1).

Buoy 62105 (55.2N 12.7W) reported highest seas of 11 m (36 ft) at 0100 UTC on the 22nd. The ASCAT image in Figure 13 returned a swath of winds 50 to 65 kts in the southwest semicircle of the low. The cyclone then moved northeast with a weakening trend, passing east of Iceland by the 22nd.

North Atlantic Storm, October 24-26:

The second in a series of late October cyclones originated over the Canadian Maritime Provinces on October 23rd and moved east over the north central Atlantic waters, where it developed hurricane force winds on the night of the 24th and on the 25th, with the system developing a lowest central pressure of 968 hPa near 51N 23W at 1800 UTC on the 25th. The **MAERSK TEAL** (S6HK) near 50N 20W reported northwest winds of 60 kts at 1100 UTC on the 25th. The ship **BATFR56** near 45N 29W encountered northwest winds of 50 kts three hours later. The **ATLANTIC CARTIER** (SCKB) near 56N 26W reported north winds of 58 kts and 13.4 m seas (44 ft) at 1800 UTC on the 26th. An ASCAT pass from 1257 UTC on the 25th returned winds 50 to 60 kts on the southwest and west sides of the low center, similar to Figure 13 for the preceding event. The cyclone subsequently weakened while tracking slowly east and then southeast toward Europe, and dissipated by the 28th.

North Atlantic Storm, October 27-30:

A third late October storm originated as a low pressure wave south of Newfoundland near 40N late on the 25th and moved northeast, developing a central pressure of 960 hPa near 54N 23W at 1800 UTC on the 28th. Hurricane force winds occurred on the 28th and early on the 29th, with an ASCAT pass from 2143 UTC on the 28th returning a swath of west to northwest winds 50 to 55 kts south and southwest of the center, similar to the November event described below. The lowest central pressure of 957 hPa occurred near 59N 29W at 1800 UTC on the 29th as the system turned toward the northwest, with top winds down to storm force. Weakening followed, as the cyclone stalled and dissipated southwest of Iceland on the 31st.

Northeast Atlantic Storm, November 11-13:

Concurrent with the passage of Kate as a tropical cyclone and extratropical storm and referring back to **Figure 2** and **Figure 3**, a non-tropical cyclone rapidly intensified while passing west and then north of the British Isles, with the central pressure falling 24 hPa during this 24 hour period. **Figure 3** shows the cyclone at maximum intensity. **Figure 5** is an ASCAT-B image showing a swath of west to northwest winds of 50 to 60 kts south and southwest of the cyclone's center. The **WALTHER HERWIG III** (DBFR) reported west winds of 45 kts near 59N 15W at 2300 UTC November 12th. The buoy 64041 (60.7N 2.8W) reported southwest winds of 55 kts at 0600 UTC on the 13th and a highest wave height of 10.4 m (34 ft) two hours later. Buoy 62105 (55.2N 12.8W) reported southwest winds of 40 kts with gusts to 62 kts at 1300 UTC on the 12th and highest seas 9.8 m 32 ft) two hours later. Another buoy, 64045 (59.1N 11.7W), reported seas of 10.7 m (35 ft) at 0100 UTC on the 13th. The system subsequently weakened while moving northeast into the Norwegian Sea on the 13th.

North Atlantic, Greenland area, November 30-December 2:

A new low formed over the north central waters late on November 29th and moved northeast into the east Greenland waters on the night of the 30th before turning north west and developing hurricane force winds with a 956 hPa center near 63N 40W at 1200 UTC December 1. The central pressure fell 35 hPa in the preceding 24 hours. An ASCAT (METOP-B) pass from 1425 UTC on the 1st returned a swath of northeast winds 50 to 70 kts north of 64N near the east Greenland coast, similar to **Figure 9** for the early October event.
The **NEWFOUNDLAND LYNX** (VAAZ) near 55N 56W reported northwest winds of 45 kts at 1000 UTC November 30. The system then stalled and weakened near the Greenland coast over the next few days with winds lowering to gale force late on the 2nd.

North Atlantic Storms, December 3-9:

The development of the second most intense cyclone of the four month period over a 36 hour period is depicted in **Figure 14**, when the central pressure dropped 57 hPa. It was one of two December cyclones with central pressures below 940 hPa. An ASCAT pass from 2222 UTC on the 4th returned an area of west to southwest winds to 55 kts on the south side when the center was near the south coast of Iceland. A not quite as intense event followed, originating over the south central waters on December 5th and moving north, with **Figure 15** showing the final 36 hours of development. The central pressure fell 39 hPa in the 24 hour period ending at 1200 UTC on on the 7th. The ASCAT-B image in **Figure 16** revealed a stronger wind pattern than in the previous event, with more widespread winds of 50 kts or more and some 70 kts winds in the easterly flow north of the center. The **MAERSK PALERMO** (PDHW) reported west winds of 45 kts near 45N 15W at 0600 UTC on the 7th. Buoy 62105 (55.1N 13.3W) reported southwest winds of 40 kts with gusts to 55 kts and 7 m seas (23 ft) at 1000 UTC on the 9th and highest seas 7.9 m (26 ft) two hours later. The cyclone then turned northwestward and weakened, and made a cyclonic loop in the east Greenland waters before dissipating on the 10th. A weaker event occurred at the same time over the southwest waters, originating near the North Carolina coast on the 7th and then tracking northeast to 41N 58W with a lowest pressure of 990 hPa at 1200 UTC on the 9th, when it briefly developed hurricane force winds. It then moved east along 41N through the 11th before turning northeast and becoming absorbed west of Ireland on the 15th. The ship **ZDKY3** (40N 58W) reported northwest winds of 45 kts and 8.2 m seas (27 ft).

North Atlantic Storm, December 15-19:

A low pressure system moved east from New England on the 15th and developed storm force winds south of Nova Scotia later that day and then hurricane force winds out over the central North Atlantic on the 17th (**Figure 17**), before turning toward the northeast with a weakening trend.

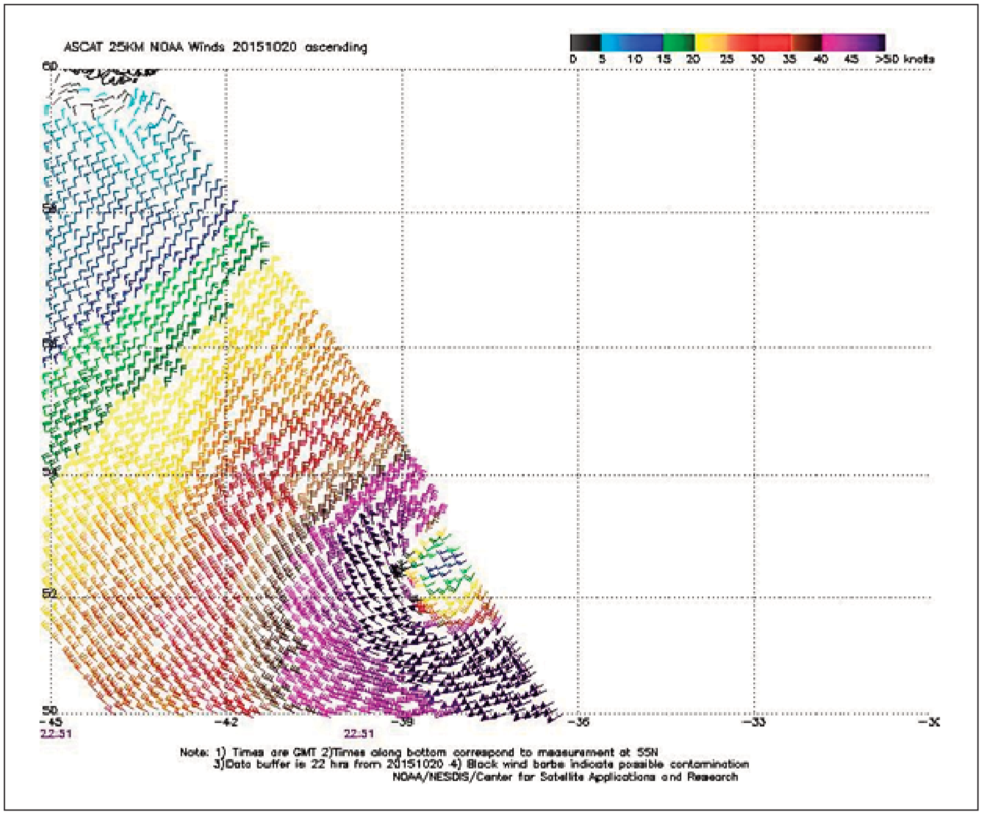

Figure 13. ASCAT (METOP-A) image of satellite-sensed winds with 25-km resolution around the south and west sides of the hurricane-force low shown in the second part of Figure 12. The valid time of the pass is 2251 UTC October 20, 2015, or about seven hours prior to the valid time of the second part of Figure 12. The southern tip of Greenland appears on the upper-left edge of the image. Imagery is courtesy of NOAA/NESDIS/ Center for Satellite Applications and Research.

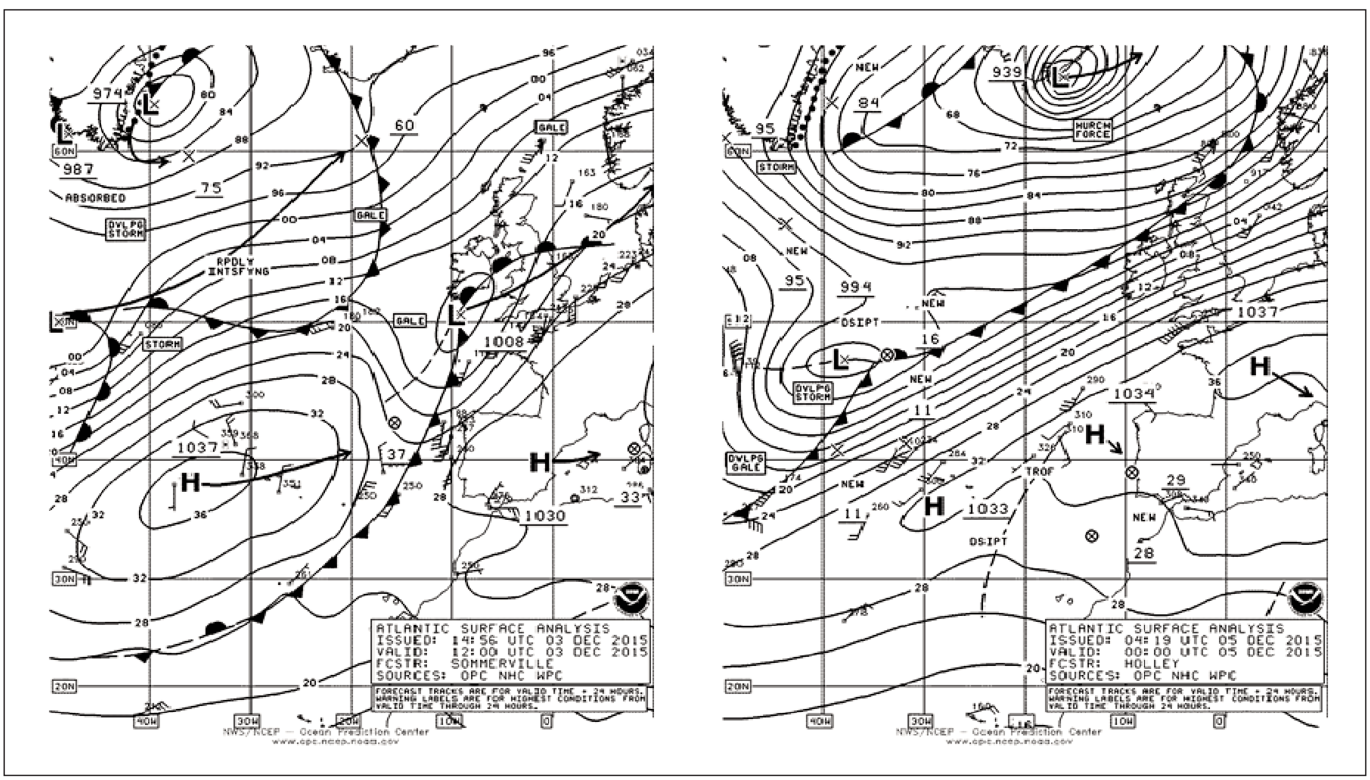

Figure 14. OPC North Atlantic Surface Analysis charts (Part 1) valid 1200 UTC December 3 and 0000 UTC December 5, 2015. The two parts overlap between 40W and 50W.

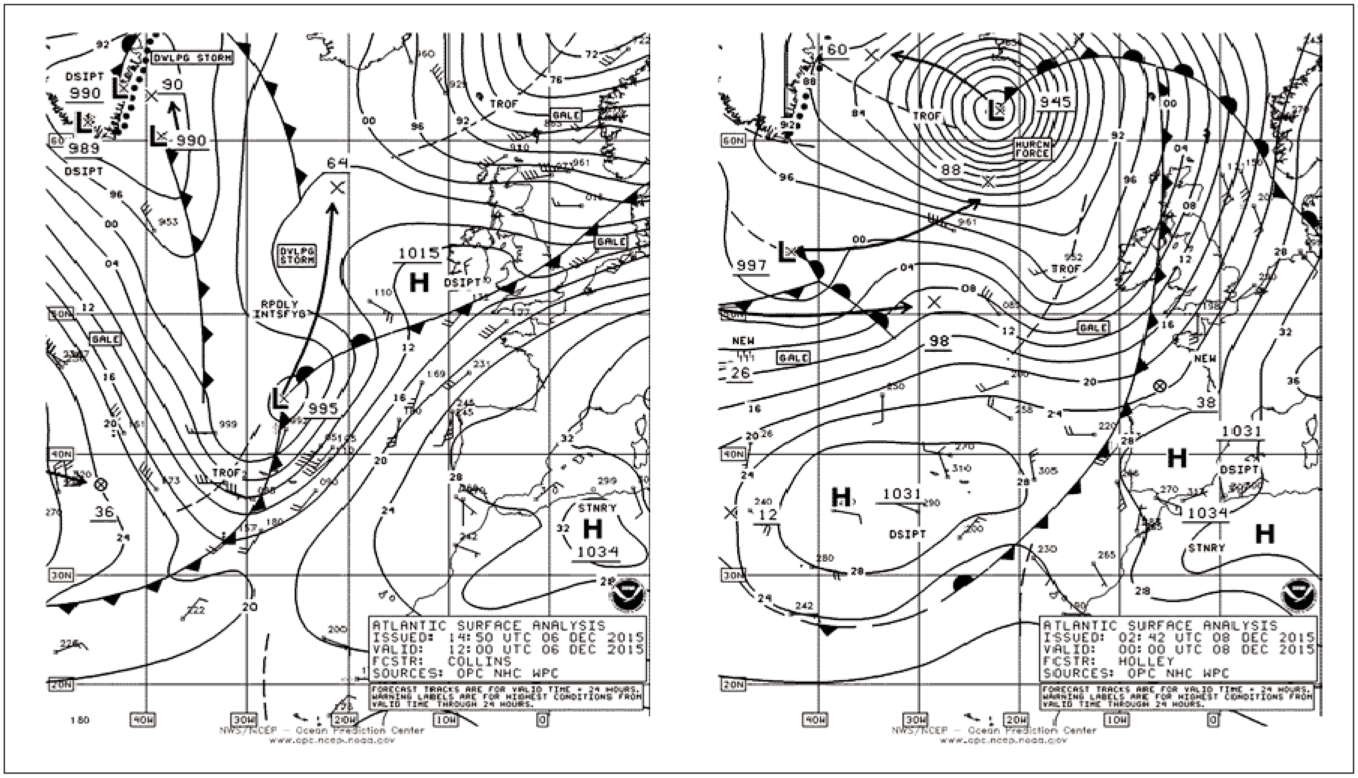

Figure 15. OPC North Atlantic Surface Analysis charts (Part 1) valid 1200 UTC December 6 and 0000 UTC December 8, 2015.

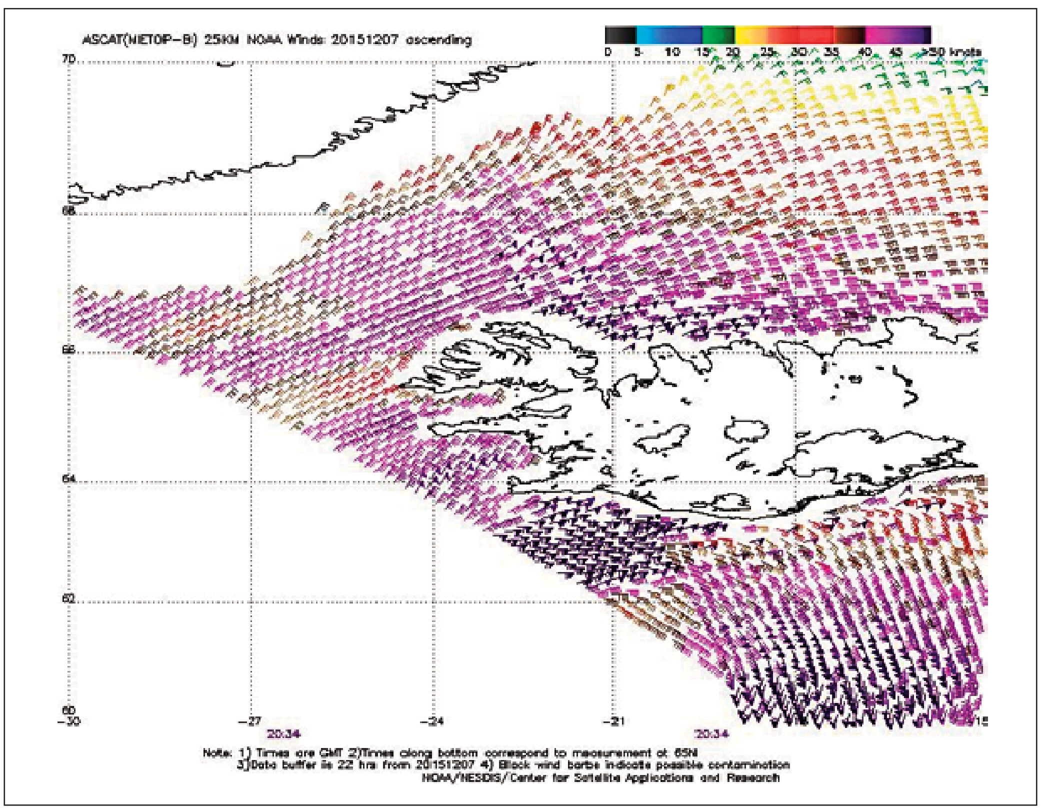

Figure 16. ASCAT (METOP-B) image of satellite-sensed winds with 25-km resolution around the north and north-east sides of the hurricane-force low, around Iceland, shown in the second part of Figure 15. The valid time of the pass is 2034 UTC December 7, 2015, or about three and one-half hours prior to the valid time of the second part of Figure 15. Imagery is courtesy of NOAA/NESDIS/ Center for Satellite Applications and Research.

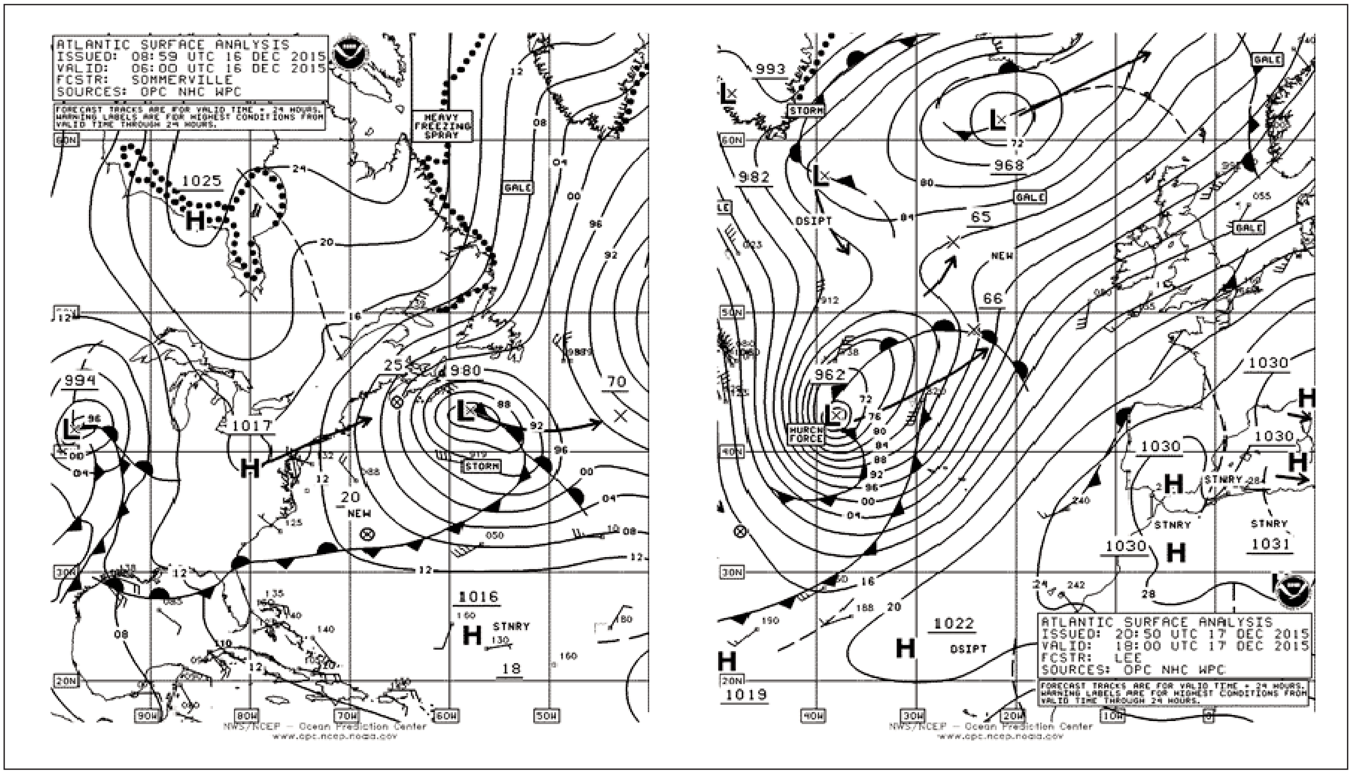

Figure 17. OPC North Atlantic Surface Analysis charts valid 0600 UTC December 16 (Part 2) and 1800 UTC December 17, 2015 (Part 1)

The second part of **Figure 17** shows the cyclone at maximum intensity. **Figure 18** is a 12.5 km resolution Rapidscat image of winds around the cyclone near maximum intensity, with numerous hurricane force wind retrievals on the south side of the circulation. **Figure 19** showing remotely sensed wave heights from radar altimeters aboard the Jason 2 and AltiKa satellites. Note the 45 ft (13.7 m) observation in the swath cutting through the south side of the analyzed low center. The platform **HIBERNIA** (VEP717, 46.7N 48.7W) reported north winds of 60 kts at 1200 UTC on the 17th. 12 hours later the **NRP VIANA DO CASTELO** (CTPA) near 38N 25W reported south winds of 50 kts.

North Atlantic Storm, December 19-22:

This intense system in the northwestern Atlantic (Figure 20) developed from the consolidation and rapid intensification of the low pressure complex over the south of the Canadian Maritime Provinces over a 36 hour period. The central pressure fell 44 hPa in the 24 hour period ending at 0600 UTC on the 20th, almost twice the “bomb” rate at 60N. The ASCAT-B image in **Figure 21** has some similarity to **Figure 11** for the October 10-12 event, except with more coverage of 50-55 kt winds, especially on the south side of the cyclone. The platform **HIBERNIA** (46.7N 48.7W) reported northwest winds of 52 kts at 1200 UTC on the 21st, and highest seas of 6.4 m (21 ft) three hours later.

The cyclone subsequently moved east and slowly weakened through the 21st before degenerating into a trough by the 22nd.

Northwest Atlantic, Greenland Storms, December 24-30:

Late December was very active in the northern waters, starting with development of a strong low in the Davis Strait on December 25th which developed hurricane force southeast winds between the occluded front and the southwest Greenland coast (**Figure 22**). **Figure 23** with partial ASCAT coverage reveals this enhanced southeast flow. The system weakened in the Davis Strait while forming a new center near the southern tip of Greenland, with the new low taking over and developing hurricane force winds with a 955 hPa center on the 27th (**Figure 22**). This low then lingered in the east Greenland waters to the end of the month while briefly redeveloping hurricane force winds on the 30th (**Figure 24**) before weakening on the 31st. An ASCAT-B pass from 2238 UTC on the 30th revealed a swath of west to northwest winds 50 to 55 kts extending from the southern tip of Greenland.

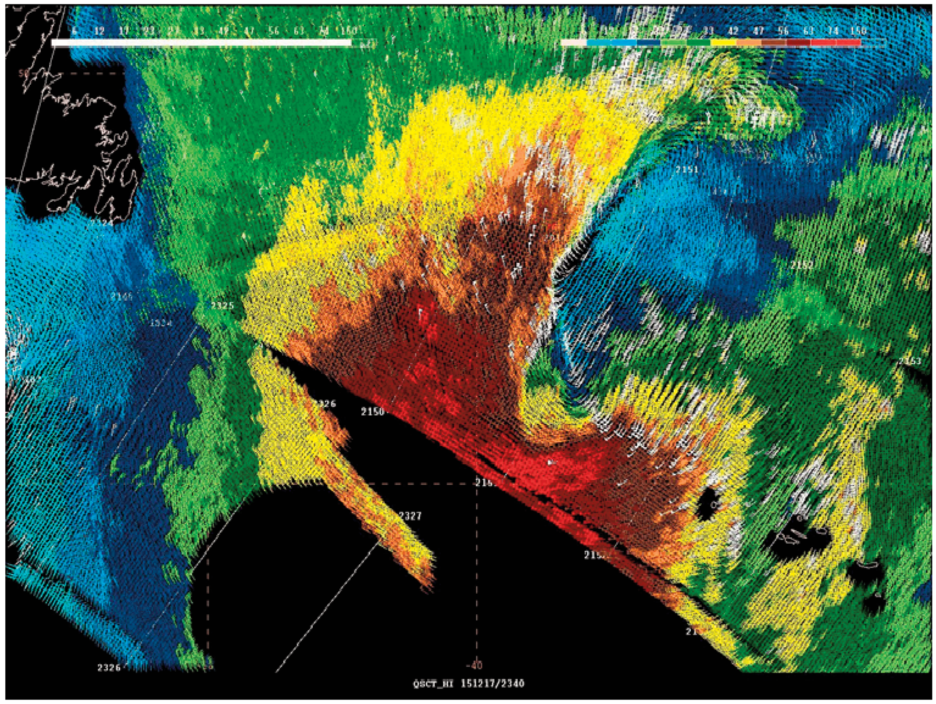

Figure 18. Rapidscat image of satellite-sensed winds with 12.5-km resolution, from an instrument aboard the International Space Station, around the hurricane-force low shown in the second part of Figure 17. The white lines labeled with four-digit UTC times are cross-track time lines of the satellite, with the higher wind retrievals in the lower middle portion of the image in a pass corresponding to a valid time of 2151 UTC December 17, 2015, about three and three-quarters hours later than the valid time of the second part of Figure 17. Wind barbs are colored according to the scale near the top of the image, with hurricane-force barbs colored light red and white barbs indicating possible rain contamination.

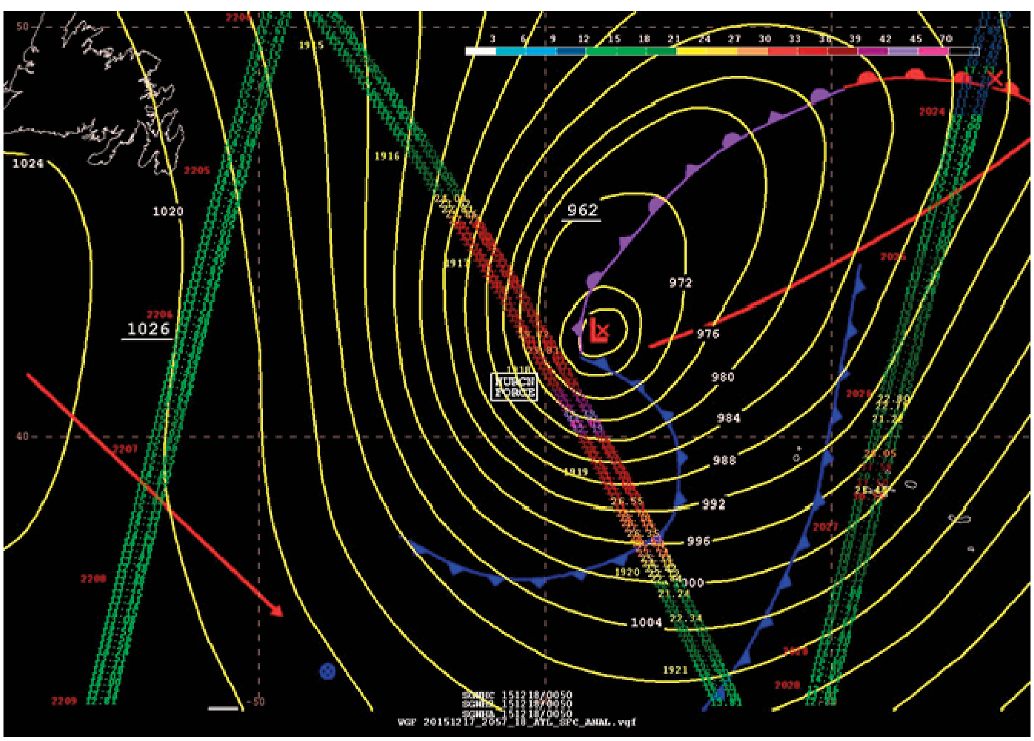

Figure 19. Jason-2 and AltiKa satellite altimeter passes around the hurricane-force low shown in the second part of Figure 17 with a surface analysis for 1800 UTC December 17, 2015 included. The satellite tracks include four-digit significant wave heights in feet to two decimal places and four-digit times to the left in UTC. The valid time of the pass near the center of the cyclone is approximately one hour later than the valid time of the second part of Figure 17.

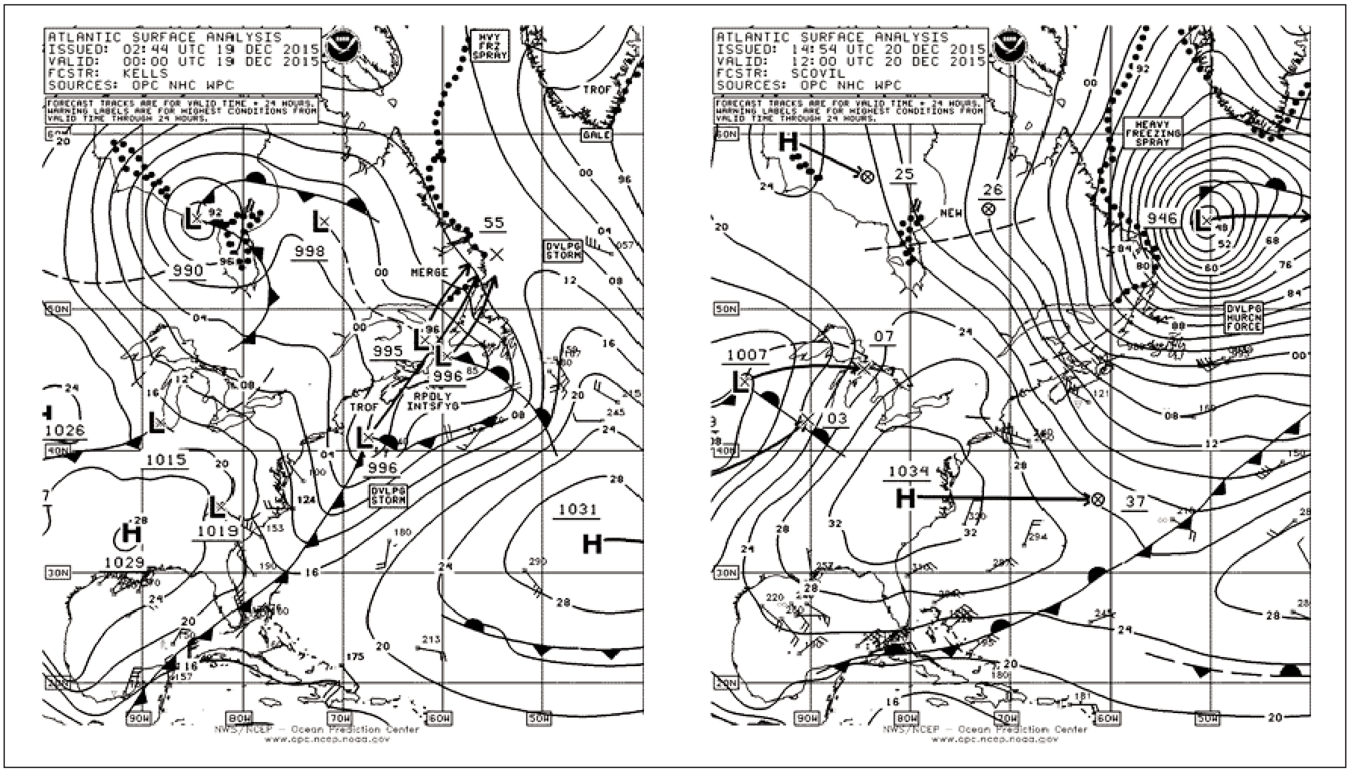

Figure 20. OPC North Atlantic Surface Analysis charts (Part 2) valid 0000 UTC December 19 and 1200 UTC December 20, 2015.

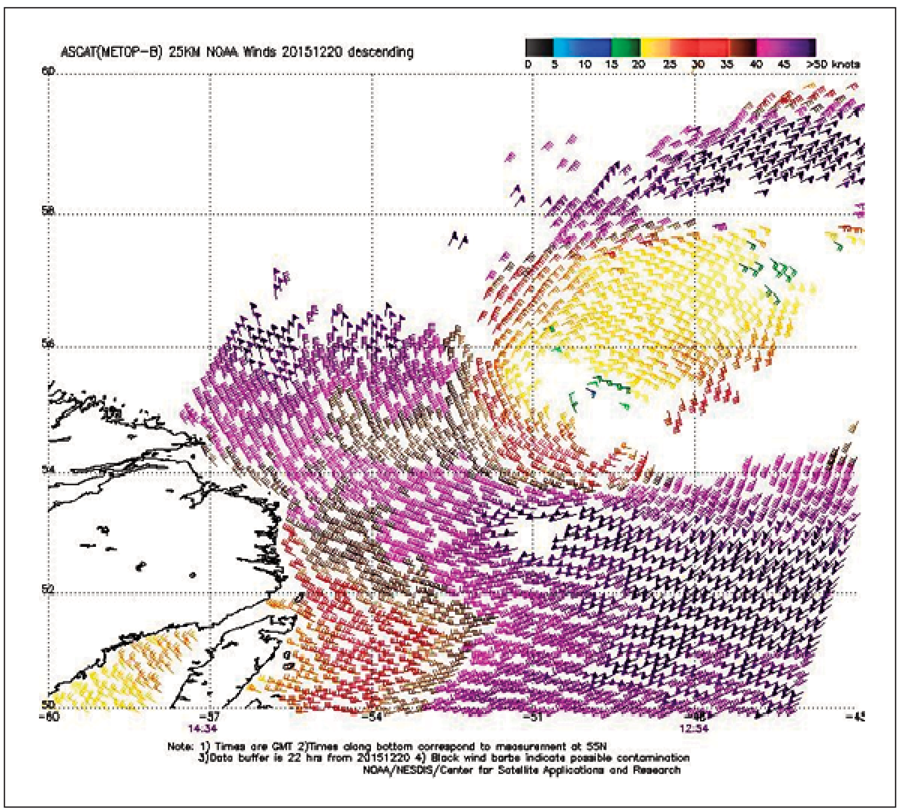

Figure 21. ASCAT (METOP-B) image of satellite-sensed winds with 25-km resolution around the cyclone shown in the second part of Figure 20. Portions of two passes (1254 and 1434 UTC December 20, 2015) are shown, with valid times about one hour and two and one-half hours, respectively, later than the valid time of the second part of Figure 20. Portions of Newfoundland and Labrador appear on the lower-left side of the figure. Imagery is courtesy of NOAA/NESDIS/ Center for Satellite Applications and Research.

