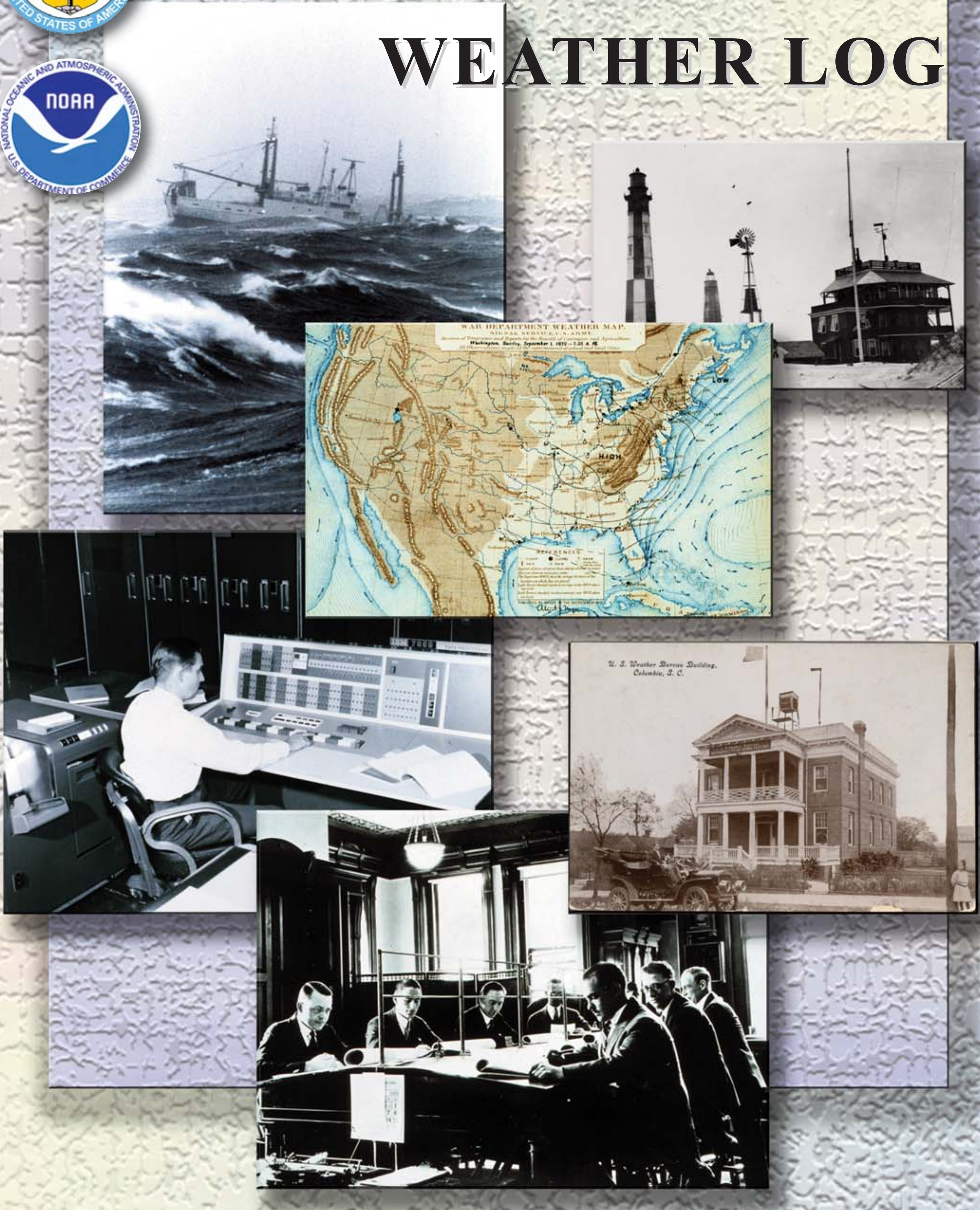
Mariners

WEATHER LOG



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See these Web pages for further links.

From the Editor

Welcome to the December issue of the Mariners Weather Log! Here we are, nearing the end of another year. It seems like this year just flew by. Happy Holidays to all in the coming season and lets ring in the New Year with kindness and warm wishes for all.

This past August, a long overdue workshop/conference for the Port Meteorological Officers was held on-site at the NASA Stennis Space Center Mississippi. I think the consensus was overwhelming that it was a huge success. We covered a lot of issues and got to discuss our various needs with the Deputy Director of NOAA's National Weather Service, Laura Furgione. Laura's visit to our workshop was in itself validating that our VOS program and our PMO's are held high in regard at the Headquarters level; her report showed that VOS was ranked in the top 50% among all NOAA observing systems! John Murphy, director of the National Weather Service Office of Science and Technology, reiterated this fact plus more. It was a productive busy three days! You can find the rest of the story and some great photos on page 28.

We have several great articles to offer you this issue. One that I would like to mention is a collaborative effort; our colleagues from National Weather Service Headquarters in Silver Spring Maryland and a Senior Forecaster in the National Weather Service Forecast Office in Eureka, California. When I initially received this article, I took notice of how lengthy it was; after reading this article, there was nothing I would want to cut out to shorten it. This is one of those great articles that give you the much needed background on how much effort goes into the production of marine weather forecasting. This article also gives great insight on the history of marine weather forecasting and slowly brings you up to the current practices as well as offering insight on the up and coming new technologies. I found it so very interesting and detailed, I know you will too. We have come a long way since 1870! Richard, David, Wayne and Brian, thank you for writing and sharing such a grand article. (Page 4)

Another great article on page 18 is our PMO Corner show casing ship reports from the Straits of Florida. This is another collaborative effort by our PMO out of Miami, David Dellinger and the Marine Program Meteorologist "Chip" Kasper, from NWS Forecast Office Key West Florida.

So without further ado…grab yourself a nice glass of eggnog, sprinkle a little nutmeg on top, cozy in and enjoy the MWL!

Cheers!

Paula

On the Cover: Clockwise from upper left: NOAA Ship **Delaware III**, Weather Station at Cape Henry, Early Signal Service Map, NWS Columbia, SC, Weather Bureau Forecast Office, IBM 7090 console. All images courtesy NOAA's Photo Library, **http://www.photolib.noaa.gov/**

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The National Weather Service Marine Program has a mission to provide marine weather forecasts, warnings, and other information for the protection of life and property while on the waters. Weather and ocean data are critical to the mariner. This is due to a combination of hazards – such as strong wind and large waves – and the inherent isolation while on the water. Mariners in smaller vessels encountering hazardous conditions in the coastal waters and Great Lakes may be hours away from safe port and at the mercy of the elements. Large ships at sea also face potentially great dangers and are often days away from a safe port. When in peril, rescue of these vessels may be hours or days in coming. Reliable, rapid, and easy access to weather information, when properly understood and applied, supports decisions which ultimately lead to saving lives and reducing economic losses. Not having accurate and timely weather information and the knowledge to properly apply it, increases risk to mariners and their vessels.

NOAA's National Weather Service is responsible for issuing marine forecasts and warnings for the U.S. coastal waters and Great Lakes, offshore and high seas portions of the Pacific and Atlantic Oceans, Gulf of Mexico, Caribbean, and for a portion of the Arctic Ocean (north of Alaska).

In coastal areas, NWS provides vital services and products to inform and protect residents, businesses, tourists, and others from hazardous weather and surf conditions.Typically in the coastal community, rip currents, inundation due to storms and unusually high tides are the primary focus. Marine observations and forecasts also support ecological assessments and predictions, disaster response, and decision support services.

The NWS marine forecast services support vital decision-making processes for short, medium, and long-range planning, emergency response, and hazard mitigation. This empowers mariners and other users to be better informed – and therefore safer and more productive.

Over half of the U.S. population lives within 50 miles of the coast. At sea, maritime commerce has tripled in the last 50 years. In the following sections, we will explain how marine weather forecasts are made, the history of marine weather forecasting, and then take a look at the future of marine weather forecasting.

The History of Marine Weather Forecasting in the National Weather Service

In 1870, a Joint Congressional Resolution requiring the Secretary of War "to provide for taking meteorological observations at the military stations in the interior of the continent, and at other points in the States and Territories...and for giving notice on the northern lakes and on the seacoast, by magnetic telegraph and marine signals, of the approach and force of storms" was introduced. Congress passed the resolution and on February 9, 1870, President Ulysses S. Grant signed it into law. A new national weather service was born within the U.S. Army Signal Service's Division of

Telegrams and Reports for the Benefit of Commerce that would affect the daily lives of most of the citizens of the United States through its forecasts and warnings for years to come.

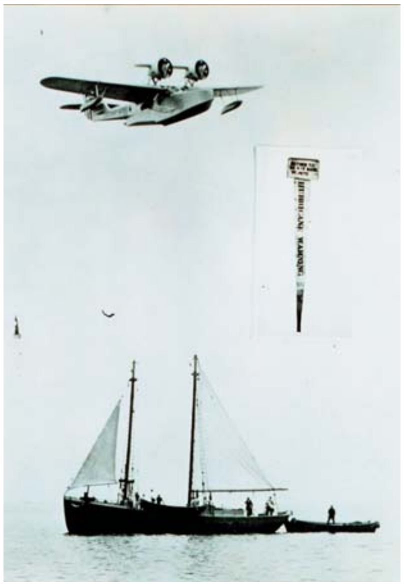
A Marine weather program began on January 23, 1873 at the United States Army Signal Service’s Division (US Army Signal Corps today) in New Orleans, Louisiana. On that day, the Signal Observer transcribed meteorological data from the ship logs of those arriving in port. On October 1, 1890, the weather service becomes a civilian agency when Congress, at the request of President Benjamin Harrison, passes an act transferring the meteorological responsibilities of the Signal Service to the newly-created U.S. Weather Bureau in the Department of Agriculture. Official three-day marine weather forecasts for the North Atlantic began in 1901 (from U.S. Navy). The responsibility of marine forecasting was transferred to the Weather Bureau in 1904 and in 1905, the **SS New York** transmits the first wireless weather report received on ship at sea.

In the early 1900s, the Norwegian Cyclone Model created by V. and J. Bjerknes provided the first glimpse as to the structure of the atmosphere across the mid latitudes. This meteorological advancement and the increase in shipboard observations for the first time provided the ability for meteorologists to create a crude map of the state of the atmosphere. In 1912, the **RMS Titanic** sank and in response, the International Convention for the Safety of Life at Sea (SOLAS) was formed in 1914. A maritime safety treaty, SOLAS determines requirements for safer ocean voyages across the globe ensuring that ships flagged by signatory States comply with minimum safety standards in construction, equipment and operation.


Courtesy of Geo. S. Bliss, U.S. Weather Bureau, Philadelphia, Pa.
SIGNALS ON DELAWARE BREAKWATER.

Picture 1 - Signal Tower for Storm Warning Flags used by day, lanterns by night. Used to warn mariners In: "The Boy and the U.S. Weather Men", 1917, p.236. Photo Courtesy of U.S. Weather Bureau circa 1910.

A hurricane warning service was established in 1935. In 1940, the Navy established a weather center and President Roosevelt ordered the U.S. Coast Guard to man ocean weather stations. A defining moment in marine weather forecasting occurred during World War Two when the decision to invade Normandy on June 6, 1944 was based on accurate weather forecasts indicating the correct combination of tides and winds.



Picture 2 - Coast Guard aircraft used to drop hurricane warnings to sponge fishermen off the west coast of Florida. Photo Courtesy of the National Weather Service circa 1938.

In 1957, the United States Weather Bureau started to publish the Mariners Weather Log, a bi-monthly publication addressing marine issues. The Mariners Weather Log is still published today and documents significant storms over and near the Earth's oceans and the Great Lakes of North America, tropical cyclones and non-tropical cyclones.

The U.S. Weather Bureau became the National Weather Service in 1970. Forecast weather maps began to be published by offices in New York City, San Francisco, and Honolulu for public use. North Atlantic forecasts were shifted from a closed U.S. Navy endeavor to a National Weather Service product suite via radiofacsimile in 1971, while northeast Pacific forecasts became publicly available by the same method in 1972.

In 1975, the first "hurricane hunter" Geostationary Operational Environmental Satellite (GOES) is launched into orbit; these satellites with their early and close tracking of hurricanes, greatly reduce the loss of life from tropical cyclones. In 1977, the success of weather satellites results in the elimination of the last U.S. weather observation ship; real time access to satellite data by national centers advances hurricane, marine and coastal storm forecasts.

It was not until the turn of the 20th century that radio communications became commonplace on ocean faring vessels, which allowed for ships to contact and be contacted by other ships or land. While early radio communications were not standardized and mainly tailored to the ability of passengers to receive telegrams, it was the first time in which real-time observations were able to be relayed to others in the region. During this same time the density of meteorological observations and understanding of the atmosphere was increasing at a rapid rate.

Today, the Ocean Prediction Center and the Tropical Analysis and Forecast Branch are responsible for issuing Offshore and High Seas forecasts and warnings for much of the North Atlantic and North Pacific Oceans including tropical sections such as the Caribbean Sea and Gulf of Mexico. These forecasts are broadcast internationally via **SafetyNET**, the international service for the broadcast and automatic reception of maritime safety information (MSI) and search and rescue (SAR) related information and **NAVTEX** (Navigational Telex), an international automated medium frequency direct-printing service used for delivery of navigational and meteorological warnings and forecasts within 200 nm of the coasts. Individual Weather Forecast Offices are responsible for issuing marine forecasts and warnings for near shore coastal waters of the U.S. and its territories.

Marine Weather Forecasting Today

Marine forecasting, that of telling the future state of wind and wave conditions, is millennia’s old. However, techniques of marine forecasting have come a long way in the last several thousand years, bringing us into the modern era of marine observations via satellite and buoys, and forecasting using sophisticated computer programs. The role of marine weather forecasters worldwide is a complicated one and will continue to change in response to evolving technology and user requirements.

Over the course of time and through the understanding of changing weather patterns, it became clear to mariners that weather controlled the conditions of the ocean. Early on however, weather forecasting over the ocean was difficult at best. In situ observations, literally meaning “on site,” were the only way of gaining information as to what the conditions were like on the water. If a mariner was skilled enough to make it back to port in poor conditions, then and only then could the severity be relayed to others preparing to venture out.

In the modern era (since the 1980s) meteorological understanding has increased at a rapid rate. In the marine environment meteorologists began accessing observations from local and transoceanic vessels as well as buoys and coastal meteorological equipment. Meteorologists also gained data from remote sensing instrumentation (i.e. satellites).

In just One Hundred years, meteorologists have gone from rudimentary to highly sophisticated marine weather forecasting. Meteorologists now have access to traditional data such as buoys and ship observations, to detailed satellite imagery and an array of remote sensing equipment. Current science allows the forecaster to see the wind field across swaths of the ocean as derived by satellite. Some satellite instrumentation even allows the meteorologist to view sea heights. High frequency radar along the coast allows mariners to view detailed information regarding the surface currents.

Vast amounts of meteorological information are available to the marine forecaster today. An incomprehensible amount of data coupled with an ever growing understanding of the atmosphere has necessitated the development of advanced atmospheric numerical models. These models are driven by atmospheric physics with observations as the initial input. Atmospheric models are only limited by the computing power available. Many models now exist and are typically researched by universities and implemented operationally by governments. Atmospheric models are not the sole beneficiary of scientific understanding and computational advancements. Wave models have also skyrocketed in their development since the 1990s when Dr. Hendrik Tolman brought wave physics to the operational realm through the development of the "wavewatch" model. The wavewatch model is primarily an open ocean wave model used globally by universities, private weather enterprise, and public weather services. Wavewatch has been possible due to the development of atmospheric models since it uses the wind field from the Global Forecast System (GFS) to drive wave development. Prior to the wave models pioneered by Dr. Tolman, only a few models from the military were developed. Otherwise wave forecasting was solely done by extrapolation by model derived wind speed using the Beaufort scale, which was instituted in 1805.

The Delft University in the Netherlands, from which Dr. Tolman came, continues to produce increasingly complex wave models through their engineering department. In the late 1990's came the SWAN (Simulating Waves Near-shore) model from Delft. This incorporated shallow water wave physics and was only possible through increased computational power. In the early 2000's SWAN was brought to the United States and adapted to near-shore wave modeling on the west coast. The chief benefit of using SWAN for near-shore waves has been separating it from using atmospheric models as the wind input, but instead utilizing forecaster knowledge to create a wind field which then drives local wave development. As of the first half of the 2010's the National Weather Service has dedicated resources to taking the SWAN engine into the operational environment through the development of the Near-shore Wave Prediction System (NWPS). As computational power increases, the marine forecaster will benefit from further development of higher resolution wave models.

In general, a Marine Forecaster must:

(1) Analyze and monitor continually the marine weather situation.

(2) Forecast marine weather phenomena, variables and parameter.

(3) Warn of hazardous phenomena.

(4) Ensure the quality of meteorological information and services.

(5) Communicate meteorological information to internal and external users.

The marine forecaster's responsibility is to continuously monitor the current situation, ongoing advisories, forecasts and warnings of weather and marine parameters and variables; and significant weather phenomena. They must determine the need for issuance, cancellation or amendment / update of advisories, forecasts and warnings according to documented thresholds and regulations. This is accomplished through maintaining a weather watch over the marine weather situation and evolving significant weather phenomena and then comparing current forecasts and warnings against observed conditions.

The Forecaster must be able to interpret:

- Radar and satellite imagery to identify fog, severe convective system, tropical cyclone, thunderstorms, squalls, sea ice and other potentially dangerous phenomena.

- Numerical weather prediction guidance (including Ensemble Prediction Systems), marine products and other forms of objective guidance, and their assimilation into forecast/warning preparation.

- Observed variables and parameters when there are differences between automatic sensor technologies and manual observing techniques and the impact on forecast and warning products.

- Coded real time raw data including buoy and ship reports.

Particular knowledge required includes:

Knowledge of relevant observing systems, platforms, and sensors that may include remote sensing (satellite altimeters, scatterometers, microwave sensors; radar, lightning detection systems); in-situ sensors (anemometers, tide gauges, moored wave buoys, drifting buoys, bottom pressure sensors); human observing procedures (ship, shore) and how their advantages and limitations vary with respect to prevailing seasonal and meteorological conditions.

Forecasts include many of the following parameters:

- Wind including Directional Variability, Speed and Wind Gusts.
- Sea State.
- Damaging Large Waves or Multiple Swell Systems.
- Precipitation and Associated Horizontal Visibilities.
- Fog or Mist, and Associated Horizontal Visibilities.
- Other types of Obscuration to Visibility, including Smoke, Haze, Sand-Storms, Dust-Storms, Blowing Snow, Volcanic Ash, Rock and Associated Horizontal Visibilities.
- Sea Ice State.
- Synoptic situation for Tropical, Sub-tropical, Temperate and Polar Climate Zones as required.
- Thunderstorms, Heavy Precipitation with Poor Horizontal Visibility, Down-Burst, Microburst, Squalls or Gust Front, Hail, Tornadic, Water Spout Activity.
- Freezing Spray or Precipitation, Snowfall.
- Icing on the Vessels or Structures.
- Tropical Cyclones, Hurricanes, Typhoons.
- Icebergs and their movement.

Warning of hazardous phenomena is the most critical aspect to the marine forecast. Protection of life and property is of the utmost importance. Warnings must be issued in a timely manner when hazardous conditions are expected to reach documented threshold values or impacts and as appropriate, amended or cancelled, according to documented criteria.

The phenomena to be warned and forecasted for includes, but may not be limited to:

a. Tropical Cyclone / Hurricanes / Typhoons

b. Wind Hazards - Gales, Storm, Hurricane Force Wind

c. Thunderstorms, Heavy Precipitation with Poor Horizontal Visibility, Down-Burst, Microburst, Squalls or Gust Front, Tornadic Hail, Tornadic Water Spout activity

d. Ice Accretion
- Freezing Spray or Precipitation and Icing on the Vessels or Structures

e. Restricted Visibility (less than 1nm)
- Reduced Horizontal Visibility caused by Precipitation, Fog, Smoke, Smog, Dust, Haze, Sand-Storms, Dust-Storms and Blowing Snow
- Reduced Horizontal Visibility caused by Volcanic activity

f. Unusual and Hazardous Sea-Ice conditions
- Exceptional and rapidly changing Sea Ice conditions
- Icebergs

g. Storm-induced Water (Sea) levels
- Sea Level and Storm Surge

Once the forecast and / or warning messages are complete, it must be communicated in a timely manner to meet user community needs. This is done through ensuring that all forecasts and warnings are disseminated via the authorized communication channels to user groups. NWS marine forecasters also provide marine weather briefings as necessary, providing consultation to meet specific user needs (Decision Support Services) and utilizing the forecasts and warnings of meteorological parameters and phenomena to describe their impact on marine operations.

Today, in a National Weather Service (NWS) Weather Forecast Office, marine forecasting is a complex task of viewing data, both observed and model, then synthesizing it through knowledge and experience to create a forecast product. Within the NWS, the marine forecaster uses powerful workstation computers to create a forecast.

Today, when a forecaster arrives on station for a forecasting shift the first item of business is to receive a briefing from the forecaster leaving duty. This provides immediate situational awareness to the incoming shift. Once settled at a workstation, the forecaster will check the ongoing forecast against currently available observations, both winds and seas. At times some observations will be missing which will then require the forecaster to use local knowledge and meteorological understanding to fill in the gaps in observed data. These steps are completed to ensure the ongoing forecast remains valid and does not become unrepresentative of the ongoing conditions. If the forecast is valid then no amendments are required. Otherwise, the forecast will need to be updated to reflect current conditions.

Across nearly all the U.S. coastal waters the NWS uses a Graphical Forecast Editor (GFE) to create the marine forecast. GFE is a gridded database in which each grid represents a 2.5km square area and allows the forecasters to define a value for a given weather element (wind, wave, period, etc.) within an individual grid.

Creating a strong marine forecast always begins by verifying model data against current conditions. Model assessment should originate at the synoptic scale (a large area) then downscaled to the local area. If models have initialized well against observed data then the forecast process may proceed easily. However, if the models are not handling the current situation well, which is typically the case along complex coastlines, then local knowledge and high resolution atmospheric models should be utilized. The marine forecaster should be able to mentally correct for model inadequacies and include this information into GFE.

GFE is where the marine forecaster creates a foundational dataset by assigning specific values to each of the grids, described previously. From this foundational dataset all marine products will emanate. Within GFE the wind field should be the first edited by the marine forecaster, as winds provide the forcing to generate local waves. In some areas there are meso-scale wind effects or timing issues that models may not pick up on which the marine forecaster needs to include into the foundational dataset. As such, standard tools that are used to populate the gridded wind field with model data may not be appropriate. In these cases it will take a personalized touch from the marine forecaster to ensure the winds are correct for the situation. Tools and methodologies to populate the wind field can vary from office to office depending upon local needs. The NWS provides a wind forecast that goes out to minimum of seven days.

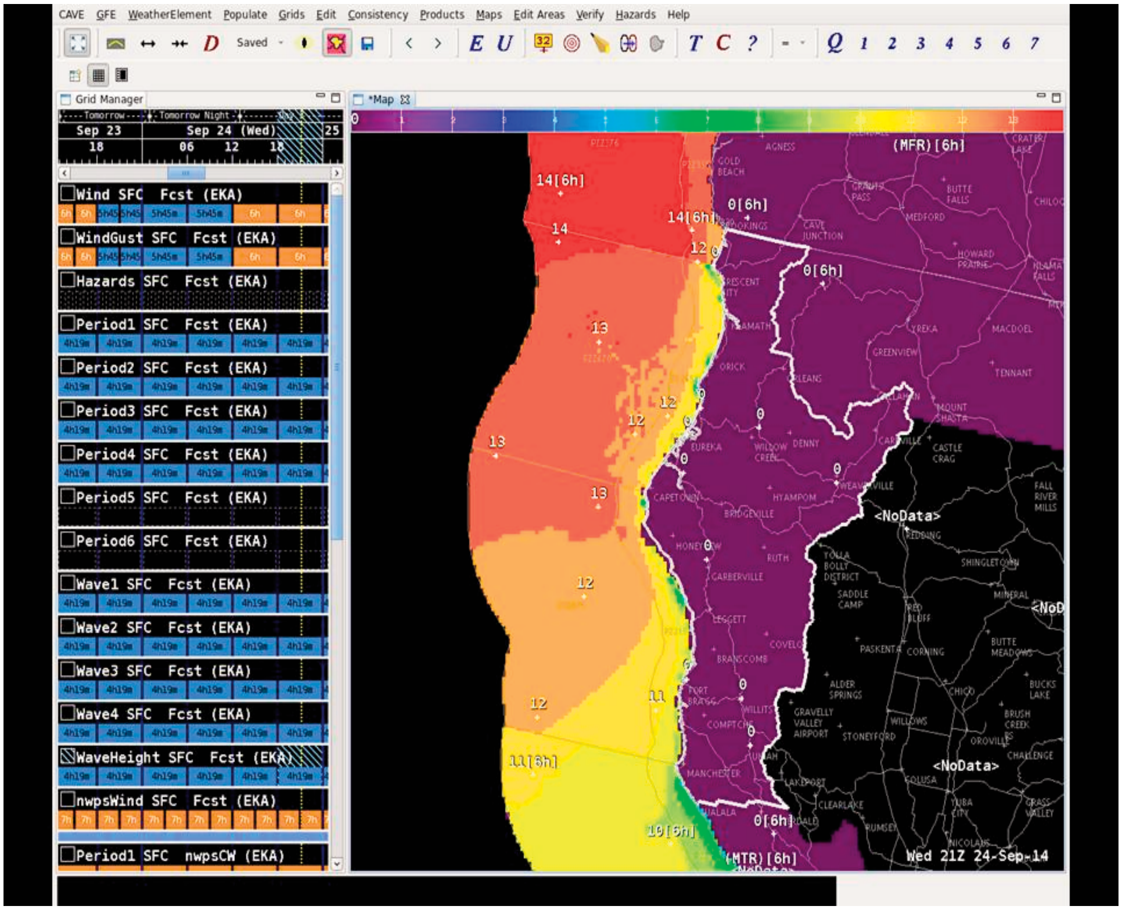
Once the wind grids are in place the marine forecaster will being to assess the local wave regime. Many coastal offices within the NWS solely provide a singular wave height with the addition of primary wave direction and period at the offices discretion. Offices in the Pacific basin tend to include multiple wave systems including their direction, height, and period. For the purposes here, we will highlight the Pacific basin while making reference to the others.

For NWS offices along the west coast and Gulf of Mexico the Simulating Waves Nearshore (SWAN) model is available to generate local waves based on the edited wind grids the marine forecaster would have already completed. Other offices that do not use SWAN would rely on tools that derive local wave energy based on wind speed from the GFE wind grids. Outside the local wave energy is distant source wave energy. This is accounted for by the Wavewatch model.

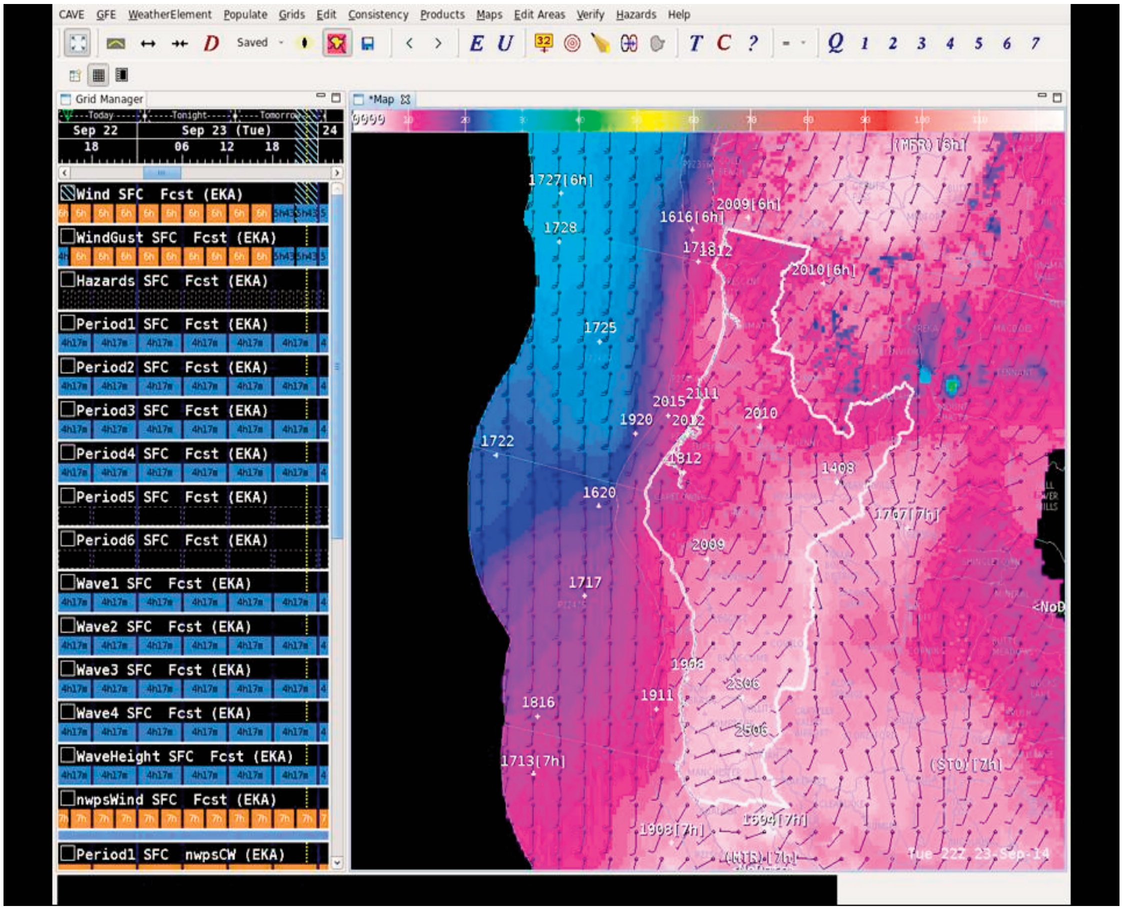
Mariners are interested in waves that will make their time at sea rough. This could be in the form of a steep locally generated wave or a couple different waves arriving from differing directions which can make for an uncomfortable ride. When utilizing the SWAN model, the marine forecaster can expect to wait a short time for the model to run and return data useful for GFE. After the returns it will need to be quality controlled to verify how well it has initialized against current conditions, similar to the winds previously. If the model has initialized well and seems to be handling the forecast situation in an acceptable manner, the marine forecaster can populate the local waves with data from SWAN and non-local wave data from the Wavewatch. Usually minor manipulations are needed to adjust model wave data toward observed wave data. Tools have been developed to perform such tasks within GFE.

For the west coast marine forecaster there are typically three wave systems available for use in GFE. While each is not utilized at all times it allows for placement of a steep locally generated wave and two separate distant source waves (or swells). Once quality control has been completed the marine forecaster uses tools within GFE to pull model data into the foundational dataset. It will be up to the forecaster to decide which and how much data to put into the foundational dataset, but will be based on current and developing conditions. Some basic editing may be needed to clean up these forecast grids in the foundational dataset.

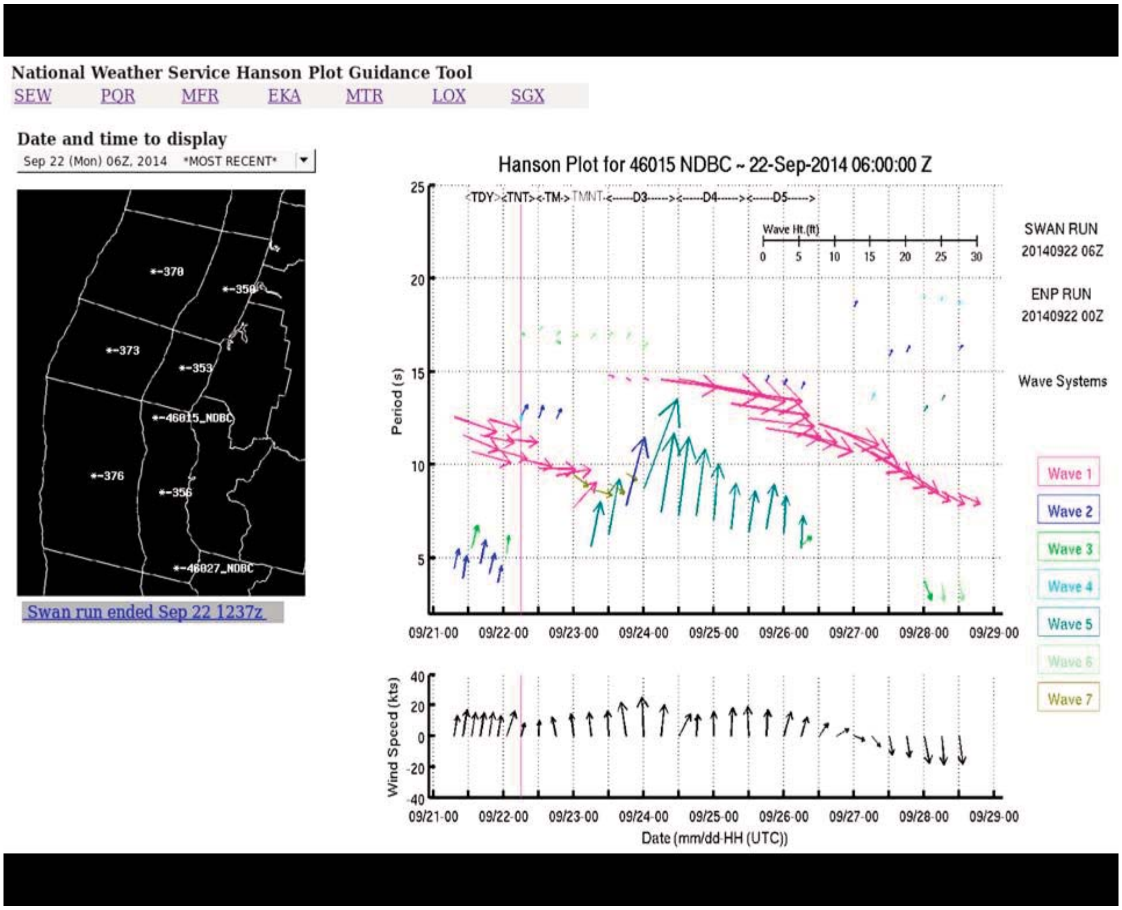
Now that the wind and wave grids are complete and representative current conditions, products can be generated using the information from the foundational dataset.



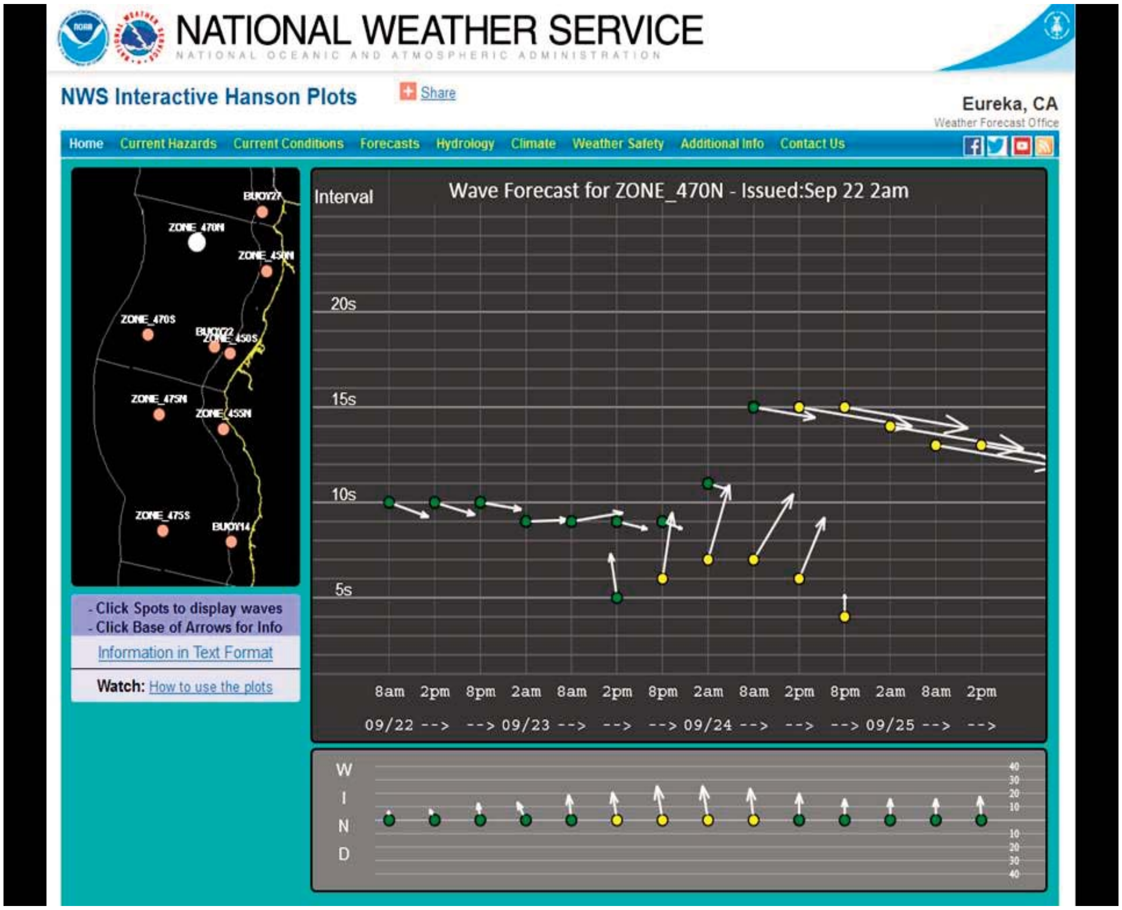
Example of a gridded forecast for wave height utilizing GFE in a NWS Waether Forecast Office



Example of a forecasted gridded wind speed and direction on a GFE at a NWS Waether Forecast Office.



Some National Weather Serive Forecast Offices utilize Hanson Plots to display varying sets of wave trains that affect the coastal waters.



Interactive Hanson Plots shown here from Weather Forecast Office, Eureka, CA.

The most widely seen product across the coastal waters and Great Lakes is the coastal waters and open lakes forecast. To generate this product the marine forecaster will run a program that samples the individual grid points over a particular area then calculates an average (typically a weighted average) which is returned in the form of a discrete value in the text forecast. The program will perform this averaging for each wind, wave, and period timeframe in the forecast.

The coastal waters and open lakes forecast's are not the only product that can be generated from the foundational dataset. This dataset is the base for all marine forecast information and simply needs to be told what to return. Some offices have had success running a surf zone forecast in support of user groups like surfers and crabbers. A "bar" forecast can also be generated from the foundational dataset for mariners going into or out of a harbor. Again, the forecast data is there once the marine forecaster has entered the latest and best information, all that needs to be done now is to have someone tell it what products to yield.

Products that fall out of the foundational dataset can be found online from local forecast offices, as well as on NOAA weather radio.

Outside of coastal forecast offices, the NWS also has a few National Centers that have responsibilities for the high seas of the Atlantic and Pacific from around the equator to high latitudes of around 70°N. The high seas forecast data is slowly transitioning toward a GFE based forecast. However, the geographical area that is covered is much too immense at this time to easily grid and entire basin and have a computer process those fields with any timeliness. That said, steps have been taken to bring the offshore waters (60 to 250 nautical miles from the coast, as well as the Gulf of Mexico, Caribbean Sea, and the Bering Sea) into the modern era of gridded forecasts.

Currently, the high seas forecasts are done through a mix of graphical forecast charts which display the position, intensity and movement of lows and highs through time, and through a succinct text product that provide basic regions of marine warnings and forecast conditions.

Regardless of which office a marine forecaster is located in, the steps are the same. First is to compare model data to observed data to verify consistency. Second is to generate a foundational dataset that begins with observed data then runs out in time with the best forecast based on the understanding of the atmosphere. Third is to run programs that pull data from the foundational dataset to create forecast text and graphical products. Finally, and this should be done at each step, quality control everything to ensure the best information is making it out.

The best information will lead to the best decisions which will lead to saving lives, moving vessels most efficiently, and building our Nation's economy.

Meteorologists are looking into the future where more and higher resolution remote sensing can be achieved. This will come in broader areas of satellite derived winds and seas, greater detail of sea surface, and more and better shipboard observations. The possibility even exists, with cost effective technology, that ships may carry their own remote sensing equipment, such as highly detailed weather radars, which could replace the coarse radars aboard ships now. The modern mariner now includes anyone from merchant mariners to pleasure crafting weekend recreational boaters.