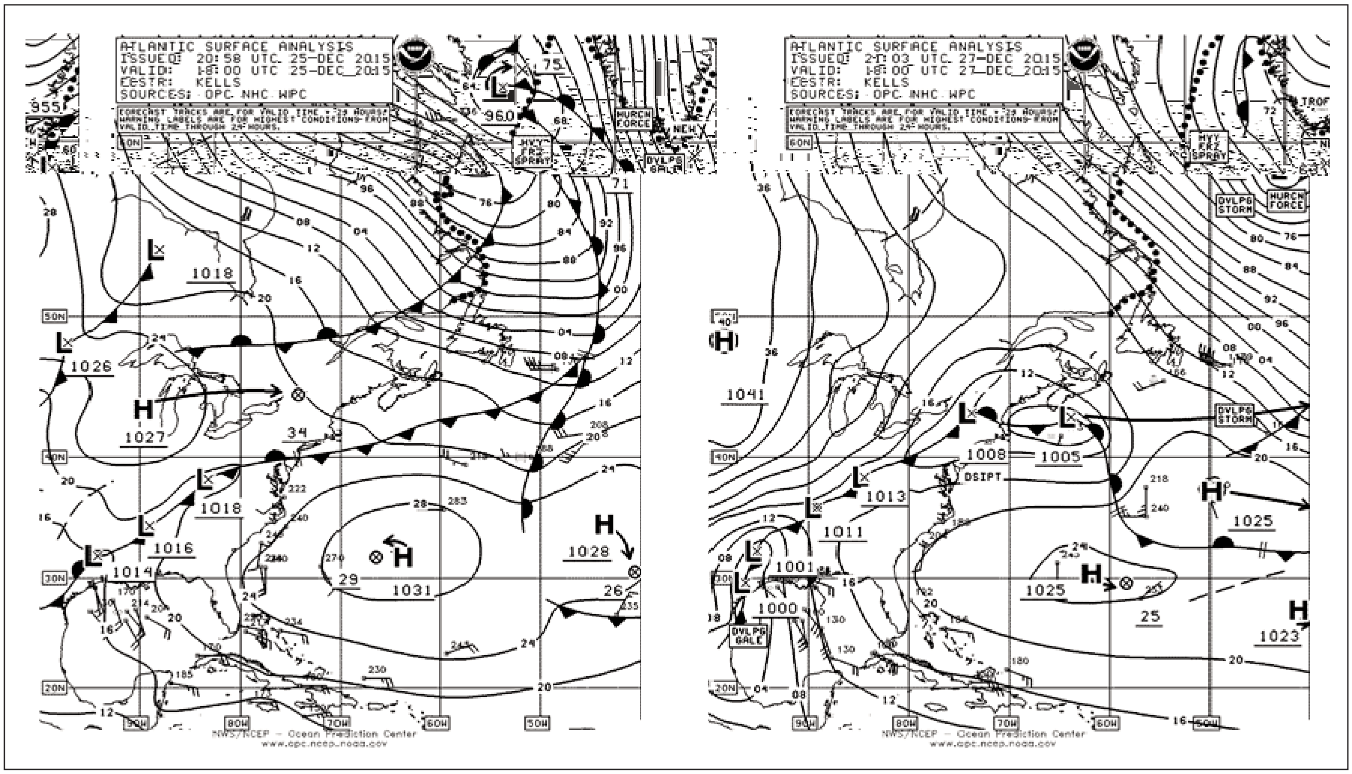

Figure 22. OPC North Atlantic Surface Analysis charts (Part 2) valid 1800 UTC December 25 and 27, 2015.

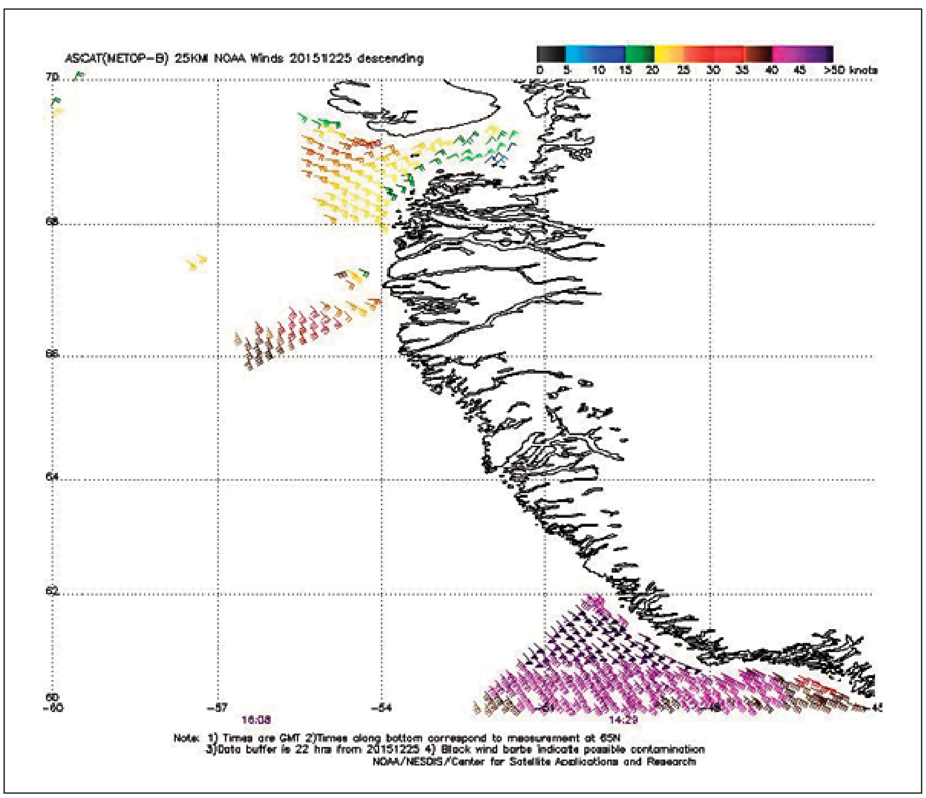

Figure 23. ASCAT (METOP-B) image with partial coverage of satellite-sensed winds with 25-km resolution around the east side of the cyclone west of Greenland shown in the first part of Figure 22. The valid time of the eastern pass containing the strongest winds is 1429 UTC December 25, 2015, or three and one-half hours prior to the valid time of the first part of Figure 22. Imagery is courtesy of NOAA/NESDIS/ Center for Satellite Applications and Research.

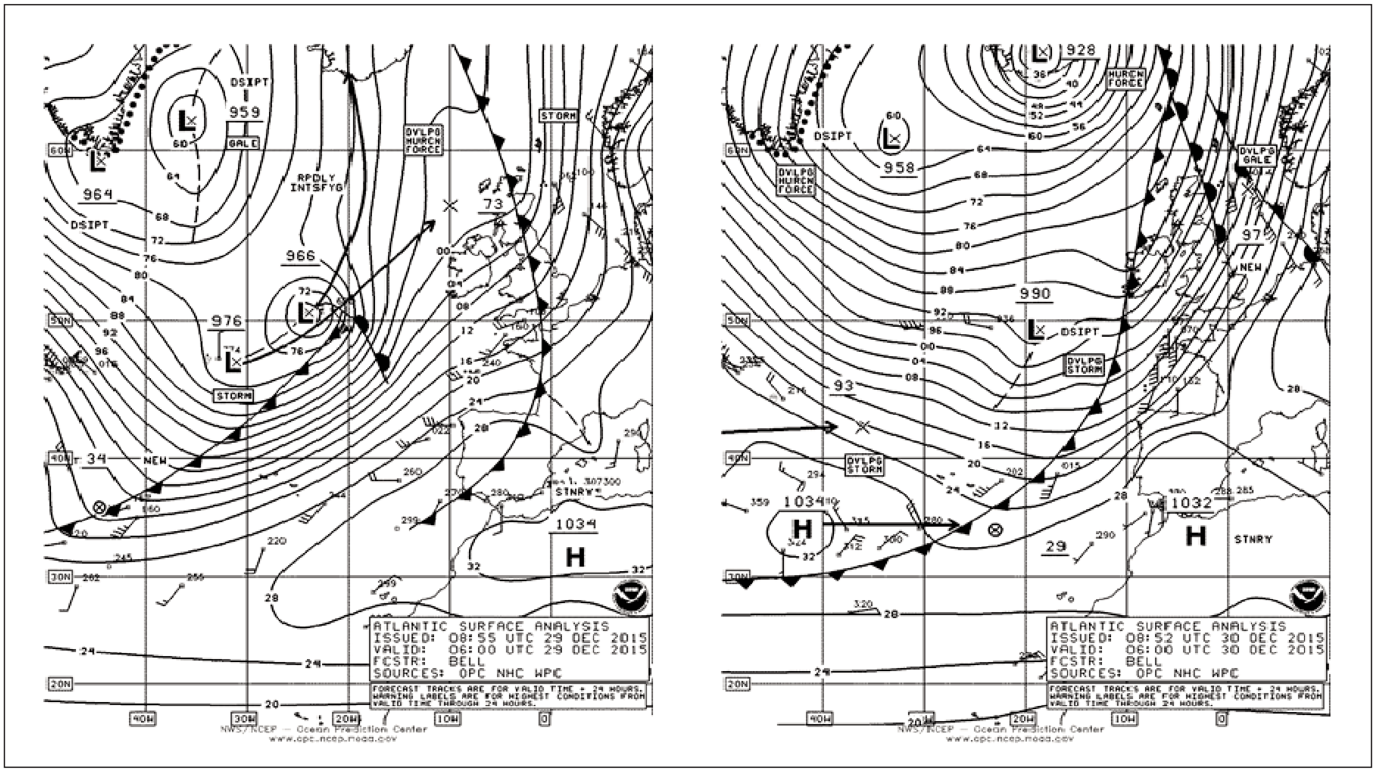

Figure 24. OPC North Atlantic Surface Analysis charts (Part 1) valid 0600 UTC December 29 and 30, 2015.

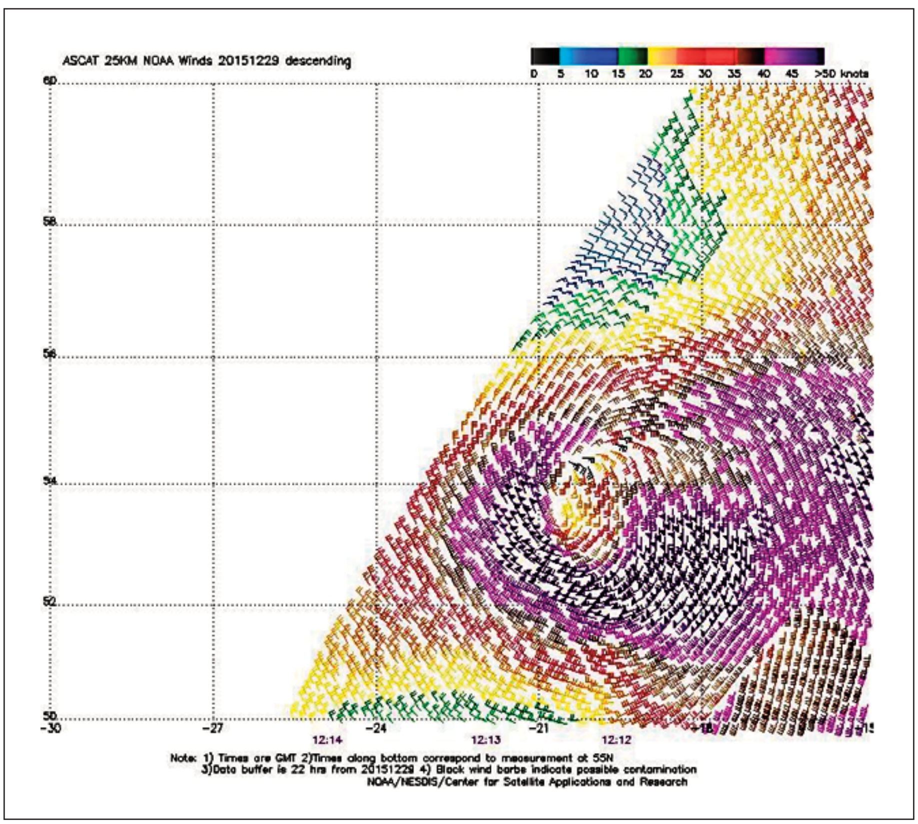

Figure 25. ASCAT (METOP-A) image of satellite-sensed winds with 25-km resolution around the hurricane-force cyclone in Figure 24. The valid time of the pass is 1213 UTC December 29, 2015, or about six and one-quarter hours later than the valid time of the first part of Figure 24. The low was rapidly intensifying at this time with the center west of Ireland near 54N 20W. Imagery is courtesy of NOAA/NESDIS/ Center for Satellite Applications and Research.

Northeast Atlantic Storms, December 13-15:

Figure 24 depicts the development of the strongest low of the period in the North Atlantic with a 928 hPa (27.40 inches) over Iceland, from the dominant low center west of the British Isles over a 24 hour period. The central pressure dropped 42 hPa in the 24 hour period ending at 0000 UTC on the 30th. Actually both lows in the first part of **Figure 24** developed hurricane force winds six hours later before the trailing low weakened as **Figure 24** indicates. A British reference to the intense 928 hPa low is included in Reference 8.

The ASCAT image in **Figure 25** depicts winds around the dominant low west of the British Isles about six hours later than the valid time of the first part of **Figure 24**, and shows good support for hurricane force status. At 0600 UTC on the 29th the **MSC XIAN** (A8KY2) near 50N 21W reported southeast winds of 65 kts.
The **INDEPENDENT VOYAGER** (A8XY2) encountered west winds of 60 kts three hours later. Buoy 64045 (59.1N 11.7W) reported highest seas of 12.5 m (41 ft) at 2300 UTC on the 29th. The intense low then passed north of Iceland later that day.

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2. Ocean Surface Winds, http://manati.star.nesdis.noaa.gov/products.php

3. VonAhn, Joan. and Sienkiewicz, Joe, “Hurricane Force Extratropical Cyclones Observed Using QuikSCAT Near Real Time Winds”, Mariners Weather Log, Vol. 49, No. 1, April 2005.

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8. http://www.mashable.com/2015/12/28/Freak-atlantic-storm-uk-Frank/#V5Ew ⚓

Marine Weather Review – North Pacific Area

September to December 2015

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NOAA National Center for Environmental Prediction

Introduction

The weather pattern over the North Pacific was most active at the end of September and October with the heavy weather season off to an early start, starting with a hurricane force event in the eastern Pacific late in September and an unusually intense low with a pressure down to 948 hPa in the far west. There were eight hurricane force lows in October including ones with tropical origin, and five each in November and December. There was a period in late October when three such events were occurring at the same time. The most intense systems moved from the western waters near Japan or the Kurile Islands to the Bering Sea or along or just south of the Aleutian Islands and toward eventual weakening over Alaska or the Gulf of Alaska. Some of the significant events originated over the south central waters and contributed to the occurrence of some hurricane force events in the northeast Pacific. The most significant event of the period was the cyclone that developed a 924 hPa central pressure near the central Aleutian Islands in December, matching the pressure reached in the post tropical Nuri event in November 2014 (Reference 6).

There was considerable tropical activity including contributions from the Central Pacific which experienced record activity. There were 12 named systems, with four coming from the Central Pacific, but there was only one super typhoon (with sustained winds of 130 kts or higher).Two of the cyclones, in October, became powerful extratropical lows as they recurved into the mid-latitude westerlies.

Tropical Activity

Hurricane Ignacio:

Unusually warm Central Pacific water allowed Ignacio, which originally came from the eastern Pacific (east of 140W) to move north into OPC's high seas area near 30N 164W as a hurricane with 65 kts sustained winds early on September 4th. As Ignacio moved north it became a post-tropical storm force low by the 5th (**Figure 1**). The ASCAT imagery in **Figure 2** covering only the east side of the cyclone indicates a core of storm force winds close to the center which is just outside the data swath. The cyclone continued to move slowly north through the 6th before turning northeast as a gale on the 7th and dissipating near the Canadian coast on the 9th.

Typhoon Kilo:

Kilo crossed 180W as September began and was a major but weakening hurricane with sustained winds of 105 kts, tracking west northwest from 23N 180W. It weakened to a tropical storm on the 9th. Figure 3 depicts Kilo transitioning to an extratropical storm. An ASCAT (METOP-B) pass from 1200 UTC on the 11th returned partial coverage and showed winds to 45 kts on the northeast side when the center was east of Hokkaido, Japan. Post-Tropical Kilo weakened to a gale the next day, passed inland over Russia late on the 12th, and then dissipated over Alaska on the 14th.

Tropical Storm Etau:

Etau originated as T.D.18W near 21N 139E at 1800 UTC on the 6th and became a tropical storm six hours later. Etau became strongest with sustained winds of 55 kts near the southern coast of Japan at 1800 UTC on the 8th. After crossing into the Sea of Japan Etau weakened to a post tropical gale early on the 9th and then moved north and inland late on the 11th.

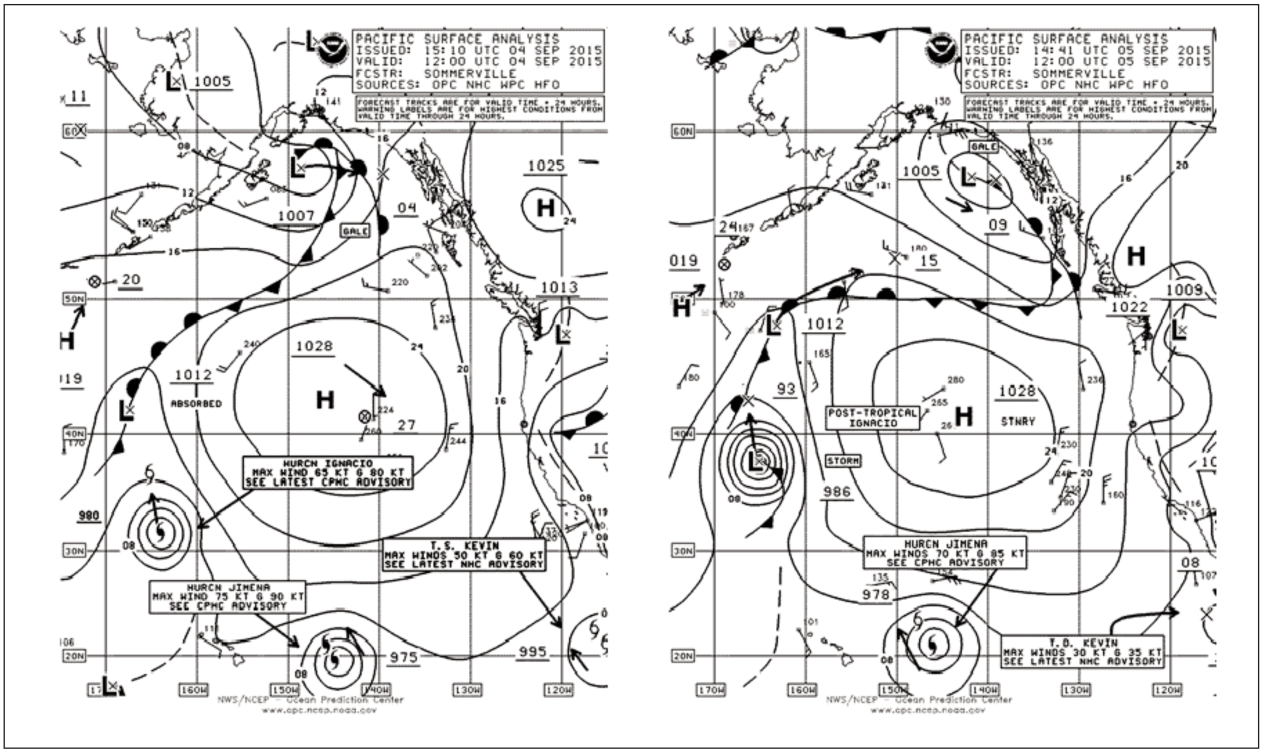

Figure 1. OPC North Pacific Surface Analysis charts (Part 1 - east) valid 1200 UTC September 4 and 5, 2015. Twenty-four hour forecast tracks are shown with the forecast central pressures given as the last two whole digits in millibars (hPa), with the exception of tropical cyclones, for which just a tropical symbol is given at the twenty-four hour position (if still a tropical cyclone). Tropical cyclone information appears in text boxes.

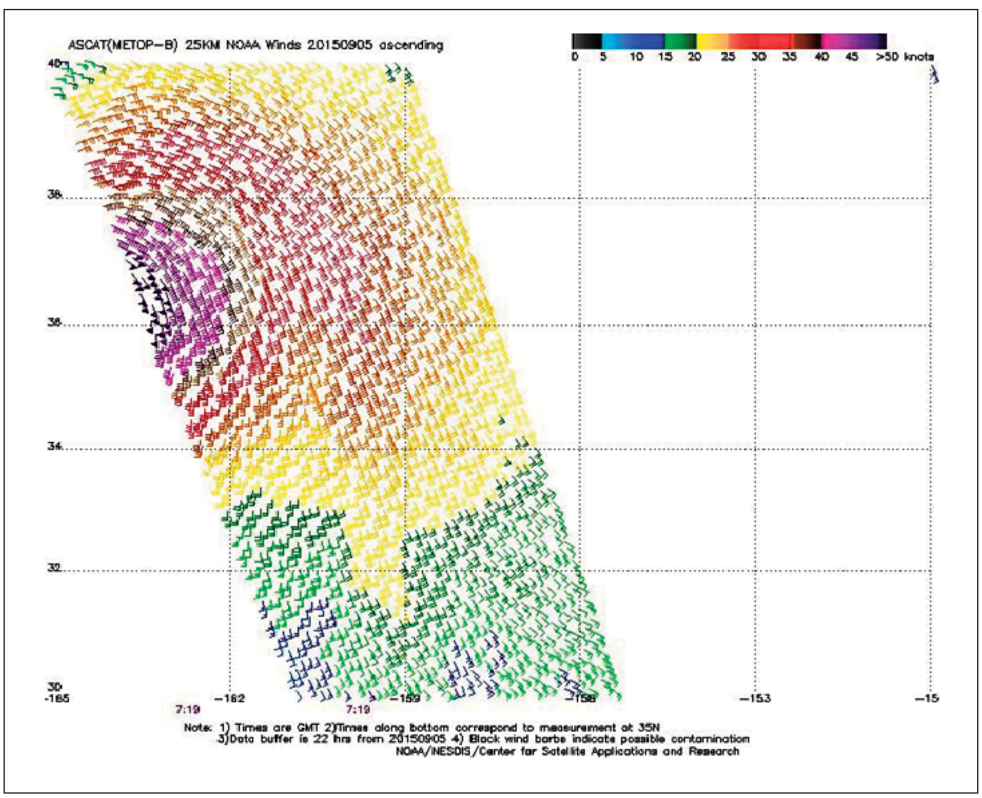

Figure 2. ASCAT METOP-B (Advanced Scatterometer) image of satellite-sensed winds (25-km resolution) around the north and east sides of Post-Tropical Ignacio shown in the second part of Figure 1. The valid time of the pass is 0719 UTC September 5, 2015, or about four and three-quarters hours prior to the valid time of the second part of Figure 1. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

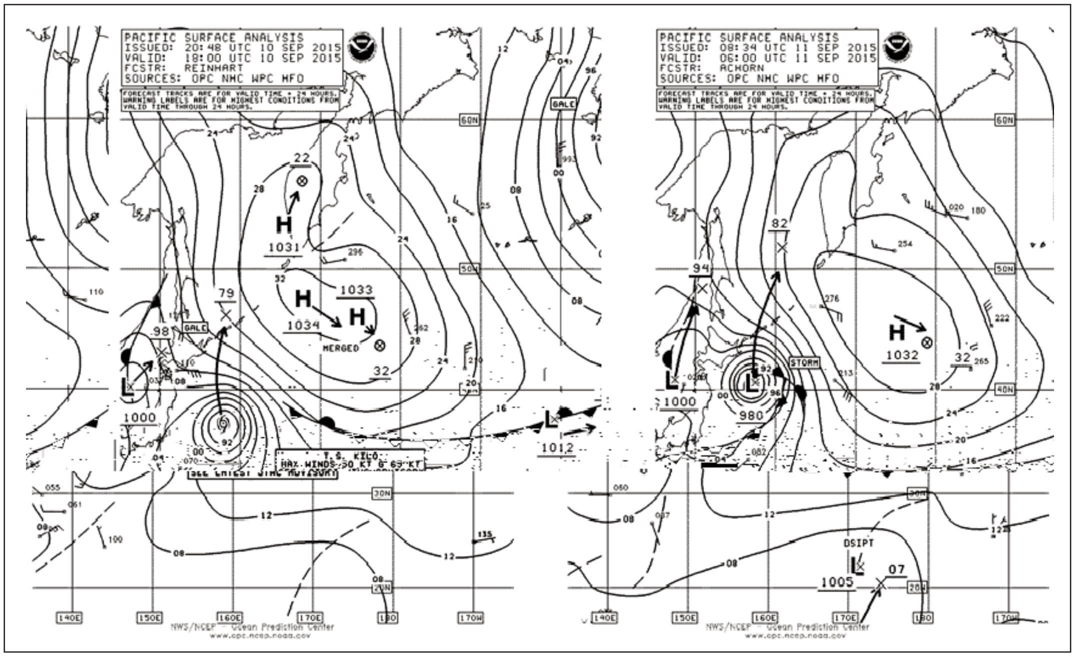

Figure 3. OPC North Pacific Surface Analysis charts (Part 2 - west) valid 1800 UTC September 10 and 0600 UTC September 11, 2015.

Typhoon Krovanh:

T.D. 20W forming near 18N 151E late on September 14th moved northwest and intensified to Typhoon Krovanh early on the 18th , and briefly to a major typhoon late on the 17th near 24N 143E with sustained winds of 105 kts. A weakening trend then set in as the cyclone began to recurve to the northeast. **Figure 4** shows transition over a 12 hour period to a post tropical storm force low. The ASCAT image in **Figure 5** returned winds to 45 kts mainly on the northeast side. A small negative bias at those wind speeds suggests Krovanh as having marginal storm force winds. Post Tropical Krovanh then stalled east of northern Japan for several days with a weakening trend before dissipating by the 26th.

Tropical Storm Malia:

Malia was another Central Pacific system which moved north toward OPC's high seas marine area. It appears as T.D. 5-C in **Figure 4**. It became Tropical Storm Malia with 35 kts sustained winds reaching 29N 173W at 1200 UTC September 22nd before becoming extratropical and absorbed late on the 22nd.

Tropical Storm Dujuan:

T.D. 21W formed near 16N 140E at 1800 UTC September 21st and drifted north while becoming Tropical Storm Dujuan 0000 UTC on the 23rd with sustained winds of 40 kts. Dujuan reached 136E six hours later and passed west of the area, eventually become a typhoon west of the area two days later.

Typhoon Choi-Wan:

Tropical Storm Choi-Wan formed from a non-tropical gale near 18N 168E 0600 UTC October 2nd and moved northwest, becoming a typhoon near 24N 151E late on the 5th. It peaked at only 70 kts before weakening to a strong tropical storm early on the 7th. **Figure 6** shows the transition of its large circulation into an intense post-tropical hurricane force low over a 12 hour period. The ASCAT-B pass reveals circulation on the north side of the cyclone with winds to 60 kts. A Rapidscat pass from nine hours later revealed winds to 70 kts from the west to northwest. The **SIMUSHIR** (UBRI5) reported north winds of 60 kts near 49N 144E at 1800 UTC on the 8th. The **HATSU EXCEL** (VSXV3) near 47N 161E encountered east winds of 40 kts and seas11.3 m (37 ft) at that time. The cyclone then moved slowly north into the Sea of Okhotsk and weakened, with its winds diminishing to gale force on the 9th.

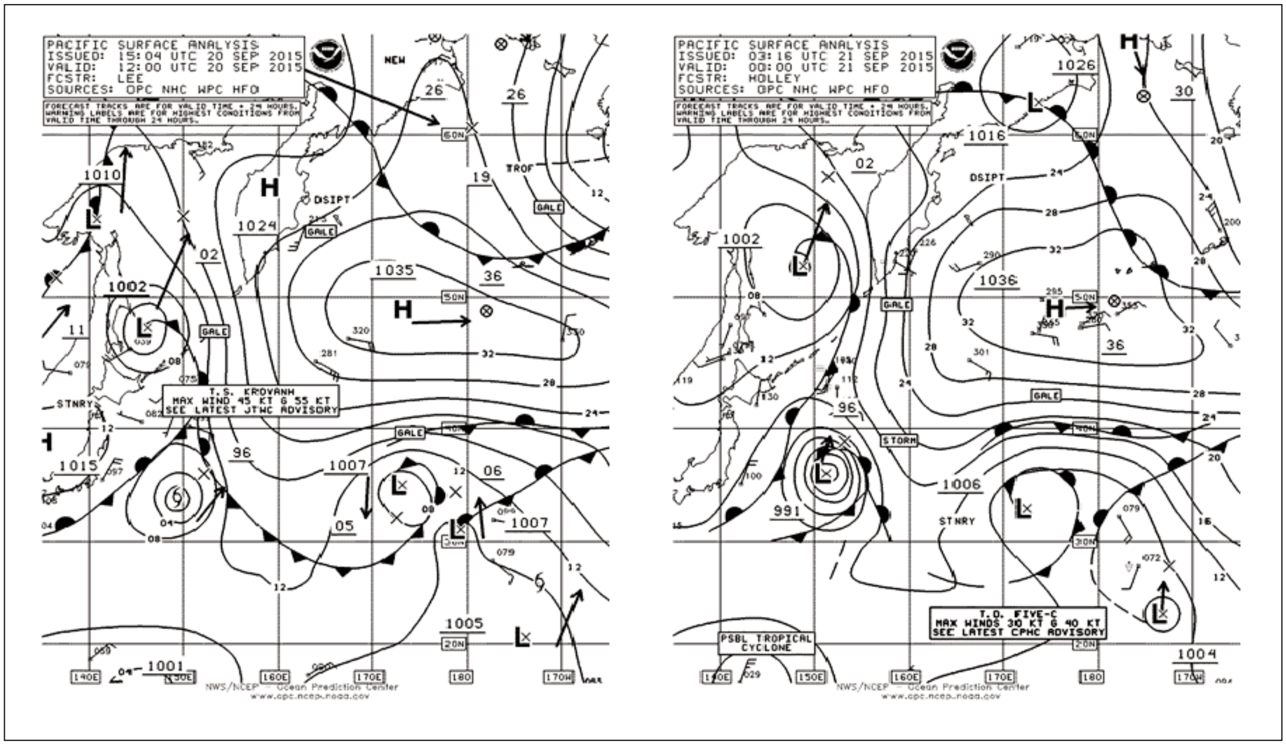

Figure 4. OPC North Pacific Surface Analysis charts (Part 2) valid 1200 UTC September 20 and 0000 UTC September 21, 2015.