The Future of Marine Weather Forecasting in the National Weather Service

The National Weather Service (NWS) routinely assesses its marine weather forecast products and services to identify areas of improvement. Future strategic planning for all NWS products and services revolves around the concept of building a Weather-Ready Nation. NOAA's Weather-Ready Nation is about building community resilience in the face of increasing vulnerability to extreme weather and water events. For more information on NOAA's Weather Ready Nation go to: **http://www.nws.noaa.gov/com/weatherreadynation/#.VA8VdvIdVHU**

Services – Mobile Devices and Internet

With the popularity of mobile electronic devices such as smart phones and tablets increasing rapidly, the NWS recognizes the need to make its most critical information available via mobile devices. The NWS sends urgent weather warnings via Wireless Emergency Alerts (WEA); text messages sent by authorized government alerting authorities through mobile carriers. Marine weather messages currently sent through WEA are Tsunami Warning, Typhoon Warning, and Hurricane Warning and there are plans to add more urgent marine weather messages to WEA in the future. For more information on WEA, go to: **http://www.nws.noaa.gov/com/weatherreadynation/wea.html#.VA8W-vldVHV**. The NWS also has a mobile version of their webpage at **www.mobile.weather.gov** and at **www.cell.weather.gov**, one can get text products for a mobile device.

The NWS will make the National Marine Weather Web Portal operational in the near future. It is currently experimental and can be viewed at: **http://preview.weather.gov/mwp**
This new portal displays hazards, forecasts, observations and many other data layers useful for briefing mariners, coastal managers, emergency managers and first responders on current and future marine weather. This web page can be configured to display information pertinent to a geographic area. Forecast tracks of tropical systems will be available along with other vital datasets such as tides, sea surface temperatures and analysis and forecasts of key marine variables such as wind, wind gusts, significant wave height and surface water currents.

Product Improvement - Graphics

Graphical marine weather products will be an important part of the future of marine weather forecasting. For example, the Tropical Analysis and Forecast Branch (TAFB), the Ocean Prediction Center (OPC) and the Honolulu Weather Forecast Office (HFO) will provide graphical forecasts (on an experimental basis) for their offshore waters and high seas forecast areas of responsibility for the Atlantic and Pacific basins. The Weather Forecast Offices (WFOs) in Fairbanks, Anchorage and Juneau, Alaska will provide (experimentally) graphical forecasts over their offshore waters in the Arctic basin. For an example of what these look like, go to: **http://www.nhc.noaa.gov/marine/grids.php**

Improvements in Wave Forecasting

NWS offices are testing an experimental enhancement to their Coastal Waters Forecast (CWF), additional wave height fields using advanced theoretical statistics (Rayleigh Distribution.) Future marine forecasts will have several different wave statistics based on this Distribution; such as the Significant Wave Height (HS) and the average height of the highest 10 percent of waves (H1/10) observed at sea.

The current CWF product provides a forecast range of the expected significant wave height (average height of the highest 1/3 of the waves) across the coastal waters. For example:

“Tonight...Northwest winds 13 to 18 knots becoming northeast 16 to 21 knots. Seas 2 to 4 feet building to 4 to 6 feet late. Dominant period 6 seconds. Intracoastal waters choppy in exposed areas. Slight chance of showers.”

Adding the highest 10 percent of waves height to the CWF product will provide a more descriptive and accurate assessment of the wave field expected for any particular time across a given marine zone. User knowledge of this information could reduce the number of marine accidents at sea, saving lives.
For example an improved forecast will look like the following:

“Tonight...Northwest winds 13 to 18 knots becoming northeast 16 to 21 knots. Seas 2 to 4 feet with occasional 5 feet building to 4 to 6 feet with occasional 8 feet possible late. Dominant period 6 seconds. Intracoastal waters choppy in exposed areas. Slight chance of showers.”

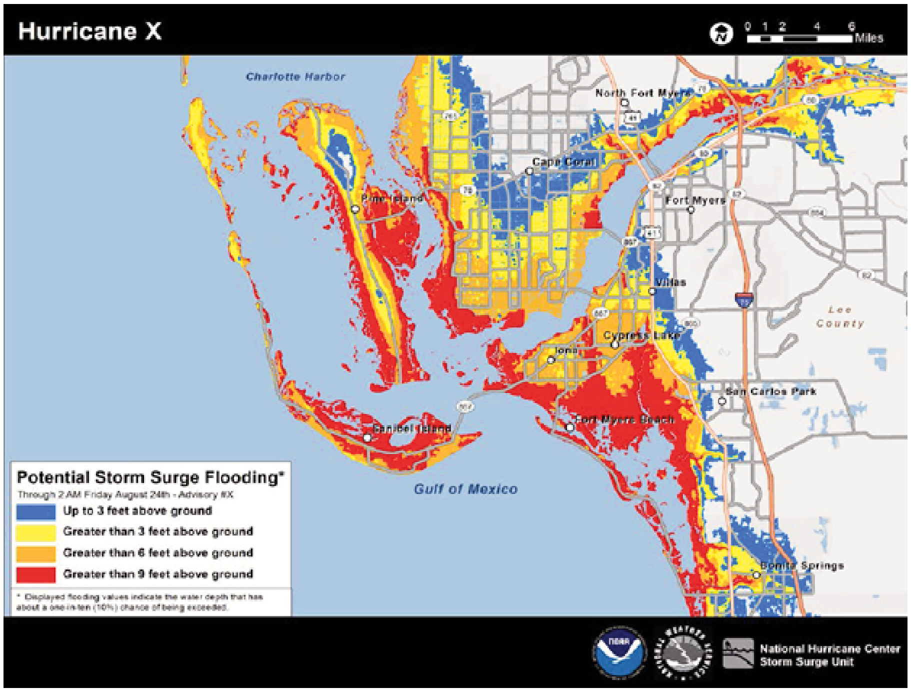
Digital Forecast Improvements

The NWS is improving its forecasts for major shipping channels by using digital forecast data. For example, the Tampa Bay Marine Channel Forecast (experimental) uses digital forecast data of winds, gusts, waves, weather, rain chance, and hazards and also includes water level relative to mean sea level. The Marine Channel Forecast is displayed on a static Google map with the Tampa Bay shipping channel and the forecast points overlaid. Users may click on any forecast point to view the forecast. The Marine Channel Forecast is currently available at the following web address: **http://www.srh.noaa.gov/tbw/?n=marinechannelsforecast**

Storm Surge

In an effort to improve overall awareness and understanding of the storm surge flooding threat, the NWS is working towards implementing a storm surge watch/warning which would be issued for life threatening storm surge events. Storm surge is an abnormal rise of water generated by a storm (tropical or non tropical), over and above the predicted astronomical tides. Storm surge is the greatest weather related threat to life and property along the coast.

In 2014, the NHC began issuing an experimental Potential Storm Surge Flooding map. The Potential Storm Surge Flooding Map is an experimental product (Google interface) which depicts the risk associated with the storm surge hazard from a tropical cyclone. The map shows, geographical areas where inundation from storm surge could occur and how high above ground the water could reach in those areas. The map is based on the forecast track, intensity, and size of a tropical storm or hurricane. Plans are for the product to remain experimental for two years and become operational in 2016. The experimental Potential Storm Surge Flooding Map paves the way for a graphical depiction of storm surge flooding from non tropical storm surge in the future. In the future, the storm surge watch / warning and Potential Flooding Map will be provided in a GIS format. The map will be part of an interactive display made available on the NHC website (**www.hurricanes.gov**) in situations where hurricane watches and warning are in effect for portions of the continental U.S. The map will be experimental for at least two years (2015 and 2016). This effort will be expanded for tropical cyclones in the Pacific Ocean and similar products and services for storm surge associated with non tropical storms are also being developed.



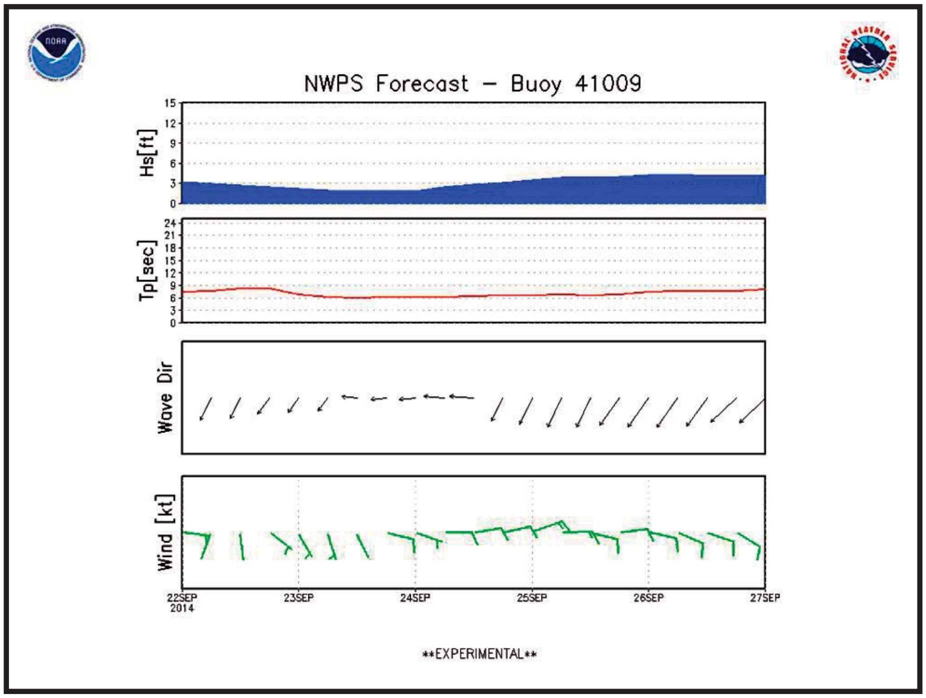
Example of a Potential Flooding Map associated with a fictional hurricane affecting the West coast of Florida.

Near Shore Wave Prediction

The Near shore Wave Prediction System (NWPS) is a numerical modeling system designed to provide routine and on-demand, high-resolution near shore wave model guidance to coastal NWS forecasters throughout the United States. For more information, go to: **http://polar.ncep.noaa.gov/waves/nwps/**

The development of NWPS will enhance the forecasting skill for surf zone hazards by providing guidance on a space and time scale small enough to capture common hazards of the surf zone such as rip currents. A statistical rip current forecasting model is under development using NWPS. The new model will provide consistent rip current forecast guidance to specific beaches; a much smaller scale than the current forecasting methods.

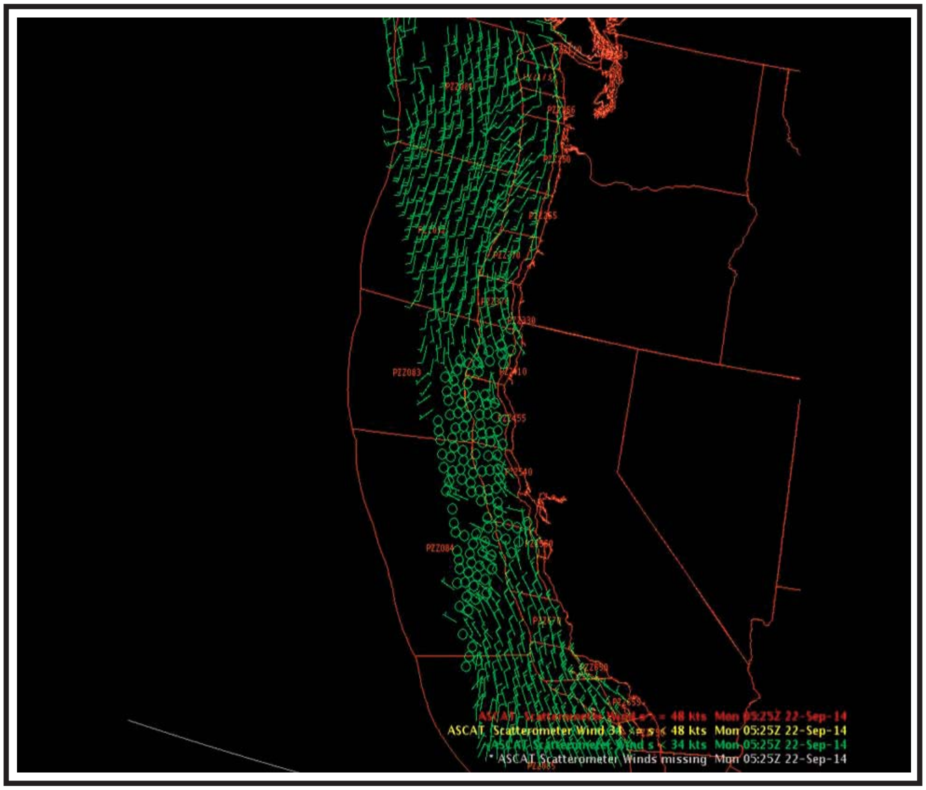
For a complete listing of NWS marine forecasts and services, visit the Marine and Coastal Services Branch webpage at: **http://www.nws.noaa.gov/om/marine/home.htm**



Output from NWPS includes wind, wave direction as well as wave height and period.

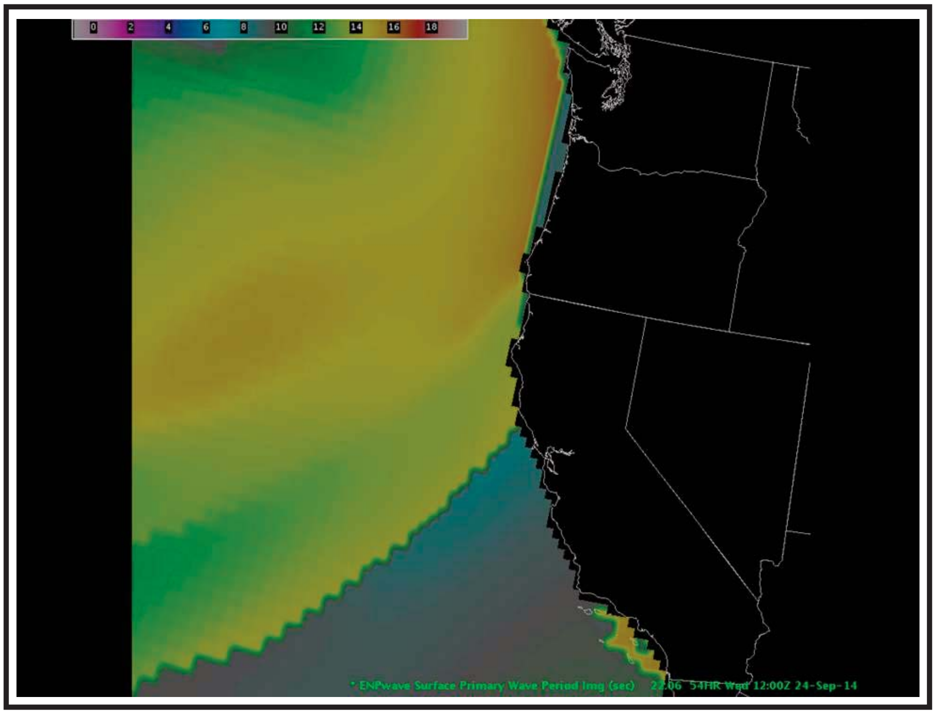
National Weather Service (NWS) Marine Weather Forecasting – Conclusion

The NWS and marine weather forecasting within NWS began in the 1870s. For the first Thirty years or so, the marine weather program in the NWS provided mainly observations at sea and not much in the way of predicting future conditions. In the early 1900s, a better understanding of the atmosphere began to emerge and rapid advances in radio communication took marine weather forecasting to a new level of future prediction.



Output from NWPS includes wind, wave direction as well as wave height and period.

The sinking of the **RMS Titanic** in 1912 created a need for international marine weather forecasting policies. A defining moment in marine weather forecasting within the U.S. Government came when accurate wind and tide forecasts helped make the decision to invade Normandy during World War Two. Advances in satellite technology greatly improved forecasting of tropical cyclones and international broadcasts of marine meteorological information allowed for a much wider audience to receive important marine weather forecasts. These two developments significantly reduced the number of lives lost due to extreme marine weather events.



Output from the Wave Watch III and ENP models shown here along the US West Coast.

In the past One Hundred years, techniques have come a long way bringing us into the modern era of marine weather forecasting using sophisticated computer programs, and marine observations via satellite and buoys. Today marine forecasting is a complex task of viewing data, both observed and model, then synthesizing it through knowledge and experience. The NWS marine forecaster then uses powerful workstation computers to create forecasts – in both graphic and text formats.

Warning of hazardous phenomena is the most critical aspect to the marine forecast. Protection of life and property is of the utmost importance. Warnings must be issued in a timely manner when hazardous conditions are occurring or expected. Hazards include tropical and non-tropical cyclones, high winds and waves, thunderstorms, ice accretion, reduced visibilities, sea ice, and rising water at the shorelines. When a forecast or warning message is complete, it must be communicated to users in a timely manner. Marine weather forecasts and warnings are disseminated to mariners at sea via voice radio frequencies, radio teletype, and satellite broadcasts. As more mariners take mobile phones out on the water, the NWS is making its information available in user friendly formats via these mobile devices.

Meteorologists are looking into the future where more and higher resolution remote sensing can be achieved. This will come in broader areas of satellite derived winds and seas, greater detail of sea surface, more and better shipboard observations, and possible highly detailed weather radars on ships.

In the future, The National Weather Service will improve its marine weather services by developing products and services which can be easily viewed on mobile electronic devices and the Internet. The NWS will continue to develop more graphical products and digital forecasts which along with text products will enhance understanding of weather information and decision making based on weather information. Current experimental projects within the National Weather Service will allow for improvements in critical components of marine weather forecasting such as waves, storm surge and near shore wave conditions.

PMO Corner:

Ship Reports from the Straits of Florida in Plain Language

Kennard "Chip" B. Kasper
Marine Program Meteorologist
NOAA/NWSFO, Key West Florida

David Dellinger
Port Meteorological Officer - South Florida
NOAA/NWSFO, Miami Florida

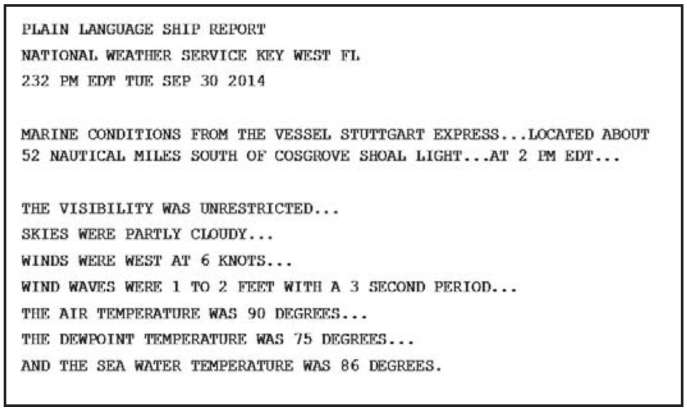
Weather and ocean observations taken at sea by the diligent crews of Voluntary Observing Ships (VOS) around the world are of great value to the weather forecasting enterprise. The VOS observations help to accurately initialize weather and ocean prediction models, and they are used directly by marine weather forecasters in their analyses of marine weather both along the coast and across the high seas. The VOS observations also are of interest to people in maritime communities along the coast, especially where few fixed or buoy observations are available. One such locale is the Florida Keys, an archipelago with island communities extending in a southwesterly arc from the southern end of the Florida Peninsula. The Florida Keys are located between the Gulf of Mexico and the Straits of Florida. Communities are connected via the "Overseas Highway", a roadway consisting of 42 bridges. The Florida Reef tract, the third largest barrier reef in the world, lies just 5–10 nautical miles south of the Keys, with the "Florida Current" typically flowing just beyond the reefs in the Straits of Florida between Cuba and the Keys.

The shipping lanes in the Straits of Florida are among the busiest in the world, and the NOAA/National Weather Service Weather Forecast Office in Key West has developed a means by which to share VOS reports from the Straits with the local maritime community via a "Plain Language Ship Report". Senior Forecaster, Sean Daida, and former Information Technology Officer, Tony Freeman, wrote a computer program that decodes VOS observations in the Straits, and presents a portion of each of the decoded reports in a plain-language bulletin. This Plain Language Ship Report then is shared both online and via broadcasts from NOAA All Hazards Weather Radio transmitters at Sugarloaf Key (VHF 2), Tea Table Key (VHF 5), and Princeton (VHF 4). **(http://forecast.weather.gov/product.php?site=NWS&product=PLS&issuedby=KEY)**

Many people in the Florida Keys fishing, diving, boating, and cruising communities have found the VOS reports from the "big ships" offshore to be an important source of "sea truth", and helpful to smaller craft heading out where no weather data buoys exist.

The VOS observations thus are valuable to a wide variety of users, including hurricane specialists, national and local marine weather forecasters, and even recreational boaters and charter boat captains in the Florida Keys.

Due to the great success of the Plain Language VOS Ship Reports that the Key West Weather Forecast Office has enjoyed, more weather offices along the Florida coast are quickly adopting this technology to their local web sites. Weather Forecast Office Miami will be adding this service to several points along the eastern coast of Florida to its Marine Weather Page in the very near future. As the popularity grows, we hope more coastal forecast offices in other states and regions look to the VOS ships and community for valuable weather data in the busy shipping lanes. ⚓



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PLAIN LANGUAGE SHIP REPORT
NATIONAL WEATHER SERVICE KEY WEST FL
232 PM EDT TUE SEP 30 2014

MARINE CONDITIONS FROM THE VESSEL STUTTGART EXPRESS...LOCATED ABOUT
52 NAUTICAL MILES SOUTH OF COSGROVE SHOAL LIGHT...AT 2 PM EDT...

THE VISIBILITY WAS UNRESTRICTED...
SKIES WERE PARTLY CLOUDY...
WINDS WERE WEST AT 6 KNOTS...
WIND WAVES WERE 1 TO 2 FEET WITH A 3 SECOND PERIOD...
THE AIR TEMPERATURE WAS 90 DEGREES...
THE DEWPOINT TEMPERATURE WAS 75 DEGREES...
AND THE SEA WATER TEMPERATURE WAS 86 DEGREES.
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Shipwreck: CARL LEVERS WRECKED IN CYCLONE 50 YEARS AGO

By Skip Gillham

Photo: as PRINS MAURITS at Lock 22 of the old St. Lawrence canal on July 10, 1956, by Dan McCormick

After twenty-eight years of trading, the **Carl Levers** was far from more familiar waters when it got caught in a tropical cyclone and wrecked at Bombay, India, just over fifty years ago.

The ship was much more at home on the North Atlantic and Great Lakes routes. It was built for trading in these waters and launched at Fredriksstad, Norway, on Sept.16,1936. It was completed the following month as **Harpefjell** and saw brief service across the Atlantic and into the Great Lakes for the Fjell Line of Norway.

Olsen & Ugelstad had recognized the potential of these markets and raw materials that could come and go from the inland ports of North America. The company began this service on a regular basis with the Vardefjell in 1932. The volume of business increased and more ships were needed. Among these was the **Harpefjell**.

Meanwhile, a Dutch flag operation, the Oranje Lijn, also saw the potential of this business and while working separately at the beginning, they later joined to provide service under the banner of the Fjell-Oranje Line. Oranje purchased two vessels capable of Great Lake trading from Fjell and **Harpefjell** was one of these. It was renamed **Prins Maurits** late in 1937.

Prins Maurits crossed the Atlantic on a regular basis beginning in 1938. It returned in 1939 but, due to World War Two, spent the conflict on other routes. The ship was part of Convoy HX 65 that sailed from Halifax on Aug.12,1940. Six of the ships were lost to U-boat attacks while two more were bombed and sunk by aircraft. **Prins Maurits** survived this and other wartime duty and resumed inland navigation in 1946 after peace had been won. The ship was used for another decade to serve company customers on both sides of the Atlantic.

With the St. Lawrence Seaway on the horizon, and new ships under construction for the Oranje Lijn, **Prins Maurits** was sold to Ernest A. Levers of West Germany, in 1956 and renamed **Carl Levers**. The 258 foot long by 42 feet, 1 inch wide steamship continued to come to the Great Lakes in 1957 and 1958 but it never traded through the new Seaway system which opened in 1959.

The **Carl Levers** was resold to the Gill Amin Steamship Co. (Pty) Ltd. and registered in India in 1959 without any change in name.

The **Carl Levers** spent its final years trading around the Middle East and Southeast Asia. It was tied at Bombay, (now Mumbai) India, when Cyclonic Storm Five, as it was known, developed in the Arabian Sea on August 6.

As the wild weather approached, the ship was cast adrift rather than be pounded against the dock. As a result, it went aground on August 7, 1964, on a pylon off Mahul Creek that supported electrical wires. The ship caught fire there on Aug. 24, suffered extensive damage and became a total loss.

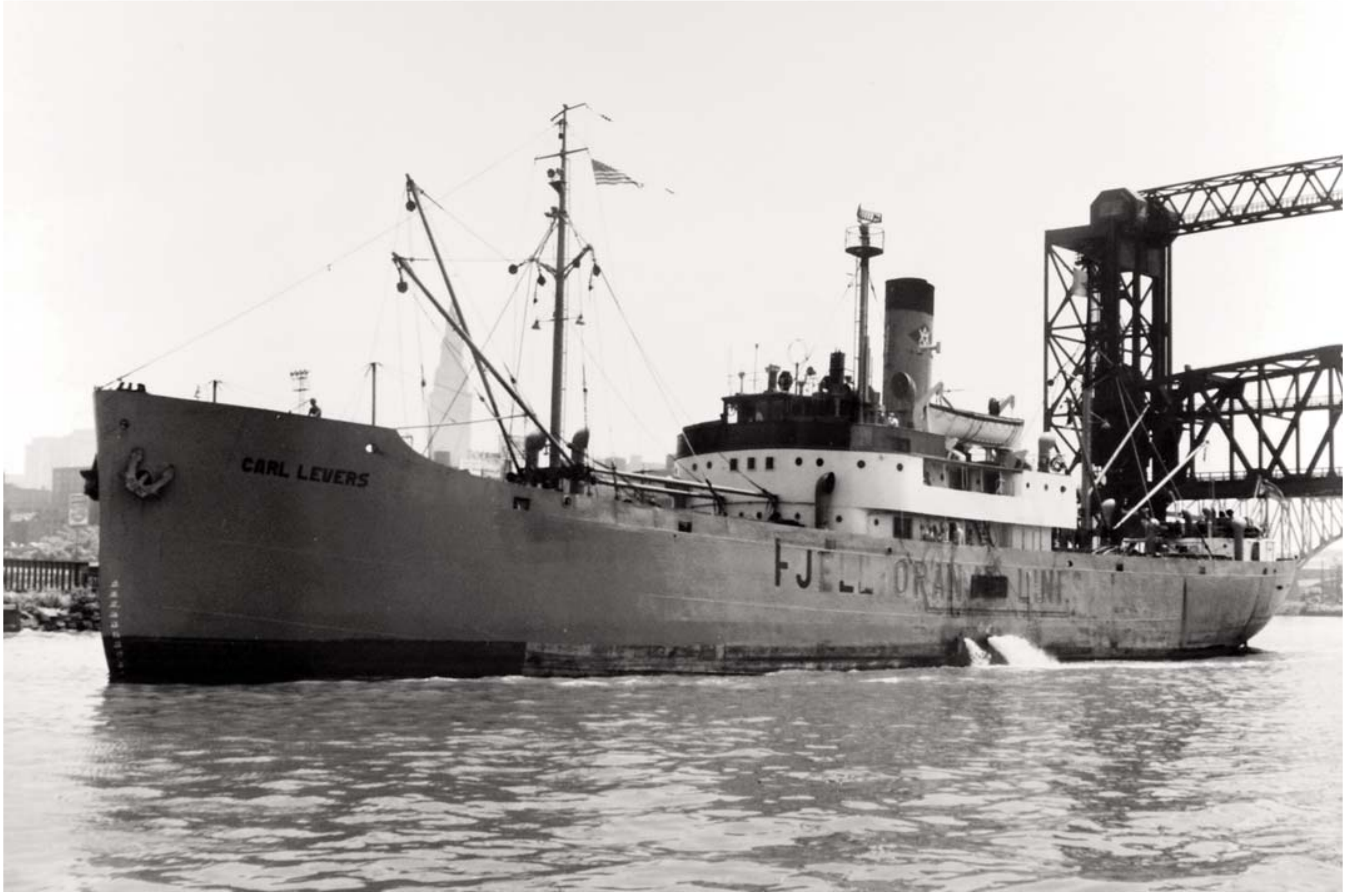

Photo: as CARL LEVERS at Cleveland in 1956 - by Pete Worden, Dan McCormick Collection.

In time, **Carl Levers** was released but was soon sold for scrap, taken back to Bombay, and broken up by N.P. Patel.

⚓

Wave Setup during Hurricane Katrina and Tropical Cyclone Mahina

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email: sahsu@lsu.edu

Abstract: On the basis of wave setup measurements during Tropical Cyclone Mahina in the South Pacific and Hurricane Katrina in the Gulf of Mexico, it is found that, during a tropical cyclone over an open and flat coast, the maximum wave setup (in meters) = $0.15H_{smax} = 0.030(1013-P_o)$, where H_{smax} is the max significant wave height in meters in deep water before shoaling and P_o is the minimum sea-level pressure in hPa before landfall. This wave setup needs to be added to the storm surge produced jointly by the barometric tide, the Coriolis tide, and the wind-stress tide in order to get more accurate total inundation for optimum ship mooring and coastal engineering projects.

1. Introduction

According to Dean and Dalrymple (2002), the total storm surge includes the sum of following four components: the barometric tide, the wind-stress tide (see, e.g. Hsu, 2013), the Coriolis tide, and the wave setup, which is a phenomenon that occurs primarily within the wave breaking zone and results a super elevation of the water level.

According to Nott et al. (2014), new evidence suggests Tropical Cyclone Mahina on 5 March 1899 near Bathurst Bay, northeast Australia, had a central pressure (P_o) of 880hPa and could have produced a maximum storm surge of approximately 9m and a total inundation of roughly 13m. The purpose of this brief note is to provide some confirmation of Nott et al (2014) using more recent measurements during Hurricane Katrina in August 2005 near Long Beach, MS, USA. Furthermore, knowledge of the magnitude of wave setup is needed for many practical applications such as optimum ship mooring, structural damage assessments, and coastal engineering projects.

2. Met-Ocean Conditions near Katrina's Landfall

The meteorological and oceanographic (met-ocean) conditions as represented by the atmospheric pressure and ocean waves are briefly described as follows:

According to Knabb et al. (2005), Hurricane Katrina made landfall near Buras, LA on 29 August at 1110UTC with P_o = 920 hPa (or mb) and near LA/MS border 3 hours and 35 minutes later with P_o = 928 hPa (see **Figure 1**). On the right-hand side of the track, the National Data Buoy Center (NDBC) operated 2 stations: 42007 and 42040 for our analysis. As shown in **Figure 2**, P_o = 927.4 hPa. The significant wave height, H_s, defined as the average height of the highest one-third of the waves observed at a specific point (see, e.g., Hsu, 1988), is plotted in **Figure 3**. The maximum H_s, H_{smax}, is approximately 16.91m or 55ft.

3. Wave Setup Measurement during Katrina

According to Guza and Thornton (1981), the max wave setup, W_{setmax}, is linearly related to H_{smax}, so that:

$$W_{setmax} = A\, H_{smax} \quad (1)$$

Where the coefficient, A, needs to be determined from measurements and H_{smax} is the maximum significant wave height in deep-water before shoaling. Both units of W_{setmax} and H_{smax} are in meters. From field experiments, Guza and Thornton (1981) have determined that A = 0.17.

As illustrated in **Figure 4**, the wave setup can be estimated as the difference between the high water mark outside the structure and High

Water Mark inside the structure. Based on Stations KMSC-05-12 and KMSC-05-17 in **Figure 5**, the maximum wave setup = 33ft-25ft = 8ft during Katrina. Now, from Fig.3, H_{smax} =16.91m or 55ft. Substituting these values into Eq. (1), we have A = 8ft/55ft = 0.15 so that:

$$W_{setmax} = 0.15\ H_{smax} \quad (2)$$

According to Hsu (2014), for practical use,

$$H_{smax} = 0.2(1013 - P_o) \quad (3)$$

Now, substituting Eqs.(3) into (2), we get:

$$W_{setmax} = 0.15\ H_{smax} = 0.030(1013 - P_o) \quad (4)$$

For quality assurance, substituting P_o = 927.4hPa from **Figure 2** into Eq. (3), one gets H_{smax} = 17m and into Eq. (4) W_{setmax} = 2.57m or 8ft. Since these results are nearly identical to the measured 16.91m (see **Figure 3**) for H_{smax} and 8ft for wave setup as stated above, Eqs. (3) and (4) may be used to evaluate the results of Nott et al. (2014).

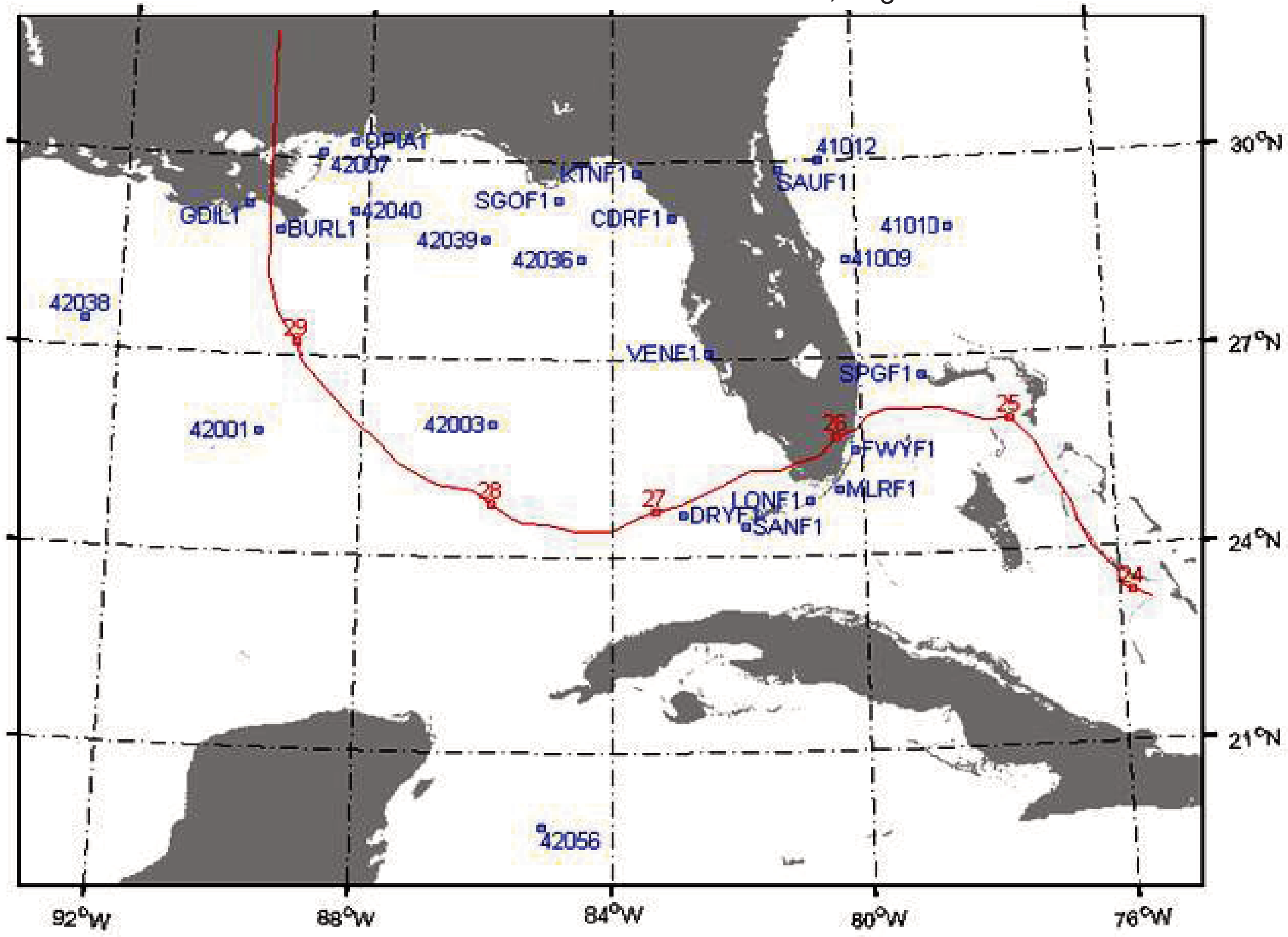
NDBC Stations within 300nm of Katrina: 23-30, August 2005

Figure1. Hurricane Katrina's track and NDBC stations. Katrina's track (in red with the start of each day numbered) is from the positions of the National Hurricane Center's Forecasts/Advisories (http://www.ndbc.noaa.gov/hurricanes/2005/katrina/).

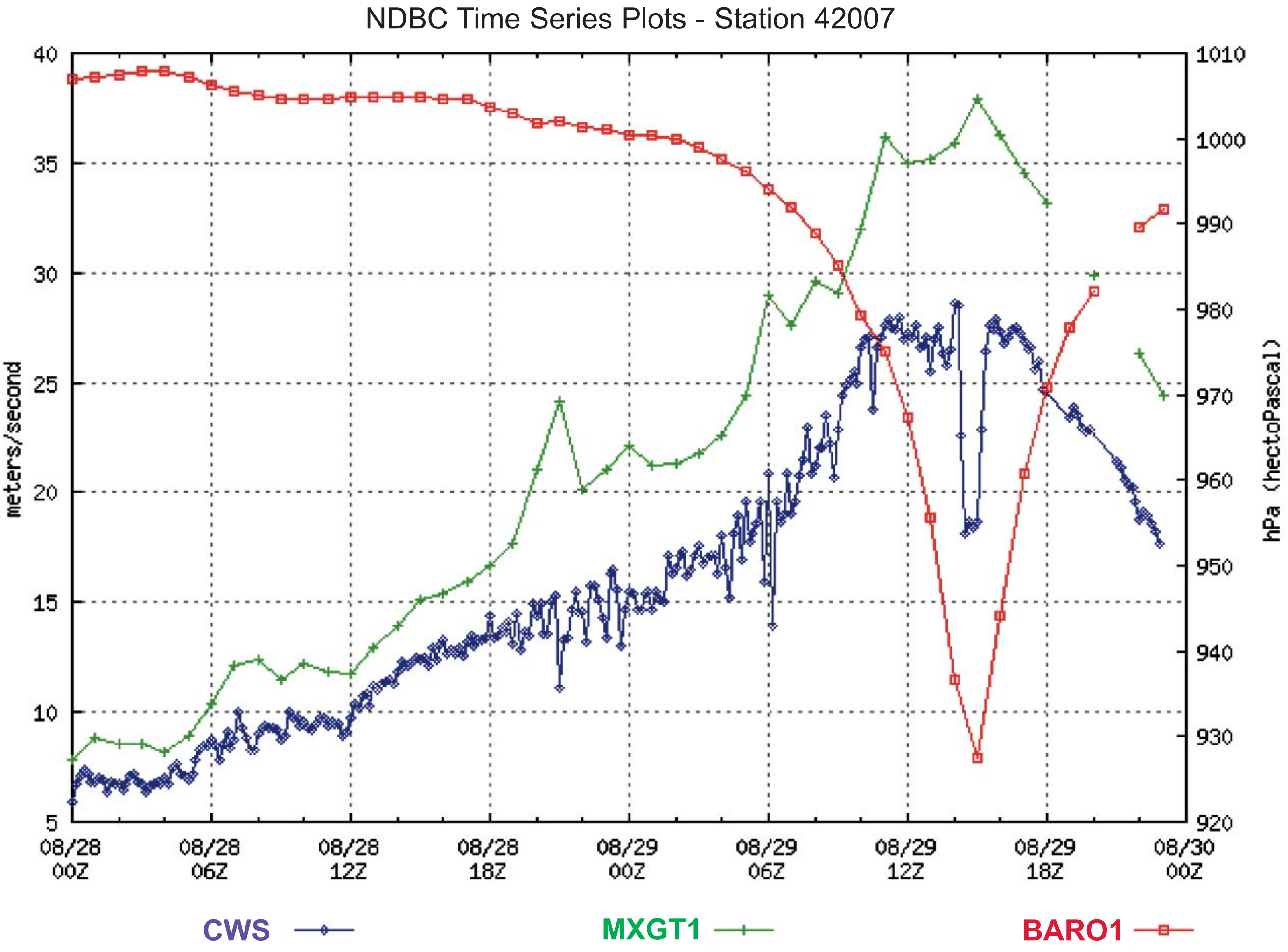

Figure 2. Station 42007: Winds (Anemometer Height 5m) and Sea-level Pressure (http://www.ndbc.noaa.gov/hurricanes/2005/katrina/). Note that P_o = 927.4hPa. For station location, see Figure 1.

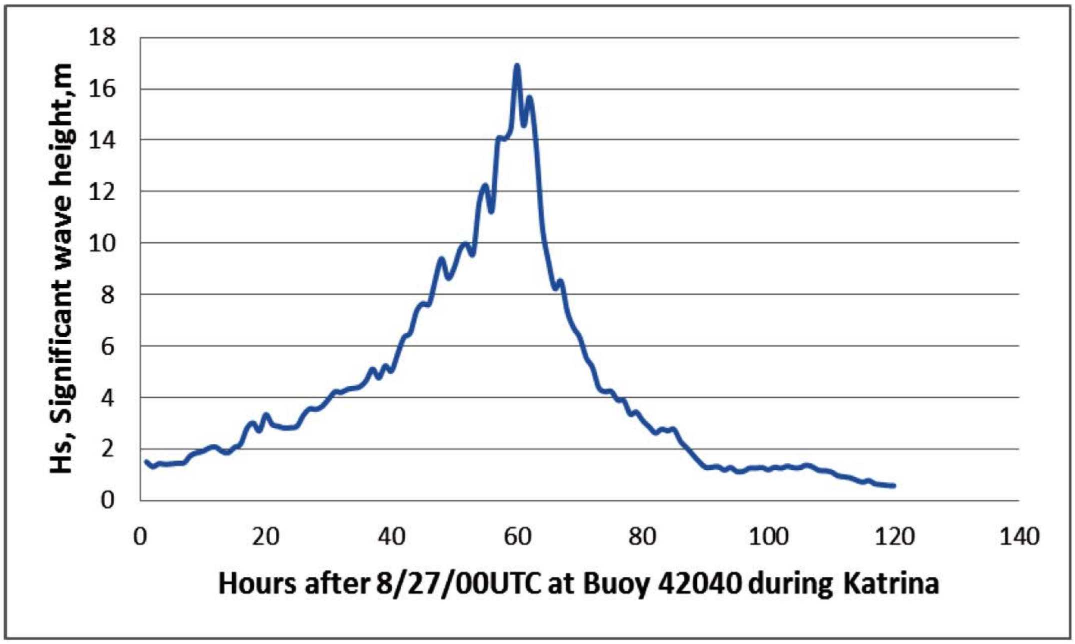

Figure 3. Deep water significant wave height measurements at NDBC Buoy 42040 during Katrina. Data source: (www.ndbc.noaa.gov). Note that H_{smax} = 16.91m or 55ft. For station location, see Figure 1.

4. Wave setup during Tropical Cyclone Mahina

Now, according to Nott et al. (2014) as stated in the introduction, P_o = 880hPa. Substituting this value into Eq. (4), we get the wave setup to be 4m. Since the wave setup during Mahina = total inundation - surge = 13m - 9m = 4m, which is identical to our result, we can say that the conclusions reached by Nott et al. (2014) is plausible.

5. Conclusions

On the basis of aforementioned discussions, it is concluded that the results presented by Nott et al. (2014) are plausible since they are supported by more recent measurements during Hurricane Katrina. Certainly, more measurements of wave setup during tropical cyclones worldwide are needed to further substantiate Eq. (4).

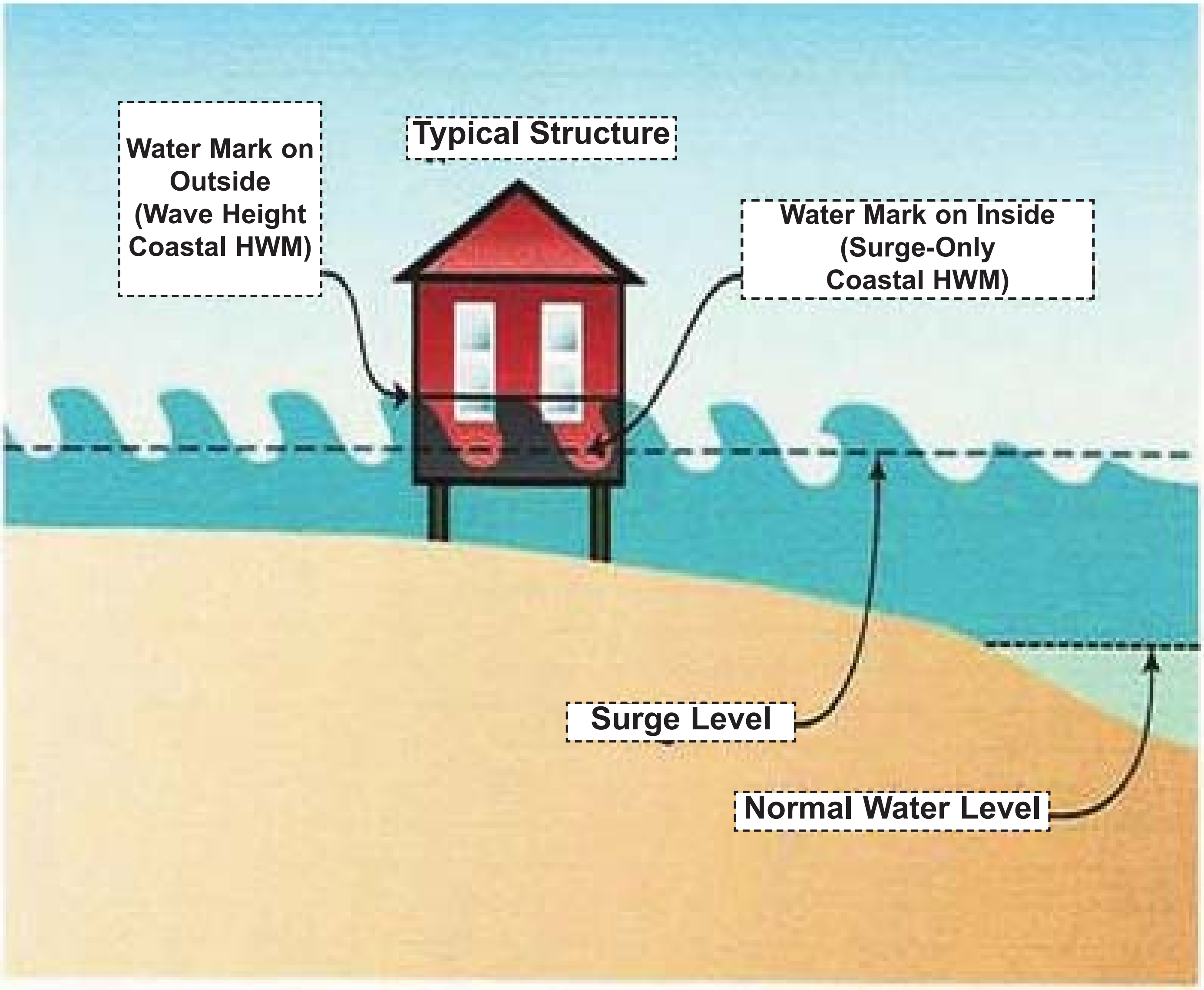

Figure 4. An illustration of wave setup = (high water mark outside – high water mark inside the structure) (See FEMA, 2006). Note that HWM stands for High Water Mark.

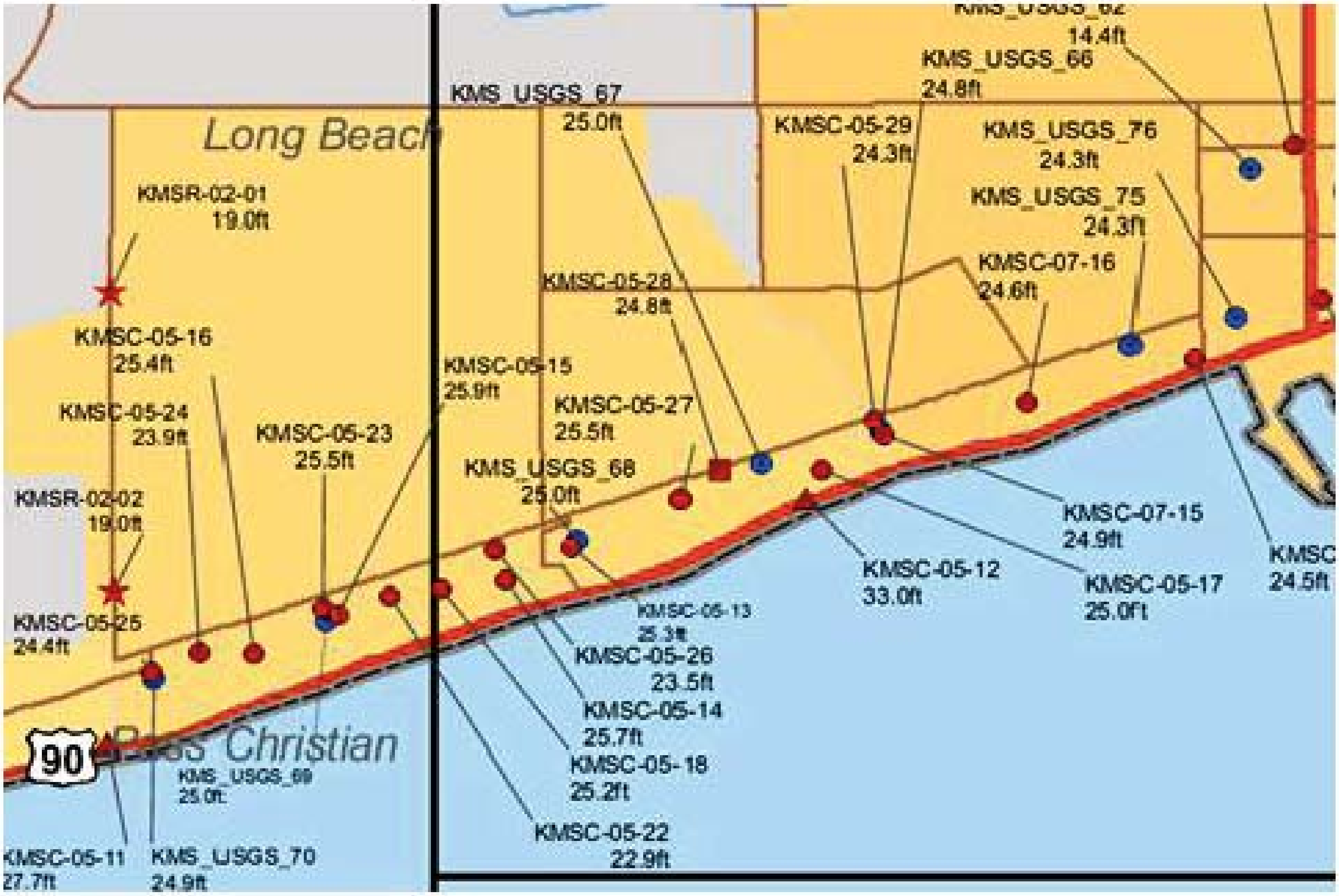

Figure 5. A section of HWM surveys along MS after Katrina (see FEMA, 2006). Note that an 8ft wave setup existed as a result of the difference between total inundation of 33ft at station KMSC-05-12 and the 25ft surge-only at nearby KMSC-05-17 (see FEMA, 2006).

References:

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Acknowledgements: Many thanks go to the National Data Buoy Center (NDBC) for providing buoy data and graphs related to Katrina and to Federal Emergency Management Agency (FEMA) for high water mark surveys and wave setup illustration. ⚓

Japan Tsunami Debris Update

Sherry Lippiatt, Ph.D.
California Regional Coordinator
NOAA Marine Debris Program / IMSG
Office of Response and Restoration
Matthew Thompson
Seattle PMO

More than three years have passed since the devastating earthquake and tsunami struck northeastern Japan, killing thousands and devastating coastal communities. The NOAA Marine Debris Program continues to request at-sea and shoreline reports of suspected Japan tsunami marine debris (JTMD) to **DisasterDebris@noaa.gov**; reports should include the date/time, location, description of the item, and photos. To date, NOAA has received more than 1,500 reports of suspected JTMD.

Recent reports of Japanese skiffs came from a NOAA field team at Pearl and Hermes Atoll in the Northwestern Hawaiian Islands in October 2014: **http://marinedebrisblog.wordpress.com/2014/10/14/marine-debris-divers-find-potential-tsunami-debris-in-pearl-and-hermes-atoll/**. For the latest updates on observed Japan tsunami marine debris please visit: **http://marinedebris.noaa.gov/tsunamidebris/updates.html.**

Above: One of the Misawa docks floating off of Hawaii.
Right: An upside down skiff found at Pearl and Hermes Atoll in October 2014 (photos courtesy NOAA MDP)

Large objects that remain floating at sea are an on-going concern. Four docks were washed out from the city of Misawa Japan on 3/11/11 – one washed ashore in Oregon in June 2012 and a second washed ashore in Washington in December 2012. The other two are still unaccounted for.

Researchers from Tattori University in Japan have released a number of transponders enclosed in 2-liter bottles in order to gather data on debris drift patterns. The transponders include instructions for how to contact the researchers if one is found. More information and a photo of the instrument can be found at: **http://oregonstate.edu/ua/ncs/archives/2014/sep/anglers-beachcombers-asked-keep-eye-out-transponders-japan**.

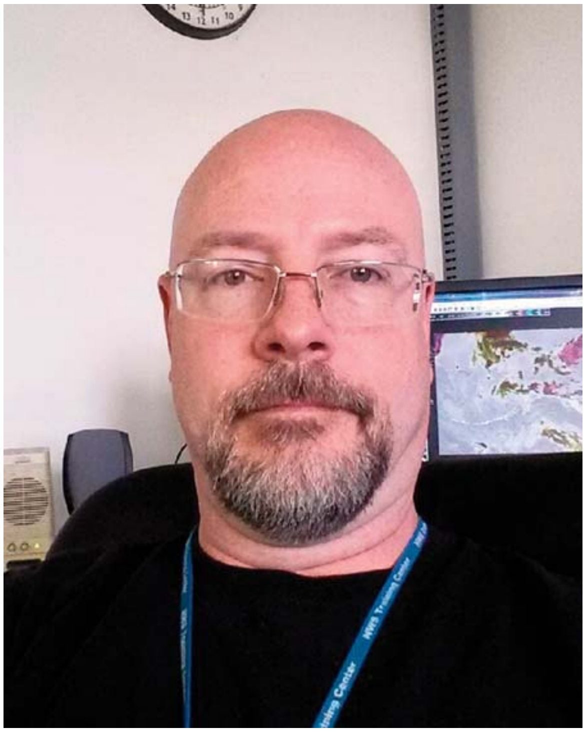
Please keep an eye out for these items. Survey forms have been distributed by the Seattle Port Meteorological Office to ships visiting the ports of Washington and Oregon that travel from Japan on their routes. This cooperative effort is to recruit more ships to send information to NOAA on any debris that is spotted along shipping routes between Japan and the west coast of the United States. Reporting forms can be found here: **http://marinedebris.noaa.gov/research/marine-debris-monitoring-and-assessment-project**. ⚓

Hail and Farewell!

Kodiak Alaska Port Meteorological Officer Rich Courtney retired in September 2014 after 20 years in the National Weather Service. Rich was well known in the Alaska marine community for his superb customer service over the last 16 years at Kodiak. Rich also had a distinguished 20 year career in the U. S. Naval Weather Service rising to the rank of Chief Warrant Officer 4.

National Weather Service Alaska Region Director Aimee Devaris had this to say at his retirement; "Rich, You are a rare an exceptional example of a person making the absolute most out of their position in Civil Service. Your expertise and ability to connect with the marine community is beyond compare. Thank you so much for your tremendous dedication in service to the National Weather Service and the public. You will be greatly missed. Best Wishes."

Kodiak Alaska PMO
Rich Courtney



Kodiak Alaska PMO Focal Point
Craig Eckert

A hardy welcome to Craig Eckert our new PMO Focal Point assuming the watch in Kodiak Alaska! Craig will be replacing Rich Courtney, and those are big shoe to fill; I am sure Craig will be up for the challenge. Craig is currently the “Official in Charge” for the National Weather Service Office in Kodiak Alaska.

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Port Meteorological Officers Hold a Workshop

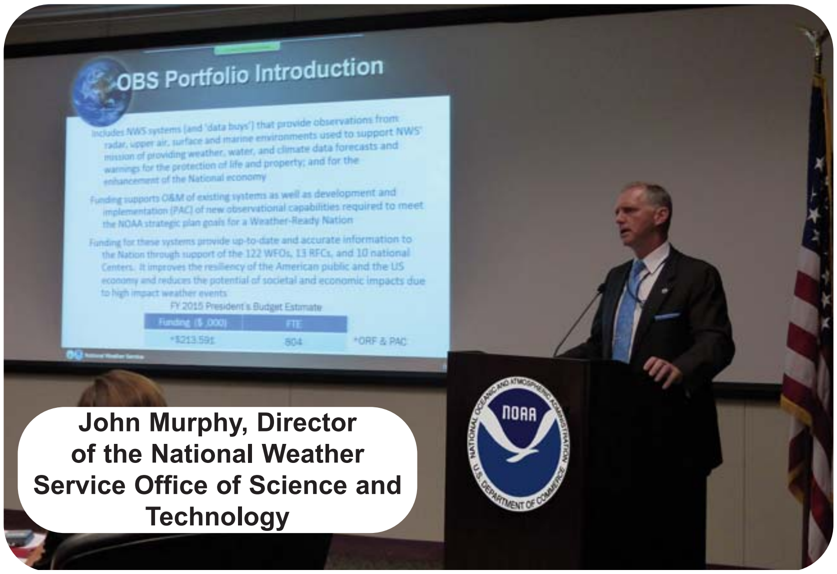
Paula Rychtar
Editorial Supervisor
Mariners Weather Log

This past August (26th-28th), the Port Meteorological Officers (PMO) attended and participated in a long overdue workshop / conference at the Stennis Space Center, Mississippi. Our keynote speaker for this conference was Laura Furgione, the Deputy Director of NOAA's National Weather Service and John Murphy, the Director of the National Weather Service Office of Science and Technology. It was confirmed that the Voluntary Observing Ship Program (VOS) was ranked in the top 50% among all the NOAA observing systems. It was also noted that VOS observations (your shipboard marine weather observations) are essential to the numerical weather prediction models and dozens of NOAA's National Weather Service marine products. The VOS program is important to NOAA's National Weather Service; which equates to what we convey to our VOS Program participants all the time, ***you and your marine observations count!***

We applaud your dedication to our VOS program, Thank you!

Over the course of this three day conference, many policies and expectations were discussed; all dedicated to the improvement and commitment to the VOS program, collecting high quality data, supportive measures for PMO's, best practices, standardization in procedures with our international colleagues and supporting our Voluntary Observing Ship fleet.

Laura Furgione, Deputy Director of NOAA's National Weather Service



OBS Portfolio Introduction

Includes NWS systems (and 'data buys') that provide observations from radar, upper air, surface and marine environments used to support NWS' mission of providing weather, water, and climate data forecasts and warnings for the protection of life and property; and for the enhancement of the National economy

Funding supports O&M of existing systems as well as development and implementation (PAC) of new observational capabilities required to meet the NOAA strategic plan goals for a Weather-Ready Nation

Funding for these systems provide up-to-date and accurate information to the Nation through support of the 122 WFOs, 13 RFCs, and 10 national Centers. It improves the resiliency of the American public and the US economy and reduces the potential of societal and economic impacts due to high impact weather events

FY 2015 President's Budget Estimate

Funding ($,000)	FTE	
*$213,591	804	*ORF & PAC

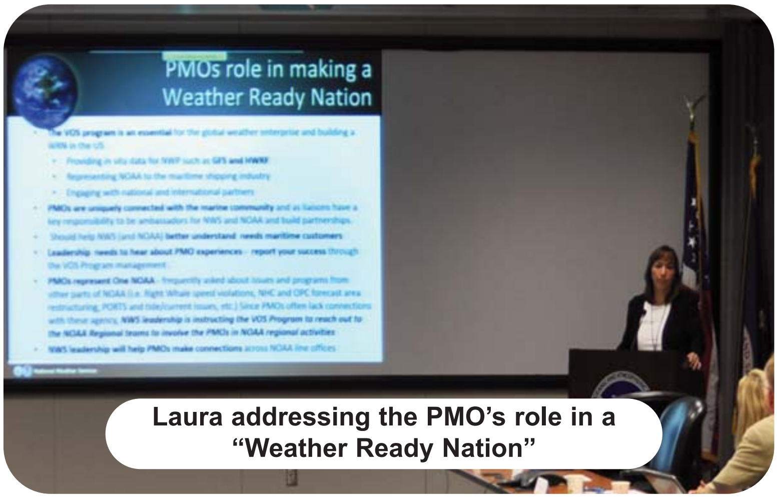
John Murphy, Director of the National Weather Service Office of Science and Technology

Joe Swaykos, NDBC Mission Control Center Branch Chief and VOS Program Manager Steve Pritchett

Laura presenting Houston, Texas PMO Chris Fakes with an award in recognition of outstanding performance and dedication to VOS.

Laura presenting Seattle, Washington PMO Matt Thompson with an award in recognition of outstanding performance and dedication to VOS.

Baltimore PMO Lori Evans and NOAA Corp Christine Shultz



Laura addressing the PMO's role in a "Weather Ready Nation"

PMO Tim Kenefick, Charleston, South Carolina

PMO Rob Niemeyer, Jacksonville, Florida

In addition to all of our PMO's presenting on some of their unique issues and showcasing their many activities some of the guests and participants included: Steve Pritchett – VOS Program Manager; Paula Rychtar - VOS Operations Manager; Sarah North, United Kingdom –VOS Ship Observations Manager; NDBC Branch Chief - Joe Swaykos; NDBC Deputy Director – Kathleen O'Neil; Eric Freeman- Marine Observation Analyst for the National Climatic Data Center; Christy Schultz – Meteorologist for the Ocean Prediction Center; Shawn Rickard- Marine Networks Specialist/PMO-Hamilton Ontario, Environment Canada; Terry Brisbin – Environmental and Safety Program Manager for Southern Region Headquarters; Commandant Jack Frost-USCG Search and Rescue Ops Manager / AMVER Program; Jennifer Lewis – Senior International Program Analyst for Headquarters; Dan Sobien- NWS Employees Organization, President; Wayne Weeks – Meteorologist for the National Weather Service Headquarters; Shaun Dolk and Francis Bringas representing Atlantic Oceanographic and Meteorological Laboratory (AOML) Miami; Commander Jeremy Adams –NOAA –Office of Marine and Aviation Operations (OMAO) Liaison to the USCG; LCDR Lindsay Kurelja-NOAA-OMAO Crew Supervisor; Captain Scott Putty-Assistant Professor for Texas A&M Maritime Academy; Captain Rick Smith- Master of the training ship **EMPIRE STATE**, New York Maritime Academy. ⚓


PMO Ron Williams, Duluth, Minnesota


PMO Pete Gibino, Norfolk, Virginia


from right to left, Miami PMO David Dellinger, Shaun Dolk AOML, Jacksonville PMO Rob Niemeyer, and Francis Bringas AOML

Photography: Stuart Hayes, NTSC

Mean Circulation Highlights and Climate Anomalies

May through August 2014

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

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

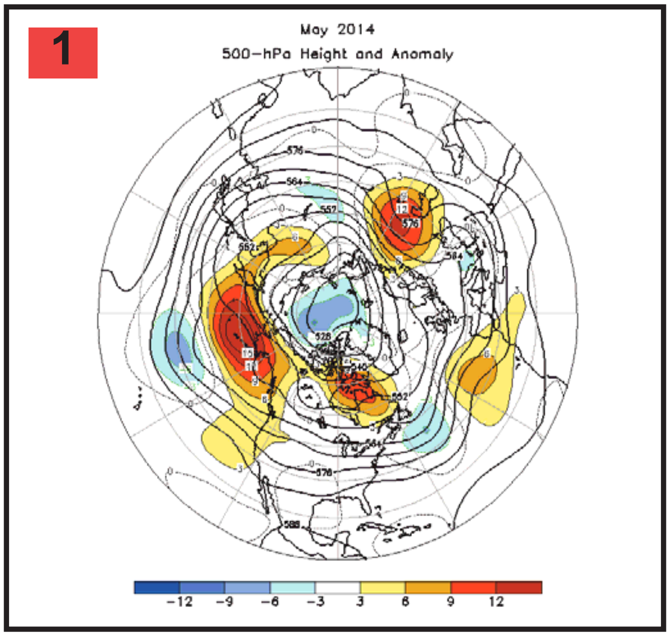
May-June 2014

The mid tropospheric circulation during May featured above average 500 hPa heights over the far northern Pacific, northeast Canada, and western Russia. It also featured below average heights over the central North Pacific, the Grand Banks area off Newfoundland, southeast Europe, and the polar region **Figure 1**. The sea level pressure (SLP) pattern is only a weak reflection of the 500 hPa height anomaly pattern, with above average SLP over the high latitudes of the North Pacific and northeast Canada, and below average SLP across the polar region **Figure 2**.

The 500 hPa circulation during June featured above average heights over the high latitudes of the North Pacific, eastern Canada, and the high latitudes of the North Atlantic, while below average 500 hPa heights dominated Alaska and much of western North America **Figure 3**. As was the case in May, the June SLP pattern broadly resembled its corresponding 500 hPa pattern, but was very weak **Figure 4**.

According to the National Climatic Data Center, a late season snowstorm was responsible for increasing snow depth by a full meter across the Central Rockies from May 11-13, causing power outages and highway closures. In June, above average temperatures and dry conditions in California led to an 11 percent increase in coverage of exceptional drought (the worst category), now covering 36.5 percent of the state (**Reference 1**).

1



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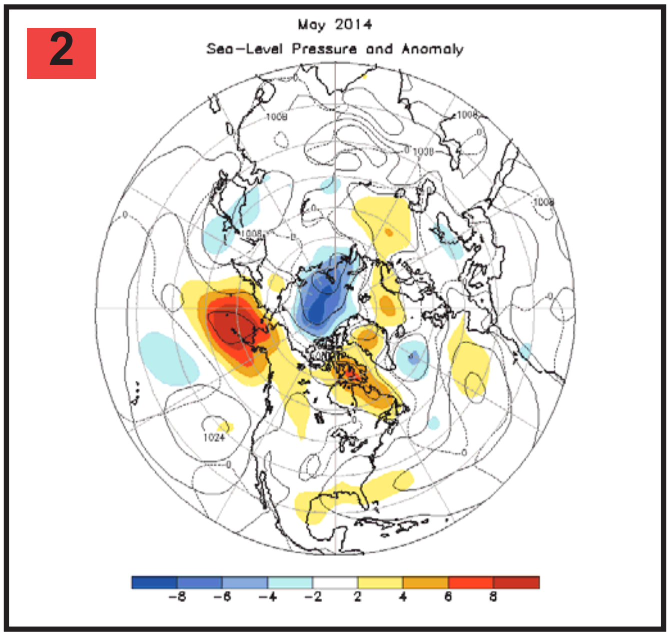

Caption for 500 hPa Heights and Anomalies: Figures 1,3,5,7
Northern Hemisphere mean and anomalous 500-hPa geopotential height (CDAS/Reanalysis). Mean heights are denoted by solid contours drawn at an interval of 6 dam. Anomaly contour interval is indicated by shading. Anomalies are calculated as departures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

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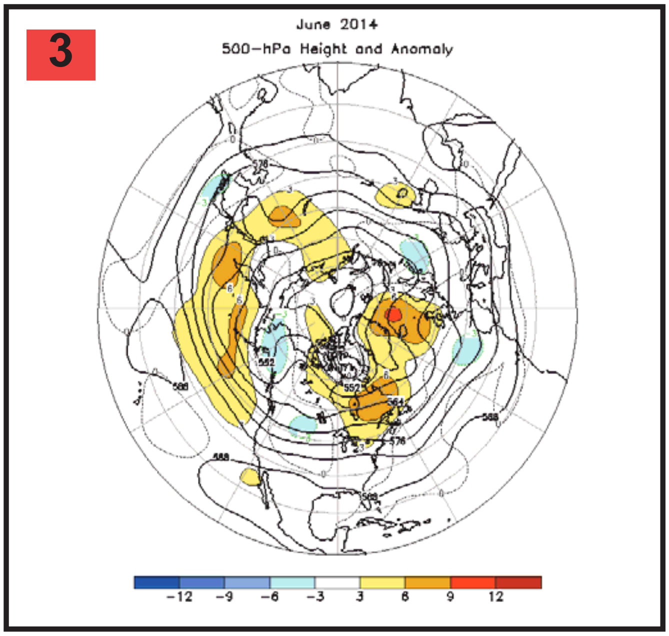

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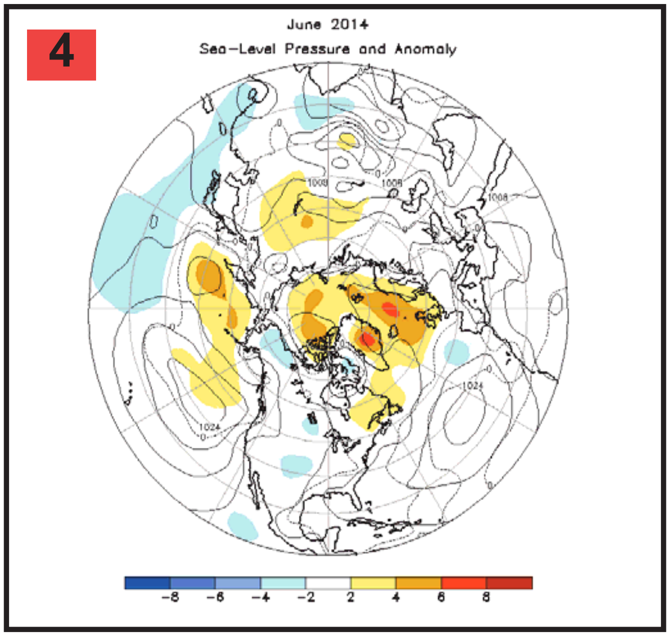

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The Tropics

Sea surface temperatures (SSTs) remained above average in the eastern and central equatorial Pacific in May, and above average across much of the equatorial Pacific in June. The latest monthly Nino index for the Nino 3.4 regions was +0.5C in both May and June. The depth of the oceanic thermocline (measured by the depth of the 20C isotherm) was above average in parts of the central and eastern equatorial Pacific, with subsurface temperatures ranging from 2-5C above average in May, and 1-4C above average in June. Equatorial low level easterly trade winds remained near average across the central and east central Pacific during the two month period, with tropical convection near average in May, and above average in the central Pacific in June. Collectively, these indicators reflect ongoing ENSO neutral conditions.

July-August 2014

The 500 hPa circulation pattern during July featured below average heights over east central North America, southwest Europe, and central Russia, while above average heights prevailed over western North America, far eastern Canada, Scandinavia, and the Bering Sea area **Figure 5**. The SLP and Anomaly map for July depicts above average SLP in Scandinavia and the Bering Sea, with only very modest spatial coverage of below average SLP **Figure 6**.

The month of August was characterized by below average 500 hPa heights over southern Alaska, northwest Europe, and far northern Russia (Kara Sea region). Above average heights were observed over Canada, Greenland, and west central Russia **Figure 7**. The SLP and Anomaly map shows a weak reflection of the upper air height anomaly pattern **Figure 8**.

According to the National Climatic Data Center, above average temperatures in July contributed to worsened drought conditions across much of the West. In California, the percent area of the state experiencing exceptional drought, the worst category, expanded to 58.4 percent, up nearly 22 percent since the start of the month. Warm conditions fueled large wildfires in the Pacific Northwest,

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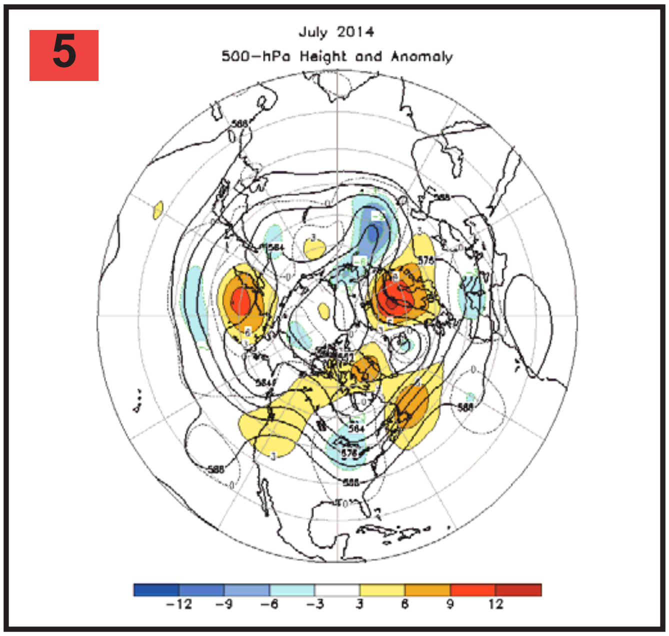

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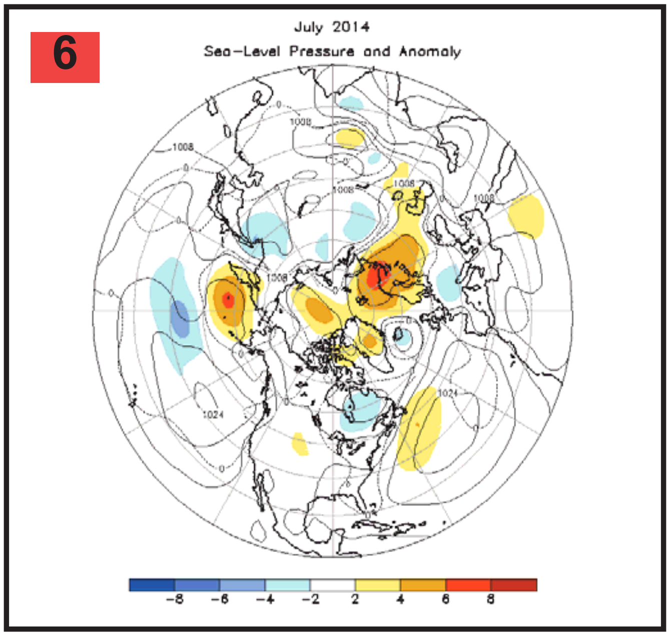

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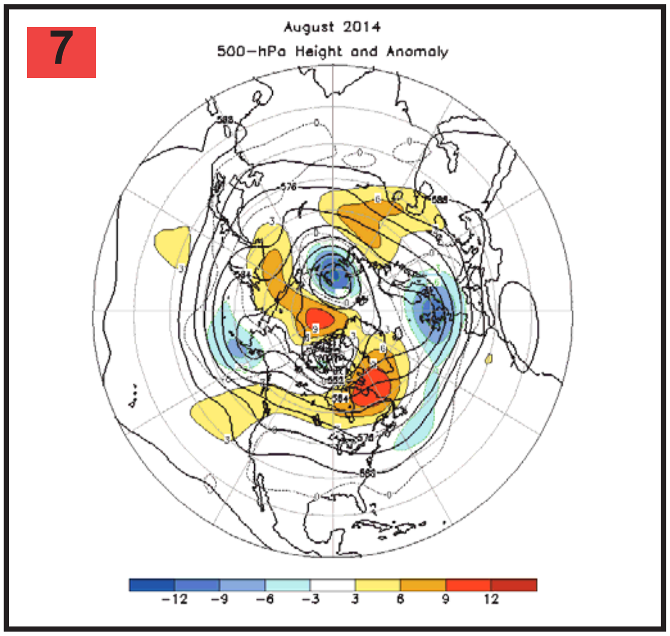

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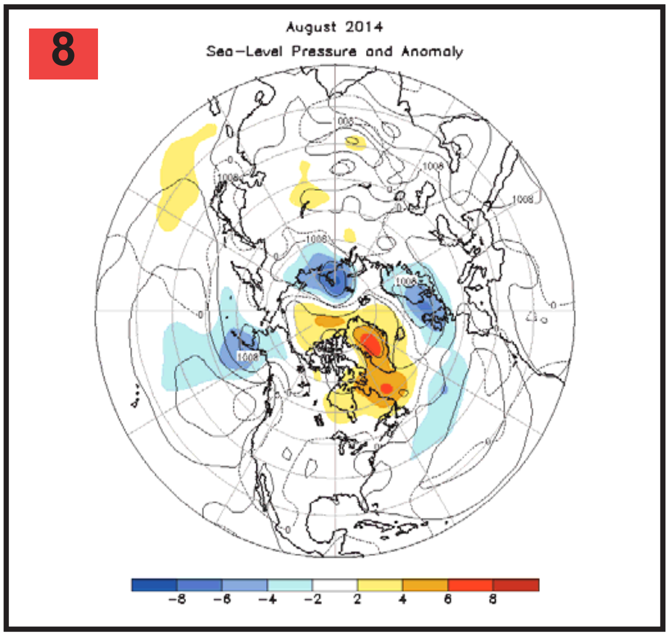

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including the Carlton Complex Fire in Okanogan County in north central Washington state, which charred a quarter of a million acres. In Alaska, Cold Bay reported its warmest month of any month on record, with an average temperature of +13.2C, while Juneau and Fairbanks had their second wettest July. On August 7, Tropical Storm Iselle made landfall on Hawaii's Big Island, with maximum sustained winds of 52 kts. This was the strongest tropical cyclone on record to make landfall on the Big Island and was the first tropical cyclone to make landfall anywhere in Hawaii since Hurricane Iniki in 1992. On August 12-13, a slow moving storm system brought 34.5 cm of rain to Islip, New York (central Long Island) over a 24 hour period, setting a new state 24 hour precipitation record for New York **Reference 2**.

The Tropics

ENSO neutral conditions persisted through July and August 2014. SSTs were near average across the central and east central portions of the equatorial Pacific (July and August) and above average over the far eastern Pacific (July) and west central and eastern Pacific (August). The latest monthly Nino indices for the Nino 3.4 region was +0.2C for both months. The depth of the oceanic thermocline ranged from near average in the central and eastern equatorial Pacific in July and above average in much of the equatorial Pacific in August. Subsurface temperatures ranged from 1-2C above average. Equatorial low level easterly trade winds were near average across the Pacific (July) and near average in the western and west central Pacific (August). Tropical convection remained enhanced over the tropical North Pacific (July) and suppressed across the western Pacific (August).

References:

1. **http://www.ncdc.noaa.gov/sotc/national/2014/5** (May) and /6 (June)
2. **http://www.ncdc.noaa.gov/sotc/national/2014/7** (July) and /8 (August)

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**)

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Marine Weather Review – North Atlantic Area

May to August 2014

By George P. Bancroft
Ocean Forecast Branch, Ocean Prediction Center, College Park, MD
NOAA National Center for Environmental Prediction

Introduction

The late spring to summer months of 2014 featured mostly a progressive pattern across the North Atlantic with occasional blocking at higher latitudes causing cyclones to move erratically or stall, especially in May and early June over the southwestern waters. The number of intense lows typically declines in May and June, and 2014 was no exception. There were only two cyclones with central pressures in the 970s hPa of non-tropical origin during the four month period, with one occurring early in May and the other at the beginning of July, with both occurring north of 55N. With the possible exception of the deeper of two early May Greenland events, there were no hurricane force lows of non-tropical origin.

The May to August period includes the first half of the Atlantic hurricane season. The first three named systems, all hurricanes, entered OPC's marine area north of 31N between Bermuda and the southeast coast of the U.S. and re-curved into the Westerlies before becoming extratropical. The first, Arthur in early July, was the strongest and made landfall in eastern North Carolina before moving offshore and becoming post tropical / extratropical over the Canadian Maritime Provinces. The others followed tracks farther offshore, and the last, Cristobal, became an intense extratropical hurricane force low with central pressures as low as 963 hPa at the end of August.

Tropical Activity

Hurricane Arthur:

The first named tropical cyclone lone of 2014 began as Tropical Depression One near the northern Bahamas early on July 1st and intensified, becoming Tropical Storm Arthur later that day with maximum sustained winds 40 kts with gusts to 50 kts. Arthur then followed a coastal track and became a hurricane early on the 3rd while passing north of 31N, with maximum sustained winds 65 kts. Arthur briefly made landfall on the North Carolina Outer Banks on the night of the 3rd with a maximum intensity of 85 kts for sustained winds with gusts to 105 kts. This places it at Category 2 of the Saffir Simpson hurricane wind scale (**Reference 4**). The cyclone then passed offshore the next day and began to weaken, crossed Georges Bank as a minimal hurricane on the evening of the 4th and then became post tropical as it reached the Bay of Fundy (**Figure 1**). **Figure 2** is a satellite image showing Arthur, still a hurricane with a central dense overcast and hint of an eye, but undergoing extratropical transition, about to merge with a broad frontal band to the north. **Table 1** lists some notable observations taken during this event. In **Figure 3** a swath of satellite derived significant wave heights cuts across the southeast side of the hurricane center where a maximum of 42.57 ft (13.0 m) appears. Arthur is shown at maximum intensity (980 hPa) as a post tropical low in **Figure 1**. The cyclone subsequently moved into the Labrador Sea as a gale, where it stalled and weakened late on the 7th.