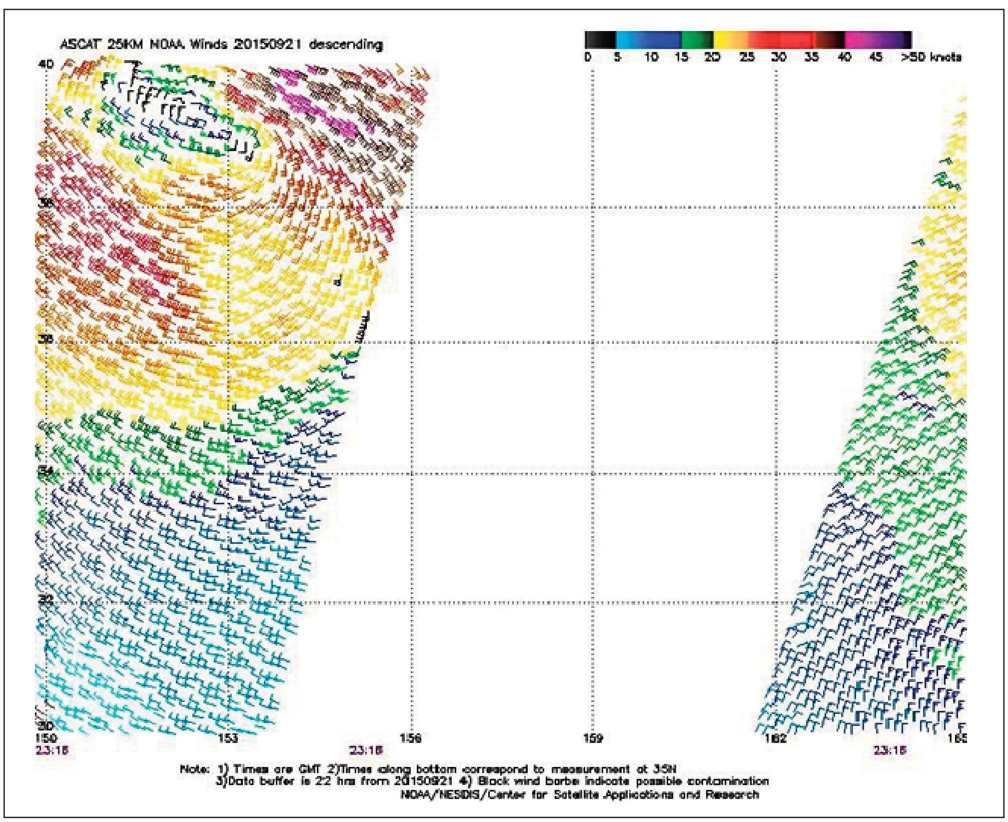

Figure 5. ASCAT (METOP-A) image of satellite-sensed winds (25-km resolution) around the storm-force low east of Japan (Post-Tropical Krovanh) shown in the second part of Figure 4. The valid time of the pass is 2318 UTC September 21, 2015, or about twenty-three hours later than the valid time of the second part of Figure 4. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

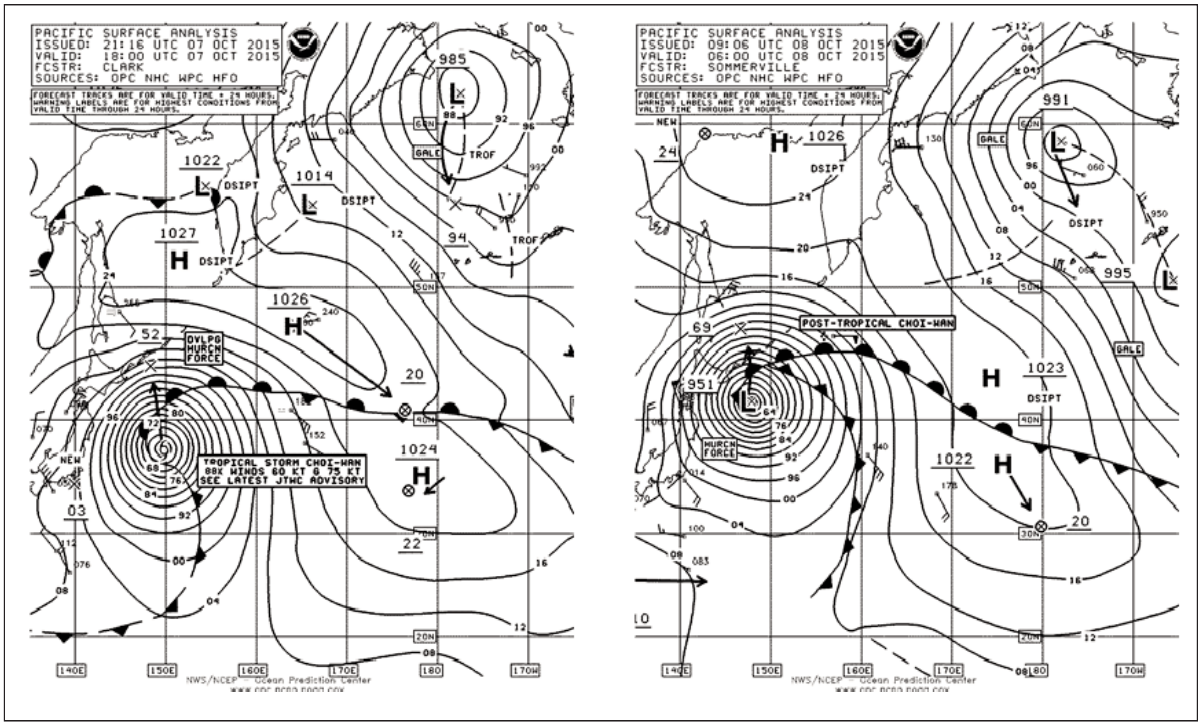

Figure 6. OPC North Pacific Surface Analysis charts (Part 2) valid 1800 UTC October 7 and 0600 UTC October 8, 2015.

Hurricane Oho:

Oho was another Central Pacific system that moved north into OPC's high seas area as depicted in **Figure 8**. Between 0000 UTC and 0600 UTC October 8th Oho crossed 30N as a hurricane with sustained winds 75 kts lowering to 65 kts, and further weaken to a tropical storm occurred six hours later and to a post-tropical gale at 1800 UTC on the 8th. Re-intensification followed as the center passed west of the Canadian coast with brief hurricane force conditions and then reaching the Gulf of Alaska with a 962 hPa center on the 9th, but top winds were down to gale force. It then dissipated over southwestern Alaska the next day.

The **BREMEN EXPRESS** (DHBN) near 48N 131W reported south winds of 45 kts and 8.2 m seas (27 ft) at 1800 UTC on the 9th.

Tropical Storm Koppu:

T.D. 24-W formed near 16N 143E at 0000 UTC October 13th and moved west and became Tropical Storm Koppu six hours later with sustained winds of 40 kt. Koppu then passed west of 136E late on the 13th while slowly strengthening.

Tropical Storm Champi:

T.D. 25-W which became Champi formed near 13N 160E early on the 13th and moved northwest while intensifying. Champi became a typhoon early on the 16th with 65 kts sustained winds near 16N 144E and briefly a super typhoon at 1200 UTC on the 18th with sustained winds of 130 kts and would by a strong Category 4 on the Saffir-Simpson scale (Reference 4). A weakening trend set in as the system passed west of the area late on the 19th. The typhoon then recurved back into the waters southeast of Japan on the 23rd. **Figure 9** and **Figure 10** depict the transition of Tropical Storm Champi to a strong post tropical low with hurricane force winds over a 24 hour period. **Figure 11** reveals a rather compact pattern of stronger winds to 60 kts close to the center, at times seen in former tropical systems. The post tropical low then moved northeast and weakened to a gale on the 26th and dissipated in the southwest Gulf of Alaska by the 28th.

Tropical Storm In-Fa:

In-Fa was formerly a typhoon southwest of the area. It moved northeast into OPC's radiofacsimile chart area near 20N 136E with sustained winds of 45 kts at 0600 UTC November 25th. It was the only November storm. The cyclone weakened and became post tropical at 1200 UTC on the 26th near 26N 142E and merged with a front.

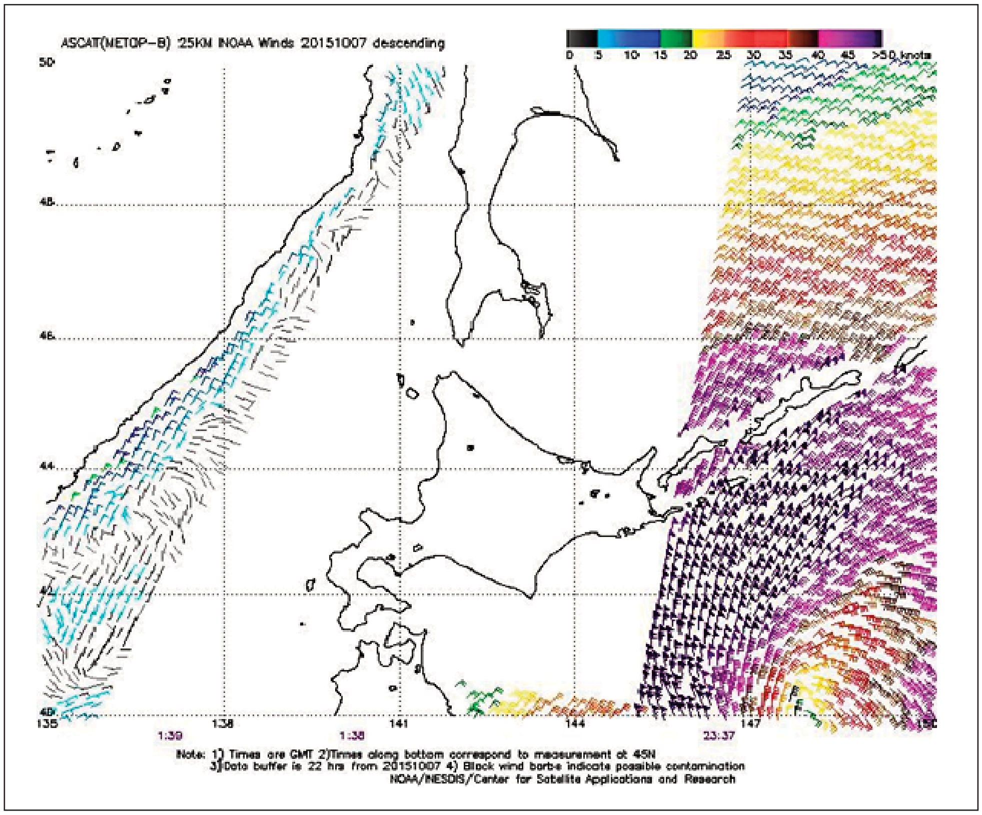

Figure 7. ASCAT (METOP-B) image of satellite-sensed winds (25-km resolution) around the north side of the hurricane-force low (Post-Tropical Choi-Wan) shown in the second part of Figure 6. The valid time of the eastern pass is 2337 UTC October 7, 2015, or about six and one-half hours prior to the valid time of the second part of Figure 6. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

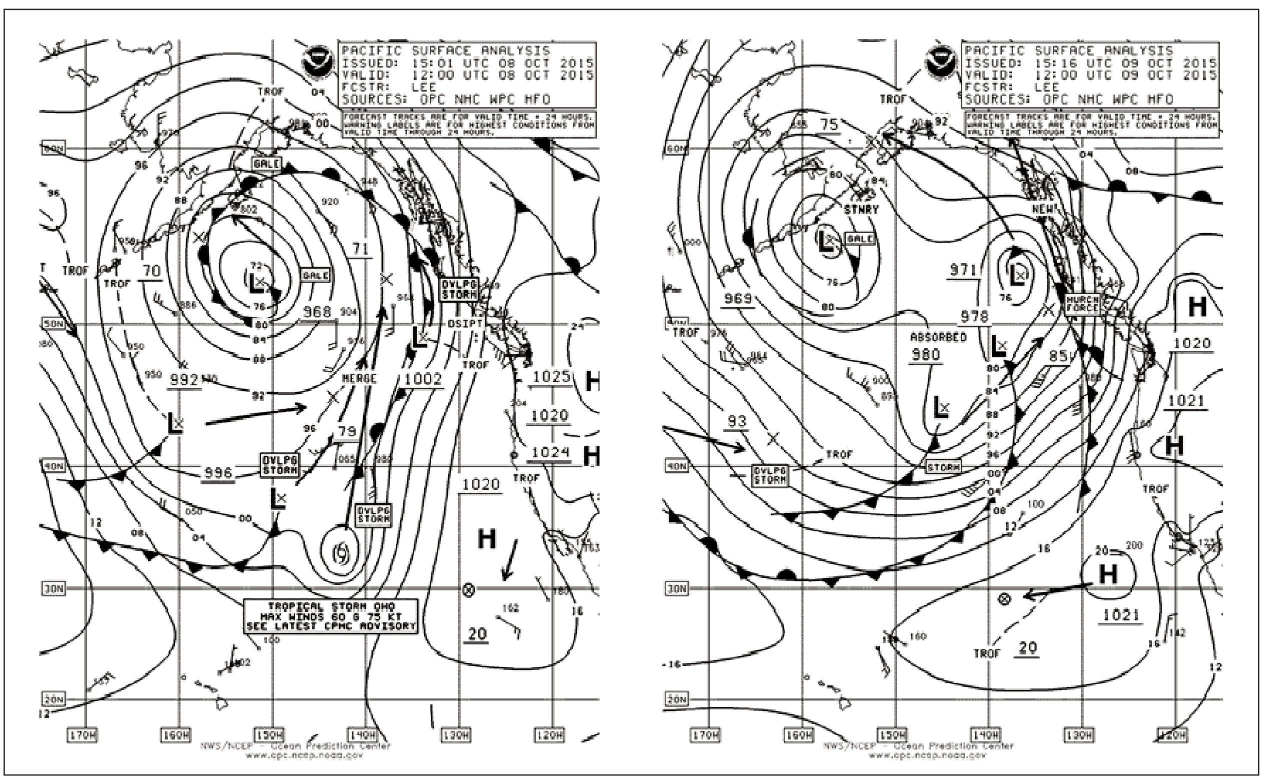

Figure 8. OPC North Pacific Surface Analysis charts (Part 1) valid 1200 UTC October 8 and 9, 2015.

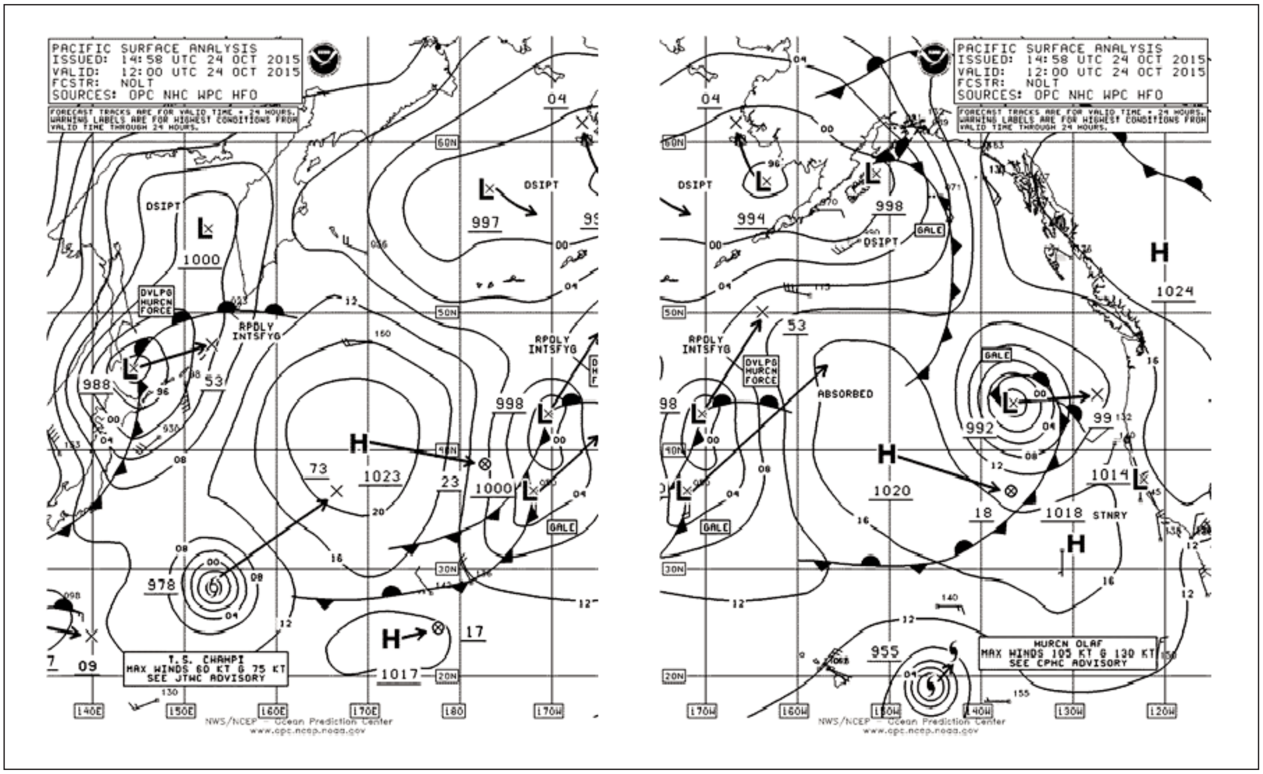

Figure 9. OPC North Pacific Surface Analysis charts (Parts 1 and 2) valid 1200 UTC October 24, 2015. The two parts overlap between 165W and 175W).

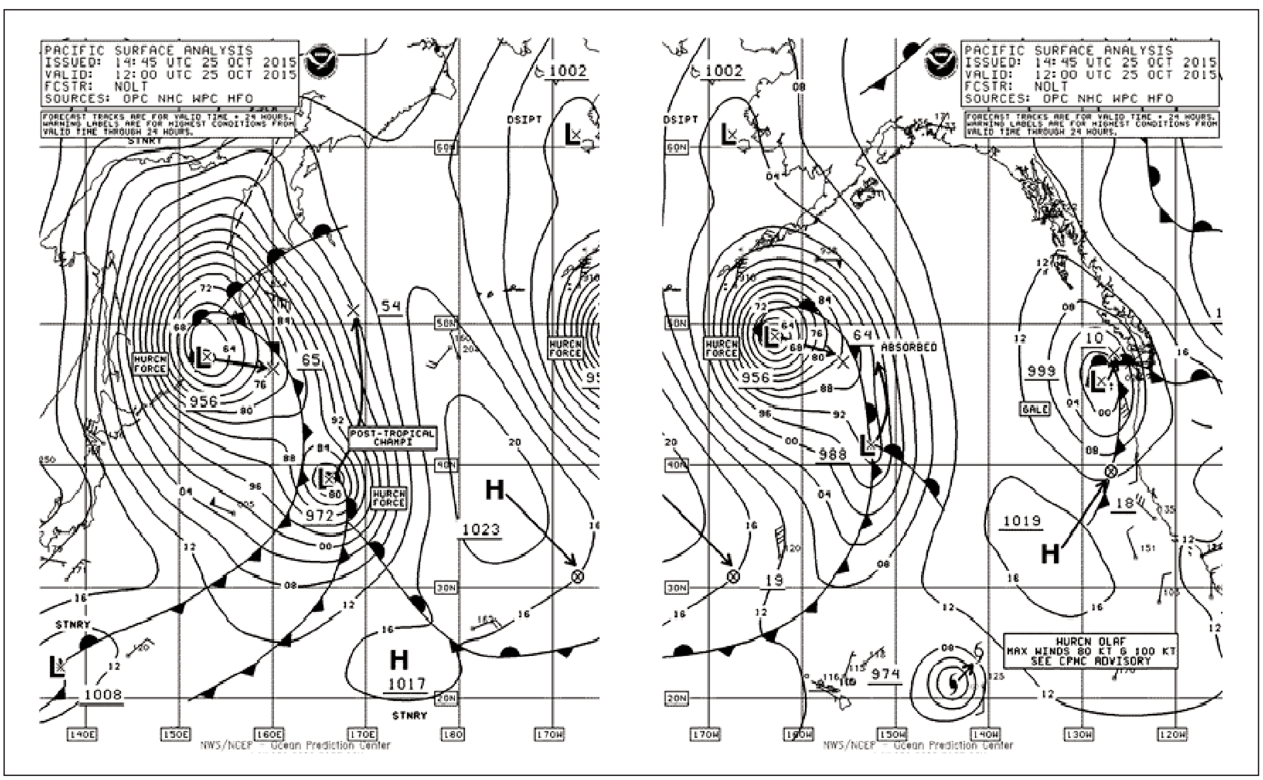

Figure 10. OPC North Pacific Surface Analysis charts (Parts 1 and 2) valid 1200 UTC October 25, 2015. The two parts overlap between 165W and 175W).

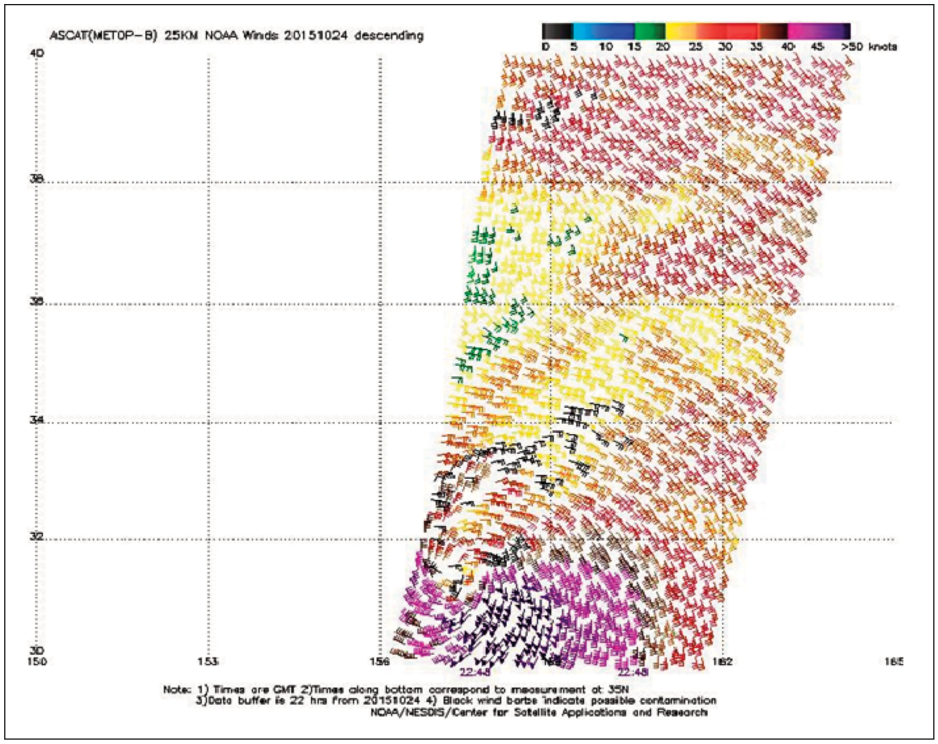

Figure 11. 25-km ASCAT (METOP-B) image of satellite-sensed winds around Post-Tropical Champi shown in Figure 10. The valid time of the pass is 2248 UTC October 24, 2015, or about thirteen and one-quarter hours prior to the valid time of Figure 10. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

Other Significant Events of the Period

Eastern North Pacific Storm, September 29-October 1:

Figure 12 displays the development of the first hurricane-force extratropical low of the fall season. The central pressure fell 24 hPa during the 24 hour period covered by this figure, impressive for that relatively low latitude.

The **POLAR ADVENTURE** (WAZV) near 42N 153W reported north winds of 72 kts and the **SHIP** (41N 151W) encountered southwest winds of 36 kts and 6.7 m seas (22 ft) at 1200 UTC on the 30th. The cyclone then drifted northeast and its winds weakened to gale force late on October 1st. It then turned back to the southwest on the 2nd and became absorbed.

Northwest Pacific Storm, October 1-2:

The explosive development of this system is shown in Figure 13. The initial development was over land and the developing center was at 40N 131E with a 988 hPa pressure at 0600 UTC on the 1st. This gives an 18 hour drop in pressure of 40 hPa. This cyclone was the only one with a central pressure below 950 hPa during the period other than in December. The ASCAT-B imagery in Figure 14 returned 50 to 70 kt winds mainly in the northern Sea of Japan.

The **SAVANNAH EXPRESS** (DNDD) reported south winds of 45 kts and 5.2 m seas (17 ft) near 35N 150E at 0300 UTC on the 2nd. A vessel with the **SHIP** call sign encountered southwest winds of 40 kts and 7.9 m seas (26 ft) at 0600 UTC on the 2nd. The cyclone then moved into the Sea of Okhotsk the next day where it stalled and weakened through the 3rd.

Eastern North Pacific Storm, October 10-12:

Figure 15 depicts the development of this hurricane force low from a rapidly intensifying frontal wave over a 24 hour period. It originated in the central waters south of the eastern Aleutian Islands early on the 9th. The central pressure fell 30 hPa in the 24 hour period covered by Figure 15. The ASCAT-A image in Figure 16 reveals a well-defined center and an area of winds 50 to 60 kts on the southeast side. The **STIKINE** (WDC8583) near 55N 132W reported southeast winds of 55 kts at 1800 UTC on the 11th. Buoy 46184 (53.9N 138.9W) reported southwest winds of 43 kts with gusts to 52 kts and 10.5 m seas (34 ft) at 2100 UTC on the 11th. The cyclone subsequently moved north into the Gulf of Alaska where it dissipated late on the 12th.

Northwest Pacific Storm, October 23-27:

Referring back to Figures 9 and 10, low pressure rapidly developed to the northwest of Champi. Its central pressure fell

32 hPa in the 24 hour period ending at 1200 UTC on the 25th. The ASCAT image in **Figure 17** reveals winds 50 to 60 kts on the south side of the system. The **STAR JAPAN** (LAZV5) near 45N 149E reported northwest winds of 55 kts and 7.0 m seas (23 ft) at 0100 UTC on the 25th.
The **TOKYO EXPRESS** (DGTX) near 37N 145E encountered northwest winds of 50 kts and 9.0 m seas at 0000 UTC on the 25th. The system then moved east and dissipated south of the central Aleutians on the 28th.

North Pacific Storm, October 24-26:

In **Figure 9** and **Figure 10** the complex area of low pressure over the central waters consolidated and rapidly deepened over the 24 hour period covered by the figures. The central pressure fell 42 hPa in the same period. The lowest central pressure, 952 hPa, occurred six hours later.
The **HORIZON ANCHORAGE** (KGTX) reported east winds of 50 kts and 7.9 m seas (26 ft) near 54N 152W at 0600 UTC on the 26th. Buoy 46066 (52.8N 155.0W) reported east winds of 41 kts with gusts to 52 kts and 9.0 m seas (30 ft) 0500 UTC on the 26th. The cyclone subsequently moved to the Gulf of Alaska by the 28th where it weakened and became stationary.

North Pacific and Bering Storm, November 3-6:

A wave of low pressure moved northeast from south of Japan on November 1st and developed hurricane force winds and a lowest central pressure of 961 hPa near the central Aleutians by 1800 UTC on the 4th. The central pressure fell 37 hPa in the 24 hour period ending at 1200 UTC on the 4th. At 0821 UTC November 4 ASCAT-B pass returned 50 to 65 kts winds in the south semicircle when the center was still south of the Aleutians. The **AMARANTHA** (VRBB3) near 55N 179W reported north winds of 48 kts and 10.4 m seas (34 ft) at 2100 UTC November 4th. Buoy 46072 (51.7N 172.2W reported southwest winds of 43 kts with gusts to 56 kts and 8.0 m seas (26 ft) at 1900 UTC on the 4th and a peak gust of 60 kts nine hours later. Highest seas were 12.0 m (39 ft) at 0000 UTC on the 5th. The cyclone then moved through the southern Bering Sea and reformed in the Gulf of Alaska after the 5th.

North Pacific and Bering Storm, November 8-12:

Low pressure originating in the Sea of Japan early on November 8th moved northeast and then east in the Bering Sea. It later reformed in the Gulf of Alaska. The lowest central pressure fell to 960 hPa at1800 UTC on the 12th. **Figure 18** shows the development of this system over a 36 hour period. The ASCAT-B data in **Figure 19** reveal winds 50 to 60 kts in the southwest semicircle. The **APL BELGIUM** (WDG8555) near 53N 177W reported northwest winds of 65 kts at 0000 UTC on the 11th.
MAERSK DANANG (A8PS5) encountered west winds of 63 kts and 8.5 m seas (28 ft) at 0000 UTC on the 12th. Buoy 46075 (53.9N 160.8W) reported west winds 47 kts with gusts to 64 kts and 14.0 m seas (46 ft).

North Pacific and Bering Storms, November 17-23:

A pair of strong lows moved from near northern Japan to the Bering Sea and then to the west coast of Alaska. The first briefly developed hurricane force winds with a 970 hPa central pressure near 54N 170E at 1800 UTC on the 18th. The central pressure dropped 36 hPa in the 24 hour period ending at 1200 UTC on the 18th. The system then weakened in the central Bering Sea and moved inland over western Alaska on the 20th. The second cyclone moved through the Bering Sea on the 22nd and 23rd and developed a lowest central pressure of 966 hPa in the western Bering Sea before weakening and moving inland. The ship **DLYL2** (49N 168W) reported south winds of 55 kts and 6.7 m seas (22 ft) at 0000 UTC on the 23rd.

North Pacific Storm, November 24-26:

A complex area of low pressure near Japan consolidated while intensifying over a 36 hour period as depicted in **Figure 20**, with the resulting intense low taking a track farther south than other cyclones in November. The central pressure initially fell 34 hPa in the 24 hour period ending at 0000 UTC on the 25th, when the system developed hurricane force winds.

An ASCAT (METOP-B) pass from 2141 UTC on the 25th returned winds of 50 to 60 kts south of the low center but with a swath of missing data. The **WEHR SINGAPORE** (V7ZG7) near 42N 157E reported west winds of 55 kts at 1800 UTC on the 24th. The system subsequently headed for the Gulf of Alaska while weakening.

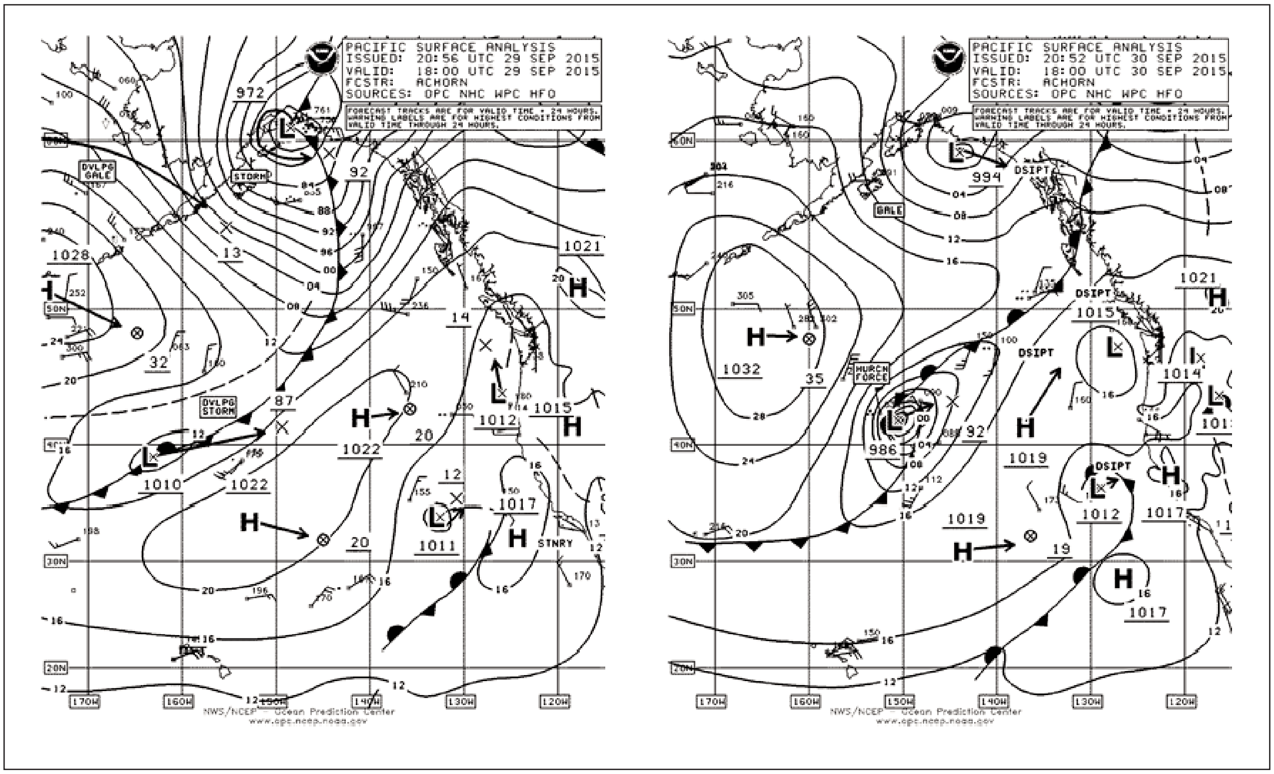

Figure 12. OPC North Pacific Surface Analysis charts (Part 1) valid 1800 UTC September 29 and 30, 2015.

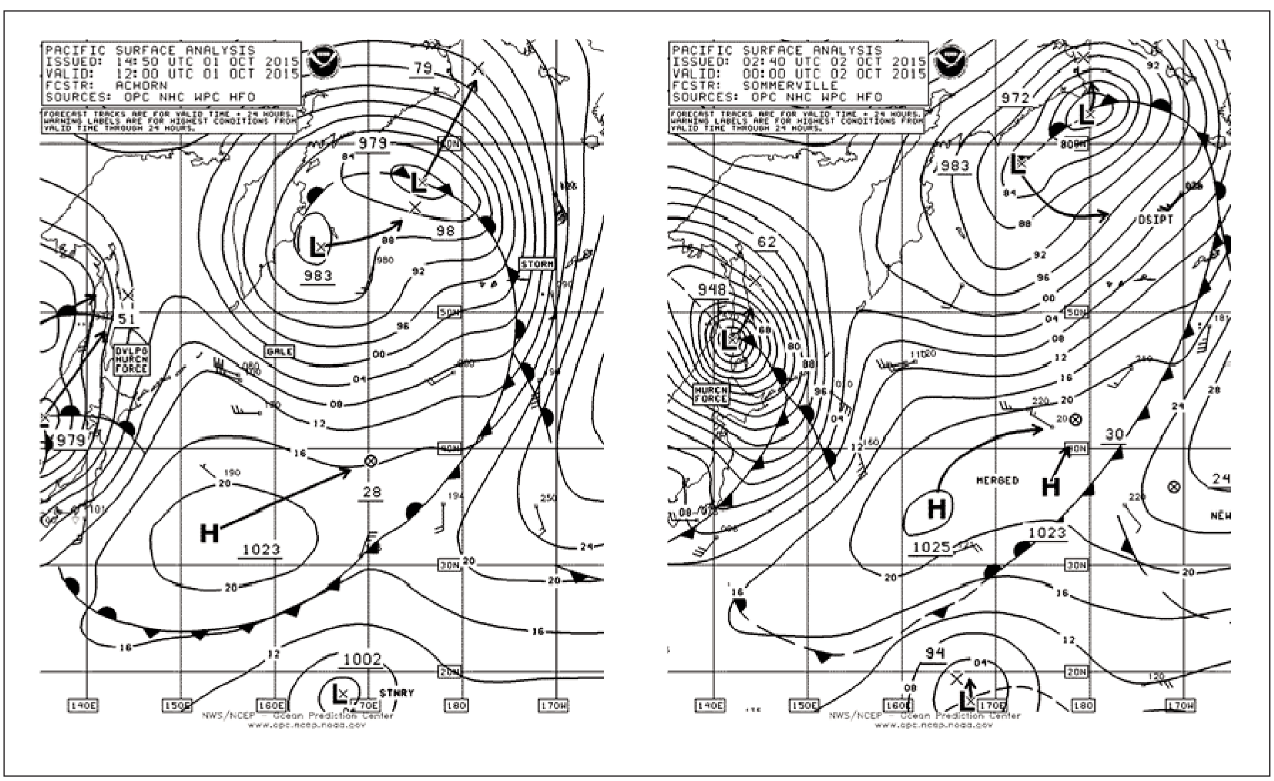

Figure 13. OPC North Pacific Surface Analysis charts (Part 2) valid 1200 UTC October 1 and 0000 UTC October 2, 2015.