Hurricane Bertha:

Bertha formed in the deep tropics east of the Windward Islands early on August 1st and moved northwest as a tropical storm until the 4th, when it became a hurricane near 29N 74W at 1800 UTC on the 4th with maximum sustained winds of 65 kts with gusts to 80 kts. Bertha then followed a re-curving path farther offshore than Arthur, passing

OBSERVATION	POSITION	DATE/TIME (UTC)	WIND	SEAS (m/ft)
KABP	38.5N 75.5W	04/1500	N 42	5.5 / 18
	38.3N 74.5W	04/1600	NW 55	5.8 / 19
SHIP	46.4N 62W	05/1700	SE 45	
Buoy 41004	32.5N 79.1W	03/1600	NW 45 G58	4.5 / 15
Buoy 41037	34.0N 77.4W	03/2300	SE 56 G68	
Buoy 41036	34.2N 76.9W	04/0000	SE 56 G70	7.0 / 23
		04/0100	Peak G76	Max 9.0/30
Buoy 41025	35.0N 75.4W	04/0700	S 49 G60	7.0 / 23
			Peak G64	
Buoy 44095	35.8N 75.3W	04/0900		Max 6.5 / 21
Buoy 44014	36.6N 74.8W	04/1000	E 41 G52	5.5 / 18
		04/1300	Peak G62	
		04/1100		6.5 / 21
Buoy 44066	39.6N 72.6W	04/2000	N 41 G51	
		04/2100		4.5 / 15
Buoy 44020	41.4N 70.2W	05/0200	N 40 G48	2.4 / 8
		05/0300	Peak G51	
Buoy 44024	42.3N 65.9W	05/0600	SE 40 G54	
		05/1200		5.5 / 18
Buoy 44258	44.5N 63.4W	05/1400	S 35 G45	5.0 / 16
		05/1600		7.0/23
Cape Lookout	34.6N 76.4W	04/0200	SE 62 G73	
(CLKN7)		04/0300	Peak G88	

Table 1. Selected ship, buoy and C/MAN station observations taken during the passage of Hurricane Arthur.

between Bermuda and the southeast coast of the U.S. and maintained its intensity until 0600 UTC on the 5th and then weakened to a tropical storm. Tropical Storm Bertha passed near 39N 64W at 1200 UTC on the 6th with maximum sustained winds of 45 kts and then became a post tropical gale six hours later. Post tropical Bertha then passed over the Grand Banks late on the 7th and moved out over the North Atlantic along 47N before turning northeast toward the British Isles and re intensifying (**Figure 4**). Bertha became the stronger of two extratropical lows that affected the North Sea from the 9th to the 12th. The ship **BATFR27** (49.5N 3.5W) reported west winds of 61 kts at 1000 UTC August 10th. The platform **Ekofisk** (LF5U) near 56.5N 3.2E reported southwest winds of 46 kt and 6.0 meter seas (20 ft) at 0900 UTC on the 11th. The platform **62119** (57.0N 1.9E) encountered west winds of 51 kts and 6.5 meter seas (21 ft) at 1200 UTC on the 11th and maximum seas of 7.0 m (23 ft) one hour prior. The platform **62113** (56.3N 2.2E) reported southwest winds of 47 kts at 0800 UTC on the 11th and maximum seas of 8.5 m (28 ft) four hours later. **MQTL6** (58.0N 1.0E), possibly a platform, reported a pressure of 974.3 hPa at 0800 UTC on the 11th. The cyclone subsequently stalled and weakened north of the British Isles late on the 12th.

Hurricane Cristobal:

Tropical Depression Four formed near the southeastern Bahamas late on August 23rd and moved north while intensifying, becoming Tropical Storm Cristobal twelve hours later and then a hurricane at 0600 UTC on the 26th while passing near 25N 72W. Cristobal followed a track parallel to and a bit east of Bertha's track and maintained Category 1 hurricane strength all the up to 45N 49W 1200 UTC on the 29th before becoming post tropical.

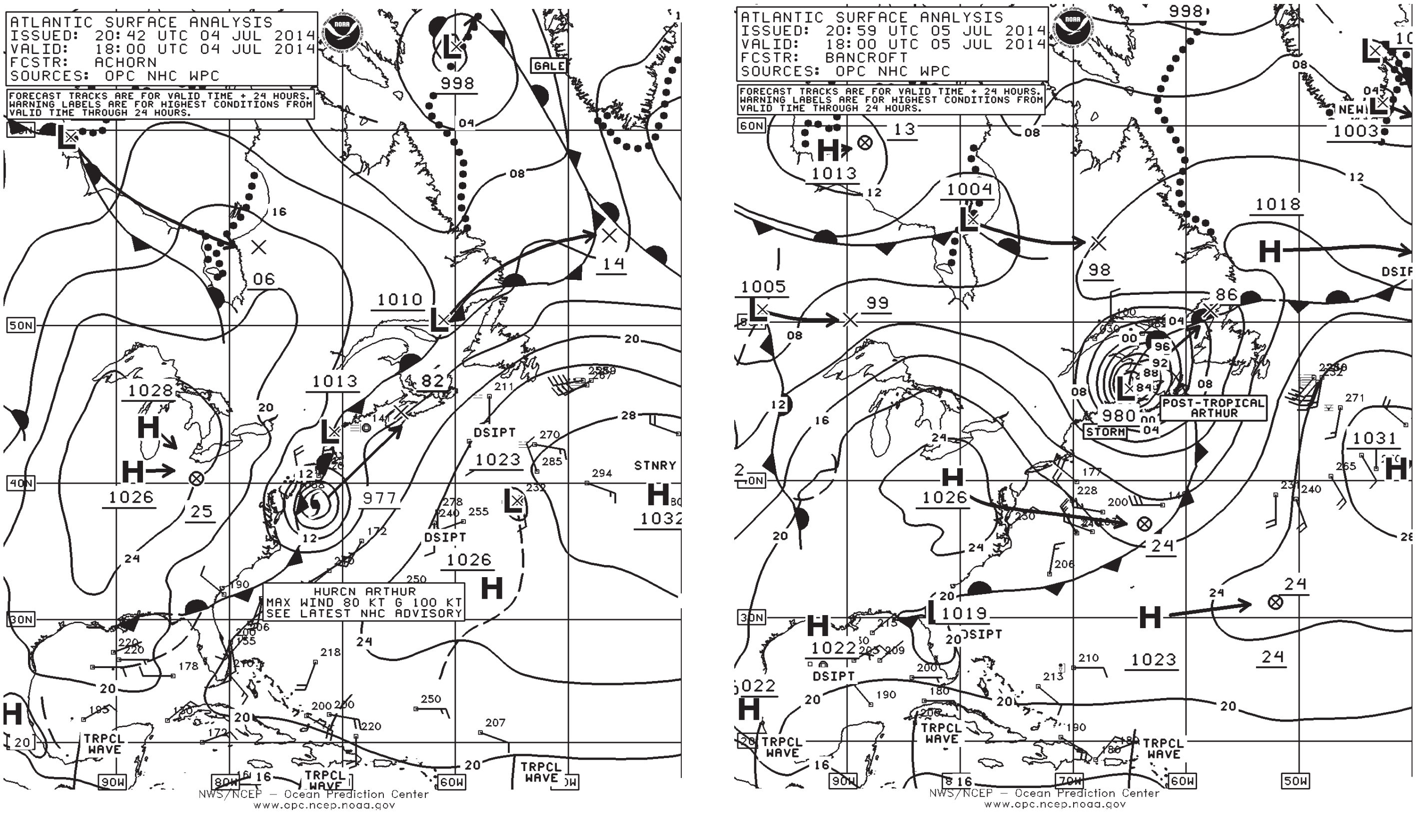


Figure 1. OPC North Atlantic Surface Analysis charts (Part 2 – west) valid 1800 UTC July 4 and 5, 2014. Twenty-four hour forecast tracks are shown with the forecast central pressures given as the last two whole digits in millibars. Information from the latest National Hurricane Center advisory appears in a text box.

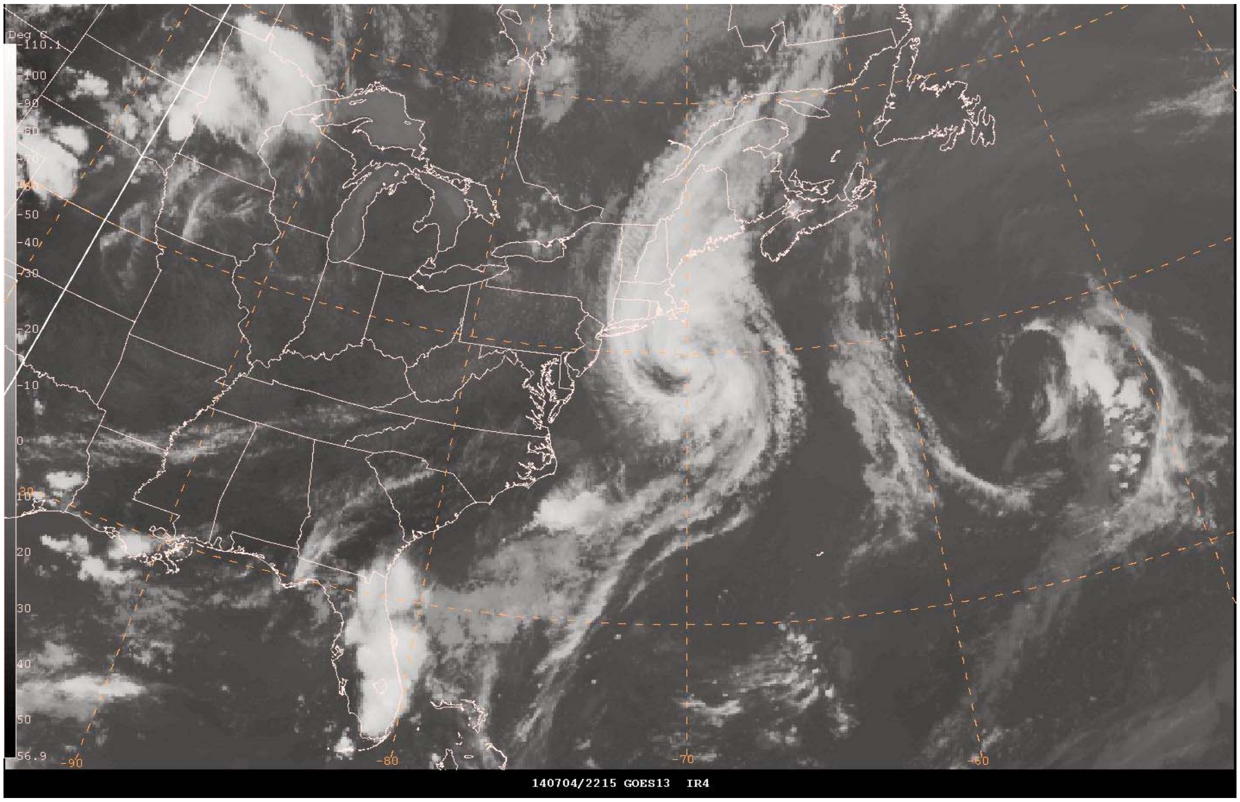


Figure 2. GOES-13 infrared satellite image valid 2215 UTC July 4, 2014. The satellite senses temperature on a scale from cold (white) to black (warm) in this type of imagery. The valid time of the picture is about four hours later than the valid time of the first part of Figure 1.

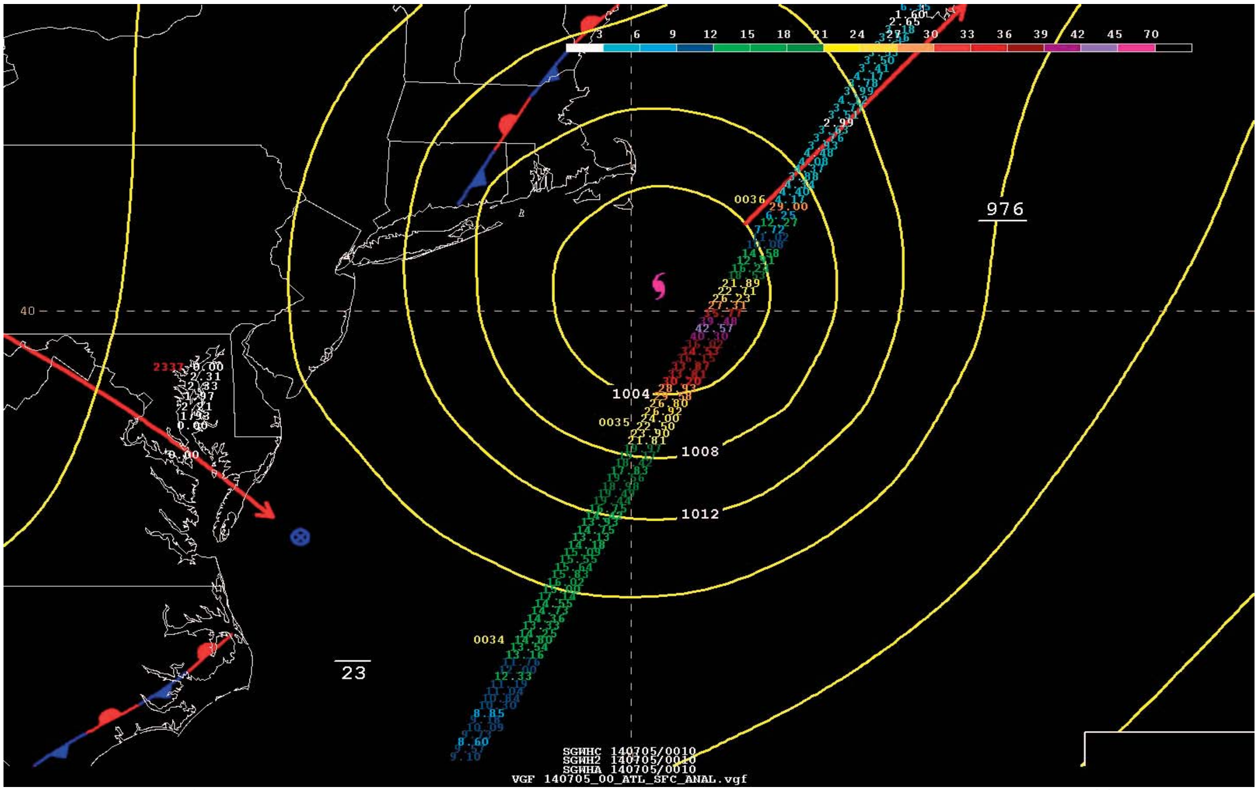


Figure 3. Portion of an image showing a pass of one of the three satellite-based altimeters (Cryosat, Jason-2 and Altika) operational at that time. The numbered track of the satellite shows significant wave heights in feet to two decimal places, colored according to the scale on the upper right. The four-digit numbers to the left of the track are times in UTC. The OPC North Atlantic surface analysis valid at 0000 UTC July 5, 2014 (or six hours later than the valid time of the first part of Figure 1) is overlaid on the image. Image is reprocessed by NOAA/NESDIS/ Center for Satellite Application and Research.

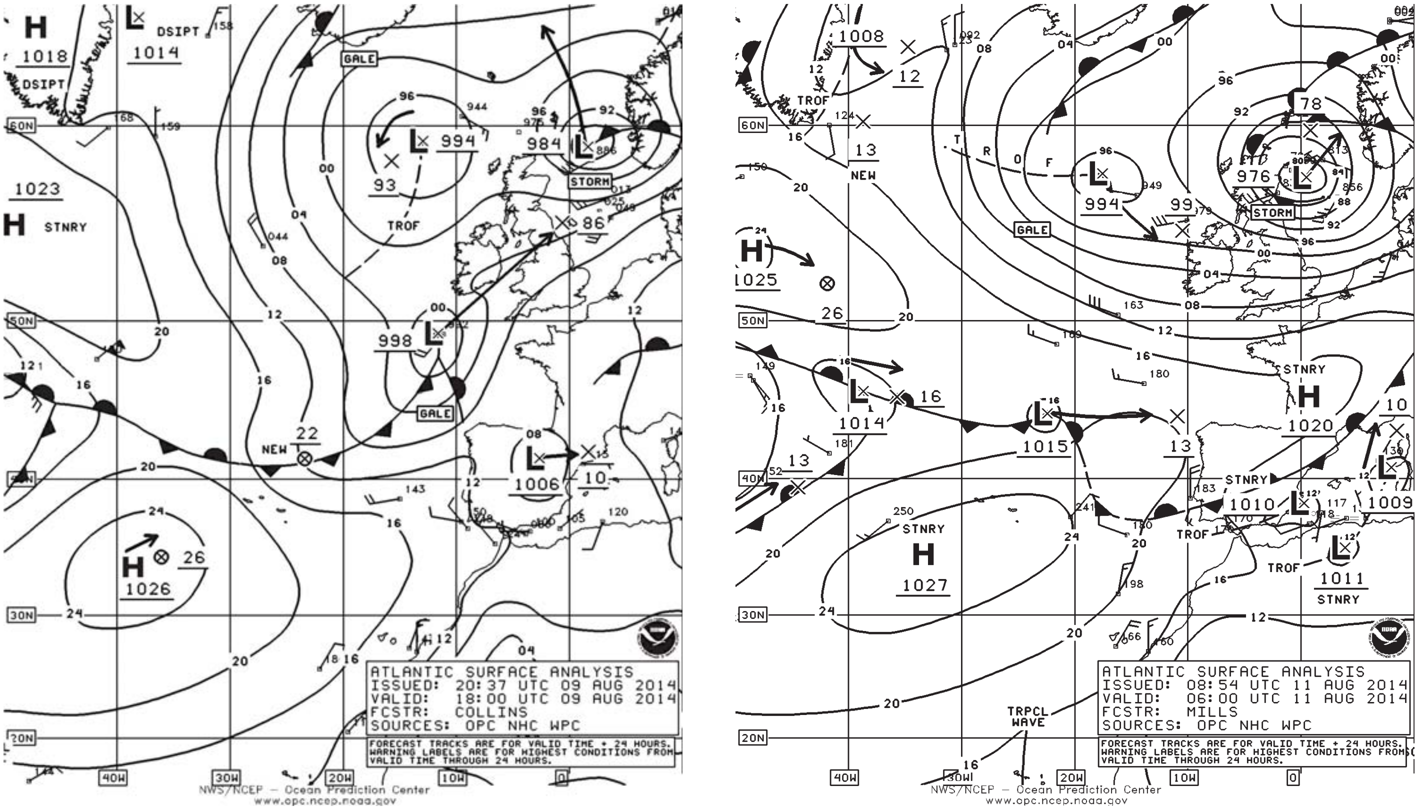


Figure 4. OPC North Atlantic Surface Analysis charts (Part 1 - east) valid 1800 UTC August 9 and 0600 UTC August 11, 2014.

Buoy 41048 (32.0N 69.5W) reported southwest winds of 39 kts with gusts to 51 kts and 7.5 meter seas (25 ft) at 2300 UTC on the 27th and maximum seas of 8.0 m (26 ft) one hour prior. **Hibernia Platform** (VEP717, 46.7N 48.7W) reported northeast winds of 59 kts at 1500 UTC on the 29th, and seas as high as 5.8 m (19 ft) nine hours later. The anemometer height is 139 m. The cyclone briefly developed a maximum intensity of 75 kts for sustained winds and gusts to 90 kts at 0600 UTC on the 29th. **Figure 5** shows Cristobal becoming an intense post tropical hurricane force low over a twelve hour period as it merges with a frontal zone. The ASCAT image in **Figure 6** shows retrieved winds around the hurricane with the highest winds, up to 70 kts but mostly 50 to 60 kts, on the south side. **Figure 7** depicts further intensification of Post tropical Cristobal as it reforms northeast toward Iceland while absorbing the low near Greenland. The lowest central pressure was 963 hPa at 0600 UTC on the 31st. The ASCAT image in **Figure 8** shows a swath of west to southwest winds up to 60 kts on the south side of the cyclone which is centered north of 60N close to the time of the second part of **Figure 7**. The ship **UDYG** (65N 33W) reported northeast winds of 45 kts at 1200 UTC on the 31st. Late on the 31st the cyclone passed north of Iceland and weakened.

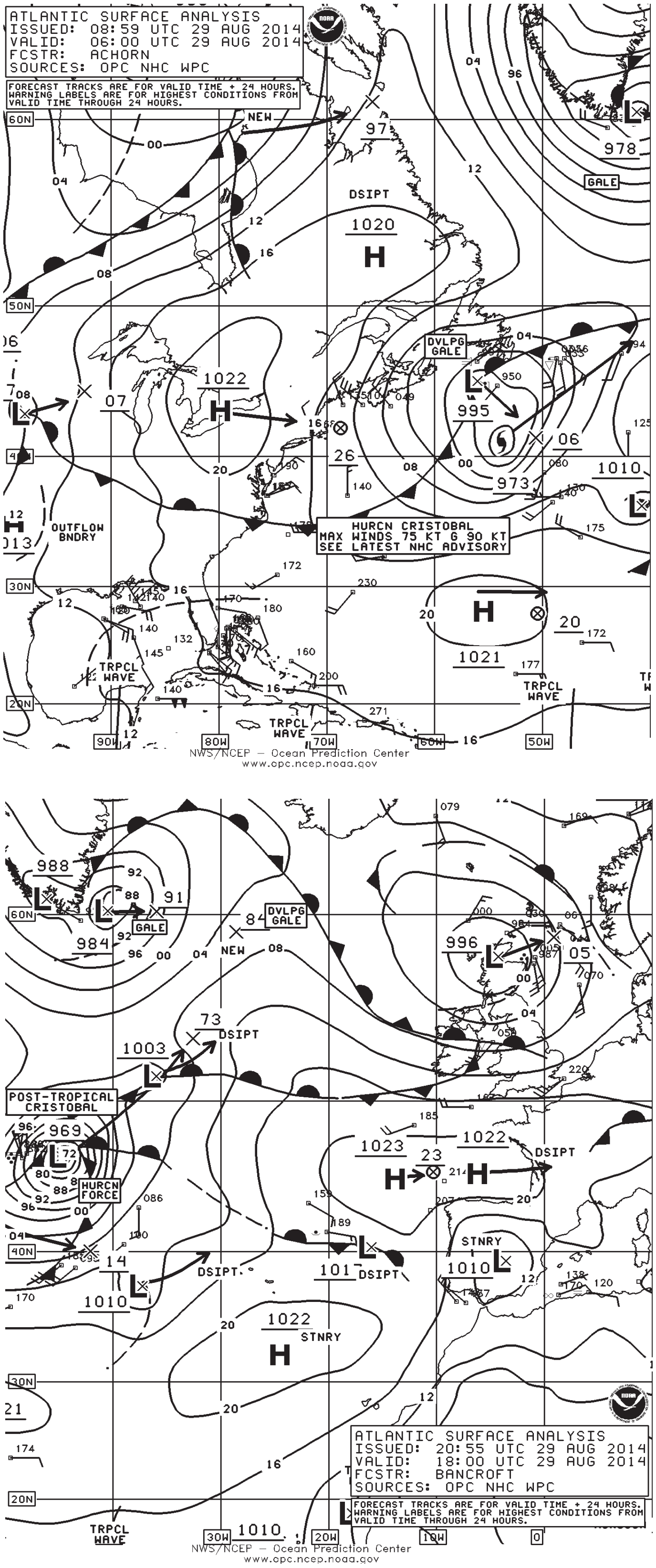


Figure 5. OPC North Atlantic Surface Analysis charts valid 0600 UTC (Part 2) and 1800 UTC (Part 1) August 29, 2014.

Other Significant Events of the Period

North Atlantic Storms/ Greenland area, May 1-4:

The first two significant events of the period developed in close succession. The storm near Greenland in the first part of **Figure 9** originated near 43N 45W at 1800 UTC April 29. The development of the stronger of the two lows is shown in **Figure 9**, originating from the 1003 hPa low at 40N 39W. The ASCAT image of the stronger system (**Figure 10**) taken about four and a half hours later shows retrieved winds of up to 60 kts. This indicates possible hurricane force as the low moved closer to Greenland and with low bias of winds at high speeds. The stronger low subsequently looped back to the southwest and then southeast and weakened, similar to the first low.

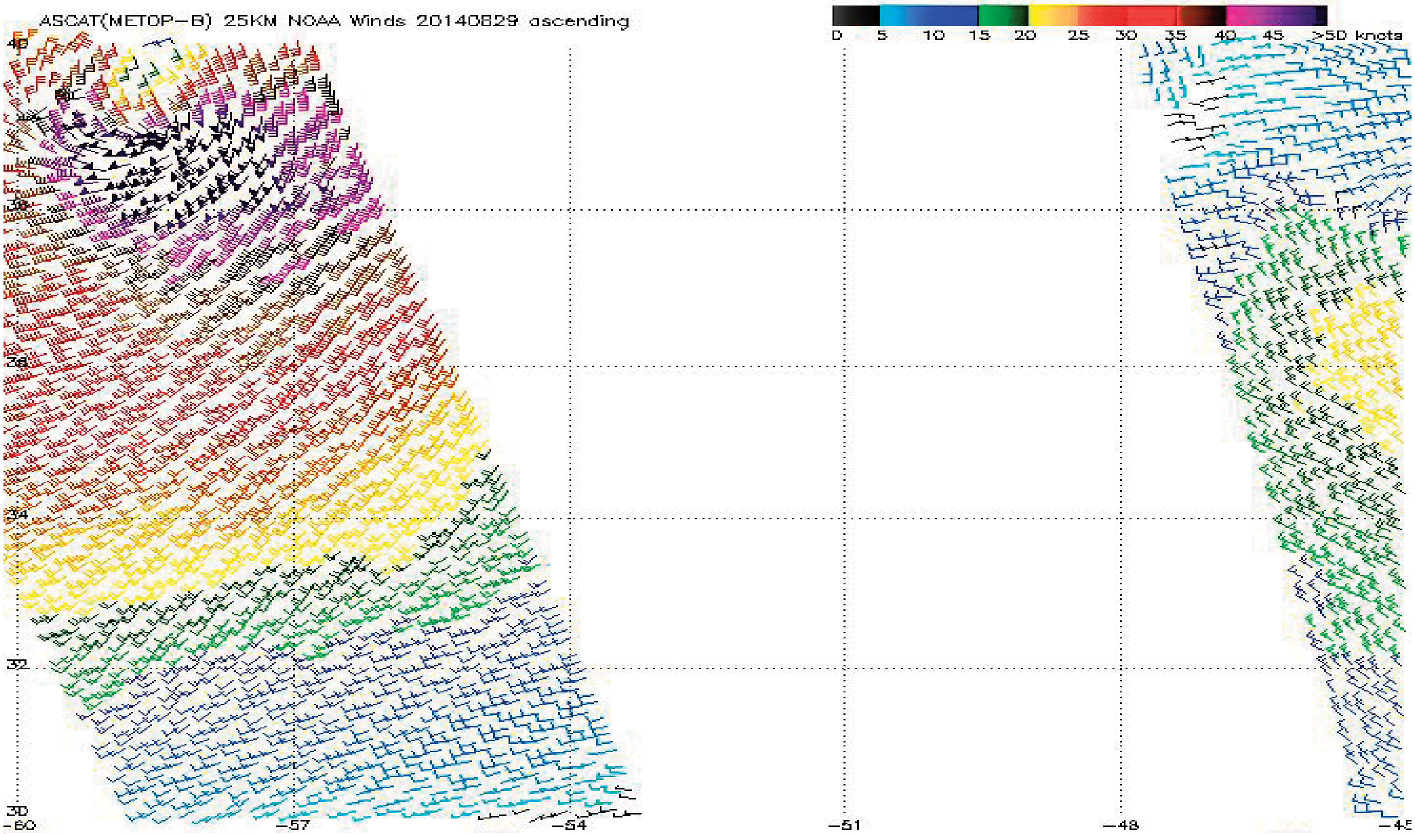


Figure 6. 25-km ASCAT (METOP-B) image of satellite-sensed winds around Hurricane Cristobal shown in the upper-left side of the image. The valid time of the pass is 0029 UTC August 29, 2014, or about fine and one-half hours prior to the valid time of the first part of Figure 5. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

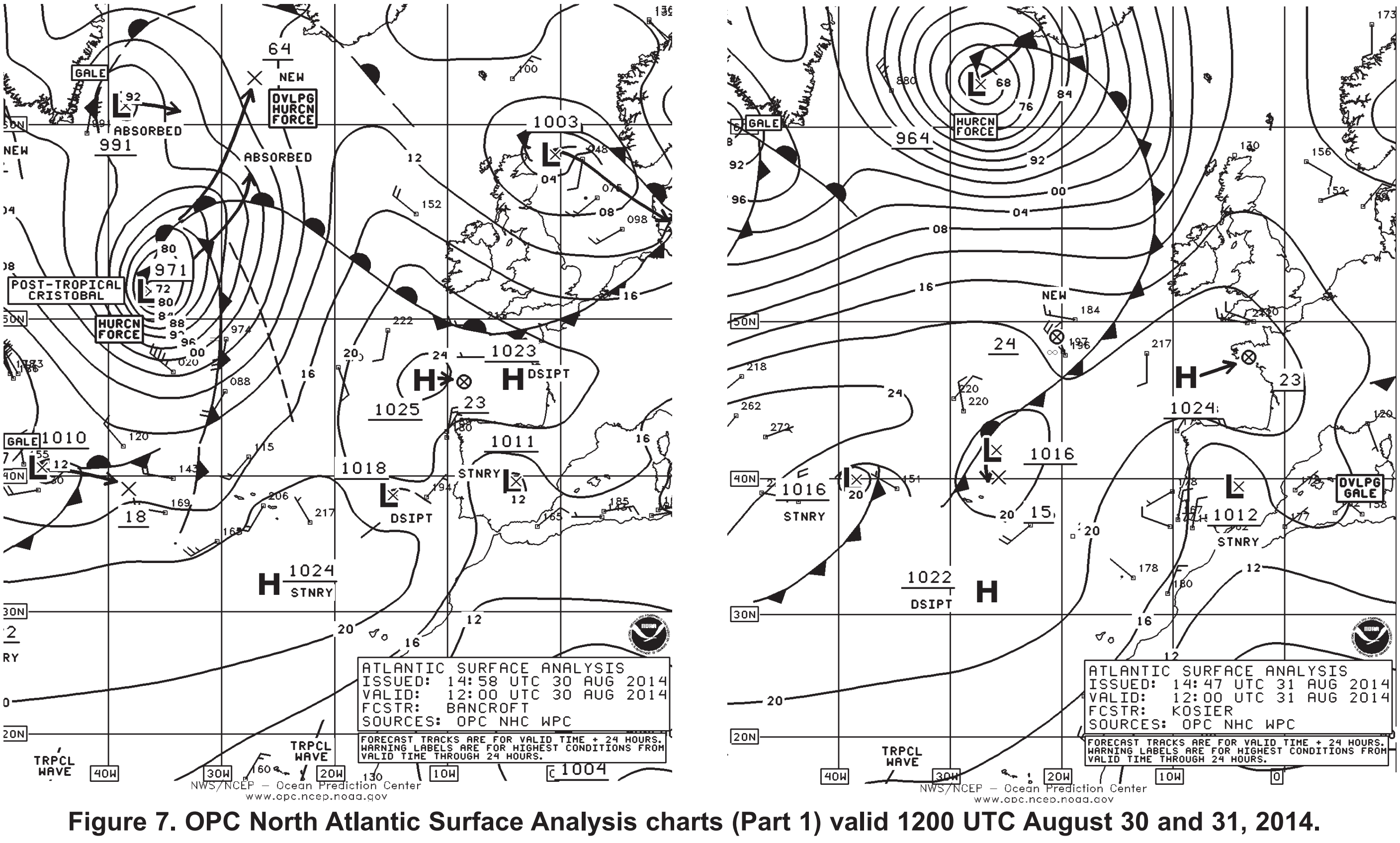
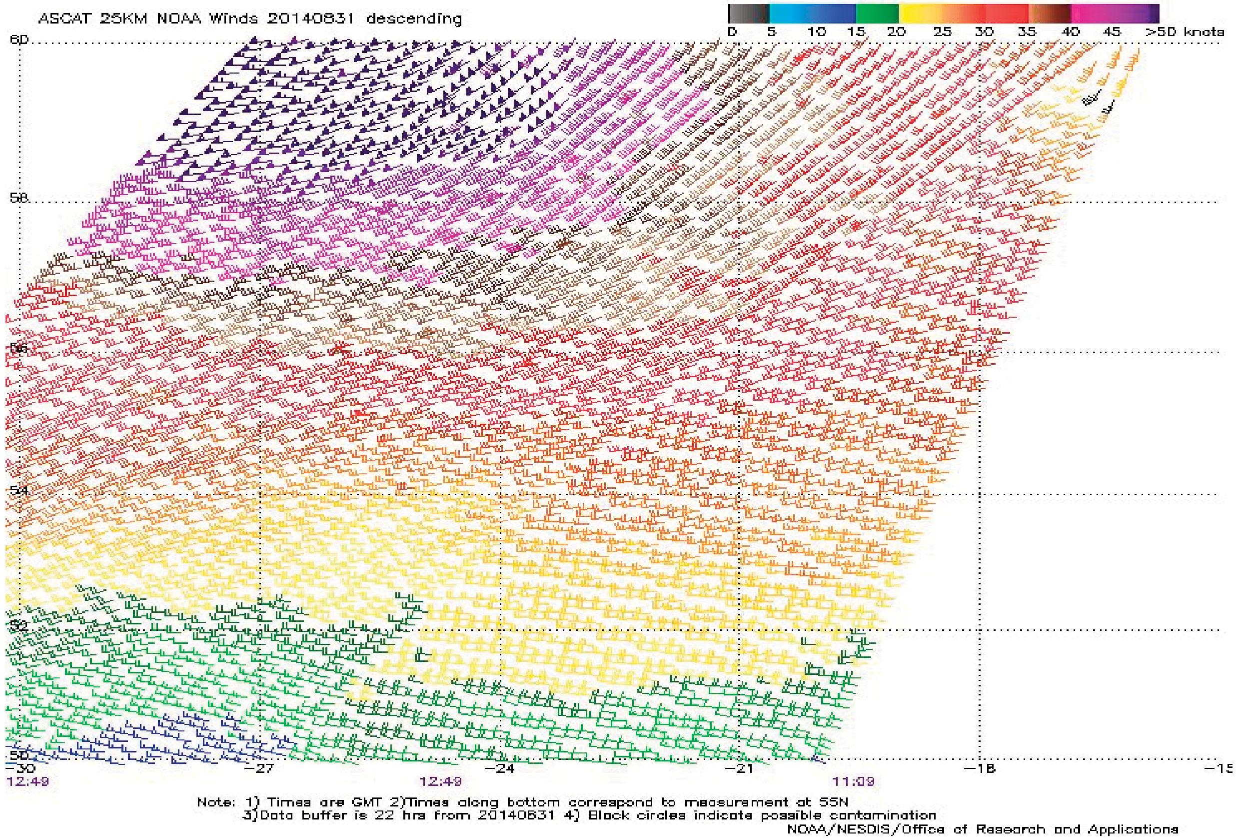
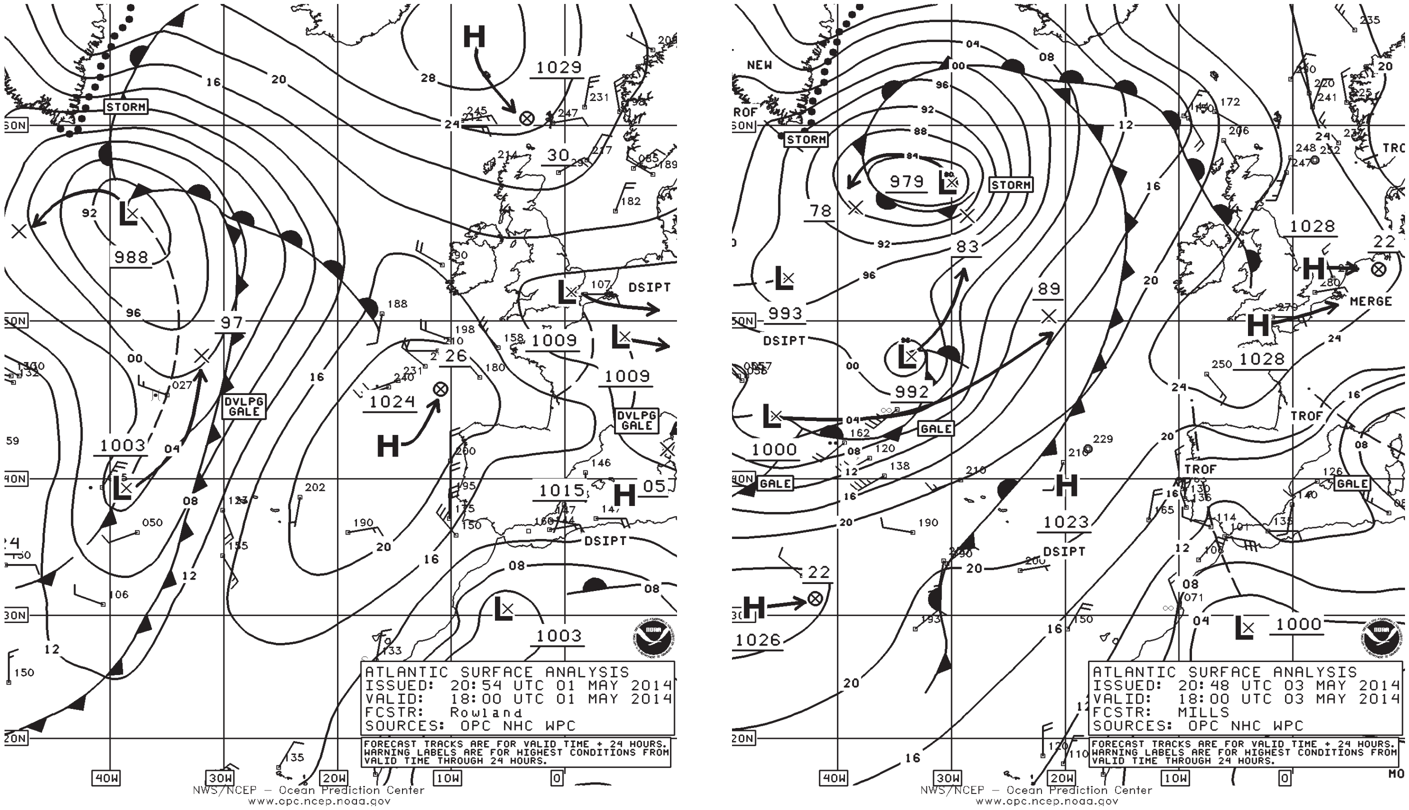


Figure 7. OPC North Atlantic Surface Analysis charts (Part 1) valid 1200 UTC August 30 and 31, 2014.



Note: 1) Times are GMT 2)Times along bottom correspond to measurement at 55N
3)Data buffer is 22 hrs from 20140831 4) Black circles indicate possible contamination
NOAA/NESDIS/Office of Research and Applications

Figure 8. 25-km ASCAT (METOP-A) image of satellite-sensed winds on the south side of the hurricane-force low (Post-tropical Cristobal) shown in the second part of Figure 7. Portions of two satellite passes are shown. The valid time of the pass containing the stronger wind retrievals is 1249 UTC August 31, 2014, or less than one hour later than the valid time of the second part of Figure 7. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.


ATLANTIC SURFACE ANALYSIS
ISSUED: 20:54 UTC 01 MAY 2014
VALID: 18:00 UTC 01 MAY 2014
FCSTR: Rowland
SOURCES: OPC NHC WPC

FORECAST TRACKS ARE FOR VALID TIME + 24 HOURS. WARNING LABELS ARE FOR HIGHEST CONDITIONS FROM VALID TIME THROUGH 24 HOURS.

ATLANTIC SURFACE ANALYSIS
ISSUED: 20:48 UTC 03 MAY 2014
VALID: 18:00 UTC 03 MAY 2014
FCSTR: MILLS
SOURCES: OPC NHC WPC

FORECAST TRACKS ARE FOR VALID TIME + 24 HOURS. WARNING LABELS ARE FOR HIGHEST CONDITIONS FROM VALID TIME THROUGH 24 HOURS.

Figure 9. OPC North Atlantic Surface Analysis charts (Part 1) valid 1800 UTC May 1 and 3, 2014.

North Atlantic Storm, Greenland area, May 11-14:

A developing low moved off the Labrador coast early on May 10th and passed south of Greenland with a lowest central pressure of 982 hPa on the afternoon of the 12th as shown in **Figure 11**. An ASCAT (METOP-A) pass from 2234 UTC on the 12th is similar to **Figure 10** except not quite as high, up to 50 kt. The cyclone subsequently drifted northeast and weakened, and dissipated near 60N 30W on the 15th.

North Atlantic Storms, May 14-17:

The development of the first storm is shown in **Figure 11**. The frontal wave of low pressure over New England moved southeast and slowed down while getting trapped under a building high to the north over a two and a half day period. At 1800 UTC on the 15th a new low formed on the front south of the old low near 30N 42W and moved north while strengthening, becoming the stronger 998 hPa low shown in the first part of **Figure 12**. A vessel with a **SHIP** call sign reported east winds of 45 kts near 46N 35W at 2100 UTC May 16th.

The **Canmar Honour** (ZCBP5) encountered north winds of 37 kts and 4.5 m seas (15 ft) near 42N 47W at 1600 UTC on the 16th. In **Figure 12** the low has stalled and lost frontal features while blocked by the ridge to the north. The infrared satellite image in **Figure 13** shows a cyclone unlike an ordinary mid-latitude system with an eye like feature surrounded by convective clouds. An ASCAT (METOP-B) pass from 0101 UTC May 18th showed a circular area of gales surrounding a core of lighter winds. The cyclone subsequently continued its weakening trend while drifting north.

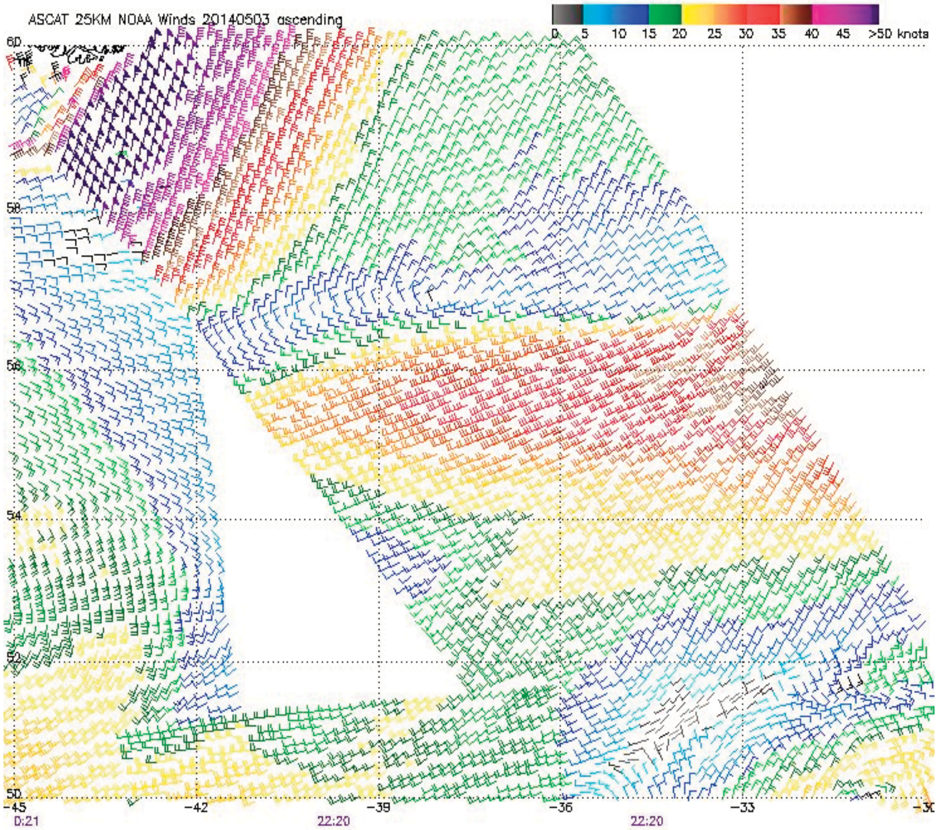


Figure 10. 25-km ASCAT (METOP-A) image of satellite-sensed winds on the northwest side of the cyclone shown in the second part of Figure 9. Portions of two passes are shown. The valid time of the pass containing the highest wind retrievals is 2220 UTC May 3, 2014, or about four and one-half hours later than the valid time of the second part of Figure 9. The southern tip of Greenland appears near the upper left corner of the image. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

Northeastern Atlantic Storm, May 15-17:

This short lived event began as a new frontal wave of low pressure near 58N 20W at 1800 UTC May 18th which moved northeast and passed east of Iceland twenty-four hours later as a storm force low with a central pressure of 989 hPa. With the central pressure falling 29 hPa during this period, this development could be considered a meteorological bomb (**Reference 1**). An ASCAT (METOP-A) pass from 2112 UTC May 16th shows a swath of west winds to 45 kts south of the center and resembles **Figure 15** for the early July event. The cyclone then moved northeast away from the area by the 17th.

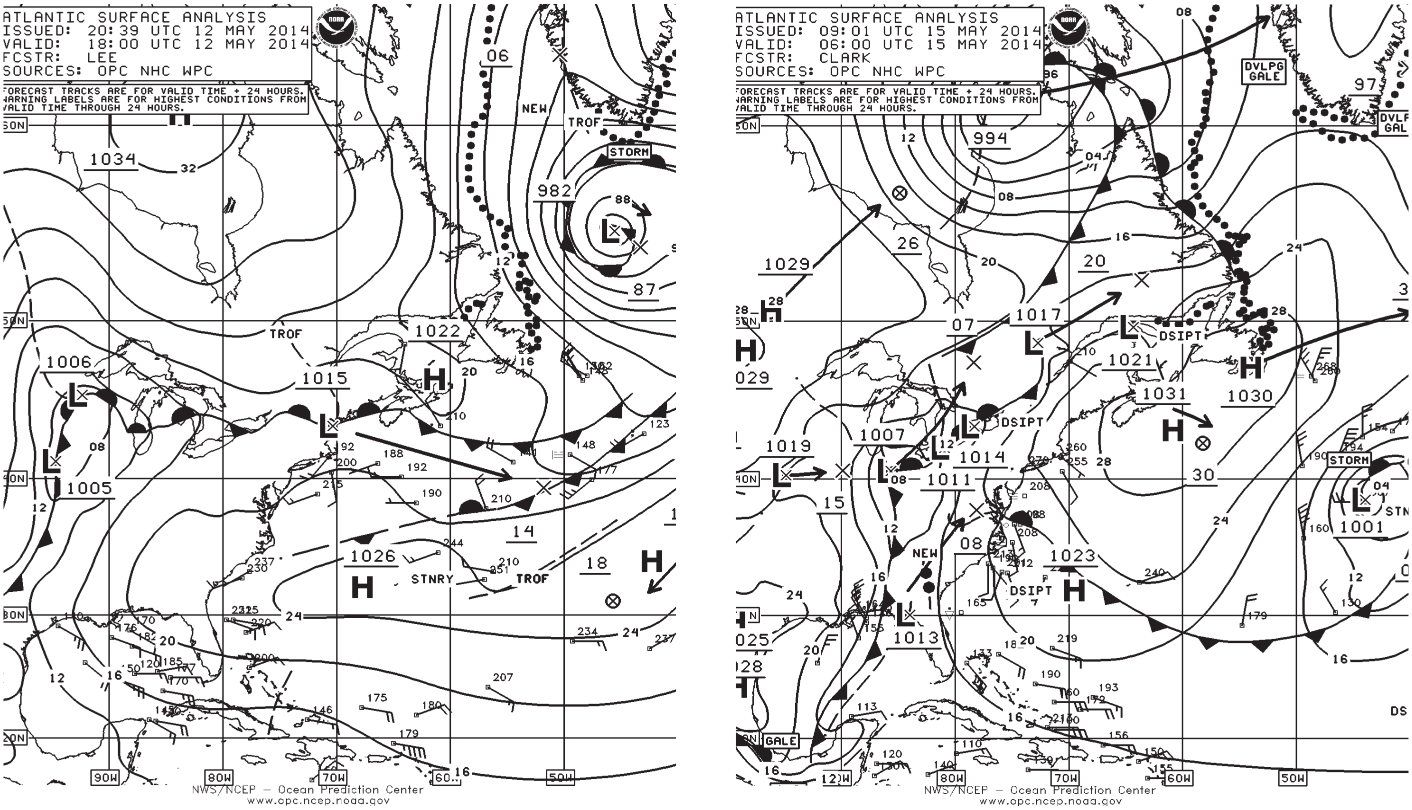


Figure 11. OPC North Atlantic Surface Analysis charts (Part 2) valid 1800 UTC May 12 and 0600 UTC May 15, 2014.

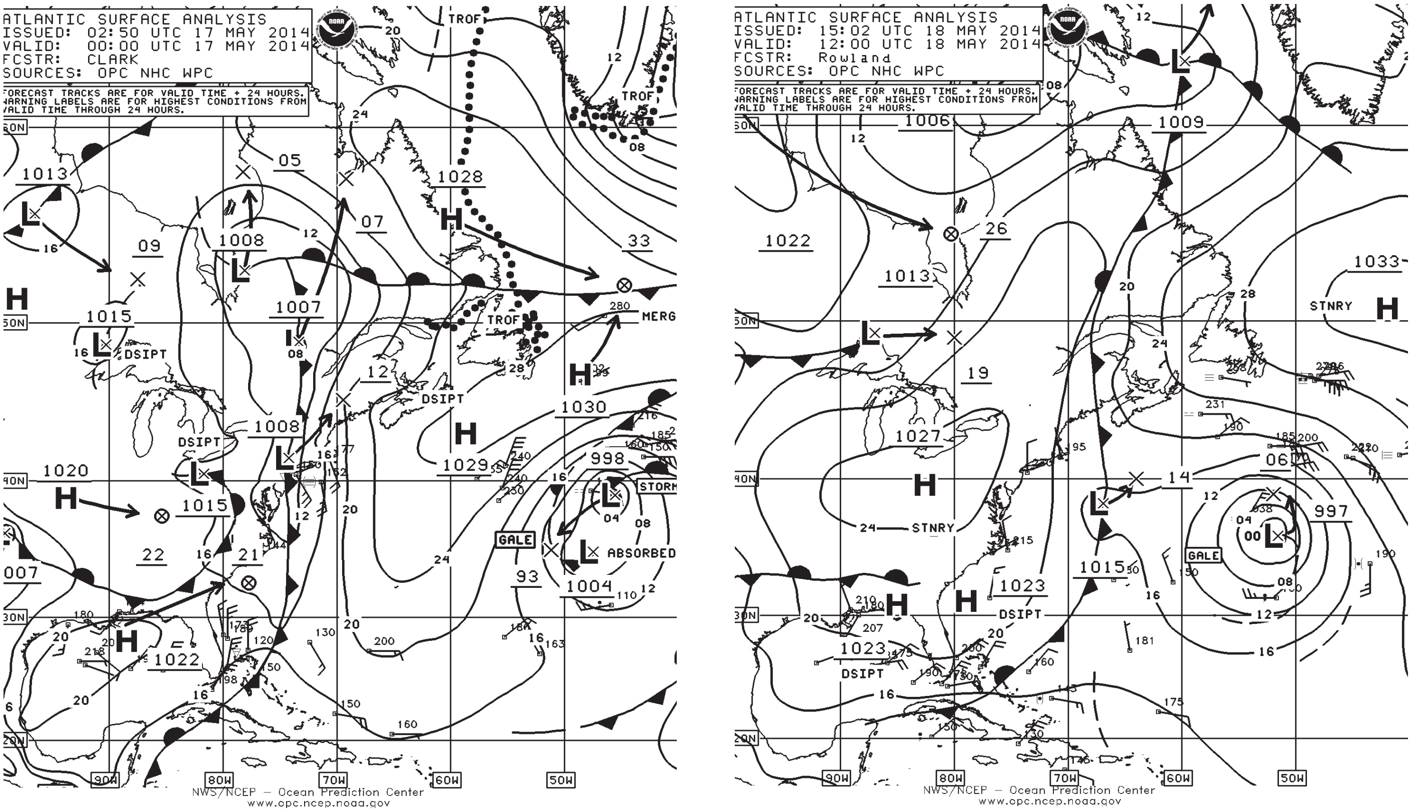


Figure 12. OPC North Atlantic Surface Analysis charts (Part 2) valid 0000 UTC May 17 and 1200 UTC May 18, 2014.

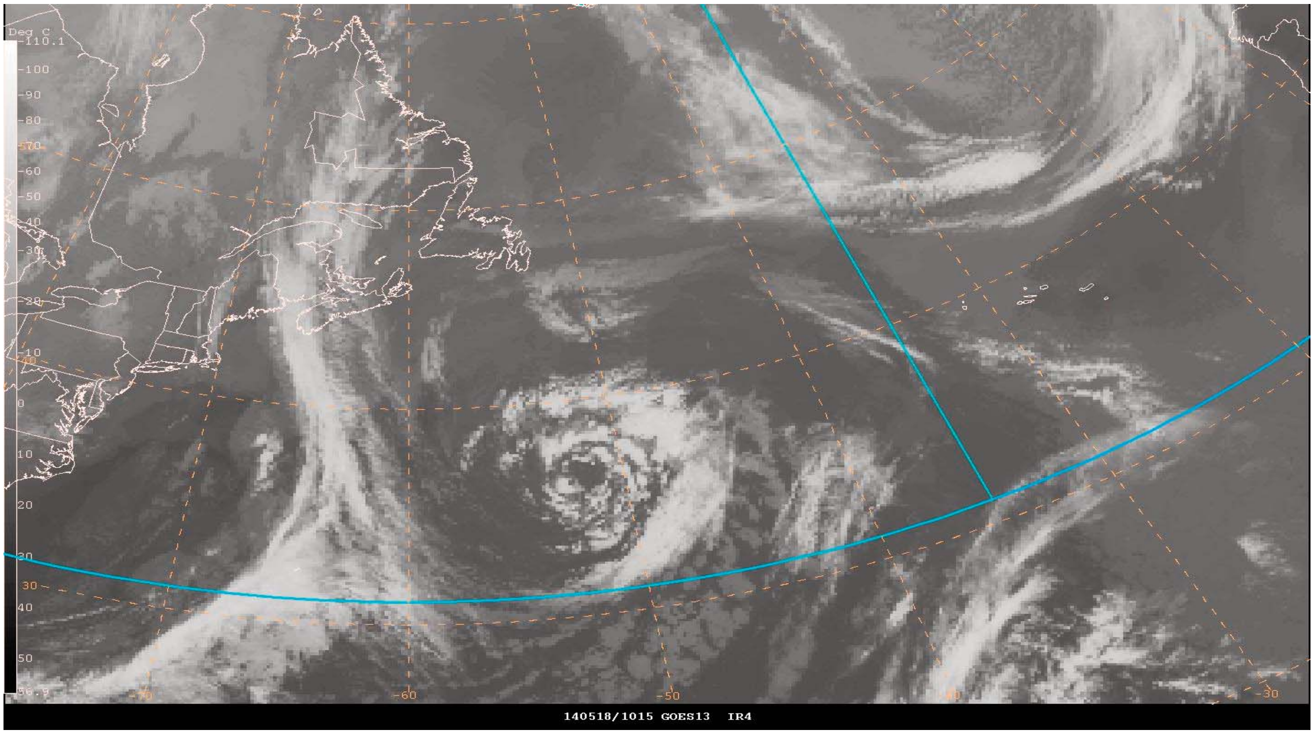


Figure 13. GOES-13 infrared satellite image valid 1015 UTC May 18, 2014. The valid time of the picture is one and three-quarters hours prior to the valid time of the second part of Figure 12.

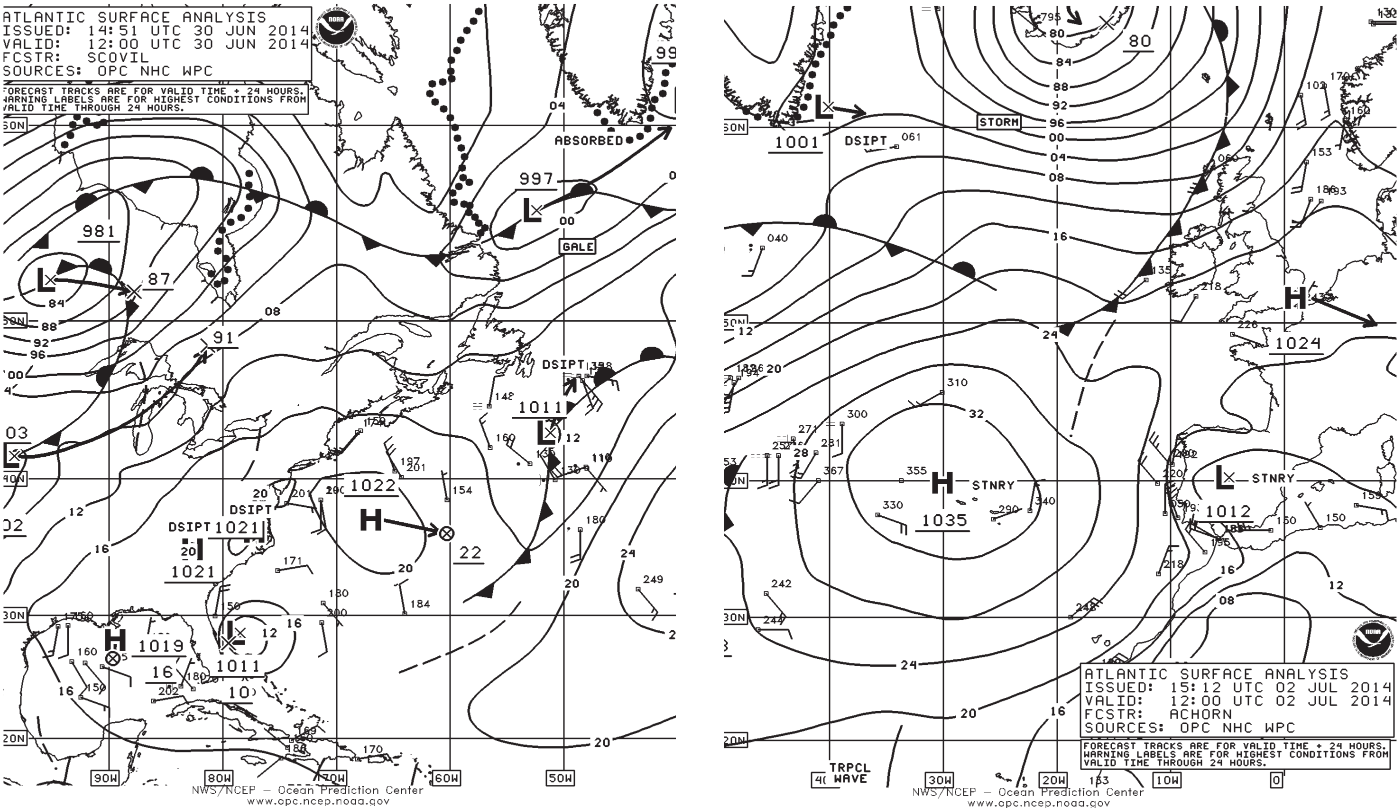


Figure 14. OPC North Atlantic Surface Analysis charts valid 1200 UTC June 30 (Part 2) and 1200 UTC July 2 (Part 1), 2014.

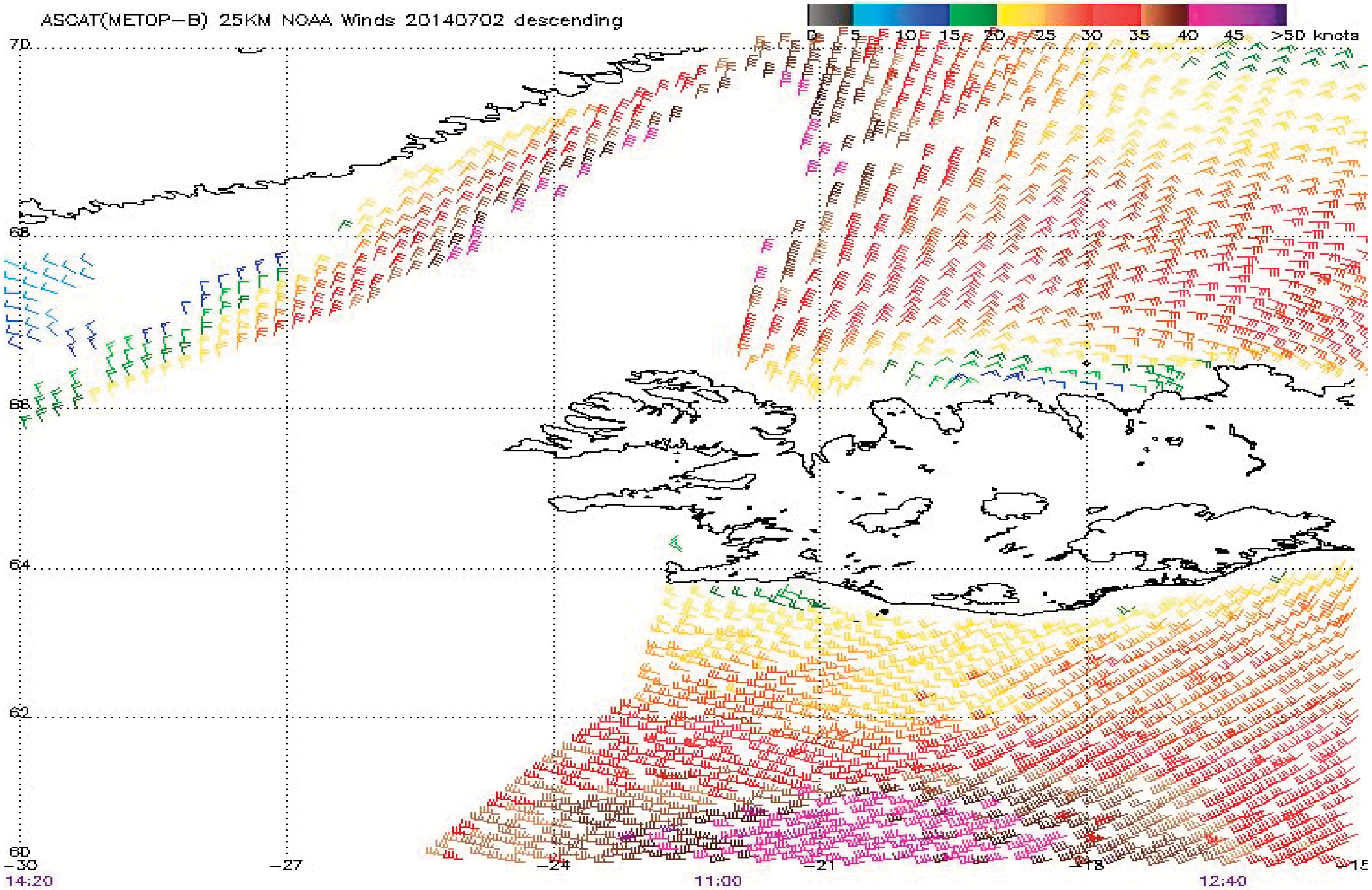


Figure 15. 25-km ASCAT (METOP-B) image of satellite-sensed winds around the storm centered over Iceland shown in the second part of Figure 14. Portions of three passes are shown, with the highest wind retrievals appearing in the 1100 UTC July 2 pass. The valid time of this pass is one hour prior to the valid time of the second part of Figure 14. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

Southwestern North Atlantic Storm, May 31-June 1:

A new low formed off the mid Atlantic coast of the U.S, near 37N 68W with a 1012 hPa central pressure at 0000 UTC May 31st and drifted east over the next twenty-four hours while the pressure fell 11 hPa. This was enough for the cyclone to develop storm force winds with a relatively modest central pressure at 0000 UTC June 1st, with the center near 38N 62W. An ASCAT pass from 0157 UTC June 1st reveals wind retrievals of 40 and 45 ktsaround the west semicircle and is similar to **Figure 17** for the mid August event. The ship **9HJC9** (35N 68W) reported northwest winds of 45 kts and 5.5 m seas (18 ft) at 1300 UTC May 31st . The cyclone subsequently stalled and weakened with winds dropping to below gale force late on June 2nd.

Northeastern Atlantic Storm, July 1-2:

An unseasonably deep low developed near Iceland on July 2nd. It originated from a wave of low pressure near the Labrador coast at 0600 UTC June 30th. It intensified gradually while tracking across the northern waters (**Figure 14**). The lowest central pressure was 975 hPa at 1200 UTC July 2nd as the center moved over Iceland. The ASCAT image in **Figure 15** reveals a swath of west winds to 45 kts south of Iceland. The low bias of ASCAT at higher wind speeds supports analysis of this system as a storm. This was the deepest cyclone of non-tropical origin in the Atlantic during the four month period. The cyclone remained nearly stationary and weakened slowly over the next two days before drifting southeast and dissipating near 61N 11W late on the 7th.

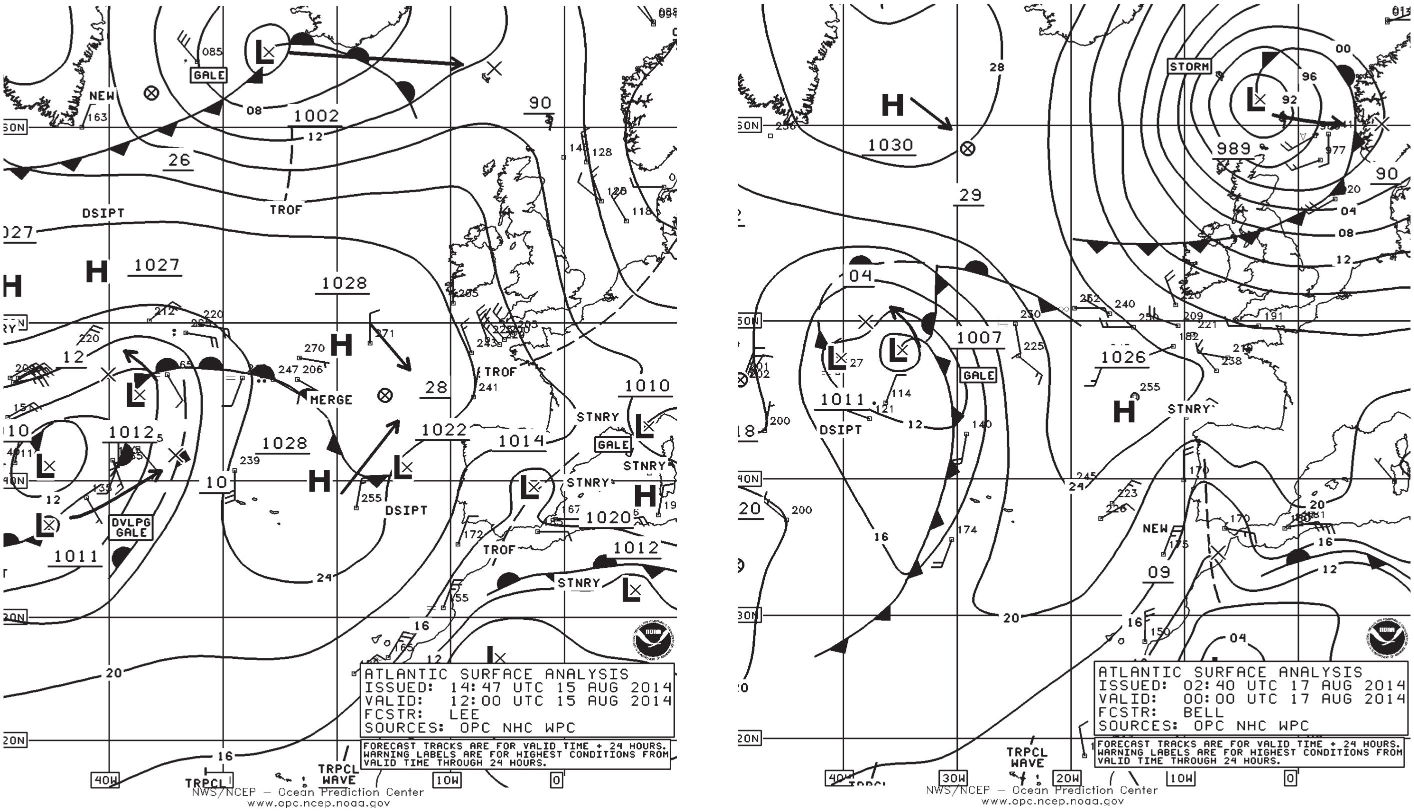


Figure 16. OPC North Atlantic Surface Analysis charts (Part 1) valid 1200 UTC August 15 and 0000 UTC August 17, 2014.

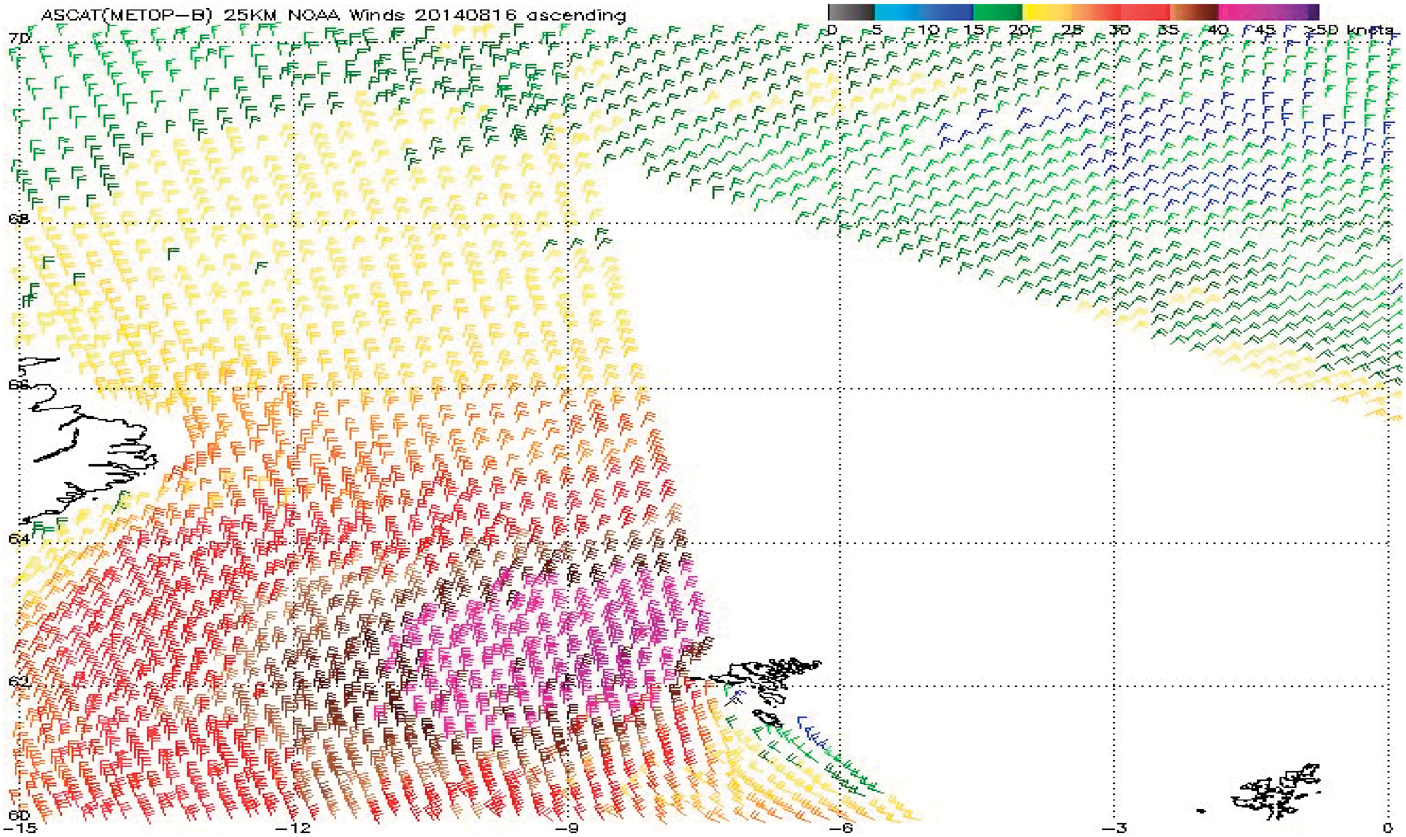


Figure 17. 25-km ASCAT (METOP-B) image of satellite-sensed winds around the west and north sides of the storm shown in the second part of Figure 16. Portions of two passes are shown, with the left pass containing the strongest winds valid at 2203 UTC August 16, 2014, or about two hours prior to the valid time of the second part of Figure 16.

North Atlantic Storm, Greenland area, July 26-27:

A developing low originating just south of Nova Scotia at 1200 UTC July 25th moved northeast across Newfoundland and the Labrador Sea to the east Greenland waters on the 27th, where it briefly developed storm force winds and a 990 hPa central pressure. An ASCAT (METOP-B) pass from 1404 UTC on the 27th returns a swath of north to northwest winds to 45 kts to the west of the low and is similar to **Figure 17** for the mid August event. The cyclone subsequently moved east and passed near Iceland the following night with winds weakening to gale force.

Northeastern Atlantic Storm, August 15-16:

Low pressure originating near Greenland at 0000 UTC August 14th remained nearly stationary over the next twenty-four hours before spawning a new low to the east near 64N 30W by 0600 UTC on the 15th. The new low moved east southeast, briefly developing storm force winds and a lowest central pressure of 988 hPa near 61N 1W late on the 16th (**Figure 16**). The ASCAT image in **Figure 17** reveals north winds to 45 kt west of the Faroe Islands. Buoy 64045 reported highest seas of 8.0 m (26 ft) at 0700 UTC on the 17th.

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

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*.

4. Saffir-Simpson Scale of Hurricane Intensity: **http://www.nhc.noaa.gov/aboutsshws.php**

5. Tropical Cyclone Reports, 2014, National Hurricane Center, **http://www.nhc.noaa.gov/data/tcr/index.php?season=2014&basin=atl**

Marine Weather Review – North Pacific Area

March to August 2014

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Introduction

The main storm track across the North Pacific was from near Japan northeast toward the Gulf of Alaska, but occasionally the upper air pattern became more amplified and caused developing cyclones to turn north toward the Kurile Islands or Sea of Okhotsk, where they would slow down and weaken. Others would form secondary low centers or originate in the eastern North Pacific and move toward Alaska or British Columbia. March brought late winter weather with five cyclones developing hurricane force winds and five cyclones with central pressures in the 960's hPa or below. There was one hurricane force low in April, the last of the season. Although May had none, it did produce a 968 hPa low in the middle of the month. Cyclonic activity weakened and shifted north in the summer. July was the least active month, producing no cyclones exceeding gale force.

Tropical activity appearing on OPC's oceanic radio facsimile charts consisted of one typhoon each in March, April and July, and a super typhoon with sustained winds of 130 kts or more that became an extratropical storm force low while moving through the Sea of Japan in August. Additionally there were two cyclones in August, a typhoon and a hurricane, which moved into OPC's high seas waters north of 30N and east of 160E and originated in the eastern tropical North Pacific.

Tropical Activity

Typhoon Faxai:

Faxai formed as a tropical storm near 9N 150E at 1200 UTC March 1st with maximum sustained winds 35 kts with gusts to 45 kts. The cyclone drifted northeast over the next three days and intensified to a typhoon near 19N 152E by 1800 UTC on the 4th with maximum sustained winds of 75 kts with gusts to 90 kts. The cyclone then began to weaken, becoming a 60 kts tropical storm twelve hours later near 21N 154E and then a post tropical remnant low with gale force winds at 23N 156E 1800 UTC on the 6th. Weakening continued thereafter, with the low dissipating near 30N 173E at 0000 UTC on the 9th.

Typhoon Tapah:

A non-tropical low near 11N 146E at 1200 UTC April 27 became a tropical depression six hours later with maximum sustained winds of 30 kts while drifting north, and then intensified to a tropical storm at 0000 UTC on the 28th with maximum sustained winds of 50 kts with gusts to 60 kts, and then at 0000 UTC on the 29th became Typhoon Tapah near 16N 147E with maximum sustained winds 65 kts with gusts to 80 kts. A weakening trend began on the 29th with the cyclone drifting northwest, and the maximum sustained winds lowered to 35 kts (minimal tropical storm) near 21N 145E at 0000 UTC May 1st. The cyclone was downgraded to a tropical depression six hours later and to a remnant low after another six hours. Dissipation followed by May 2nd.

Typhoon Neoguri:

A non-tropical low near 10N 147E at 1800 July 2nd drifted northwest and became Tropical Depression 08W six hours later and a minimal tropical storm near 12N 143E 1800 UTC on the 3rd. Rapid strengthening followed, with the system becoming Typhoon Neoguri near 15N 139E at 1800 UTC on the 4th with maximum sustained winds 65 kts with gust to 80 kts.

Six hours prior, a vessel with a **SHIP** call sign reported northwest winds of 40 kts and 4.6 m seas (15 ft) near 13N 138E. At 1800 UTC on the 5th Neoguri developed a maximum intensity of 120 kts for sustained winds and gusts to 145 kts. This is at Category 4 on the Saffir-Simpson scale (**Reference 4**). The cyclone maintained this intensity over the following twenty-four hours and passed west of 130E, the western boundary of the National Weather Service's unified surface analysis. At 0600 UTC on the 6th a vessel with a **SHIP** call sign reported northeast winds of 45 kts and 7.0 m seas (23 ft) near 17N 134E. Neoguri weakened west of the area and then turned back toward the northeast, passing near 32N 131E as a tropical storm with maximum sustained winds 45 kts at 0000 UTC July 10th. The cyclone then passed near Tokyo at 0000 UTC on the 11th with similar intensity and then became a post tropical / extratropical gale near 37N 144E with a 991 hPa central pressure six hours later. A slow weakening trend then continued as the cyclone moved northeast, with no redevelopment into a strong extratropical low.

Super-Typhoon Halong:

A non-tropical low near 11N 155E at 1800 UTC July 26 drifted northwest over the next two days and became Tropical Depression 11W near 13N 149E at 1800 UTC on the 28th and a tropical storm six hours later with maximum sustained winds 45 kts with gusts to 55 kts. A vessel using the **SHIP** call sign reported northeast winds of 56 kts and 5.2 m seas (17 ft) near 21N 132E at 1800 UTC on the 30th. The cyclone became Typhoon Halong south of Japan near 15N 137E at 1800 UTC August 1st with maximum sustained winds 75 kts with gusts to 90 kts. Rapid intensification to a super typhoon followed over the next eighteen hours, with Halong passing near 15N 135E with maximum sustained winds of 135 kts with gusts to 165 kts at 1200 UTC on the 2nd. The maximum intensity was 140 kts sustained winds and gusts to 170 kts with a central pressure of 918 hPa (27.11 inches), reached at 0000 UTC on the 3rd near 15N 134E. This placed it at Category 5 on the Saffir-Simpson scale, the highest in a range of 1 to 5. An infrared satellite picture from MTSAT2 near this time (**Figure 2**) shows Halong with a well defined eye and a circular central dense overcast or eye wall within an expansive area of cirrus outflow. A weakening trend began on the 3rd as the cyclone drifted north along 130E over the next three days. **Northwest Shearwater** (ZCAO7) near 13N 133E reported southwest winds of 45 kts and 3.7 m seas (12 ft) at 2100 UTC on the 3rd. The typhoon began a turn to the northeast on the 6th and by 1200 UTC on the 7th the center passed near 26N 132E with an intensity of 75 kts sustained winds. The cyclone passed over western Japan later on the 9th as a strong tropical storm. The **APL Thailand** (WCX8882) near 34N 137E reported southwest winds of 45 kts and 9.0 m seas (30 ft) at 0600 UTC on the 10th. **Figure 1** depicts transition of Neoguri into a post tropical storm force low. Post tropical Neoguri passed near 43N 137W with a lowest central pressure of 979 hPa at 0600 UTC August 11th. At this time the **Santa Cruz** (LXCA) encountered southwest winds of 35 kts and 7.9 m seas (26 ft) near 40N 139E. The ASCAT image in **Figure 3** reveals a vigorous circulation with 50 kts wind vectors northwest of the center. The cyclone subsequently drifted northeast to near Sakhalin Island later on the 12th, where its top winds weakened to below gale force.

Tropical Cyclone Genevieve:

Genevieve originally formed as a tropical storm in the eastern Pacific tropical area near 12N 135W at 1200 UTC July 25th, an area monitored by the National Hurricane Center. Genevieve passed west of 140W on the 27th into the area monitored by the Central Pacific Hurricane Center, where it was classified as a tropical depression or even post- tropical while passing well south of Hawaii. Rapid intensification followed late on August 5th, with the cyclone becoming Hurricane Genevieve near 13N 176W at 1200 UTC on the 6th and Super Typhoon Genevieve near 15N 179.7E at 0600 UTC on the 7th, after

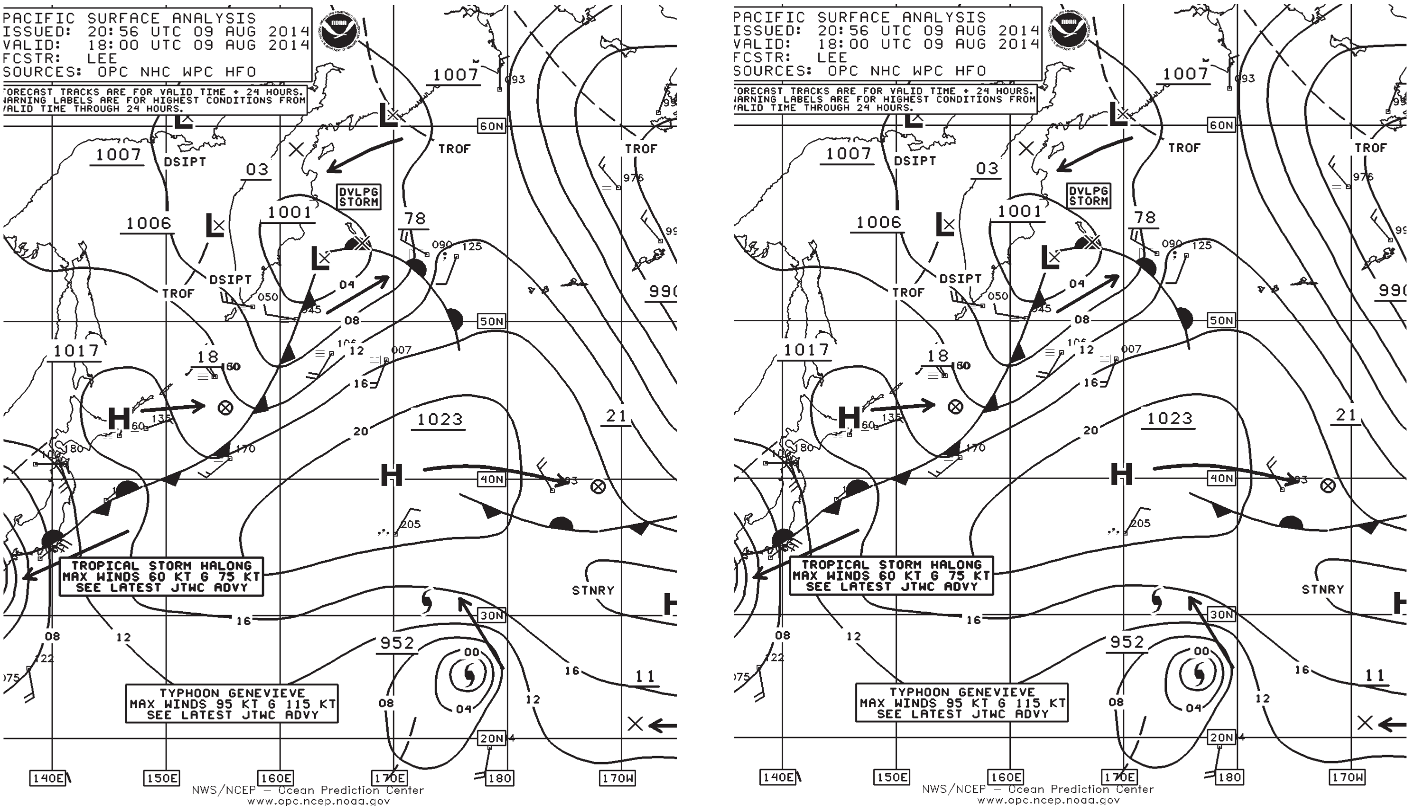

Figure 1. OPC North Pacific Surface Analysis charts (Part 2 - west) valid 1800 UTC August 9 and 10, 2014. Twenty-four hour forecast tracks are shown with the forecast central pressures given as the last two whole digits in millibars. Tropical cyclone information from the latest advisories issued by the Joint Typhoon Warning Center is shown in text boxes.

passing 180W into the Joint Typhoon Warning Center's area of responsibility. The peak intensity was 140 kts for sustained winds and gusts to 170 kts, reached six hours later. A weakening trend began by the 8th as the cyclone turned northward toward cooler water. Figure 1 shows a weakening Typhoon Genevieve moving north of 30N into OPC's high seas area of responsibility (north of 30N east of 160E and east of a line from 50N 160E to the Bering Strait. Rapid weakening followed on the 10th and 11th with Genevieve becoming a post tropical remnant low late on the 11th near 34N 165E.