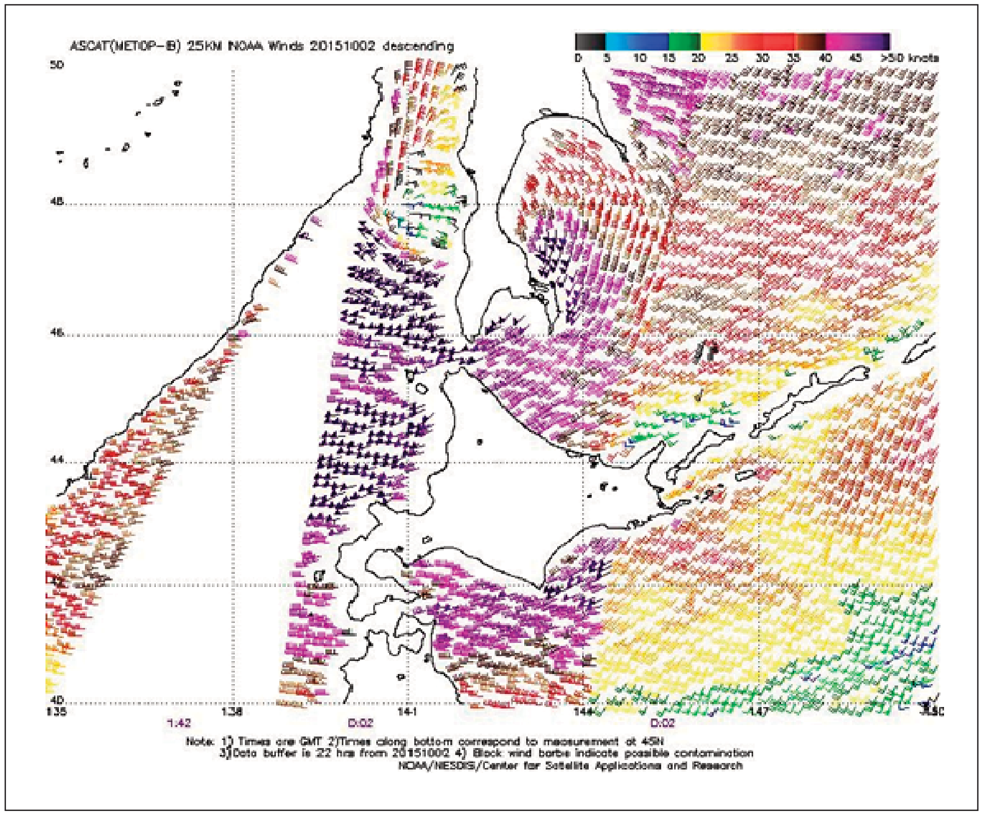

Figure 14. ASCAT (METOP-B) image of satellite-sensed winds (25-km resolution) around the hurricane-force low displayed in the second part of Figure 13. The valid time of the pass containing the strongest winds 0002 UTC October 2, 2015, approximately the valid time of the second part of Figure 13. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

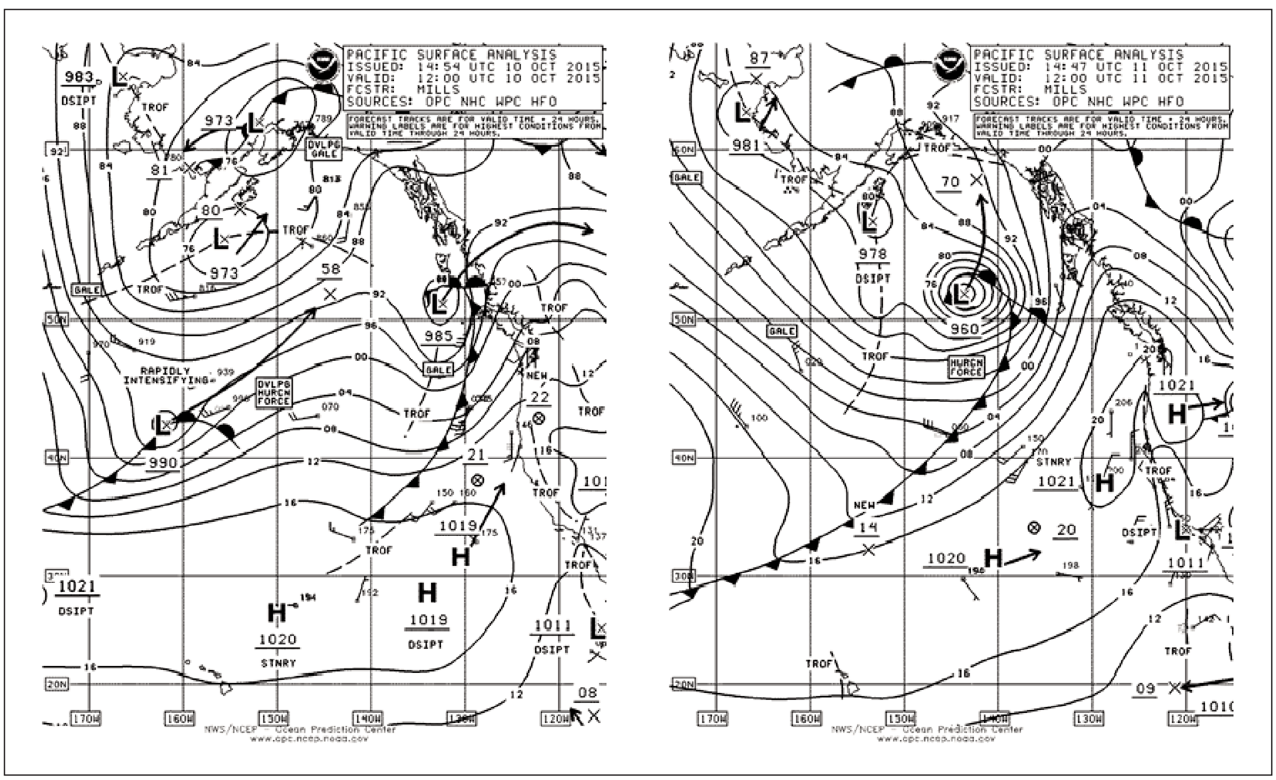

Figure 15. OPC North Pacific Surface Analysis charts (Part 1) valid 1200 UTC October 10 and 11, 2015.

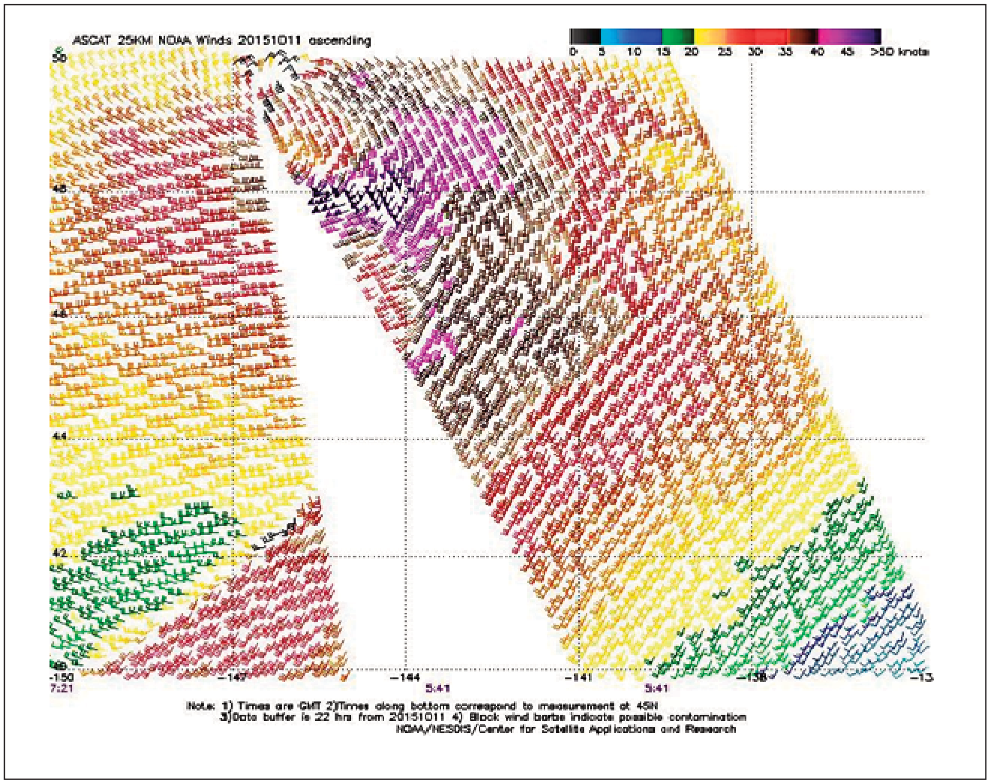

Figure 16. 25-km ASCAT (METOP-A) image of satellite-sensed winds mainly around the south semicircle of the hurricane-force low shown in the second part of Figure 15. Portions of two passes are shown, with valid times of 0541 UTC and 0721 UTC November 11, 2015. The valid time of the later pass is about four and one-half hours prior to the valid time of the second part of Figure 15. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

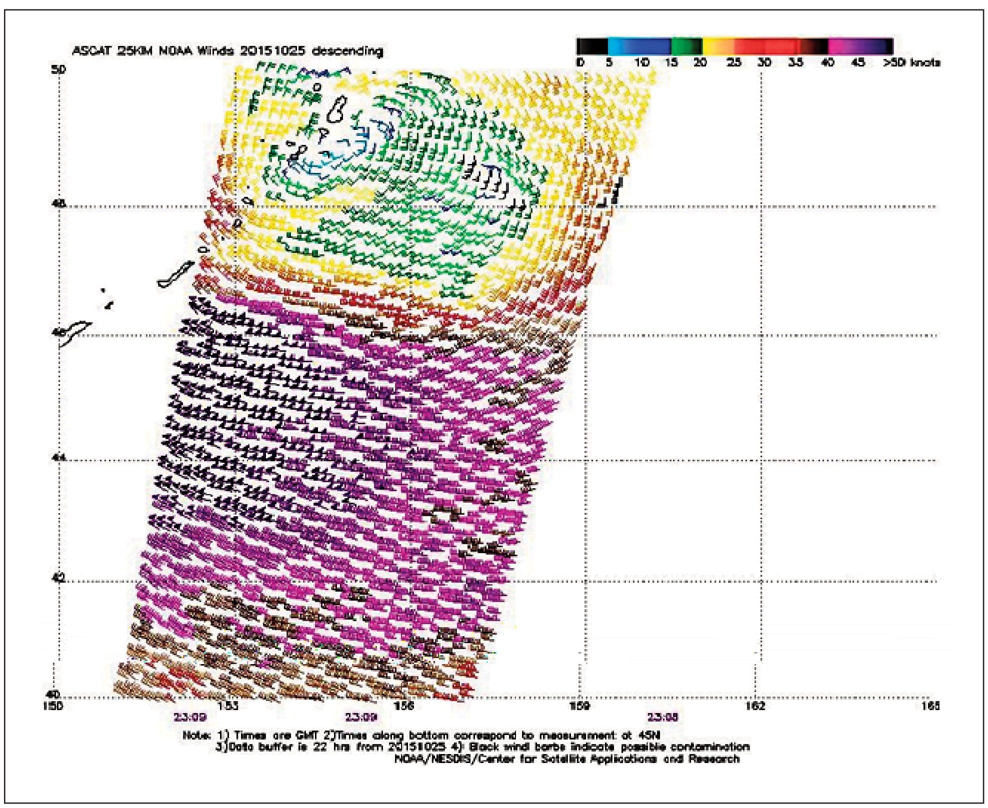

Figure 17. ASCAT (METOP-A) image of satellite-sensed winds (25-km resolution) around mainly the south semicircle of the western-most cyclone shown in Figure 10. The valid time of the pass is 2309 UTC October 25, 2015, or about eleven hours later than the valid time of Figure 10. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

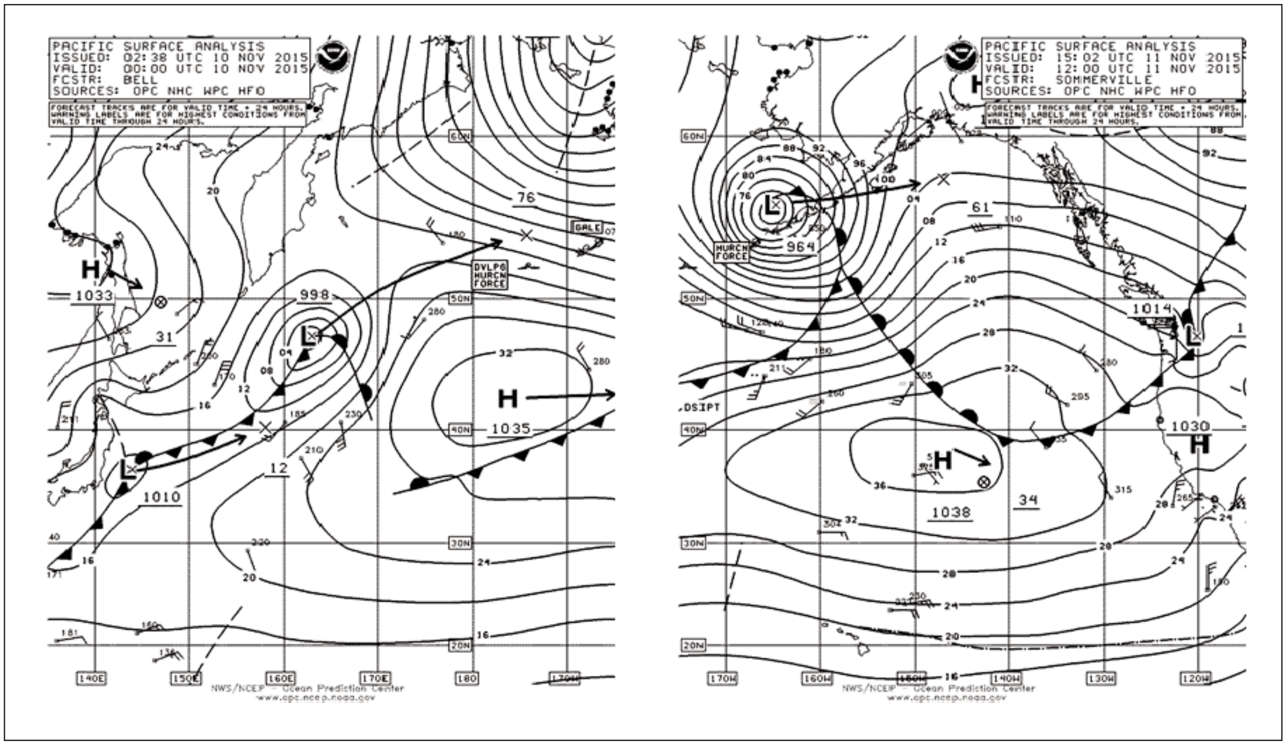

Figure 18. OPC North Pacific Surface Analysis charts valid 0000 UTC November 10 (Part 2) and 1200 UTC November 11, 2015 (Part 1).

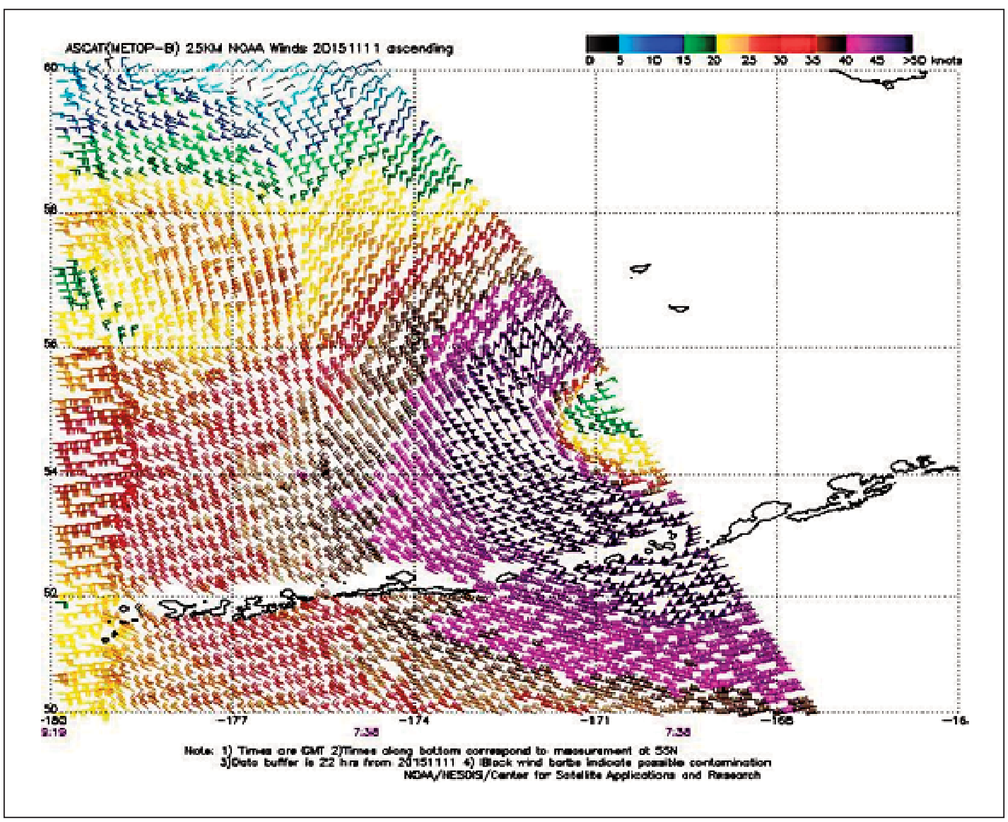

Figure 19. 25-km ASCAT (METOP-B) image of satellite-sensed winds around the southwest semicircle of the hurricane-force low shown in the second part of Figure 18. Portions of two passes are shown, with valid times of 0738 UTC and 0919 UTC November 11, 2015. The valid time of the earlier pass containing the stronger wind retrievals is about four and one-half hours prior to the valid time of the second part of Figure 18. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

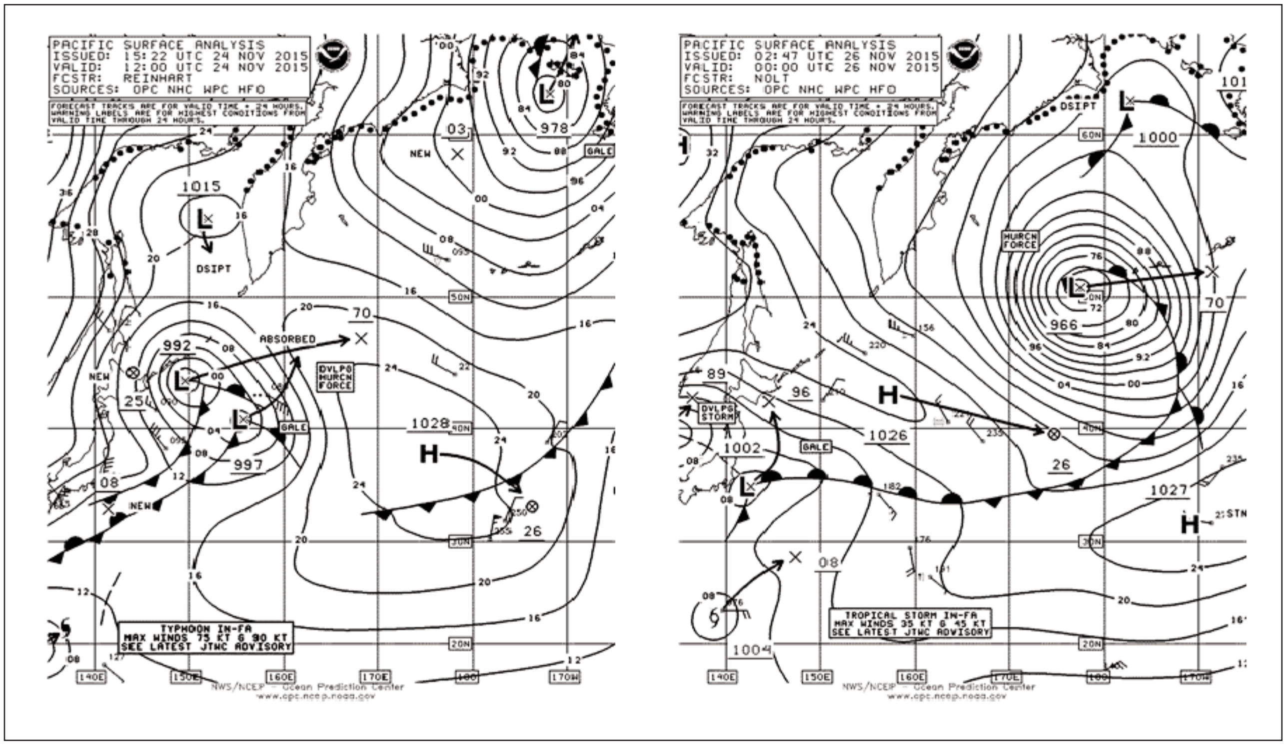

Figure 20. OPC North Pacific Surface Analysis charts (Part 2) valid 1200 UTC November 24 and 0000 UTC November 26, 2015.

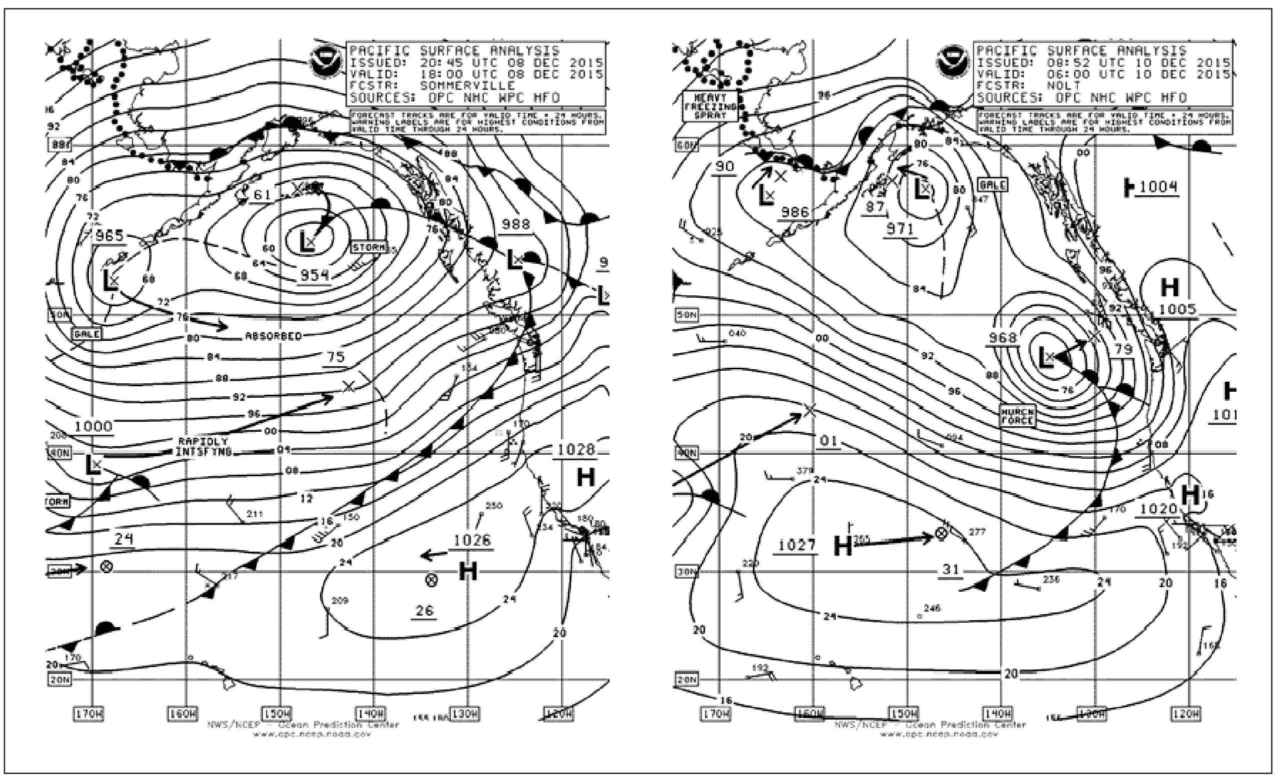

Figure 21. OPC North Pacific Surface Analysis charts (Part 1) valid 1800 UTC December 8 and 0600 UTC December 10, 2015.

Eastern North Pacific Storm, December 8-11:

Low pressure originating off Northern Japan early on December 7th tracked rapidly east southeast before turning more northeast in the eastern waters and rapidly intensifying (Figure 21). The cyclone developed a lowest central pressure of 966 hPa at 1200 UTC on the 10th with hurricane force winds. The ASCAT pass in Figure 23 reveals a swath of northwest winds 50 to 60 kts south of the cyclone center. Buoy 46002 (42.6N 130.5W) reported west winds of 41 kts with gusts to 56 kts and 12 m seas (39 ft) at 1100 UTC on the 10th and highest seas 13 m (43 ft) two hours later. The system then moved inland over the Pacific Northwest on the 11th.

Intense North Pacific and Bering Storm, December 10-15:

Figure 23 and Figure 24 depict the final 24 hours of development of this major event, which originated south of Japan. The central pressure fell 49 hPa in the 24 hour period ending at 0000 UTC on the 13th, or twice the "bomb" rate at 60N (Sanders and Gyakum, 1980). The central pressure reached 924 hPa six hours later, matching the record Nuri event of November 2014. The 500 millibar analysis in Figure 25 falls in the middle of the period of rapid intensification and shows two short wave troughs about to phase and reinforce each other, and develop negative tilt. More information on use of the 500 millibar chart may be found in the References (Sienkiewicz and Chesneau, 2008). Figure 26 is an infrared satellite image of the fully developed cyclone, with well-defined and cold cloud features. Figure 27 is a Rapidscat image of the system with hurricane force wind retrievals colored light red. Adak, Alaska in the central Aleutians reported southwest wind of 82 kts with gusts to 106 kts at 0916 UTC on the 13th and a pressure of 27.73 inches at 0416 UTC on the 13th. The buoy 46072 (51.7N 172.2W) reported 16 m seas (53 ft) at 0900 UTC on the 13th. At 0500 UTC on the 13th the same buoy reported southwest winds of 45 kts with gusts to 64 kts and 10 m seas (33 ft).The cyclone subsequently drifted northeast and slowly weakened through the 15th.

Eastern North Pacific Storm, December 11-13:

An event similar to December 8th -11th occurred simultaneously with the intense North Pacific and Bering event, (Figures 23 and 24). It originated in the southwest waters late on the 8th and tracked east northeast to near Vancouver Island by early on the 13th. An ASCAT pass from 1812 UTC on the 12th returned an area of west winds 50 to 60 kts south of the low center. The cyclone moved inland on the 13th.

Northwest Pacific and Bering Storm. December 15-19:

A complex system of low pressure areas consolidated and intensified over a 36 hour period to produce the large and intense Bering system (Figure 28). The central pressure fell 36 hPa in the 24 hour period ending at 0600 UTC on the 18th. The lowest pressure of 940 hPa (27.76 inches) makes this cyclone the second deepest of the four month period. The ASCAT-B image in Figure 29 reveals a sprawling system with the stronger winds of 50 to 55 kts on the periphery. The buoy 46073 (55.0N/172.0W) reported 12 m seas (41 ft) at 0800 UTC on the 19th. A weakening trend set in on the 18th, and the cyclone dissipated over southwest Alaska on the 20th.

North Pacific Storm, December 30-January 1, 2016:

A new low formed in the south central waters near 37N 178E and tracked east northeast while rapidly intensifying. The central pressure fell 33 hPa in the 24 hour period ending at 0000 UTC on the 31st.

Figure 30 shows the system near maximum intensity and relatively compact with hurricane force winds. ASCAT winds with this system appear similar to Figure 16 for the October 10th - 12th event.

The **HORIZON ANCHORAGE** (KGTX) reported southeast winds of 60 kts near 53N 147.3W at 1200 UTC January 1st. The cyclone subsequently drifted north with slow weakening into early January.

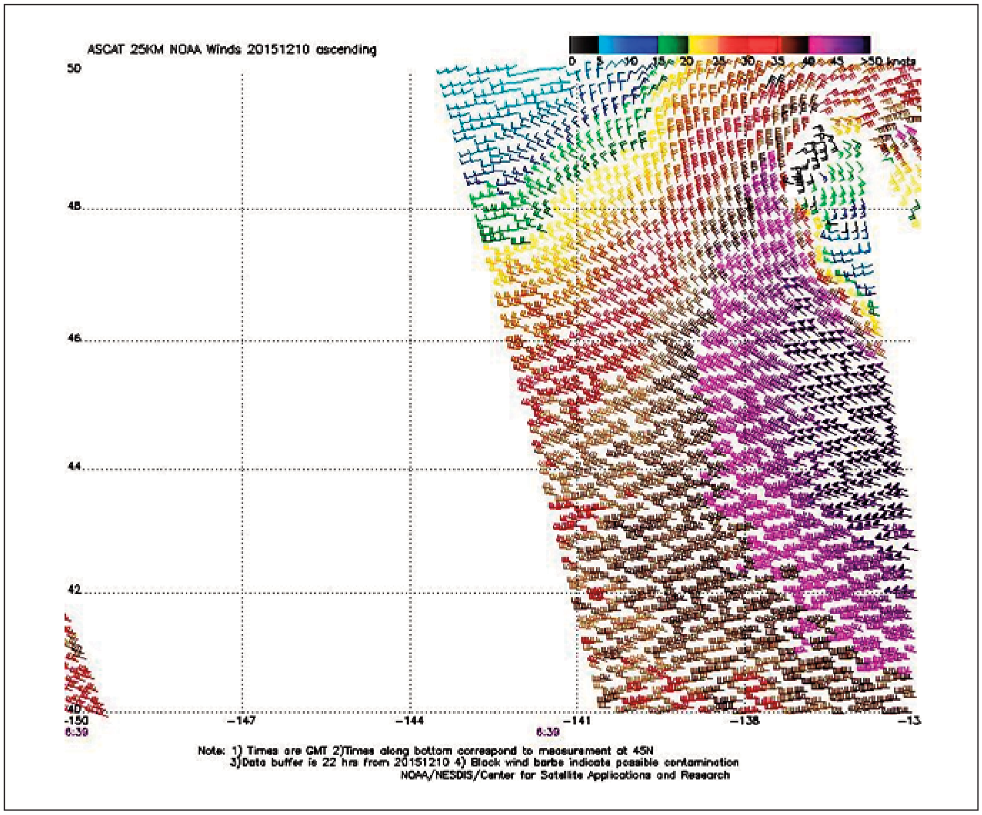

Figure 22. ASCAT (METOP-A) image of satellite-sensed winds (25-km resolution) mainly around the west side of the cyclone shown in the second part of Figure 21. The valid time of the pass is 0839 UTC December 10, 2015 or about two and three quarters hours later than the valid time of the second part of Figure 21. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

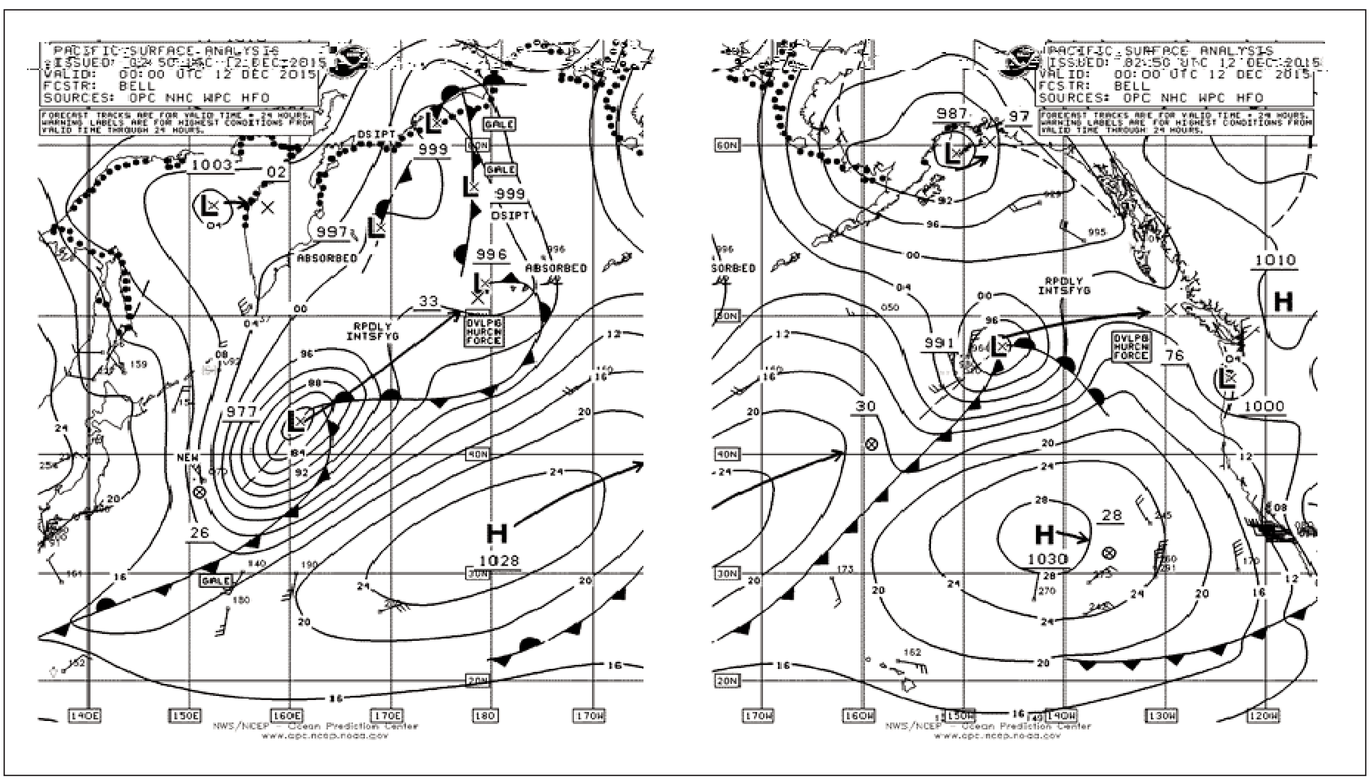

Figure 23. OPC North Pacific Surface Analysis charts (Parts 1 and 2) valid 0000 UTC December 12, 2015. The two parts overlap between 165W and 175W.

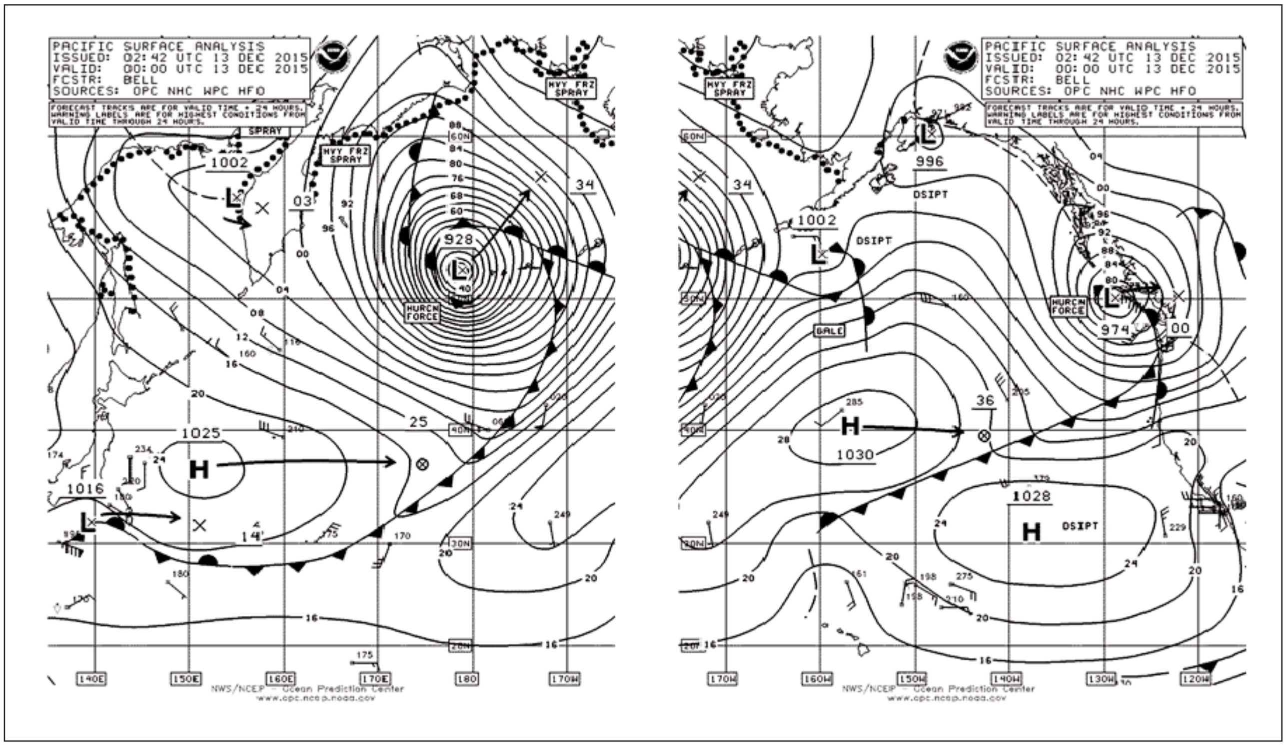

Figure 24. OPC North Pacific Surface Analysis charts (Parts 1 and 2) valid 0000 UTC December 13, 2015. The two parts overlap between 165W and 175W.

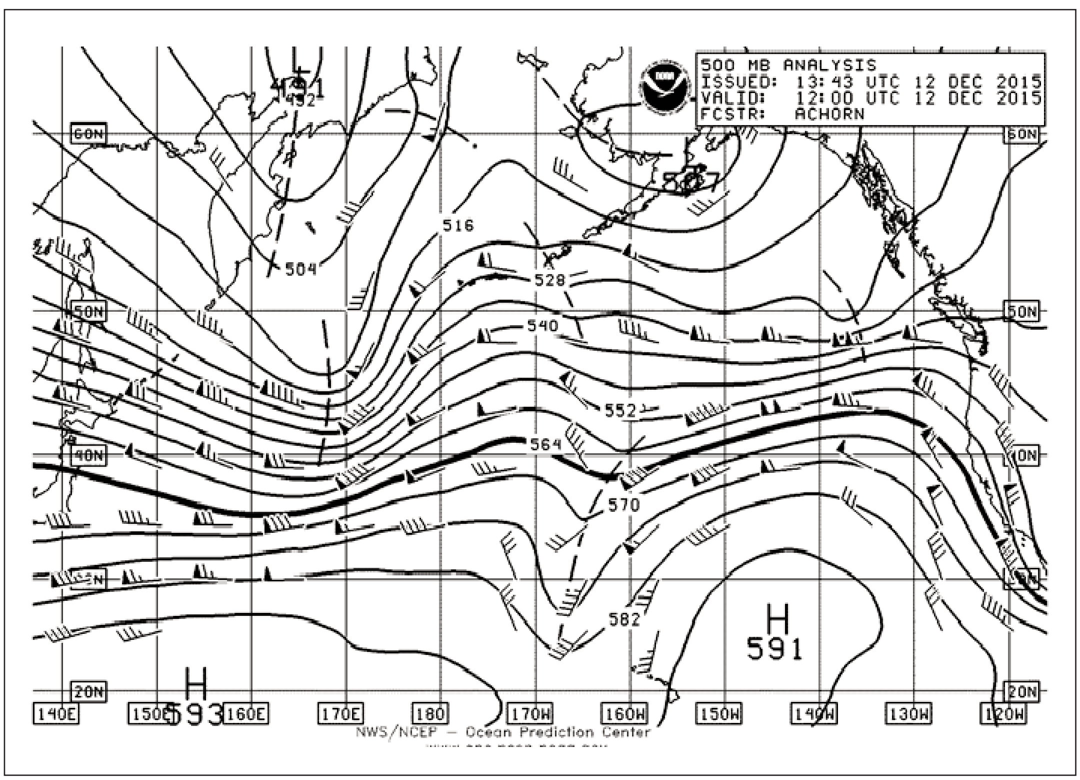

Figure 25. OPC North Pacific 500 MB Analysis valid 1200 UTC December 12, 2015. The chart is computer-generated, with short-wave troughs (dashed lines) manually added.

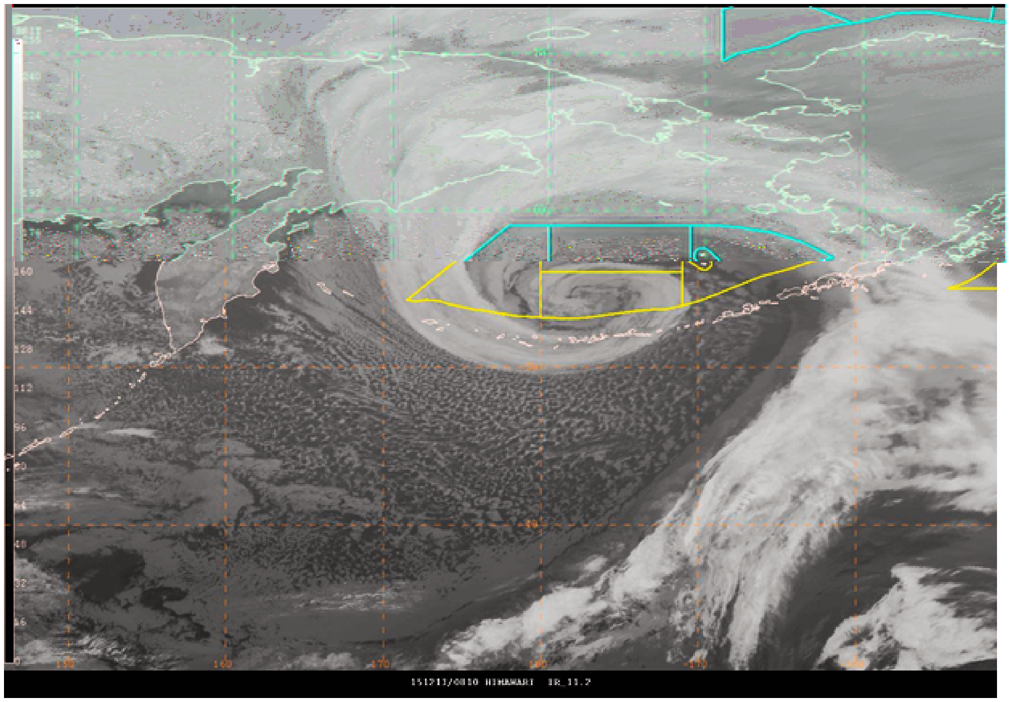

Figure 26. Himawari infrared satellite image valid 0810 UTC December 13, 2015, or about eight hours later than the valid time of Figure 24. Satellite senses temperature on a scale from warm (black) to cold (white) in this type of image.

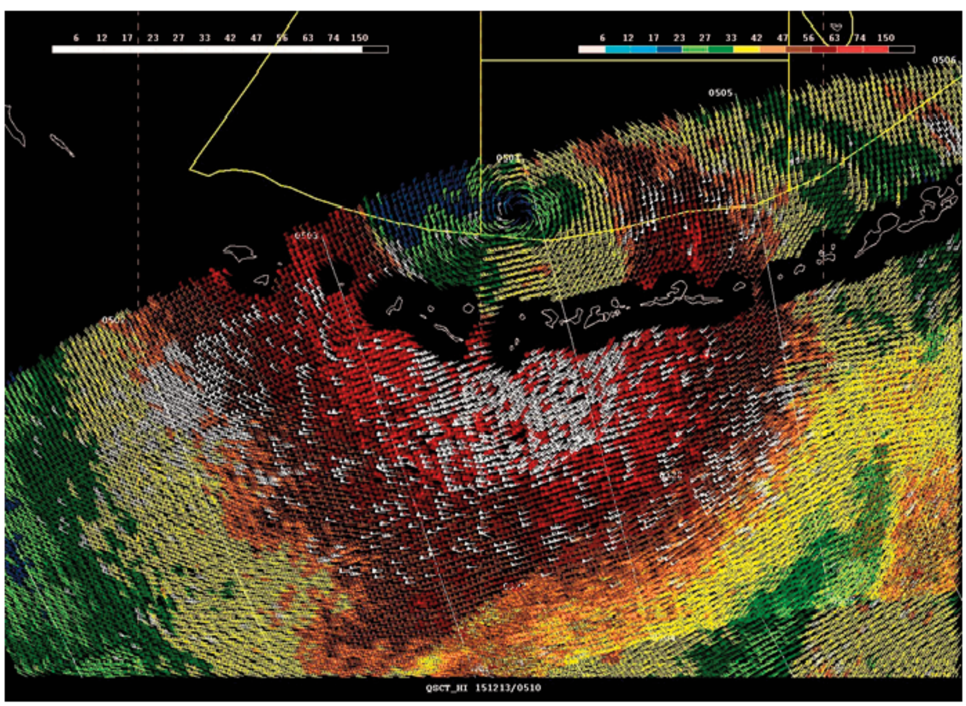

Figure 27. Rapidscat image of satellite-sensed winds (12.5-km resolution) around the hurricane-force low shown in Figure 24. The valid time of the pass is approximately 0504 UTC December 13, 2015, based on the diagonal cross-track time line labeled with a four-digit UTC near the center of the image. The valid time is about five hours later than the valid time of Figure 24. In this case the satellite is an instrument attached to the International Space Station. Wind barbs are colored according to the scale at the top, with white barbs rain-flagged.

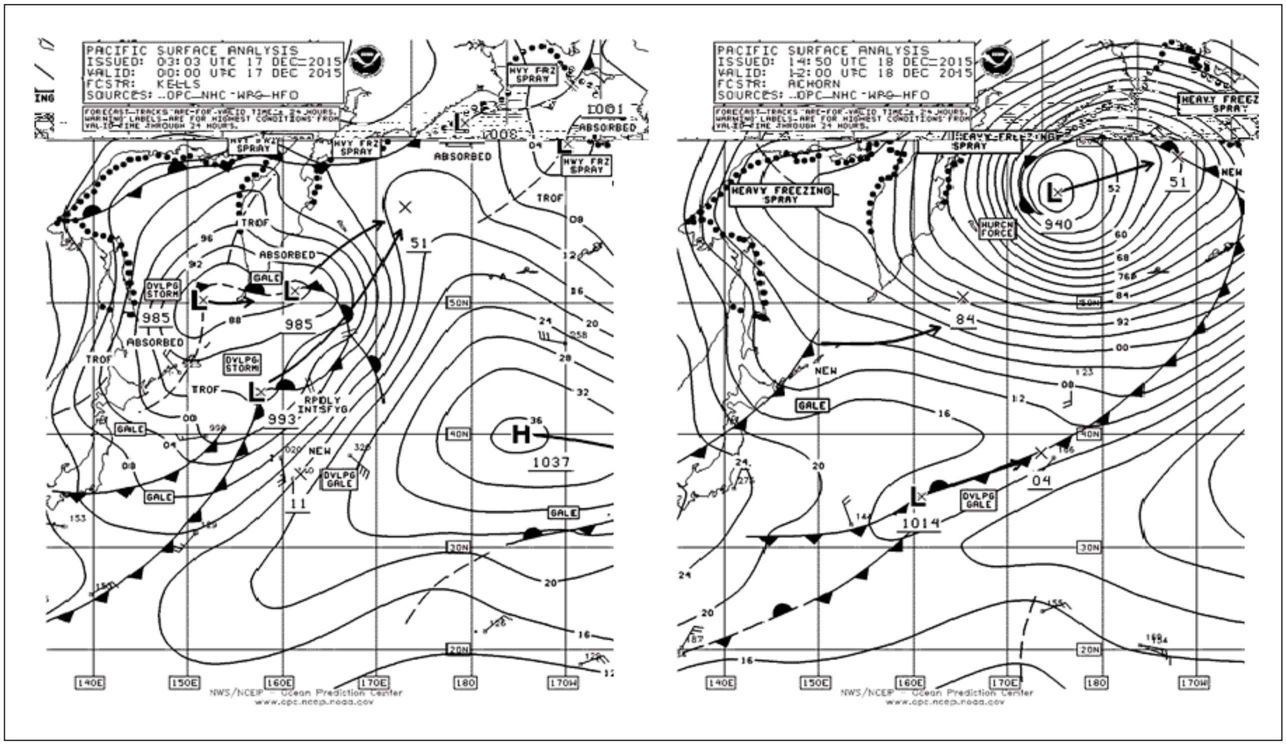

Figure 28. OPC North Pacific Surface Analysis charts (Part 2) valid 0000 UTC December 17 and 1200 UTC December 18, 2015.

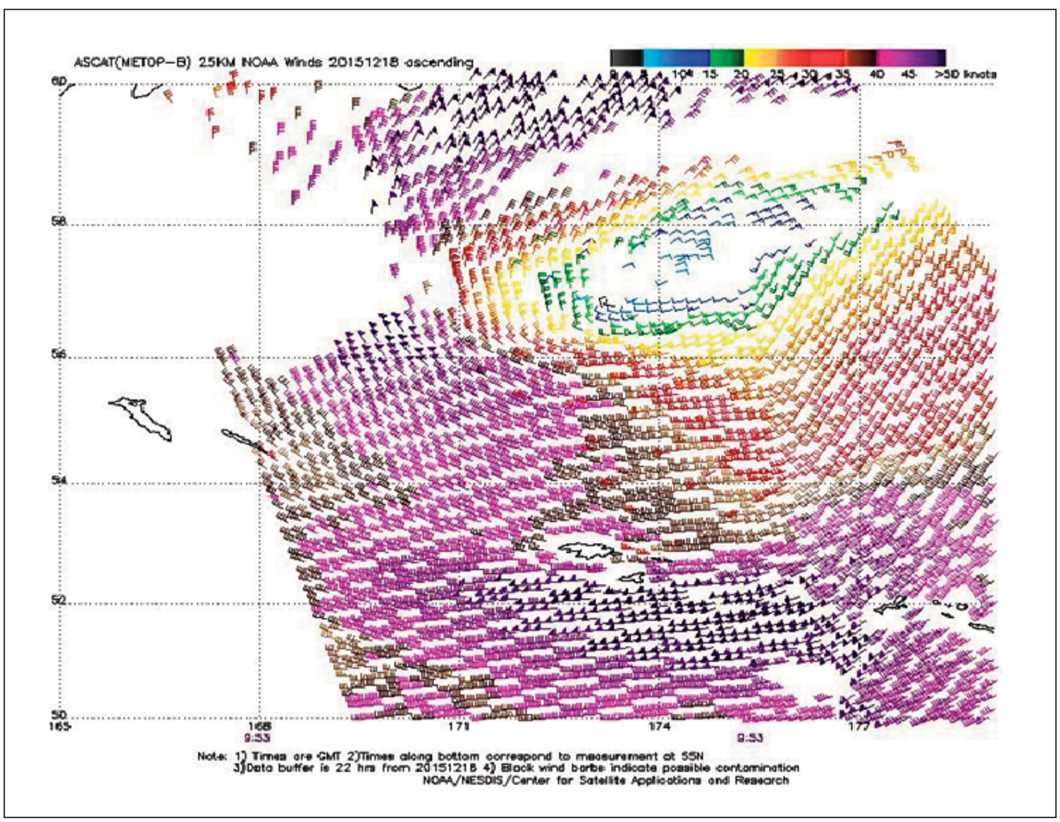

Figure 29. ASCAT (METOP-B) image of satellite-sensed winds (25-km resolution) around the south, west and north sides of the hurricane-force low shown in the second part of Figure 28. The valid time of the pass is 0953 UTC December 18, 2015 or about two hours prior to the valid time of the second part of Figure 28. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

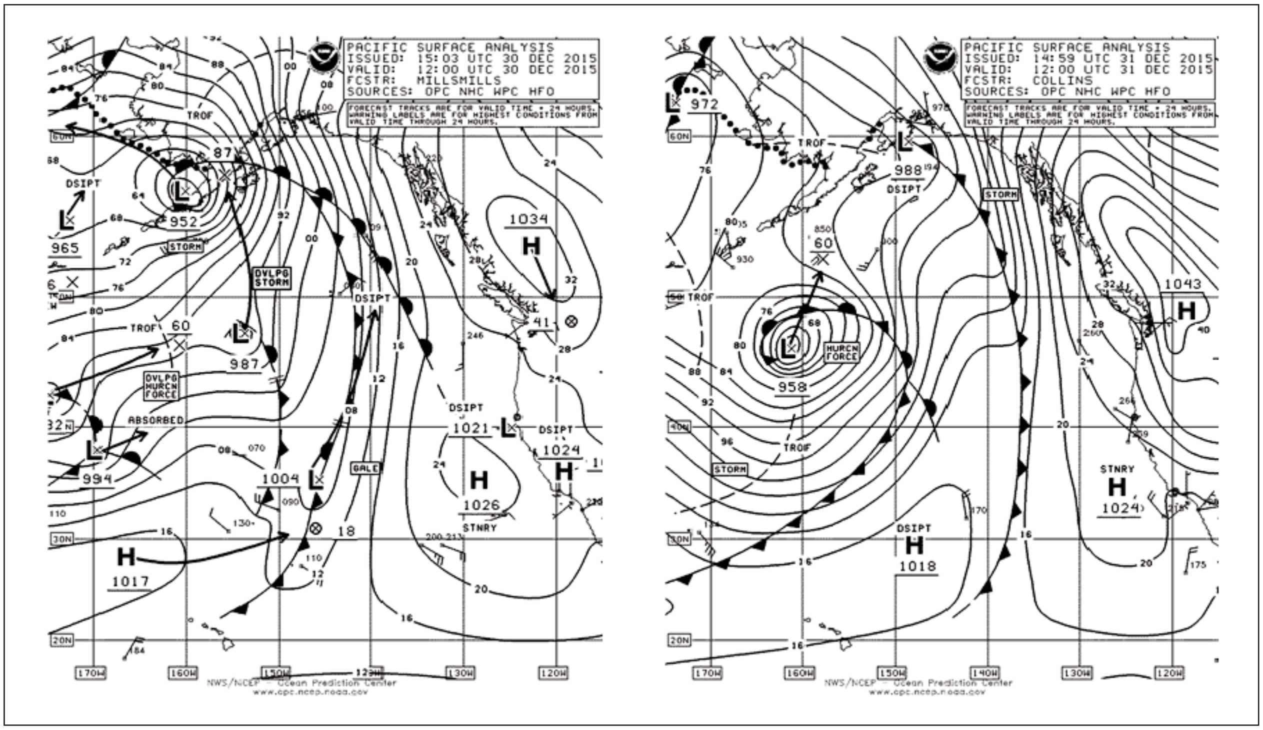

Figure 30. OPC North Pacific Surface Analysis charts (Part 1) valid 1200 UTC December 30 and 31, 2015.

References

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2. Ocean Surface Winds, http://manati.star.nesdis.noaa.gov/products.php

3. VonAhn, Joan. and Sienkiewicz, Joe, “Hurricane Force Extratropical Cyclones Observed Using QuikSCAT Near Real Time Winds”, Mariners Weather Log, Vol. 49, No. 1, April 2005.

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7. Sienkiewicz, Joe and Chesneau, Lee, “Mariner’s Guide to the 500-Millibar Chart”, Mariners Weather Log, December 2008.

8. http://www.mashable.com/2015/12/28/Freak-atlantic-storm-uk-Frank/#V5Ew

Tropical Atlantic and Tropical East Pacific Areas

January through April 2016

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

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

Atlantic Highlights

The TAFB Atlantic High Seas area of responsibility (AOR) extends from 7°N to 31°N west of 35°W, including the Caribbean Sea and Gulf of Mexico. Forty eight gale warnings were issued for this area from January through April 2016; with four storm force wind warnings and no hurricane force wind warnings issued during the period. The 48 warnings issued in the Atlantic basin was the second highest number of warnings ever issued by TAFB during a winter season, following the record breaking winter season of 2015 with 54 warnings. The number of warnings was up from the January through April five year average of 31 warnings. Of the 48 warnings issued, 15 of these were located in the Gulf of Mexico, 13 of these were located in the Atlantic Ocean, and 20 were located in the Caribbean Sea.

Table 1. Non-tropical warnings issued for the Atlantic Ocean between 01 January 2016 and 30 April 2016. Storm events are in Yellow and the duration of the storm warning is in parentheses.

ONSET	REGION	PEAK WIND (kts)	GALE DURATION (STORM)	FORCING
01 Jan 0000 UTC	Caribbean	35	24 h	Pressure Gradient
01 Jan 1800 UTC	Gulf of Mexico	40	24 h	Cold Front
03 Jan 0000 UTC	Gulf of Mexico	35	06 h	Cold Front
03 Jan 1800 UTC	Gulf of Mexico	35	06 h	Cold Front
06 Jan 1200 UTC	**SW North Atlantic**	**55**	**66 h (12 h)**	**Cold Front**
10 Jan 0600 UTC	**SW North Atlantic**	**50**	**78 h (12 h)**	**Cold Front**
15 Jan 0600 UTC	Gulf of Mexico	35	12 h	Pressure Gradient
15 Jan 1200 UTC	SW North Atlantic	40	36 h	Pressure Gradient
17 Jan 0000 UTC	**Gulf of Mexico**	**50**	**18 h (12 h)**	**Cold Front**
17 Jan 1200 UTC	SW North Atlantic	40	24 h	Pressure Gradient
22 Jan 0600 UTC	Gulf of Mexico	40	42 h	Cold Front
22 Jan 1800 UTC	SW North Atlantic	35	66 h	Cold Front
26 Jan 0600 UTC	Caribbean	35	12 h	Pressure Gradient
27 Jan 0600 UTC	Caribbean	35	12 h	Pressure Gradient
27 Jan 0600 UTC	Gulf of Mexico	35	42 h	Cold Front

ONSET	REGION	PEAK WIND (kts)	GALE DURATION (STORM)	FORCING
29 Jan 0600 UTC	SW North Atlantic	40	30 h	Cold Front
04 Feb 0000 UTC	Gulf of Mexico	35	06 h	Cold Front
04 Feb 1800 UTC	Gulf of Mexico	35	12 h	Cold Front
07 Feb 1200 UTC	**SW North Atlantic**	**50**	**36 h (12 h)**	**Cold Front**
08 Feb 1800 UTC	Gulf of Mexico	35	36 h	Cold Front
09 Feb 0000 UTC	SW North Atlantic	35	42 h	Cold Front
11 Feb 0600 UTC	Caribbean	35	12 h	Pressure Gradient
12 Feb 0600 UTC	Caribbean	35	12 h	Pressure Gradient
15 Feb 0600 UTC	Caribbean	35	12 h	Pressure Gradient
16 Feb 0600 UTC	SW North Atlantic	35	12 h	Cold Front
19 Feb 0600 UTC	Caribbean	35	12 h	Pressure Gradient
20 Feb 0600 UTC	Caribbean	35	12 h	Pressure Gradient
21 Feb 0600 UTC	Caribbean	35	12 h	Pressure Gradient
23 Feb 1800 UTC	Gulf of Mexico	35	30 h	Cold Front
04 Mar 1200 UTC	SW North Atlantic	35	06 h	Cold Front
07 Mar 1800 UTC	SW North Atlantic	40	24 h	Cold Front
09 Mar 0600 UTC	Gulf of Mexico	35	36 h	Cold Front
10 Mar 0000 UTC	Caribbean	35	36 h	Pressure Gradient
11 Mar 1800 UTC	Caribbean	35	18 h	Pressure Gradient
20 Mar 0000 UTC	Gulf of Mexico	40	30 h	Cold Front
23 Mar 0000 UTC	Caribbean	35	12 h	Pressure Gradient
24 Mar 0000 UTC	Caribbean	35	06 h	Pressure Gradient
25 Mar 0000 UTC	Caribbean	35	12 h	Pressure Gradient
26 Mar 0000 UTC	Caribbean	35	12 h	Pressure Gradient
27 Mar 0600 UTC	Caribbean	35	06 h	Pressure Gradient
28 Mar 0000 UTC	Caribbean	35	12 h	Pressure Gradient
31 Mar 0600 UTC	Gulf of Mexico	40	06 h	Pressure Gradient
02 Apr 0600 UTC	Gulf of Mexico	40	18 h	Cold Front
09 Apr 0600 UTC	Caribbean	35	06 h	Pressure Gradient
10 Apr 0600 UTC	Caribbean	35	06 h	Pressure Gradient
11 Apr 0600 UTC	Caribbean	35	06 h	Pressure Gradient
20 Apr 0600 UTC	SW North Atlantic	35	12 h	Cold Front
25 Apr 1200 UTC	SW North Atlantic	40	24 h	Pressure Gradient

Table 1 details the warnings issued in the TAFB Atlantic High Seas AOR from January through April 2016. The strongest wind event this winter season was a storm force event that occurred in the southwest North Atlantic region that materialized as a weak 1012 hPa low pressure area on 06 January at 1800 UTC across the northwestern Bahamas. The low went through a period of rapid-intensification, deepening to 987 hPa, a drop of more than 1 hPa an hour within a 24 hour period by 07 January at 1800 UTC. The result of this rapid deepening generated gale force conditions for almost three days beginning 06 January at 1200 UTC in the vicinity of the low center. A brief 12 hour period of storm force winds occurred- near the low center with **Figure 1** showing a MetOp Advanced SCATerometer (ASCAT-B) pass from 07 January. Note the blue and pink wind barbs indicating 34-49 kts gale force winds and purple wind barbs indicating 50-63 kts storm force winds in the southwest North Atlantic that reached the surface. Warnings were discontinued across the region by 0600 UTC 09 January.

Figure 2 shows a RapidScat pass several hours later on 07 January indicating the storm force winds within the southwestern quadrant of the low. The RapidScat instrument is currently a scatterometer onboard the International Space Station (ISS).

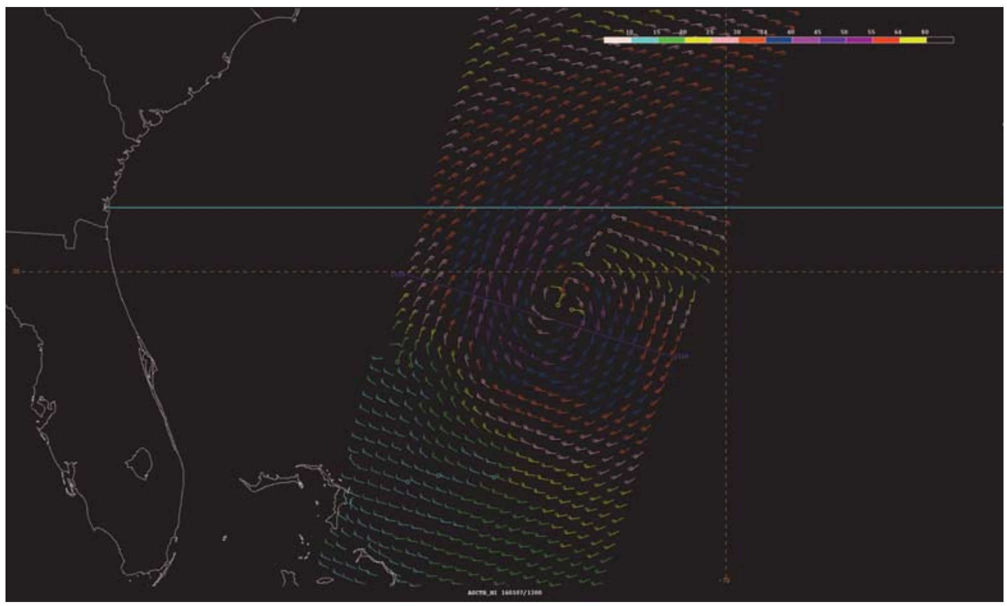

Figure 1.
A scatterometer pass from the MetOp Advanced SCATerometer (ASCAT-B) valid around 1510 UTC 07 January. Note the dark blue and pink wind barbs in the southwest North Atlantic indicating gale force winds between 34 kts and 49 kts and the purple wind barbs indicating storm force winds between 50 kts and 63 kts.

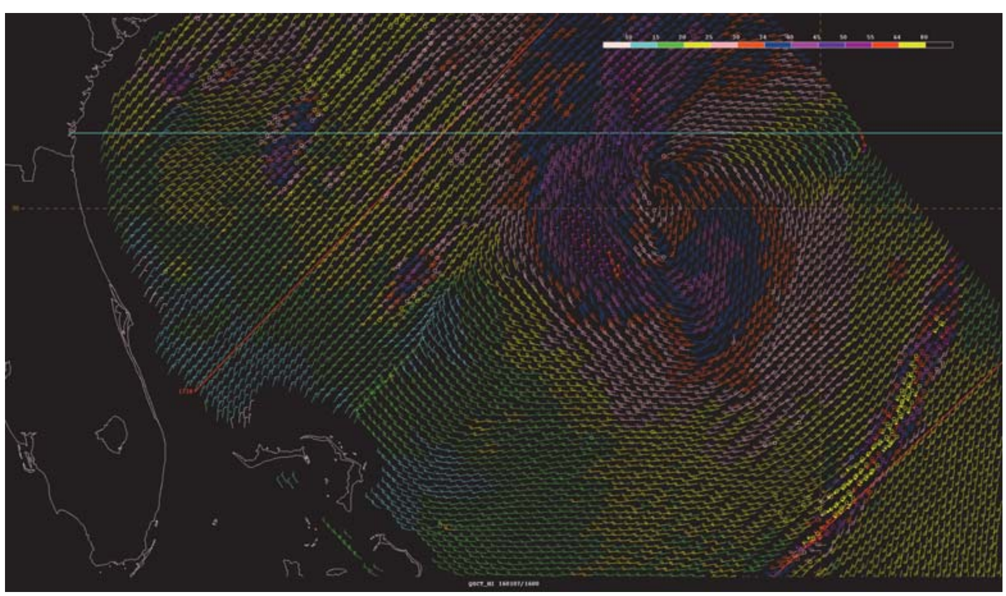

Figure 2.
A RapidScat pass valid around 1738 UTC 07 January. Note the dark blue and pink wind barbs in the southwest North Atlantic indicating gale force winds between 34 kts and 49 kts and the purple wind barbs indicating storm force winds between 50 kts and 63 kts.

During this storm force wind event, several ships reported gale or storm force conditions and these are summarized in **Table 2**.

Table 2. Ship observations during the gale warning period beginning 06 January 1200 UTC and ending 09 January 0600 UTC.

SHIP	CALL SIGN	WIND SPEED	LOCATION	DATE / TIME
CARNIVAL FANTASY	H3GS	40 kts	23.5N 80.0W	06 Jan 1200 UTC
CARNIVAL FASCINATION	C6FM9	35 kts	26.5N 79.3W	06 Jan 1200 UTC
CELEBRITY ECLIPSE	9HXC9	39 kts	25.6N 77.5W	06 Jan 2300 UTC
COSCO GERMANY	CQGT	45 kts	28.4N 74.3W	07 Jan 1200 UTC

The longest duration gale force wind event for the Caribbean Sea was 36 hours in length and formed due to a strong pressure gradient set up between a relatively strong high pressure system anchored across the southwest North Atlantic Ocean and lower pressure across the northwestern South American continent. Gale force conditions persisted for a day and a half before a frontal trough across the southeastern United States weakened the southwest North Atlantic ridging and relaxed the pressure gradient across the Caribbean Sea. **Figure 3** shows a MetOp Advanced SCATerometer (ASCAT-B) pass from 10 March.

Note the blue wind barbs indicating 34 to 40 kts winds in the southwestern Caribbean Sea near the coast of Colombia that reached the surface. In addition, the red wind barbs indicate near gale force winds, 28 to 33 kts winds extending 120 nmi off the northern coast of Colombia. **Figure 4** shows a RapidScat pass more than 24 hours later early on 11 March indicating the extent of near gale to gale force winds continuing across a large portion of the southwest Caribbean Sea. Warnings were discontinued in the Caribbean Sea by 1200 UTC 11 March.

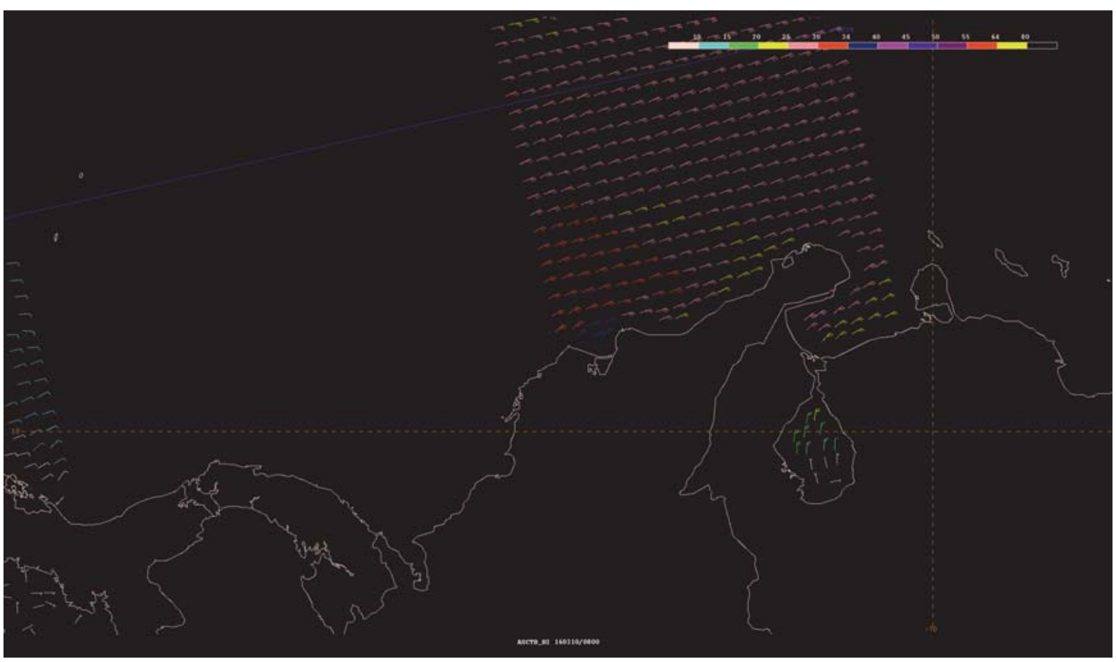

Figure 3. A scatterometer pass from the MetOp Advanced SCATerometer (ASCAT-B) valid around 0238 UTC 10 March. Note the dark blue wind barbs in the southwest Caribbean Sea off the coast of Colombia indicating gale force winds between 34 kts and 49 kts. In addition, the red wind barbs indicate near gale force winds between 28 kts and 33 kts extending 120 nmi off the coast of Colombia.