Hurricane Julio:

Julio was another eastern tropical Pacific system which moved northwest into the Central Pacific Hurricane Center's (CPHC) area as a major hurricane 0600 UTC August 8th and then weakened at first while passing north of Hawaii. By 1200 UTC on the 12th its intensity was down to 55 kts for sustained winds while passing near 29N 157W (tropical storm strength). Julio then re-intensified into a hurricane upon moving north into OPC's high seas area, usually a hostile environment for tropical cyclones. One of the hurricane discussions issued by CPHC indicated that sea surface temperatures north of Hawaii were unusually high. The cyclone developed maximum sustained winds of 70 kts with gusts to 85 kts near 31N 31N 159W at 1800 UTC on the 13th. Julio then drifted north and weakened to a tropical storm the next day and to a post tropical low at 1800 UTC on the 15th. The cyclone then dissipated near 39N 159W by the 18th.

Other Significant Weather of the Period

Northwest Pacific Storm, March 5-7:

A developing cyclone coming from just south of Japan late on March 4 rapidly intensified while passing east of Japan on the 5th. The central pressure fell an impressive 35 hPa in the twenty-four hour period ending at 0600 March 6th, when the central pressure

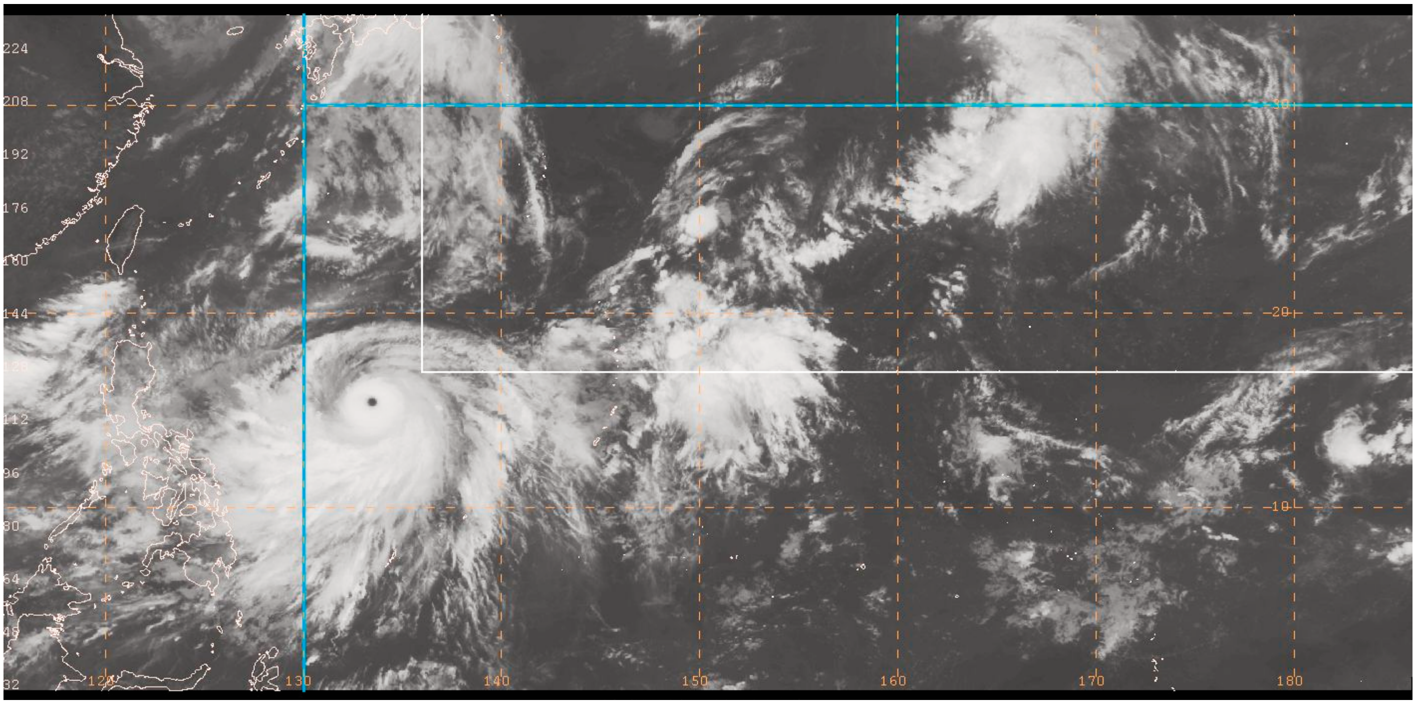

Figure 2. MTSAT2 infrared satellite image valid 0332 UTC August 3, 2014 showing Halong as a super-typhoon about six and one-half days prior to the valid time of the first part of Figure 1. The satellite senses temperature on a scale from white (cold) to black (warm) in this type of imagery. The eye of the typhoon is near 16N 133E, east of the Philippines and well south of Japan.

reached 967 hPa over the central Kurile Islands. The cyclone briefly developed hurricane force winds in the southern Sea of Okhotsk early on the 6th before stalling and weakening. The **Zim Chicago** (A8SI9) near 37N 143E reported south winds 45 kts at 1200 UTC on the 5th. The ship **UGSM** (44N 137E) encountered northwest winds of 50 kts at 0000 UTC on the 7th. The **Ludwigshafen Express** (DILE) reported southeast winds of 55 kts and 6.7 m seas (22 ft) near 45N 151E at 0000 UTC on the 6th.

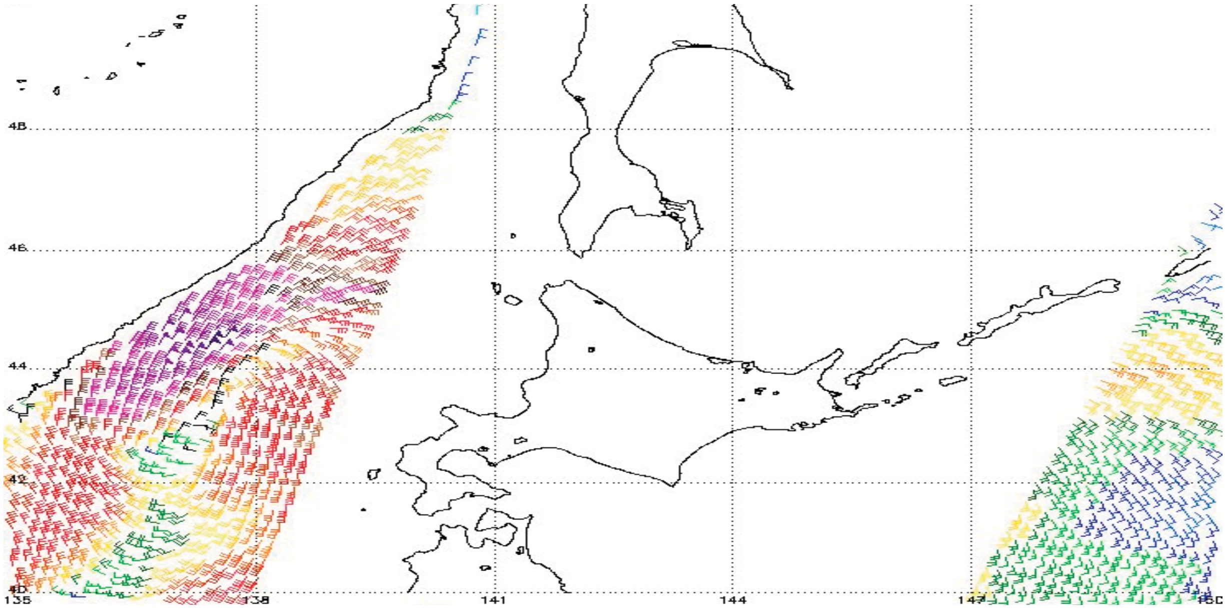

Figure 3. 25-km ASCAT METOP-A (European Advanced Scatterometer) image of satellite-sensed winds around Post-Tropical/ Extratropical Halong in the northern Sea of Japan shown in the second part of Figure 1. The valid time of the pass is 0029 UTC August 11, 2014, or about six and one-half hours later than the valid time of the second part of Figure 1. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

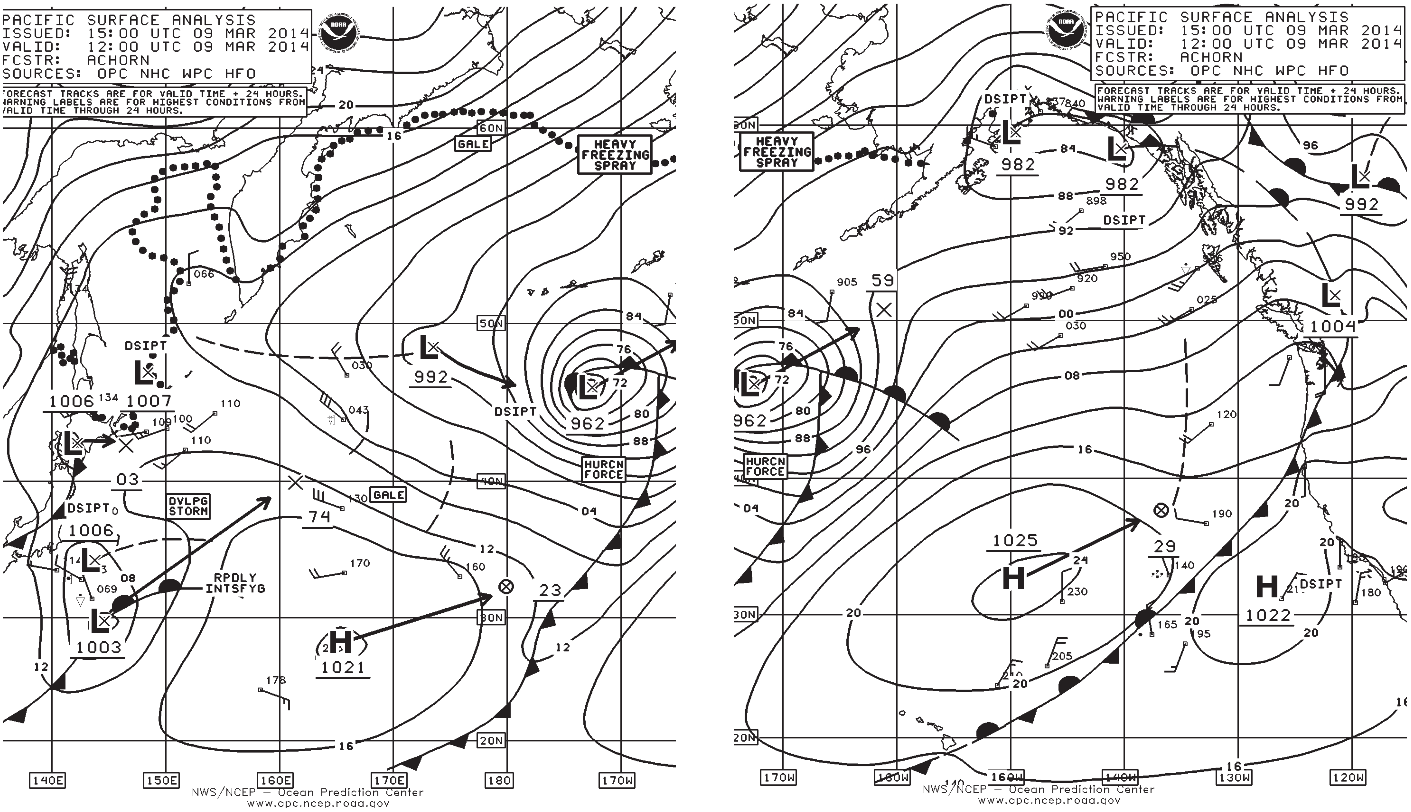

Figure 4. OPC North Pacific Surface Analysis charts (Part 2 – west and Part 1 - east) valid 1200 UTC March 9, 2014. The two parts overlap between 165W and 175W.

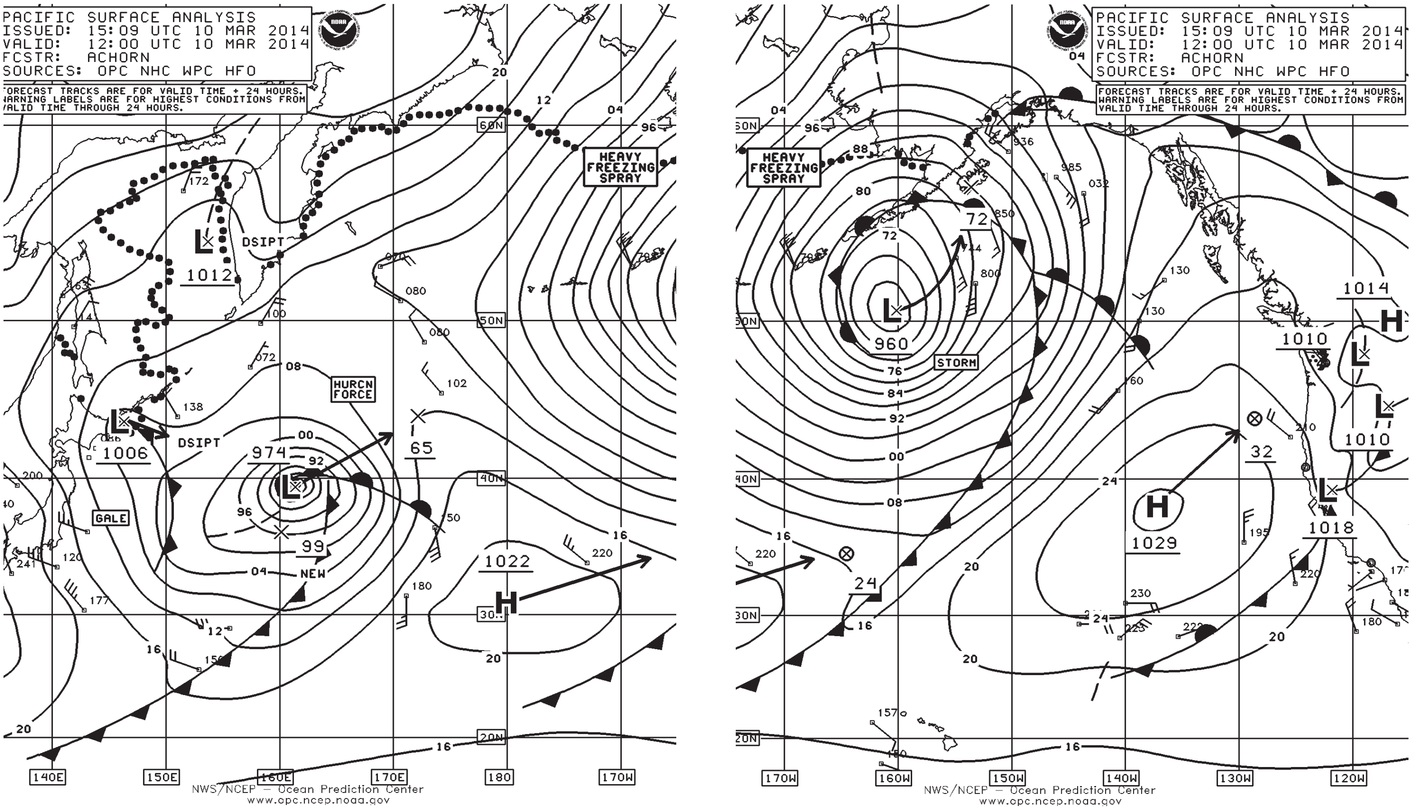

Figure 5. OPC North Pacific Surface Analysis charts (Part 2 – west and Part 1 - east) valid 1200 UTC March 10, 2014. The two parts overlap between 165W and 175W.

North Pacific Storm, March 8-10:

Low pressure forming at the end of a front southeast of Japan at 0600 UTC March 7th moved northeast and rapidly intensified over the central Pacific, resulting in the central Pacific system in **Figure 4**. The central pressure fell 29 hPa in the twenty-four hour period ending at 1800 UTC on the 9th. The lowest central pressure was 958 hPa at 1800 UTC on the 9th, making it the deepest non tropical cyclone of the six month period. The ASCAT image in **Figure 6** reveals a wind maximum of 50 to 60 kts on the south side of the well defined circulation center. The **Antwerpen Express** (DGAF) near 51N 148W reported south winds 50 kts and 9.0 m seas (30 ft) at 0000 UTC on the 11th. **Figure 5** shows the cyclone becoming mature and expanding in size while beginning to weaken. Winds weakened to gale force the next day and then, late on the 12th, moved inland.

North Pacific Storm, March 9-12:

The next hurricane force low is shown developing over the western waters in **Figure 4** and **Figure 5**. The central pressure fell 30 hPa in the twenty-four hour period ending at 1800 UTC on the 10th, but the cyclone attained its lowest central pressure of 965 hPa twenty-four hours later near 45N 178E when top winds were down to storm force. An ASCAT image (**Figure 7**) near the valid time of **Figure 5** shows a more compact cyclone with the highest winds, up to 65 kts, in the northwest semicircle. The system maintained storm force winds until dissipation near 46N 170W at 1800 UTC on the 12th, as a new low formed to its northeast.

North Pacific Storm, March 13-15:

A low pressure system tracked east northeast across the Pacific, starting as a storm force low with a relatively modest pressure of 1001 hPa near 39N 156E at 1200 UTC March 11th. After weakening over the central waters, the cyclone re-intensified east of 170W and developed hurricane force winds on the 14th. The lowest central pressure was 978 hPa near 44N 153W at 1800 UTC on the 14th. An ASCAT (METOP-B) image from 2049 UTC on the 14th revealed a swath of west to northwest winds 50 to 60 kts on the south side of the cyclone, somewhat like **Figure 6** for a larger and more intense event but a smaller area. The **Parana** (ZDNC4) encountered north winds of 45 kts and 8.0 m seas (26 ft) near 48N 154W at 0000 UTC on the 15th. The cyclone subsequently turned toward the northeast and weakened to a gale the next day and moved inland on the 16th.

Western North Pacific Storm, March 20-22:

Low pressure originating over southern Japan, already a gale at 0600 UTC on the 20th moved northeast and rapidly intensified over the next thirty hours. A drop in central pressure of 27 hPa in twenty-four hours led to a lowest central pressure of 962 hPa near 43N 150E at 1200 UTC on the 21st (**Figure 8**). The ASCAT data in **Figure 9** is a partial view of the winds around this cyclone, and it may miss the highest winds. It does show winds of at least 60 kts on the south side of this system. The **Albert Maersk** (OUON2) near 46N 157E reported east winds of 60 kts and 8.8 m seas (29 ft) at 1200 UTC on the 21st.
The **Baltic Cougar** (V7AA2) near 49N 155E encountered northeast winds of 45 kts and 10.7 m seas (35 ft) at 0000 UTC on the 22nd. The cyclone began to weaken late on the 21st and its top winds dropped to gale force late on the next day.

Western North Pacific Storm, March 30-April 2:

Figure 10 depicts the development of the next low moving off Japan, emerging already as a strong system. The second part of **Figure 10** shows the cyclone at maximum intensity. The **Hanjin Vienna** (DIBZ) near 45N 156E reported east winds of 68 kts at 1500 UTC on the 31st. The ship **DGXT2** (43N 149E) reported northwest winds of 50 kts and 10.1 m seas (33 ft) at 0000 UTC April 1st. The ASCAT imagery in **Figure 11** shows a swath of 50-55 kts wind retrievals. With the low bias of ASCAT at high wind speeds and the ship report noted above, this may be a hurricane force event. The cyclone subsequently moved slowly northeast and began to weaken late on May 1st, and reached the central Aleutians by the 3rd as a gale.

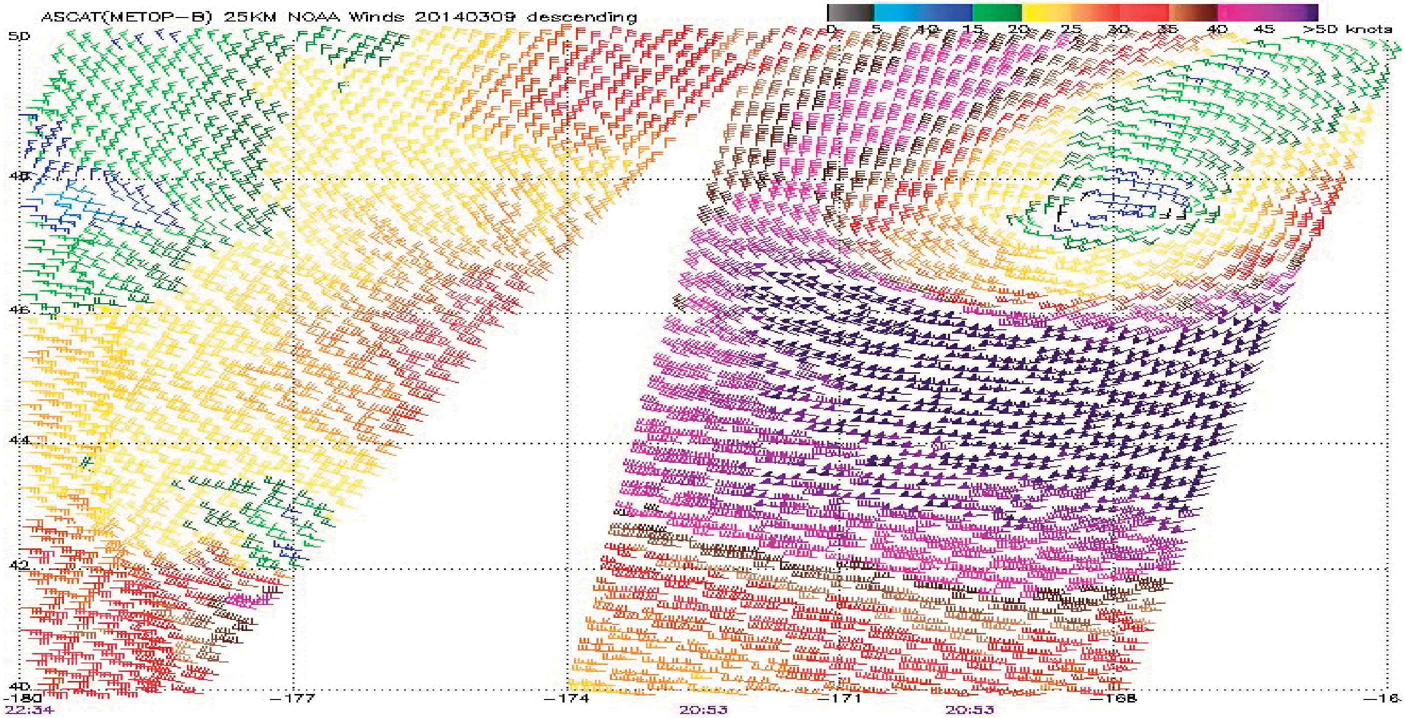

Figure 6. 25-km ASCAT (METOP-B) image of satellite-sensed winds around the hurricane-force low shown in Figure 4. Portions of two passes are shown, with the pass from 2053 UTC March 9, 2014 containing the strongest winds. The valid time of this pass is about nine hours later than the valid time of Figure 4. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

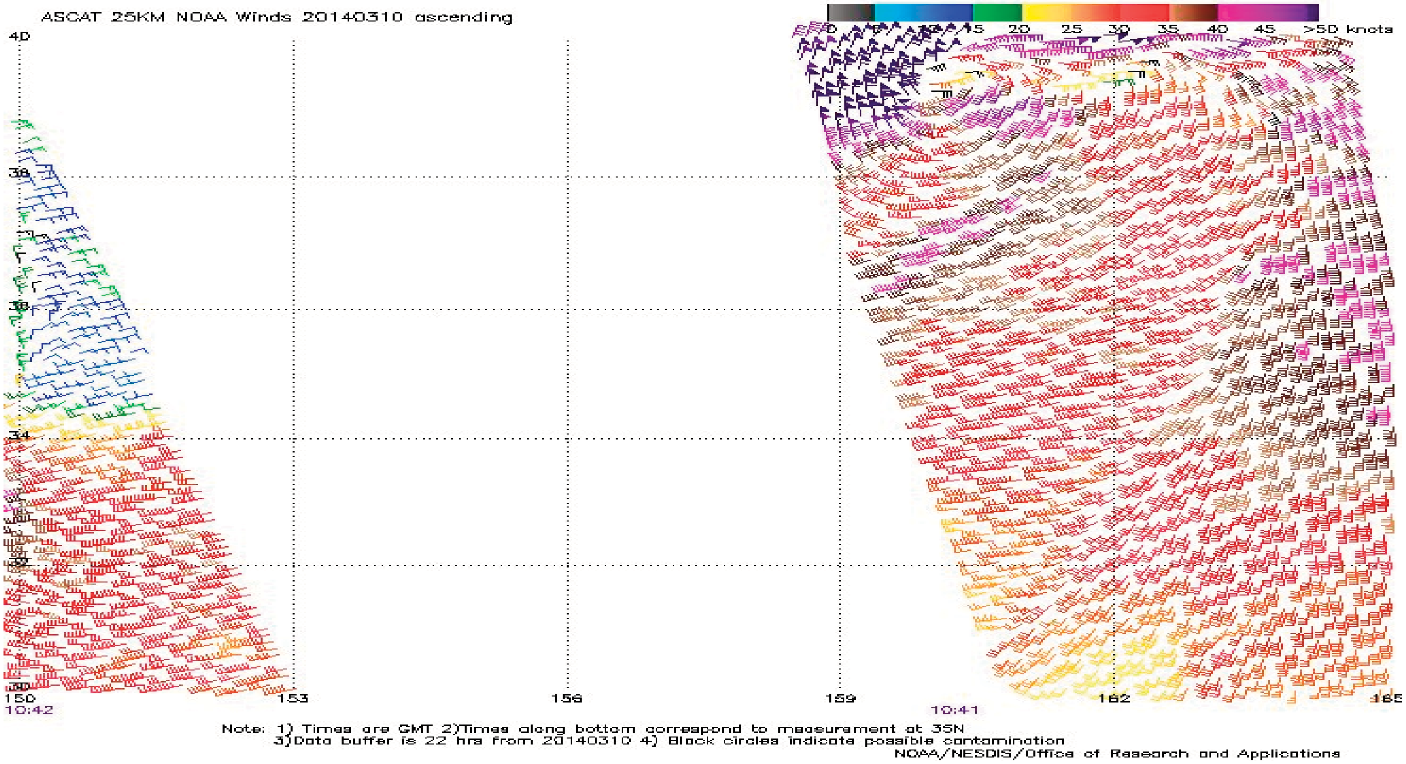

Figure 7. 25-km ASCAT (METOP-A) image of satellite-sensed winds around the hurricane-force low shown in Figure 5. The valid time of the pass is 1041 UTC March 10, 2014, or about one and one-quarter hours prior to the valid time of Figure 5. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

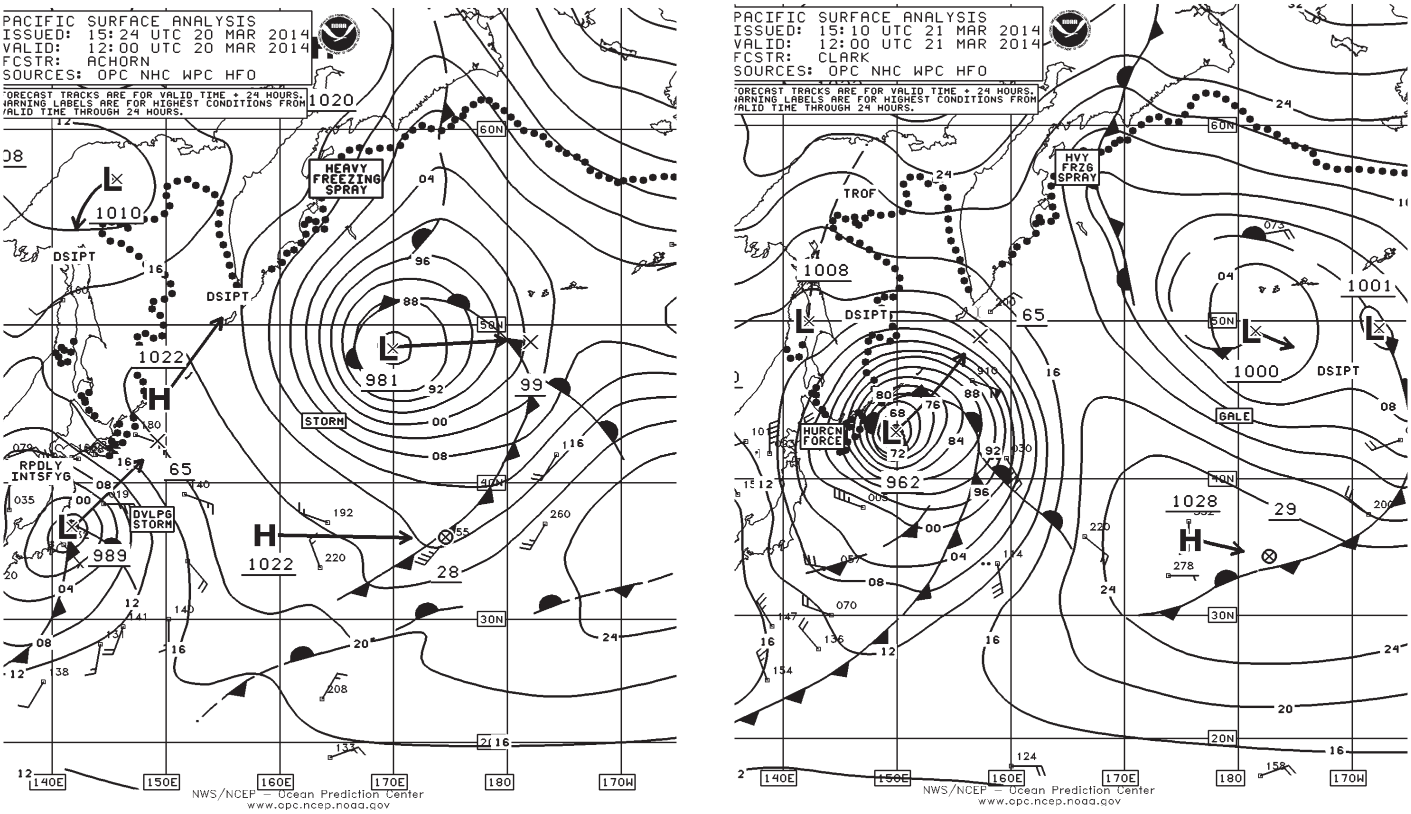

Figure 8. OPC North Pacific Surface Analysis charts (Part 2) valid 1200 UTC March 20 and 21, 2014.

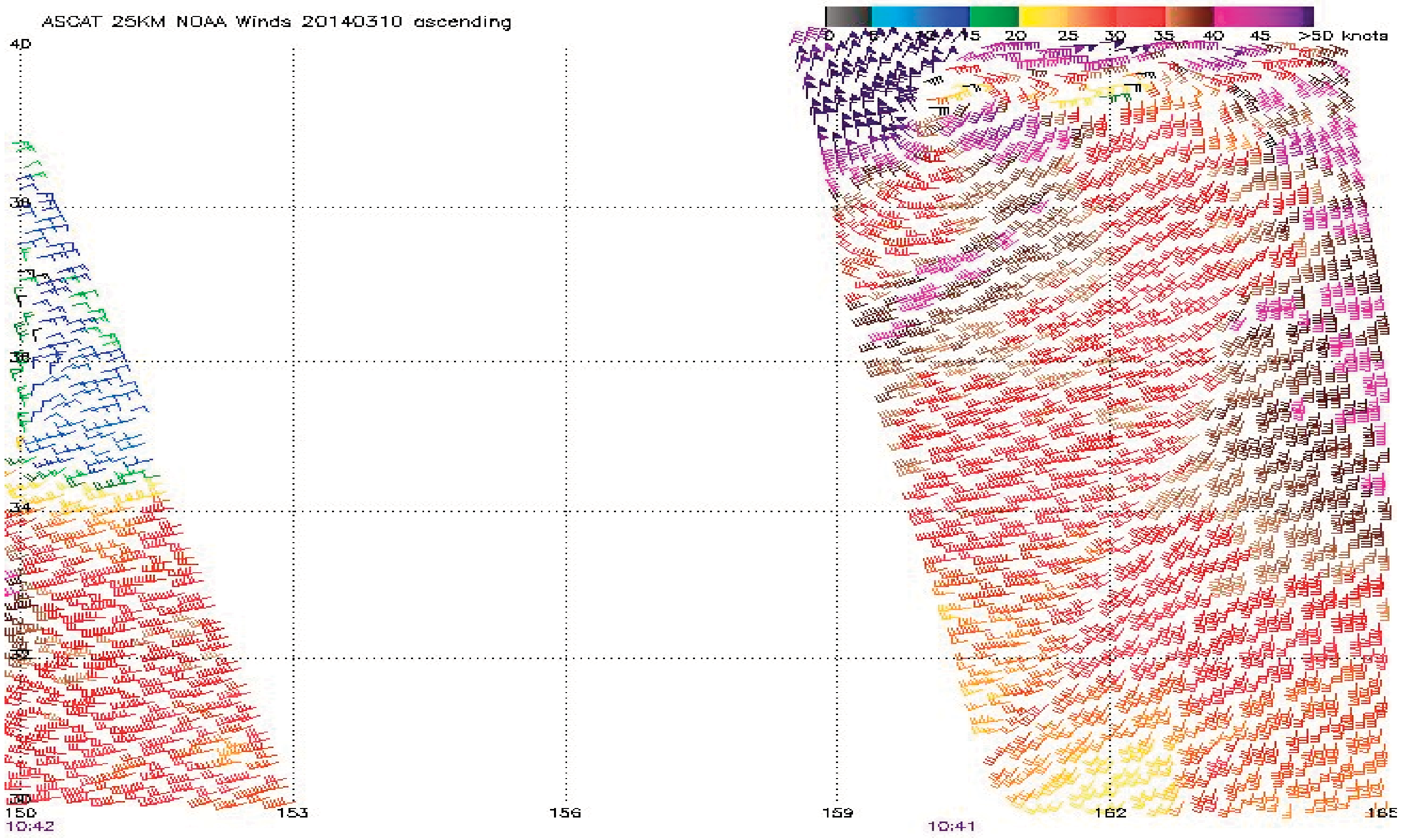

Figure 9. 25-km ASCAT (METOP-A) image of satellite-sensed winds around the eastern semicircle of the hurricane-force low shown in the second part of Figure 8. The valid time of the pass is 1017 UTC March 21, 2014 or about one and three-quarters hours prior to the valid time of the second part of Figure 8. The center of the cyclone is just off the left side of the image. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

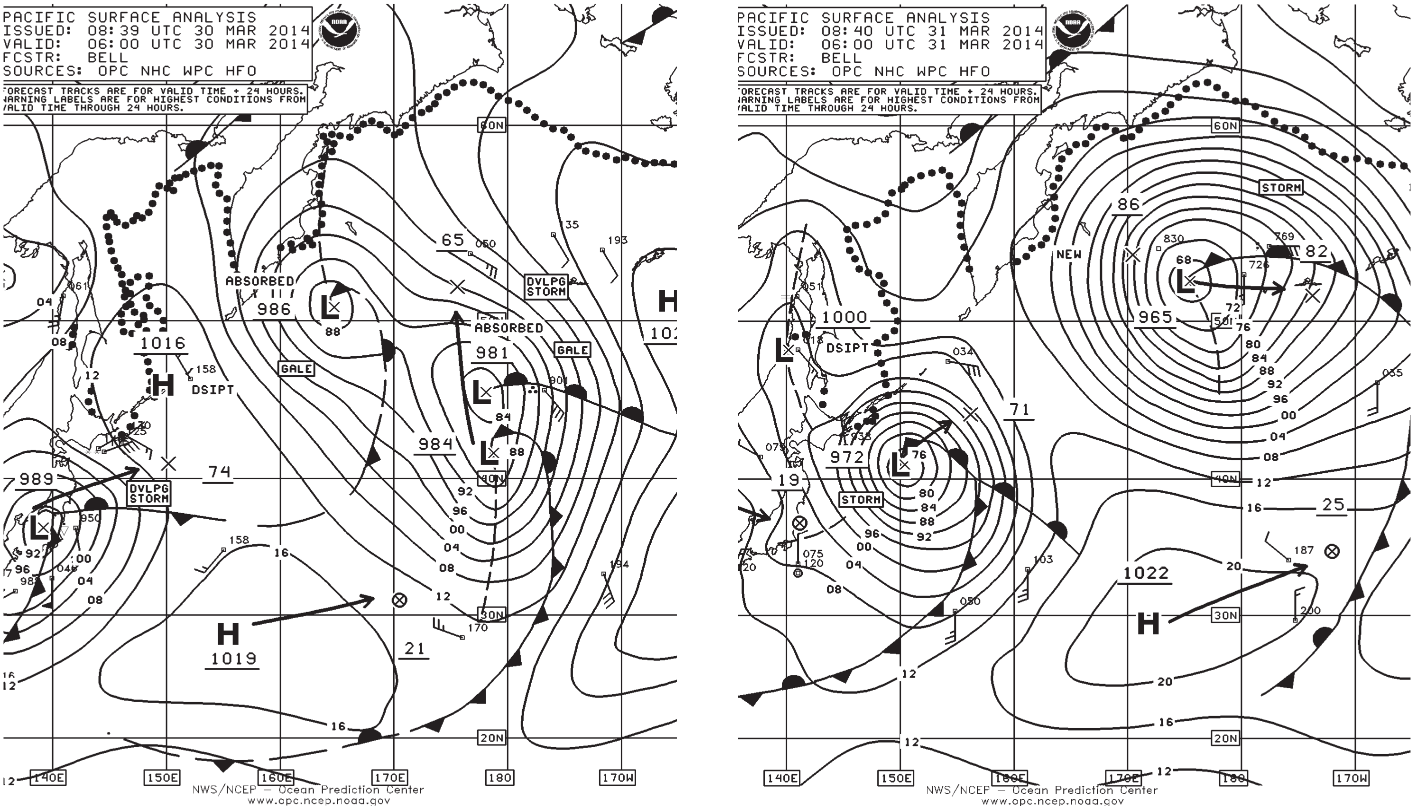

Figure 10. OPC North Pacific Surface Analysis charts (Part 2) valid 0600 UTC March 30 and 31, 2014.