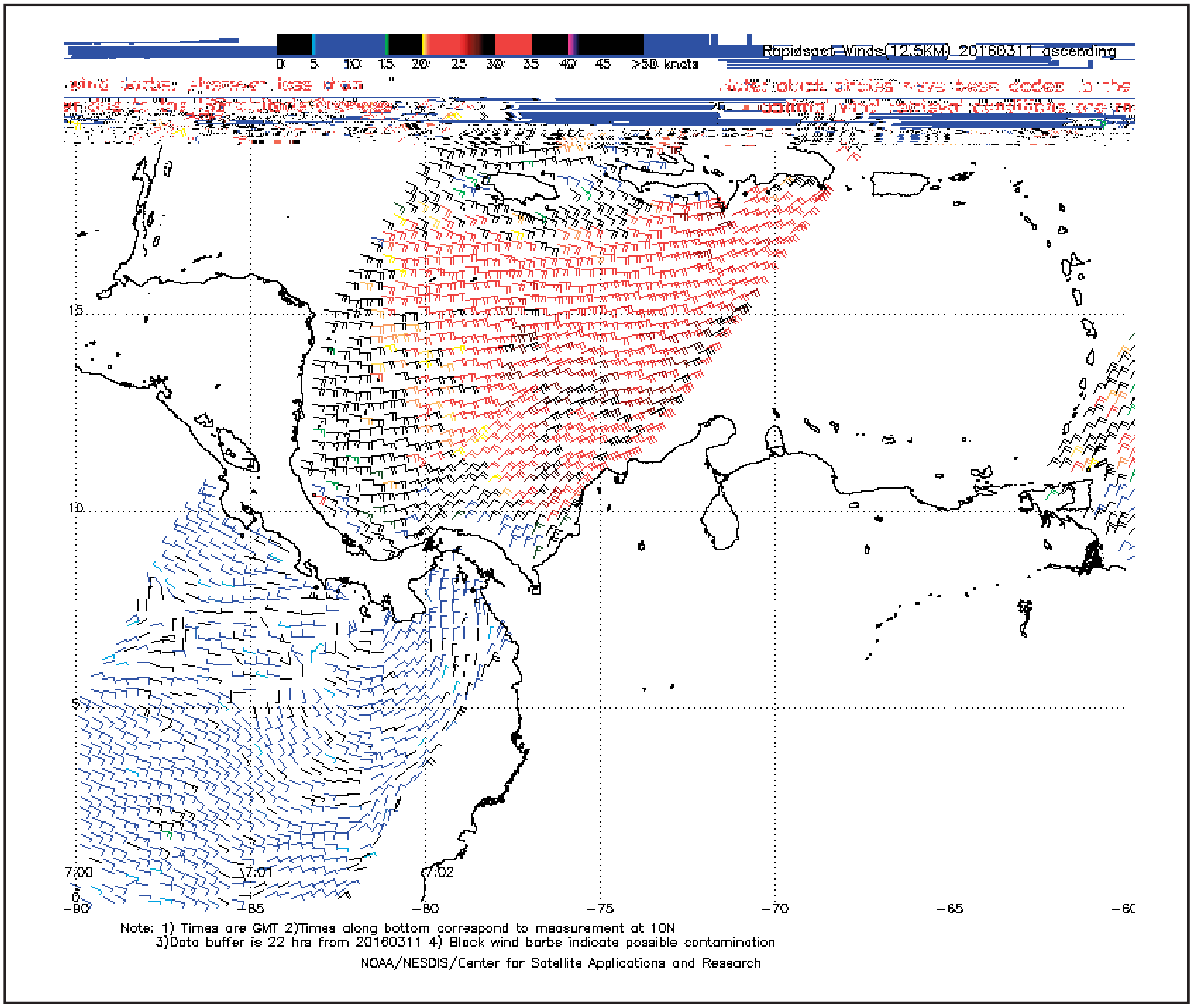

Figure 4. A RapidScat pass valid around 0702 UTC 11 March. Note the brown wind barbs in the southwest Caribbean Sea indicating gale force winds between 34 kts and 49 kts and the red wind barbs indicating near gale force winds between 28 kts and 33 kts.

The strongest and longest duration Gulf of Mexico warning was a gale force warning that occurred across the basin in the four month period. This gale force warning began at 0600 UTC 22 January and persisted for 42 hours. A strong surface pressure gradient materialized across the Gulf of Mexico waters after the passage of a strong cold front. **Table 3** summarizes ships that reported winds of gale force or greater west of the cold front. The following two figures, **Figure 5** and **Figure 6**, are RapidScat passes valid during the warning period time showing brown and red wind barbs which indicate near gale to gale force conditions.

Table 3. Ship observations during the gale warning period beginning 22 January 0600 UTC and ending 24 January 0000 UTC.

SHIP	CALL SIGN	WIND SPEED	LOCATION	DATE / TIME
DISCOVERER DEEP SEAS	V7HC6	38 kts	28.7N 90.0W	22 Jan 0600 UTC
OVERSEAS ANACORTES	KCHV	40 kts	28.7N 88.0W	22 Jan 0600 UTC
PACIFIC SHARAV	D5DY4	44 kts	27.1N 91.2W	22 Jan 0700 UTC
MAERSK CAROLINA	WBDS	37 kts	26.6N 89.2W	22 Jan 1200 UTC
MAERSK CAROLINA	WBDS	35 kts	27.3N 91.1W	22 Jan 1800 UTC

SHIP	CALL SIGN	WIND SPEED	LOCATION	DATE / TIME
NORWEGIAN JADE	C6WK7	36 kts	28.2N 92.9W	23 Jan 0000 UTC
BRASIL VOYAGER	C6ZJ8	38 kts	29.1N 87.1W	23 Jan 0000 UTC
CARIBBEAN PRINCESS	ZCDG8	45 kts	24.2N 88.6W	23 Jan 0000 UTC
CARNIVAL DREAM	3ETA7	35 kts	22.5N 85.7W	23 Jan 0100 UTC
ASIA VISION	C6AX3	40 kts	23.9N 84.1W	23 Jan 0300 UTC
NORWEGIAN DAWN	C6FT7	40 kts	22.1N 86.5W	23 Jan 0700 UTC
SEABULK TRADER	KNJK	45 kts	26.8N 89.9W	23 Jan 1000 UTC
NORWEGIAN STAR	C6FR3	43 kts	23.6N 86.0W	23 Jan 1200 UTC
REGAL PRINCESS	ZCEK6	40 kts	23.7N 81.8W	23 Jan 2000 UTC

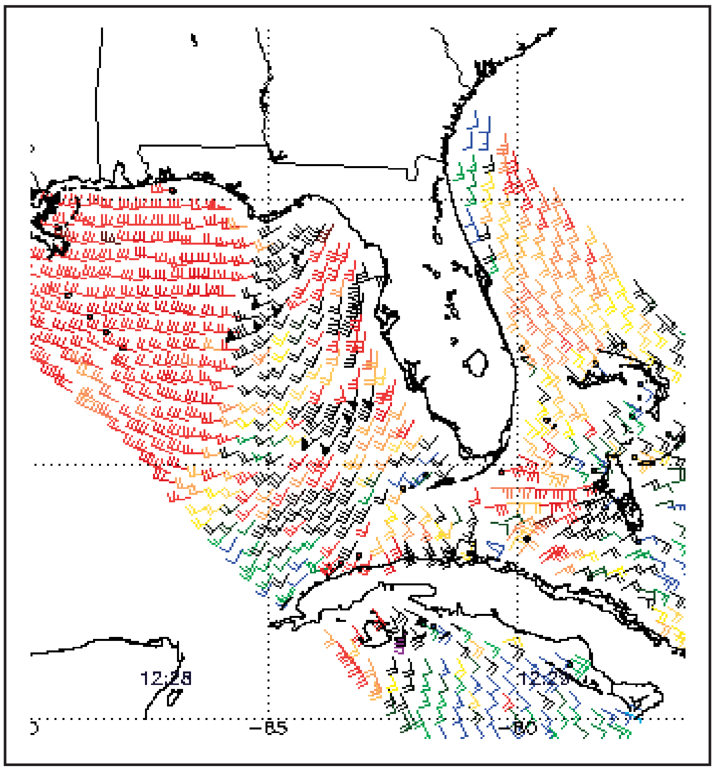

Figure 5. A scatterometer pass from the RapidScat instrument aboard the International Space Station (ISS) valid around 1228 UTC 22 January. Note the brown and red wind barbs in the eastern Gulf of Mexico indicating near gale to gale force winds.

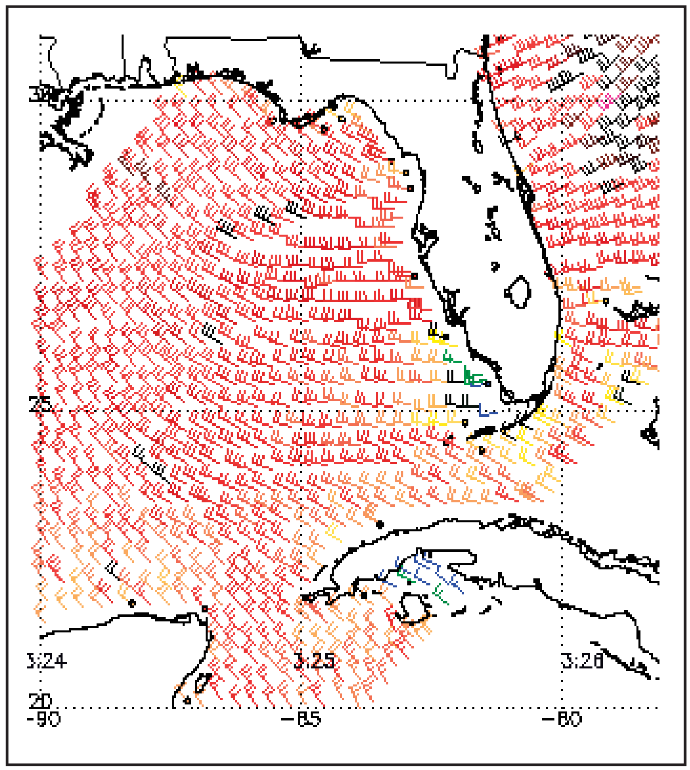

Figure 6. A scatterometer pass from the RapidScat instrument aboard the International Space Station (ISS) valid around 0325 UTC 23 January. Note the brown and red wind barbs in the eastern Gulf of Mexico indicating near gale to gale force winds.

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

Pacific Highlights There were 25 gale or stronger events in the North Pacific east of 140W between 30N and the equator from 01 January 2016 to 30 April 2016 (**Table P-A**). Of these events, 11 occurred over the gulf of Tehuantepec, 4 over the Gulf of Papagayo, 5 over the open waters of the Pacific N of 27N, 4 over the Gulf of California, and 1 over the tropical Pacific. Four of the events over the Gulf of Tehuantepec reached Storm Force of 50 kts or greater with nine events over this portion of the Pacific persisting 36 hours or longer at gale force.

Table P-A lists the Gale or greater events over the northern Pacific east of 140 W between 30 N and the Equator. Storm events are in Yellow and the duration of the storm warning is in parentheses.

ONSET	REGION	PEAK WIND (kts)	GALE / STORM DURATION	FORCING
0430 UTC 01 Jan	Gulf of Tehuantepec	40	108 hr	Gap
0430 UTC 03 Jan	Eastern Pacific 27N	35	12 hr	Front
1630 UTC 10 Jan	Eastern Pacific 28N	35	06 hr	Front
1630 UTC 10 Jan	Gulf of Tehuantepec	40	24 hr	Gap
0430 UTC 13 Jan	Gulf of Tehuantepec	35	12 hr	Gap
1630 UTC 17 Jan	**Gulf of Tehuantepec**	**50**	**72 hr / 06 hr**	**Gap**
1030 UTC 19 Jan	Gulf of Papagayo	35	30 hr	Gap
1630 UTC 22 Jan	**Gulf of Tehuantepec**	**50**	**54 hr / 24 hr**	**Gap**
1030 UTC 24 Jan	Gulf of Papagayo	35	36 hr	Gap
1030 UTC 28 Jan	Gulf of Tehuantepec	40	36 hr	Gap
1030 UTC 01 Feb	Gulf of California	35	18 hr	Front
1030 UTC 04 Feb	**Gulf of Tehuantepec**	**50**	**252 hr / 30 hr**	**Gap**
0430 UTC 05 Feb	Gulf of California	35	18 hr	Front
1630 UTC 07 Feb	Gulf of Papagayo	40	126 hr	Gap
0430 UTC 14 Feb	Eastern Pacific 13N	40	36 hr	Trough
0430 UTC 17 Feb	Gulf of Tehuantepec	45	84 hr	Gap
1030 UTC 19 Feb	Gulf of Papagayo	35	36 hr	Gap
0430 UTC 23 Feb	Eastern Pacific 29N	35	06 hr	Front
2230 UTC 24 Feb	**Gulf of Tehuantepec**	**55**	**96 hr / 12 hr**	**Gap**
1030 UTC 08 Mar	Eastern Pacific 29N	35	12 hr	Front
1030 UTC 08 Mar	Gulf of California	35	12 hr	Front
2230 UTC 10 Mar	Eastern Pacific 27N	35	12 hr	Front
2230 UTC 20 Mar	Gulf of Tehuantepec	45	54 hr	Gap
1030 UTC 29 Mar	Gulf of California	35	12 hr	Front
0430 UTC 03 Apr	Gulf of Tehuantepec	40	114 hr	Gap

February 5 Gulf of California Gale:

There were several Gulf of California Gale events during the first four months of 2016. These gale events can occur from a variety of pressure forcing schemes. Gale events February 1 and again March 8 occurred due to a strong cold front passing across the region. A different setup forced the gale event on February 5. **Figure 1**, a trough of low pressure developed over western Mexico to the east of the Gulf of California, while a very strong 1042 hPa high pressure builds southeastward over the Great Basin. This particular event was not directly from a frontal passage, but rather from the tight pressure gradient that established itself across the region. **Figure 2**, a Strong to gale-force north-northwest winds extend across the entire length of the Gulf of California. This particular event lasted only 12 hours, as the diurnally driven trough dissipated. By the time the trough redeveloped the next day, the strong high to the north had shifted to the east.

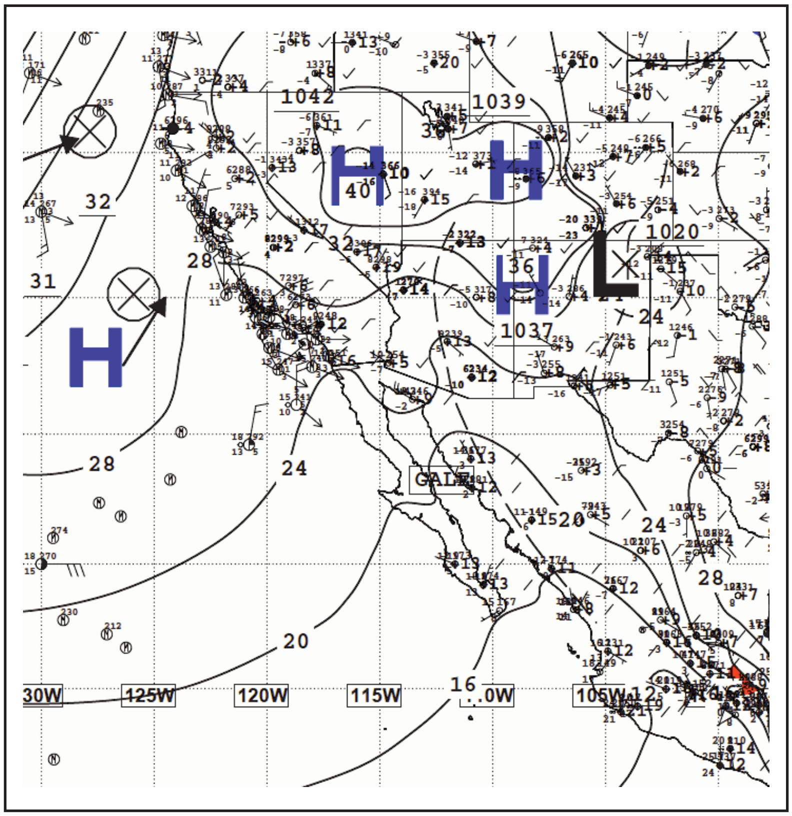

Figure 1. National Weather Service Unified Surface Analysis (USA) Valid 0600 UTC 05 February 2016

Gulf of Tehuantepec Gale and Storm Warnings:

The Gulf of Tehuantepec wind events are usually driven by mid-latitude cold frontal passages through the narrow Chivela Pass in the Isthmus of Tehuantepec between the Sierra Madre de Oaxaca Mountains on the west and the Sierra Madre de Chiapas Mountains on the east. The northerly winds from the southwest Gulf of Mexico funnel through the pass delivering stronger winds into the Gulf of Tehuantepec. The 906 hours of duration of gale force or higher warnings in the January through April 2016 period for the Gulf of Tehuantepec nearly matched the 936 hours during the same period in 2015, and was 45% greater than the 627 hours in 2014. The 72 hours of storm warnings for this period in 2016 exceeded the 60 hours of storm warnings for this same period in 2015.

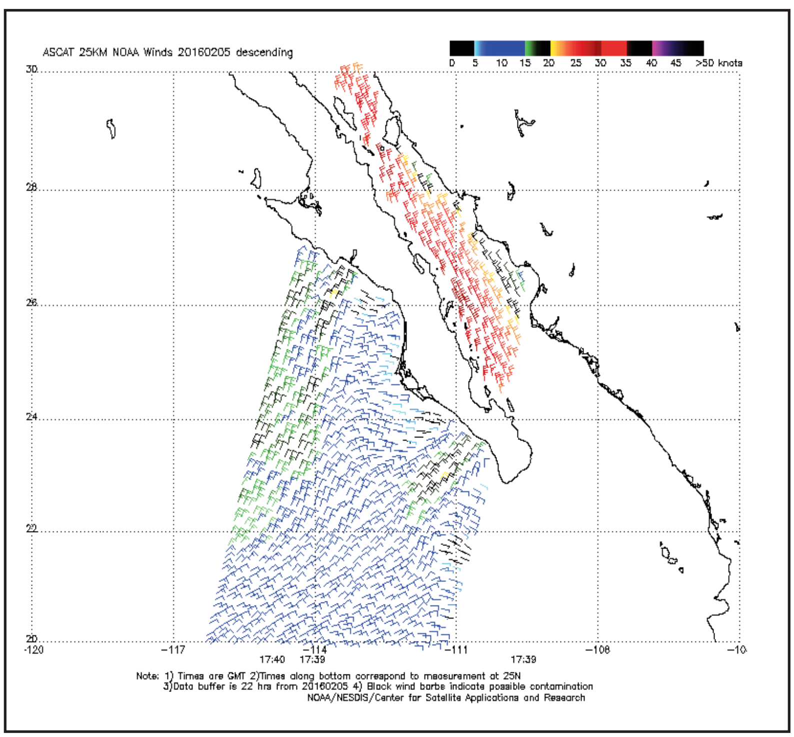

Figure 2. European Advanced Scatterometer (ASCAT) Pass Valid at 1739 UTC 05 February 2016

The longest duration gale/storm event that occurred during the January to April 2016 time period began 1030 UTC February 4 with long duration gale force winds lasting until 2230 UTC February 14 (a total of 252 hours). Storm-force winds developed during two different time periods during this long duration gale, (from 0430 UTC-2230 UTC February 5, and from 1030 UTC-2230 UTC February 7) totaling 30 hours. The same high pressure ridge that forced the February 1 Gulf of California event eventually helped to force this Tehuantepec event. Also, the classic setup for driving a Tehuantepec event was indicated in computer model forecasts and Gale warnings were hoisted 24 hours in advance of the event while the strong cold front crossed northeastern Mexico. (**Figure 3**) Severe gale winds are occurring over the Gulf of Tehuantepec north of 15N along 95W. (**Figure 4**) Gale conditions were already underway over the Gulf of Tehuantepec while a reinforcing Gulf of Mexico cold front pushed across the coast of southern Mexico. A strong 1029 hPa high over southern Texas behind the front forced the Tehuantepec gap winds to increase to storm force over the subsequent 12 hours.

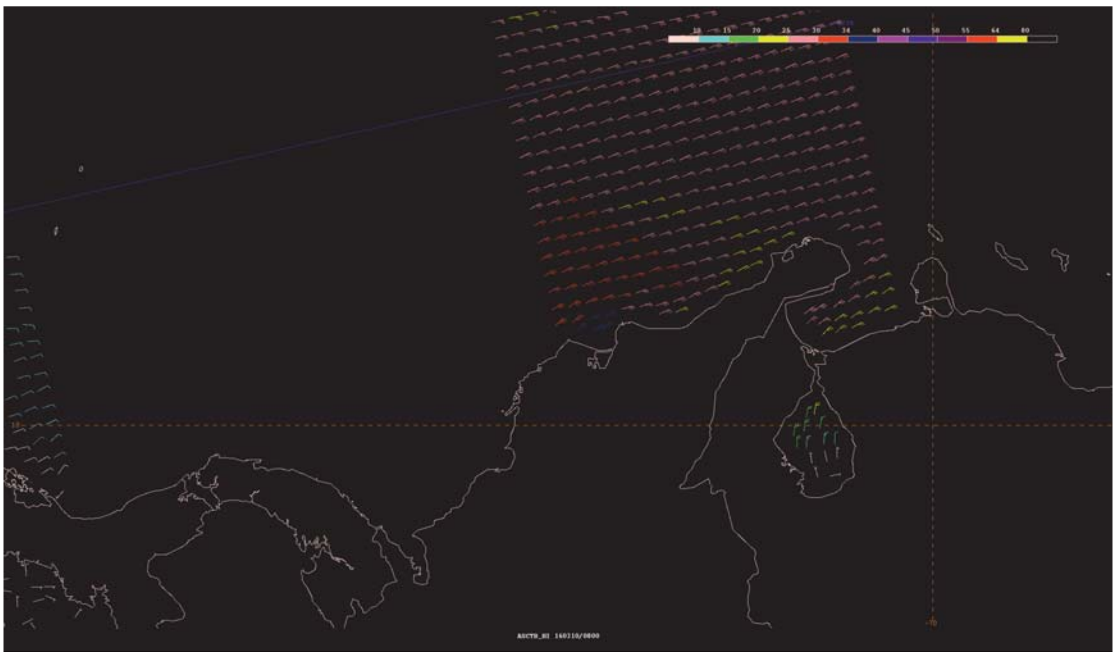

Figure 3. European Advanced Scatterometer (ASCAT) Pass Valid at 0402 UTC 06 February 2016.

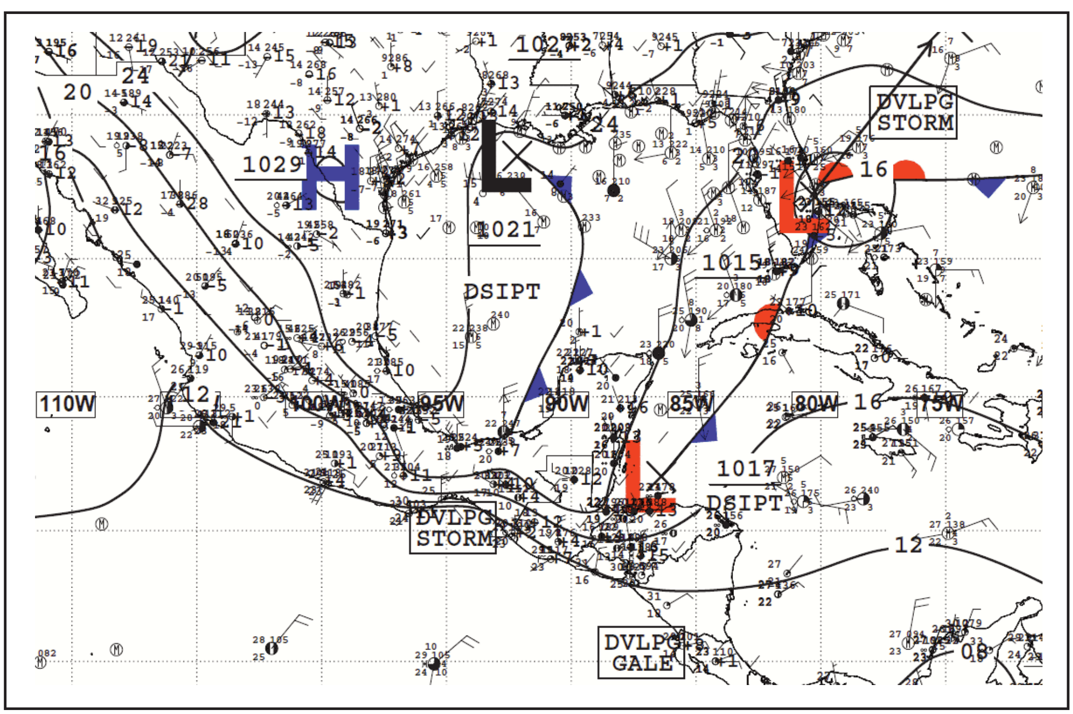

Figure 4. National Weather Service Unified Surface Analysis (USA) Valid 0000 UTC 07 February 2016.

Five Day Papagayo Gale:

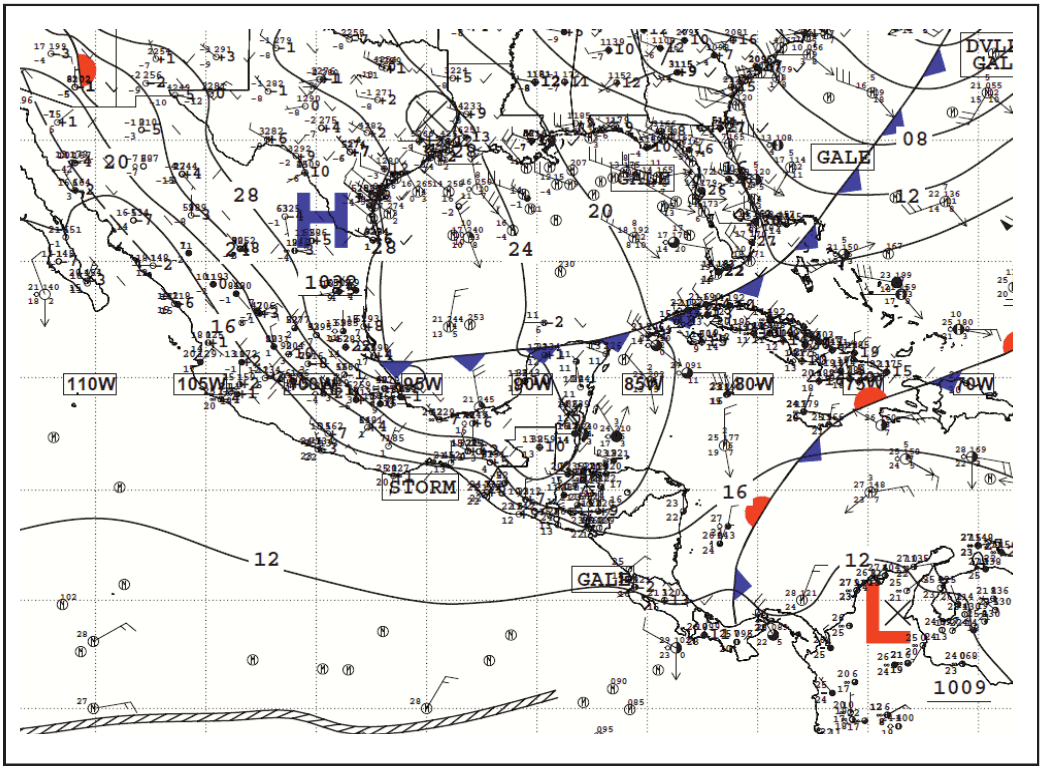

Figure 5. National Weather Service Unified Surface Analysis (USA) Valid 1200 UTC 09 February 2016.

The Gulf of Papagayo gap wind events are usually driven by strong Caribbean Sea trade winds that traverse the San Juan River valley and the southern portion of Lake Nicaragua to the Pacific Ocean. Winds in the Gulf of Papagayo during these events are usually less than gale force. On rare occasions a strong cold front reaches the coast of southern Nicaragua and funnels stronger winds through the gap. The winds are further enhanced by nocturnal and early morning drainage flow. The same strong high pressure that forced the long duration early February Tehuantepec event built southeastward over the Gulf of Mexico February 4 and was reinforced on February 8 as a series of cold fronts swept across the Gulf of Mexico and western Caribbean. The strength of the first high forced a cold front unusually far south into the southwestern Caribbean on February 6 and 7, initiating this gap wind event. The second high helped to reinforce the tight pressure gradient across the region (**Figure 5**). A cold front has already passed southeast of Nicaragua and has stalled out over the southwestern Caribbean to Panama. (**Figure 6**) Winds to gale-force extend from the Gulf of Papagayo as far west as 88W between 10.5N and 11.5N. The **ISLAND PRINCESS** (ZCDG4) also reported gale force winds on 11 February 2016 while passing by the Gulf of Papagayo.

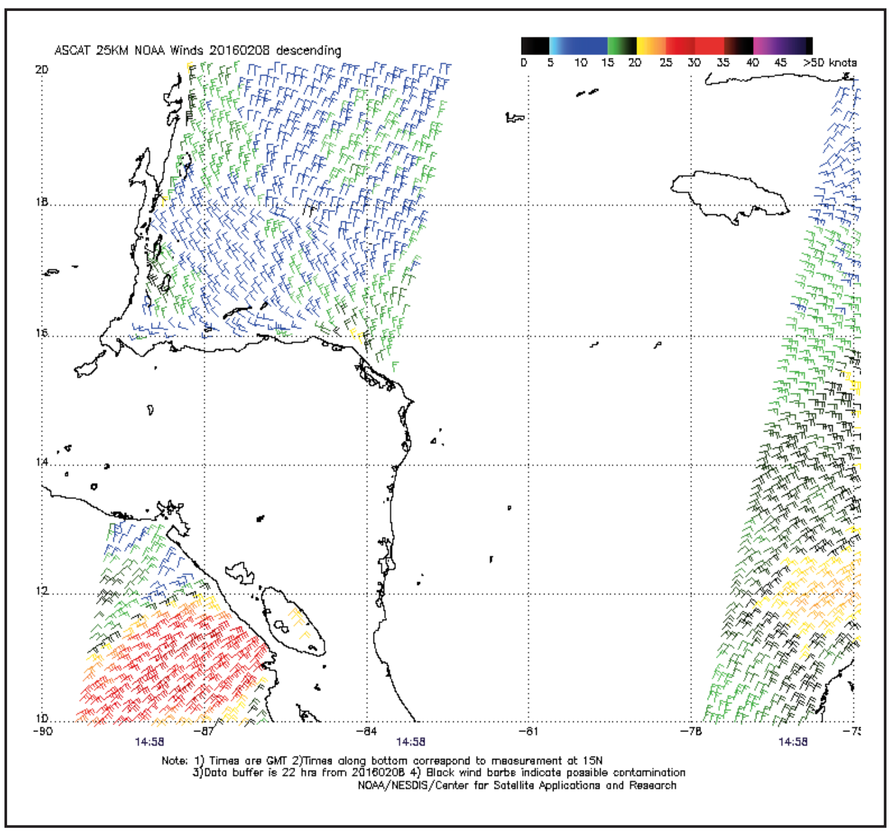

Figure 6. European Advanced Scatterometer (ASCAT) Pass Valid at 1458 UTC 08 February 2016.

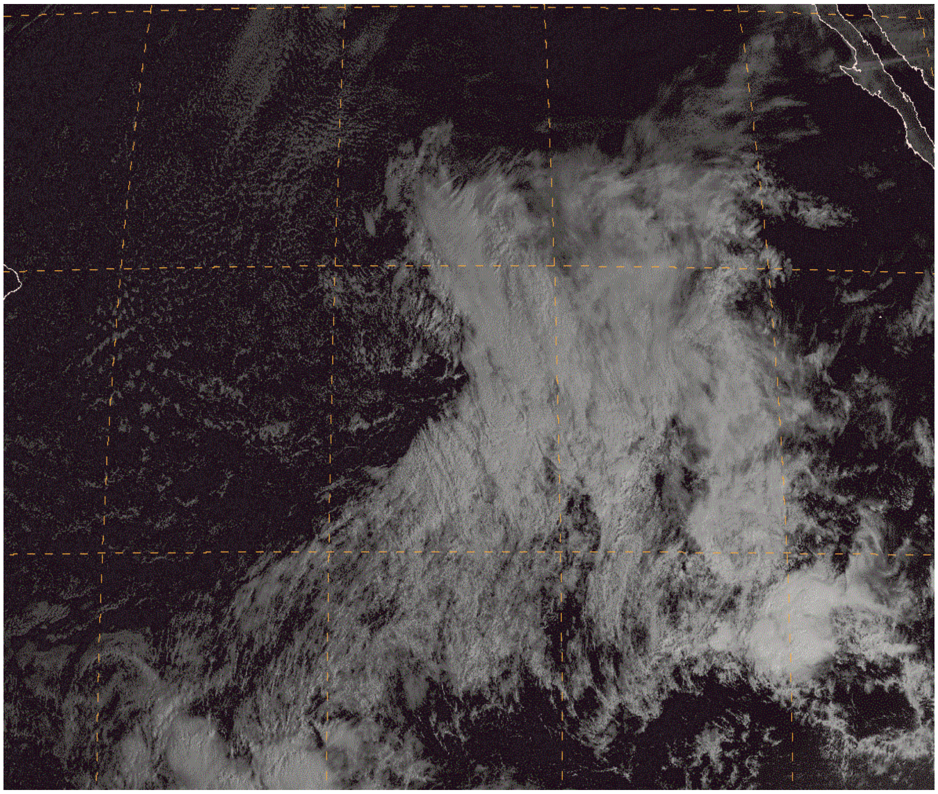

Figure 7. Goes-15 Visible Satellite Image Valid 1730 UTC February 14, 2016.

Figure 8. Satellite Altimeter Data for 14 February, 2016 and European Advanced Scatterometer (ASCAT) Pass Valid at 1758 UTC 14 February 2016.

Valentine's Day Tropical Pacific Gale Event:

A broad upper level low over the tropical eastern Pacific began to translate to the surface in the form of a surface trough on February 1 near 06N132W to 14N128W. Intensifying high pressure to the north of the trough tightened the pressure gradient on both sides of trough. This gradient supported a broad area of winds to 30 kts, locally to gale force of 40 kts, beginning 0430 UTC February 14, 2016 and persisting for 36 hours. (**Figure 7**) A large area of cloud cover imagery produced by the combination of the upper level trough and surface trough over the region was evident in visible satellite imagery. (**Figure 8**) An area of 25 kts to 35 kts winds are verified from 08N to 19N between 128W and 136W around the surface trough. Combined seas to 18 ft were occurring at the end of a long fetch of winds nearing gale force.

The trough would remain quasi-stationary through February 15. However, with the high to the north of the area weakening, the pressure gradient loosened and winds diminished below gale-force. ⚓

National Weather Service VOS Program New Recruits:

March 1, 2016 through June 30, 2016

SHIP NAME	CALL SIGN
CAPE INSCRIPTION	WSCJ
CIELO DI PALERMO	3FRS8
CIELO DI SAN FRANCISCO	IBKA
CLAXTON BAY	VRGA8
CLIPPER ICHIBAN	3FHN7
CLIPPER IYO	3ETM8
CRYSTAL SERENITY	C6SY3
EVER LASTING	2FRK7
EVER LAWFUL	9V9288
GROUSE HUNTER	D5KT4
HANJIN CZECH	9HA4003
HELSINKI BRIDGE	3FIW4
KINGCUP	V2FP8
PACIFIC JOURNEY	3FFE
PARAMOUNT HALIFAX	2CWC2
PERLA DEL CARIBE	KPDL
PRT DREAM	3EXT
SAGA WAVE	VRYO7
SAKURA OCEAN	3FRC8
SKYWALKER	D5IB9
SOMBEKE	ONHD

VOS Program
Cooperative Ship Report:
January 1, 2016 through June 30, 2016

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	0	2	0	0	2							8
ALASKA MARINER	WSM5364	A	Anchorage	29	8	15	0	3	16							71
ALASKA TITAN	WDE4789	A	Anchorage	40	1	15	20	7	19							102
ALASKAN EXPLORER	WDB9918	A	Anchorage	39	29	39	84	63	53							307
ALASKAN FRONTIER	WDB7815	A	Anchorage	42	58	40	47	46	31							264
ALASKAN LEADER	WDB7198	A	Anchorage	2	1	0	0	1	1							5
ALASKAN LEGEND	WDD2074	A	Anchorage	53	71	81	83	10	0							298
ALASKAN NAVIGATOR	WDC6644	A	Anchorage	25	174	126	153	97	58							633
ALBEMARLE ISLAND	C6LU3	A	Miami	12	15	2	3	0	5							37
ALBERT MAERSK	OUOW2	A	New York City	0	0	30	0	0	3							33
ALERT	WCZ7335	A	Anchorage	0	4	0	2	2	3							11
ALGOLAKE	VCPX	A	Duluth	1	0	0	0	48	75							124
ALGOMA GUARDIAN	CFK9698	A	Duluth	0	0	0	0	3	22							25
ALGOMA MARINER	CFN5517	A	Duluth	7	0	15	0	0	0							22
ALGOMA NAVIGATOR	VGMV	A	Duluth	0	0	0	0	0	0							0
ALLIANCE FAIRFAX	WLMQ	A	Jacksonville	31	11	33	13	34	46							168
ALLIANCE NORFOLK	WGAH	A	Jacksonville	0	0	0	0	0	0							0
ALLIANCE ST LOUIS	WGAE	A	Charleston	0	19	2	8	17	2							48
ALLURE OF THE SEAS	C6XS8	A	Miami	35	42	56	79	59	56							327
ALPENA	WAV4647	A	Duluth	0	0	0	0	4	16							20
AMALTHEA	CQDE	A	New York City	0	0	1	43	8	33							85
AMERICAN CENTURY	WDD2876	A	Duluth	91	0	7	259	325	331							1013
AMERICAN COURAGE	WDD2879	A	Duluth	0	0	0	0	0	0							0
AMERICAN INTEGRITY	WDD2875	A	Duluth	6	0	0	11	22	28							67
AMERICAN MARINER	WQZ7791	A	Duluth	0	0	0	55	91	54							200
AMERICAN SPIRIT	WCX2417	A	Duluth	0	0	0	1	14	23							38
AMSTERDAM	PBAD	A	Anchorage	165	79	74	191	205	142							856
ANDROMEDA VOYAGER	C6FZ6	A	Anchorage	50	37	62	48	0	0							197
ANTWERPEN	VRBK6	A	Anchorage	0	0	1	0	0	0							1
APL AGATE	WDE8265	A	Charleston	28	29	35	26	48	42							208
APL BELGIUM	WDG8555	A	New York City	65	54	39	50	35	34							277
APL CHINA	WDB3161	A	Los Angeles	0	28	110	190	141	78							547
APL CORAL	WDF6832	A	Charleston	33	10	6	0	0	0							49
APL KOREA	WCX8883	A	Los Angeles	26	52	72	69	80	31							330
APL PHILIPPINES	WCX8884	A	Los Angeles	30	19	22	52	81	61							265
APL PHOENIX	9V9918	A	Los Angeles	0	0	0	0	0	0							0
APL SCOTLAND	9VDD3	A	New York City	38	28	0	28	23	28							144
APL SINGAPORE	WCX8812	A	Los Angeles	76	81	98	33	55	71							414
APL THAILAND	WCX8882	A	Los Angeles	11	41	19	41	39	43							194

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
AQUARIUS VOYAGER	C6UC3	A	Jacksonville	5	7	28	18	9	10							77
ARCTIC BEAR	WBP3396	A	Anchorage	0	0	0	0	7	0							7
ARCTIC TITAN	WDG2803	A	Anchorage	21	3	7	7	14	4							56
ARCTURUS VOYAGER	C6YA7	A	Anchorage	40	37	47	45	72	45							286
ARIES VOYAGER	C6UK7	A	Anchorage	39	9	24	25	14	31							142
ARNOLD MAERSK	OXES2	A	Seattle	0	37	49	15	45	14							160
ARTHUR M. ANDERSON	WDH7563	A	Duluth	0	0	2	21	53	50							126
ASHKINI SPIRIT	C6WJ9	A	Anchorage	125	158	162	94	0	0							539
ATLANTIC CARTIER	SCKB	A	Norfolk	35	35	14	20	16	23							143
ATLANTIC EXPLORER (AWS)	WDC9417	A	Anchorage	32	0	76	211	46	0							365
ATLANTIC GRACE	VRDT7	A	Anchorage	0	0	47	32	60	29							126
ATLANTIC GRACE	V7UX9	A	New Orleans	0	0	0	0	6	0							6
ATLANTIC HOPE	VRDT5	A	Baltimore	54	26	34	43	28	37							222
ATLANTIC ROSE	VREF7	A	Anchorage	26	15	0	0	0	0							41
ATLANTIS (AWS)	KAQP	A	Anchorage	0	10	598	372	731	308							2019
ATTENTIVE	WCZ7337	A	Anchorage	16	5	0	8	1	0							30
AURORA	WYM9567	A	Anchorage	75	0	0	17	77	136							305
AURORA TAURUS	V7EX3	A	Anchorage	9	14	27	11	11	9							81
AVIK	WDB7888	A	Anchorage	0	0	0	0	2	1							3
AWARE	WCZ7336	A	Kodiak	22	7	0	0	5	0							34
AXEL MAERSK	OUUY2	A	New York City	18	19	16	0	0	0							53
BADGER	WBD4889	A	Duluth	0	0	0	0	28	130							158
BAIE COMEAU	CFN6357	A	Duluth	0	0	0	0	0	15							15
BALTIC LEOPARD	V8VG9	A	Anchorage	8	0	0	0	0	0							8
BARBARA FOSS	WYL4318	A	Anchorage	0	0	0	0	0	0							0
BARRINGTON ISLAND	C6QK	A	Miami	26	28	33	29	26	32							174
BELL M. SHIMADA (AWS)	WTED	A	Seattle	440	479	419	506	317	255							2414
BERGE NANTONG	VRBU6	A	Anchorage	48	16	11	0	0	0							75
BERGE NINGBO	VRBQ2	A	Anchorage	0	17	21	5	23	2							68
BEARING LEADER	WDC7227	A	Anchorage	0	1	0	0	1	0							2
BERLIAN EKUATOR	HPYK	A	Anchorage	0	0	0	0	0	0							0
BERNARDO QUINTANA A.	C6KJ5	A	New Orleans	77	71	69	63	72	83							435
BILLIE H.	WCY4992	A	Anchorage	0	0	0	2	11	19							32
BISMARCK SEA	WDE5016	A	Anchorage	4	3	2	1	2	0							12
BLS ABILITY	ELXX8	A	Anchorage	0	0	0	0	0	0							0
BLS LIWA	VREF5	A	Anchorage	61	34	163	162	9	0							429
BLUEFIN	WDC7379	A	Seattle	0	0	105	74	99	94							372
BOMAR QUEST	V7JX5	A	Anchorage	0	0	0	1	0	0							1
BRISTOL LEADER	WDE7168	A	Anchorage	0	0	0	0	0	0							0
BUCCANEER	WYW5588	A	Kodiak	0	0	0	0	0	0							0
BUFFALO	WXS6134	A	Duluth	3	0	3	10	69	37							122
BUFFALO HUNTER	VROJ5	A	New York City	62	61	31	74	30	56							314
BULK SPAIN	A8VL9	A	Anchorage	43	25	0	0	0	0							68
BULWARK	WBN4113	A	Anchorage	6	5	7	16	10	4							48
BURNS HARBOR	WDC6027	A	Duluth	35	0	1	20	20	45							121

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	0	15	39	2							56
CALIFORNIA VOYAGER	WDE5381	A	New Orleans	17	7	13	13	28	30							108
CALUMET	WDE3568	A	Duluth	0	0	0	32	97	108							237
CAPE INSCRIPTION	WSCJ	A	Los Angeles	0	0	0	0	0	0							0
CAPRICORN VOYAGER	C6UZ5	A	Anchorage	28	65	35	38	40	45							251
CARNIVAL BREEZE	3FZO8	A	Miami	3	0	0	0	0	5							8
CARNIVAL CONQUEST	3FPQ9	A	Miami	0	0	0	0	0	32							32
CARNIVAL DREAM	3ETA7	A	Jacksonville	59	94	66	66	67	83							435
CARNIVAL ECSTASY	H3GR	A	Miami	48	58	136	95	60	23							420
CARNIVAL ELATION	3FOC5	A	New Orleans	28	9	6	1	11	2							57
CARNIVAL FANTASY	H3GS	A	Charleston	35	9	35	20	12	10							121
CARNIVAL FASCINATION	C6FM9	A	Jacksonville	7	11	27	55	10	1							111
CARNIVAL FREEDOM	3EBL5	A	Miami	10	11	16	11	5	20							73
CARNIVAL GLORY	3FPS9	A	Miami	53	37	33	37	12	64							236
CARNIVAL IMAGINATION	C6FN2	A	Miami	33	27	26	9	0	0							95
CARNIVAL INSPIRATION	C6FM5	A	Los Angeles	30	0	0	0	55	87							172
CARNIVAL LEGEND	H3VT	A	Miami	225	372	400	416	124	172							1709
CARNIVAL MAGIC	3ETA8	A	Houston	19	9	31	55	20	7							141
CARNIVAL MIRACLE	H3VS	A	Seattle	0	22	61	49	40	38							210
CARNIVAL PARADISE	3FOB5	A	Miami	34	0	0	0	0	0							34
CARNIVAL PRIDE	H3VU	A	Jacksonville	8	8	5	14	18	10							63
CARNIVAL SENSATION	C6FM8	A	Jacksonville	0	0	0	1	20	13							34
CARNIVAL SPLENDOR	3EUS	A	Anchorage	3	18	6	0	0	0							27
CARNIVAL SUNSHINE	C6FN4	A	Jacksonville	34	27	48	14	0	18							141
CARNIVAL TRIUMPH	C6FN5	A	Houston	0	10	0	44	64	30							148
CARNIVAL VALOR	H3VR	A	Jacksonville	30	5	6	4	16	64							125
CARNIVAL VICTORY	3FFL8	A	Miami	9	21	6	14	0	4							54
CAROLINE MAERSK	OZWA2	A	Seattle	25	15	36	27	18	45							166
CASON J. CALLAWAY	WDH7556	A	Duluth	2	0	2	65	52	44							165
CASTOR VOYAGER	C6UZ6	A	Anchorage	38	33	31	27	37	27							193
CELEBRITY CONSTELLATION	9HJI9	A	Miami	316	170	92	72	65	55							770
CELEBRITY ECLIPSE	9HXC9	A	Miami	300	261	248	216	135	166							1326
CELEBRITY EQUINOX	9HXD9	A	Miami	0	0	0	0	0	191							191
CELEBRITY INFINITY	9HJD9	A	Miami	81	27	81	32	5	106							332
CELEBRITY MILLENNIUM	9HJF9	A	Anchorage	235	159	87	20	8	112							621
CELEBRITY REFLECTION	9HA3047	A	Miami	85	78	104	105	86	111							569
CELEBRITY SILHOUETTE	9HA2583	A	Miami	132	106	137	150	117	304							946
CELEBRITY SOLSTICE	9HRJ9	A	Seattle	194	150	169	174	124	112							923
CELEBRITY SUMMIT	9HJC9	A	Miami	24	28	15	20	2	136							225
CHARLES ISLAND	C6JT	A	Miami	45	28	20	43	26	24							186
CHARLESTON EXPRESS	WDD6126	A	Houston	66	50	102	56	40	74							388
CIELO DI PALERMO	3FRS8	A	New Orleans	0	0	0	10	10	0							20
CIELO DI SAN FRANCISCO	IBKA	A	New Orleans	0	0	0	53	3	0							56
CLIPPER ICHIBAN	3FHN7	A	New Orleans	0	0	0	0	0	3							0
CLIPPER IYO	3ETM8	A	New Orleans	0	0	0	0	38	34							72

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
CLIPPER KYTHIRA	V7JJ2	A	New Orleans	1	61	36	27	3	0							128
COASTAL NOMAD	WDC6439	A	Anchorage	13	1	4	3	4	0							25
COASTAL PROGRESS	WDC6363	A	Anchorage	4	5	0	0	4	2							15
COASTAL TRADER	WSL8560	A	Anchorage	3	10	4	1	0	0							18
COASTAL VENTURE	WDF3547	A	Charleston	0	0	0	0	0	0							0
COLUMBIA	WYR2092	A	Seattle	0	0	0	0	0	47							47
COLUMBINE MAERSK	OUHC2	A	Norfolk	0	0	5	32	26	17							80
CORBIN FOSS	WDB5265	A	Anchorage	0	0	0	0	0	0							0
CORNELIA MAERSK	OWWS2	A	New York City	12	2	0	0	7	1							22
CORWITH CRAMER	WTF3319	A	Anchorage	0	0	0	9	7	0							16
COSTA FORTUNA	IBNY	A	Miami	74	66	77	32	53	20							322
COSTA MEDITERRANEA	IBCF	A	Anchorage	0	0	0	0	0	0							0
CROSS POINT	WDA3423	A	Anchorage	0	0	0	2	4	3							9
CRYSTAL MARINE	9VIC4	A	Anchorage	3	3	7	0	0	0							13
CRYSTAL SERENITY	C6SY3	A	Anchorage	0	0	0	1	46	56							103
CRYSTAL SUNRISE	9V2024	A	Anchorage	20	4	0	0	0	0							24
CS RELIANCE	V7CZ2	A	Baltimore	31	76	128	84	34	19							372
CSAV LONCOMILLA	VRFB3	A	Charleston	0	0	0	0	0	0							0
CSCL MELBOURNE	VRBI8	A	Anchorage	151	436	0	36	64	15							702
CSCL SYDNEY	VRBH9	A	Norfolk	0	11	25	11	12	22							81
CSL ASSINIBOINE	VCKQ	A	Duluth	4	0	0	15	57	24							100
CSL LAURENTIEN	VCJW	A	Duluth	21	0	0	4	6	27							58
CSL ST-LAURENT	CFK5152	A	Duluth	0	0	0	0	0	5							5
CWB MARQUIS	XJBO	A	Duluth	0	0	0	36	24	50							110
DANIEL FOSS	WTS3171	A	Anchorage	0	0	0	0	2	0							2
DEEPWATER CHAMPION	YJVM9	A	Houston	52	35	17	0	0	0							104
DEFENDER	WBN3016	A	Jacksonville	0	0	0	0	2	2							4
DIANE H	WUR7250	A	Anchorage	0	0	4	2	0	3							9
DISCOVERER CLEAR LEADER	V7MO2	A	Houston	121	114	124	118	124	120							721
DISCOVERER DEEP SEAS	V7HC6	A	Houston	189	10	0	0	0	0							199
DISCOVERER INSPIRATION	V7MO3	A	Houston	24	25	16	4	4	2							75
DISNEY DREAM	C6YR6	A	Jacksonville	4	44	46	65	77	54							291
DISNEY FANTASY	C6ZL6	A	Jacksonville	10	7	7	1	0	2							27
DISNEY MAGIC	C6PT7	A	Jacksonville	41	50	0	12	30	11							144
DISNEY WONDER	C6QM8	A	Miami	36	16	7	22	27	8							116
DOMINATOR	WBZ4106	A	Anchorage	18	42	39	28	0	24							151
DUBAI EXPRESS	VRBN8	A	New York City	0	0	0	0	0	6							6
DUNCAN ISLAND	C6JS	A	Miami	44	10	27	25	18	15							139
EAGLE ATLANTA	S6TE	A	Houston	76	74	75	54	1	0							280
EAGLE BALTIMORE	9VHG	A	New York City	28	7	42	65	51	37							230
EAGLE KUANTAN	9V8376	A	Houston	0	2	0	1	0	0							3
EAGLE KUCHING	9V8132	A	Houston	20	0	0	0	0	0							20
EAGLE SIBU	9VIJ3	A	New York City	21	9	19	6	0	0							55
EAGLE STAVANGER	3FNZ5	A	Houston	18	22	13	2	0	0							55
EAGLE TORRANCE	9VMG5	A	Houston	27	0	0	0	0	28							55

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
EAGLE TUCSON	S6NK5	A	Houston	30	15	0	16	0	0							61
EDGAR B. SPEER	WDH7562	A	Duluth	128	0	34	161	224	204							781
EDWIN H. GOTT	WDH7558	A	Duluth	77	0	45	245	110	175							652
EMPIRE STATE	KKFW	A	New York City	0	0	0	0	102	124							226
ENDEAVOR (AWS)	WCE5063	A	New York City	607	650	438	636	435	647							3413
ENDURANCE	WDE9586	A	Baltimore	21	58	22	69	22	51							243
ENDURANCE	WDF7523	A	Anchorage	16	0	9	10	8	7							50
EOT SPAR	WDE9193	A	Miami	44	23	23	27	48	45							210
ERNEST N	A8PQ6	A	Anchorage	49	36	43	0	19	3							150
EURODAM	PHOS	A	Miami	60	58	74	148	102	71							513
EVER DAINTY	9V7951	A	Baltimore	15	10	40	14	13	16							108
EVER DECENT	9V7952	A	New York City	45	52	98	74	21	0							290
EVER DELIGHT	3FCB8	A	New York City	12	0	13	0	22	0							47
EVER DEVELOP	3FLF8	A	New York City	14	12	4	4	24	28							86
EVER DEVOTE	9V7954	A	New York City	0	0	6	0	10	5							21
EVER DIADEM	9V7955	A	New York City	0	32	68	75	93	94							362
EVER DIAMOND	3FQS8	A	New York City	0	2	0	9	1	34							46
EVER EAGLE	ZNZH6	A	Seattle	4	2	0	0	0	0							6
EVER ENVOY	VSQL9	A	Seattle	0	0	0	0	0	3							3
EVER EXCEL	VSXV3	A	Los Angeles	16	26	12	3	0	0							57
EVER LAWFULL	9V9288	A	New York City	0	0	0	0	0	0							0
EVER LEADING	2FRK8	A	Norfolk	38	8	0	36	34	56							172
EVER LEGACY	9V9290	A	New York City	18	33	33	31	36	18							169
EVER LIBRA	BKIC	A	New York City	0	0	0	0	0	48							48
EVER LISSOME	2HDG3	A	New York City	0	0	0	0	0	23							23
EVER SAFETY	3EMQ4	A	Anchorage	2	3	1	2	0	0							8
EVER SALUTE	3ENU5	A	Anchorage	0	0	0	0	6	2							8
EVER SHINE	MJKZ4	A	Anchorage	13	1	0	0	0	0							14
EVER STEADY	3EHT6	A	Anchorage	0	0	0	0	0	5							5
EVER STRONG	3EJG3	A	Seattle	0	0	0	19	7	0							26
EVER SUMMIT	3EKU3	A	Anchorage	0	1	0	0	0	0							1
EVER SUPERB	3EGL5	A	Anchorage	15	0	0	1	0	0							16
EVER UBERTY	9V7960	A	Seattle	0	0	10	2	15	16							43
EVER ULYSSES	9V7962	A	Anchorage	0	2	3	0	0	0							5
EVER UNIFIC	9V7961	A	Anchorage	7	22	16	1	0	0							46
EVER UNION	3FFG7	A	Seattle	19	14	75	31	22	18							179
EVER UNITY	3FCD9	A	New York City	67	66	59	66	60	48							366
EVER URSULA	3FCB9	A	Seattle	0	0	0	0	2	0							2
EVER USEFUL	3FCC9	A	Anchorage	21	7	1	12	0	0							41
EVER UTILE	3FZA9	A	Seattle	6	5	1	0	0	5							17
EXCALIBUR	ONCE	A	Houston	120	106	1	8	53	91							379
EXCEL	ONAI	A	Houston	4	54	65	87	74	85							369
EXCELERATE	ONDY	A	Houston	68	58	96	37	0	0							259
EXCELSIOR	ONCD	A	Houston	66	68	67	81	37	32							351
EXPLORER	WBN7618	A	Jacksonville	0	0	0	0	0	0							0

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FAIRCHEM FRIESIAN	V7PU7	A	Anchorage	0	31	6	2	10	7							56
FAIRCHEM MAVERICK	V7EP2	A	Anchorage	27	46	54	1	3	1							132
FAIRWEATHER	WDB5604	A	Anchorage	0	0	0	0	1	0							1
FAIRWEATHER (AWS)	WTEB	A	Anchorage	0	0	0	0	410	552							962
FEDERAL BERING	V7NB6	A	Anchorage	0	1	0	0	0	0							1
FEDERAL HUNTER	VRWP2	A	New Orleans	0	0	25	4	2	0							31
FEDERAL YUKINA	VRHN7	A	Anchorage	0	0	13	21	9	27							70
FERDINAND R. HASSLER	WTEK	A	Norfolk	0	272	494	203	71	0							1040
FISH HAWK	WRB5085	A	Anchorage	0	0	0	7	3	1							11
FLORIDA	WFAF	A	Houston	1	0	0	0	21	34							56
FLORIDA VOYAGER	WDF4764	A	Baltimore	1	2	5	5	26	0							39
FREEDOM	WDB5483	A	Jacksonville	58	22	3	5	13	33							134
FREEDOM OF THE SEAS	C6UZ7	A	Jacksonville	0	2	10	36	7	3							58
FRITZI N	A8PQ4	A	Anchorage	0	0	0	0	0	0							0
G. L. OSTRANDER	WCV7620	A	Duluth	21	0	26	74	87	55							263
GENCO AUGUSTUS	VRDD2	A	Anchorage	0	0	0	0	0	0							0
GENCO CLAUDIUS	V7SY6	A	Anchorage	0	0	0	0	3	30							33
GENCO HADRIAN	V7QN8	A	Anchorage	78	52	18	0	0	0							148
GENCO RAPTOR	V7NB8	A	Anchorage	0	0	0	0	0	0							0
GENCO THUNDER	V7LZ4	A	Anchorage	0	12	0	0	0	0							13
GENCO TIBERIUS	VRDD3	A	Anchorage	1	0	0	0	0	0							1
GENERAL RUDDER	WTAU	A	Houston	0	0	0	0	1	8							9
GEORGE N	A8PQ5	A	Anchorage	0	1	3	0	0	0							4
GERDA MAERSK	OUJS2	A	Los Angeles	0	0	1	0	0	0							1
GLEN CANYON BRIDGE	3EFD9	A	Norfolk	20	23	31	53	72	47							246
GOLDEN BEAR	NMRY	A	San Francisco	0	0	0	2	44	56							102
GORDON GUNTER (AWS)	WTEO	A	New Orleans	160	0	0	292	504	309							1265
GRANDEUR OF THE SEAS	C6SE3	A	Jacksonville	54	14	21	3	12	15							119
GREAT REPUBLIC	WDH7561	A	Duluth	2	0	0	33	48	52							135
GREEN BAY	WDI3177	A	Jacksonville	0	0	0	0	0	33							33
GREEN LAKE	WDDI	A	Jacksonville	47	44	36	31	20	5							183
GREEN RIDGE	WZZF	A	Jacksonville	0	33	58	28	6	32							157
GRETA	WDF3298	A	Anchorage	0	0	0	0	1	0							1
GRETCHEN H	WDC9138	A	Anchorage	0	0	0	2	0	0							2
GROUSE HUNTER	D5KT4	A	Anchorage	0	0	0	6	34	4							44
GUARDIAN	WBO2511	A	Kodiak	14	7	4	9	15	5							54
GUARDSMAN	WBN5978	A	Anchorage	0	0	0	0	6	0							6
GULF TITAN	WDA5598	A	Anchorage	20	31	27	0	24	15							117
GUNDE MAERSK	OUIY2	A	Seattle	0	0	0	14	18	0							32
H A SKLENAR	C6CL6	A	Houston	170	129	164	149	161	108							881
H. LEE WHITE	WZD2465	A	Duluth	2	0	0	21	47	55							125
HANJIN AMI	VRNF8	A	Los Angeles	34	20	23	12	12	0							101
HANJIN CZECH	9HA4003	A	New York City	0	0	0	0	8	15							23
HANJIN MILANO	V7SG8	A	New York City	9	13	9	13	2	0							46
HELSINKI BRIDGE	3FIW4	A	New York City	0	0	0	39	0	0							39

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HENRY B. BIGELOW (AWS)	WTDF	A	New York City	0	0	0	322	498	207							1027
HENRY BRUSCO	WDC9691	A	Anchorage	0	0	0	5	0	0							5
HENRY GOODRICH	YJQN7	A	Houston	0	0	0	0	165	226							391
HERBERT C. JACKSON	WL3972	A	Duluth	0	0	0	0	0	0							0
HI'IALAKAI (AWS)	WTEY	A	Honolulu	0	0	0	71	72	162							305
HOEGH CHIBA	LAVD7	A	Jacksonville	0	0	0	0	0	0							0
HOEGH MASAN	S6HK	A	Charleston	0	0	0	0	0	0							0
HON. JAMES L. OBERSTAR	WL3108	A	Duluth	46	0	695	719	739	720							2919
HONOR	WDC6923	A	Baltimore	24	32	33	25	18	28							160
HOOD ISLAND	C6LU4	A	Miami	23	27	28	36	43	35							192
HORIZON ANCHORAGE	KGTX	A	Anchorage	54	35	25	36	57	65							272
HORIZON CONSUMER	WCHF	A	Seattle	31	53	45	49	12	1							191
HORIZON ENTERPRISE	KRGB	A	Seattle	33	67	79	69	50	58							356
HORIZON PACIFIC	WSRL	A	Seattle	49	47	55	51	39	31							272
HORIZON RELIANCE	WFLH	A	Los Angeles	0	0	0	0	30	60							90
HORIZON SPIRIT	WFLG	A	Los Angeles	37	41	61	35	59	78							311
HOS ACHIEVER	YJVG4	A	Houston	0	0	0	0	0	0							0
HOUSTON	KCDK	A	Miami	0	0	0	0	2	0							2
HUNTER	WBN3744	A	Anchorage	0	3	6	7	20	9							45
HYDRA VOYAGER	C6AB8	A	Anchorage	35	11	3	16	10	1							76
IBRAHIM DEDE	V7QW6	A	New York City	15	43	10	21	22	17							128
INDEPENDENCE II	WGAX	A	Baltimore	31	28	30	32	59	35							215
INDEPENDENCE OF THE SEAS	C6WW4	A	Miami	28	8	5	0	0	13							54
INDIANA HARBOR	WXN3191	A	Duluth	0	0	0	0	0	0							0
INLAND SEAS	WCJ6214	A	Duluth	0	0	0	0	3	0							3
INTEGRITY	WDC6925	A	Baltimore	50	62	30	17	6	3							168
INTEGRITY	WDD7905	A	Anchorage	31	49	0	27	30	0							137
ISLA BELLA	WTOI	A	Jacksonville	37	55	23	18	59	76							268
IVER FOSS	WYE6442	A	Anchorage	0	0	0	0	0	3							3
IVS MERLION	S6LP5	A	Baltimore	18	0	0	0	0	0							18
JAMES L. KUBER	WDF7020	A	Duluth	0	0	0	120	259	160							539
JAMES R. BARKER	WYP8657	A	Duluth	330	0	0	0	201	0							531
JEAN ANNE	WDC3786	A	Los Angeles	9	1	0	0	0	0							10
JENNY N	A8PQ7	A	Anchorage	84	20	0	0	259	223							586
JOHN B. AIRD	VCYP	A	Duluth	0	0	6	16	31	12							65
JOHN G. MUNSON	WDH7557	A	Duluth	0	0	0	0	0	0							0
JOHN J. BOLAND	WZE4539	A	Duluth	0	0	0	32	35	13							80
JONATHAN SWIFT	A8SN5	A	New York City	155	61	36	83	104	108							547
JOSEPH L. BLOCK	WXY6216	A	Duluth	400	0	409	719	602	576							2706
JUSTINE FOSS	WYL4978	A	Anchorage	33	37	45	22	0	1							138
KAAN KALKAVAN	TCTX2	A	New York City	53	26	19	51	34	34							217
KAROLINE N	A8PQ8	A	Anchorage	3	1	0	0	0	0							4
KAUAI	WSRH	A	San Francisco	0	0	0	0	20	28							48
KAYE E. BARKER	WCF3012	A	Duluth	352	0	56	576	707	696							2387
KENNICOTT	WCY2920	A	Anchorage	0	0	7	23	7	2							39

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KESWICK	C6XE5	A	Anchorage	2	5	17	3	1	7							35
KILO MOANA	WDA7827	A	Honolulu	2	0	13	68	52	0							135
KINGCUP	V2FP8	A	New Orleans	0	0	0	0	1	0							1
LAHORE EXPRESS	VRBY8	A	Anchorage	23	16	21	18	7	0							85
LAUREN FOSS	WDG8426	A	Anchorage	0	0	0	0	44	37							81
LAURENCE M. GOULD (AWS)	WCX7445	A	Seattle	744	696	743	718	741	720							4362
LECONTE	WZE4270	A	Anchorage	28	0	0	8	6	2							44
LEE A. TREGURTHA	WUR8857	A	Duluth	573	0	0	0	0	201							774
LIBERTY EAGLE	WHIA	A	Houston	32	40	97	39	60	29							297
LIBERTY GLORY	WADP	A	Houston	34	51	5	12	19	55							176
LIBERTY GRACE	WADN	A	Houston	121	11	64	32	18	72							318
LIBERTY PRIDE	KRAU	A	Charleston	30	37	53	55	70	45							290
LIBERTY PROMISE	WWMZ	A	Jacksonville	0	0	0	0	15	2							17
LION CITY RIVER	9VJC5	A	Anchorage	0	1	2	0	0	0							3
LOWLANDS ORCHID	ONFP	A	Anchorage	15	0	0	0	0	0							15
LOWLANDS PHOENIX	9HIY9	A	Anchorage	24	29	21	0	0	14							88
LYLA	V7QK3	A	Anchorage	0	9	21	21	0	0							51
MAASDAM	PFRO	A	Miami	130	66	129	93	100	57							575
MAERSK ATLANTA	WNTL	A	Charleston	42	46	20	16	0	50							174
MAERSK CAROLINA	WBDS	A	Charleston	47	52	46	8	28	46							227
MAERSK CHICAGO	WMCS	A	Norfolk	0	0	0	8	20	17							45
MAERSK COLUMBUS	WMCU	A	Norfolk	0	0	0	0	0	0							0
MAERSK DANANG	A8PS5	A	New York City	34	16	16	23	5	0							94
MAERSK DENVER	WMDQ	A	New York City	68	28	3	31	36	18							184
MAERSK DETROIT	WMDK	A	Norfolk	56	35	31	40	58	54							274
MAERSK HARTFORD	WMHA	A	New York City	12	0	32	49	42	36							171
MAERSK HEIWA	9V9746	A	Anchorage	2	2	0	0	0	0							4
MAERSK IDAHO	WKPM	A	New York City	37	30	32	35	16	12							162
MAERSK IOWA	KABL	A	Norfolk	30	22	36	29	62	85							264
MAERSK KENSINGTON	WMKN	A	Charleston	29	69	73	78	61	56							366
MAERSK KENTUCKY	WKPY	A	New York City	10	10	8	7	1	0							36
MAERSK KINLOSS	WMKA	A	New York City	0	0	0	0	22	1							23
MAERSK MEMPHIS	WMMK	A	Charleston	7	59	36	24	25	30							181
MAERSK MISSOURI	WAHV	A	Norfolk	26	51	17	30	67	66							257
MAERSK MONTANA	WCDP	A	New York City	80	45	26	22	66	32							271
MAERSK NIAGARA	VREO9	A	Anchorage	0	0	0	1	0	0							1
MAERSK OHIO	KABP	A	New York City	88	95	50	56	79	71							439
MAERSK PEARY	WHKM	A	Houston	104	84	59	65	59	61							432
MAERSK PITTSBURGH	WMPP	A	New York City	49	49	72	59	53	54							336
MAERSK WESTPORT	VRFO4	A	Charleston	54	55	63	54	7	0							233
MAERSK WISCONSIN	WKPN	A	Norfolk	8	18	46	29	21	17							139
MAHIMAHI	WHRN	A	Los Angeles	2	1	9	8	1	0							21
MAIA H	WYX2079	A	Anchorage	0	0	1	0	3	0							4
MAJESTY OF THE SEAS	C6FZ8	A	Jacksonville	29	7	14	29	25	36							140
MAJORIE C	WDH6745	A	Los Angeles	0	0	0	0	0	23							23