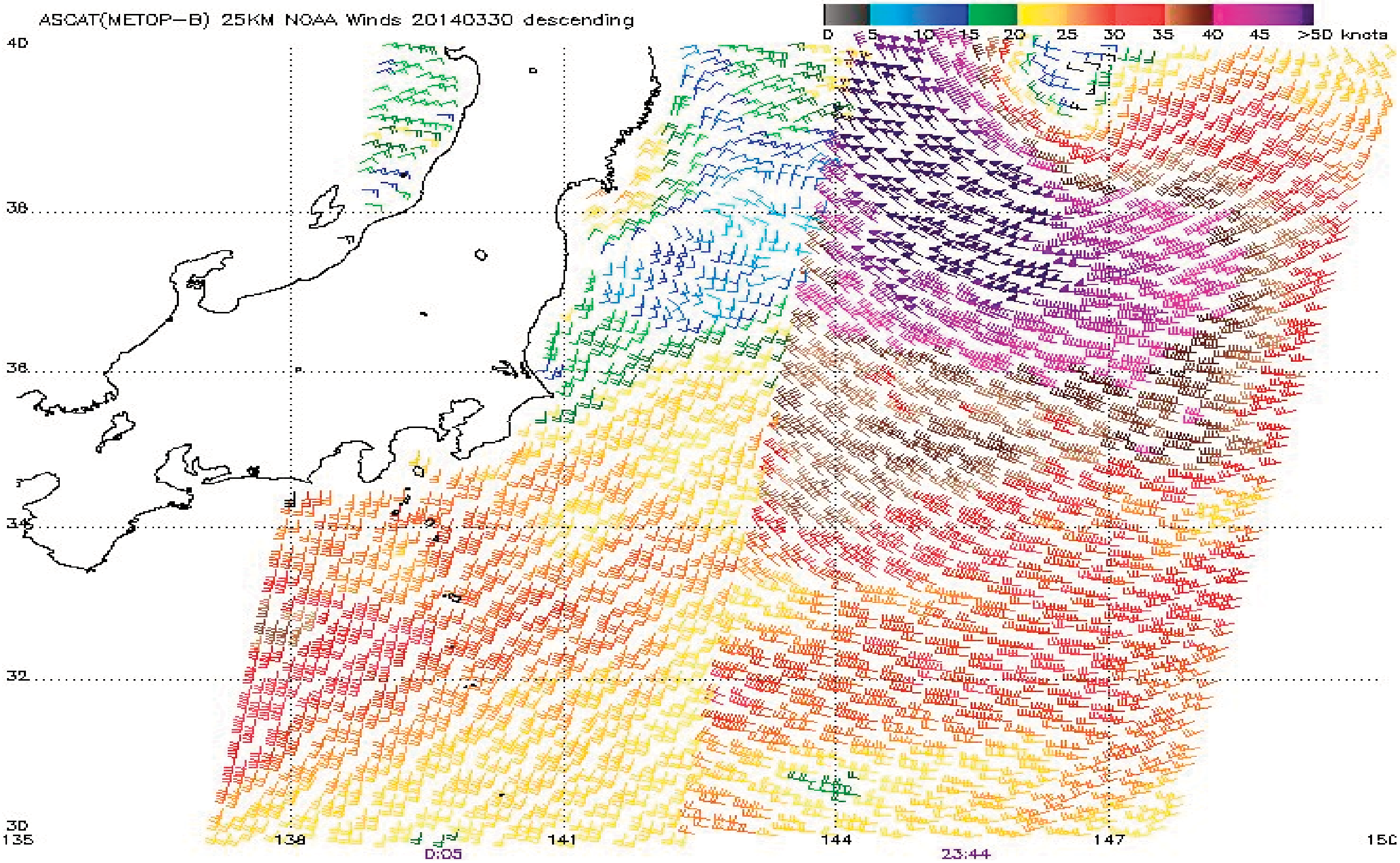

Figure 11. 25-km ASCAT (METOP-B) image of satellite-sensed winds around the south semicircle of the cyclone shown in the second part of Figure 10. Portions of two passes are shown, with the more recent pass (2344 UTC March 30, 2014) containing the highest wind retrievals. The other pass closer to Japan is an older pass, from 0005 UTC March 30. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

Northeastern Pacific Storm, April 17-19:

Figure 12 shows the development of the season's final hurricane force event. The cyclone originated as a weak low south of Japan. It tracked east northeast and developed storm force winds upon crossing 172W. The second part of Figure 12 shows the cyclone at maximum intensity. An ASCAT (METOP-A) pass from 1928 UTC April 18th shows a swath of northwest winds 50 to 55 kts but with a large data gap but is otherwise similar to Figure 11 for the March 30th April 2nd event. This was the last hurricane force low analyzed by OPC during the heavy weather season ending in the spring of 2014. At 0800 UTC on the 18th the **APL Korea** (WCX8883) encountered southwest winds of 49 kts near 40N 154W.
Later, the **Polar Resolution** (WDJK) near 50N 135W reported southeast winds of 45 kts and 8.0 m seas (26 ft) at 0100 UTC on the 19th. Buoy 46036 (48.4N 133.9W) reported southwest winds of 35 kts and 8.0 m seas (26 ft) at 1500 UTC on the 19th, and highest seas 9.8 m (32 ft) seven hours later. The cyclone subsequently turned north into the Gulf of Alaska, stalled and drifted southeast through the 22nd with diminishing winds.

Eastern North Pacific Storm, April 30-May 2:

The storm shown in the second part of Figure 13 formed from the merging of two weak lows west of California. The **Matsonia** (KHRC) near 43N 145W reported northwest winds of 38 kts and 6.7 m seas (22 ft) at 1500 UTC May 2nd. Figure 14 is an ASCAT image of the storm showing a swath of 40 kts or more around the south and southeast sides of the cyclone, where there are most likely to be storm force winds. The system subsequently drifted northeast over the next three days with diminishing winds.

Northwestern Pacific Storm, May 15-16:

A low pressure wave south of Japan rapidly developed as it moved east of Japan toward the Kurile Islands. The lowest central pressure was 968 hPa making it the deepest low in the May to August period. The ASCAT image in Figure 16 shows an area of 35 to 40 kts with a possible isolated 45 kts around the north side of the cyclone. The system subsequently drifted northeast near the Kurile Islands with its top winds diminishing to below gale force late on the 18th.

Western North Pacific Storm, May 20-22:

Another storm force low formed east of Japan in late May as depicted in Figure 17. It was already well developed while still over Japan. The cyclone developed a lowest central pressure of 980 hPa at 0600 UTC May 22nd. A vessel using the **SHIP** call sign reported west winds of 57 kts and 8.2 m seas (27 ft) near 36N 148E at 0300 UTC on the 22nd. The ship **7JDE** (36N 148E) encountered west winds of 50 kts at 0600 UTC on the 22nd. The cyclone subsequently moved slowly east and then northeast and weakened, approaching the western Aleutian Islands by the 25th with winds below gale force.

Northeastern Pacific and Gulf of Alaska Storm, June 16-17:

The storm force low near Kodiak Island in Figure 18 originated as a new low near 44N 170W at 0000 UTC June 15th and was the stronger of two cyclones that tracked northeast into the Gulf of Alaska in the middle of June. The cyclone developed gale force winds on the evening of the 15th near 52N 159W and briefly storm force conditions 0600 UTC on the 17th (Figure 18) when it developed its lowest central pressure. The ship **WDA2760** (60N 148W) reported northeast winds of 50 kts at 0600 UTC on the 17th. The **Oosterdam** (PBKH) near 59N 143W encountered southeast winds of 45 kts five hours prior. Buoy 46061 (60.2N 146.8W) reported east winds of 40 kts with gusts to 51 kts and 5.2 m seas (17 ft) at 0800 UTC on the 17th. The cyclone then stalled and weakened near the Alaskan coast by 1200 UTC on the 18th when top winds dropped to below gale force.

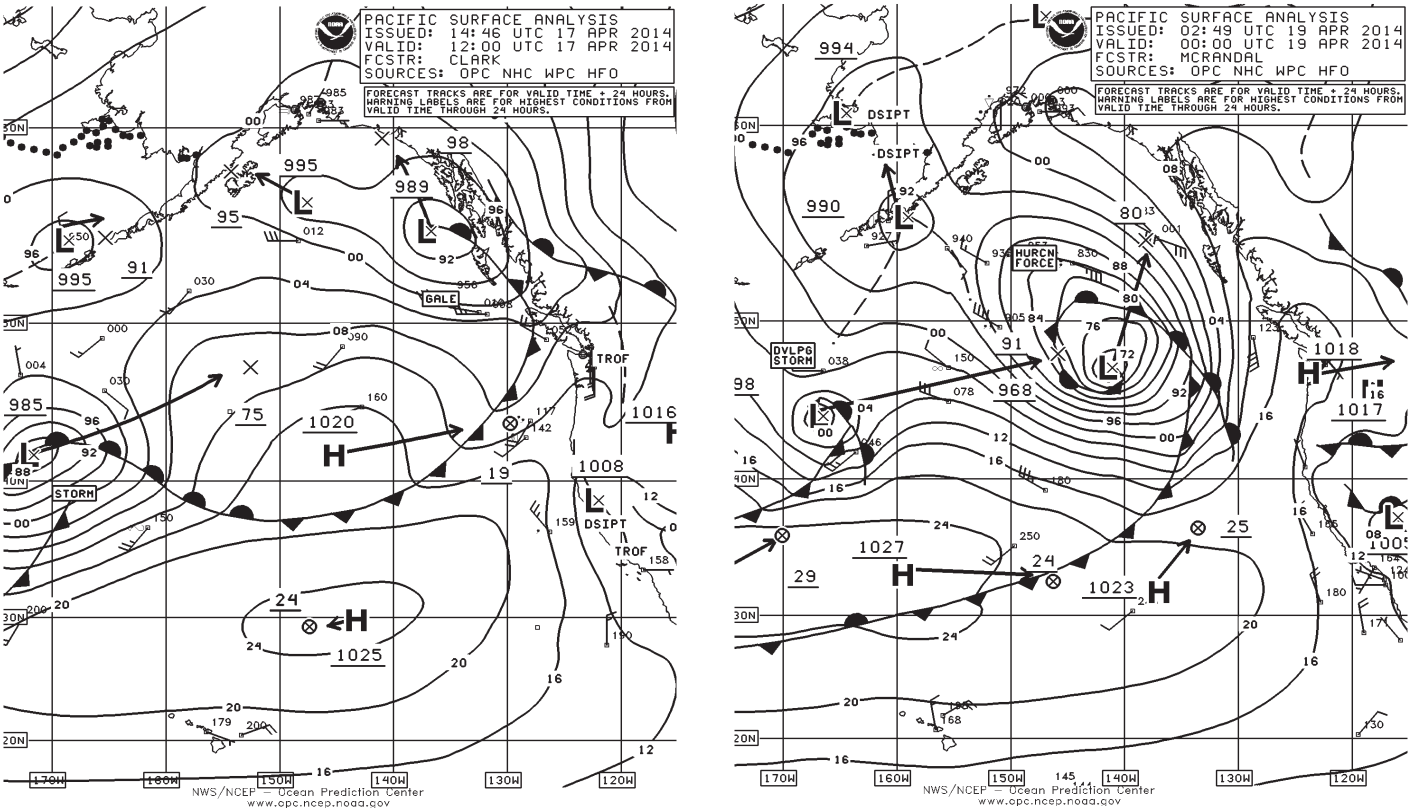

Figure 12. OPC North Pacific Surface Analysis charts (Part 1) valid 1200 UTC April 17 and 0000 UTC April 19, 2014.

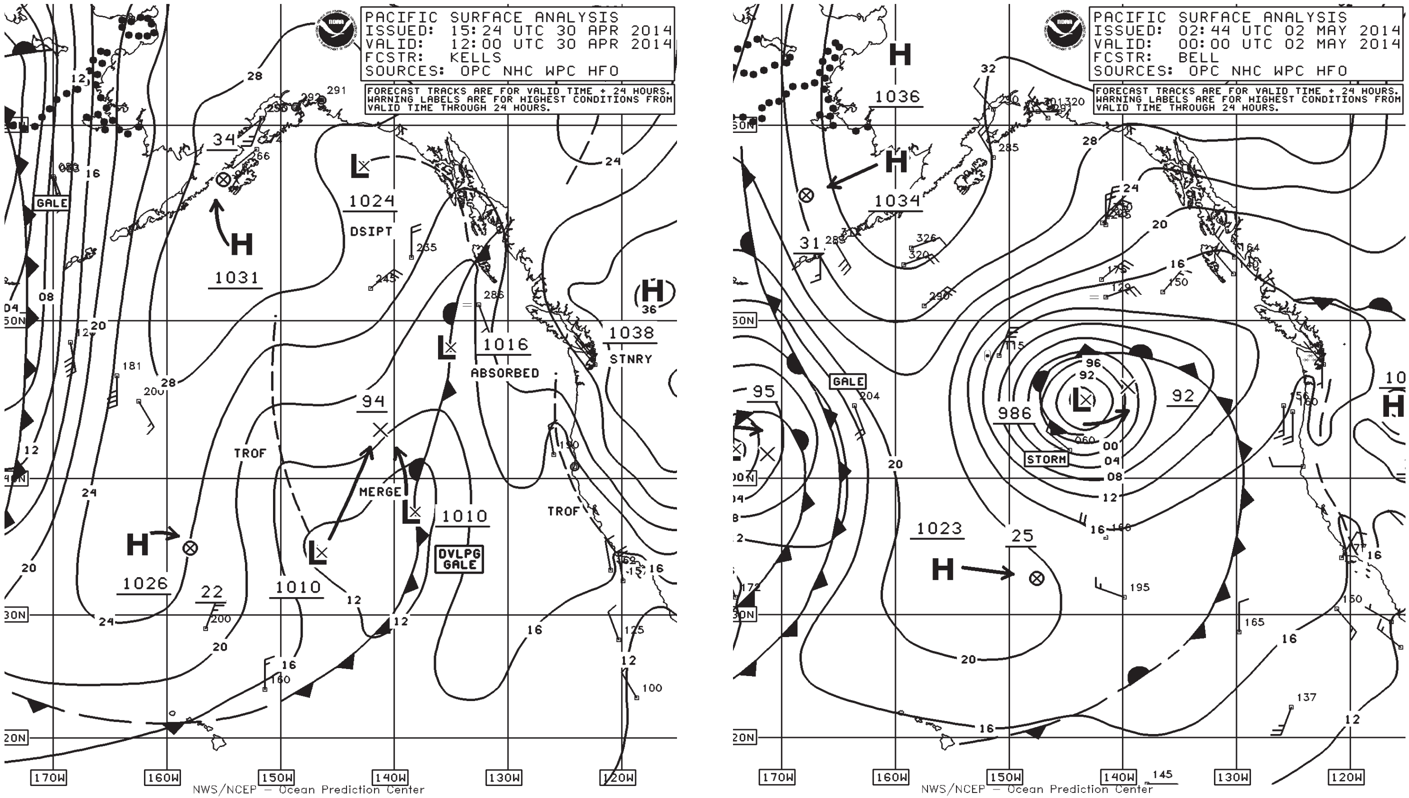

Figure 13. OPC North Pacific Surface Analysis charts (Part 1) valid 1200 UTC April 30 and 0000 UTC May 2, 2014.

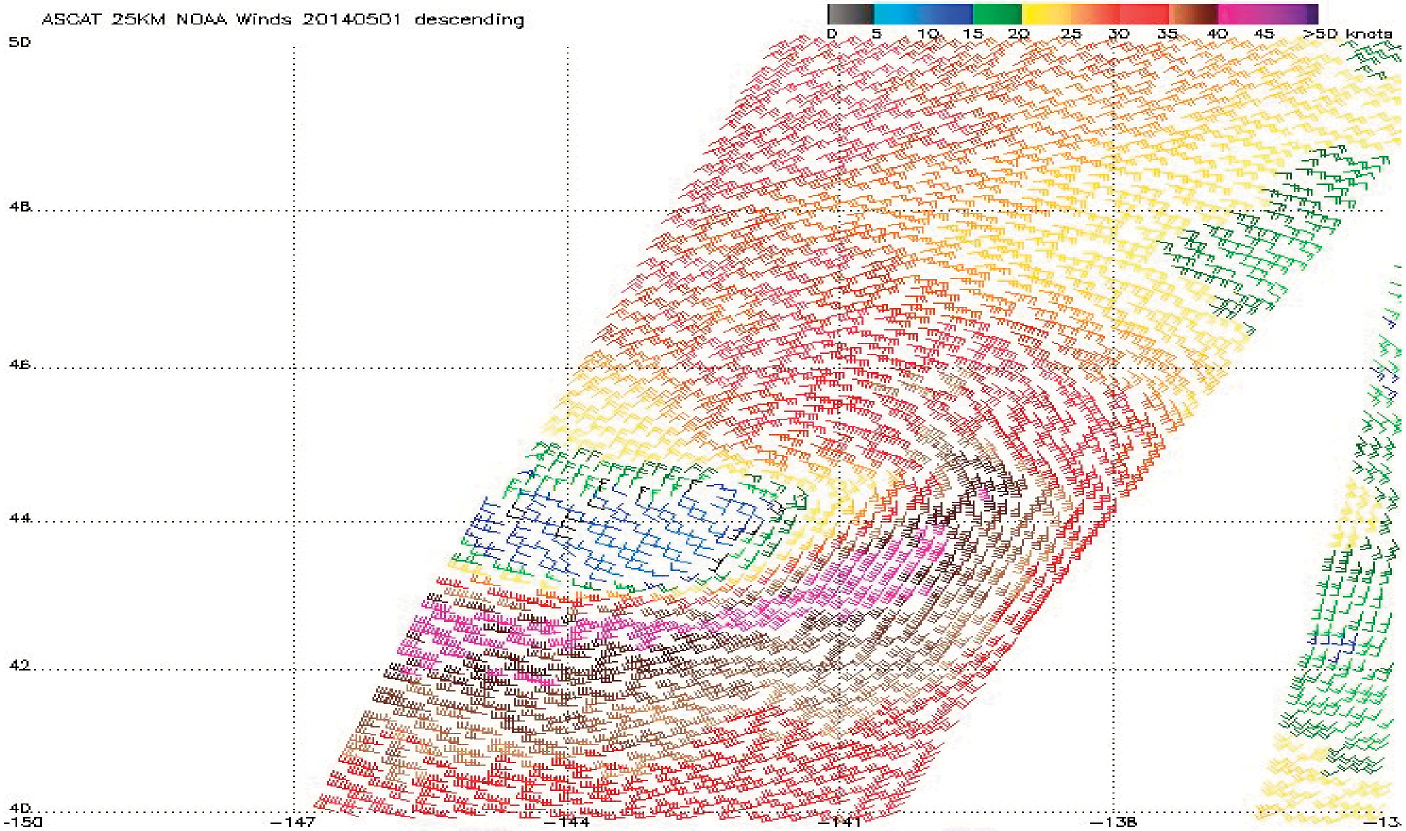

Figure 14. 25-km ASCAT (METOP-A) image of satellite-sensed winds around the eastern side of the storm shown in the second part of Figure 13. The valid time of the pass is 2001 UTC May 1, 2014, or about four hours prior to the valid time of the second part of Figure 13. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

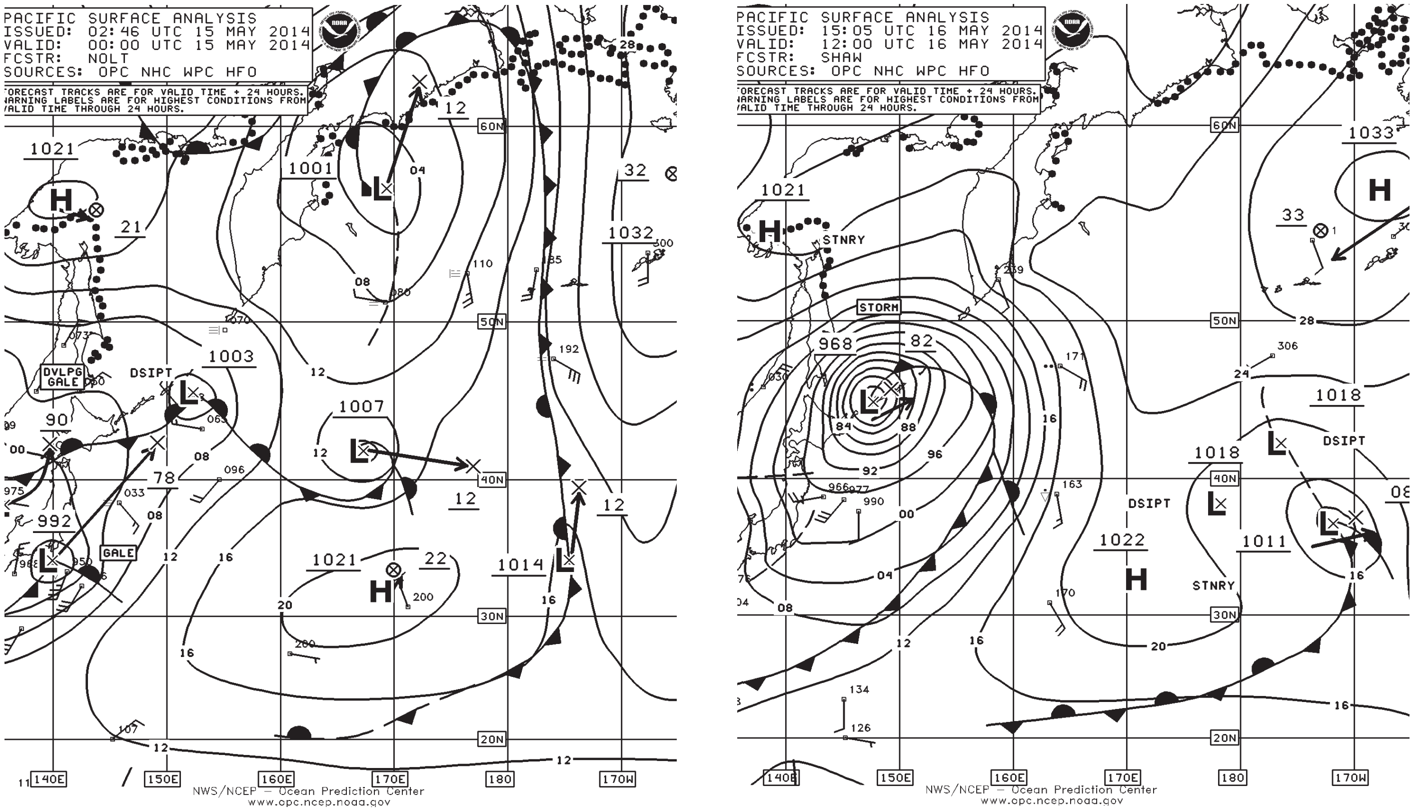

Figure 15. OPC North Pacific Surface Analysis charts (Part 2) valid 0000 UTC May 15 and 1200 UTC May 16, 2014.

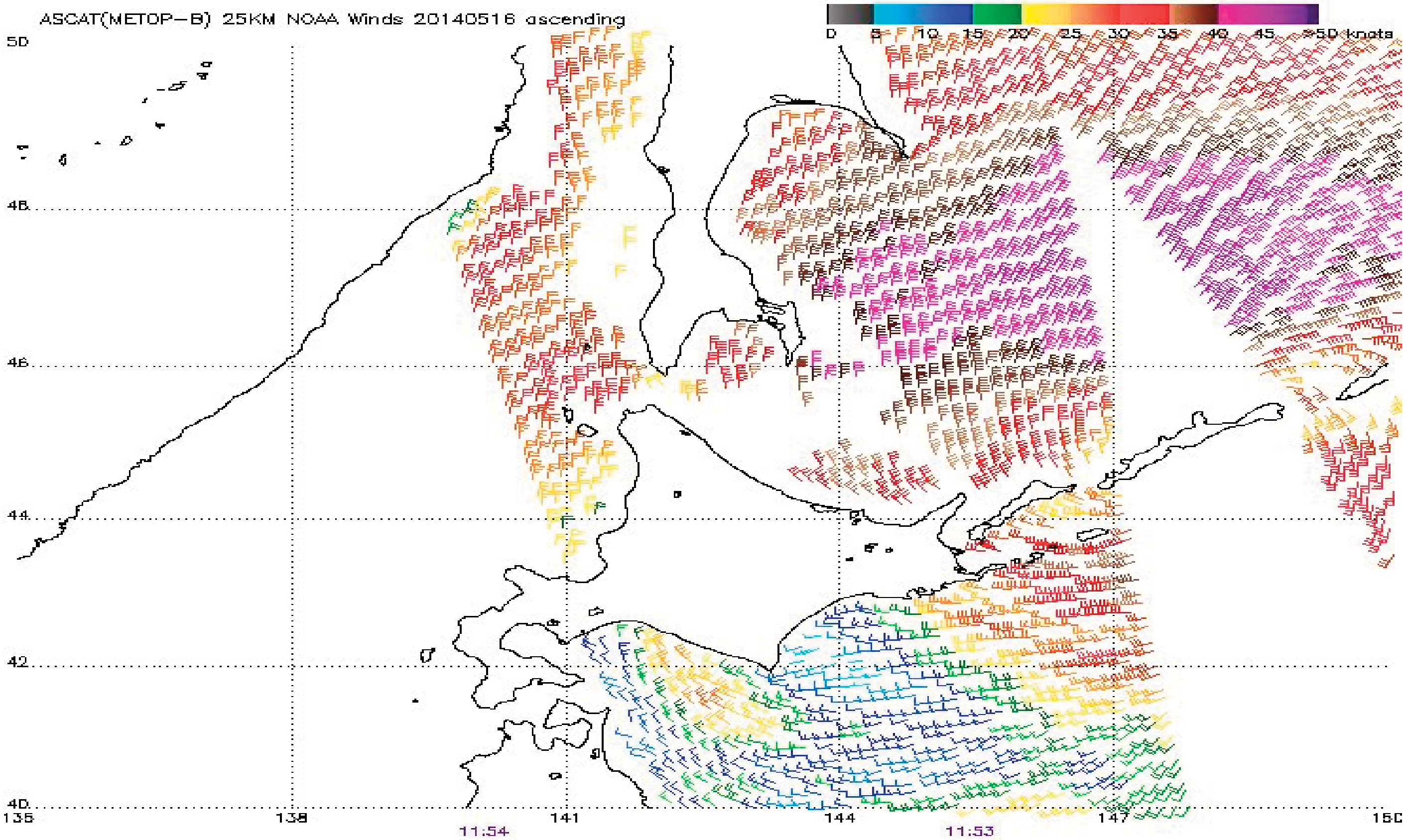

Figure 16. 25-km ASCAT (METOP-B) image of satellite-sensed winds around the storm shown in the second part of Figure 15. The valid time of the pass is 1153 UTC May 16, 2014, approximately the valid time of the second part of Figure 15. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

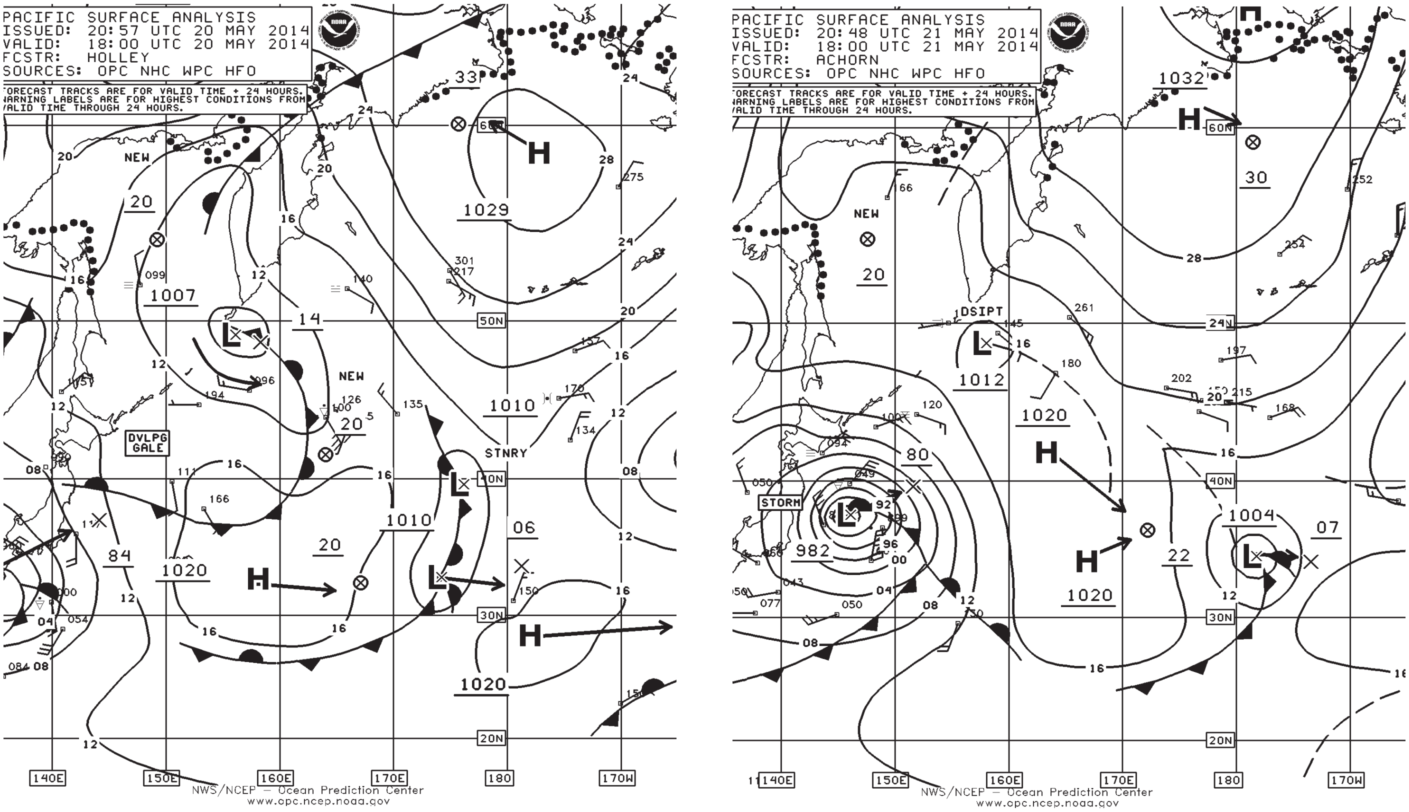

Figure 17. OPC North Pacific Surface Analysis charts (Part 2) valid 1800 UTC May 20 and 21, 2014.

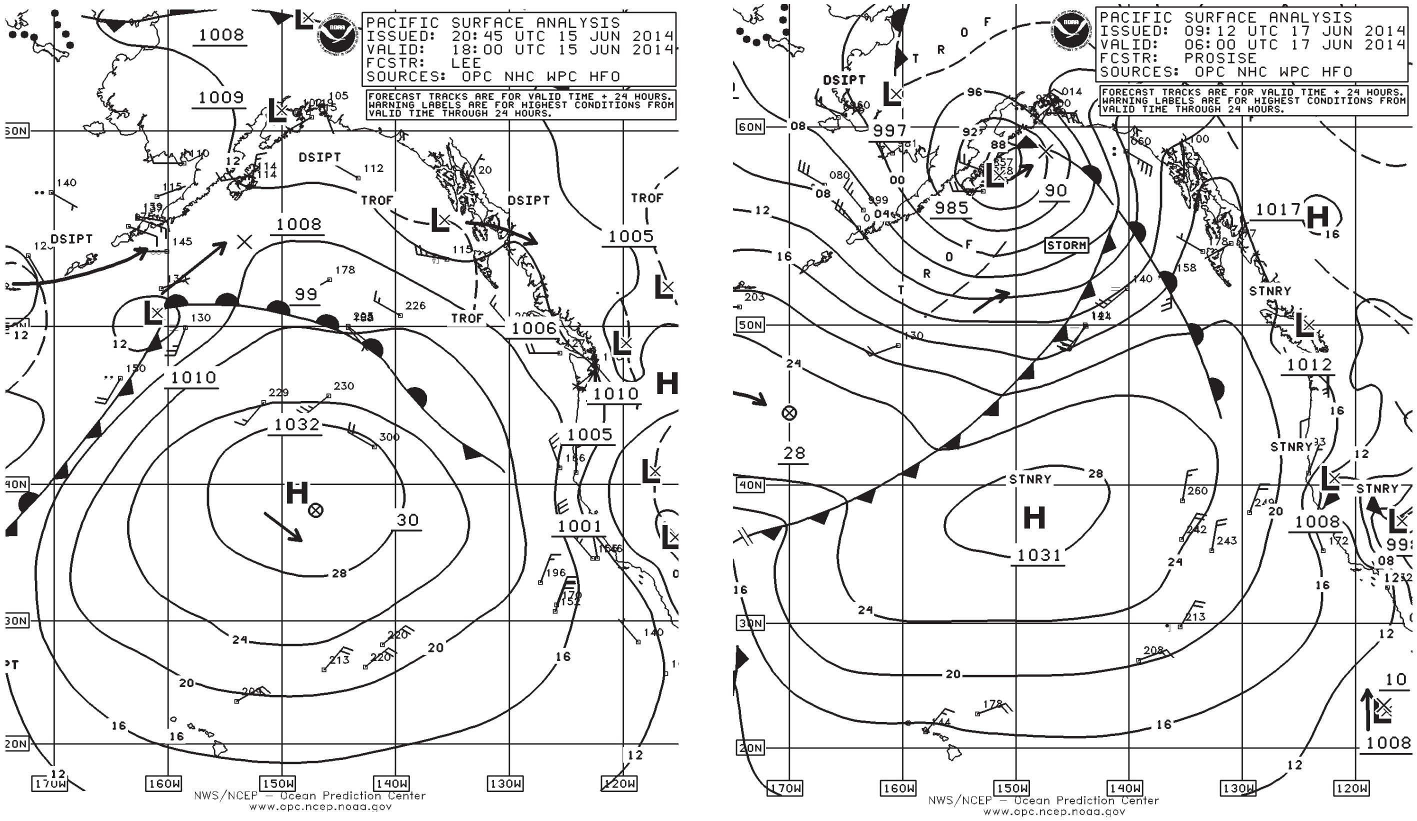

Figure 18. OPC North Pacific Surface Analysis charts (Part 1) valid 1800 UTC June 15 and 0600 UTC June 17, 2014.

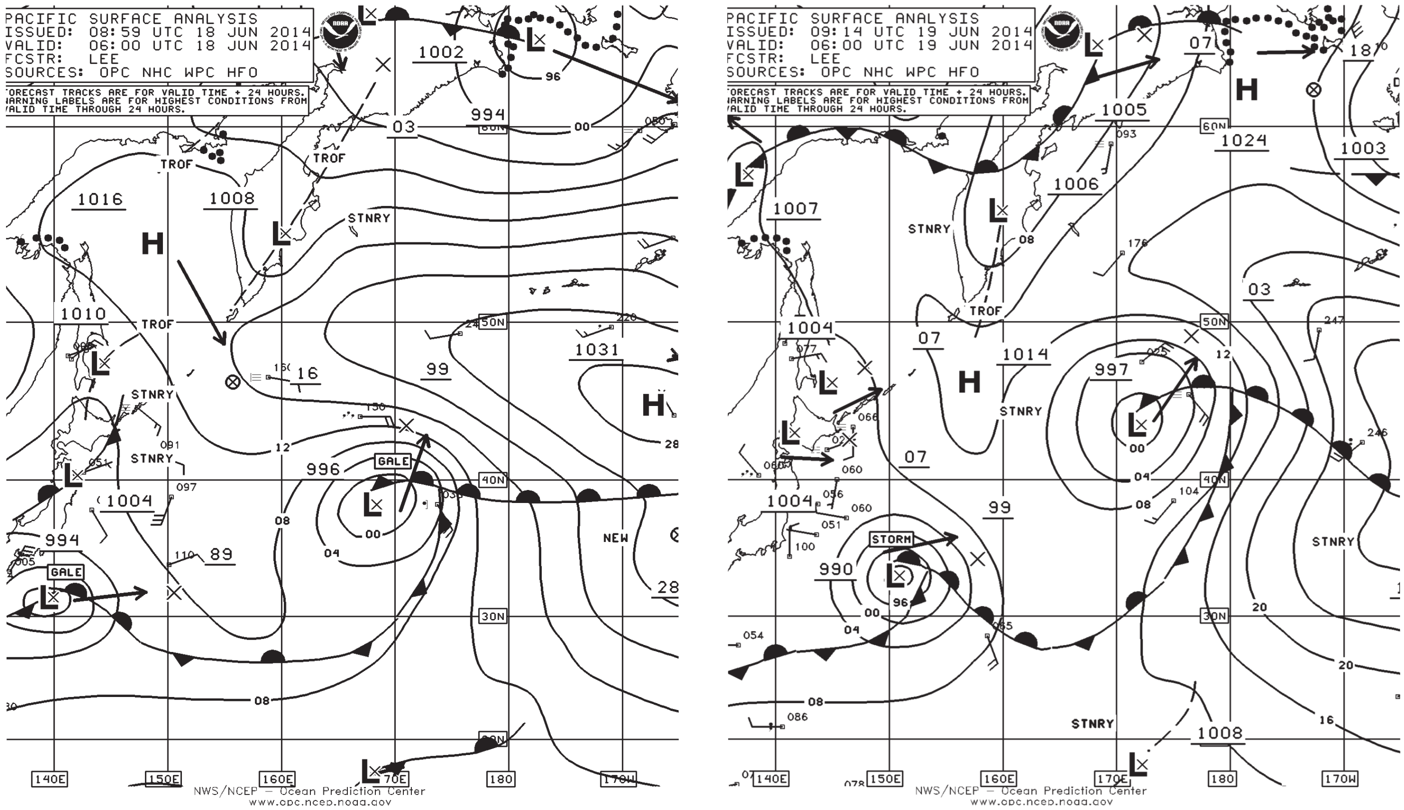

Figure 19. OPC North Pacific Surface Analysis charts (Part 2) valid 0600 UTC June 18 and 19, 2014.

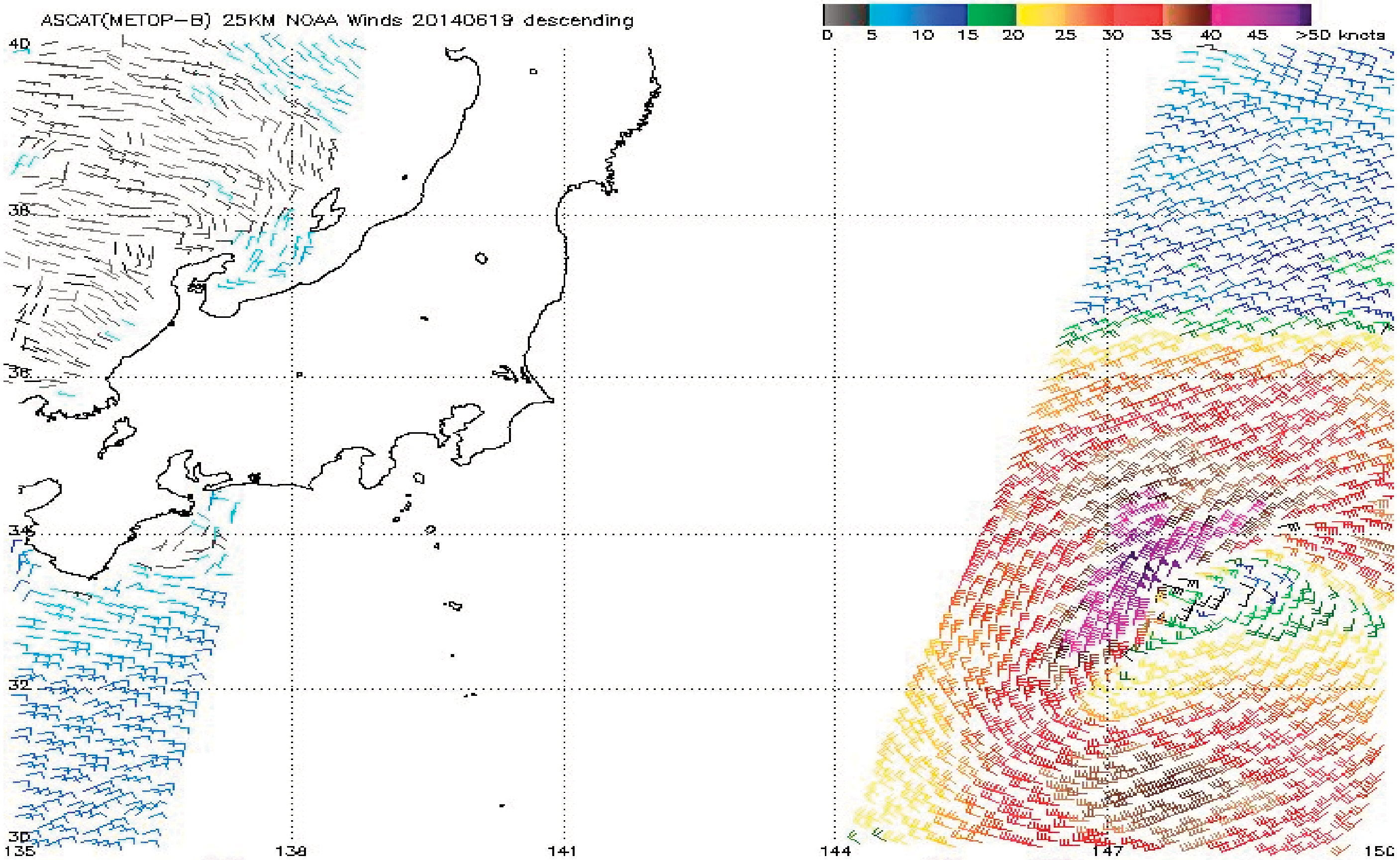

Figure 20. 25-km ASCAT (METOP-B) image of satellite-sensed winds around the storm shown in the second part of Figure 19. The valid time of the pass is 0028 UTC June 19, 2014, or about five and one-half hours prior to the valid time of the second part of Figure 19. Image is courtesy of NOAA/NESDIS/ Center for Satellite Application and Research.