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
MALASPINA	WI6803	A	Anchorage	2	0	0	0	1	0							3
MALOLO	WYH6327	A	Anchorage	2	0	0	0	1	0							3
MANISTEE	WDB6831	A	Duluth	0	0	0	0	0	0							0
MANITOWOC	WDE3569	A	Duluth	25	0	0	2	34	20							81
MANOA	KDBG	A	San Francisco	0	0	0	8	7	10							25
MANUKAI	WRGD	A	Los Angeles	81	55	51	60	52	72							371
MANULANI	WECH	A	Los Angeles	41	41	29	28	31	26							196
MARCUS G. LANGSETH (AWS)	WDC6698	A	Anchorage	715	684	651	658	714	670							4092
MARINE EXPRESS	3FHX2	A	Anchorage	0	0	0	0	0	0							0
MATANUSKA	WN4201	A	Anchorage	1	0	0	0	0	0							1
MATSON KODIAK	KGTZ	A	Anchorage	37	63	55	49	28	15							247
MATSON NAVIGATOR	WPGK	A	Los Angeles	0	26	0	0	5	41							72
MATSON PRODUCER	WJBJ	A	Jacksonville	0	0	0	0	0	0							0
MATSON TACOMA	KGTY	A	Anchorage	30	4	0	0	0	23							57
MATSONIA	KHRC	A	Los Angeles	13	10	54	53	35	34							199
MAUNALEI	KFMV	A	Baltimore	32	28	28	0	20	25							133
MAUNAWILI	WGEB	A	Los Angeles	18	45	31	35	26	28							183
MELVILLE (AWS)	WECB	A	Los Angeles	343	0	148	0	0	0							491
MESABI MINER	WYQ4356	A	Duluth	417	0	5	560	638	527							2147
METTE MAERSK	OUJK2	A	Los Angeles	0	0	0	0	0	0							0
MIDNIGHT SUN	WAHG	A	Seattle	12	21	6	23	45	42							149
MIKE O'LEARY	WDC3665	A	Anchorage	0	0	0	0	14	10							24
MINERAL BEIJING	ONAR	A	Anchorage	34	40	0	0	20	73							167
MINERAL BELGIUM	VRKF5	A	Anchorage	3	0	0	0	0	10							13
MINERAL DALIAN	ONFW	A	Anchorage	26	29	29	41	37	7							169
MINERAL DRAGON	ONFN	A	Anchorage	25	16	3	4	0	32							80
MINERAL FAITH	VRKS4	A	Anchorage	55	42	9	1	4	11							122
MINERAL KYOTO	ONFI	A	Anchorage	13	1	89	100	96	26							325
MINERAL NEW YORK	ONGI	A	Anchorage	0	14	26	4	8	37							89
MINERAL NINGBO	ONGA	A	Anchorage	73	0	0	0	25	39							137
MINERAL NOBLE	ONAN	A	Anchorage	0	0	0	0	0	0							0
MINERAL TIANJIN	ONBF	A	Anchorage	75	45	69	40	17	15							261
MISSISSIPPI VOYAGER	WDD7294	A	San Francisco	0	2	4	0	0	0							6
MOKIHANA	WNRD	A	San Francisco	37	19	24	36	33	26							175
MOL PARADISE	9V3118	A	Anchorage	24	27	2	18	27	5							103
MORNING HARUKA	A8GK7	A	Anchorage	0	3	14	25	57	25							124
MSC KINGSTON	9HA3344	A	New York City	30	13	0	0	0	0							43
MSC POESIA	3EPL4	A	Miami	0	0	0	0	0	0							0
MUKADDES KALKAVAN	V7AP5	A	New York City	33	9	12	0	0	0							54
MV GEYSIR	WDF3296	A	Norfolk	17	0	12	0	0	0							30
NACHIK	WDE7904	A	Anchorage	0	0	0	2	1	0							3
NAKOLO	WDD9308	A	Anchorage	0	0	0	0	0	0							0
NANCY FOSTER (AWS)	WTER	A	Charleston	0	0	75	498	421	464							1458
NANUQ	WDF2026	A	Anchorage	0	0	0	0	1	0							1
NATHANIEL B. PALMER (AWS)	WBP3210	A	Seattle	744	696	743	718	740	720							4361

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NATIONAL GLORY	WDD4207	A	Houston	33	25	41	39	24	15							177
NAVIGATOR OF THE SEAS	C6FU4	A	Houston	2	1	18	16	30	12							79
NEPTUNE VOYAGER	C6FU7	A	New Orleans	11	32	29	0	33	42							147
NEVZAT KALKAVAN	TCMO2	A	New York City	19	0	44	10	7	77							157
NIEUW AMSTERDAM	PBWQ	A	Miami	131	131	166	137	125	138							828
NOKEA	WDD6946	A	Anchorage	0	1	0	0	0	0							1
NOORDAM	PHET	A	Miami	313	129	236	260	173	123							1234
NORTH STAR	KIYI	A	Seattle	12	5	21	10	20	33							101
NORTHERN VICTOR	WCZ6534	A	Anchorage	0	0	0	1	0	1							2
NORTHWEST SWAN	ZCDJ9	A	Anchorage	33	44	61	47	45	11							241
NORWEGIAN BREAKAWAY	C6ZJ3	A	New York City	48	71	48	9	0	0							176
NORWEGIAN DAWN	C6FT7	A	New Orleans	421	282	324	417	214	21							1679
NORWEGIAN EPIC	C6XP7	A	Miami	0	0	0	4	0	0							4
NORWEGIAN ESCAPE	C6BR3	A	Miami	65	49	16	88	97	58							373
NORWEGIAN GEM	C6VG8	A	Jacksonville	43	27	69	204	239	116							698
NORWEGIAN GETAWAY	C6ZJ4	A	Miami	11	14	69	54	69	26							243
NORWEGIAN JADE	C6WK7	A	Anchorage	101	116	131	133	87	222							790
NORWEGIAN JEWEL	C6TX6	A	Jacksonville	81	56	37	16	25	105							320
NORWEGIAN PEARL	C6VG7	A	Anchorage	331	219	457	536	429	439							2421
NORWEGIAN SKY	C6PZ8	A	Miami	48	35	28	78	70	55							314
NORWEGIAN SPIRIT	C6TQ6	A	New Orleans	75	250	151	140	137	35							788
NORWEGIAN STAR	C6FR3	A	Anchorage	101	53	45	68	21	34							322
NORWEGIAN SUN	C6RN3	A	Miami	304	309	290	348	112	191							1554
NUNANIQ	WRC2049	A	Anchorage	0	0	0	0	3	0							3
NYK ARCADIA	3EXI5	A	Charleston	0	0	0	0	0	0							0
NYK ARTEMIS	HOVU	A	Los Angeles	0	0	0	55	24	0							79
NYK RUMINA	9V7645	A	New York City	24	33	38	20	41	47							203
NYK TRITON	3FUL2	A	New York City	35	51	58	47	60	0							251
OASIS OF THE SEAS	C6XS7	A	Miami	5	0	6	7	1	1							20
OCEAN CRESCENT	WDF4929	A	Houston	18	30	83	88	55	49							323
OCEAN EAGLE	WDG8082	A	Anchorage	3	1	0	0	0	0							4
OCEAN GIANT	WDG4379	A	Jacksonville	76	94	46	52	2	39							309
OCEAN MARINER	WCF3990	A	Anchorage	0	0	0	0	4	0							4
OCEAN NAVIGATOR	WSC2552	A	Anchorage	0	0	0	2	0	0							2
OCEAN RANGER	WAM7635	A	Anchorage	0	0	0	0	3	14							17
OCEANUS	WXAQ	A	Seattle	0	0	0	19	45	126							190
OKEANOS EXPLORER (AWS)	WTDH	A	New York City	167	359	616	544	290	596							2572
OLEANDER	V7SX3	A	New York City	25	38	31	34	31	30							189
OLIVE L. MOORE	WDF7019	A	Duluth	0	0	0	9	190	237							436
OOCL AMERICA	VRWE8	A	Seattle	0	0	5	6	7	8							26
OOCL VANCOUVER	3EBG2	A	New York City	8	12	23	22	12	29							106
OOSTERDAM	PBKH	A	Anchorage	90	197	126	40	98	69							620
ORANGE BLOSSOM 2	D5DS3	A	New York City	0	0	0	50	45	33							128
ORANGE OCEAN	D5DS2	A	New York City	12	5	12	22	0	0							51
ORANGE SKY	ELZU2	A	New York City	4	15	13	52	42	83							209

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ORANGE STAR	A8WP6	A	New York City	0	0	28	23	14	4							69
ORANGE SUN	A8HY8	A	New York City	36	4	45	16	57	56							214
ORANGE WAVE	ELPX7	A	New York City	5	68	26	41	1	0							141
ORE DONGJIAKOU	9V9116	A	Anchorage	0	1	0	0	0	0							1
ORE ITALIA	9V9129	A	Anchorage	93	213	351	303	313	136							1409
OREGON II (AWS)	WTDO	A	New Orleans	0	0	117	4	23	141							285
OREGON VOYAGER	WDF2960	A	San Francisco	0	1	0	0	0	0							1
ORIENTAL QUEEN	VRAC9	A	Anchorage	0	0	0	0	0	4							4
OSCAR DYSON (AWS)	WTEP	A	Anchorage	98	413	529	648	575	623							2886
OSCAR ELTON SETTE (AWS)	WTEE	A	Honolulu	7	400	546	586	507	237							2283
OURO DO BRASIL	ELPP9	A	Baltimore	47	36	0	0	3	5							91
OVERSEAS ANACORTES	KCHV	A	Miami	10	21	17	12	17	26							103
OVERSEAS BOSTON	WJBU	A	Anchorage	38	56	7	10	9	43							163
OVERSEAS CASCADE	WOAG	A	Miami	15	7	1	16	23	7							69
OVERSEAS CHINOOK	WNFQ	A	Houston	84	83	61	51	81	86							446
OVERSEAS HOUSTON	WWAA	A	Miami	0	2	3	0	0	0							5
OVERSEAS LONG BEACH	WAAT	A	Houston	2	17	41	16	12	1							89
OVERSEAS LOS ANGELES	WABS	A	Seattle	42	45	73	30	65	51							306
OVERSEAS MARTINEZ	WPAJ	A	Anchorage	3	21	17	18	15	16							90
OVERSEAS NIKISKI	WDBH	A	Anchorage	26	12	8	31	43	42							162
OVERSEAS SANTORINI	WOSI	A	Houston	29	38	27	21	29	9							153
OVERSEAS TAMPA	WOTA	A	Baltimore	4	0	2	14	6	3							29
OVERSEAS TEXAS CITY	WHED	A	New York City	10	40	12	6	38	90							196
PACIFIC FREEDOM	WDD3686	A	Anchorage	1	0	0	0	33	36							70
PACIFIC JOURNEY	3FFE	A	New Orleans	0	0	0	0	1	1							2
PACIFIC RAVEN	WDD9283	A	Anchorage	0	0	0	0	2	0							2
PACIFIC SANTA ANA	A8W13	A	Houston	0	0	0	4	18	19							41
PACIFIC SHARAV	D5DY4	A	Houston	9	16	12	27	31	29							124
PACIFIC TITAN	WCZ6844	A	Anchorage	0	0	0	0	1	0							1
PACIFIC WOLF	WDD9286	A	Anchorage	0	1	1	1	1	0							4
PANDALUS	WAV7611	A	Anchorage	0	0	0	0	1	0							1
PARAGON	WDD9285	A	Anchorage	0	0	0	0	1	1							2
PARAMOUNT HALIFAX	2CWC2	A	Houston	0	0	0	0	0	2							2
PATRIARCH	WBN3014	A	Jacksonville	0	0	0	7	0	0							7
PAUL GAUGUIN	C6TH9	A	Anchorage	52	0	2	7	1	0							62
PAUL R. TREGURTHA	WYR4481	A	Duluth	302	0	160	639	593	515							2209
PERLA DEL CARIBE	KPDL	A	Jacksonville	0	0	43	62	62	62							229
PERSEVERANCE	WDE5328	A	Anchorage	1	1	1	2	0	0							5
PHILADELPHIA EXPRESS	WDC6736	A	Houston	104	113	91	40	130	140							618
PHILIP R CLARKE	WDH7554	A	Duluth	17	0	12	51	87	40							207
PISCES (AWS)	WTDL	A	New Orleans	0	0	1	193	99	414							707
POLAR ADVENTURE	WAZV	A	Seattle	45	22	3	2	9	21							102
POLAR DISCOVERY	WACW	A	Seattle	48	42	34	47	48	62							281
POLAR ENDEAVOUR	WCAJ	A	Seattle	73	14	14	17	39	29							186
POLAR ENDURANCE	WDG2085	A	Anchorage	0	0	0	4	3	1							8

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POLAR ENTERPRISE	WRTF	A	Seattle	30	31	35	40	6	0							142
POLAR KING	WDC7562	A	Anchorage	0	0	0	2	0	0							2
POLAR RANGER	WDC8652	A	Anchorage	0	0	0	2	8	14							24
POLAR RESOLUTION	WDJK	A	Seattle	14	54	44	19	48	26							205
POLAR STORM	WDE8347	A	Anchorage	0	2	3	1	1	0							7
POLAR VIKING	WDD6494	A	Anchorage	0	0	8	0	0	0							8
PREMIUM DO BRASIL	A8BL4	A	Baltimore	26	20	60	46	28	38							218
PRESQUE ISLE	WDH7560	A	Duluth	0	0	8	39	88	107							242
PRIDE OF AMERICA	WNBE	A	Anchorage	0	0	0	0	1	0							1
PRIDE OF BALTIMORE II	WUW2120	A	Baltimore	0	0	0	0	14	39							53
PRINSENDAM	PBGH	A	Miami	54	41	53	34	33	11							226
PRT DREAM	3EXT	A	New Orleans	0	0	0	0	0	7							7
PSU EIGHTH	9V6346	A	Anchorage	48	30	39	14	2	0							133
R. J. PFEIFFER	WRJP	A	Los Angeles	25	30	40	30	8	0							133
R. M. THORSTENSON	KGCJ	A	Anchorage	0	0	0	0	0	0							0
R/V KIYI	KAO107	A	Duluth	0	0	0	0	6	45							51
RADIANCE OF THE SEAS	C6SE7	A	Anchorage	0	0	0	0	2	1							3
RAINIER (AWS)	WTEF	A	Seattle	50	0	0	0	138	127							315
RANGER	WBN5979	A	Jacksonville	0	1	0	0	0	0							1
REBECCA LYNN	WCW7977	A	Duluth	0	0	0	0	0	0							0
REDOUBT	WDD2451	A	Anchorage	2	0	0	0	31	0							33
REGATTA	V7DM3	A	Seattle	114	39	29	60	24	60							326
RESOLVE	WCZ5535	A	Baltimore	46	22	19	0	0	0							87
REUBEN LASKER (AWS)	WTEG	A	Seattle	568	0	206	512	564	230							2080
RHAPSODY OF THE SEAS	C6UA2	A	Anchorage	11	0	8	24	1	0							44
ROBERT C. SEAMANS	WDA4486	A	Anchorage	0	0	0	9	7	18							34
ROBERT GORDON SPROUL (AWS)	WSQ2674	A	Los Angeles	743	696	682	240	737	720							3818
ROBERT BLOUGH	WDH7559	A	Duluth	0	0	82	346	324	66							818
ROGER REVELLE (AWS)	KAOU	A	Los Angeles	591	696	736	714	732	718							4187
RONALD H. BROWN (AWS)	WTEC	A	Charleston	499	503	438	584	565	322							2911
RONALD N	A8PQ3	A	Anchorage	135	62	25	9	68	47							346
RTM DHAMBUL	9V2783	A	Anchorage	0	3	0	0	1	12							16
S/R AMERICAN PROGRESS	KAWM	A	Miami	0	1	0	0	2	23							26
SAGA ADVENTURE	VRBL4	A	Anchorage	0	0	0	0	2	23							25
SAGA ANDORINHA	VRMV6	A	Anchorage	28	30	36	1	2	11							108
SAGA CREST	VRWR7	A	Anchorage	0	35	5	0	0	0							40
SAGA DISCOVERY	VRBR8	A	Seattle	0	32	12	53	2	21							120
SAGA ENTERPRISE	VRCC8	A	Anchorage	35	79	8	3	0	0							125
0SAGA FRONTIER	VRCP2	A	Anchorage	0	0	24	41	125	3							193
SAGA FUTURE	VRKX8	A	Anchorage	0	29	45	64	0	0							138
SAGA MONAL	VRZQ9	A	Anchorage	0	0	40	196	13	0							249
SAGA NAVIGATOR	VRDA4	A	Anchorage	0	0	3	5	46	74							128
SAGA SPRAY	VRWW5	A	Anchorage	24	149	449	591	254	703							2170
SAGA TUCANO	VRVP2	A	Anchorage	208	82	419	369	558	217							1853
SAGA VIKING	VRXO6	A	Anchorage	39	27	14	58	3	0							141

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SAGA WAVE	VRYO7	A	Anchorage	0	0	0	0	4	26							30
SAKURA OCEAN	3FRC8	A	New Orleans	0	0	0	0	15	26							41
SAM LAUD	WZC7602	A	Duluth	63	0	0	82	105	78							328
SAMSON MARINER	WCN3586	A	Anchorage	1	0	1	1	1	0							4
SAMUEL DE CHAMPLAIN	WDC8307	A	Duluth	5	0	17	16	28	20							86
SAN SABA	V7UT8	A	Anchorage	19	19	19	13	4	0							74
SANDRA FOSS	WYL4908	A	Anchorage	0	0	0	0	0	1							1
SEA PRINCE	WYT8569	A	Anchorage	0	0	0	0	0	0							0
SEA VOYAGER	WCX9106	A	Anchorage	0	1	26	35	30	10							102
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
SEA-LAND LIGHTNING	9V3291	A	Los Angeles	33	26	4	15	16	43							137
SEA-LAND RACER	VRME2	A	New York City	0	0	0	0	0	0							0
SEABOURN ODYSSEY	C6XC6	A	Miami	158	17	16	5	0	0							196
SEABOURN QUEST	C6YZ5	A	Miami	34	21	24	8	1	1							89
SEABULK ARCTIC	WCY7054	A	Miami	55	13	9	6	28	48							159
SEABULK TRADER	KNJK	A	Miami	47	22	34	40	34	39							216
SEASPAN CHIWAN	VRBH3	A	Anchorage	24	0	8	0	2	31							65
SEASPAN FELIXSTOWE	VRBH8	A	Seattle	22	34	11	25	1	31							124
SEASPAN SAIGON	VRBT7	A	New York City	8	0	0	12	53	35							108
SENTRY	WBN3013	A	Jacksonville	0	0	0	4	0	0							4
SEOUL TRADER	9HA3782	A	Los Angeles	0	0	0	0	0	0							0
SESOK	WDE7899	A	Anchorage	0	0	0	0	1	0							1
SEVEN SEAS MARINER	C6VV8	A	Anchorage	469	292	241	206	341	483							2032
SEVEN SEAS NAVIGATOR	C6ZI9	A	Anchorage	526	450	417	133	111	0							1637
SEVEN SEAS VOYAGER	C6SW3	A	Anchorage	2	117	238	124	49	137							667
SHANDONG DA CHENG	9V9131	A	Anchorage	56	43	12	60	72	49							292
SHANDONG DA DE	9V9128	A	Anchorage	8	147	291	147	128	174							895
SIANGTAN	9V9832	A	Seattle	59	5	14	4	35	12							129
SIDNEY FOSS	WYL5445	A	Anchorage	0	0	0	0	0	0							0
SIGAS SILVIA	S6ES6	A	Anchorage	466	584	559	399	526	538							3072
SIKU	WCQ6174	A	Anchorage	0	0	0	65	136	49							250
SIKULIAQ (AWS)	WDG7520	A	Anchorage	0	51	102	408	727	661							1949
SILVER SHADOW	C6FN6	A	Anchorage	0	0	0	0	0	0							0
SKYWALKER	D5IB9	A	New Orleans	0	0	0	24	59	18							101
SOL DO BRASIL	ELQQ4	A	Baltimore	32	45	17	40	14	29							177
SOMBEKE	ONHD	A	Houston	0	0	17	75	138	126							356
SPAR	NJAR	A	Kodiak	0	2	0	0	0	1							3
SPICA	A8QJ5	A	New Orleans	28	34	28	33	34	40							197
SPLENDOUR OF THE SEAS	C6TZ9	A	Anchorage	115	88	64	46	0	0							313
SS MAUI	WSLH	A	Seattle	60	49	47	1	3	0							160
ST LOUIS EXPRESS	WDD3825	A	Houston	104	42	191	102	86	44							569
ST. CLAIR	WZA4027	A	Duluth	0	0	0	0	0	0							0
STACEY FOSS	WYL4909	A	Anchorage	0	0	0	0	0	0							0

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STAR EAGLE	LAWO2	A	New Orleans	0	0	0	0	0	0							0
STAR GRAN	LADR4	A	Jacksonville	0	2	0	5	0	0							7
STAR HARMONIA	LAGB5	A	Baltimore	0	0	0	0	0	0							0
STAR HERDLA	LAVD4	A	New Orleans	0	8	17	0	29	11							65
STAR ISFJORD	LAOX5	A	New Orleans	0	16	22	2	13	8							61
STAR ISMENE	LANT5	A	Baltimore	35	13	36	7	5	11							107
STAR ISTIND	LAMP5	A	Seattle	20	0	13	20	4	29							86
STAR JAPAN	LAZV5	A	Seattle	0	80	0	29	0	0							109
STAR JAVA	LAJS6	A	Baltimore	0	0	0	0	0	0							0
STAR JUVENTAS	LAZU5	A	Baltimore	1	14	0	0	41	0							56
STAR KINN	LAJF7	A	Anchorage	0	0	0	0	0	0							0
STAR KIRKENES	LAHR7	A	New Orleans	3	4	27	10	11	60							115
STAR KVARVEN	LAJK7	A	Seattle	19	37	13	27	5	0							101
STAR LIMA	LAPE7	A	Jacksonville	3	0	15	16	18	0							52
STAR LINDESNES	LAQJ7	A	Jacksonville	28	28	1	1	5	3							66
STATE OF MAINE	WCAH	A	New York City	0	0	0	0	66	27							93
STELLAR VOYAGER	C6FV4	A	Seattle	0	0	1	16	19	30							66
STEWART J. CORT	WDC6055	A	Duluth	347	0	115	707	740	719							2628
STIKINE	WDC8583	A	Anchorage	0	0	0	1	1	0							2
SUNSHINE STATE	WDE4432	A	Miami	0	0	11	26	29	10							76
SUPERSTAR LIBRA	C6DM2	A	Anchorage	120	105	118	116	118	118							695
SUSAN MAERSK	OYIK2	A	Seattle	93	8	27	13	0	0							141
SYLVIE	VRCQ2	A	Anchorage	41	22	15	7	9	8							102
TAKU	WI9491	A	Anchorage	0	0	0	0	1	0							1
TALISMAN	LAOW5	A	Jacksonville	0	0	19	35	21	2							77
TANGGUH HIRI	C6XC2	A	Anchorage	90	125	54	115	134	134							652
TECUMSEH	CFN5905	A	Duluth	1	0	0	1	0	0							2
THOMAS JEFFERSON (AWS)	WTEA	A	Norfolk	0	7	19	0	0	0							26
TIM S. DOOL	VGPY	A	Duluth	0	0	0	13	23	21							57
TRIUMPH	WDC9555	A	Anchorage	0	0	0	0	2	1							3
TROPIC CARIB	J8PE3	A	Miami	61	54	60	78	81	92							426
TROPIC EXPRESS	J8QB8	A	Miami	42	50	37	39	48	97							313
TROPIC JADE	J8NY	A	Miami	104	62	60	54	59	74							413
TROPIC LURE	J8PD	A	Miami	42	31	40	46	51	47							257
TROPIC MIST	J8NZ	A	Miami	13	22	31	37	46	52							201
TROPIC NIGHT	J8NX	A	Miami	35	38	73	102	95	38							381
TROPIC OPAL	J8NW	A	Miami	108	98	102	66	38	39							451
TROPIC PALM	J8PB	A	Miami	29	26	24	70	78	83							310
TROPIC SUN	J8AZ2	A	Miami	92	51	66	70	62	83							424
TROPIC TIDE	J8AZ3	A	Miami	86	92	98	92	50	77							495
TROPIC UNITY	J8PE4	A	Miami	84	51	54	115	73	26							403
TS KENNEDY	KVMU	A	New York City	90	85	0	0	0	0							175
TUG DEFIANCE	WDG2047	A	Duluth	18	0	1	12	38	46							115
TUG DOROTHY ANN	WDE8761	A	Duluth	231	33	141	656	533	720							2314
TUG MICHIGAN	WDF5344	A	Duluth	17	0	0	0	0	1							18

SHIP NAME	CALL	Status	PMO	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TUG SPARTAN	WDF5483	A	Duluth	0	0	0	19	18	20							57
TUSTUMENA	WNGW	A	Anchorage	58	11	8	0	32	37							146
TYCO DECISIVE	V7DI7	A	Baltimore	59	28	4	30	9	60							190
TYCO RESPONDER	V7CY9	A	Baltimore	39	7	2	0	1	42							91
UACC RAS LAFFAN	A8VG7	A	Anchorage	0	0	0	0	0	0							0
UBC SAIKI	P3GY9	A	Seattle	0	0	0	0	0	0							0
UBC SANTA MARTA	5BDK2	A	New Orleans	0	0	0	0	0	0							0
UNIQUE EXPLORER	VRGT8	A	Anchorage	0	0	0	0	0	0							0
UNIQUE GUARDIAN	VRJM6	A	New Orleans	22	31	10	41	4	2							110
USCGC ALDER	NGML	A	Duluth	0	0	4	2	1	0							7
USCGC HEALY	NEPP	A	Seattle	0	0	0	0	15	34							49
USCGC HEALY (AWS)	NWS0003	A	Seattle	0	0	0	0	0	337							337
USCGC HOLLYHOCK	NHHF	A	Duluth	0	0	5	1	0	0							6
USCGC MACKINAW	NBGB	A	Duluth	7	2	6	11	5	2							33
VALDEZ RESEARCH (AWS)	WXJ63	A	Anchorage	703	684	708	629	721	720							4165
VEENDAM	PHEO	A	Miami	213	146	187	69	53	169							837
VISION OF THE SEAS	C6SE8	A	Miami	0	0	3	0	0	0							3
VOLENDAM	PCHM	A	Anchorage	221	105	180	237	338	386							1467
W. H. BLOUNT	C6JT8	A	New Orleans	41	34	18	57	41	24							214
WALTER J. MCCARTHY JR.	WXU3434	A	Duluth	0	0	0	81	106	17							204
WARRIOR	WBN4383	A	Anchorage	1	0	0	0	0	0							1
WASHINGTON EXPRESS	WDD3826	A	Houston	64	92	62	10	26	89							343
WESTERDAM	PINX	A	Miami	169	172	101	324	147	75							988
WESTERN RANGER	WBN3008	A	Anchorage	0	0	0	0	1	0							1
WESTWOOD COLUMBIA	C6SI4	A	Seattle	23	27	53	34	61	22							220
WESTWOOD OLYMPIA	C6UB2	A	Seattle	21	26	26	27	21	21							142
WESTWOOD RAINIER	C6SI3	A	Seattle	13	8	34	42	36	46							179
WHITTIER RESEARCH (AWS)	KXI29	A	Anchorage	744	684	739	717	737	720							4341
WILFRED SYKES	WC5932	A	Duluth	309	0	0	665	740	677							2391
XPEDITION	HC2083	A	Anchorage	0	8	29	20	27	14							98
YM ANTWERP	VRET5	A	Anchorage	10	23	0	8	6	47							94
YORKTOWN EXPRESS	WDD6127	A	Houston	54	35	32	47	32	29							229
YUHSAN	H9TE	A	Anchorage	1	0	0	0	0	0							1
ZAANDAM	PDAN	A	Anchorage	553	466	271	459	515	387							2651
ZIM SHANGHAI	VRGA6	A	New York City	17	30	27	19	31	16							140
ZIM SHEKOU	A8KX2	A	Baltimore	0	42	36	8	17	1							104
ZIM YOKOHAMA	A8MY4	A	Charleston	0	0	0	0	0	0							0
ZUIDERDAM	PBIG	A	Anchorage	78	13	62	170	103	80							506

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⚓

NOAA Weather Radio Network

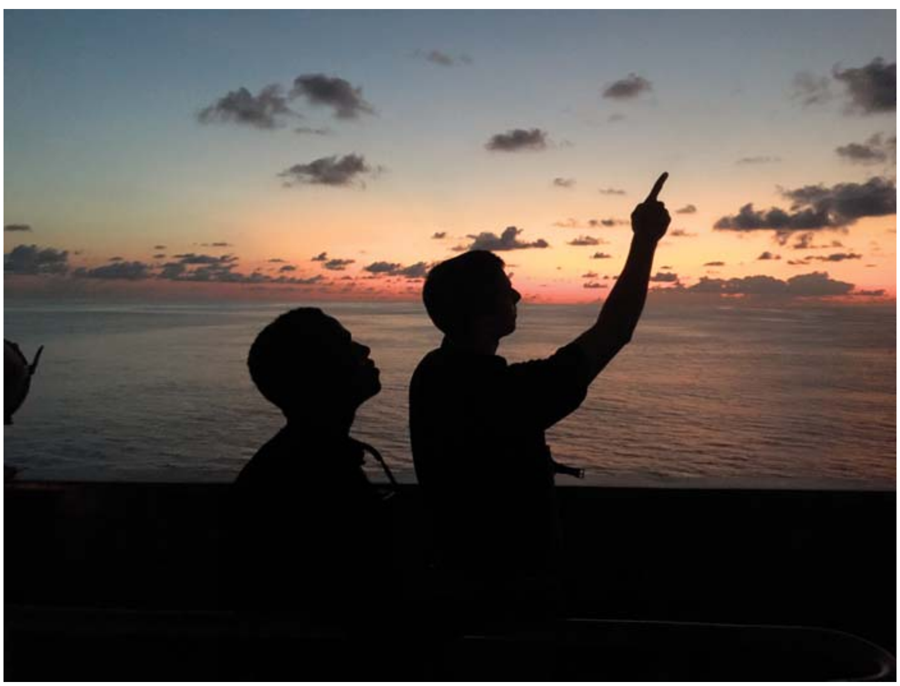
(1) 162.550 mHz
(2) 162.400 mHz
(3) 162.475 mHz
(4) 162.425 mHz
(5) 162.450 mHz
(6) 162.500 mHz
(7) 162.525 mHz

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

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

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

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



U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Data Buoy Center
Building 3203
Stennis Space Center, MS 39529-6000
Attn: Mariners Weather Log

SHIP	CALL SIGN	WIND SPEED and SEAS	LOCATION	DATE / TIME
Pazifik	ZDKS7	35 kts	13.8N 96.5W	1200 UTC 24 Nov
Cap Palliser	A8OH4	38 kts	14.4N 94.3W	1200 UTC 04 Dec
CSCL Dalian	VRBH4	39 kts 16 ft (5 m)	14.3N 95.8W	1800 UTC 04 Dec
Alliance Fairfax	WLMQ	45 kts 16 ft (5 m)	13.1N 96.2W	1300 UTC 06 Dec
Regatta	V7DM3	50 kts	10.9N 86.6W	0700 UTC 27 Dec
Island Princess	ZCDG4	39 kts 7 ft (2 m)	11.3N 86.2W	1100 UTC 27 Dec

Observation	Position	Date / Time UTC	Wind Speed, kts	Seas (m/ft)
Seven Seas Navigator	35.6N 75W	02/0800	N 50	N/A
(C6ZI9)	35N 75W	02/1100	NW 50	N/A
Maersk Iowa	40N 72W	02/1400	N 50	N/A
(KABL)				
Maersk Detroit	40N 65W	02/1800	SW 50	10.7/35
(WMDK)				
Ship CFL24	43.8N 60.6W	03/0900	W 51	6.0/20
Thebaud Platform	43.9N 60.2W	03/0600	SW 54 G67	N/A
(CFO383)				
Buoy 44014	36.6N 74.8W	02/0200	NW 41 G49	4.5/15
		02/0600	Peak gust 51	
		02/0800		Maximum 6.0/20
Buoy 41048	32.0N 69.5W	02/0600	SW 35 G49	5.5/18
		02/0900		Maximum 8.0/26
Buoy 44137	42.3N 62.0W	03/0300	SW 43 G52	9.5/31
		03/0200	Peak gust 54	
		03/0400		Maximum 10.0/33
Buoy 44024	42.3N 65.9W	03/0200	NW 37 G47	7.5/25
		03/0700		Maximum 8.0/26

Observation	Position	Date / Time UTC	Wind Speed, kts	Seas (m/ft)
Ship CFL24	43.8N 60.6W	22/2200	NE 62	N/A
		23/0300	NW 57	6.0/20
		23/0400		7.5/25
Thebaud Platform	43.9N 60.2W	23/0000	NE 51 G62	N/A
(CFO383)		23/0300	NW 60 G72	N/A
Buoy 44141	43.0N 58.0W	23/0600	W 47 G58	8.0/26
		23/0700		8.5/28
		25/0900		Maximum 9.0/30
Buoy 41002	31.9N 74.8W	24/1700	SW 35 G49	4.5/15
		24/1900	Peak Gust 62	5.0/16
Buoy 41025	35.0 75.4W	24/1000	SW 37 G49	6.0/20
		24/1100	Peak Gust 60	6.5/21
Buoy 44139	44.2N 57.1W	25/1000	S 39 G51	7.0/23
		25/1700		Maximum 9.5/31
Buoy 44037	43.5N 67.9W	27/1800	NE 45 G56	9.0/30
		28/0000		Maximum 10.0/33
Buoy 44024	42.3N 65.9W	27/1100	NE 49 G64	N/A
		27/2000		9.0/30
Buoy 44008	40.5N 69.2W	27/0800	NE 45 G58	8.5/28
		27/0700	Peak Gust 60	N/A

Table 2. Selected platform and buoy observations taken during the North Atlantic storms of January 23-28, 2015.

ONSET	REGION	PEAK WIND (kts)	GALE DURATION (STORM)	FORCING
22 Feb 0000 UTC	Caribbean	35	18 h	Pressure Gradient
23 Feb 0000 UTC	Caribbean	35	18 h	Pressure Gradient
24 Feb 0600 UTC	Caribbean	35	12 h	Pressure Gradient
25 Feb 0600 UTC	Caribbean	35	12 h	Pressure Gradient
26 Feb 0600 UTC	Caribbean	35	18 h	Pressure Gradient
27 Feb 0600 UTC	Caribbean	35	12 h	Pressure Gradient
28 Feb 0600 UTC	Caribbean	35	12 h	Pressure Gradient
29 Feb 0000 UTC	Caribbean	40	60 h	Pressure Gradient
02 Mar 1800 UTC	Caribbean	35	18 h	Pressure Gradient
04 Mar 0000 UTC	Caribbean	35	18 h	Pressure Gradient
05 Mar 0000 UTC	Caribbean	40	114 h	Pressure Gradient
05 Mar 0600 UTC	Gulf of Mexico	50	48 h (12 h)	Cold Front
07 Mar 1200 UTC	Gulf of Mexico	35	06 h	Cold Front
10 Mar 0000 UTC	Caribbean	40	18 h	Pressure Gradient
11 Mar 0000 UTC	Caribbean	40	42 h	Pressure Gradient
13 Mar 0000 UTC	Caribbean	35	18 h	Pressure Gradient
14 Mar 0000 UTC	Caribbean	35	18 h	Pressure Gradient
15 Mar 0000 UTC	Caribbean	35	18 h	Pressure Gradient
27 Mar 1200 UTC	Gulf of Mexico	40	12 h	Cold Front
07 Apr 0600 UTC	Caribbean	35	12 h	Pressure Gradient
08 Apr 0600 UTC	Caribbean	35	12 h	Pressure Gradient
10 Apr 0600 UTC	Caribbean	35	12 h	Pressure Gradient
27 Apr 0000 UTC	SW North Atlantic	35	12 h	Cold Front

Table A-A details the warnings issued in the TAFB Atlantic High Seas AOR from January through April 2015. The first longer duration gale of 2015 began on 1 January and occurred in the Caribbean Sea as a strong pressure gradient set up between a relatively strong high pressure system anchored across the Southwest North Atlantic Ocean and lower pressure across the Northwestern South American continent. Gale force conditions persisted for six and a half days before a strong frontal trough weakened the Southwest North Atlantic ridging and relaxed the pressure gradient across the Caribbean Sea. **Figure 1** shows a MetOp Advanced SCATerometer (ASCAT-B) pass from 04 January. Note the blue wind barbs indicating 34-40 kts winds in the Southwestern Caribbean Sea that reached the surface. Warnings were discontinued in the Caribbean by 1800 UTC 07 January.