Western North Pacific Storm, June 18-19:

A relatively compact cyclone formed southeast of Japan in the middle of June, where it briefly developed storm force winds (Figure 19). It originated southwest of Japan early on the 17th. The compact circulation of this storm appears in the ASCAT image of Figure 20 with the strongest wind retrievals, up to 50 kts, on the northwest side close to the center. The lowest central pressure was 988 hPa when the center was near 33N 148E at 0000 UTC on the 19th. The cyclone subsequently weakened and turned toward the northeast, with its winds diminishing to below gale force as the center passed near 37N 161E at 1800 UTC on the 20th.

Northeastern Pacific Storm, June 18-20:

A developing low in the eastern waters developed storm force winds while moving from 45N 142W to 49N 132W over the twenty-four hour period ending at 1800 UTC on the 19th, when it briefly developed storm force winds with a compact circulation and a 997 hPa central pressure. The **Polar Enterprise** (WRTF) reported northwest winds of 50 kts near 48N 133W at 1800 UTC on the 19th.
Another ship nearby, **Adrian Maersk** (OXLD2) near 48N 131W), encountered southwest winds of 45 kts and 6.5 m seas (21 ft) at that time. The cyclone then weakened and moved inland over British Columbia early on the 20th.

Northeastern Pacific Storm, June 21-22:

A somewhat stronger eastern Pacific formed later in June, originating as a secondary development on a front associated with an older low to the west, near 48N 150W at 0600 UTC on the 21st. The cyclone moved northeast and developed a lowest central pressure of 992 hPa and storm force winds for a brief period near 53N 137W at 0600 UTC on the 22nd. The **Sofia Express** (DGZT2) near 51N 134W encountered south winds of 45 kts at 0200 UTC on the 22nd. Another vessel, the **Carnival Miracle** (H3VS) near 55N 134W, reported southeast winds of 45 kts and 8.5 m seas (28 ft) at that time. The cyclone subsequently moved north and then stalled and weakened in the Gulf of Alaska later on the 22nd and the 23rd.

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

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*.

4. Saffir-Simpson Scale of Hurricane Intensity: **http://www.nhc.noaa.gov/aboutsshws.php**

5. Tropical Cyclone Reports, 2014, National Hurricane Center, **http://www.nhc.noaa.gov/data/tcr/index.php?season=2014&basin=atl** ⚓

Tropical Atlantic and Tropical East Pacific Areas

May through August 2014

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National Hurricane Center, Miami, Florida
NOAA National Center for Environmental Prediction

Atlantic Ocean including the Caribbean Sea and the Gulf of Mexico

There were six non-tropical cyclone gale events that occurred between 1 May and 31 August, 2014 in the area of high seas forecast responsibility (7N to 31N, west of 35W including the Caribbean Sea and Gulf of Mexico) of the National Hurricane Center's (NHC) Tropical Analysis and Forecast Branch (TAFB). This was relatively quiet compared to the average activity of the last 5-10 years for the May through August period, but busier in the Caribbean Sea compared to last year.

Table 1. Non-tropical cyclone warnings issued for the subtropical and tropical Atlantic Ocean, including the Gulf of Mexico and Caribbean Sea between 1 May and 31 August 2014.

Onset	Region	Peak Wind Speed	Gale Duration	Weather Forcing
12 UTC 14 May	Gulf of Mexico	35 kts	30h	Cold Front
06 UTC 13 Jun	Caribbean Sea	35 kts	12h	Pressure Gradient
06 UTC 25 Jun	Caribbean Sea	35 kts	12h	Pressure Gradient
06 UTC 09 Jul	Caribbean Sea	35 kts	12h	Pressure Gradient
06 UTC 22 Jul	Caribbean Sea	35 kts	30h	Pressure Gradient
18 UTC 21 Aug	SW N Atlantic	35 kts	24h	Low Pressure

Gulf of Mexico Gale Warning:

The gale event with the longest duration during this time period occurred from 14 to 15 May in the Gulf of Mexico behind an unusually strong late season cold front. The cold front moved over the warm Gulf of Mexico sea surface temperatures (SST) followed by cold air advection as strong high pressure anchored by a 1029 hPa high over northern Mexico built southward across the region. The cold front reached from a 1014 hPa low over southeast Louisiana to inland Mexico just south of Veracruz Mexico at 1200 UTC 14 May (**Figure 1**- National Weather Service Unified Surface Analysis (USA) map from 1200 UTC 14 May showing cold front across the western Gulf of Mexico with gale conditions observed to the northwest of the front).

A gale warning was issued at 1200 UTC 14 May for areas behind the front as the cold air advection over the warm sea surface temperatures led to boundary layer instability resulting in NW to N gale force winds in the range of 25 to 35 kts. (**Figure 2** - METOP-A Advanced Scatterometer (ASCAT) wind retrieval at 1534 UTC 14 May. Note the solid area of minimal gale force winds (red color) over the far western Gulf surrounded by a large area of 20 to 30 kts winds). The high pressure weakened throughout the remainder of the 14th, and into the next day of May 15 allowing the tight pressure gradient behind the front to slacken. As a consequence, the winds diminished to below gale threshold by 1800 UTC on 15 May.

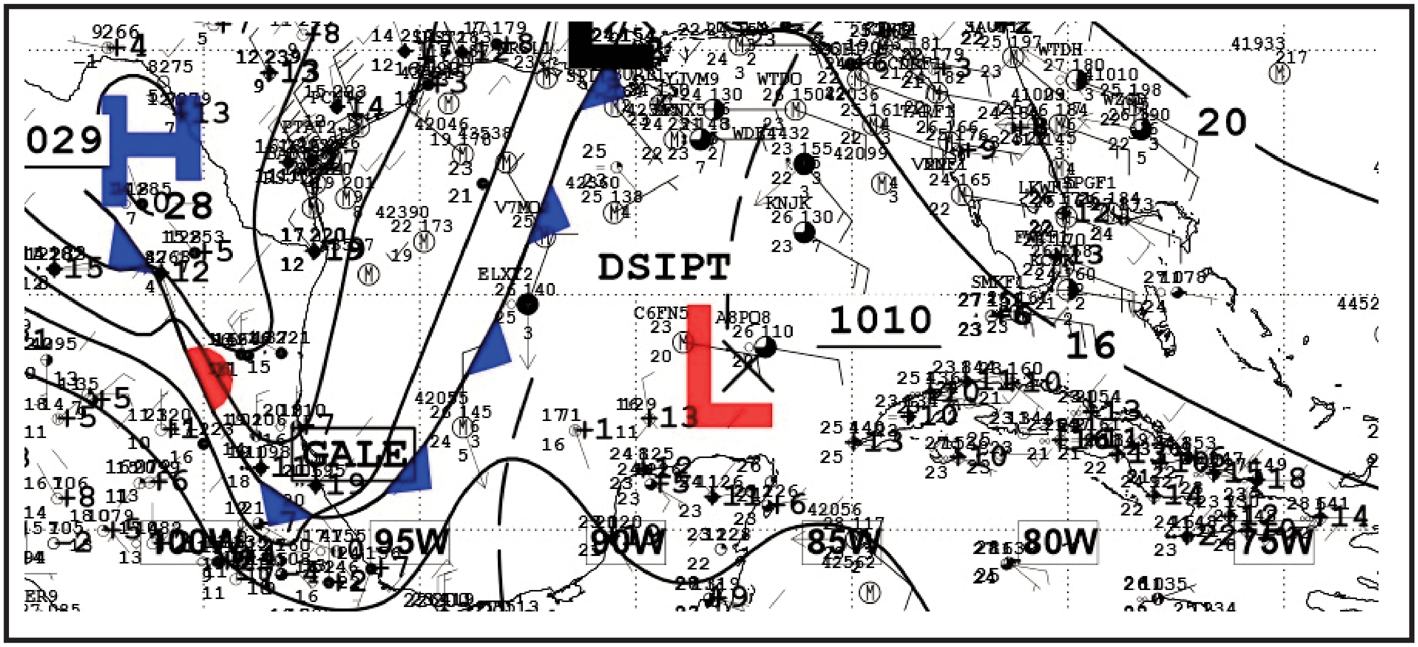


Figure 1. National Weather Service Unified Surface Analysis (USA) map vaild 1200 UTC 14 May showing cold front across the western Gulf of Mexico with gale conditions observed to the northwest of the front.

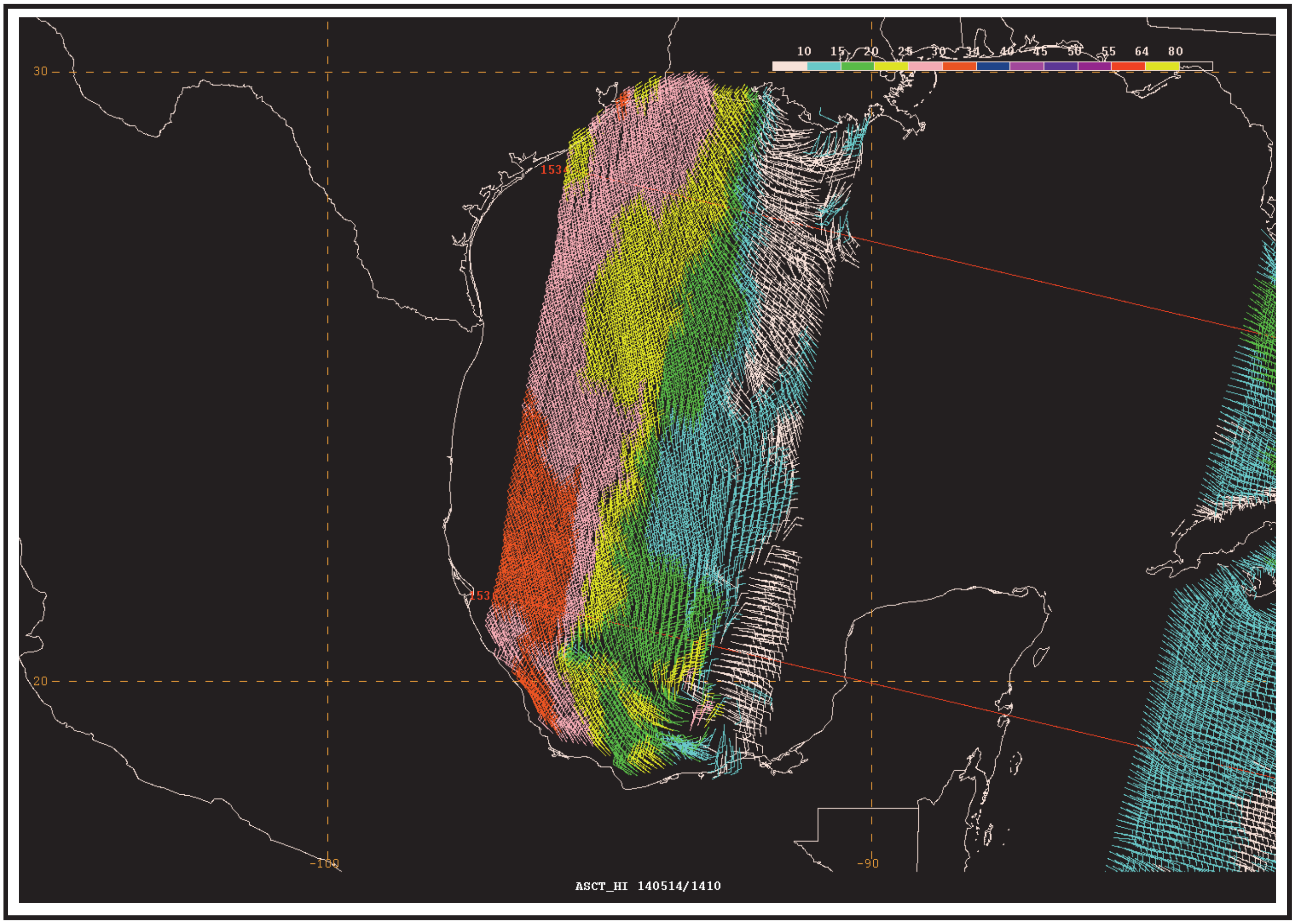


Figure 2. METOP-A Advanced Scatterometer (ASCAT) wind retrieval valid at 1410 UTC 14 May 2014. Note the solid area of gale force 30 to 35 kts winds (red color) over the far western Gulf.

Pre-Cristobal Gale Event:

A tropical wave was analyzed near 65W with low pressure of 1009 hPa just northeast of Puerto Rico and the Virgin Islands near 19N65W at 1200 UTC 22 Aug (**Figure 3** - Composite image of surface analysis valid 1200 UTC 22 August with an ASCAT pass from 1410 UTC the same day. Note the area of 25 to 30 kts winds with a small embedded swath of 30 to 35 kts, in red, in the northeast quadrant of the low). A tight pressure gradient between these features and a surface ridge to their north roughly along 28N produced an area of east to southeast 30 to 35 kts winds within 90 nm of the low center in the northeast quadrant. Cruise ship **ALLURE OF THE SEAS** (call sign C6XS8) reported northeast winds near 35 kts just northwest of the low at 1800 UTC on 22 August, while the ship **TROPIC TIDE** (call sign J8AZ3) reported similar winds from the east to southeast at the same time (**Figure 4** - National Weather Service USA map from 1800 UTC August 22). This system was eventually classified as Tropical Depression Four on 23 August.

Caribbean Gale Events:

There were four gale events in the Southwest Caribbean Sea with the longest duration occurring from 0600 UTC 22 July to 1200 UTC 23 July in the favorable climatological area of strongest trade winds found in the southwest sector of the Caribbean Sea south of 14N to the coasts of Colombia and northwestern Venezuela. This particular event was confined to between 72W and 75W. The tight pressure gradient between a subtropical ridge to the north over the Atlantic and low pressure across the Colombian basin initiated NE to E 30 to 35 kts winds with seas to 12 ft across the region. An observation from the HAZMAT ship **MAERSK NITEROI** (call sign VRFW5) located near the coast of Colombia reported northeast winds of 35 kts at 0600 UTC 22 July. This observation was used to verify the gale warning in effect. (**Figure 5** – National Weather Service USA map from 0600 UTC 22 July. Note the tight pressure gradient over the SW Caribbean Sea and **MAERSK NITEROI** (call sign VRFW5) reporting NE 35 kts winds near the coast of Colombia).

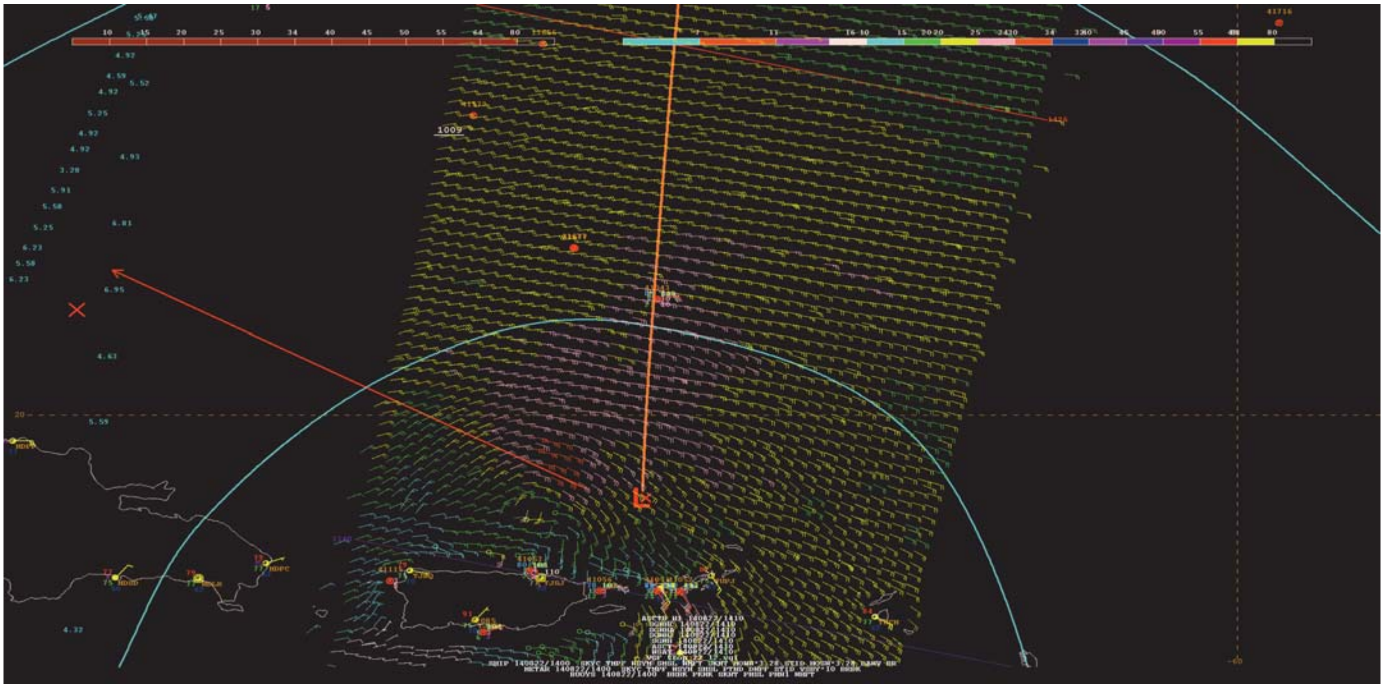


Figure 3. Composite image of surface analysis valid 1200 UTC 22 Aug. 2014 with an ASCAT pass from 1410 UTC the same day. Note the area of 25-30 kts winds with a small embedded swath of 30 to 35 kts (in red) in the northeast quadrant of the low.

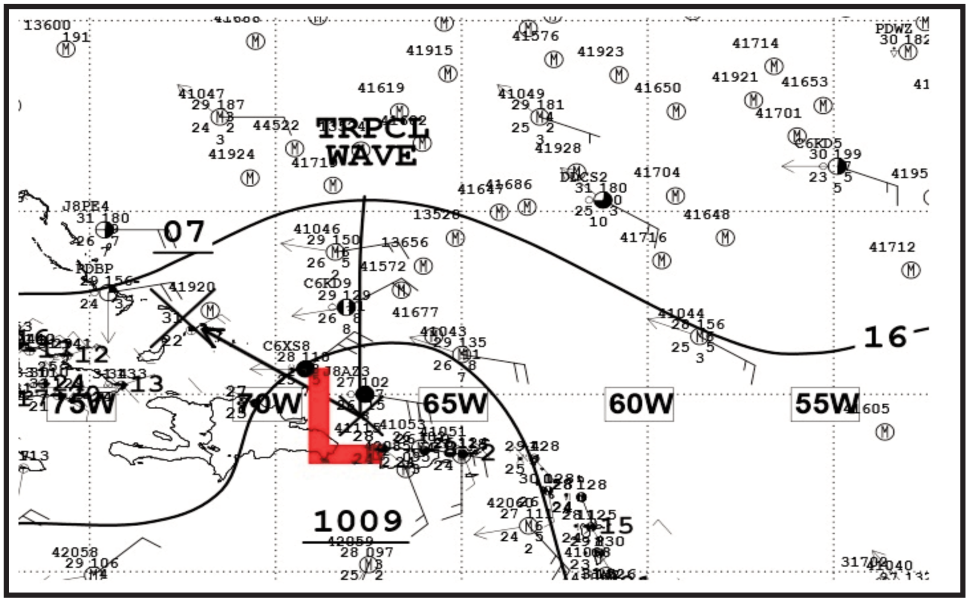


Figure 4 . National Weather Service USA map from 1800 UTC 22 Aug 2014.

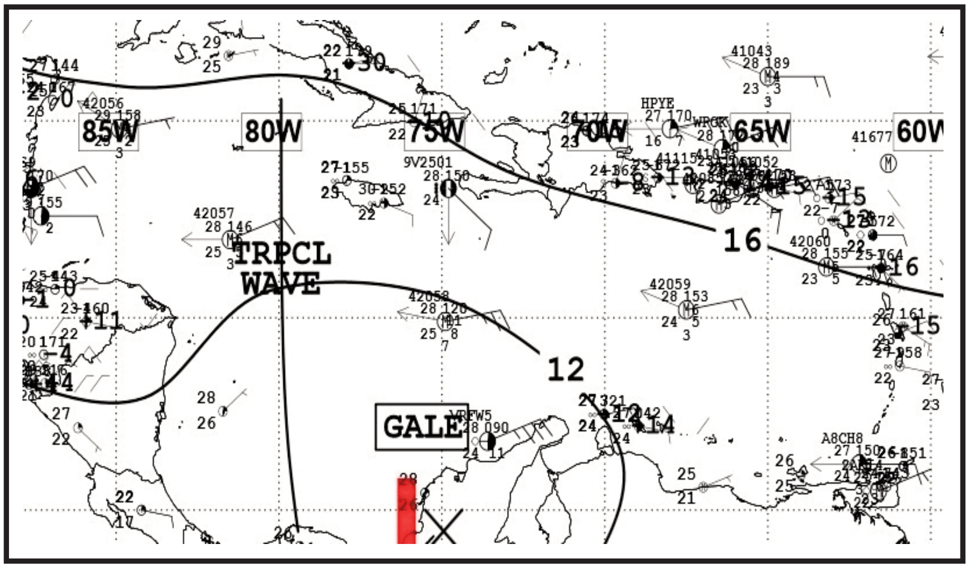


Figure 5. National Weather Service USA map from 0600 UTC Jul 22. Note the tight pressure gradient over the SW Caribbean Sea and ship "VRFW5" reporting NE 35 kts winds near the coast of Colombia.

Winds diminished to below gale force just after 1200 UTC on 23 July as the tight pressure gradient weakened. The remaining gale events in the May to August period occurred under a similar synoptic scale pattern. These events were of 12 hour duration with one beginning on 13 June at 0600 UTC and lasting to 1800 UTC that same day. Similarly, the remaining two began on 25 June at 0600 UTC and at 0600 UTC on 09 Jul. (Figure 6 - Advanced Scatterometer (ASCAT) wind retrieval at 0208 UTC 09 Jul 2014 with minimal gale force winds in the SW Caribbean Sea).

Eastern North Pacific Ocean:

Three significant warning events not associated with tropical cyclones were documented primarily by scatterometer data in the May through August 2014 time period. Table 2 provides details on these gale wind events.

Table 2. Non-tropical cyclone warnings issued for the subtropical and tropical eastern North Pacific between 1 May and 31 August 2014.

Onset	Region	Peak Wind Speed	Gale Duration	Weather Forcing
1800 UTC 03 May	Gulf of Tehuantepec	40 kts	18h	Pressure Gradient
1500 UTC 14 May	Gulf of Tehuantepec	45 kts	75h	Pressure Gradient
1200 UTC 13 Jul	Gulf of Tehuantepec	35 kts	3h	Pressure Gradient

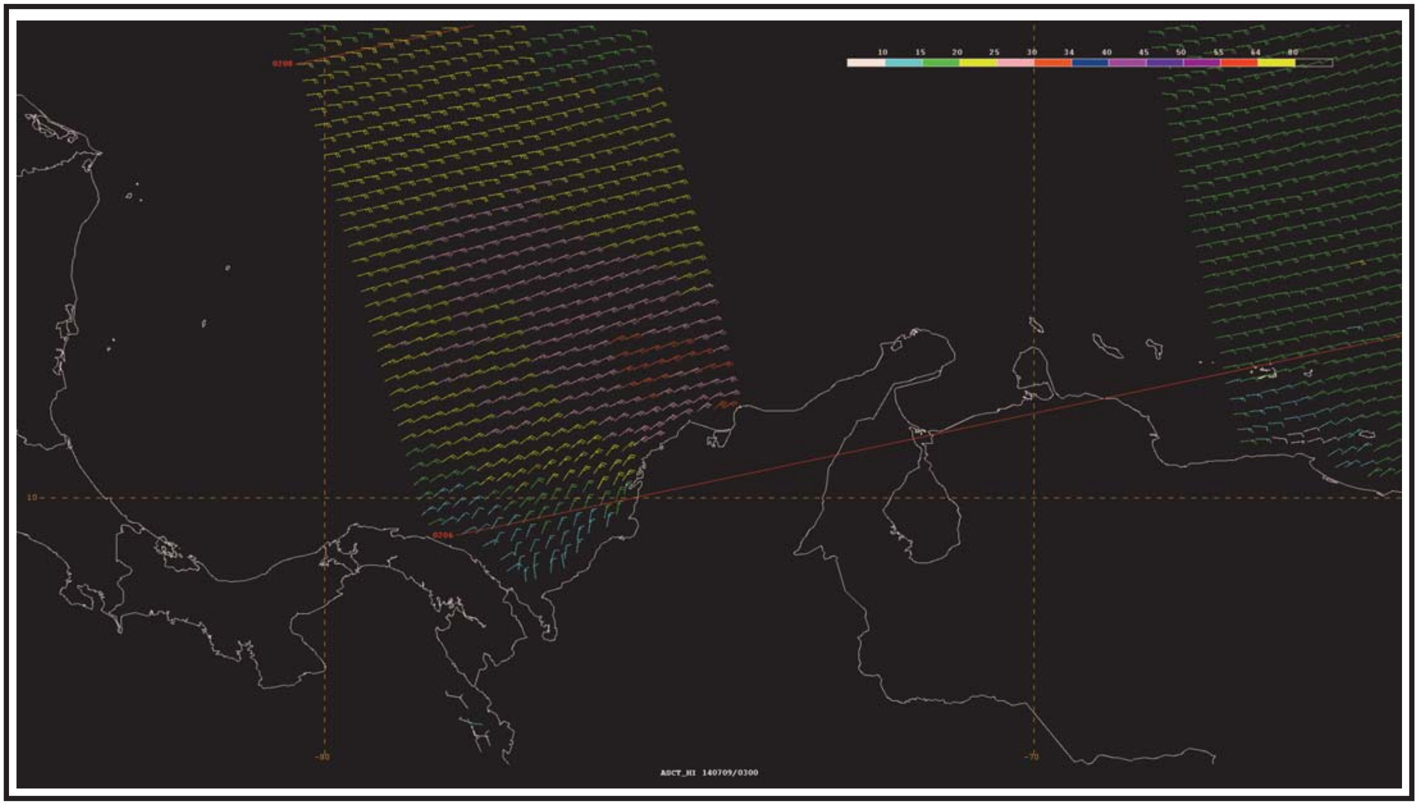
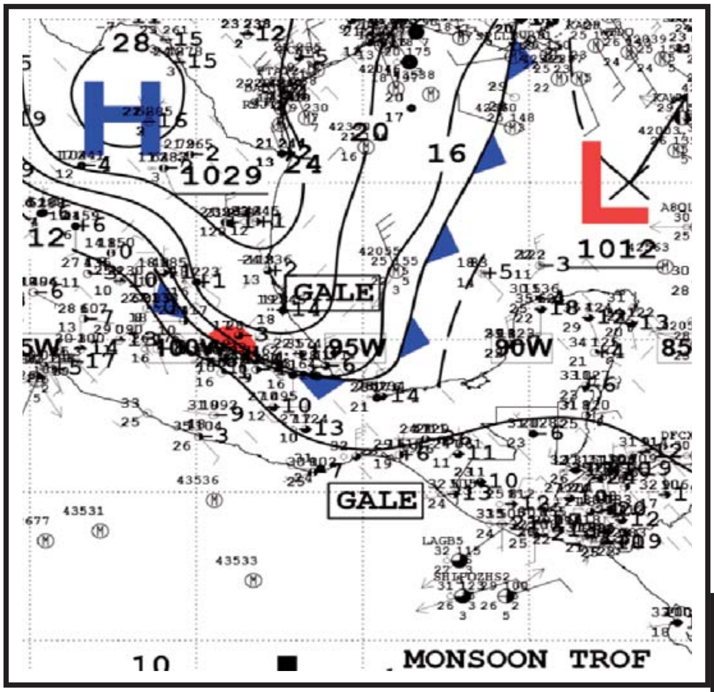
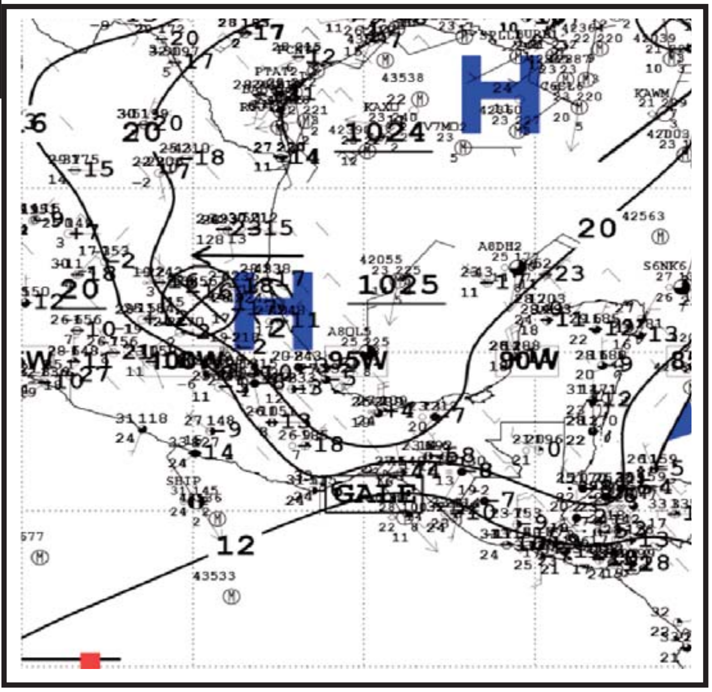


Figure 6. Advanced Scatterometer (ASCAT) wind retrieval at 0208 UTC 09 Jul 2014 with gale force winds in the SW Caribbean Sea.

Gale warnings were issued for two circulations which were subsequently upgraded to tropical storms six hours later, ELIDA at 0600 UTC June 30, and FAUSTO a week later at 1800 UTC July 7. The first half of May was an extension of an unusually strong winter and early spring season in 2013-14, which was the most active for gale and storm force gap wind events in the Gulf of Tehuantepec ever recorded. There were a total of thirty-three Gulf of Tehuantepec high wind events this season, which shattered the previous record of twenty-four which occurred in the 2003-04 and 2011-12 seasons. Late season Gulf of Tehuantepec wind events are typically initiated by strong northerly winds behind a cold front across the western Gulf of Mexico. This strong flow advects cold air southward, and funneling effects are most pronounced across the Isthmus of Tehuantepec. This was the case for both gale warnings issued for the Gulf of Tehuantepec in May 2014. The more significant of these two events commenced around 1500 UTC May 14. It was significant for three reasons. First, it occurred much later than usual, more than two weeks after the climatological end of the Gulf of Tehuantepec high wind season in late April. Second, it was also very intense, with maximum winds approaching storm force. This is rare for a late season. Lastly, it was of unusually long duration, with scatterometer data showing winds exceeding gale force for more than three days. Strong high pressure behind a cold front reaching the Bay of Campeche in the Gulf of Mexico and a broad monsoon trough across the eastern North Pacific produced a tight pressure gradient across southern Mexico resulting in gale force northerly winds, both in the southern Gulf of Mexico early on the morning of May 14, then later that day in the Gulf of Tehuantepec. (**Figure 7**). High pressure behind the front persisted over southern Mexico through the evening of May 16 (**Figure 8**) before slowly shifting eastward and weakening. As a result, a very tight pressure gradient remained across the Tehuantepec region for several days, supporting gale force winds from 1500 UTC on May 14 until finally coming to an end at 1800 UTC May 17.



(Left): Figure 7. National Weather Service Unified Surface Analysis (USA) chart from 1800 UTC 14 May 2014, centered on southern Mexico and Central America. A strong high pressure ridge extending southeast from a 1029 hPa high in northern Mexico behind a late-season cold front pushing into southern Mexico was producing gale force winds on both sides of the Isthmus of Tehuantepec. An automated weather station at Salina Cruz (WMO station ID number 76833) at 16.2N 95.2W on the Pacific coast reported 23 kts sustained wind at 1740 UTC, a reliable indicator for marine forecasters that gale force winds were occurring over water in the Gulf of Tehuantepec.



(Right): Figure 8. National Weather Service USA chart from 1800 UTC 16 May 2014, centered on southern Mexico and Central America. Strong 1025 hPa high pressure persisted over southern Mexico while a 1012 hPa isobar was analyzed along the Pacific coast of Mexico and Guatemala. This tight pressure gradient across the Isthmus of Tehuantepec was the primary reason gale force winds continued for several days in the Gulf of Tehuantepec.

A series of METOP-A Advanced Scatterometer (ASCAT) scatterometer passes over the area were able to capture this high wind event from its onset through peak winds on the morning of May 15 until the weakening phase. Forecasters expected the gale to begin around 1800 UTC on May 14 but an ASCAT pass at 1538 UTC showed the high winds were already occurring, which prompted TAFB to amend its High Seas forecast at 1805 UTC to indicate a gale warning was in effect (**Figure 9**). Peak winds of 40 to 47 kts were measured by an ACSCAT pass at 0404 UTC May 16 (**Figure 10**). Forecasters expected the high wind event to conclude Saturday morning May 17, but an ASCAT pass at 1616 UTC confirmed a small area of 35 kts was still present (**Figure 11**) so the gale warning was allowed to continue another six hours, and expired at 0000 UTC May 18. Several ships in the vicinity of the Gulf of Tehuantepec during this time period also provided marine observations.

The cargo vessel **STAR HARMONIA** (call sign LAGB5) reported 37 kts at 1200 UTC May 15 near 14.3N 95.5W, and the cargo vessel **CAP PALLISTER** (call sign A8O84) reported 38 kts with 14 ft seas at 2100 UTC May 16 near 15.0N 94.6W. Both observations were used to verify the gale warning in effect.

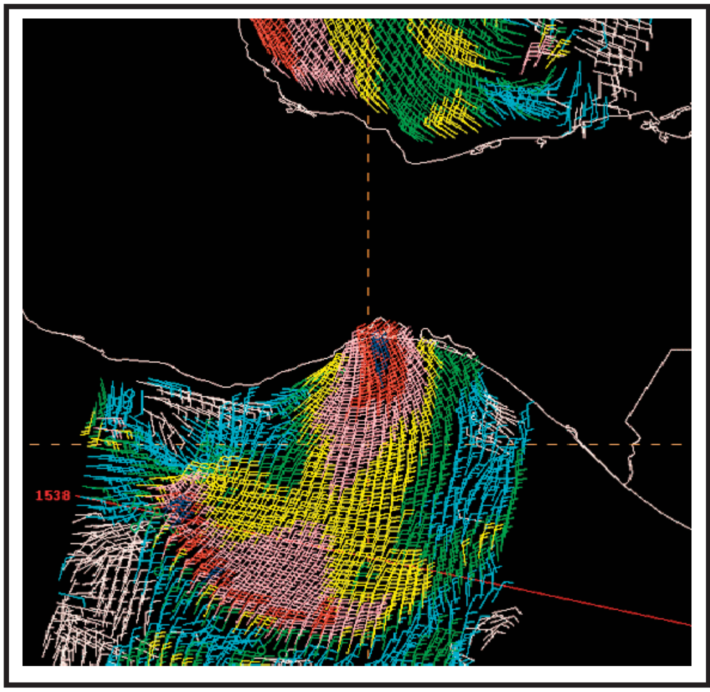


Figure 9. METOP-A Advanced Scatterometer (ASCAT) pass at 1538 UTC 14 May 2014 depicts the onset of gale force winds near the coast in the Gulf of Tehuantepec. Highest northerly winds of 33-37 kts (in purple) are shown within 15 nm of the Isthmus of Tehuantepec.

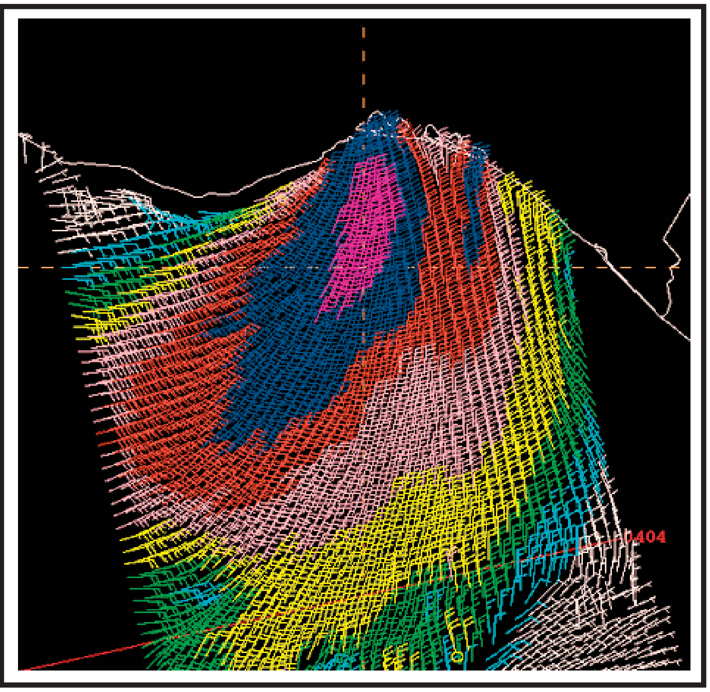


Figure 10. This METOP-A Advanced Scatterometer (ASCAT) pass at 0404 UTC 16 May 2014 captured the gale wind event in the Gulf of Tehuantepec near peak intensity. Maximum winds to 40-47 kts (in blue and pink) are evident in a narrow band of north to northeast winds 20 to 90 nm downwind from the Isthmus of Tehuantepec.

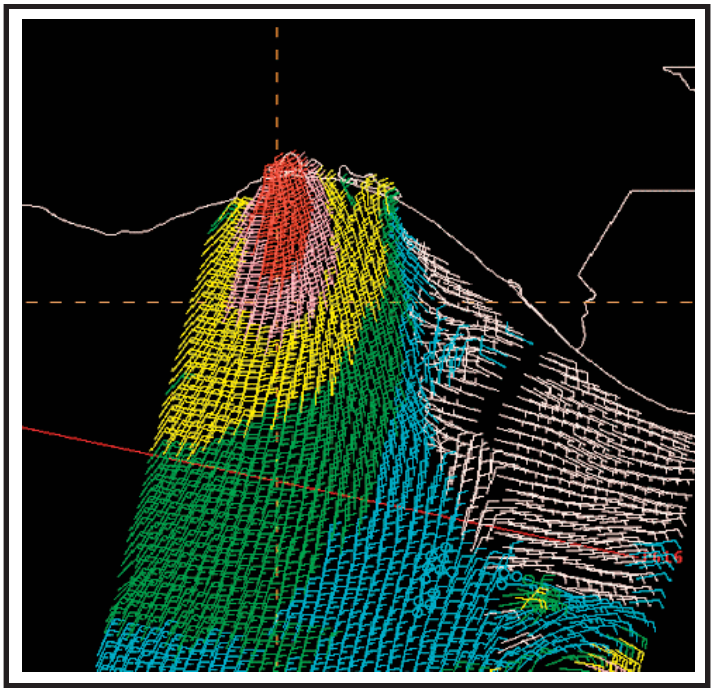


Figure 11. METOP-A Advanced Scatterometer (ASCAT) pass at 1616 UTC 17 May 2014 depicts a late season gale force wind event nearing its conclusion in the Gulf of Tehuantepec. Highest northerly winds to 35 kts (in red) are shown within 40 nm of the Isthmus of Tehuantepec. Maximum winds diminished to less than 30 kts later that afternoon.

National Weather Service VOS Program New Recruits:

July through October 2014

SHIP NAME	CALL SIGN
ADAM E. CORNELIUS	WCY9870
ALGOLAKE	VCPX
CMA CGM FLORIDA	2AKU3
CMB BIWA	ONED
COASTAL SEA	WCA7944
CSAV LONCOMILLA	VRFB3
CSCL MANZANILLO	VRFO2
CSCL NEW YORK	VRBH7
EVER LEADING	2FRK8
EVER LEGACY	9V9290
EVER LEGEND	9V9724
EVER LINKING	2GLI9
EVER LISSOME	2HDG3
EVER LIVEN	BKIE
EVER SUPERB	3EGL5
EXCELLENCE	ONBG
EXQUISITE	ONFX
HANJIN MILANO	V7SG8
LEO VOYAGER	C6AB7
MOL PARADISE	3ECJ7
MONTREALAIS	VDWC
OOCL HALIFAX	VQUQ4
ORANGE BLOSSOM 2	D5DS3
PT. THOMPSON	WBM5092
TEXAS	VRFH2

Got Weather Photo Submissions

Weather Images from Our Readers:

Photo by: Denice Drass, Marine Biologist, NOAA NMFS Pascagoula Laboratory, Pascagoula, MS. This photo was taken off of the stern of the NOAA Ship OREGON II. Approximately 27 59.88 / 084 28,23 on the 23rd of September around 6pm. You can see showers off in the distance towards the left.

The Cooperative Ship Reports can now be found online by clicking here.

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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
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Attn: Mariners Weather Log